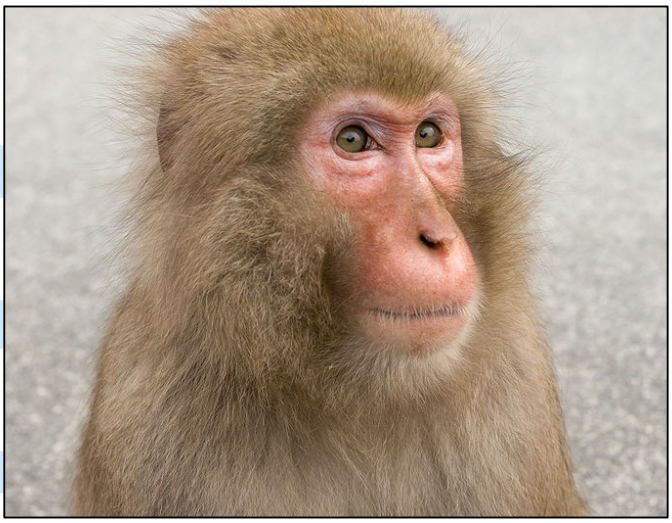
PEST RISK ASSESSMENT

Japanese macaque

Macaca fuscata



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March 2011

Department of Primary Industries, Parks, Water and Environment
Resource Management and Conservation Division

Tasmania
Explore the possibilities

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About this Pest Risk Assessment
This pest risk assessment is developed in accordance with the *Policy and Procedures for the Import, Movement and Keeping of Vertebrate Wildlife in Tasmania* (DPIPWE 2011). The policy and procedures set out conditions and restrictions for the importation of controlled animals pursuant to s32 of the *Nature Conservation Act 2002*. This pest risk assessment is prepared by DPIPWE for the use within the Department.

For more information about this Pest Risk Assessment, please contact:
Wildlife Management Branch
Department of Primary Industries, Parks, Water and Environment
Address: GPO Box 44, Hobart, TAS. 7001, Australia.
Phone: 1300 386 550
Email: wildlife.reception@dpipwe.tas.gov.au
Visit: www.dpipwe.tas.gov.au

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1. Summary

Japanese macaques (*Macaca fuscata*) are short-tailed Old World monkeys found in Japan. They are highly adaptable and can occupy suitable habitat at a variety of altitudes, with sites ranging from sea level to 3,180m above sea level. There is no evidence of Japanese macaques establishing outside their native range, although a troop of 150 macaques was transferred to Texas for research purposes in 1972, where they exist in semi free-ranging conditions, but are provisioned with food daily.

Japanese macaques are a major agricultural pest in Japan, and annually cause the equivalent of $AU19.5million damage to crops and infrastructure. Approximately 10,000 Japanese macaques are destroyed each year to protect crops. They have few natural predators and are capable of spreading diseases such as canine distemper virus, hepatitis E and herpes B virus.

Establishment of Japanese macaques in Tasmania could impact primary industries and native species, although modelling suggests that the Tasmanian climate is unsuitable. The Japanese macaque is currently listed as a species of 'least concern' under the IUCN Red List and Japanese macaques are 'controlled animals' under the Tasmanian *Nature Conservation Act 2002*.

This risk assessment concludes that Japanese macaques are a serious threat to Tasmania and proposes that imports be restricted to those license holders approved for keeping serious threat species.

2. Introduction

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2.1 NAME AND TAXONOMY

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Primates

Family: Cercopithecidae

Genus: *Macaca*

Species: *M. fuscata*

Sub-species: *M. fuscata* ssp. *fuscata*, *M. fuscata* ssp. *yakui*.

Common names: Japanese macaques, snow monkeys, Japanese monkeys.

Known hybrids: Hybrids have been produced between the Japanese macaque and introduced populations of crab-eating macaques (*M. fascicularis*), Taiwanese macaques (*M. cyclopis*), Rhesus monkeys (*M. mulatta*) and lion-tailed macaque (*M. silenus*) (Fooden & Aimi, 2005; Kawamoto 2005).

Close relatives: The genus *Macaca* is phylogenetically close to mangabeys and baboons, and contains 21 species (Hamada & Yamamoto, 2010; Myers *et al.* 2008). Of these, *M. fascicularis* (crab-eating macaques) and *M. mulatta* (Rhesus monkeys) are listed on the IUCN Global Invasive Species Database (2011). *M. fascicularis* is also included on the Global Invasive Species Database list of 100 of the "World's Worst" invaders. *M. fascicularis* is native to south-east Asia and has been introduced into Mauritius, Palau (Angaur Island), Hong Kong and parts of Indonesia (Tinjil Island and Papua). They are opportunistic feeders that consume native plants and crops and cause agricultural damage. They reach high densities in degraded forest areas, including disturbed habitats where they have few natural predators, and contribute to the dispersal of exotic plants (Global Invasive Species Database, 2011).

2.2 DESCRIPTION

Japanese macaques are Old World monkeys with short tails approximately 82-91mm long (Fooden & Aimi, 2005). Sexes are dimorphic, with males generally larger than females. Head and body length is 570mm in males and 522mm in females, while body weight on average is 11.3kg in males and 8.4kg in females (Fooden & Aimi, 2005).

The fur of Japanese macaques varies from pale yellow-brown to grey-brown and dark golden brown, and can be quite white in older individuals (Fooden & Aimi, 2005). Dorsal fur is relatively long, with an average of 40mm, although the longest hairs in this region may be 70-90mm long. Japanese macaques moult annually in late spring/early summer, and dorsal fur may be short and dark following this process (Fooden & Aimi, 2005).

The colour of the fur on the dorsal surface of the hands can distinguish the two subspecies. *M. fuscata yakui* has blackish fur in this area which is distinctly darker than that on the dorsal surface of the trunk, while *M. fuscata fuscata* has pale to dark brown fur on the hands which is similar to, or paler than, that on the dorsal surface of the trunk (Fooden & Aimi, 2005).

The bare skin on the face, nipples and perineum is pink to reddish in colour, and becomes intensely red during the mating season (Fooden & Aimi, 2005).

Young are born with grey to dark fur, and the facial skin is a pale pink. By four to five months, the fur is replaced and resembles that of adults (Fooden & Aimi, 2005).

An instance of hybridisation between Japanese macaques and Rhesus monkeys (*M. mulatta*) resulted in hybrids of intermediate size and fur colour, and tail length similar to the Rhesus monkey, but perineal skin similar to Japanese macaques. A hybrid of Japanese macaques and Taiwanese macaques (*M. cyclopis*) had a tail length approximately intermediate between the two species (Fooden & Aimi, 2005).

2.3 CONSERVATION AND LEGAL STATUS

CONSERVATION STATUS

The Japanese macaque is currently listed as a species of 'least concern' under the IUCN Red List (Watanabe & Tokita, 2008). In 2005, the total population was estimated at approximately 100,000 individuals (Fooden & Aimi, 2005).

The Japanese Ministry of Environment Red List describes the species as having 'endangered regional populations' (Enari & Suzuki, 2010). The species became locally extinct in some areas after local residents hunted them for food and medical supplies during the Second World War. Remnant populations have recovered in recent decades (Enari & Suzuki, 2010).

LEGAL STATUS

The species is classed as a 'serious' threat under the Vertebrate Pest Committee's list of exotic animals (Vertebrate Pest Committee, 2007). It is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

In Tasmania, Japanese macaques are 'controlled animals' under the Tasmanian *Nature Conservation Act 2002*.

Japanese macaques are listed on Appendix II of CITES.

3. Biology and Ecology

3.1 LIFE HISTORY

Japanese macaques are diurnal mammals that live in mixed-sex troops of 10 to 160 individuals (Fooden & Aimi, 2005). Longevity is largely dependent on food supply, as provisioned populations[1] have greater rates of survival. In a study of a wild non-provisioned population, females had an average longevity of 6.3 years (±5.2 years) (Takahata *et al.* 1998). The greatest life span in a provisioned population is 33 years in a female and 28 years in a male (Kayoma *et al.* 1992, Nakamichi *et al.* 1995; in Fooden & Aimi, 2005).

Mating is normally between autumn and winter (September to February) with births occurring in spring and summer after a gestation of approximately 173 days (Fooden & Aimi, 2003; Takahata, 1980). Socially dominant males sire the most offspring and monopolise the majority of female matings by mate-guarding behaviour (Soltis *et al.* 2001). Females may select mates from multiple dominance ranks and low ranking males engage in sneak copulations with females outside the presence of other males (Soltis *et al.* 2001).

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Females have an oestrus cycle of 34 days (Takahata, 1980). In a free-ranging provisioned population, pubescent females between 3.5-6.5 years showed oestrus but had low sexual activity, whilst females aged 7.5-16.5 years showed high sexual activity with a high conception rate. Sexual activity in females over 17.5 years was low (Takahata, 1980). Males are sexually mature after 4 years (Nigi, 1975; in Takahata, 1980).

Generally a single offspring is produced, although twinning is possible. Young are suckled for the first six months, eat solid food at 4-6 weeks and are generally weaned by 6-8 months, although young may be nursed for up to 2.5 years if there are no intervening births (Fooden & Aimi, 2005).

There is no evidence of sperm storage in this species.

Hybridisation between Japanese macaques and other macaques has been observed under captive and free-ranging conditions (Fooden & Aimi, 2005). In captivity, hybrids have been produced with both crab-eating macaques (*M. fascicularis*) and lion-tailed macaques (*M. silenus*), whilst free-ranging Japanese macaques have bred with Taiwanese macaques (*M. cyclopis*) and Rhesus monkeys (*M. mulatta*) (Fooden & Aimi, 2005; Kawamoto 2005). Of these, reproductively viable offspring have been observed between Japanese macaque and Rhesus monkeys (*M. mulatta*), and Japanese macaque and Taiwanese macaque (*M. cyclopis*) (Fooden & Aimi, 2005). On the basis of available

[1] Populations which are provisioned with food by humans.

evidence, Fooden & Aimi (2005) state that females and males in Japanese macaque troops will spontaneously interbreed with other macaque species if given the opportunity.

3.2 HABITAT REQUIREMENTS AND PREFERENCES

Japanese macaques utilise a variety of habitat types, including cool-temperate deciduous forests, warm-temperate evergreen forests, alpine scrubs, conifer plantations and human settlements, including farmlands (Yamada & Muroyama, 2010). They are highly adaptable and can occupy habitat at a variety of altitudes, with sites ranging from sea level to 3,180m above sea level (Nakagawa *et al.* 2010). They tolerate a wide range of temperatures, and although sites such as Shiga Heights in Japan have an average winter temperature of -15˚C and snow depths exceeding 2m (Nakagawa *et al.* 2010), Japanese macaques have also demonstrated an ability to adapt to warmer temperatures with transferred populations surviving and prospering in Texas, USA (Field *et al.* 1997).

Japanese macaques usually sleep in trees, but may sleep on the ground in areas with no predators (Fooden & Aimi, 2005). They forage in trees and on the ground and are adept swimmers, with reports of a young male swimming 600m to an outlying island (Mito, 1980; in Fooden & Aimi, 2005). The Japanese macaque is noted for utilising heated volcanic springs in order to maintain body heat in areas of extreme cold.

3.3 NATURAL GEOGRAPHIC RANGE

Japanese macaques are found in Japan on Honshu, Shikoku, Kyushu, and the islands of Awaji, Shodo, Yaku, Kinkazan (Miyagi Prefecture), Kojima (Miyazaki Prefecture) and others. They were previously found on Tane Island, but are now extinct (Watanabe & Tokita, 2008). Of the two subspecies, *M. fuscata yakui* is found only on the Yakushima island (Agetsuma, 1995) - the small southern island shown in Figure 1. The natural geographic range of Japanese macaques is approximately 88,684km^2.

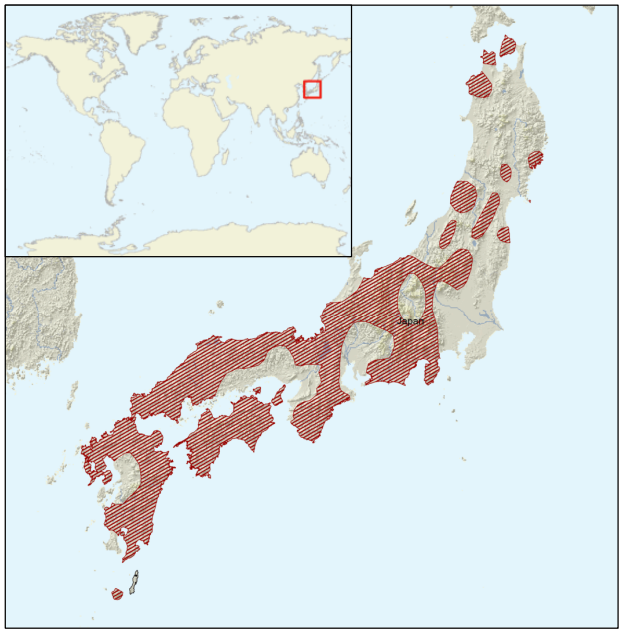

Figure 1. Native range of the Japanese macaque (*M. fuscata*) (Source: Watanabe & Tokita, 2008).

3.4 INTRODUCED GEOGRAPHIC RANGE

Japanese macaques are not recorded on the Global Invasive Species Database (2011); however they have been recognised as an animal with high environmental adaptability (Richard *et al.* 1989).

In 1972, a population of 150 macaques was translocated from Japan to Texas for research purposes (Fedigan & Zohar, 1997). The population is called the Arashimaya West group, which acclimatised and increased from 150 to 800 individuals in the 21 years following their introduction (Field *et al.* 1997). Individuals initially occupied a 42ha enclosure of native bushland in Loredo, Texas, and later a 20ha enclosure in Dilley, Texas (Fedigan & Zohar, 1997). Mechanical problems with electric fences at both sites meant that sometimes the entire group would range outside the enclosures. The population was fed daily with monkey chow, grain and fruit (Fedigan & Zohar, 1997), however colloquial reports indicate that the population also ate local beans, cactus fruits and pilfered from local farms (e.g. Baker, 2005). The current status and habitat alterations caused by this population are unknown, although studies by Field *et al.* (1997) indicate the population may feed on nests of bobwhite quail (*Colinus virginianus*).

3.5 POTENTIAL DISTRIBUTION IN TASMANIA

Using modelling by the Bureau of Rural Science (DAFF), a climate comparison between the species' current distribution in Japan (Watanabe & Tokita, 2008) and potential Australian distribution is shown in Figure 2. Modelling suggests that only eastern Australia has areas of similar climate which may support introduced populations of Japanese macaques. Modelling suggests that Tasmania's climate is highly dissimilar, with climate match scores between 0 and 2.

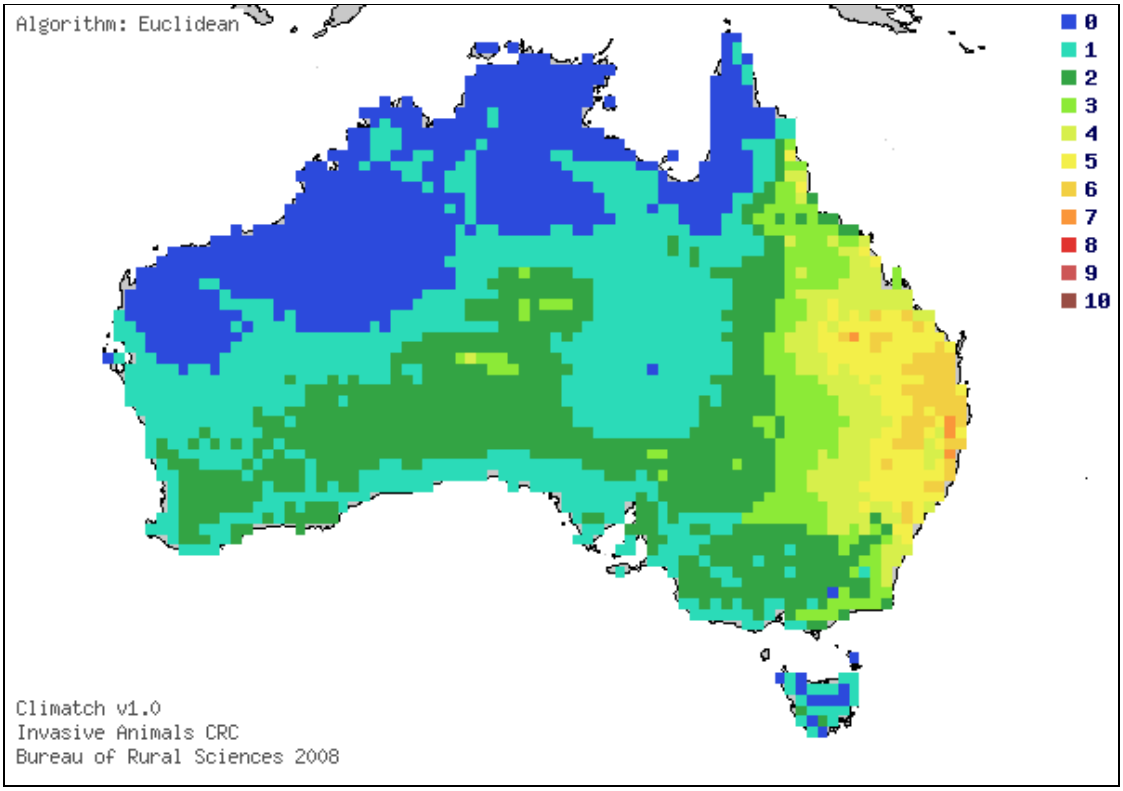

Figure 2. Climate comparison between the natural range of *M. fuscata* and Australia, where 10 is a 'perfect' climate match and 0 having a dissimilar climate. Tasmania shows a match between 0 and 2

A population of captive Japanese macaques is maintained in Launceston City Park, Tasmania. The population is provisioned and housed in exhibition enclosures with heated sleeping quarters.

3.6 DIET AND FEEDING BEHAVIOUR

Japanese macaques are generalist feeders, and consume a wide variety of foods (Hill, 1997). The diet varies significantly with the seasons (Go, 2010), however in the wild, the annual diet comprises 35% leaves and shoots, 30.2% fleshy fruit, 13.2% seeds, 5.5% flowers and 4.6% fungi. Japanese macaques also feed on invertebrates and other animal matter and this accounts for 10.3% (Hill, 1997). Other minor dietary components include plant roots, grasses, crabs, spiders, molluscs, fish, frogs, lizards and dead birds (Fooden & Aimi, 2005).

When entering human zones and adjacent settlements, Japanese macaques eat radishes, turnips, carrots, onions, cabbages, broccoli, rice crops, beans, nuts, various cultivated fruits, including kiwi fruit, figs and citrus fruits, and ornamental plants in gardens (Yumada & Muroyama, 2010). They are a major agricultural pest in Japan (Enari & Suzuki, 2010), although groups with more abundant wild resources are less likely to utilise human settlements (Yamada & Muroyama, 2010).

Japanese macaques forage and feed for about seven hours a day (Agetsuma, 1995). Seasonal fluctuations in food distribution and abundance influences home range size and home range use (Go, 2010). In summer, when food is most abundant, Japanese macaques occupy a smaller feeding range than other seasons, as less foraging effort is required to obtain food at this time (Go, 2010). Feeding range is also dependent on habitat type, and is smaller in evergreen coniferous forest (1.6-6.4ha per group member) than deciduous broadleaf forest (9-79ha per group member) (Takasaki, 1981; in Fooden & Aimi, 2005).

3.7 SOCIAL BEHAVIOUR AND GROUPINGS

Females remain with the natal group for life, while males emigrate and join other groups before reaching sexually maturity. Males may join and leave groups several times in their lives (Fukuda, 2004; in WPRC, 2010). Hierarchy is integral to macaque groups, and includes a dominant alpha male and respectively ranked males and females. Socially dominant males sire the most offspring and monopolise the majority of female matings (Soltis *et al.* 2001). Female ranking is stable and female offspring assume similar rank to their mothers (WPRC, 2010).

Relationships are maintained by grooming, which is commonly seen among related females or used to gain social benefits such as support or to demonstrate coalition or alliance (Kutsukake, 2010). Alliances are important to troop relationships, and are likely to be formed among high-ranking individuals against low-ranking individuals, although the alpha male and mothers may support the weaker individual in a conflict (Watanabe, 1979, cited in Kutsukake, 2010).

In situations where home ranges overlap, troops seldom approach each other, instead opting to avoid another troop (Kawanaka, 1973). During troop encounters, aggression varies depending on the group identity, reproductive seasonality and population (Saito *et al.* 1998). Food competition

and mate guarding may motivate inter-troop aggression, and more aggressive behaviours are demonstrated during the mating season (Saito *et al.* 1998). Both sexes participate in aggressive behaviours such as biting, charging and hitting, although males are generally more aggressive than females (Saito *et al.* 1998).

3.8 NATURAL PREDATORS AND DISEASE

Japanese macaques have few predators in their natural environment. Their main predator, the grey wolf (*Canis lupis*) became extinct in Japan at the beginning of the twentieth century (Enari & Suzuki, 2010). Mountain hawk-eagles (*Spizaetus nipalensis*) are known to take Japanese macaques, and feral dogs frequently preyed upon the macaques prior to government control in the 1970s (Fooden & Aimi, 2005). Since 1998, more than 10,000 Japanese monkeys have been killed per year in order to reduce their impact on agriculture (Oi, 2003; in Fooden & Aimi, 2005).

In Tasmania, potential predators include the Tasmanian devil (*Sarcophilus harrissii*), spotted-tailed quoll (*Dasyurus maculates*), large raptors such as wedge-tailed eagles (*Aquila audax fleayi*) and, should it become established, the introduced European red fox (*Vulpes vulpes*).

Japanese macaque are known to carry the herpes virus *Cercopithecine herpesvirus* (B virus). Although this virus is pathogenic to humans, infected macaques can carry herpes B without overt signs of disease (Huff & Barry, 2003). The virus is transmitted venereally, via fomites, or through bite wounds by infected individuals, and animals in overcrowded or poor housing conditions have a higher prevalence of the disease (Williams & Barker, 2001). Once B virus is transmitted, macaques retain the infection for life. Oral herpetic lesions and conjunctivitis are symptoms of infection, and identification of oral herpetic lesions is considered to be sufficient grounds for euthanasia of captive animals (Huff & Barry, 2003).

Canine distemper virus is found in Japanese macaques. Yoshikawa *et al.* (1989) demonstrated that a group of 22 captured Japanese macaques showed high amounts of the antibody to canine distemper virus, indicating that a natural epidemic of canine distemper virus had occurred in the population.

Japanese macaques are vulnerable to measles, and contract the disease via airborne particles when exposed to infected humans in captivity (Choi *et al.* 1999). Measles can be fatal in this species and, in a case study, 12 of 53 Japanese macaques died following a measles outbreak at Everland Zoological Gardens in Korea (Choi *et al.* 1999).

Japanese macaques are vulnerable to hepatitis E virus, which is the agent of hepatitis E (Hirano *et al.* 2003). The virus is thought to be spread via the faecal-oral route, with outbreaks of hepatitis E associated with virus-contaminated water. Japanese macaques are reservoirs for the virus, and the rate of infection increases with sexual maturity (Hirano *et al.* 2003). There are suggestions that Japanese macaques may also carry other hepatitis strains such as hepatitis A, but this has not been proven (Hirano *et al.* 2003).

Japanese macaques may carry parasites such as tapeworm and nematodes, although occurrences of these are relatively rare. They are vulnerable to ectoparasites such as lice and ticks, but these are often removed during the grooming process (Fooden & Aimi, 2005).

3.9 THREAT TO HUMAN SAFETY

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Japanese macaques have the potential to cause moderate physical injury by biting and scratching, which may require moderate medical attention. The associated consequences from a bite or scratch may be serious and require hospitalisation.

The Macaca genus has been noted for its ability to harbour a wide variety of zoonoses[2]. Macaques can carry a variety of diseases including herpes B, hepatitis E, ebola viruses and avian influenza which pose a threat to human safety (Pavlin et al. 2009).

Humans can become infected with herpes B through Japanese macaque bites, scratches, and contact with body fluid or tissue (Huff & Barry, 2003). Infection can be severe and result in ascending paralysis and a high fatality rate, or neurological impairment (Huff & Barry, 2003; Williams & Barker, 2001). The prevalence of human infection with herpes B virus is low, as is secondary transmission of the virus. The captive population of Japanese macaques in Launceston City Park is known to have the herpes B virus, however the Launceston City Council – which manages the exhibit – considers that the risk of human infection is low (ABC Radio, 2000).

Japanese macaques are reservoirs of hepatitis E virus (the agent of hepatitis E), which can be transmitted to humans (Hirano *et al*. 2003). The virus can be spread in contaminated water, and although person to person transmission is possible, it is relatively infrequent (Hirano *et al*. 2003). Symptoms of hepatitis E include jaundice, loss of appetite, inflammation of the liver, abdominal pain, nausea, vomiting, and fever. Hepatitis E virus infections are usually self-limited, and hospitalization is generally not required. No available therapy is capable of altering the course of acute infection (World Health Organisation, 2005).

3.10 HISTORY AS A PEST

Japanese macaques are one of Japan's most serious mammalian pests due to the damage they cause to agriculture (Enari & Suzuki, 2010). In 2007, the total annual agricultural damage caused by Japanese macaques reached ¥1,600,000,000 (approximately $AU19.5 million) (Ministry of Agriculture, Forestry and Fisheries of Japan, unpublished data, cited in Enari & Suzuki, 2010). The macaques consume crops and cause damage to fruit orchards, rice paddies and root vegetable

[2] Infectious animal diseases which can be transferred to humans.

farms and cause property damage such as broken roof tiles and home intrusions (Enari & Suzuki, 2010).

Damage by Japanese macaques has been recorded since the seventeenth century and has increased in recent decades (Enari & Suzuki, 2010). Yamada & Muroyama (2010) consider this due to habitat modification in the macaque's native range. Conifer plantations are increasingly replacing native forests preferred by the macaques, and these plantations are unable to provide adequate food. This causes troops to enter human areas to search for food (Yamada & Muroyama, 2010). Following habituation to the local people, macaques lose their natural fear of humans and escalate their behaviour to threaten people and intrude into houses (Suzuki & Muroyama, 2010). Restrictions in hunting, loss of predators and declines in snow accumulation in Japan are also thought to have contributed to increased conflict (Enari & Suzuki, 2010).

3.11 POTENTIAL IMPACT IN TASMANIA

The Japanese macaque is likely to compete with Tasmanian possum species for leaves and shoots, fruits, insects and flowers. Possums which would compete for these resources include the common brushtail possum (*Trichosurus vulpecula*), common ringtail possum (*Pseudocheirus peregrinus*), eastern pygmy possum (*Cercartetus nanus*) and little pygmy possum (*Cercartetus lepidus*) (Strahan, 1995).

Other species which may experience competition with the Japanese macaque include the eastern quoll (*Dasyurus viverrinus*), southern brown bandicoot (*Isoodon obesulus*) and eastern barred bandicoot (*Perameles gunnii*). These three species are largely insectivorous, but the eastern quoll also opportunistically eats fruit and small vertebrates (Bryant & Squires, 2009; Menkhorst & Knight, 2001). Macropods such as Bennetts wallaby (*Macropus rufogriseus*) and Tasmanian pademelon (*Thylogale billardierii*) could also experience competition.

Although climate modelling shows Tasmania's climate to be highly unsuitable, should populations establish in Tasmania, several agricultural industries could be affected. At-risk agricultural industries in Tasmania include those producing vegetables, fruit, cereal, other crops and horticulture, oil seeds and grain legumes.

4. Risk Assessment

4.1 PREVIOUS RISK ASSESSMENTS

The species is classed as a 'serious' threat under the Vertebrate Pest Committee's list of exotic animals (Vertebrate Pest Committee, 2007). A formal risk assessment has not been carried out for this species previously.

4.2 RISK ASSESSMENT

The following risk assessment determines the risk of Japanese macaque to Tasmania using the Bomford model (2008) and proposes assigned threat categories and import classifications for the species.

Species:	**Japanese macaques (*Macaca fuscata*)**	
Date of Assessment:	March 2011	
Literature search type and date:	See references	
Factor	**Score**	
A1. Risk posed from individual escapees (0-2)	2	*Animal that sometimes attacks when unprovoked and/or is capable of causing serious injury (requiring hospitalisation) or fatality.* Japanese macaques are capable of spreading diseases such as herpes B which can be fatal to humans. This disease is currently found in captive populations in Australia.
A2. Risk to public safety from individual captive animals (0-2)	0	*Nil or low risk (highly unlikely or not possible) (feasible and consequences could be fatal).* Although there is a risk of contracting fatal diseases from this species, the probability of irresponsible products being obtained and irresponsibly used is unlikely.
Stage A. Risk posed by individual animals (risk that a captive or escape animal would harm people)	**Public Safety Risk Score** = A1 + A2 = 2	**Public Safety Risk Ranking** A ≥ 2, Highly Dangerous A = 1, Moderately Dangerous A = 0, Not Dangerous = Highly Dangerous
B1. Climate match score (1-6)	1	*Very low climate match score.* Climate match scores were between 0 and 2.

B2. Exotic population established overseas score (0-4)	0	*No exotic populations have been established overseas.* The semi free-ranging population of Texas receives food provisions on a daily basis and so is not classified as an established exotic population under the Bomford model (2008).
B3. Overseas range size score (0-2)	0	*Overseas size range <1 million km2.* The geographic range is approximately 88,684km^2.
B4. Taxonomic class score (0-1)	1	*Mammal.*
Stage B. Likelihood of establishment (risk that a particular species will establish a wild population in Tasmania)	**Establishment Risk Score** = B1 + B2 + B3 + B4 = 2	**Establishment Risk Ranking** B = 11-13, Extreme B = 9-10, High B = 6-8, Moderate B ≤ 5, Low = Low
C1. Taxonomic group (0-4)	0	*Other group.* No taxonomic matches.
C2. Overseas range size (0-2)	0	*Overseas range size <10 million km2.* The geographic range is approximately 88,684km^2.
C3. Diet and feeding (0-3)	3	*Mammal that is primarily a grazer or a browser.* Japanese macaques are browsers. In the wild, plant matter makes up 90% of the annual diet (35% leaves and shoots, 30.2% fleshy fruit, 13.2% seeds, 5.5% flowers and 4.6% fungi) (Hill, 1997). The other 10% includes invertebrate and other animal matter, and minor dietary components include plant roots, grasses, crabs, spiders, molluscs, fish, frogs, lizards and dead birds (Fooden & Aimi, 2005).
C4. Competition for native fauna for tree hollows (0-2)	0	*Does not use tree hollows.*
C5. Overseas environmental pest status (0-3)	0	*Never reported as an environmental pest in any country or region.* The species has not been reported to cause declines in abundance of any native species of plants or animal or caused degradation to any natural communities in any country of region.
C6. Climate match to areas with susceptible native	0	*The species has no grid squares within the*

species or communities (0-5)		*highest six climate match classes (i.e. 10 to 5) that overlap the distribution of any susceptible native species or ecological communities.*
C7. Overseas primary production (0-3)	3	*Major pest of primary production in any country or region.* Japanese macaques are a major agricultural pest in Japan, causing damage to crops and infrastructure.
C8. Climate match to susceptible primary production (0-5)	0	*No match between climate and susceptible primary production.*
C9. Spread disease (1-2)	2	*Mammal.*
C10. Harm to property (0-3)	0	*<$100,000 per year.* As there was no climatch score ≥5 in any region of Tasmania, estimated harm to property is very low.
C11. Harm to people (0-5)	4	*Injuries or harm severe or fatal but few people at risk.* Japanese 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.
Stage C. Consequence of Establishment (risk that an established population would cause harm)	**Consequence Risk Score** = sum of C1 to C11 = 12	**Consequence Risk Ranking** C > 19, Extreme C = 15-19, High C = 9-14, Moderate C < 9, Low = Moderate
ASSIGNED THREAT CATEGORY:	**SERIOUS**	
PROPOSED IMPORT CLASSIFICATION:	**IMPORT RESTRICTED TO THOSE LICENSE HOLDERS APPROVED FOR KEEPING SERIOUS THREAT SPECIES**	

5. Risk Management

This risk assessment concludes that Japanese macaques (*Macaca fuscata*) are a serious threat to Tasmania and that imports be restricted to those license holders approved for keeping serious threat species. On the basis of this risk assessment, it is recommended that Japanese macaques be placed on the list of imports permitted with conditions.

As defined under the *Policy and Procedures for the Import, Movement and Keeping of Vertebrate Wildlife in Tasmania* (DPIPWE 2011), the following mandatory conditions will apply to the import and keeping of this species. Additional conditions may be required.

1. The animal must not be released, or be allowed to escape from effective control.
2. Specimens seized or forfeited as a result of illegal or accidental introductions, where rehousing is not available, will be humanely euthanized.
3. Animal welfare requirements under the *Animal Welfare Act 1993* and any approved Code of Practice or Management Plan must be met.
4. Import only permitted by holders approved to keep the species under licence.
5. Individuals to be micro-chipped or otherwise identified, or treated to allow identification.
6. Facility must meet minimum standards for welfare and security.
7. Facility must be available for inspection at any reasonable time.
8. Audits of facilities and collections.
9. The maximum number of individuals of a species held at the facility to be stipulated on the licence, taking into account relevant factors. Gender may also be stipulated.
10. Written approval prior to movement of animals between facilities and trade of species under licence.
11. Record keeping and reporting to DPIPWE as required by DPIPWE.
12. Collections containing species subject to approval by DPIPWE as meeting best practice for keeping the species concerned.
13. Bonds, insurance or cost recovery systems.
14. Import of serious threat species will generally be prohibited unless there is a clear public benefit and sufficient measures exist for the secure housing and on-going management of the species. Species kept solely for:
    - Public display and education purposes approved by DPIPWE and/or
    - Genuine scientific research approved by DPIPWE.

6. References

ABC Radio. (2000). *Herpes ridden monkeys to stay alive in Tasmania*. Reporter: Maura Angle. <http://www.abc.net.au/pm/stories/s165929.htm>. Accessed 3 February 2011.

Agetsuma, N. (1995). Foraging strategies of Yakushima macaques (*Macaca fuscata yakui*). *International Journal of Primatology* (16)(4): 595-609.

Baker, E. (2005). The legendary snow monkeys of Texas. *The Austin Chronicle*. <www.austinchronicle.com>.

Bomford, M. (2008). *Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand*. Report prepared for the Invasive Animals Cooperative Research Centre.

Bryant, S. & Squires, T. (2009). *Animals of Tasmania, wildlife of an incredible island*. Quintus Publishing, Tasmania.

Choi, Y.K., Simon, M.A., Kim, D.Y., Yoon, B.I., Kwon, S.W., Lee, K.W., Seo, I.B. & Kim, D.Y. (1999). Fatal measles virus infection in Japanese macaques (*Macaca fuscata*). *Veterinary Pathology* (36): 594-600.

Enari, H. & Suzuki, T. (2010). Risk of agricultural and property damage associated with the recovery of Japanese monkey populations. *Landscape and Urban Planning* (97): 83-91.

Fedigan, L.M. & Zohar, S. (1997). Sex differences in mortality of Japanese macaques: twenty-one years of data from the Arashiyama West population. *American Journal of Physical Anthropology* (102) 161-175.

Field, J.G., Henke, S.E. & McCoy, J.G. (1997). Depredation on artificial ground nests by Japanese macaques: the unspoken exotic in Texas. *Internet Centre for Great Plains Wildlife Damage Control, University of Nebraska – Lincoln.*

Fooden, J. & Aimi, M. (2003). Birth-season variation in Japanese macaques, *Macaca fuscata*. *Primates* (44): 109-119.

Fooden, J. & Aimi, M. (2005). Systematic review of Japanese macaques. *Fieldiana: Zoology*. Series 104. Field Museum of Natural History, United State of America.

Global Invasive Species Database. <http://www.issg.org/database> (Accessed 24 January 2011).

Go, M. (2010). Seasonal changes in food resource distribution and feeding sites selected by Japanese macaques on Koshima Islet, Japan. *Primates* (51): 149-158.

Hamada, Y. & Yamamoto, A. (2010). Morphological characteristics, growth and Aging in Japanese macaques. In: *The Japanese Macaques.* Nawagata, N., Nakamichi, M. & Sugiura, H. (eds.). Springer.

Hill, D.A. (1997). Seasonal variation in the feeding behaviour and diet of Japanese macaques (*Macaca fuscata yakui*) in lowland forest of Yakushima. *American Journal of Primatology* (43): 305-322.

Hirano, M., Ding, X., Tran, H.T., Li, T., Takeda, N., Sata, T., N., S. & Abe, K. (2003). Prevalence of antibody against hepatitis E virus in various species of non-human primates: evidence of widespread infection in Japanese monkeys (*Macaca fuscata*). *Japanese Journal of Infectious Diseases* (56)(8): 8-11.

Huff, J.L. & Barry, P.A. (2003). B-virus (*Cercopithecine herpesvirus* 1) infection in humans and macaques: potential for zoonotic disease. *Emerging Infectious Diseases* (9)(2): 246-250.

Kawamoto, Y. (2005). NRAMP1 polymorphism in a hybrid population between Japanese and Taiwanese macaques in Wakayama, Japan. *Primates* (46): 203-206.

Kawanaka, K. (1973). Intertroop relationships among Japanese monkeys. *Primates* (14)(2-3):113-59.

Kutsukake, N. (2010). Japanese macaque society as a complex adaptive system. In: *The Japanese Macaques.* Nawagata, N., Nakamichi, M. & Sugiura, H. (eds.). Springer.

Menkhorst, P. & Knight, F. (2001). *A field guide to the mammals of Australia.* Oxford University Press, Australia.

Myers, P., Espinosa, R., Parr, C. S., Jones T., Hammond G. S., & Dewey T. A. (2008). *The Animal Diversity Web (*online). Accessed January 24, 2011 <http://animaldiversity.org>.

Nakagawa, N., Nakamichi, M. & Sugiura, H. (eds.)(2010). *The Japanese Macaques*. Springer.

Pavlin, B.I., Schloegel, L.M. & Daszak, P. (2009). Risk of importing zoonotic diseases through wildlife trade, United States. *Emerging Infectious Diseases* (11): 1721-1726.

Richard, A.F., Goldstein, S.J. & Dewar, R.E. (1989). Weed macaques: the evolutionary implications of macaque feeding ecology. *International Journal of Primatology* (10): 569-594.

Saito, C., Sato, S., Suzuki, S., Sugiura, H., Agetsuma, N., Takahata, Y., Sasaki, C., Takahashi, H., Tanaka, T. & Yamagiwa, J. (1998). Aggressive intertroop encounters in two populations of Japanese macaques (*Macaca fuscata*). *Primates* (39)(3): 303-312.

Soltis, J., Thomsen, R. & Takenaka, O. (2001). The interaction of male and female reproductive strategies and paternity in wild Japanese macaques, *Macaca fuscata*. *Animal Behaviour* (62):485-494.

Strahan, R. (1995). The mammals of Australia (revised edition). Strahan, R. (ed.). *Reed Books Australia*.

Suziki, K. & Muroyama, Y. (2010). Resolution of human-macaque conflicts: changing from top-down community-based damage management. In: *The Japanese Macaques.* Nawagata, N., Nakamichi, M. & Sugiura, H. (eds.). Springer.

Takahata, Y., Suzuki, S., Agetsuma, N., Okayasu, N., Sugiura, H., Takahashi, H., Yamagiwa, J., Izawa, K., Furuichi, T., Hill, DA., Maruhashi, T., Saito, C., Sato, S. & Sprague, DS. (1998). Reproduction of wild Japanese macaque females of Yakushima and Kinkazan islands: a preliminary report. *Primates* (39)(3):339-349.

Takahata, Y. (1980). The reproductive biology of a free-ranging troop of Japanese monkeys. *Primates* (21)(3): 303-329.

Vertebrate Pest Committee. (2007). *Vertebrate Pest Committee list of exotic vertebrate animals in Australia, July 2007*. <www.feral.org.au>.

Watanabe, K. & Tokita, K. (2008). *Macaca fuscata.* In: IUCN 2010. *IUCN Red List of Threatened Species.* Version 2010.4. <www.iucnredlist.org>.

Wisconsin Primate Research Centre (WPRC) (2010). Japanese macaque – *Macaca fuscata*. Primate Info Net. <http://pin.primate.wisc.edu>

Williams, E.S. & Barker, I.K. (2001). *Infectious diseases of wild mammals* (third edition). Wiley-Blackwell.

World Health Organisation. (2005). *Hepatitis E; factsheet No. 280*. <http://www.who.int> Accessed 2 February 2011.

Yamada, A. & Muroyama, Y. (2010). Effects of vegetation type of habitat use by crop-raiding Japanese macaques during a food-scarce season. *Primates* (51): 159-166.

Yoshikawa, Y., Ochikubo, F., Matsubara, Y., Tsuruoka, H., Ishii, M., Shirota, K., Nomura, Y., Sugiyama, M. & Yamanouchi, K. (1989). Natural infection with canine distemper virus in a Japanese monkey (*Macaca fuscata*). *Veterinary Microbiology* (20): 193-205.

7. Appendices

APPENDIX A: CALCULATING TOTAL COMMODITY DAMAGE SCORE

Column 1	Column 2	Column 3	Column 4	Column 5
Industry	**Commodity Value Index (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**	N/A		
Timber (includes native and plantation forests)	**10**	1	0	0
Aquaculture	**6**	N/A		
Sheep (includes wool and meat)	**5**	N/A		
Vegetables	**5**	3	0	0
Fruit (includes wine grapes)	**5**	3	0	0
Poultry (including eggs)	**1.5**	N/A	0	0
Cereal grain (includes wheat, barley, sorghum etc)	**1**	3	0	0
Other crops and horticulture (includes nuts and flowers)	**1**	3	0	0
Pigs	**1**	N/A		
Bees (includes honey, beeswax, and pollination)	**0.5**	N/A		
Oilseeds (includes canola, sunflower etc)	**0.5**	1	0	0
Grain legumes (includes soybeans)	**0.3**	1	0	0
Other livestock (includes goats and deer)	**0.3**	N/A		
Total Commodity Damage Score (TCDS)				0

APPENDIX B: ASSIGNING SPECIES TO THREAT CATEGORIES

A: Danger posed by individual animals (risk a captive or escaped individual would harm people)	**B: Likelihood of establishment** (risk that a particular species will establish a wild population in Tasmania)	**C: Consequence of establishment** (risk that an established population would cause harm)	**Threat category**	**Implications for any proposed import into Tasmania**
Highly, Moderately or Not Dangerous	Extreme	Extreme	Extreme	Prohibited
Highly, Moderately or Not Dangerous	Extreme	High		
Highly, Moderately or Not Dangerous	Extreme	Moderate		
Highly, Moderately or Not Dangerous	Extreme	Low		
Highly, Moderately or Not Dangerous	High	Extreme		
Highly, Moderately or Not Dangerous	High	High		
Highly, Moderately or Not Dangerous	Moderate	Extreme		
Highly, Moderately or Not Dangerous	High	Moderate	Serious	Import restricted to those license holders approved for keeping serious threat species
Highly, Moderately or Not Dangerous	High	Low		
Highly, Moderately or Not Dangerous	Moderate	High		
Highly Dangerous	Moderate	Moderate		
Highly Dangerous	Moderate	Low		
Highly, Moderately or Not Dangerous	Low	Extreme		
Highly, Moderately or Not Dangerous	Low	High		
Highly Dangerous	Low	Moderate		
Highly Dangerous	Low	Low		
Moderately or Not Dangerous	Moderate	Moderate	Moderate	Import restricted to those license holders approved for keeping Moderate Threat species
Moderately or Not Dangerous	Moderate	Low		
Moderately or Not Dangerous	Low	Moderate		
Moderately Dangerous	Low	Low		
Not Dangerous	Low	Low	Low	Import Permitted
Unknown	Any value	Any value	Extreme until proven otherwise	Prohibited
Any Value	Unknown	Any value		
Any Value	Any value	Unknown		
Unassessed	Unassessed	Unassessed		

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