ferrets, is subject to repeated petitions to repeal the ownership ban, and has diverse wildlife communities vulnerable to exotic animal introductions. The impacts of ferrets upon native wildlife and ecosystems, agribusiness, and human health and safety were compiled from a thorough review of the published literature and the analysis of four surveys of U.S. state agencies, including our unpublished survey data. Results highlight two primary concerns: the ferret can easily escape confinement, and could impact native bird populations, as do feral cats; and human safety concerns, especially with infants, because of the proclivity of the ferret to bite. The requirements for introduction and establishment of an exotic animal are discussed in relation to the case studies of feral ferret populations and applicable life history traits. While the pet ferret may lack the genetic rigor and instincts to be an effective predator and invader, the European polecat (*M. p. putorius*) and ferret-polecat hybrids can and do exploit vulnerable ecosystems such as islands. Regulatory strategies and environmental impact mitigation measures are presented: methods for minimizing the risk of release and for quantifying risk/benefits in general; addressing gaps in regulation, enforcement, funding, and information sharing; mitigating human health and safety concerns by mandatory sterilization /vaccination and pet owner education; and improving monitoring of invasive species and adequacy of emergency response and eradication measures.

Key words: California, environmental impact, ferret; hybrid, invasive species, *Mustela putorius furo,* pet, polecat

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Scientific Nomenclature and Regulatory Classification of the Ferret

The taxonomic status of the domesticated ferret (*Mustela putorius furo*) is relevant to discuss because it is at the heart of regulatory arguments over the degree of domestication and any latent ability to revert back to a wild form and cause environmental damage. The domesticated ferret is often cited as having been selectively bred in captivity for over 2 millennia (Thomson 1951; Zeuner 1963; Fox 1988; Anderson 1989; Blandford 1987). The oldest literature references do not properly differentiate ferrets from other mustelids such as polecats and weasels (Owen 1969; Corbet and Southern 1977). The purpose of ancient selective breeding efforts was probably not to create a pet, but a hunting companion, as most early references indicate the use of ferrets to flush out, or "ferret out," prey from holes or other refugia (Everitt 1897; Camp 1966; Woodford 1967). Ferrets are often cited as deriving from an albinistic polecat (Bissonnette 1950; Hvass 1961; Kowalski 1976; Howes 1980; Lever 1985), but domesticated lineages are often crossed with each other or outbred with wild polecats to artificially select for color, docility,

hunting ability, and genetic vigor, or to eradicate diseases from inbreeding depression (Bell 1837; Fennell 1843; Hagedoorn 1954; Mathews 1968; Corbet and Southern 1977). Recent genetic analysis of the entire genus *Mustela* (Davison et al. 1999) demonstrates that the ferret's origins are obscure and complex.

The taxonomic treatment of domesticated ferrets has varied greatly over the last three centuries, but most authors prefer the trinomen *Mustela putorius furo*, which is often incorrectly attributed to Linnaeus (1758). Linnaeus (1758) recognized the ferret as its own species *Mustela furo*, a taxon distinct enough, he determined, to separate it from its wild ancestor—the polecat—which he named *Mustela putorius*. The validity of the taxa *Mustela putorius* and *M. p. furo* has been challenged, and often recombined or misspelled, and synonyms include the following: *Mustela furio* [sic], *Mustela putorious* [sic]; *Putorius vulgaris*; *Putorius foetidus*, and *Putorius furo* (Bachrach 1930; Cabrera 1930; Corbet and Southern 1977; Blandford 1987). Similarly, the vernacular names of *Mustela putorius sensu lato* and its subspecies are quite varied and include European polecat, western polecat, ffwlbart, fitch, foulmart, and iltis (Bachrach 1930; Thomson 1951; Corbet and Southern 1977). The vernacular names for *M. p. furo* typically differ from those of the wild polecat, such as domestic ferret, domesticated fitch, and European ferret, but 'ferret' is often synonymized with 'polecat,' which obfuscates the differences between genomes of those populations artificially or naturally selected (Bachrach 1930; Anderson 1989). Such synonymy has also made difficult the determination of the adverse impacts that ferrets alone may have caused upon the environment. Some earlier authors considered the domesticated ferret to be sufficiently divergent from the European polecat and steppe polecat to assign it to the distinct species *Mustela furo* (Linnaeus 1758; Bachrach 1930; Corbet and Southern 1977; Blandford 1987; Poole 1973). In contrast, genetic analysis of *Mustela* by Davison et al. (1999) indicates that interspecific variation was generally too low to properly resolve species-level relationships and their analysis could not resolve whether ferrets were originally domesticated from *M. p. putorius* or *M. eversmannii* (steppe polecats). Interbreeding between mustelid species has been documented (Miller 1933; Blandford 1987; Owen 1969; Corbet and Southern 1977; Fox 1988; Chadwick 1991). Forsyth *et al.* (2004) describe the combined polecat-ferret taxon (*Mustela putorius sensu lato*) as a spectrum, with the polecat at one end displaying the genotype and phenotype of an untamable animal able to thrive in the wild and colonize suitable habitat, and the ferret at the other end of the spectrum, displaying the opposite attributes. Furthermore, ferrets and polecats cannot be easily differentiated phenotypically; traditional taxonomic characters (pelage color, cranium measurements) are unreliable and sexual dimorphism exists (Ashton and Thomson 1954; Walton 1977; Blandford 1987; King 1990; He et al. 2002). Agency surveys report that a wide variety of taxonomic and vernacular names are used by state agencies to identify ferrets (Jurek and Ryan 1999; Graening et al. 2010; Lepe et al. 2017). These unresolved taxonomy issues pose a challenge to the regulation of ferret importation and ownership as well as the identification of stray or feral ferrets.

In the past century, the regulatory classification of ferrets was an important issue because the regulatory authority of some state agencies depended upon whether the animal was classified as wildlife/exotic animal or a domesticated animal/pet (see review by Herman 2000). With the advent of sterilization techniques and vaccines, as well as selective breeding for docility, most state agencies and non-governmental organizations now recognize the ferret as a pet or domesticated animal. The classification of the ferret in a particular state or municipality is often dictated by its regulatory status. The vast majority of state agencies classify it as a pet or domestic animal, while states that ban ferret ownership (California, Hawaii) label it as a wild or exotic animal (Jurek and Ryan 1999; Graening 2010; Lepe et al. 2017).

The weasel genus *Mustela* originated in Eurasia, and may have colonized North America in the Middle Pleistocene during land connection with Russia (i.e., Beringia); the stoat (*Mustela erminea*) and the black-

footed ferret (*Mustela nigripesMustela putorius sensu lato*) is not (Kurtén and Anderson 1980; Anderson 1989; Jameson and Peeters 2004). Other mustelids (e.g., *Martes*, *Lontra*, and *Taxidea*) may have colonized North America as early as the Miocene Epoch (Kurtén and Anderson 1980; Jameson and Peeters 2004).

Ferrets were first imported into North America from Europe in the 19th century for use in hunting and pest control and importations continued into the early 20th century for fur production (Lantz 1909; Bissonnette 1950; Dolensek and Burn 1976; Fox 1988). In the USA, a ferret breeding industry developed at the beginning of the 20th century and displaced importation (Harding 1915). By the mid-20th century, the use of ferrets in hunting declined and cats gradually replaced ferrets as the popular animal companion for rodent control (Kowalski 1976). Since the 1930s, ferrets were bred and used in the laboratory for biomedical research (Besch-Williford 1987). Around the 1970s, ferrets re-emerged as a novel exotic pet, were popularized in the 1990s in cinema, and hundreds of thousands are now bred for the pet trade (Paisley and Lauer 1988; Graening 2010). Despite numerous accidental and intentional introductions, the ferret is not considered to be one of the naturalized mammals of North America (Banfield 1974; Hall 1981; Lever 1985; Fox 1988; Eisenberg 1989); a few authors include the ferret in the North American fauna based upon incidents of stray ferrets persisting in Arizona and New Mexico (Hoffmeister (1986; Jones et al. 1997; Jones and Schmitt 1997).

Censuses of Pet Ferrets

The enumeration of the pet ferret population in the USA and California is important for several reasons: it provides information about economic impacts, both beneficial and adverse; it may be used to support or refute arguments that ferrets impact the environment; it may be used in risk analyses and cost-benefit analyses; and it is a measure of civil disobedience (i.e. number of Californians ignoring the ferret ban) and indicates the relative need for future licensing, monitoring, or enforcement actions. No scientific census of ferrets has ever been performed in the USA; all existing estimates are based upon opinion or extrapolation of pet owner surveys or ferret product sales. Published estimates for total numbers of pet ferrets in the USA for the last 3 decades range from 275,000 to 10,000,000, but most hover around 1,000,000 (Paisley and Lauer 1988; Wiesser 1991; Jeans 1994; AVMA 2007; Jurek 1998; Boyce et al. 2001; Ball 2002; Nagami 2004; American Pet Products Association, Inc. 2010; Graening 2010). Published estimates for total numbers of pet ferrets in California for the last 3 decades range from 30,000 to 1,000,000, but most cluster around 100,000 (Weiser 1991; Umbach 1997; Jurek 1998; Boyce et al. 2001; Graening 2010). Ferret sales are in the range of 150,000 animals each year (Paul Juszczak, Director of Sales, Marshall Pet Products, personal communication, 2010).

Impacts of Domesticated Ferrets Upon Wildlife

General impacts of invasive species.—Impacts from invasive species are second only to habit destruction in worldwide biodiversity loss (Stein et al. 2000). At least 4,500 exotic species have established free-living populations in the USA, and California experiences a new exotic species introduction at a rate of about every 4 months (U.S. Congress, Office of Technology Assessment 1993; CDFG 2007). In California alone, there are at least 12 exotic mammals that have become naturalized, and environmental impacts are documented (Mooney et al. 1993; CDFG 2007). California, particularly the California Floristic Province,

is a global biodiversity hotspot (defined as a megadiverse region under imminent threat of destruction) (Stein et al. 2000). It is generally very difficult to assess the impact of an introduced species on the ecosystem it has invaded (U.S. Congress, Office of Technology Assessment 1993; Parker et al. 1999). In most cases, data are not available to compare communities before and after the invasion (Courchamp et al. 2003).

Islands are particularly sensitive to exotic species invasions for a variety of reasons, including the lack of predators or competitors and the naiveté of prey (Moors 1983; Courchamp et al. (2003). Natural ecosystems of the Hawaiian Islands are particularly vulnerable and have been devastated by introduced species: more than half of Hawai'i's free-living species are non-indigenous (U.S. Congress, Office of Technology Assessment 1993). Atkinson (2001) discusses the concept of "mainland islands", which are intensively managed areas such as nature preserves that are targeted for ecological restoration, including the removal of non-native mammals. Wildlife agency biologists argue that California may function as a mainland island (Jurek 2001); however, California has twenty native species of terrestrial carnivores, half of which are mustelids (Jameson and Peters 2004).

According to Forsyth et al. (2004), the process of biological invasion involves four stages: transport; introduction; establishment; and spread. Various factors increase the probability of establishment of an exotic species: increased number of individuals released and number of release events; the new host habitat more closely matches the invader's native habitat; and more competitive life history traits (Forsyth et al. 2004). The ideal conditions for establishment of a feral ferret population are hypothesized to be: a moderate climate in the introduction area; an abundance of preferred prey (rabbits, rats, etc.); a lack of competitors and predators; and a large population of released ferrets with repeated introductions (Blandford and Walton 1991; Davison et al. 1999). All of the ideal conditions for establishment of a feral ferret population have not yet been met in California; predation and competition from California's wildlife may be important factors that limit the success of the establishment of a feral ferret population.

Mustela putorius sensu lato are carnivores and prefer live prey, but can eat carrion and non-meat foods (Blandford 1987; Anderson 1989; Ball 2002). The primary prey items of polecats and ferrets are rabbits and rodents, although ground-nesting birds and eggs are common targets (e.g., Anderson 1989; Alterio and Moller 1997; Clapperton 2001). Feral ferrets are implicated in the decline of seabirds on the Azores archipelago (Pitta Groz et al. 2002) and birds in New Zealand (King 1984b). Thus, escaped feral ferrets could impact California wildlife, especially ground-nesting birds, and islands ecosystems are particularly vulnerable.

Life history traits of the ideal invader compared to the ferret.—The characters of a model invasive species include commensal or mutualist relationship with humans; omnivory and ability to live in a wide range of physical environments; relatively long life-span and short reproductive cycle; high genetic variability; and competitive superiority (Ehrlich 1986; Newsome and Noble 1986; Bomford and Hart 1998).

According to r/K-selection life history theory, animals that are r-selected strategists are better suited to colonization (or invasion) of new habitats (MacArthur and Wilson 1967). King and Moors (1979) compared the life histories of various mustelids, and concluded that polecats and feral ferrets were in the middle of the r/K-selection continuum. Ferrets have some, but not all, of the life history traits of an ideal invader species. *M. putorius sensu lato* reach sexual maturity by about six to nine months of age (Mead 1989). The female is polyestrous, and can produce two litters per year; litter size is 2–12 kits (Mead 1989; Seal 1989; Murphy 1989). *M. p. furo* life expectancy is 5–8 years, with some pet ferrets living up to 14 years (Williams 1984; Applegate and Walhout 1998; Boyce et al. 2001; Ball 2002). New Zealand biologists have performed the most extensive studies on population dynamics of ferrets (e.g. Lavers 1973). Byrom (2002) studied the dispersal and survival of juvenile feral ferrets in New Zealand.

Clapperton (2001) summarized the population dynamics of feral ferrets, including estimates of mortality, recruitment, and age-specific survivorship.

New Zealand case study of escaped/feral ferrets establishing in the wild.— Before human colonization of the islands, New Zealand had only two species of land mammals, both bats, and no predators (Moors 1983). From the mid-19th century to the beginning of the 20th century, mustelid carnivores (weasels, stoats, and ferrets) were introduced to control non-native rabbit populations, and now all of these mustelids are established and widespread (McCann 1956; Cowan 1984; Lever 1985; Wodzicki 1950; King and Moors 1979; King 1990). New Zealand now has the world's largest population of feral ferrets, and along with the other introduced mammalian predators, are causing a decline in indigenous shorebirds and biodiversity in general (King and Moors 1979; Fitzgerald et al. 1984; King 1990; Alterio and Moller 1997; Dowding and Murphy 2001). It should be noted, however, that the term 'ferret' was used generically, and various authors reported that undomesticated ferrets and polecats were also released into New Zealand (McCann 1956; Roots 1976; Walton 1977; Blandford 1987; King 1984a, 1990). Attempts to eradicate mustelids have been unsuccessful (Wodzicki 1950; King and Moors 1979; Clapperton 2001). Ironically, one of the most effective means of controlling ferret populations in New Zealand is to reduce rabbit populations (Fitzgerald et al. 1984; King 1990; Clapperton 2001). In 2001, the New Zealand Department of Conservation declared ferrets unwanted organisms under the Biosecurity Act. In 2002, the law was strengthened to ban the sale, distribution and breeding of ferrets. Feral, breeding populations of *Mustela putorius sensu lato* have apparently existed in New Zealand for over a century; the exact genetic makeup of these animals is not certain, and may vary by region.

Australia case study.— Instances of stray or feral ferrets have apparently occurred in Australia, but there is little evidence of the establishment of any feral breeding population (Forsyth et al. 2004; Markula et al. 2009). An exception may be a breeding population in Tasmania, but this instance appears to be anecdotal or the population extirpated (Bomford and Hart 1998; Markula et al. 2009). Some scientists express a concern over the possible establishment of mustelids in Australia (Bomford and Hart 1998; Forsyth et al. 2004; Markula et al. 2009). Nationally, Australia apparently does not ban the importation or possession of pet ferrets.

European cases studies.—Established feral populations of released domesticated ferrets are reported in: the British Isles, especially on smaller islands (Shetland Islands, Isles of Anglesey, Arran, Man, Mull, and Lewis); some Mediterranean islands (Azores, Sardinia, Sicily); and the Netherlands (Roots 1976; Walton 1977; Corbet and Ovenden 1980; Lever 1985; Blandford 1987; Varnham 2005; Buckley and Sleeman 2007). The current status of these populations is not well known, and the distribution of feral ferrets in Europe is sympatric with European polecats and the subspecies may not be distinguishable (Corbet and Ovenden 1980; Davison et al 1999; Anderson 1989).

United States case studies.— Ferrets were apparently introduced into the San Juan Archipelago in the mid-20th century, either by purposeful introduction to counter the impacts of introduced rabbits, or by accidental release by hunters during ferreting, or a combination of both (Stevens 1975). There is anecdotal evidence that a feral ferret or polecat population may have persisted for several years on San Juan Island (Stevens 1975, 1979, 1982); the decline of feral ferrets may have coincided with the reduction in rabbit populations. Currently, agency personnel and academic biologists cannot document any ferrets in the San Juan Archipelago (Jurek and Ryan 1999; Graening 2010). Currently, there is no evidence of any feral breeding population of ferrets in the state of Washington, and agency personnel that responded to surveys did not express and serious concern over the possible establishment of ferrets in Washington (Dalquest 1948; Schoen 1972; Larrison 1970; Graening 2010; Lepe et al. 2017).

Instances of stray or feral ferrets have occurred in Alaska, but there is no evidence of the establishment

of any feral breeding population (Alaska Epidemiology Office 1986; Jurek and Ryan 1999; Jurek 2001; Graening 2010). Alaska agency personnel had historically expressed concern over the possible establishment of ferrets in their state in the 1980s, but recent communications and surveys indicate that Alaska agency personnel are not as concerned (Graening 2010; Lepe et al. 2017).

Instances of stray or feral ferrets have occurred in New Mexico, including reports of the intentional release of ferrets to control prairie dogs (*Cynomys ludovicianus*) in the 1980s, but there is no evidence of the establishment of any feral breeding population (Findley et al. 1975; Jones and Schmitt 1997; Jurek and Ryan 1999; Jurek 2001; Graening 2010). New Mexico agency personnel have previously expressed concern over the possible establishment of feral ferret populations in their state in the Jurek and Ryan (1999) agency survey, but this concern was not expressed in the Graening (2010) agency survey.

Instances of stray or feral ferrets may have occurred in Nevada, but there is no evidence of the establishment of any feral breeding population (Hitchcock 1995; Jurek and Ryan 1999; Graening 2010). Nevada agency personnel have previously expressed concern over the possible establishment of ferrets in their state (Jurek and Ryan 1999), but this concern was not expressed concern in the Graening (2010) agency survey.

Instances of stray or feral ferrets have occurred in Arizona, but there is no evidence of the establishment of any feral breeding population (Hoffmeister 1986; Jurek and Ryan 1999; Graening 2010). Arizona agency personnel have previously expressed concern over the possible establishment of ferrets in their state (Jurek and Ryan 1999), but this concern was not expressed in the Graening (2010) survey and Arizona state agencies did not respond to the Lepe et al. 2017 survey.

Instances of stray or feral ferrets have occurred in Florida, but there is no evidence of the establishment of any feral breeding population (Layne 1997; Florida Fish and Wildlife Conservation Commission 2010; Graening 2010).

Instances of stray or feral ferrets have occurred in California, but there is no evidence of the establishment of any feral breeding population (Stephens 1906; Ingles 1947, 1965; Constantine and Kizer 1988; Constantine 1986; Laudenslayer et al. 1991; Gustaitis and McGrath 1992; Hitchcock 1994; Jurek and Ryan 1999; Jurek 2001).

Reports of impacts upon wildlife from state agency surveys.—The state agency responses to the 1987–1989 survey performed by pro-ferret groups revealed no indication of breeding populations of feral ferrets, except for New Mexico, which suspected wild ferret breeding populations existed in the past (Californians for Ferret Legalization 2000a). However, some wildlife agencies reported instances of stray ferrets and many agencies reported a data deficiency. A few wildlife agencies expressed concern about potential impacts from feral ferrets (Californians for Ferret Legalization 2000a; Jurek 2001). In the 1996–1997 survey performed by California Department of Fish and Game staff, five states reported free-living individual ferrets as having survived more than a few days in the wild (Jurek and Ryan 1999). Alaska, New Mexico, and Washington reported suspected wild ferret breeding populations to exist in the past. Most states reported data deficiencies, and no state reported indifference to the threats posed by an established breeding population (Jurek and Ryan 1999). In the 2009–2010 survey performed by biologists at California State University, Sacramento (CSUS), 12 states reported instances of stray ferrets, but no state agency reported the current existence of a feral ferret breeding population, with the exception of Washington, which reported the historic existence of breeding populations on the San Juan Islands (Graening 2010). Most states reported data deficiencies. Eight State agencies estimated instances of ferrets killing or harassing wildlife in the range of 1 to 100 per year. Only California and Hawai'i expressed serious concern regarding the potential for a breeding population to impact wildlife

(Graening 2010). In the 2016–2017 survey performed by a biological consulting firm, about half of states reported rare or sporadic instances of stray ferrets, but no state agency reported the existence of a current feral ferret breeding population or any significant impacts upon wildlife (Lepe et al. 2017). Most state agencies did not express severe concern about feral ferrets when compared to the impacts of feral cats and dogs upon wildlife and human safety (Lepe et al. 2017).

Impacts of Domesticated Ferrets Upon Agriculture

Reports of impacts upon agriculture from literature.—Smallwood and Salmon (1992) provided a literature review of the impact of exotic species upon livestock. Polecats and feral ferrets are known to be highly destructive of poultry and other confined livestock (Bachrach 1930; Roots 1976; Blandford 1987; Lewington 1988; Nagami 2004; Markula et al. 2009). A bulletin by the U.S. Department of Agriculture (Lantz 1909) stated that lost ferrets may "…adapt themselves to wild conditions and become a pest by preying upon poultry and birds." The California Department of Health Services stated concerns about the ferret's impact upon poultry, rabbits, and other small livestock (Hitchcock 1994). In 2003, the California Waterfowl Association strongly opposed California Senate Bill SB89 (which would legalize ferret ownership), writing that: "…legal ownership of ferrets in California will result in the establishment of healthy feral populations of this exotic, predatory species causing significant negative environmental impacts on our native fauna, particularly waterfowl and ground-nesting birds." The Audubon Society and Sierra Club have opposed ferret legalization because of the threat to wildlife (Martindale 2016). In 1994, the California Farm Bureau wrote to the California State Assembly that they opposed Assembly Bill 2497 (which would legalize ferret ownership), stating: "We believe the temperate climate and diversity of our natural and agricultural environments could result in serious unintended consequences to our wildlife and some domestic animals. Some poultry producers, for example, could experience severe flock depredation. Moreover, threatened or endangered birds and small mammals could also fall victim to the ferret." Escaped, stray, or feral ferrets also have the potential to vector diseases to livestock. In particular, ferrets may serve as a reservoir, or vector, of bovine tuberculosis (*Mycobacterium bovis*) (Smith et al. 1995; Clapperton 2001; Byrom 2002). Clapperton (2001) discussed potential beneficial impacts of feral ferrets upon wildlife and agricultural interest, primarily the control of nuisance rabbits. Similar to cats, ferrets may be effective in controlling rats and other pest populations in urban or suburban environments.

The literature documents that ferrets may have impacted European poultry production, especially in the late 19th and early 20th century. The literature is largely devoid of any instances of ferrets impacting agricultural resources in the USA. The USA has, for the most part, phased out household poultry and egg production and now relies almost exclusively on commercial facilities (confined animal feeding operations); these facilities are better protected from predators than traditional domestic hen houses and coops.

Reports of impacts upon agriculture from state agency surveys.—In the 1987–1989 survey (Californians for Ferret Legalization 2000b), the vast majority of state agricultural agencies reported no adverse effects from ferrets upon their agricultural industries. However, some agencies reported data deficiencies and some agencies expressed concerned about impacts from ferrets, but these concerns pertained primarily to human health and safety. The Jurek and Ryan (1999) survey and the Lepe et al. (2017) survey did not investigate agricultural impacts.

In the Graening (2010) agency survey (**Appendix I (PDF) (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=202564&inline)**), eight states gave estimates of ferrets killing or harassing livestock in the range of 1 to 10 instances per year, but 28 states reported a data deficiency. No responding state agricultural department personnel, including California's, indicated any serious concern about ferrets impacting agricultural resources in their State (Graening 2010).

Impacts of Domesticated Ferrets Upon Human Health and Safety

Disease transmission.—Rabies (*Lyssavirus*) and canine distemper (Paramyxoviridae) are rare in ferrets now that effective vaccines are available, and medical and veterinarian communities agree that all pet ferrets should be vaccinated for rabies and distemper (Ball 2002, 2006; Rupprecht and Gibbons 2004; National Association of State Public Health Veterinarians, Inc. 2008). The Centers for Disease Control and Prevention stated that currently in the USA, human rabies is a rare disease and is relegated largely to non-pet vectors (Rupprecht et al. 1996).

Aggression towards humans.—Although the modern ferret has been selectively bred for docility, ferrets still have a propensity to bite humans (Lewington 1988; Jeans 1994; Boyce et al. 2001; Childs 1989; Schilling 2007). Such biting can range from playful mouthing and nips to a hard bite with clamped jaw. Aggression, fear, hunger, excitement, and play motivate the domestic ferret to bite, and these emotions can be difficult to differentiate (Morton and Morton 1995; Boyce et al. 2001; Ball 2002). Occasionally, ferrets attack humans viciously; a common target is the unsupervised infant (Fennell 1843; Apfelbach 1978a; Marcuse 1987; Applegate and Walhout 1998; Nagami 2004). Many state agencies do not adequately or regularly track cases of ferret attacks (Hitchcock 1994; Applegate and Walhout 1998). State agency survey responses indicated a general data deficiency, but about half of states reported or estimated ferret attacks at a range of several per year to hundreds per year (Graening 2010). In municipalities where ferret ownership is illegal, ferret attacks are under-reported. Constantine and Kizer (1988) estimated that the rate of ferret attacks in California were 1 attack per 1 million residents per year. State agencies and anti-ferret groups often cite these attack cases as proof that ferrets are not appropriate pets and as compelling reasons to prohibit ferret ownership. Pro-ferret groups counter that serious injuries and fatalities resulting from ferret attacks are extremely rare, and should not serve as the basis for regulatory decisions. Pro-ferret groups often make the argument that dogs and cats attack people much more often than do ferrets, yet dogs and cats are legal to own and bite risks are tolerated (Herman 2000; Sacks et al. 2000). Bites from small animals such as ferrets represent only a small proportion of the total number of animal bites per year in the United States (Garth et al. 2009).

Risk Assessment, Cost/Benefit Analysis, and Environmental Impact Assessment

Risk assessment and cost/benefit analysis.—A research study (i.e., a controlled experiment or pilot study) could be performed that investigated the potential for pet ferrets to revert to a feral condition and survive in the wild; most authors envision fencing pet ferrets in large enclosures in the wild and determining if ferrets can survive and breed using the available wildlife and in various representative climates (Hunt 1986; Nelms 1993; Umbach 1997). The California Game and Fish Commission (2005)

requires an initial experimental introduction, such as an introduction into a confined area or the introduction of sterile individuals, before a non-native species can be de-regulated in California. Because of the possibility that hybrids or polecats could be imported into California, the study may need to analyze polecats and hybrids as well.

Another approach would be to use a predictive model to determine if escaped ferrets had the potential to establish feral breeding populations, or to perform a cost-benefit analysis that weighed the relative costs of legalization (cost of licensing, regulating, and monitoring, and impacts to wildlife or environment, etc.) to the benefits (license program and pet industry revenue, increases in numbers of vaccinated ferrets, etc.). Bomford (1991, 2006) and Bomford and Hart (1998) created a risk assessment model that employed a cost-benefit analysis to the decision of whether or not to allow introduction of an exotic vertebrate. Forsyth et al. (2004) refined their predictive model. Forsythe et al. (2004) developed a computer model to analyze the success or failure of vertebrate introductions into Australia. They determined that species were more likely to successfully establish where they had wide climate tolerance or that the climate of their native range matched that of Australia, where they had been successfully introduced elsewhere, where more effort had been put into their introduction, and where the body size was small and reproduction rates fast. Smallwood and Salmon (1992) provided a review of the literature on the impact of exotic species upon native wildlife and then created a rating system and applied it to species of concern in California; they rated the European ferret as highly invasive, but empirical data were lacking (Smallwood and Salmon 1992).

The U.S. Congress, Office of Technology Assessment (1993) discussed the general costs and benefits of non-indigenous species upon economies and environments and the process and efficacy for risk assessment and cost-benefit analysis. Potential beneficial impacts from ferret legalization include: the generation of licensing program revenues (assuming revenues exceeded the cost of running the licensing program); elimination of costs associated with enforcing a ban on ferret possession; economic stimulus of the pet trade, pet supply, and veterinarian industries (but most states, including California, do not currently interfere with the sale of ferret-related pet products or medicinal care); and increased compliance with vaccination and sterilization of pet ferrets. Clapperton (2001) discussed potential beneficial impacts of feral ferrets upon wildlife and agricultural interest, primarily the control of nuisance rabbits.

Potential adverse impacts from ferret legalization include: the cost of running a licensing program; increased costs for animal control staffing and animal shelters; an increase in cases of attacks on humans; the destruction of poultry or other small, confined livestock by stray or feral ferrets; and the establishment of feral breeding populations and impacts to wildlife and associated control costs. The U.S. Congress, Office of Technology Assessment (1993) found that the USA spends billions of dollars trying to repair the damage of harmful exotic species.

Risk of inadvertent release.— Ferrets have a natural tendency to explore, to escape confinement, and to cache objects of interest—hence their Latin name "*furo*" which translates to "thief." Ferrets are often called "animal Houdinis" or escape artists (Lewington 1988; Wellstead 1981; Boyce et al. 2001). Most ferret owners, including laboratory animal keepers, veterinarians, and pro-ferret authors, report that it is difficult to confine ferrets and to retrieve escapees (Mathews 1968, 1971; Howes 1980; Williams 1984; Morton and Morton 1985; Scharmann and Wolff 1987; Jeans 1994; Schilling 2007). Some ferrets are apparently abandoned and set free by pet owners that no longer want them (Williams 1984; Constantine and Kizer 1988; Jurek 2001; Schilling 2007). American Pet Products Association, Inc. (2010) lists various categories of where pet ferrets were obtained in 2008; while the majority (73%) were obtained from pet stores, 2% were "caught outside." The literature indicates that ferrets can, and do, escape confinement,

and that accidental or intentional releases of ferrets into the environment do occur. In the Jurek and Ryan (1999) agency survey, more than half of states reported instances of stray ferrets in urban areas: 28 states reported instances to be 'rare' or 'sporadic', and New Mexico and Georgia reported stray ferrets to be 'Common' and 'Frequent', respectively. In the Graening (2010) agency survey, 12 states reported instances of stray ferrets. In the Lepe et al. (2017) agency survey, about half of states reported rare or sporadic instances of stray ferrets. It does not appear to be possible to completely eliminate the risk of ferrets escaping confinement in California. In California, stray ferrets are found every year (Jurek 2001).

Risk of ferrets establishing a breeding population.—The case studies of feral ferrets in New Zealand and other parts of the world demonstrate that mustelids within the polecat-ferret spectrum (*M. putorius sensu lato*) can establish breeding populations and adversely impact wildlife. It is not clear whether the American lineage of pet ferret can be directly compared to these feral ferret populations or whether they can be assigned the same risk of establishment and adverse impact upon the environment. Analysis of these case studies is important because both pro-ferret groups and wildlife agencies have used these case studies as arguments for the inability or proclivity (respectively), of ferrets to revert to a feral condition and establish breeding populations (Hunt 1986; Umbach 1997).

Since pet ferrets have been selectively bred in captivity for many decades, with emphases on pelage color, morphological neoteny, and docility, the resulting altered phenotype and restricted genotype may limit the capacity of domesticated ferrets to survive, hunt, and breed in the feral state (Poole 1972; Blandford 1987; Gustafson et al. 2017). The popular literature is full of statements that pet ferrets have lost their instincts to hunt, eschew live prey, and would not be able to survive long without human support (e.g. Weiser 1991; Morton and Morton 1995; Schilling 2007). Ferrets are often described as being intolerant of temperature extremes (Bell 1837; Harding 1915; Lewington 1988). But there are some scientific studies that indicate that hunting and courting behavior must be learned in the wild. Acoustical, optical, and olfactory cues are important for hunting, and ferrets and polecats must learn these cues *in feras* and imprint these cues at an early age (Apfelbach and Wester 1977; Apfelbach 1978a,b; Apfelbach 1986; Blandford 1987). Live prey are killed with a neck bite, which is instinctive but must be perfected with practice (Blandford 1987). A non-fatal neck clasp is necessary to copulate, but this bite in the nape must be learned, usually in sibling play (Blandford 1987). Black-footed ferrets which were raised in captivity and then released into their native range have limited reproductive success, may not develop critical behavioral skills, and may be more prone to predation (Chadwick 1991; Godbey and Biggins 1994; Russell et al. 1994). Ferrets and polecats are subject to predation by birds of prey and larger carnivorous mammals (Markula et al. 2009). Ferrets and polecats do have some defense mechanisms: the expression of noxious odors from scent glands; sharp teeth to bite the nose and face of an attacker; and dense fur and loose skin that discourage successful jaw clamps (Poole 1970; Blandford 1987)

The pet ferret is also subject to a variety of diseases and disorders, making this pet expensive to own and shortening its average lifespan: distemper, rabies, parasites, bone marrow suppression, insulinoma, adrenal gland disease, diarrhea, colds, flus, ringworm, heat stroke, urinary stones, and cardiomyopathy (Ryland and Gorham 1978; Fox 1988; Duda 2003; Schilling 2007). Hoppes (2010) states that although the life span of pet ferrets is 8 to 10 years, most veterinarians consider ferrets to be geriatric as early as 3 years of age because they already display signs of aging such as nutritional issues and geriatric diseases. Gustafson et al. (2017) recommended outbreeding of ferrets and crossing with populations from separate continents to restore genetic vigor.

Female ferrets (jills) have certain physiological challenges relating to their reproductive system. Jills are induced ovulators and remain in estrus until pregnant; persistent estrus beyond a few months is often fatal due to elevated estrogen levels, which can cause bone marrow depression (Bernard et al. 1983). Jills

with prolonged estrus may die of thrombocytopenia, hemorrhaging, severe aplastic anemia, or infections induced by leukopenia (Hart 1987; Ball 2002).

Environmental Impact Assessment.— In Jurek and Ryan (1999)'s survey, respondents did not indicate that any state agency prepared an environmental impact report during a ferret legalization or regulation action. The Graening (2010) survey produced slightly different results: Washington District of Columbia and Hawai'i used an environmental impact review during their regulatory actions on ferret ownership (Graening 2010). An environmental impact report would need to be prepared before the California Fish and Game Commission would remove an animal from the Fish and Game Code Section 671 restricted animal list (Fischer, CFGC, personal communication, 2009). This is because removal is a rulemaking action, and as such, would trigger compliance with the California Environmental Quality Act (14 CCR, §15000 et seq.), because of statements made by Governor Schwarzenegger in 2004, and because the action is regulated by the Commission's 2005 Miscellaneous Policy: Introduction of Non-native Species.

Regulatory Strategies and Environmental Impact Mitigation Measures

Regulatory strategies.— The U.S. Congress, Office of Technology Assessment (1993) discussed all of the policy options generally available to agencies to control non-indigenous species, primarily: more stringent policies; better screening of plants and animals at ports of entry; improved surveillance and emergency responses; increasing fees and other funding; increasing accountability; environmental education; and addressing gaps in regulation and in information. There is little consensus among states as to the regulatory status of ferrets, and the state agency surveys indicate that many states do not regulate ferrets at all (Ryan and Jurek 1999; Graening 2010; Lepe et al. 2017). Only two states (California and Hawaii) ban importation and possession. An increasing number of states and municipalities are now regulating ferrets as a pet similar to dogs and cats.

Minimizing risk of release.— Various mechanisms are available to minimize the risk of release of ferrets and other non-native carnivores into the environment. The most immediate tool is regulatory. However, in the Graening (2010) survey, 25 states and Washington, D.C. responded that they have no regulations against release of ferrets from captivity. California Fish and Game Code (14 CCR, § 671.6) prohibits the release of captive wild/exotic animals, and all states and municipalities should enact similar prohibitions to protect their native wildlife. The use of ferrets in hunting represents a direct mechanism of introduction into the environment; at least 22 States prohibit use of ferrets for hunting (Jurek and Ryan 1999). An extensive network of shelters and communication systems could be established to handle unwanted or abandoned ferrets. A public outreach/education program could be implemented to disseminate information about the disposition, needs, and proper care of ferrets, as well as the environmental impacts of releasing mustelids into the wild.

Mandatory sterilization of ferrets is common in the pet industry. Sterilization of ferrets is recommended by veterinarians to avoid endocrine diseases and to reduce musky odors (Williams 1984; Ball 2002). While sterilized individuals could still prey upon wildlife, they could not establish breeding populations. While ferrets available for purchase through the pet trade may not possess the necessary traits to become an invasive species, polecat-ferret hybrids and European polecats likely have these necessary traits. Like wolf-dog hybrids, some ferret owners may wish to have a more exotic and charismatic animal than the common pet ferret stock produced by breeders such as Marshall Farms. Polecat-ferret hybrids are advertised for sale on various Internet websites, and the merit of owning a

hybrid is discussed in ferret-ownership manuals (e.g., Schilling 2007). Non-indigenous hybrids represent particular management challenges: wolf-dog hybrids, for example, are dangerous to humans and obstruct recovery of endangered wolves in the wild (U.S. Congress, Office of Technology Assessment 1993.

A licensing and compliance program could be established in each state. Punitive measures could be established to discourage the importation or sale of fertile ferrets, hybrids, or polecats, or the establishment of illegal breeding facilities. The compliance program may need to include scientific training to identify different species of mustelids, especially those specimens within the ferret-polecat spectrum. Phillips and Shimbo (1990) give instances of CDFW game wardens mistaking native weasels for ferrets. However, California agency personnel have not been convinced that regulation and enforcement are sufficient to protect California's wildlife communities from the establishment of a feral ferret breeding population (Jurek 2001; Steele, pers. comm. 2010). Even with a ban, California has not been able to stop the illegal importation of ferrets and now California has the largest populations of pet ferrets in the USA.

Health and safety.—Serious ferret attacks appear to be rare and to be confined to those humans that cannot defend themselves against a small animal, which for the most part, consists of infants and small children, but may also include the elderly and the disabled. Mandatory warning labels should accompany ferrets offered for sale, and states such as South Carolina require this by law. Other mitigation measures include public outreach and the ban of ferrets from homes with infants, elderly, or the disabled, and the euthanization of ferrets proven to cause serious injury. The vaccination of ferrets against rabies and distemper should be made mandatory, and many states have such regulations. With the implementation of mitigation measures, the health and safety risks can be significantly reduced.

Monitoring invasions and emergency response.— The various surveys of state agencies reveal a major data deficiency in the enumeration of stray and feral mustelids, and non-native wildlife in general, in the USA. In the Jurek and Ryan (1999) agency survey, 43 states responded that no effort had been made to assess the status of ferrets in the wild, and 34 states responded that it was '*not considered to be important*' to do such an assessment. The few states that did assess feral ferrets did so by '*opportunistically documentation*' and not by '*concerted surveys*.' In the Graening (2010) survey, most state agency personnel responded "*Don't know*" when asked about ferrets impacting wildlife or the existence of stray or feral ferrets in their states; 41 state agencies indicated that censusing stray or feral ferrets was not important. The primary tools available to detect introductions of animals are visual inspections by biologists, traps, and information collection and dissemination (U.S. Congress, Office of Technology Assessment 1993).

Eradication of an invasive species is technically feasible but complicated, costly, and subject to public opposition (U.S. Congress, Office of Technology Assessment 1993). Agencies should establish a program for elimination or control of an established feral ferret population or any other introduced species. Control measures consist of: trapping, poison bait, biological control agents, and habitat or behavior modification, but no measures have completely eradicated ferrets from New Zealand (Clapperton 2001; IUCN 2010). The primary biological control agent currently is canine distemper: the case fatality rate approaches 100% for ferrets (Williams 2010). In the Jurek and Ryan (1999) agency survey, no state wildlife agency marked the option that an established breeding population '*would not be a serious concern*,' and 48 states responded that some form of control action would be taken upon discovery of an established breeding population. Yet in the Graening (2010) agency survey, 13 state agencies indicated that no action would be taken upon discovery of stray or feral ferrets; the remaining states responded that some action would be taken. Surprisingly, 10 states responded that no action would be taken upon discovery of an established breeding population of domesticated ferrets (Graening 2010). In the four

USA agency surveys performed over four decades, there appears to be a temporal trend of decreasing concern over the risk and impact of ferrets being released into the environment. While feral ferrets may not be the greatest threat to wildlife in their jurisdictions, state agencies should not become complacent to the risks of introductions of non-native mammals, which continue to wreak havoc among native wildlife communities (Stein et al. 2000). Herman (2000) makes the argument that any control measures implemented upon feral ferrets must also focus on feral cats because of their well-documented destruction of bird populations.

Requirements for legalizing ferret ownership in California.—The history of regulations and policies in California pertaining to ferrets is presented in **Appendix II (PDF) (http://https//nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=202565&inline)**. There are two basic paths to the legalization of ferrets in California—enact legislation or change state policy (Umbach 1997; Fischer, CDFG, personal communication, 2009). Legal analysts have proposed the following requirements for legislation (in contrast to unrestricted ownership or continued prohibition): sale only through licensed breeders or animal welfare agencies; vaccination against rabies and other ferret diseases; spaying /neutering before sale; and a public education program to inform prospective ferret owners about the appropriate circumstances for ferret ownership (Umbach 1997; Herman 2000). Various California legislators and agency personnel have criticized attempts to legalize ferret ownership through the legislative process because it bypasses the need for environmental impact review, which is required by California Environmental Quality Act for non-legislative decisions by state agencies. To legalize the importation and possession of ferrets in California by a policy change, the California Fish and Game Commission would need to change the status of the ferret by a majority vote at a Commission meeting, and then Fish and Game Code Section 2118 would be changed to include the ferret as an exception to the wild animals regulated under Section 2116. The California Fish and Game Commission would first require adherence to its 2005 policy document "Miscellaneous Policies: Introduction of Non-Native Species" before ferrets are legalized in California, which requires careful evaluation of the potential impacts of introduction, including the species' ability to disperse outside the introduction area, and an initial experimental introduction into a confined area, or the introduction only of sterile individuals (Fischer, CFGC, personal communication, 2009). Additional, the Draft and Final Environmental Impact Report would need to demonstrate that any significant impacts can be mitigated to a less-than-significant level, or the Lead Agency would need to file a Statement of Overriding Considerations which determines that benefits to the public outweigh unmitigable environmental impacts. CDFW is likely to impose restrictions on ferret ownership, such as: the importation of only sterilized ferrets and the exclusion of polecat-ferret hybrids or polecats; a ban on breeding of ferrets in California; prohibition of release of ferrets into the wild; and prohibition of ferrets on all of California's islands, which are sensitive to exotic mammal introductions.

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Literature Cited

- Alaska Epidemiology Office. 1986. Epidemiology Bulletin No. 9: Ferrets—A New Menace To Health; Public Health Warning. Alaska Division of Public Health, Anchorage, AK, USA.
- Alterio, N., and H. Moller. 1997. Diet of feral house cats *Felis catus*, ferrets *Mustela furo* and stoats *M. erminea* in grassland surrounding yellow-eyed penguin *Megadyptes anitpodes* breeding areas, South Island, New Zealand. Journal of Zoology, London 243:869–877.
- American Pet Products Association, Inc. 2010. 2009–2010 APPA National Pet Owners Survey. American Pet Products Association, Inc., Greenwich, CT, USA.
- American Veterinary Medical Association (AVMA). 2007. U.S. Pet Ownership and Demographics Sourcebook. American Veterinary Medical Association, Schaumburg, IL, USA.
- Anderson, E. 1989. The phylogeny of mustelids and the systematics of ferrets. Pages 10–20 in U. S. Seal, E. T. Thorne, M. A. Bogan, and S. H. Anderson, editors. Conservation Biology and the Black-footed Ferret. Yale University Press, New Haven, CT, USA.
- Apfelbach, R. 1978a. Instinctive predatory behavior of the ferret (*Putorius putorius furo* L.) modified by chlordiazepoxide hydrochloride (Librium®). Psychopharmacology 59(2):179–182.
- Apfelbach, R. 1978b. A sensitive phase for the development of olfactory preference in ferrets (*Mustela putorius furo* L.). International Journal of Mammalian Biology (Zeitschrift fur Saugetierkunde) 43(5):289–295.
- Apfelbach, R. 1986. Imprinting on prey odors in ferrets (*Mustela putorius f. furo* L.) and its neural correlates. Behavioral Processes 12:363–381.
- Apfelbach, R., and U. Wester. 1977. The quantitative effect of visual and tactile stimuli on the prey-catching behaviour of ferrets (*Putorius furo* L.). Behavioural Processes 2:187–200.
- Applegate, J. A., and M. F. Walhout. 1998. Childhood risks from the ferret. Journal of Emergency Medicine 16(3):425–427.
- Ashton, E. H., and A. P. D. Thomson. 1954. Some characteristics of the skulls and skins of the European polecat, the Asiatic polecat and the domestic ferret. Proceedings of the Zoology Society of London 125:317–333.
- Atkinson, I. A. E. 2001. Introduced mammals and models for restoration. Biological Conservation 99:81–96.
- Bachrach, M. 1930. Fur: A Practical Treatise. Prentice-Hall, New York, NY, USA.
- Ball, R. S. 2002. Husbandry and management of the domestic ferret. Lab Animal 31(5):37–42.
- Ball, R. S. 2006. Issues to consider for preparing ferrets as research subjects in the laboratory. Institute for Laboratory Animal Research Journal 47(4):348–357.
- Banfield, A. W. F. 1974. The Mammals of Canada. Published for the National Museum of Natural Sciences, National Museums of Canada. University of Toronto Press, Toronto, Ontario, Canada.
- Bell, T. 1837. A history of British quadrupeds, including the Cetacea. Van Voors, London, UK.

- Bernard, S. L., C. W. Leathers, D. F. Brobst, and J. R. Gorham. 1983. Estrogen-induced bone marrow depression in ferrets. American Journal of Veterinary Research 44:657–661.
- Besch-Williford, C. L. 1987. Biology and medicine of the ferret. Veterinary Clinics of North America: Small Animal Practice 17:1155–1183.
- Bissonnette, T. H. 1950. Ferrets. Pages 234–255 in Edmond J. Farris, editor. The Care and Breeding of Laboratory Animals. John Wiley & Sons, New York, NY, USA.
- Blandford, P. R. S. 1987. Biology of the polecat *Mustela putorius*: A literature review. Mammal Review 17(4):155–198.
- Blandford, P. R., and K. C. Walton. 1991. Feral ferret *Mustela furo*. Pages 405–406 in G. B. Corbett and S. Harris, editors. The Handbook of British Mammals. Blackwell Scientific Publications, Oxford, UK.
- Bomford, M. 1991. Importing and keeping exotic vertebrates in Australia: Criteria for the assessment of risk. Bureau of Rural Resources Bulletin No. 12, Department of Primary Industries, Australian Government Publishing Services, Canberra, Australia.
- Bomford, M., and Q. Hart. 1998. Risk assessment for importing and keeping exotic vertebrates. Pages 406–410 in R. O. Baker and A. C. Crabb, editors. Proceedings of the 18th Vertebrate Pest Conference, University of California, Davis, CA, USA.
- Bomford, M. 2006. Risk assessment for the establishment of exotic vertebrates in Australia: Recalibration and refinement of models. Bureau of Rural Sciences, Australian Government, Canberra, Australia.
- Boyce, S. W., B. M. Zingg, and T. L. Lightfoot. 2001. Behavior of *Mustela putorius furo* (the domestic ferret). The Veterinary Clinics of North America—Exotic Animal Practice—Behavior 4(3):697–713.
- Buckley, D. J., D. P. Sleeman, and J. Murphy. 2007. Feral ferrets *Mustela putorius furo* L. in Ireland. The Irish Naturalists' Journal 28(9):356–360.
- Byrom, A. E. 2002. Dispersal and survival of juvenile feral ferrets *Mustela furo* in New Zealand. Journal of Applied Ecology 39:67–78.
- Cabrera, A. 1930. The fatherland of *Putorius furo* (Atlas Mountains, Spanish Morocco). Boletín de la Real Sociedad Española de Historia Natural 30:477–480.
- California Domestic Ferret Alliance. 2000a. 50 state survey on the supposed existence of feral populations of domestic ferrets in each state. Pages 39–70 in Californians for Ferret Legalization, Menlo Park, California. Exhibit submitted to the 3 February 2000 California Fish and Game Commission Meeting.
- California Domestic Ferret Alliance. 2000b. 50 state survey on the effects of domestic ferrets on agricultural interests in each state. Pages 71–99 in Californians for Ferret Legalization, Menlo Park, California. Exhibit submitted to the 3 February 2000 California Fish and Game Commission Meeting.
- California Fish and Game Commission. 2005. Miscellaneous policies: Introduction of Non-native Species, Amended 23 July 23 2005. Available from: **https://fgc.ca.gov/About/Policies/Miscellaneous (https://fgc.ca.gov/About/Policies/Miscellaneous)**
- California Department of Fish and Game (CDFG). 2007. California Wildlife Conservation Challenges: California's Wildlife Action Plan. Prepared by Wildlife Health Center, University of California, Davis, CA, USA.
- Camp, R. R., editor. 1966. Ferreting. Pages 958–960 in The New Hunter's Encyclopedia. 3rd Edition. Stackpole Books, Harrisburg, PA, USA.
- Chadwick, D. H. 1991. Rescuing our rarest prairie predator. Defenders 66(2):10–23.
- Childs, G. 1989. Attack ferrets? Journal of the American Medical Association 261(11):1583–1584.
- Clapperton, B. K. 2001. Advances in New Zealand mammalogy 1990–2000: Feral ferret. Journal of the Royal Society of New Zealand 31(1):185–203
- Constantine, D. G. 1986. Wild animal pets: hazardous and illegal. Outdoor California, Jan–Feb:16-18.
- Constantine, D. G., and K. W. Kizer. 1988. Pet European ferrets: A hazard to public health, small livestock and wildlife. California Department of Health Services, Sacramento, CA, USA.

- Corbet, G. B., and H. N. Southern, editors. 1977. The Handbook of British Mammals. 2nd edition. Blackwell Scientific Publications, London, UK.
- Corbet, G. B., and D. Ovenden. 1980. The Mammals of Britain and Europe. Collins, London, UK.
- Courchamp, F., J. L. Chapuis, and M. Pascal. 2003. Mammal invaders on islands: Impact, control and control impact. Biological Reviews 78:347–383.
- Cowan, D. P. 1984. The use of ferrets (*Mustela furo*) in the study and management of the European wild rabbit (*Oryctolagus cuniculus*). Journal of Zoology 49:570–574.
- Dalquest, W. W. 1948. The Mammals of Washington. Volume 2. University of Kansas Publications, Museum of Natural History, Lawrence, KS, USA.
- Davison, A., J. D. S. Birks, H. I. Griffiths, A. C. Kitchener, D. Biggins, and R. K. Butlin. 1999. Hybridization and the phylogenetic relationship between polecats and domestic ferrets in Britain. Biological Conservation 87(2):155–161.
- Dolensek, E. P., and B. Burn. 1976. A practical guide to impractical pets. Viking Press, New York, NY, USA.
- Dowding, J. E., and E. C. Murphy. 2001. The impact of predation by introduced mammals on endemic shorebirds in New Zealand: A conservation perspective. Biological Conservation 99:47–64.
- Duda, J. 2003. *Mustela putorius furo*: domestic ferret. Animal Diversity Web, University of Michigan Museum of Zoology. Available from: **http://animaldiversity.ummz.umich.edu/site/accounts/information/Mustela_putorius_furo.html (http://animaldiversity.ummz.umich.edu/site/accounts/information/Mustela_putorius_furo.html)**.
- Ehrlich, P. R. 1986. Which animal will invade? Pages 79–95 in H. A Mooney and J. A. Drake, editors. Ecology of Biological Invasions of North America and Hawaii. Springer-Verlag, New York, NY, USA.
- Eisenberg, J. F. 1989. Mammals of the Neotropics. University of Chicago Press, Chicago, IL, USA.
- Everitt, N. 1897. Ferrets: Their management in health and disease with remarks on their legal status. Adams and Charles Black, London, UK.
- Farley, J. L., and A. A. Brock. 1933. Rules and regulations governing the importation of wild birds and animals into the state of California and conditions under which same may be kept in confinement. California State Printing Office, Harry Hammond State Printer, Sacramento, California.
- Fennell, J. H. 1843. A natural history of British and foreign quadrupeds. Thomas, London, UK.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, NM, USA.
- Fitzgerald, B. M., W. B. Johnson, C. M. King, and P. J. Moors. 1984. Research on mustelids and cats in New Zealand: a report prepared by the mustelid and cat research review subcommittee. Wildlife Research Liaison Group, Research Review Number 3, Wellington, New Zealand.
- Florida Fish and Wildlife Conservation Commission. 2010. Florida's Nonnative Wildlife, Species detail: Ferret – *Mustela putorius*. Available from: **http://www.myfwc.com/WILDLIFEHABITATS/Nonnative_Ferret.htm (http://www.myfwc.com/WILDLIFEHABITATS/Nonnative_Ferret.htm)**
- Forsyth, D. F., R. P. Duncan, M. Bomford, and G. Moore. 2004. Climatic suitability, life-history traits, introduction effort, and establishment and spread of introduced mammals in Australia. Conservation Biology 18(2):557–569.
- Fox, J. G. 1988. Biology and Diseases of the Ferret. Lea & Febiger, Philadelphia, PA, USA.
- Garth, A. P., N. S. Harris, and C. S. Spanierman. 2009. eMedicine Specialties: Emergency Medicine, Environmental, Animal Bites. Available from: **http://emedicine.medscape.com/article/768875-overview (http://emedicine.medscape.com/article/768875-overview)**
- Godbey, J., and D. Biggins. 1994. Recovery of the black-footed ferret: looking back, looking forward. Endangered Species Technical Bulletin 19(1):10–13.
- Graening, G. O. 2010. Analysis of the potential impacts of domesticated ferrets upon wildlife, agriculture, and human health in North America, with a focus upon California, based upon literature review and survey of North American governmental agencies. University Enterprises, Inc., Grant

Number 517021. Prepared for California Fish and Game Commission. Department of Biological Sciences, California State University, Sacramento, CA, USA.
- Gustaitis, R., and R. McGrath. 1992. Ferret: Pet, pest or vampire? Page 27 in Animals Out Of Place—Species Wars 2. California Coast and Ocean 8(1):13–30.
- Gustafson, K. D., M. G. Hawkins, T. L. Drazenovich, R. Church, S. A. Brown, H. B. Ernest. 2017. Founder events, isolation, and inbreeding: Intercontinental genetic structure of the domestic ferret. Evolutionary Applications 11(5):694–704.
- Hagedoorn, A. L. 1954. Animal Breeding. 5th edition. Crosby Lockwood & Son Ltd., London, UK.
- Hall, E. R. 1981. The Mammals of North America. 2nd edition. John Wiley & Sons, New York, NY, USA.
- Harding, A. R. 1915. Ferret Facts and Fancies. A. Harding, Columbus, OH, USA.
- Hart, J. 1987. Oestrogen toxicity in the ferret. British Journal of Experimental Pathology 68:601–603.
- He, T., H. Friede, and S. Kiliaridis. 2002. Macroscopic and roentgenographic anatomy of the skull of the ferret (*Mustela putorius furo*). Laboratory Animals 36:86–96.
- Herman, D. L. 2000. California law and ferrets: Are they truly "wild weasels"? Environmental Law and Policy Journal 23:37–53.
- Hitchcock, J. C. 1994. The European ferret, *Mustela putorius*, its public health, wildlife and agricultural significance. Pages 207–212 in W. S. Halverson and A. C. Crabb, editors. Proceedings of the 16th Vertebrate Pest Conference, University of California, Davis, CA, USA.
- Hitchcock, J. C. 1995. Public health aspects of the European ferret, *Mustela putorius*, as a household "pet." Vector Ecology Newsletter 1(26):16–18
- Hoffmeister, D. F. 1986. Mammals of Arizona. University of Arizona Press, Tucson, AZ, USA.
- Hoppes, S.M. 2010. The senior ferret (*Mustela putorius furo*). The Veterinary Clinics of North America. Exotic Animal Practice 13(1)107–122.
- Howes, C. A. 1980. Aspects of the history and distribution of polecats and ferrets in Yorkshire and adjacent areas. Naturalist 105:3–16.
- Hunt, E. G. 1986. Memorandum: Could domestic ferrets establish wild populations in California? California Department of Fish and Game, Wildlife Management Division, Sacramento, CA, USA.
- Hvass, H. 1961. Mammals of the World. Methuen & Co. Ltd., London, UK.
- Ingles, L. G. 1947. Mammals of California and Its Coastal Waters. Stanford University Press, Stanford, CA, USA.
- Ingles, L. G. 1965. Mammals of the Pacific States. Stanford University Press, Stanford, CA, USA.
- International Union for Conservation of Nature (IUCN). 2010. *Mustela furo* database report. Global Invasive Species Database, IUCN Species Survival Commission Invasive Species Specialist Group, Gland, Switzerland. Available from: **http://www.invasivespecies.net (http://www.invasivespecies.net/)**
- Jameson Jr., E. W., and H. J. Peeters. 2004. Mammals of California. California Natural History Guides No. 66. University of California Press, Berkeley, CA, USA.
- Jeans, D. 1994. A Practical Guide to Ferret Care. 1st edition. Ferrets Inc., Miami, FL, USA.
- Jones, C., and C. G. Schmitt. 1997. Mammal species of concern in New Mexico. Pages 185–212 in T. L. Yates, W. L. Gannon, and D. E. Wilson, editors. Life among the Muses: Papers in Honor of James E. Findley. Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM, USA.
- Jones, C., R. S. Hoffman, D. W. Rice, M. D. Engstrom, R. D. Bradley, D. J. Schmidly, C. A. Jones, and R. J. Baker. 1997. Revised checklist of North American mammals north of Mexico, 1997. Occasional Papers of the Museum of Texas Tech University, Number 173, Lubbock, TX, USA.
- Jurek, R. M. 1998. A review of national and California population estimates of pet ferrets. Bird and Mammal Conservation Program Report 98-09, California Department of Fish and Game, Wildlife Management Division, Sacramento, CA, USA.
- Jurek, R. M. 2001. Nuisance and exotic wildlife species: Domestic ferret issues in California, 2001

update. Technical memorandum, California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Program, Sacramento, CA, USA.
- Jurek, R. M., and P. Ryan. 1999. 1996–97 ferret survey of state wildlife agencies, Rep. 1999-04. California Department of Fish and Game, Species Conservation and Recovery Program, Sacramento, CA, USA.
- King, C. M. 1984a. Introduced predators and conservation. New Zealand Environment 42:11–14.
- King, C. M. 1984b. Immigrant killers: Introduced predators and the conservation of birds in New Zealand. Oxford University Press, Oxford, UK.
- King, C. M. 1990. Ferret. Pages 320–330 in C. M. King, editor. The Handbook of New Zealand Animals. Oxford University Press, Oxford, UK.
- King, C. M., and P. J. Moors. 1979. The life-history tactics of mustelids, and their significance for predator control and conservation in New Zealand. New Zealand Journal of Zoology 6:691–622.
- Kowalski, K. 1976. Mammals, an Outline of Theriology. Panstwowe Wydawnicto, Naukowe Warsaw, Poland.
- Kurtén, B., and E. Anderson. 1980. Pleistocene Mammals of North America. Columbia University Press, New York, NY, USA.
- Lantz, D. E. 1909. How to destroy rats. Farmers' Bulleting 369. Bureau of Biological Survey, U.S. Department of Agriculture, Washington, D.C., USA.
- Larrison, E. J. 1970. Washington Mammals, Their Habits, Identification and Distribution. Seattle Audubon Society, Seattle, WA, USA.
- Laudenslayer, Jr., W. F., W. E. Grenfell, Jr., and D. C. Zeiner. 1991. A check-list of the amphibians, reptiles, birds, and mammals of California. California Fish and Game 77:109–141.
- Lavers, R. B. 1973. Aspects of the biology of the ferret, *Mustela putorius forma furo* L. at Pukepuke Lagoon. Proceedings of the New Zealand Ecological Society 20:7–12.
- Layne, J. 1997. Chapter 10: Nonindigenous Mammals. Pages 157–186 in D. Simberloff, D. Schmitz, and T. Brown, editors. Strangers in Paradise: Impact and Management of Nonindigenous Species in Florida. Island Press, Washington, D.C., USA.
- Lepe, A., V. Kaplan, A. Arreaza, R. Szpanderfer, D. Bristol, and M. S. Sinclair. 2017. Environmental impact and relative invasiveness of free-roaming domestic carnivores—a North American survey of governmental agencies. Animals 7(78):1–18.
- Lever, C. 1985. Naturalized Mammals of the World. Longman Inc., New York, NY, USA.
- Lewington, J. H. 1988. Ferrets—a compendium. The T.G. Hungerford *vade mecum* Series for Domestic Animals, Number 10. University of Sydney Post Graduate Foundation in Veterinary Science, Camperdown, Australia.
- Linnaeus, C. 1758. Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis, Editio decima, reformata. 10th edition. Impensis Direct. Laurentii Salvii, Holmia, Sweden.
- MacArthur R. L., and E. O. Wilson. 1967. The Theory of Island Biogeography. Princeton University Press, Princeton, NJ, USA.
- Marcuse, E. K. 1987. Ferocious ferrets. Pediatrics 79:617.
- Markula, A., M. Hannan-Jones, and S. Csurhes. 2009. Pest animal risk assessment: Ferret/polecat —*Mustela furo* and *M. putorius*. Invasive Plants and Animals, Biosecurity Queensland, Queensland Primary Industries and Fisheries, Brisbane, Australia.
- Martindale, D. 2016. The fight to legalize ferrets in California. Earth Island Journal. Available from: **https://www.earthisland.org/journal/index.php/articles/entry/freeing_californias_ferrets/ (https://www.earthisland.org/journal/index.php/articles/entry/freeing_californias_ferrets/)**
- Mathews, L. H. 1968. British Mammals. New Naturalist Series No. 21, Collins, London, UK.
- Mathews, R. K. 1971. Wild Animals as Pets. Doubleday & Company, Inc., New York, NY, USA.
- McCann, C. 1956. Observations on the polecat (*Putorius putorius* Linn.) in New Zealand. Records of

the Dominion Museum, Wellington 2(3):151–165.
- Mead, R. A. 1989. Reproduction in Mustelids. Pages 124–137 in U. S. Seal, E. T. Thorne, M. A. Bogan, and S. H. Anderson, editors. Conservation Biology and the Black-footed Ferret. Yale University Press, New Haven, CT, USA.
- Miller, G. S. 1933. The origin of the ferret. Scottish Naturalist 1933:153–155.
- Mooney, H. A., S. P. Hamburg, and J. A. Drake. 1986. The invasions of plants and animals into California. Pages 250–274 in H. A. Mooney and J. A. Drake, editors. Ecology of Biological Invasions of North America and Hawaii. Springer-Verlag, New York, NY, USA.
- Moore, T. G., and D. A. Whisson. 1998. Potential risks associated with the legalization of exotic predators such as the ferret (*Mustela putorius furo*) in California. Pages 96–99 in R. O. Baker and A. C. Crabb, editors. Proceedings of the 18th Vertebrate Pest Conference, Costa Mesa, California. University of California, Davis, CA, USA.
- Moors, P. J. 1983. Predation by mustelids and rodents on the eggs and chicks of native and introduced birds in Kowhai Bush, New Zealand. Ibis 125:137–154.
- Morton, C., and F. Morton. 1995. Ferrets: Everything about purchase, care, nutrition, disease, behavior, and breeding. Barrons Publishers, Woodbury, NY, USA.
- Murphy, B. D. 1989. Chapter 8: Reproductive physiology of female mustelids. Pages 107–123 in U. S. Seal, E. T. Thorne, M. A. Bogan, and S. H. Anderson, editors. Conservation Biology and the Black-footed Ferret. Yale University Press, New Haven, CT, USA.
- Nagami, P. 2004. Bitten: True Medical Stores of Bites and Stings. St. Martin's Press, New York, NY, USA.
- National Association of State Public Health Veterinarians, Inc. 2008. Compendium of Animal Rabies Prevention and Control, 2008. Morbidity and Mortality Weekly Report, Volume 57, No. RR-2.
- Nelms, P. 1993. Memorandum: California Domestic Ferret Association v. Department of Fish and Game. Signed by Phil Nelms, Captain, Wildlife Protection Division, California Department of Fish and Game, Sacramento, CA, USA.
- Newsome, A. E., and I. R. Noble. 1986. Ecological and physiological characters of invading species. Pages 1–20 in R. H. Groves and J. J. Burdon, editors. Ecology of Biological Invasions. Cambridge University Press, New York, NY, USA.
- Owen, C. 1969. The domestication of the ferret. Pages 489-493 in P. J. Ucko and G. W. Dimbleby, editors. The Domestication and Exploitation of Plants and Animals. Proceedings of Research Seminars in Archaeology and Related Subjects, Institute of Archaeology, London University, London, UK.
- Paisley, J. W., and B. A. Lauer. 1988. Severe facial injuries to infants due to unprovoked attacks by pet ferrets. Journal of the American Medical Association 259(13):2005–2006.
- Parker, I. M., D. Simberloff, W. M. Lonsdale, K. Goodell, M. Wonham, P. M. Kareiva, M. H. Williamson, B. Von Holle, P. B. Moyle, J. E. Byers, and L. G. Byers. 1999. Impact: Toward a framework for understanding the ecological effects of invaders. Biological Invasions 1:3–19.
- Phillips, W. B., and F. Shimbo. 1990. California Domestic Ferret Association: 1990 Public Information Manual. Produced in Cooperation with the Ferret Unity and Registration Organization, Inc. Available from: **https://legalizeferrets.org/wp-content/uploads/2017/03/CDFA.pdf (https://legalizeferrets.org/wp-content/uploads/2017/03/CDFA.pdf)**
- Pitta Groz, M., J. C. Pereira, and A. G. Silva. 2002. Chapter 2: Invasive alien species as the main threat to Azores seabirds populations. Workshop on Invasive Alien Species on European Island and Evolutionary Isolated Ecosystems, Convention on the Conservation of European Wildlife and Natural Habitats. Council of Europe, Strasbourg, France.
- Poole, T. B. 1972. Some behavioral differences between the European polecat, *Mustela putorius*, the ferret, *M. furo*, and their hybrids. Journal of Zoology, London 166:25–35.
- Poole, T. B. 1973. The aggressive behavior of individual male polecats towards familiar and

unfamiliar opponents. Journal of Zoology, London 170:395–414.
- Roots, C. 1976. Animal Invaders. Universe Books, New York, NY, USA.
- Rupprecht, C. E., J.S . Smith, J. Krebs, M. Niezgoda, and J. E. Childs. 1996. Current issues in rabies prevention in the United States: Health dilemmas, public coffers, private interests. Public Health Reports 111(5):400–407.
- Rupprecht, C. E., and R. V. Gibbons. 2004. Prophylaxis against rabies. The New England Journal of Medicine, Clinical Practice 351(25):2626–2635.
- Russell, W. C., E. T. Thorne, R. Oakleaf, and J. D. Ballou. 1994. The genetic basis of black-footed ferret reintroduction. Conservation Biology 8:263–266.
- Ryland, L. M., and J. R. Gorham. 1978. The ferret and its diseases. Journal of the American Veterinary Medical Association 173:1154–1158.
- Ryland L. M., and S. L. Bernard. 1983. A clinical guide to the pet ferret. The Compendium on Continuing Education for the Practicing Veterinarian 5:25–32.
- Sacks, J. J., L. Sinclair, J. Gilchrist, G. C. Golab, and R. Lockwood. 2000. Special Report: Breeds of dogs involved in fatal human attacks in the United States between 1979 and 1998. Vet Med Today: Special Report, Journal of the American Veterinary Medical Association 217(6):836–840.
- Seal, U. S. 1989. Introduction. Pages xi-xvii in U. S. Seal, E. T. Thorne, M. A. Bogan, and S. H. Anderson, editors. Conservation Biology and the Black-footed Ferret. Yale University Press, New Haven, CT, USA.
- Scharmann, W., and D. Wolff. 1987. A cage for the ferret. Laboratory Animals 21:43–47.
- Schilling, K. 2007. Ferrets for Dummies. 2nd edition. Wiley Publishing, New York, NY, USA.
- Schoen, J. 1972. Mammals of the San Juan Archipelago: Distribution and colonization of native land mammals and insularity in three populations of *Peromyscus maniculatus*. Thesis, University of Puget Sound, Tacoma, WA, USA.
- Smallwood, K. S., and T. P. Salmon. 1992. A rating system for potential exotic bird and mammal pests. Biological Conservation 62:149–159.
- Smith, G. P., J. R. Ragg, H. Moller, and K. A. Waldrup. 1995. Diet of feral ferrets (*Mustela furo*) from pastoral habitats in Otago and Southland, New Zealand. New Zealand Journal of Zoology 22:363–369.
- Stein, B. A., L. S. Kutner, and J. S. Adams. 2000 Precious Heritage: The Status of Biodiversity in the United States. Oxford University Press, Oxford, UK.
- Stephens, F. 1906. California Mammals. West Coast Publishing Company, San Diego, CA, USA.
- Stevens, W. F. 1975. The biology of the European rabbit, *Oryctolagus cuniculus*, on San Juan Island, Washington. Thesis, University of Washington, Seattle, WA, USA.
- Stevens, W. F. 1979. Status of ferrets and other introduced animals on San Juan Island. San Juan Environmental Studies Report, San Juan, WA, USA.
- Stevens, W. F. 1982. Observation and analysis of European rabbit (*Oryctolagus cuniculus*) crash on San Juan Island and in San Juan Island National Historical Park, Washington. Report to National Park Service, Pacific Northwest Region, San Francisco, CA, USA.
- Thomson, A. P. D. 1951. A history of the ferret. Journal of the History of Medicine and Allied Sciences 6(4):471–480.
- Umbach, K. W. 1997. Ferrets: A selective overview of issues and options. California State Library, California Research Bureau Note 4(3):1–9.
- United States Congress, Office of Technology Assessment. 1993. Harmful non-indigenous species in the United States. OTA-F-565. United States Government Printing Office, Washington, D.C., USA.
- Varnham, K. 2005. Non-native species in UK Overseas Territories: a review. Joint Nature Conservation Committee Report 372. Peterborough, United Kingdom.
- Walton, K. C. 1977. Ferret *Mustela furo*. Pages 352–352 in G. B. Corbet and H. N. Southern, editors. The Handbook of British Mammals. 2nd edition. Blackwell Scientific Publications, London, UK.

- Weiser, P. 1991. Ferrets—playful pets or health menace? Outdoor California 52(2):6–9.
- Wellstead, G. 1981. The Ferret and Ferreting Guide. David and Charles, London, UK.
- Williams, L. 1984. Ferrets fast becoming favorites. DVM Newsmagazine June:59–61.
- Williams, B. H. 2010. Pathology of the domestic ferret (*Mustela putorius furo*). Department of Telemedicine, Armed Forces Institute of Pathology, Washington, D.C., USA. Available from: **http://www.afip.org/consultation/vetpath/ferrets/ (http://www.afip.org/consultation/vetpath/ferrets/)**
- Wodzicki, K. 1950. Introduced mammals of New Zealand. New Zealand Department of Scientific and Industrial Research Bulletin No. 98.
- Woodford, M. H. 1967. A Manual of Falconry. Adam and Charles Black, London, UK.
- Zeuner, F. E. 1963. A History of Domesticated Animals. Hutchinson, London, UK.

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