Australian Government
Department of Agriculture, Water and the Environment

Department Risk Analysis

Application to add *Mustela putorius furo* (domestic ferret) to the Environment Protection and Biodiversity Conservation Act 1999 *List of Specimens taken to be Suitable for Live Import*

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INTRODUCTION

Purpose of the proposed import

The CSIRO have applied to add domestic ferrets (*Mustela putorius furo)* to the List of Specimens taken to be Suitable for Live Import (Live Import List) for research purposes. The proposed import is to support ongoing research at CSIRO's Australian Centre for Disease Preparedness (ACDP) (formerly the Australian Animal Health Laboratory). Ferrets are extensively used in biomedical research including areas such as virology, reproductive physiology, anatomy, endocrinology and neuroscience. This includes their use as an animal model for COVID 19 research due to their susceptibility to respiratory diseases and influenza type viruses **(**Belser et al. 2011) and COVID 19 (Shi et al. 2020).

Although not in the Live Import List, ferrets have been present in Australia since the 1880's with the legislation managing them varying greatly between states and territories. CSIRO has identified that obtaining healthy, disease-free ferrets in Australia is difficult and therefore are seeking to obtain known clean ferrets via commercial laboratory animal suppliers overseas.

The proposal is to use domestic ferrets in biomedical research in an approved research facility

Background

Under s303EC of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the responsible Minister may amend the *List of specimens taken to be suitable for live import* (Live Import List) by including a specimen on the list. There are two parts to the List:

- Part 1 comprises specimens that can be imported without a permit under the EPBC Act and
- Part 2 comprises specimens that require a permit under the EPBC Act to be imported. Import restrictions generally apply to the specimens listed on Part 2, such as 'Eligible non-commercial purpose only, excluding household pets'. Additional conditions may also be applied when the permit for import is issued.

Before amending the Live Import List, the Minister must consult with appropriate Ministers and other persons, and consider a report assessing the potential environmental impacts of the proposed amendment. When applying to the department to amend the Live Import List, all applicants are required to provide a report that addresses specific terms of reference.

The department undertakes a risk assessment using the information in the applicant's report and any other sources of relevant information. The department also considers comments and information received through the public consultation process (including from states and territories).

Biology and Ecology of *Mustela putorius furo*

Introduction

The ferret (*Mustela putorius furo)* is considered the domesticated form of the wild European or Western polecat (*Mustela putorius*) and the steppe polecat (*Mustela eversmannii*) (Davidson et al. 1999, GISD, 2020). It is often considered as a subspecies of the European polecat and *furo* added to the scientific name for the domestic form which can be shortened to *Mustela furo* (Gentry et al. 2004). Genetically, the ferret and the two polecats are the same species, with all three species being able to interbreed successfully producing fertile young (Davidson et al. 1999). In this report, the term 'ferret' will be used for the domestic animal and 'Polecat' will be used in reference to wild Polecats.

Conservation status

The ferret, European polecat and the steppe polecat are not listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora

Ferrets are not listed on the IUCN Red List.

The IUCN Red List lists the Western polecat (*M. putorius*) as Least Concern with a current population trend as decreasing (Stumatov et al. 2016).

The IUCN Red List lists the steppe polecat (*M. eversmannii)* as Least Concern with a current population trend as decreasing (Maran et al. 2016).

Taxonomy

Ferrets have a long history of domestication dating back to 1500 BC when the Egyptians kept them to control rats and mice (Markula et al. 2016). Over this time, the ferret has been subject to selective breeding and back-crossing with wild polecats. While the ferret has been traditionally split taxonomically from its wild ancestors, such splits appear questionable, based on the following evidence:

- fertile hybrids can be produced between all three species (ferret, European polecat and steppe polecat), with polecat/ferret hybrids commonly occurring in Britain (Davidson et al. 1999, Croose, 2016) and Eurasia (Kurose et al. 2000);
- ferrets only differ from their wild ancestors in subtle morphological and behavioural ways that reflect the impacts of domestication (Davidson et al. 1999);
- the molecular phylogeny of ferrets is unresolved and currently there is no significant genetic distinction between the domestic ferret and the wild European polecat and the steppe polecat (Kurose et al. 2000);
- A study of the molecular phylogeny of Mustelidae suggests that the domestic ferret may have been domesticated from the African branch of *Mustela putorius* (Gippoliti, 2011, Ahmin, 2013), which diverged from the European branch of the polecat in the late Middle Pleistocene period (Sato et al. 2003).
- Davidson et al. (1999) concluded that the ancestor of ferrets and the two polecats is impossible to determine given their high degree of genetic homology and that along with the black-footed ferret (*Mustela nigripes*) from North America they could be considered as one Holarctic species;
- The close relationships within the polecat group (*M. putorius, M. furo, M. eversmannii, M. nigipes,* and *M. lutreola*) support that these species constituted a Holarctic species complex forming a syngameon (a grouping of genetically related organisms that may or may not be morphologically similar and are recognized by systematists as being in different species or sub-species and may even belong to different genera) (Lode´ et al. 2005).
- A study of the genetics of the Eurasian members of the *Mustela* genus also showed that the European mink (*M. lutreola*) has a high level of genetic homology with the ferret group (Kurose et al. 2000) and can produce fertile hybrids (Tumanov and Abramov, 2002, Lode´ et al. 2005).
- The black-footed ferret and the steppe polecat probably evolved from a common ancestor and share a high degree of genetic homology (Anderson et al. 1986). Offspring of polecats and black-footed ferrets are fertile (Williams et al. 1996).
- The American mink (*Neovison vison)* which was introduced to Europe in the 1920's can crossbreed with polecats (Olsen and Jensz, 2005).
- In Britain, 31% of wild polecats were found to be polecat-ferret hybrids (Croose, et al. 2018).

- '*A decision to allow importation of Mustella putorius furo is a decision to import genetic variability of the species Mustella putorius'*. Australian Wildlife Management Society submission to ferret listing application in 2000 (Georges, 2000).

The Government has an established policy that no hybrid specimens can be imported unless specifically listed on the Live Import List even if each parent species is listed. The only mustelids listed are for zoo display purposes and comprise three species of otters and the European badger. There are no ferrets, polecats or minks listed.

The literature demonstrates that the modern ferret is probably a hybrid of possibly up to four species of mustelids and it could be argued that the ferret, as one of the oldest domesticated animals, has now evolved into a new species due to anthropogenic actions. As a counterpoint evidence shows the ferret is still undergoing crossbreeding with other members of the polecat group. Crossing of polecats with ferrets has been reported as still occurring in Croatia to stabilise the native polecat population as ferrets are considered domesticated polecats in that country (Markula *et al.* 2016). As a result, different sources of ferrets will contain different ratios of the polecat group and therefore from a genotype perspective must be considered as one species.

The department proposes that the ferret is considered for listing on the Live Import List not as a species but as a hybrid animal, *Mustela putorius furo*, a domesticated hybrid form of the European polecat. The ferret could also be considered as a subspecies of the European polecat. This would also mean the 'parent' species of the 'ferret' could not be imported unless specifically listed.

The Government's policy position is that hybrids are not permitted into Australia unless specifically listed on the Live Import List. By defining ferrets as a hybrid, the department acknowledges they are not a true species in the classic taxonomic sense but the result of repeated cross breeding between more than one mustelid species. There is no clear definition of what composition of each mustelid species or what mustelid species constitute a domestic ferret.

Habitat

Ferrets are an adaptable animal that can inhabit a range of habitats including sand dunes and cliff faces, their location is strongly linked to prey species (Bryom, 2002). In Europe, the polecat's habitat includes riparian vegetation, water courses, grasslands, agricultural land, pastures, human settlements, woodland edge, and montane pine forests depending on the region (Croose et al. 2018). In New Zealand ferrets prefer pastures, rough grassland, scrubland and adjoining forest fringes and are uncommon in forests and developed or open pastures (Blandford, 1987). Although rabbit burrows are a favoured den site, ferrets readily use man-made structures and farmyards particularly if there is an abundance of prey such as rodents present (Ragg and Moller, 2000).

In Australia they would be expected to readily find suitable habitat in temperate areas, particularly in areas such as creek or river gullies that contain cover such as blackberries, rock crevasses or fallen timber.

Climate Matching suggests most of Australia south of the tropic of Capricorn would be suitable habitat for ferrets with the southern coastal regions being highly suited to ferrets (Appendix B). The sum of the values for the five highest match classes (6 -10) was 1075 which gives a Climatch match of 4 or high according to the mammal risk assessment model for the establishment of exotic vertebrates in Australia and New Zealand (Bomford, 2008).

Home range and social structure

New Zealand studies show adult ferrets remain in their home range with resident animals not moving far from their core range. The home range is dependent on the abundance of food and the season. New Zealand ferret ranges can vary from 18 to over 300 hectares with an average of around 130 ha (Clapperton, 2001). However, unlike many other animals, home ranges are overlapping with each ferret sharing parts of its range with other ferrets, particularly in areas of high prey abundance (Clapperton, 2001). Ferret density in New Zealand is generally around four ferrets per km^2 in suitable habitat (Morley, 2002).

If food sources rapidly decline the ferret have been shown to triple their home range or move up to four km from their home range (Norbury et al. 1998). When a ferret population is rapidly depleted (such as in a targeted poisoning campaign) reinvasion is rapid, reaching 75 percent of the pre poisoning density within 30 days (Young, 1998). They are observed to use a range of dens throughout their range rather than a single den (Blandford, 1987). Ferrets are generally a solitary animal but will share dens and scavenge together from dead prey and show a high level of social interaction devoid of territoriality (Clapperton, 2001).

Breeding

The average gestation period is 42 days and in Australia and New Zealand the young are born in October or November (Olsen and Jensz, 2004).

Healthy domestic ferrets can have up to three successful litters per year, each of up to 15 young, particularly if modified light periods or hormonal induction is used (Jekl & Hauptman, 2017). In the wild ferrets produce up to two litters per year, with one litter being more common (Olsen and Jensz, 2004) with a second litter only being produced if the first litter is lost or only a few kits are produced (Olsen and Jensz, 2005). Litter sizes range from four to 15 kits with the average being between four and seven (Jekl & Hauptman, 2017).

The kits are totally dependent on their mother until weaned at six to eight weeks. The young begin to disperse at about three months of age with males dispersing first (Olsen and Jensz 2004). Young ferrets have been shown to disperse on average five km with some moving up to 45 km with no sex bias in distances travelled (Bryom, 2002).

Puberty is dependent on body condition and changes in the photoperiod but generally occurs at six to nine months of age. Ferrets are seasonal breeders, with breeding commencing when daylight exceeds eight hours per day (Jekl, & Hauptman, 2017). Female ferrets are seasonally polyoestrous between March and September, are induced ovulators and will remain in heat for three to six months if they are not impregnated (CSIRO, 2020).

This extended oestrus may lead to hyperestrogenism, or estrogen toxicosis. Females remain in oestrus for extended periods, which results in anaemia, blood disorders and bone marrow disorders which lead to death. About 50% of domestic females suffer from hyperestrogenism, which has a 40% mortality rate (Jekl, & Hauptman, 2017). Previous applications to list ferrets as pets have cited this condition as a possible reason why ferrets are unlikely to establish in Australia claiming an unmated female could not survive (2016 application).

Diet

Ferrets are defined as a strict carnivore (Olsen and Jensz, 2005) and until recently were bred to be an intelligent, effective and efficient killer (Hitchcock, 1994).

Ferrets near bird nesting sites heavily prey on birds, eggs and fledglings and can have significant impacts on bird recruitment levels. In some areas, birds and reptiles account for about half the ferret's diet (Clapperton, 2001).

In New Zealand, flightless birds such as penguins, wekas and kiwis are particularly at risk and only successfully breed on ferret free offshore islands (Georges, 2000). The ferrets will target penguins at all life stages consuming eggs right through to adult birds, with ferrets producing young to coincide with penguin nesting periods (Young, 1998).

Ferrets will also prey on insects, crustaceans, reptiles and amphibians. Carrion appears to only make up a small part of the diet, but ferrets will scavenge when other food sources are limited (Clapperton, 2001, Olsen and Jensz 2005). This suggests that the ferret is adaptable in its food sources and should be thought as a generalist rather than a specialist carnivore.

This can have consequences where the dominant food source is rapidly depleted by disease or a control program. New Zealand studies show ferrets target primarily rabbits and hares, however when rabbit numbers rapidly decrease, as seen with myxoma or calici virus outbreaks, ferrets readily switch to native animals with little decrease in ferret numbers (Norbury et al. 1998, Courchamp, et al. 2000, Clapperton, 2001).

Current status in Australia

The ferret was introduced into Australia in the 1880's for rabbit control (DPIPWE, 2011, Olsen and Jensz, 2005). Despite the long history of ferrets in Australia there is limited evidence that feral populations have established despite their reputation for escaping captivity (Olsen and Jensz, 2005). Known feral populations are generally small and are poorly studied. As ferrets are primarily a small, cryptic, nocturnal animal (Clapperton, 2001), more colonies may yet be found. Wild ferrets or polecats are predominately a solitary animal, with the domestic version being described as happy to live in social groups (Brown, 2020). It is probable that wild ferrets in Australia revert to the solitary form and therefore true colonies may not actually exist.

Why have they not already formed a feral population?

It has been proposed that failure to establish is due to ferret's long history of domestication and they therefore may be unsuited for establishing wild populations (Bomford 2003, Forsyth et al. 2004, Markula et al. 2016). Evidence suggests ferrets have been domesticated for at least 2000 years, with Aristotle describing them in the fourth century BC (Davidson et al. 1999).

Evidence from New Zealand shows that ferrets are cryptic by nature and extremely difficult to control. A study of control measures on wild tagged ferrets clearly showed the difficulties in managing these animals in the wild. In one trial nine of 23 tagged ferrets were not recaptured during the trial and in the second trial only two of 13 radio collared ferrets were recaptured at the end of the five-week trial (King et al. 2008). This finding mirrored that seen in Europe with unsuccessful control programs for the American mink (King et al. 2008).

This suggests that feral ferret populations may already be established in Australia but that the population has not reached the critical mass where their presence or impacts are obvious.

Given ferrets have been present in Australia since the 1880's (DPIPWE, 2011, Olsen and Jensz, 2005) and their wide use in ferreting for rabbits, it is likely that ferrets have escaped human control. Groups wanting ferrets added to the Live Import List as pets cite this as historical evidence that ferrets cannot establish a feral population in Australia (2016 application). The department, in investigating the biology and literature on ferrets, has the view while feral ferrets are not yet a problem, they should be managed in a way to prevent this situation changing.

An example of a latent species becoming invasive is the European carp which was present in Australia for many decades in low numbers and few reported environmental impacts. The

introduction of the 'Boolarra' genes to the population in the 1960's introduced new genetics resulting in the carp becoming a widespread environmental pest (Bomford, 2003).

Another example is the European rabbit which was introduced with the first fleet in 1788 and was repeatedly imported but failed to establish or spread from their release site until their release near Winchelsea in Victoria in 1859 (Cooke, 2012).

'*It is possible that a run of favourable seasons and good food supply, or the release of new strains of ferrets that are closer to the wild polecat end of the genetic spectrum rather than the domesticated strains that are currently most common in Australia, could lead to a sudden rapid expansion of the wild ferret population'* (Bomford, 2003).

The ferret in Australia is a domesticated animal historically bred as a hunting animal but also to be readily handled and form a symbiotic relationship with humans for its survival. An animal that will not return to its owner when used or shows aggression towards its owner is of little use. Since the 1980's the activity of ferreting has decreased, and ferrets are now mostly bred as companion animals.

Ferrets have two main coloration patterns; sable, which resembles the native polecat markings, and albino. It is plausible that the coloration of escaped ferrets may contribute to their invasion success. An albino animal is more likely to be picked off by predators and may have a lower hunting success than a darker animal. Albino ferrets are reported to have sight problems which would further reduce their ability to colonise. Their above-ground excursions are almost entirely nocturnal; any daytime activity is normally underground (Clapperton, 2001).

The ferret has established outside its native range in New Zealand, Canada, the USA, Italy, Netherlands, Portugal, Spain, the United Kingdom and Western Europe (GISD, 2020).

Australia differs from these countries in one key area and that is the influence of other mustelid genetics on the domestic animal. The Australian ferret appears to have less genetic mixing than other populations and could be thought of as a semi pure ferret breed compared with New Zealand where the founder population was deliberately interbred with European Polecats to make a bigger, more robust animal for release (Blandford, 1987). In Europe and Asia, the crossing of ferrets and native polecats has resulted in a hybrid animal evolving which may give the animal more environmental plasticity.

New Zealand ferrets

There are many theories regarding why ferrets readily established in New Zealand and not in Australia.

It is generally accepted that New Zealand has the largest population of feral ferrets in the world. Ferrets were introduced to New Zealand as a form of control for rabbits, with thousands being bred and released into the wild between 1880 and 1920 (Blandford, 1997, King, 2017). One estimate at the time suggests upwards of 75,000 ferrets were bred and released into the South Island. (King, 2017*).* This combination of ferrets being imported from the UK and Australia, combined with the active breeding programs and placement of ferrets into the wild in New Zealand, would have provided enormous propagule pressure and genetic diversity that ensured the establishment of ferrets in the wild.

In Australia releases have been more sporadic and most from escaped animals from captivity or lost while ferreting for rabbits, meaning the propagule pressure and genetic diversity was much lower. It has been proposed that the ferrets released in New Zealand were not fully domesticated. Most ferrets shipped from the UK were wild captured (King, 2017) and

contained some polecats or had polecat genetics in them (Blandford, 1987, Department of Conservation (NZ), 2020).

In New Zealand ferrets are predated by cats, other ferrets, dogs and harriers. It is considered in Australia that foxes, dogs, cats and possibly native predators like Tasmanian Devils, dingos, snakes and large raptors have limited the establishment of ferrets. The Tasmanian Government Ferret Risk assessment concluded that Devils may be a significant predator of ferrets and as the Devil population drops this may result in the establishment of ferrets in Tasmania (DPIPWE, 2011).

Propagule pressure

Ferrets have been present in captivity in Australia for over 140 years and actively used to hunt rabbits which has resulted in lost ferrets. People wishing for ferrets to be listed for pet purposes use this scenario as proof that ferrets will not establish a wild population. They argue that enough ferrets have been lost over time that a population should have established. Although a logical argument, many researchers feel this is too simplistic and that good fortune has prevented establishment rather than ferrets being unable to (Bomford, 2003, Forsyth et al. 2004).

A New Zealand study of successful and unsuccessful establishment of a range of introduced ungulates showed a threshold of about six individuals for successful establishment. (Forsyth and Duncan, 2001). This threshold was replicated in Australia for deer species (Forsyth et al. 2004). Although both studies showed that greater than six specimens resulted in establishment, they were primarily focussed on ungulates, the studies also demonstrated that small high fecundity species could establish in Australia and New Zealand from very low founder numbers. The 2004 study which looked at a broad range of introduced species, noted that the ferret appeared to not follow the criteria for invasiveness and that some other factor was acting on ferrets to prevent their establishment in Australia (Forsyth et al. 2004).

A plausible reason why ferrets have not established is that the Australian ferret population is genetically narrow comprising mainly domestic animals kept for ferreting (Bomford, 2003) or that the Australian ferrets suffer a type of founder effect (a population established by a very small number of individuals with limited genetic variation), that limits their establishment in the wild. Any increase in the genetic variability in the initial non-native population may increase the chances of establishment (Lockwood et al. 2005).

It is possible that increased genetic variation within the Australian population will boost the "*probability of establishment well beyond what we would expect if we were to discount problems of low genetic variability, and might also account for variation in establishment success that propagule pressure fails to explain'* (Lockwood et al. 2005).

Pest status

In New Zealand, ferrets are a biodiversity risk due to their predation on smaller animals and nesting birds and are listed as Unwanted Organisms under the *Biosecurity Act 2003* (NZ Department of Conservation, 2020).

Ferrets are illegal in California, Hawaii, Washington DC, New York City and their keeping is regulated in 28 US states. They are banned in Puerto Rico, South Africa and Portugal ('pethelpful' website, 2020)

In Australia ferrets are not listed as a specimen suitable for live import under the EPBC Act and an application to list them was refused in 2006.

The keeping of ferrets is banned in Queensland and the Northern Territory; in Victoria and the ACT a licence is required to keep them as pets. New South Wales, Western Australia, Tasmania and South Australia do not have controls on the keeping of ferrets.

Ferrets are rated as an extreme risk in the Australian List of Threat Categories of Non-indigenous Vertebrates, 2018. Under this rating it is recommended that its import should be prohibited, unless adequate risk management measures exist to reduce the potential risks to an acceptable level (EIC, 2018).

In the Northern Hemisphere, ferrets are identified as a risk to native and domestic animals due to predation which leads to a reduction of biodiversity and as a risk to genetic resources (GISD, 2020). Due to the ability of ferrets to cross breed with a range of mustelids they are identified as a risk due to genetic alteration of native species. Hybridisation between ferrets and other mustelids have been shown in Europe (Lode´, 2005), Russia (Tumanov & Abramov, 2002) and North America (Davidson et al. 1999).

A paper by King *et al.* in 2008 explored the effectiveness of various control programs in New Zealand concluded that control of ferrets is very inefficient, and eradication is unlikely as they are a small, intelligent, fast-moving and wide-ranging carnivore that is difficult to observe directly in the wild (King et al. 2008). This supported the findings of Clapperton (2001). In the UK ferrets and polecats have been persecuted and subject to bounties for centuries, with wild animals remaining throughout the UK (Croose, 2016).

Environmental impacts

Ferrets have been selectively bred as a hunting animal for at least 2000 years; it is only in recent times the animal has been kept and bred for the pet market. Many authors identify this occurring from the early 1970s following their use in several films. It can be assumed that ferrets as pets have about 40 years of breeding versus about 2500 years of selection as a hunting animal. Given ferrets become fertile at between four and eight months old and can produce two litters per year this equates to about 40 generations being bred as docile pets versus over 5000 generations as hunters. To suggest that recent breeding has removed their aggressive hunting instincts is not supported by the literature.

In countries where ferrets have established it has been documented that they can significantly impact ground dwelling animals and birds. In New Zealand, which has no native predators, the impacts are particularly severe. Species such as penguins, Weka and Kiwis are particularly at risk and only successfully breed on ferret free offshore islands (Georges, 2000). The ferrets will target the penguins at all life stages consuming eggs right through to adult birds. In New Zealand ferrets produce young to coincide with bird nesting periods (Young, 1998). Ferrets have also contributed to the decline of seabird populations on the Azores and reduced bird populations in the Scottish Isles (GISD, 2020).

There is some evidence that, as a small predator, they are suppressed by larger or higher order predators such as foxes and cats and that if these predators are reduced this can create a mesopredator release scenario. In Europe introduced larger predators such as the American mink (*Neovison vison*) and the raccoon dog (*Nyctereutes procyonoides*) have been shown to cause significant decreases in polecat populations (Croose et al. 2018). The Tasmanian Government Risk Assessment posed that a decrease in Tasmanian Devil populations may result in increased ferret numbers (DPIPWE, 2011). It has been proposed that predation from foxes, snakes and raptors may have prevented establishment in Australia, and the absence of these predators may have been one of the reasons ferrets have established in New Zealand (Georges, 2000).

The New Zealand Department of Conservation (2020) have concluded that while ferrets have been established in New Zealand for over a century, they are still having huge impacts on

vulnerable native species. '*No equilibrium with the environment has been reached - native species are still declining because of ferrets'* (Department of Conservation (NZ), 2020). During the 2005 assessment of ferrets, the New Zealand Department of Conservation provided comments to the department strongly advising to not allow the listing due the demonstrated impacts of ferrets in New Zealand.

Introduced predators can thwart this conservation goal by having severe impacts on native wildlife through the hyperpredation effect (Courchamp, *et al.* 2000). Hyperpredation is when an introduced predator uses an introduced prey species and obtains higher than expected numbers. This then flows onto native prey species being targeted by the high predator numbers if the primary food source decreases. Mustelids and rabbits have been implicated in this process in New Zealand and on oceanic islands.

In regions where mustelids naturally occur such as the Northern Hemisphere, the major risk is hybridisation with native mustelids and damage to the genetics of the wild mustelids on top of their demonstrated impacts to the environment through predation.

Ferrets are known to cross, and produce fertile hybrid animals, with mustelid species across Europe (Davidson et al. 1999, Lode´ et al. 2005), Asia (Tumanov and Abramov, 2002) and North America (Davidson et al. 1999). This can lead to impacts on native species such as the European polecat (Davidson et al. 1999, Croose, 2018) particularly in the UK where the polecat has been persecuted for centuries and is now threatened. Surveys in the UK, where polecats (*M. putorius*) are a native species, show that pure polecats are decreasing in number while hybrids are increasing (Croose, 2016).

Agricultural Impacts

Ferrets are adept at escaping captivity and have been reported boldly approaching wildlife. The keeping of ferrets was banned in California in 1935 (where it was considered that they were not fully domesticated) due to their impacts on poultry and small animals (Constantine and Kizer, 1988).

The ferret is an active hunter attracted to moving prey and there is evidence that they thrill kill especially in chicken or other bird enclosures. Reports from the USA indicate that impacts to commercial bird and rabbit breeding facilities from ferrets can be significant (Hitchcock, 1994).

Ferrets are reported in New Zealand as a reservoir for bovine tuberculosis (*Mycobacterium bovis*) (Caley, et al. 2002) which is transmitted to cattle and deer. Ferrets are also implicated in acting as a reservoir for rabies in Europe and the USA (Constantine and Kizer, 1988).

A draft Import Risk Analysis on ferrets undertaken by the then Australian Quarantine and Inspection Service in 2000 identified eight World Organisation for Animal Health (OIE) and 26 non OIE listed disease agents that may pose a risk to Australia (AQIS, 2000).

Risk to humans

The application states that ferrets can inflict painful bites to humans, with the literature showing that infants and small children are most at risk from unprovoked attacks with 452 reported cases being identified in three USA states between 1978 and 1987. Of 64 reported cases on infants, 18 required reconstructive surgery to their faces (Kizer and Constantine, 1989, Hitchcock, 1994). There are verified reports of ferrets killing infants (Kizer and Constantine, 1988). Pickering et al. (2008) recommends that ferrets should not be kept in houses containing children under five years old and quotes that the American Veterinary Medical Association does not recommend keeping ferrets as pets and anyone who is incapable of removing himself or herself from the bite of a ferret should not be left unattended with a ferret (Pickering et al. 2008). The Risk Assessment for the IPAC listing

rated the ferret as a risk to humans with a maximum score being applied for this criterion (EIC, 2018).

Ferrets have been selectively bred not only to be instinctively unafraid of humans but simultaneously ferocious and tenacious to prey species (Constantine and Kizer, 1988).

Serious attacks on humans are generally confined to those who physically cannot fight back such as infants. It is postulated that infants suckling, and squeaking noises resemble those of suckling rabbits and therefore invoke the predatory response. This is further supported by the fact ferrets selectively target the head, face and neck region of prey, which are the most common sites of human infant injuries. There are reports of the risks to infants from ferrets dating back to the 1830's (Constantine and Kizer, 1988).

Although not present in Australia, rabies is a significant risk from ferret bites with ferrets posing as a carrier for the disease between wild and captive populations of animals (Hitchcock, 1994).

Proposed risk mitigation strategies

Constantine and Kizer in their 1988 review of the risks of ferrets to the public, livestock and wildlife questioned the humaneness of producing and marketing an animal as a pet that must generally undergo operations to decrease its aggressiveness (castration of males), offensive odours (gland removal) and to prevent the death of female ferrets from anaemia (hypoestrogenism).

Reasons for the 2006 refusal to include ferrets on the Live Import List as household pets include potential disease risk, risk of introducing new genetic material that may increase the potential for the animal to establish feral populations, and their pest potential if they were to establish. The Risk Assessment report used in the 2006 listing refusal concluded '*It is difficult to recommend conditions and restrictions for reducing the potential for negative environmental impacts that are likely to be effective'* (Olsen and Jensz 2005). The 2016 application to include ferrets on the list as household pets did not provide any new strategies to change this conclusion.

The CSIRO application and proposal for listing on Part 2 is the only plausible way the department could consider recommending that ferrets be allowed to enter the country.

The application to list ferrets for research purposes in high security facilities may result in more genetically diverse ferrets entering Australia, but due to the security requirements there is an extremely low possibility these could enter the pet ferret population or increase the pest potential of pet ferrets in Australia. The requirements for ferrets as research animals will reduce the risk of any new or novel diseases entering the country, due to the strict hygiene requirements for the research facilities.

The application has two parts, the use of ferrets in research within a highly secure facility where escape or release is as close to impossible as can be achieved. The second is the establishment of a small breeding colony of ferrets in an offsite but still high security facility. The breeding facility is managed by CSIRO for the purposes of providing laboratory animals to the ACDP, although not as secure a facility the measures in place would be sufficient to reduce the risk of escape or release.

There is a possibility that CSIRO may breed and sell some ferrets to other high-level research facilities within Australia for biomedical research. The department recommends that any listing of ferrets would be for research purposes only in high security facilities. Under the EPBC Act this listing would mean all ferrets imported and their progeny would be subject to the listing conditions. This means any ferrets sold could only be to another research facility of an appropriate biosecurity level.

The biosecurity standards and certification of these facilities are managed by the department and in the case of the ACDP facility, as an international reference laboratory, international bodies such as the World Health Organisation (human health) and the World Organisation for Animal Health (OIE).

Some of the comments received during the first consultation round were against ferrets being bred in Australia under any circumstances. The department considers that an importation of ferrets to establish a small breeding colony that could be used in secure research facilities would limit the number of new animals entering the country and further reduce the risk of new genes entering the Australian ferret population.

Previous Risk Assessments

There have been numerous Risk Assessments undertaken in Australia for the ferret. These risk assessments include the Commonwealth Department of Environment and Heritage (Olsen and Jensz, 2005), the Tasmanian Government (DPIPWE, 2011), the Western Australian Government (Kirkpatrick et al. 2008), the Queensland Government (Markula et al. 2016), and a draft Import Risk Assessment commenced, but not finalised, by the former Australian Quarantine and Inspection Service (AQIS) in 2000. All rate the ferret as an extreme risk to the Australian environment.

The draft AQIS Import Risk Analysis showed that the ferret posed animal health and agricultural risks and that, given the cryptic nature of the ferret, control in a disease outbreak would be very difficult. The role of ferrets in maintaining and circulating Bovine Tuberculosis in New Zealand is one such example of a risk the animal may pose in Australia. The Import Risk Analysis was never completed as the application to list the ferrets as pets was refused.

The above-mentioned assessments cover the basic biology, breeding and risks of the ferret in Australia. They all show the likelihood that ferrets could establish and pose an extreme risk to the environment and agriculture if they were imported as pets.

The Commonwealth/State Environment and Invasives Committee (EIC) rate the ferret as an extreme risk. The committee regards animals with this classification as being prohibited from import unless sufficient risk management measures exist to reduce the potential risks to an acceptable level.

On 12 January 2006 the then Minister refused to include the ferret on the Live Import List for the purposes of household pets. Reasons for the refusal include potential disease risk, risk of introducing new genetic material that may increase the potential for the animal to establish feral populations and their pest potential if they were to establish.

The 2005 assessment report, prepared by Latitude 42 Environmental Consultants (Olsen and Jensz, 2005) on behalf of the department, considered possible conditions or restrictions, including single-sex or sterile animals only. The report concluded that these conditions would be unlikely to be totally effective or acceptable, and that they may be unenforceable. The report cited the situation in California in which neutered male ferrets were permitted, but inspectors were unable to ascertain whether animals had been neutered and sterilisation documentation was falsified. As a result, ferrets were totally banned in California (Moore and Whisson, 1998).

Prior to the research application from CSIRO, the department received several applications to list ferrets as pets. The most recent in 2016 suggested that importations be limited to castrated males only, with it being possible for inspectors to visually confirm desexing, rather than relying on certification. The Live Import Section at the department have confirmed that, on Occupational Health and Safety grounds, the inspectors would not manually inspect ferrets to

determine if they had been castrated. Bomford (2003) quotes the sterilisation of ferrets as an unenforceable management strategy.

As this management measure was part of the 2006 Ministerial Decision and given that it could not be enforced at the border, the department considers that it is not an effective management option.

As no new management measures that would sufficiently reduce the risk to the Australian environment to an acceptable level have been provided, the applications to list ferrets for pet purposes have never been finalised.

Related Live Import List listings

There are 3 mustelids in Part 2 of the Live Import List:

Taxon	Common Name	Conditions for import
Aonxy cinerea	Oriental Small-clawed Otter	Eligible non-commercial purpose only, excluding household pets
Lutrogale perspicillata	Smooth-coated Otter	Eligible non-commercial purpose only, excluding household pets
Meles meles	Eurasian Badger	Eligible non-commercial purpose only, excluding household pets

There are no reports of any of the species in Part 2 forming feral populations or having any environmental impacts in Australia.

An application to add the ferret as a pet in Part 1 of the Live Import List was refused in 2006, due to the extreme risks and threats that ferrets pose to the Australian environment should they be imported and escape or be released.

A 2016 application to list the ferret in Part 1 of the List as a pet has not been finalised as the department was waiting on information from the applicant demonstrating management conditions that would lower the ferret's risks to an acceptable level. The department considers that there are no management conditions that could be applied that would allow the listing of ferrets in Part 1 of the Live Import List.

Risk assessment of ferrets

The department used the Australian Bird and Mammal Risk Assessment Model (Bomford, 2008) to assess the risks posed by the importation of ferrets (**Appendix A**). The results indicate that the animal has:

- a **serious** risk of establishing a wild population in the Australian environment if released,
- an **extreme** risk of becoming a pest if it were to establish, and
- the **potential to be highly dangerous** to the public from either captive or released individuals.

The ferret has a theoretical Environment and Invasives Committees threat category of **extreme** (using Australian Bird and Mammal Risk Assessment Model and Table 2.3 in Bomford, 2008).

The climate match, comparing the native range of the animal to Australian climates, indicates that the ferret has a **high** climate match to Australia (**Appendix B**). This animal has a highest

Climatch class of nine indicating that most of the Australian continent is climatically suited to ferrets.

The ferret is included in the Environment and Invasives Committee's 2018 "*Australian List of Threat Categories of Non-indigenous Vertebrates*" with a threat rating of '**extreme'**. In total 3 Mustelidae species are listed (Ferret, Oriental Small-clawed Otter and the Stoat) – all are assigned a threat rating of 'serious' or 'extreme'. All three species have an endorsed risk assessment (EIC, 2018)

Risk mitigation

The risk assessment indicates that the animal has a high potential for establishing in Australia if released. It is for this reason that it is recommended that ferrets only be imported into high security research facilities. This containment will assist in preventing the escape of this animal into suitable habitat.

Table 1: Summary of risks and mitigation measures

Risk	Likelihood	Environmental Impact	Mitigation measures	Overall risk
Release or escape of adult specimens	rare	moderate	Only kept in secure cages in an Approved Arrangement facility.	medium
Release or escape of immature specimens	rare	moderate	Only kept in secure cages in an Approved Arrangement facility.	medium
Disease transmission to native species populations	rare	moderate	Only kept in secure cages in an Approved Arrangement facility. Individuals will be vet checked prior to arrival and will be subject to Commonwealth quarantine procedures.	medium
Theft and deliberate release	rare	moderate	Due to the quarantine and containment procedures and certification of these research facilities it would be extremely hard for ferrets to be released or escape.	medium

Table 1 shows that the risks of importing ferrets to a high security facility remains at least medium, as the consequences of any release will be moderate to major. This is with the assumption the ferrets cannot escape or mix with wild animals. If this table was replicated for ferrets as pets, then based on history each likelihood would move to likely and the consequences to at least major which gives the rating of extreme. An extreme rating is the same as that produced by the Bomford model.

A similar risk table could be conducted for the organisational risk to the importing facility, in this case although the likelihood for escape/release is rare the consequences would be severe which again would result in an Extreme rating.

It is the department's view from a risk perspective the animal poses such an extreme risk that they could only be imported under extremely narrow and high regulated circumstances such

as to a high security facility for a specific purpose as research where there is no real possibility that they could ever be released.

Comments and responses from first round consultation period

The department undertook consultation with relevant ministers (or their delegates), government agencies and the public between 4 March and 3 May 2020. The department received six responses. The comments and the department's responses are detailed in Attachment C (Summary of comments).

- The ACT supports amendment of Part 2 of the Live Import List to allow for the import of ferrets for research purposes, providing the adequacy of the research facilities and the justification of why the ferrets need to be sourced from overseas is provided before any ferrets can be imported.

Department response: The application is solely for ferrets for research purposes in high security facilities. Listing ferrets on Part 2 of the List for research purposes would then require an import permit for every importation of ferrets. At the permit stage the adequacy of the research facilities and the justification of why the ferrets need to be sourced from overseas would need to be provided.

- The NSW DPI recommended that the inclusion of domesticated ferret in the Live Import List should be subject to stringent conditions and raised similar concerns to those of the ACT Government.

Department response: as for the ACT comments. NSW also raised conditions that should be applied to a permit to import ferrets instead of listing conditions.

- The Victorian Government did not provide a written response, but a verbal response was received confirming that Victoria supported the amendment. The Victorian Government has a policy of not responding to listings unless they have concerns with the proposal. Therefore, a nil response means that the Victorian Government is supportive of the listing.

Department response: As the applicants and the laboratory are both located in Victoria the department contacted the Victorian EIC representative to confirm they had no concerns with the proposed listing.

- Federation University raised several concerns with state and territory legislation around keeping, breeding and selling ferrets. They also raised questions about the adequacy of the ACDP animal facilities and the ability of ACDP to fully contain the ferrets. Their final concerns were around the experimental design.

Department response: The Federation University comments are more relevant to an application permit for a specific set of experiments than placing ferrets on the Live Import List. If the ferrets were listed many of their comments and concerns would be addressed as part of the import permit process. The department views the ACDP facilities as being potentially being one of the few places where ferrets could be held securely in Australia. It is not the department's role to question the specifics of the experiments rather that they will be undertaken in an approved facility and will be conducted as per the Australian standards.

- Humane Research Australia (HRA) challenged the use of animals in research and promotes the use of more humane and scientifically valid methodologies. They suggest that humans differ from other animals anatomically, genetically and metabolically, meaning data derived from animals cannot be extrapolated to humans with enough accuracy.

Department response: The HRA comments all relate to an objection for using animals in biomedical research and that treatments and vaccines developed in animals often do not work in humans. This is a complex subject but there is enough evidence available to show that ferrets are a useful animal model for studying respiratory diseases such as influenza and coronaviruses. The department notes their objections to the use of animals in research.

- Wildlife Queensland are concerned with proposed importation, given that so many past imported species have become extreme environmental pests/predators. They are concerned with such a high-risk species with the possibility of escape is too high.

Department response: The department views the ferret as an extreme risk to the Australian environment and therefore should never be allowed to be imported in a way that may result in their escape. The department considers the ACDP facilities as being one of the few places where ferrets could be held securely in Australia.

Conclusion

The application is specific to the domestic ferret and for a very defined set of circumstances. Under these circumstances the risks of ferrets posing an environmental risk are very low.

Following consideration of comments received and a review of the literature and previous risk assessments, the department recommends listing *Mustela putorius furo* on Part 2 of the Live Import List with the conditions:

- **Research only**
- **High security facilities only**.

Permits would be required for each import; the security of the facilities would be assessed, and further conditions may be placed on individual imports as required.

The department has concluded that the listing of the domestic ferret for any other purpose such as for pets or working animals would pose an unacceptable risk to the Australian environment. The Department therefore recommends that a listing of domestic ferrets with strict conditions in Part 2 of the Live Import List be considered as a refusal by the Minister to place the domestic ferret on Part 1 of the Live Import List.

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Appendix A: Australian Bird and Mammal Risk Assessment Model

Species identification and sources	domestic ferret
Common name	ferret
Scientific name	*Mustela putorius furo*
Date assessed	14-Apr-20
Literature Search Type And Date:	Literature, NZ DOC, GISD

Risks posed by captive or released individuals	Value	Comment
A1. Risk to people from individual escapees (0–2)	1	can attack unprovoked causing non fatal injuries that may require hospitalisation.
A2. Risk to public safety from individual captive animals (0–2)	1	moderate risk, can cause injuries that require medical attention but consequences not likely to be fatal
A. Risk posed by captive or released individuals (= Sum of A 1 to 2).	**2**	**highly dangerous**

Risk of establishment	Value	Comment
B1. Climate Match Score (1–6)	4	all of Southern Australia climatically suitable, sum level 6 value is 1075 = score of 4 or high.
B2. Exotic Population Established Overseas Score (0–4)	4	established in New Zealand (268 000 km^2) plus large areas of Europe and eastern Asia and some small islands
B3. Overseas Range Size Score (0–2)	1	about 15 million km^2
B4. Taxonomic Class Score (0–1)	1	mammal
B5. Diet Score (0–1)	1	generalist carnivore
B6. Habitat Score (0–1)	1	can live in natural and manmade ares
B7. Migratory Score (0–1)	1	non migratory
Model	2	
B. Risk of Establishment (Model 1 = Sum of B1 to B4; Model 2 = Sum of B1 to B7).	**13**	**Serious**

Risk of becoming a pest	Value	Comment
C1. Taxonomic group (0–4)	4	mustelidae, so genus with known history of impacts to agricultrue and environment
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2)	1	overseas geographic range is about 15 million km^2
C3. Diet and feeding (0–3)	2	terrestrial carnivore
C4. Competition with native fauna for tree hollows (0–2)	0	does not use tree hollows
C5. Overseas environmental pest status (0–3)	3	major environmental pest in several countries through predation and impacts to native species
C6. Climate match to areas with susceptible native species or communities (0–5)	4	> 100 grid squares in top 4 highest classes
C7. Overseas primary production pest status (0–3)	1	problem to poultry and rabbit farming
C8. Climate match to susceptible primary production (0–5) **Hint: Use the "commodity" sheet created when a CLIMATCH grid is opened.**	2	reports of damage reported overseas but not significant impacts
C9. Spread disease (1–2)	2	known to spread bovine tuberculosis in NZ and rabies in North America.
C10. Harm to property (0–3)	0	harm to property resulting in financial damage very unlikley
C11. Harm to people (0–5)	2	social nuisance, can bite and attack unprovoked. Injuries generally minor. Few people exposed
C. Pest Risk Score (= Sum of C 1 to 11).	**21**	**Extreme**

Summary	Value	
A. Risk to public safety posed by captive or released individuals	**2**	**highly dangerous**
B. Risk of establishing a wild population	**13**	**Serious**
C. Risk of becoming a pest following establishment	**21**	**Extreme**

Disclaimer This risk assessment does not account for everything that is likely to affect to the risk of establishment. It should be interpreted in the light of any other information you may have.
Further details supporting the values for each criterion can be found in the department's Risk Assessment report.
For more details on scoring and rating criteria please consult the 'Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand' (Bomford, 2008).

Appendix B: Climatch predicted range for Ferrets.