AUGUST 2005

THE GREEN VISIONS PLAN

for 21st century southern california

6. “Nuisance” Urban Wildlife

Mona Seymour

Acknowledgements: The author is grateful to Travis Longcore, Diego Martino, and Jennifer Wolch for their guidance, to Camilla Fox of the Animal Protection Institute and John Hadidian of The Human Society of the United States for their direction, and to William Vuong and Maureen Phelan for administrative support. Any errors herein lie with the author of this Technical Publication.

Prepared for: San Gabriel and Lower Angeles Rivers and Mountains Conservancy
900 South Fremont Avenue Alhambra CA 91802-1460

Cover Photo Mallard duck (*Anas platyrhynchos*) (United States Fish and Wildlife Service, http://images.fws.gov/, February 1, 2005).

Inside Photos:: All images in this report are credited to the United States Fish and Wildlife Service (http://images.fws.gov/, February 1, 2005) except for the images on p.15 (Mona Seymour) and on p.25 (woodlink.net, February 14, 2005)

Preferred Citation: Seymour, M. 2005. *Green Visions Plan for 21st Century Southern California: A Guide for Habitat Conservation, Watershed Health, and Recreational Open Space. 6. "Nuisance" Urban Wildlife.* University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California.

This report was printed on recycled paper.

USC Center for Sustainable Cities

GIS research laboratory
Department of Geography
College of Letters, Arts, and Sciences

University of Southern California
Los Angeles, CA 90089-0255
www.usc.edu/dept/geography/gislab

USC Viterbi School of Engineering

USC College of Letters, Arts & Sciences

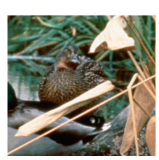
THE GREEN VISIONS PLAN

for 21st century southern california

The mission of the Green Visions Plan for 21st Century Southern California is to offer a guide to habitat conservation, watershed health and recreational open space for the Los Angeles metropolitan region. The Plan will also provide decision support tools to nurture a living green matrix for southern California. Our goals are to protect and restore natural areas, restore natural hydrological function, promote equitable access to open space, and maximize support via multiple-use facilities. The Plan is a joint venture between the University of Southern California and the San Gabriel and lower Los Angeles Rivers and Mountains Conservancy, Santa Monica Mountains Conservancy, Coastal Conservancy, and Baldwin Hills Conservancy.

www.greenvisionsplan.net

TABLE OF CONTENTS


INTRODUCTION

The *Green Visions Plan for 21st Century Southern California* (Green Visions Plan) is a venture to "develop a comprehensive habitat conservation, watershed protection, and recreational opportunities plan" for the southern California region, specifically portions of Ventura, Los Angeles, and Orange Counties (Wolch et al. 2004: 3). Among the many goals of this planning endeavor is the improvement of the relationship between urban inhabitants. "Inhabitant" in the limited sense connotes human urban-dwellers, but here it is used to express the idea that humans coexist in cities with nonhuman animals. This report is concerned with the ways in which urban humans live with, or perhaps against, urban animals, and more specifically urban wildlife. Conflicts between humans and wildlife often arise when humans take offense to an animal's infringement upon what they consider to be human living space. Example conflicts include gophers tunneling under golf course greens, coyotes scavenging in compost piles, and raccoons birthing young in attics. The ways in which humans may solve these problems with "nuisance" wildlife are examined in this report. The Green Visions Plan seeks to promote harmonious coexistence amongst urban inhabitants, and the findings of this report and a subsequent one will provide background for the proposal of a set of model ordinances that reflect that goal.

HUMANS AND WILDLIFE: SHARING THE URBAN ENVIRONMENT

The demographic shift toward cities that has occurred over the last century saw 30% of the United States population settled in urban areas at the turn of the 21st century, with another 50% residing in the suburbs (USCB 2001 in McKinney 2002). Urban population numbers are projected to increase over this decade (McGranahan and Satterthwaite 2003). The six-county southern California region has grown by over 16 million people from 1900 to 2000; by around 8.8 million from 1960 to 2000; and by almost two million from 1990 to 2000. Its 2000 population numbered over 16.5 million (SCAG nd1). Over half of the growth from 1990 to 2000 occurred in the coastal counties of Los Angeles (an increase of 656,286 people), Orange (435,621), and Ventura (84,181) (SCAG nd2).

As population grew, many newcomers and those departing city centers pushed and followed development to the urban fringe. There, infrastructure including housing subdivisions, road networks, and parking lots were built, widely dispersed across the natural landscape (McKinney 2000). This suburban sprawl and the freeways that connect it to other populated areas have brought about the outright loss of most natural areas and the fragmentation of much of the rest (Wolch et al. 2001).

A particular and important repercussion of this urbanization and growth is the radical alteration of suitable natural habitat available for native wildlife (Hough 1995). Human activity affects ecosystem processes, which alters the distribution and abundance of the natural resources that wildlife traditionally relied upon (Prange et al. 2004). Natural habitat fragmentation and reduction has served to bring wildlife into increased contact with the suburbanites whose landscaping practices and structures have put an end to certain contiguous stretches of natural land (Wolch 2002).

Rock dove (*Columba livia*)

Some wildlife species have adapted to suburban and urban ecosystems and can tolerate and even thrive in an urban existence, further explaining their presence in human-dominated landscapes (McKinney 2002). Anthropogenic environments offer abundant clusters of artificial resources, such as garbage and vegetable gardens, which are ripe for exploitation by any free-ranging creature (Prange et al. 2004). Omnivores such as coyotes, raccoons, opossums, and skunks have learned to take advantage of such types of unwittingly offered food, and may reach unnaturally high population densities in urban areas because of such artificial resources. In addition to creating an artificial food supply, the urbanization process has also facilitated predator release and/or eliminated competitors for some species. This is precisely why pigeons, starlings, house mice, and rats are so abundant in urban landscapes (McKinney 2000).

Human reactions vary to contact with their nonhuman neighbors, as humans' acceptance of nature is dependent upon the degree to which nature conforms to one's own set of values – nature is tolerated under an individual's own terms (Hough 1995). Some urban dwellers delight in their proximity to wildlife, and perceive the contact to be an aesthetic or educational experience (Dorney 1986). However, others view certain interactions with wildlife to be undesirable: wildlife are "nuisances," problems to "deal with." Some people perceive urban wildlife to be intrusive and contributory to a less livable environment for humans (Michelfelder 2003). Still others are apprehensive or fearful of coming into contact with certain wild animals; for them, a number of wildlife species represent environmental or health risks (Zinn and Pierce 2002).

When the presence of wildlife constitutes an annoyance to humans, a finite number of solutions exist. Tolerance may be exercised and no action be taken; a human may attempt to address the issue by erecting fencing, using repellents, or removing that which attracted the animal; or a lethal solution may be implemented by a citizen, a public animal control officer, or a private wildlife control operator. While lethal methods may appear to be the most definitive, failsafe method of solving a nuisance wildlife situation, they deserve reconsideration on at least two counts. First, a lethal solution cannot stand alone: without modification of the habitat or resource that attracted the wildlife, a niche has been created for another animal to fill (Van Vleck 1968; Sullivan 1979; Evans 1983; Verts and Carraway 1986; Bhat et al. 1996; Henderson et al. 2000; Sullivan et al. 2001; Blejwas et al. 2002). Second, the ease with which urban animals may be euthanized or otherwise destroyed by animal control officers and private wildlife control industry operators under state law is alarming and may lead to many unnecessary deaths; this matter will be discussed more extensively in a forthcoming report.

Lethal control is not only a faulty, incomplete solution—it is also one that attests to an unfortunate human prerogative of dominance. Humans tend to approach wildlife regulation and management with the intention of satisfying human goals, sometimes without regard for the welfare of the animals (Lopez 1986 in Meyers 2003). To promote coexistence, policymakers, the public, and the legal system must work to overcome the view of nature as something to be controlled or utilized according to human demand alone (Meyers 2003).

Urban dwellers generally are not privy to a social environment that facilitates an understanding of natural cycles. The condition of environmental illiteracy means that humans do not fully understand wildlife as an integral part of natural processes, nor do they understand themselves as a part of natural processes (Hough 1995). The animals that urban dwellers encounter are in fact part of their community, and residents have obligations to these animals (Lopez 1986 in Meyers 2003). Humans must recognize that both people and animals are in a social relationship with members of their own species and with heterospecifics, and that the social welfare of all individuals and groups in this network depends on the nature of this relationship. To some degree, humans should come to know the animals they coexist with and are linked with in this social network. Recognizing the interconnectedness of human and nonhuman lives may produce in humans an ethic of respect, mutuality, and even of caring. Put into practice, such respect would increase the chance that humans encountering heterospecifics would conduct themselves as if those animals mattered (Wolch 2002).

NUISANCE WILDLIFE CONTROL METHODS

A. Nuisance species in the Green Visions plan area

Southern California is home to a variety of mammalian, reptilian, and avian species, many of which are encountered in urban and suburban areas. As discussed previously, some of these species are actually attracted to human landscapes, as these are loci of artificial sources of food, water, and shelter; additionally wildlife may find areas of human habitation to be void of predators and competitors (McKinney 2002). This section contains a brief account of the species of wildlife found in the Green Visions plan area that are considered at times to be nuisances, and the reasons for this "nuisance" designation. In some cases, a lack of definitive knowledge exists regarding whether certain species are found in the plan area, which may have resulted in exclusions of resident species and inclusions of nonresident species; these cases will be noted in the text. Following this is a discussion of a range of possible control methods to cope with unwanted human-animal interactions and the efficacy of these methods. A table simplifying this information on species, nuisance behavior, and resolutions may be found in the Appendix (item 1).

The Green Visions plan area hosts a number of omnivorous and carnivorous species. These include the common raccoon (*Procyon lotor*); the Virginia opossum (*Didelphis virginiana*); the coyote (*Canis latrans*); the black bear (*Ursus americanus*); the striped skunk (*Mephitis mephitis*), and the western spotted skunk (*Spilogale gracilis*), which is less likely to be encountered in urban areas than the striped skunk. There are two fox species, the introduced red fox (*Vulpes vulpes*), and the native gray fox (*Urocyon cinereoargenteus*). Feral cats (*Felis catus*) are a member of this group as well. Members of these species may be implicated for foraging in garbage, compost piles, yards, fields, and gardens, and for denning in, under, or near human structures.

A multitude of herbivorous and insectivorous mammals live in the plan area as well. There is a native mule deer (*Odocoileus hemionus*). Squirrels include an exotic tree squirrel, the Eastern fox squirrel (*Sciurus niger*); a native tree squirrel, the Western gray squirrel (*Sciurus griseus*); and a native ground squirrel, the California ground squirrel (*Spermophilus beecheyi*). Rabbit species may include the black-tailed jackrabbit (*Lepus californicus*), the desert cottontail (*Sylvilagus audubonii*), the brush rabbit (*S. bachmani*), and the introduced European rabbit (*Oryctolagus cuniculus*); some uncertainty exists here. Mice and rat species include the introduced house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), and black rat (*R. rattus*); it is primarily these species rather than native rat and mice species (e.g., Pacific little pocket mouse (*Perognathus longimembris pacificus*), kangaroo rat (*Dipodomys spp*)) that are implicated as nuisances. The plan area contains the valley pocket gopher (*Thomomys bottae*) and the broad-footed mole (*Scapanus latimanus*). The following bat species may be in the plan area, although some uncertainty exists: the western pipistrelle (*Pipistrellus hesperus*), the big brown bat (*Eptesicus fuscus*), the hoary bat (*Lasiurus cinereus*), the western red bat (*L. blossevillii*), the southwestern yellow bat (*L. xanthinus*), the western long-eared myotis (*Myotis evotis*), the western small-footed myotis (*M. ciliolabrum*), the California myotis (*M.*

californicus), the fringed myotis (*M. thysanodes*), the cave myotis (*M. velifer*), the long-legged myotis (*M. volans*), the Yuman myotis (*M. yumanensis*), the pocketed free-tailed bat (*Nyctinomops femorosaccus*), the big free-tailed bat (*N. macrotis*), the Mexican free-tailed bat (*Tadarida brasiliensis*), the pallid bat (*Antrozous pallidus*), the Mexican long-tongued bat (*Choeronycteris mexicana*), Townsend's big-eared bat (*Corynorhinus townsendii*), the spotted bat (*Euderma maculatum*), the greater bonneted bat (*Eumops perotis*), the silver-haired bat (*Lasionycteris noctivagans*), and the California leaf-nosed bat (*Macrotus californicus*) (Bat Conservation International 2002). Conflicts with these species are apt to center around individuals that exploit gardens, lawns, and trees for food, and around members that den or forage inside of human structures.

There is a long list of bird species that are found within the Green Visions plan boundaries. The area hosts the following birds traditionally considered nuisances: gulls and terns (*Larus spp, Sterna spp*), ducks and geese (*Aix spp, Anas spp, Branta canadensis, Bucephala spp, Oxyura jamaicensis*), doves and pigeons (*Columba spp, Streptopelia spp, Zenaida macroura, Columbina spp*), corvids (*Corvus spp, Cyanocitta stelleri, Aphelocoma californica*), the European starling (*Sturnus vulgaris*), and the house sparrow (*Passer domesticus*) (Los Angeles Audubon Society 2000). Birds are often implicated for roosting on human structures and lawns and leaving droppings; some species scavenge in and scatter garbage as well.

Mountain lions (*Puma concolor*)

The plan area also hosts several species that may be regarded as threats more often than they are seen as nuisances, though conflicts with these animals can be minimized by using the same preventative measures suggested for coping with other more traditional nuisance animals. In southern California, mountain lions, coyotes, and snakes, and to a lesser extent bobcats, represent this category. Felid carnivores in the plan area include the mountain lion (*Puma concolor*) and the bobcat (*Lynx rufus*). Problems associated with mountain lions include their predation upon pets and attacks on humans; bobcats have recently been implicated in southern California for a small number of pet predation instances. Coyotes frequently prey upon small companion animals, but have been implicated in only one human death in U.S. history -- that of a three-year-old girl in Glendale, California (Fox and Papouchis 2005). Chance of conflict with coyotes and big cats may be reduced by addressing the availability of live food sources (pets and natural prey) and habitat (brush to hide in). Reducing the availability of live natural food sources entails landscaping private properties and public spaces in such ways that these animals' prey are not attracted to the area (Department of Fish and Game 2004); habitat modification and maintenance are discussed below.

The snake species in the plan area include both poisonous snakes such as rattlesnakes (*Crotalus spp*) and nonpoisonous snakes such as boas (*Charina spp*) and garters (*Thamnophis spp*); some uncertainty exists here about boa distribution (USGS 2003; Californiaherps.com 2004). Simple human vigilance is often the best way to avoid a snake bite. Again, the reduction of habitat and live food sources is a way to make land area less attractive to snakes.

B. Discussion of lethal wildlife control methods

Wildlife control broadly splits into lethal control measures and nonlethal control methods. The Green Visions Plan advocates humane tactics for coping with problems with wildlife, and humane often coincides with nonlethal. In this section, lethal methods are discussed in general terms for efficacy and humaneness, and in the next section nonlethal methods are evaluated in more depth for their efficacy and sometimes for humaneness.

Lethal methods of wildlife control include but are not limited to poisoning, trapping, shooting, and hunting. These methods may be called into question on counts of effectiveness and humaneness. Regarding efficacy, attempts at lethal elimination of a problem animal are not synonymous with achieving lethal elimination of that problem animal. Poison, for instance, must be administered at the correct lethal dosage for any certain species, and if poisoned bait is set out without the correct dosage, the target animal may survive the poisoning (Morris and Weaver 2003; Henderson et al. 1999). Individuals may also develop genetic resistance to a poison, as documented in rodents and rabbits (Misenheimer et al. 1994; Cowan et al. 1995; Twigg et al. 2002). Whether the animal survives the poisoning or not, it, or its carcass, may be consumed by another animal, thus introducing poison to the food chain (OTE 2004). There also exists the possibility that a nontarget animal may consume the poison bait – this could be a neighbor's cat, an endangered species, or even a conspecific of the target animal that was not responsible for the annoyance or damage that prompted the poisoning (El Hani et al. 2002; Hickling et al. 1999; O'Connor et al. 1999; Barlow 2000).

A similar argument about efficacy can be made for trapping: traps do not discriminate between nontarget and target animals. A trap-testing experiment targeting red foxes and coyotes captured domestic cats, raccoons, woodchucks, cottontail rabbits, striped skunks, a pheasant, a robin, and a mink in addition to the target species (Larkin et al. 2003). Deer and domestic cattle, in addition to coyotes, were captured in lethal neck snares in an experiment testing different snares for their ability to capture coyotes and release larger animals; all cattle were in fact able to escape but only 40 out of 91 deer were able to break out of the traps (Phillips 1996). Domestic dogs and cats are quite vulnerable to traps set in residential neighborhoods and rural areas alike (Fox 2004; Lesniak 2004). If padded traps are used in an attempt to trap an animal for death at a later time, the individual may be able to escape. For instance, brushtail possums have a 28%

escape rate from padded leg traps (Warburton 1998).

Shooting and hunting, whether by bullet or bow, beg another question of efficacy: is the hunter taking down the actual nuisance animal, or a conspecific which happened to be in the area? It is individuals that cause problems, and nuisance actions cannot necessarily be generalized to include every single member of a species (Conover 2001). If a hunter kills the wrong individual, the problem has not been solved and an uninvolved life has been taken. Many individual carnivores pose no threat at all to humans, domestic animals, and crops, yet researchers have found that hunters often fail to selectively target the individual animals responsible for predation (Jorgensen 1979; Suminski 1982; Sunde et al. 1998; Sacks et al. 1999). Some coyote packs that have lived in the proximity of domestic sheep herds for over three years have never taken a lamb (Bromley and Gese 2001b). The issue of public safety is also relevant to these two control methods. Organized deer shootings must take stringent measures to insure that no humans are within range of sharpshooters or hunters (Kilpatrick and Walter 1999). Private citizens attempting to shoot an animal browsing or grazing in their garden may be more certain that they are disposing of the correct culprit, but discharging firearms in residential areas poses a public safety hazard.

All of these lethal control techniques present ethical dilemmas in concert with their questionable efficacy. Unless any one of these techniques results in absolutely instantaneous death, the possibility exists that the animal will feel pain to some degree until it dies. Poison, whether in lethal dosage or in an under-dosage, may cause a painful death or sickness for the afflicted animal (Morris and Weaver 2003; Gregory et al. 2000; Dunn 1999). For instance, the toxicant DRC-1339, which has been used to reduce gull populations, may take up to seven days to kill a bird. One gull that survived a DRC-1399 poisoning experiment was described as showing signs of physical discomfort (limping) (Seamans and Belant 1999).

Kill-traps that do not immediately kill the victim, and traps that are not intended to be lethal, painfully injure the caught animal. Depending upon the length of time an animal is entrapped before the trap is checked, it may experience a lingering death, may suffer until the trapper arrives and destroys it, or may attempt to free itself by struggling in the trap or self-amputating an appendage (Fox 2004; Lesniak 2004). Up to around 30% of coyotes caught in certain types of lethal neck snares were found alive in the traps, caught by their necks, when trappers checked the devices (Phillips 1996). Obviously, the experience of being caught in a trap is mentally damaging as well. Even foxes that were caught in box traps and had no injury to limbs expressed pathological symptoms probably related to pacing inside of the trap (White et al. 1991 in Larkin et al. 2003). Hunting and shooting do not result in lethal hits with every shot; rather, wounded individuals may bleed and suffer until the shooter approaches and delivers a lethal blow (assuming, of course, that the shooter attempts to seek out his or her wounded victim). Animals that do die from the initial hit may not die immediately (Kilpatrick and Walter 1999).

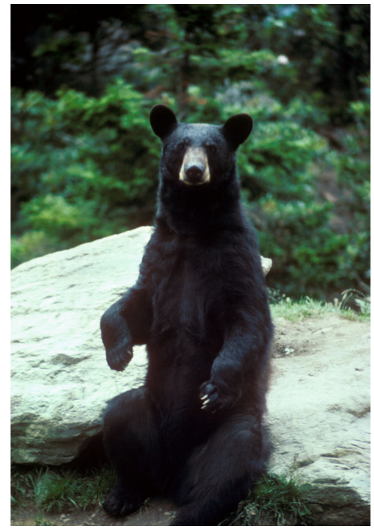
The point introduced in the discussion of efficacy of lethal methods, that problems are caused by individuals (Conover 2001), requires further discussion. If the incorrect individual is eliminated, the problem has by no means been solved. However, if the correct individual is eliminated, this does not guarantee that the problem will disappear either. Animals have the capacity to expand and contract their ranges, according to the availability of food and the presence of conspecifics. If the individual that was creating a problem is killed, another individual may move in to exploit that niche, unless measures are taken to correct the availability of that resource. Many furbearing species will migrate into depopulated land parcels that have been trapped to reduce the presence of furbearing populations (Bhat et al. 1996). Deer herd reduction may result in increased home range sizes (Henderson et al. 2000), bringing surviving deer in to exploit resource-laden areas that have been depopulated. Voles, northern pocket gophers, deer mice, and Great Basin pocket mice have been found to readily colonize sites that conspecifics were removed from (Van Vleck 1968; Sullivan 1979; Verts and Carraway 1986; Sullivan et al. 2001). Problems and conflicts concerning mountain lions and coyotes have been found to recur in the same location even after a few individuals had been removed (e.g., Evans 1983; Blejwas et al. 2002). Understanding all of this, it makes sense to attempt habitat modification before utilizing lethal control methods, in order to eliminate (access to) the resource instead of eliminating the resource utilizer. This premise is a central argument for nonlethal control measures.

C. Discussion of nonlethal wildlife control methods

Habitat modification, translocation, and contraception comprise the major nonlethal control categories discussed in this report. Habitat is used in this report to mean any resources or living space attractive to wildlife that humans have created by virtue of their settlement and occupation of the land. Habitat thus includes, but is not limited to, nonnative grass lawns, fishponds, vegetable gardens, fruit tree stands, garbage, compost piles, brush and leaf piles, and even the built environment, including human homes and sheds. This section will first discuss problems that humans create in landscaping and property maintenance, and how these problems may be addressed to avoid conflicts with certain wildlife species. Translocation, the capture and relocation of animals, will be the second nonlethal control category discussed. Lastly, methods of reproductive control will be considered.

1. Habitat modification

Habitat modification can be implemented to prevent a range of problems that urbanites may experience with wildlife. Human activity and landscaping create food and water resources as well as living space for some wildlife species. Wildlife may derive food and water resources from vegetative sources (flowerbeds, vegetable plants, trees, lawns, sports fields, golf courses, hedges) and from non-vegetative sources (birdfeeders, pets and pet food, fishponds, garbage, compost piles). Some species may find physical habitat on lawns, fields, ledges, and roofs; in brush piles, woodpiles, attics, fireplaces, and walls; and under houses, sheds and decks. Wildlife species' exploitation of these resources and spaces may not be agreeable to humans, and thus taking preventative measures against providing habitat for wildlife is the best way to avoid conflict.



Black bear (*Ursus americanus*)

a. Food sources

Vegetative food sources include flowers, vegetable plants, fruit trees, lawn grasses, and hedges. Non-vegetative food sources include birdfeeders, insects, fishponds, pet food, compost, unsecured garbage, dirty grills, and unsupervised pets. When humans unwittingly provide access to these forms of sustenance, they essentially invite wildlife into their yards and public space to partake in these edibles, which may result in conflicts with the species that come to feed. For instance, human-bear conflicts are most likely to occur if bears in the area are attraction-conditioned, meaning that the bears have learned to seek out unnatural (anthropogenic) sources of food. Bears are quick to learn where unnatural food sources are and how to get to them, even if it is by means of breaking and entering or intimidating humans (Peine 2001).

Several nonlethal options are available for preventing wildlife from feeding on unnatural food sources on public and private properties. These include selective planting, responsible maintenance and conduct, fencing, and repellents.

a.1. Selective planting

Planting vegetation that is unpalatable to herbivorous wildlife, or that is more resilient under browsing pressure (native plants may be more tolerant of browsing than non-natives), is one tactic that may be used to deter wildlife from gardens, fields, and lawns (API 2000; Landau and Stump 1994). The success of selective planting may depend on factors including the availability of other palatable vegetation and the particular species one is attempting to dissuade. For instance, suggestions of unpalatable vegetation for one species of deer in one geographic region may not parallel the ideal unpalatable vegetation for another species of deer in a different region (API 2000).

Canada geese are one species that selective planting may work for. Geese graze on turf in parks and fields, and on residential and office park lawns, and leave droppings that are considered unsanitary and unsightly (Conover and Chasko 1985). They prefer to feed on fine-bladed grasses like Kentucky bluegrass, and Conover (1991) found that captive Canada geese preferred not to feed on the tough-leaf grass species tall fescue, and would not feed on English ivy, Japanese pachysandra, or common periwinkle. He recommends replacing lawns with unpalatable ground cover or, secondarily, a tough-leaf grass species requiring more force to sever the leaves. Native grasses, wildflowers, and low shrubbery are other grass-replacement suggestions (API 2000).

Mule deer and rabbits may also cause problems by browsing in gardens and fields and grazing on lawns. Mule deer may find catnip, chives, garlic, honeybush, lavender, onion, sage, spearmint, thyme, and yarrow to be unpalatable. There are also a number of plants and flowers that may be resistant to deer, including bottle brush, daphne, Douglas fir, euonymous, hackberry, holly, jasmine, juniper, maple, oleander, limber pine, pinon pine, pomegranate, rhododendron, wild lilac, rockrose, santolina, scotch broom, and blue spruce; and black-eyed susan, chrysanthemum, daffodil, foxglove, hyacinth, Iceland poppy, iris, lavender, lily of the nile, oriental poppy, snowflake, and zinnia. Involving these plants in landscaping can be an important tool in deterring deer from browsing as well. Property borders may be lined with resistant and repellent plants to dissuade a deer from entering in search of food, and in the garden, resistant and repellent plants should be positioned around susceptible ones (API 2000). See Appendix item 2 for a more extensive chart listing repellent and preferred plants, created by The Fund for Animals.

Black-tailed jackrabbit (*Lepus californicus*)

Rabbits may be especially attracted to beans, peas, cabbage, lettuce, alfalfa, clover, timothy, orchard grass, grain sorghum, soybeans, and cowpeas – these are examples of plants that should not be included in gardens and lawns. Additionally, rabbits' and hares' diets consist 90 percent of grass, which is another strong argument against grassy green lawns (Landau and Stump 1994).

The maintenance of grass lawns may also cause problems with raccoons, skunks, and moles, which may dig in, or tunnel under, grass lawns in search of grubs and worms. Gophers also tunnel under lawns to feed on the root ends of grasses, and in doing so kill the leaves growing aboveground (Landau and Stump 1994). The elimination of grass cover may be the best way of countering unsightly lawn disturbances. Barring doing away with grass lawns, watering the lawn less frequently is suggested, as it will induce grubs and worms to burrow downward in search of moister soil; moles will follow them and thus tunnel further away from the lawn surface (HSUS 2004a). And, the natural bacteria Milky Spore will rid the lawn of grubs and subsequently of raccoon and skunk excavations (API 2003; Fund 2002).

a.2. Responsible maintenance and conduct

This section discusses measures and choices that homeowners may subscribe to in order to make their yards and homes uninteresting destinations for wildlife in search of non-vegetative food sources. Business owners and public works departments may find the information about garbage receptacles and food handouts helpful. Non-vegetative food sources comprise birdseed, fish in ponds, insects, pet food, compost, garbage, barbeque leftovers, and pets. Fallen fruit, though a vegetative food source, is included along with non-vegetative sources because it is a general maintenance issue as well. The key is to render these attractions unavailable to hungry wildlife.

Proper pet feeding may reduce visits from raccoons, opossums, skunks, coyotes, bears, foxes, feral cats, rats, and mice. Pets should be fed and watered indoors, and if this is not possible, their bowls should be brought inside directly after a meal. Dirty food bowls and food tidbits should not remain on the ground outside, and water bowls should be brought inside overnight (API 2000, 2003; CDEP 2000; Fund 2002; LACDACC nd; MSPCA 2001). Pet food as well as human food should be stored indoors, in sturdy, sealed metal, glass, or plastic containers to prevent attracting rodents into homes (Murphy et al. 2003). Raccoons also may attempt to enter homes in search of food, so doors should be shut during the day, and pet doors should be either boarded shut or engineered to respond only to a signal on a pet's collar (Fund 2002).

Wildlife like raccoons, opossums, rats, mice, and squirrels may be attracted to birdfeeders. Feeders posted on top of poles may be made inaccessible by installing cylindrical metal baffles around the post to inhibit climbing, and by installing dome bafflers over the top of the feeder to disallow jumping animals from gaining access from above. Additionally, feeders should be installed at least 10 feet away from any tree structure that could support a jumping animal, and 10 feet above the ground to deny access to bears. Feeders that are built to be squirrel-proof are another option (CDEP 2000; Fund 2004; HSUS 2004a). Spill-proof birdfeeders will make the area less attractive to mice and rats, and therefore to their predators, including foxes and coyotes (CDEP 2000; Fund 2004; MSPCA 2001).

Fish in ornamental ponds are an attractive food source, especially to raccoons. Ponds, along with birdbaths, are also water sources for raccoons and other animals, and only elimination of these features will prevent wildlife from seeking them out (OTE 2004). However, if homeowners do not want to remove a pond, the solution is to create an environment in which the fish can seek cover. Pond owners should maintain a water depth of at least three feet, and create shelter for the fish by placing cinder blocks, rocks, or pipes in the pond (API 2003; Fund 2002).

A significant point of maintenance includes keeping yards free of ripe and fallen fruit. Otherwise, scavenging and omnivorous animals including opossums, skunks, coyotes, foxes, and bears will come to feed on these (CDEP 2000; Fund nd; HSUS 2004a; LACDACC nd; MSPCA 2001).

Garbage is a major attraction to the majority of wildlife species. Dumpsters should be kept closed and locked. Trash cans should ideally be kept inside a shed or garage, and put on the street only on the morning of garbage pick-up (API 2000, 2003; Belant 1997; HSUS 2004a). Even inside of a structure, garbage bins should be closed and locked to prevent pilfering, should be water tight, and should be resistant to rat damage (LACDHS nd). If receptacles cannot be kept inside, lids should be made secure and air-tight with rope, bungee cord, or chains, and handles tied to stakes driven into the ground (API 2000, 2003; Belant 1997; HSUS 2004a). Food cans and wrappers should be rinsed prior to disposal, and garbage cans should be kept clean and deodorized (CDEP 2000). The purchase of cans with engineered secure lids is another alternative, but some municipalities' sanitation services may only empty certain types of receptacles (Fund 2002; HSUS 2004a).

Red fox (*Vulpes vulpes*)

Open compost piles are another tempting food source, so all composting should be done in secure, closed bins. Composted meat scraps may be especially attractive to omnivorous animals like foxes, coyotes, and bears; additionally, coyotes may be drawn to composted cat and dog waste and milk and egg products, and bears to sweets (API 2000; CDEP 2000). These same species, as well as mountain lions, may visit dirty grills, lured by the remnants and odor of barbequed meat. Grills should be cleaned and moved away from the house immediately after use (CDEP 2000; HSUS 2004a; OTE 2004).

On a more sobering note, omnivorous and carnivorous wildlife may view companion animals as food sources. Cats, smaller dogs, and other small companion animals should be kept indoors at night and when unsupervised during the daytime (API 2000; CDEP 2000; HSUS 2004a; LACDACC nd; MSPCA 2001). If cats are allowed outside, and there are no trees in the yard, erect a cat post – a solid wooden post at least seven feet tall with a seat on top – so that a cat has a chance to escape a pursuant coyote. Outdoor dogs should be spayed or neutered to prevent ovulating female dogs from attracting a coyote, and to prevent male dogs from following an ovulating female coyote and being killed by male pack members (API 2000; LACDACC nd).

Finally, the irresponsible, deliberate provision of food for wildlife should never occur. "Problem" animals result from handouts that are regularly available at a certain location (API 2000; Belant 1997; CDEP 2000). Human interactions with potentially dangerous animals like coyotes, mountain lions, and bears may be limited by not attempting to feed or "tame" them (API 2000; OTE 2004; Peine 2001). Feral cat colonies in alleyways and parking lots may shrink in size if humans cease to provide food and water for the felines (M. Seymour, personal observation). Seymour (forthcoming) provides a brief review of wildlife feeding ordinances in the United States.

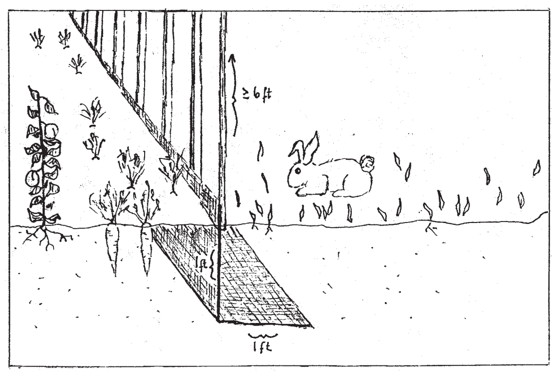
a.3. Fencing

Fencing is an extremely viable tactic for the exclusion of wildlife from gardens and fruit tree stands, and from property in general. However, homeowners associations or city governments may not allow certain types of fences to be erected, so research on acceptable fencing types should be done before installation (Rosenberry et al. 2001).

Urban dwellers may wish to exclude larger predators from home yards and school yards to protect companion animals, children, and other possible food sources. For coyote exclusion, fencing should be at least eight feet tall, with the bottom of the fencing extending at least six inches underground and then at least 15 to 20 inches away from the fence, as coyotes are adept diggers (LACDACC nd). Electric fencing may be installed along the bottom and top of a fence (API 2000). The top of the fence should be bent outward to hinder a jumping coyote. The Coyote Roller™, a rolling bar attached to the top of a fence, is another hindrance to jumping, as it eliminates the traction that a coyote needs under its front paws to support a jump (Fox and Papouchis 2005). High fencing is also necessary to exclude mountain lions if there is attractive food in a yard – lions can jump a 12-foot fence (OTE 2004).

Well-maintained fences are a means of excluding foxes from yards, especially if the base of the fence extends underground and then bends away from the property (CDEP 2000; MSPCA 2001). Fencing around a yard may help exclude snakes as well, if homeowners are worried about small children and pets. A three-foot-tall fence made of sturdy, tight-woven mesh buried several inches underground and slanted outward from the yard at a 30 degree angle may disallow snakes from entering a yard. The fence area should be kept free of rocks or vegetation ladders that would allow the snake to cross the fence (LACDACC nd).

Raccoons, skunks, rabbits, deer, moles and gophers may all be prevented from entering vegetated areas by use of a single adequate fence. Consider the fence created by Rosenberry et al. (2001). The authors created a promising less-conspicuous, moveable fence to manage deer browsing for people who do not wish to erect permanent or highly-visible fencing. They constructed a 2.4-meter-high fence or "exclosure" with plastic fencing mesh and PVC pipes; the total cost of a 6m x 6m enclosure was $70.10. Exclosure setup took about one person-hour, and removal took two people and one-half person-hours. The researchers detected no white-tailed deer browsing inside of the exclosures. However, small mammals were able to chew through the mesh, leading them to recommend that chicken wire or other sturdy wire be attached to the bottom of the fence. They also recommended permanent underground posts for easier setup, and less-conspicuous corner posts. The fence appeared relatively inconspicuous in an agricultural area with vegetated background, but probably would be more conspicuous in a residential area; however, the authors believed that it would blend into vegetated residential areas.



Above-ground and L-shaped fencing

Not only should sturdy metal wire be attached along the bottom three feet of the fence, but it should also extend one foot below the soil, bend 90 degrees, and extend one foot away from the garden. This creates an underground L-shaped barrier to prevent digging and burrowing animals from gaining access to the garden from under the fence (HSUS 2004a). If fencing is needed only to protect gardens from smaller mammals and not deer, the fence should be three feet tall, made of chicken wire or mesh, and extend one foot underground to form an L-shaped barrier (API 2003; HSUS 2004a; MSCPA).

If gophers and moles are extreme concerns, the roots of individual plants may be protected by shaping mesh into a basket around bulbs or young plants before placing them into the soil (API 2003). If rabbits are not a frequent problem in a garden, a homeowner or gardener may prefer to protect only new plantings by covering them with cut-off plastic gallon-containers (HSUS 2004a). Netting may be placed over the top of a fence in order to exclude birds from gardens (API 2003).

A variety of other fencing types exist in addition to that discussed by Rosenberry et al. (2001), including high-tensile strand wiring, mesh-woven wire, chain-link, invisible, solid wooden, double-row wooden, and electric, usually available at gardening stores (HSUS 2004a; Rosenberry et al. 2001). However, invisible fencing may result in injuries to birds and other wildlife, if they meet it at full speed and become entangled (Fund 2002). Monofilament fences, which are invisible, are not recommended for longer than two weeks for protecting vegetation from deer. Beringer et al. (2003) tested five-stranded monofilament fencing on white-tailed deer and found it to be only "marginally effective," though portable, inexpensive, unobtrusive, and low-maintenance. They noted that monofilament lines were occasionally broken by deer or tree limbs, and that deer were able to slip through the lines, which were strung 30cm apart horizontally.

Fencing material and netting are also effective in protecting individual trees from destruction. Birds and deer may be denied access to tree fruit by draping stiff plastic netting over the canopy (API 2000, 2003). Wrapping chicken wire, plastic, mesh, or hardware cloth around tree trunks will prevent deer from rubbing against trees and rabbits and gophers from chewing tree bark. The material should extend at least six inches below ground (API 2003; HSUS 2004a; MSPCA 2001).

a.4. Repellents

Repellents are utilized primarily to keep herbivorous and omnivorous species away from vegetation. Types of repellents include visual, auditory, olfactory, and oral, all of which come with the same several stipulations. All of these categories of repellent are prone to habituation, so must be used in conjunction with other tactics including fencing and other repellents; success varies geographically and by species; and success depends upon quality and quantity of other foods available (Rosell 2001; Treves and Karanth 2003). Further, when deciding which repellents to utilize, it should be kept in mind that studies on repellent efficacy vary widely in criteria for success, experimental design, what plants the repellents were tested on, and availability of other forage materials (El Hani and Conover 1997 in Fund 2002). Repellents should be put into use as soon as wildlife presence is detected, so that the animal immediately develops a negative association with a garden or other yard feature. The objective is to prevent a feeding habit rather than to try to break one (Fund 2002; HSUS 2004a).

Visual repellents may be posted in yards or gardens to startle and unsettle wildlife. Shiny, moving objects, like mylar balloons and streamers and pinwheels, have been used with varying degrees of effectiveness to deter raccoons, deer, and birds (API 2000, 2003; Belant 1997; HSUS 2004a; MSPCA 2001). Effigies and objects painted to look like eyes are other tactical options that may dissuade deer and birds (API 2000, 2003; Belant 1997; HSUS 2004a). Beringer et al. (2003) found that an animal-activated scarecrow (AAS), which combined elements of visual and auditory repellency, was an effective short-term deterrent to white-tailed deer. When a deer triggered the laser, the AAS popped up out of the vegetation plot and played recordings of barking dogs, deer distress calls, and yelling humans for 30 seconds. Additionally, it flashed a strobe light at night. The cost of their experimental system was $1,600. The researchers do not recommend use for longer than six weeks, as they noticed that the number of AAS activations increased over the six weeks study, meaning that deer were probably habituating to the mechanism. They determined the AAS to be more effective in crop protection than were propane exploders (Belant et al. 1996) and repellents (Palmer 1983, Conover 1994); similar to single-strand electric fencing (Porter 1983; Hygnstrom and Craven 1988) and crop-protection dogs (Beringer et al. 1994), and inferior to multi-strand electric fencing or three-meter woven-wire barrier fencing (Caslick and Decker 1979).

Auditory repellents produce startling or unpleasant sounds that ideally induce wildlife to leave the area. Radio noise may have this effect on raccoons (API 2003; HSUS 2004a; MSPCA 2001). Deer may also shy from radio noise, as well as from recorded distress calls of heterospecifics; rattling aluminum pie pans and tin cans; and commercial ultrasonic devices like deer whistles (API 2000; Fund 2002). Belant (1997) states that playback of distress or alarm calls has achieved varying degrees of success in frightening gulls away. Conspecific distress calls may also ward off Canada geese. Timed sirens, airhorns, electronic whistles, exploding projectiles, whistle bombs, shouting, clapping, and banging together pots and pans are other suggestions for frightening birds away from gardens (API 2003; HSUS 2004a).

Auditory repellents may also be attached directly to animals to help prevent them from utilizing certain food sources. Feral cats and domestic cats are responsible for depredation of native wildlife, including songbirds, reptiles, and rodents. British researchers performed a study to ascertain whether attaching bells to the collars of domestic cats reduced the number of prey items a cat brought to its owners. All cats wore bells for four out of eight weeks, and each cat participated in one of three experimental schedules. Researchers found that over the four weeks that cats wore bells, they brought home a mean number of 2.9 prey items, and over the four weeks that cats did not wear bells, they brought home a mean number of 5.5 prey items (Ruxton et al. 2002). Seemingly, bells attached to feral and domestic cats would help to remedy the problem of their predation on native wildlife; however, if particular feral cats survive solely by hunting, this measure may be lethal for some.

Chemical repellents, which may be either oral or olfactory repellents, are suggested for species including deer, rabbits, raccoons, skunks, squirrels, and birds. Capsaicin repellents, which produce a burning sensation when tasted, may work when sprayed on items sought after by raccoons, squirrels, and skunks (HSUS 2004a; MSCPA; API 2003; Fund 2002, 2004). Bosland and Bosland (2001) tested two concentrations of capsaicin (68,000 Scoville Heat Units (SHU) and 185,000 SHU) on rabbits. Each concentration was tested against non-treated control plants. Rabbits first consumed the control plants over the first two or three days of the test, and then consumed the treated plants. The capsaicin acted as a deterrent rather than an absolute repellent, demonstrating that repellents cannot stand alone as a management technique.

A nontoxic grape flavored repellent called Rejex-it may deter geese from feeding on lawns by making grass unpalatable (Fund 2002; API 2003). Repellents containing castor oil may offend skunks and moles, and may be homemade or commercial (API 2003; HSUS 2004a; Fund nd). Other homemade recipes may include ingredients like onions, hot peppers, garlic, and dish soap (API 2003; MSPCA 2001).

Repellents containing predator odors may be another option in the realm of olfactory repellents. Rosell (2001) found that red fox scent and raccoon scent inhibited the feeding of gray squirrels on butternuts, and recommends that predator odor repellents be tested further. However, the predator scent that is most effective will vary by geographic area, according to what predators exist in the region in question. Rosell mentions other studies that found predator odors to have reduced feeding damage caused by a few herbivorous by 60-100% for periods ranging from one to five months.

Research on deer repellents appeared to comprise a sizeable portion of repellent literature. Wagner and Nolte (2001 in Fund 2002) found Deer Away Big Game Repellent® (BGR) and Plantskydd to be the most effective deer repellents out of 20 tested. Both protected plants


Mule deer (*Odocoileus hemionus*)

from deer browsing for six to eight weeks when directly applied. Lutz and Swanson (1997, in Fund 2002) found that BGR, Hinder (mixed 1:1 with water), and 6.2% Miller Hot Sauce were the most effective repellents in several field trials.

Andelt et al. (1994) found that (BGR) and a 6.2% concentration of Hot Sauce Animal Repellent® were the two most effective repellents in a five-day winter study. However, over the course of the five days, deer progressively consumed more centimeters of the treated twigs that were offered to them daily. They used Vapor Guard® spray to prevent repellent evaporation. Repellent efficacy declined over time either because the deer habituated to the taste, or because they were hungry enough to consume the foul taste. The authors felt that the repellents could be most effective if deer were not exposed to them every day, and/or if they were only used in summer months when other food is plentiful. In the days and months that the repellent is not used, they recommend that homeowners use other tactics to deter the deer: possibilities include scarecrows, fencing, and noisemakers. Repellents are low-cost: $3.06/L of 6.2% Hot Sauce, and $7.08/L of BGR (Andelt et al. 1994). A previous study by Andelt et al. (1991) found that coyote urine, Big Game Repellent®, and chicken eggs were the most effective repellents, but failed to deter hungry deer. Note that a number of repellents made from predator urines contain urine obtained from animals that are fur farmed or that are killed by trappers (C. Fox, personal communication). Consumers should conduct research on the urine source of a particular product before purchasing it. See Appendix item 3 for a chart of repellents, ingredients, and pricing information, created by The Fund for Animals.

A *Consumer Reports* (1998, in Fund 2002) study found that among tested non-commercial repellents, Irish Spring soap and a homemade egg and hot pepper spray were the most effective. The soap is hung from trees and bushes with the wrapper still on, and should be high in tallow fatty acid. Home-made sprays may contain garlic, eggs, red pepper sauce, and water. Human hair sachets are another posited solution (Fund 2002).

There are a variety of other tactics that can be used to attempt to scare deer away from gardens. Motion-activated sprinkler systems are a suggested scare device (API 2000). However, many frightening devices, including cracker shells, gunfire, propane cannons, scarecrows, and motion-activated acoustic deterrents, have been shown to be ineffective even for short periods of time (Koehler et al. 1990; Belant et al. 1996; Belant et al. 1998; Gilsdorf 2002 in Beringer 2003).

a.5. Aversive conditioning or hazing

Aversive conditioning is included under the habitat modification heading because it is a technique for making a particular habitat an undesirable place to search for food, even though hazing directly modifies an animal's behavior rather than directly modifying a habitat.

Mild electric shock associated with an audible cue has had varying degrees of success in changing the behavior of some animals (e.g., rats, coyotes, and pigeons). Gallagher and Prince (2003) tested the efficacy of electric shock paired with a metronome at feed stations set up for white-tailed deer. They set up two feed stations in each of three plots of land. One feed station in each plot was set up with an electric grid and metronome, and the remaining station in each plot was the control, devoid of electric grid and metronome. For alternating five-day periods, the wire grid and metronome were both active, followed by periods when only the metronome was active; there was a total of three replicates of this. During periods when both the electric grid and the metronome were active, virtually no food was eaten at test stations. However, during periods when only the metronome was active, food consumption was only about 30% lower at test stations than at control stations. Food consumption returned to levels similar to the control feeder levels within 72 hours of ending an electric shock-metronome period, despite the presence of metronome sound. The researchers suggest enhancing the shock intensity, decreasing the time period between applications of the electric shock, and lengthening the time of the conditioning process, to achieve better results.

Conover (1999) attempted to teach Canada geese and mute swans not to accept food handouts from humans by offering to them bread treated with dimethyl anthranilate (irritates trigeminal nerves, which enervate facial muscles) or methiocarb (causes gastrointestinal distress). Conover used a three day pretreatment period (no chemicals on the bread handouts), a five day treatment period (chemicals on the bread), and a three day post-treatment period (no chemicals) for geese. During pretreatment, no geese refused bread. On the first day of methiocarb-treatment, 78% of the geese accepted bread; on the first day of anthranilate treatment, 80% percent accepted bread. By the fifth day of the treatment period, 0% of geese would accept either methiocarb- or anthranilate-treated bread. However, on the first day of post-treatment, geese began accepting bread again, and most geese started eating bread within a day. Weak aversions were established in the geese. Swans were tested using 10-day pretreatment, treatment (bread with methiocarb), and post-treatment periods. Fewer swans accepted bread during the treatment period than during pretreatment, and feeding delays lengthened over the course of the treatment period. During post-treatment, fewer swans accepted bread than during pretreatment, and feeding delays remained long. Also, during post-treatment, fewer swans lost their aversion to bread compared to geese, but this may be because the swan treatment period was twice as long. Conover noticed that swans no longer swam toward humans or did so slowly by halfway through the treatment period, and that they were hesitant to consume bread offered by park-goers not involved in the experiment. He also noted that geese, unlike swans, fed in groups and could learn from watching others whether the bread was safe to eat or not. Conover suggests testing different chemicals, or eliminating the post-treatment period (park managers should routinely feed treated food to birds), to strengthen the conditioned aversion.

Hazing methods may be applied to manage some larger species that humans view as threats. For instance, hazing has been recommended for cougar management. Gullo et al. (1998) report that wildlife experts have observed that cougars change their behavior in response to human activity. The authors suggest that creating a frightening experience for resident cougars (e.g., using packs of dogs to tree them) and providing an associative mechanism to the treed cougar (e.g., blasting playback of automobile horns, shouting humans, and barking dogs), may induce in the cougar fear of places with such noises. Cougars may alter their behavior and avoid urban areas, place where they have witnessed traffic noise and yelling humans.

A variety of wildlife species have been found to change their behavior in response to hunting and trapping activity perpetrated by humans. Black-tailed prairie dogs, wolves, deer, and black bears change their behavior after exposure to hunting and trapping: prairie dogs flush at greater distances from humans; wolves and bears avoid areas with roads frequented by humans; and deer shift their home ranges and spend more time in dense cover (Swenson 1982; Root et al. 1988; Brody and Pelton 1989; Thurber et al. 1994; Vosburgh and Irby 1998). If these species were hazed with riot guns or other size-appropriate pain-inflicting nonlethal arms, perhaps they too would avoid suburban areas out of fear of humans.

b. Living space

Humans create physical habitat for wildlife in their own landscaped and built environment. Some wildlife are able to exist in anthropogenic landscapes because lawns, fields, and other vegetation are not properly maintained; other species may seize the opportunity to roost or den on top of, under, and even inside of poorly-maintained structures. Below, various methods are discussed that may be used to exclude wildlife from yards, lawns, and other open space areas, and from structures.

b.1. Open space maintenance

Erecting appropriate fencing around property, as discussed above in a3, is a strong exclusionary tactic that will simultaneously protect yards against many species of wildlife. Simply eliminating excess brush, weeds, wood, rubbish, and tall grass from yards reduces available cover, and consequently safety, for wildlife including coyotes, snakes, rabbits, bears, rats, mice, and skunks (Fund nd; HSUS 2004a; LACDACC nd; MSPCA 2001). Other species, like gulls and Canada geese, may loaf in the open, on lawns. Blackwell et al. (2002) tested the effects of long-wave, moving lasers (either 633-nm or 650-nm) at nighttime on Canada geese and mallard ducks in attempt to harass the birds into vacating a lawn. Only the Canada geese were repelled from plots of land by harassment with 650-nm lasers, and only at night (only the Canada geese were tested both day and night); 90% of the geese were repelled. The authors suggest that different wavelengths of lasers ought to be tested at different times of day, and that laser repellents could be valuable, but effective wavelengths may be species-specific.

Belant (1997) suggests that keeping grass long may prevent gulls from resting on it. Lawns bordering ponds or community lakes should have boulders, shrubbery, or aquatic plants along the shore to reduce geese's visual and physical access to the water. If possible, banks should be made steeper, or decks, fencing, or boulders should be placed along the banks, to restrict access from the water to the shore. This restriction to water access may make the grass area less attractive to geese. Overhead wires or ropes strung between trees may be used to help deter geese from landing inside of fenced or otherwise blocked-off areas. Geese that are not yet habituated to an area are most easily deterred. Further, it is most helpful to modify habitat before the nesting season or before the molting season, when they must remain stationary (API 2003).

If fencing or stringent maintenance is not an option, the tolerance of natural predators of animals like gophers, rabbits, and moles, may ameliorate problems with these species. Coyotes and foxes will feed on such smaller mammals. The provision of perches for raptors may also result in a drop in the population of these smaller animals (API 2003). The presence of larger animals in an area, including llamas, donkeys, and large dogs, may dissuade coyotes and foxes from entering (API 2000; CDEP 2000; MSPCA 2001). The use of border collies to harass Canada geese into vacating properties has been successful in the past. Castelli and Sleggs (2000) found that a border collie program at a corporate complex was able to eliminate Canada geese from the lawns. Untrained working stock border collies instinctively herded geese into the company pond and either disallowed them from emerging to feed or swam after them and flushed them. Over several years of year-round, 24-hour-a-day harassment, fewer pairs of geese attempted to establish nests on the grounds in the spring, and after three years, geese were seldom observed on the property at all (Castelli and Sleggs 2000). The use of border collies to harass Canada geese has gained popularity at golf courses and universities in addition to at corporations (Hungden et al. 2000).

b.2. Structural maintenance

Poorly maintained buildings are vulnerable to entrance by a variety of wildlife, including raccoons, squirrels, skunks, bats, mice, rats, and snakes. All points of entry to a home, office building, or other structure should be covered to prevent this. Chimneys should be capped, and plumbing vent pipes, stove and bathroom exhaust vents, and roof vents should be covered with heavy-duty wire mesh. Exposed wood or cracks at the intersection of roofs and walls should be covered with heavy-duty metal screening material (AAA 2002). All holes and openings larger than ½ inch diameter should be patched with cement, steel wool, or caulking (Fund 2002). Rubber or metal runners attached to the bottom of doors are necessary to cut off a possible entry point under a badly-installed door. Rats and other animals may enter homes from beneath buildings, and hardware cloth can be attached to the bottom of a deck or structure and sunken into the earth to prevent access to crawlspace under a home (MSPCA 2001).

Some tree-climbing animals may gain access to a structure from branches that extend over or near a roof. Trimming away tree branches that grow near to a structure or attaching metal sheeting to the base of the tree will prevent this means of entry (MSPCA 2001). Vine-like plants growing on the side of buildings should be trimmed away from the eaves (LACDACC nd).

Raccoon (*Procyon lotor*)

Wildlife may also enter a building through open doors and windows. If a raccoon, skunk, or squirrel does enter a structure, attempt to close all doors that would allow the animal to move further inside, and open doors and windows to the outdoors. Allow it to escape on its own (HSUS 2004a; MSPCA 2001). If a squirrel must exit through a window, hang a rope or sheet out of the window down to the ground to provide a climbing mechanism. If a squirrel has fallen down a chimney and the damper is closed, hang a rope down the chimney so that the squirrel can climb up and out. If the fireplace can be sealed off, place a live trap in the fireplace, open the damper, and once the squirrel enters the trap, release the squirrel outside (Fund 2004). If a bat enters a structure, attempt to confine it to a room with windows or a door to the outside, and turn the lights out. The bat should exit. If the bat does not fly out or is trapped, don heavy gloves, capture the bat with a shoebox, plastic tub, or towel, and release it outside (Fund 2002, API 2003). If a snake gains entry to a building, try to guide it gently out the door with a broom. If this is not possible, or if it is a poisonous snake, confine it to a room or to a corner using boxes. At this point, call a professional to move the snake (HSUS 2004a).

Raccoons and skunks may also enter window wells or dumpsters and become unable to exit. In this case, create a ramp with a board to allow the animal to climb out (Fund 2002). If the well is deep, lower down a pet carrier or garbage can with cheese or cat food in it, and let the animal walk into the carrier. Then slowly raise the carrier out of the well and place it on the ground (HSUS 2004a; MSPCA 2001).

Sometimes an animal's entrance is for a longer stay. Female raccoons and squirrels may enter a home in search of a safe place to birth their offspring. If homeowners are agreeable to waiting for the young raccoons or squirrels to become ambulatory, the juveniles will begin to join their mother on outings. At this point, a one-way door should be installed over the entrance they have been using, so that the family cannot reenter when they return. The door should be kept there for several days to ensure that all animals have left; a layer of flour by the door creates a means of monitoring for footprints indicating that animals are still exiting. After no more footprints are apparent, seal the one-way door shut with hardware cloth, and make sure to seal all other possible points of entry as well. If the presence of a litter cannot be tolerated, harassment techniques like loud radio music, flashlights or attic lights, and ammonia-soaked rags may induce the mother to move her offspring out of the house (HSUS 2004a; MSPCA 2001; Fund 2002, 2004). If the raccoon or squirrel has had a litter in the chimney, harassment with a radio and bowl of ammonia under the damper may be attempted. After the animals have left, cap the chimney (Fund 2002, 2004).

Bats too may find dark, warm attics to be attractive roosting spots. If the presence of the colony cannot be tolerated, it should be noted that flightless newborn bats may be present in the attic from May to September, so it is advisable to exercise patience until the fall. At that point, the attic can be lit with bright lights and cooled with a fan to attempt to induce the bats to leave. They will leave at nightfall to hunt each evening, and bird netting or plastic strips should be affixed over their exit hole in order to create a one-way door that disallows reentrance into the attic. This one-way door should be kept in place for several days to

Bat box

ensure that all bats have exited, and then should be permanently sealed. There may be several entrance holes to the attic, so careful inspection should take place before permanent sealing in case bats have gained entry through other holes. Homeowners can look for cracks with oily residue around them – these indicate bat holes (Fund 2002; MSPCA 2001).

A humane addition to the above exclusionary activity is to attach a bat box to the side of the house or a tree near the entrance hole before the one-way door is put in place. Brittingham and Williams (2000) found that bat boxes were effective in providing a roost for displaced big brown bat and little brown bat maternity bat colonies. Bat boxes should be positioned so that they get adequate direct sunlight (meaning at least seven hours in Pennsylvania, where the study was conducted, but probably fewer in Southern California) and should be built in a manner that they allow many bats to roost side-by-side (76 cm width was found successful). Bat boxes with mesh at the bottom are preferable, so that plucked bat bugs fall through but young bats that fall have a chance to climb back up. High internal temperatures (eight-10 degrees C above ambient) and an internal temperature gradient were necessary for success as well.

If rats or mice are found to be inhabiting a house or other structure, they may be harassed by placing cat hair or peppermint oil-soaked rags around entry holes. The presence of rodents should result in the homeowner or maintenance crew conducting a more thorough check of the structure for entry cracks and holes and patching them over. It is advisable for homeowners to make sure cabinets have little room to support mice. Infestation is most likely to occur where there is poor structural maintenance, poor hygiene, and ample internal harborage (Murphy et al., 2003). Elsewhere in the home, clothes, books, and papers should be stored in plastic boxes to eliminate nesting locations (API 2003; MSPCA 2001).

Some wildlife species may den or hibernate in space under decks and homes that has not been sealed off. Close off space under buildings by attaching hardware cloth to the base of the building, extending it at least one foot underground, and then bending it away from the building for another foot (HSUS 2004a). If the space is not sealed off, female opossums, skunks, and foxes may have litters beneath the deck or home. If it is possible for the homeowner to wait until the young can walk, install a one-way door over their entrance to the den so that the family cannot reenter after their outing. Sprinkle flour at the doorway to pick up on the footprints of any animals still exiting from under the shed/deck; once no more footprints are being made with the flour, close up the one-way door permanently (LACDACC nd). If the animals' presence cannot be tolerated, skunk and possum mothers may be encouraged to move their young by playing a radio near the den, leaving a flashlight shining into the den, and putting ammonia-soaked rags in the den. Denning foxes may be harassed and induced to move by placing moth balls, human-scented items, ammonia-soaked rags, or loud radios by the den entrance (CDEP 2000; MSPCA 2001).

Finally, birds may roost atop buildings, and this can be ameliorated by modifying potential roosting or gathering surfaces (Fund 2002). Pigeons, starlings, gulls and other birds may perch on ledges or other flat surfaces and leave droppings on the structures and ground below. Flat ledges may be bird-proofed by affixing a wood or metal board to the ledge at a 60 degree angle; this will disallow birds from landing in that location (API 2003; Fund 2002). The use of monofilament, stainless steel, or kevlar lines placed parallel, in grid form, or in spoke form, over landing surfaces, has proven effective in deterring gulls from landing on flat surfaces (Belant 1997). Other devices, including single-strand wires, coils, and round-tip spikes may be strung along ledges, pipes, rain gutters, and chimney tops to prevent birds from landing. Netting may be attached to the corners of window inlets to prevent birds from landing on window ledges (HSUS 2004a; API 2003).

Lasers have been used as roosting deterrents to varying degrees of success. Blackwell et al. (2002) tested the effects of long-wave, moving lasers (either 633-nm or 650-nm) at nighttime on brown-headed cowbirds, starlings, and pigeons, and found the harassment to be ineffective in causing the birds to permanently vacate their perches. The authors suggest that different wavelengths of lasers ought to be tested at different times of day, and that laser repellents could be valuable, but effective wavelengths may be species-specific. Chemical repellents are another possibility to consider. Belant (1997) suggests that repellents like polybutene compounds can be used to discourage gulls from roosting on ledges and posts. However, sticky repellents can adhere to and foul birds' feathers (HSUS 2004a).

Birds may attempt to use structures for nesting as well as roosting. White and Blackwell (2003) found powdered sulfur and the deer repellent Big Game Repellent® to be ineffective in deterring starlings from nesting in nest boxes; naphthalene and phenethyl alcohol have also been found to be ineffective starling repellents (Dolbeer et.al. 1988; Belant et.al. 1998). Some repellents, including sulfur, may be undesirable to use in public or residential areas as they are offensive even to humans (White and Blackwell 2003). Gulls avoid darker surfaces like tar or rubber for nesting, so dark roofs, instead of light-colored gravel surfaces, are best (Belant 1997). Chimneys should be capped so that birds cannot enter them for nesting purposes (API 2003, Fund 2002).

2. Translocation

Translocation is not a legal solution to nuisance wildlife management in the State of California unless the California Department of Fish and Game makes an exception (as for gray squirrels and larger animals, as indicated in the Fish and Game Code and by the Director of Education at a wildlife rehabilitation center in Los Angeles County, as discussed in Seymour [forthcoming]). Nonetheless, some cases are reviewed here in the interest of discussing drawbacks to such practice.

Translocation is a controversial solution to nuisance wildlife problems. Mosillo et al. (1999) translocated raccoons from suburban Chicago to a rural forest preserve. Out of 25 translocated urban raccoons, four died and four disappeared over the course of three months in the fall. Depending upon the fates of the four "disappeared" raccoons, the mortality rate was between 16-32%. The 17 surviving raccoons seemed to establish new home ranges, but did so primarily near human residences and in agricultural fields. Even if this mortality rate is acceptable, there is a problem in that the translocated raccoons sought out suburban environs and may have become another homeowner's nuisance. The authors also worry that translocated raccoons could introduce new diseases to local populations.

AAA Wildlife Control of Canada does not practice translocation for nuisance animals, citing studies by Canada's Ministry of Natural Resources that have found that 60% of relocated raccoons may die. They additionally refer to the stressful nature of relocation for an animal, and to the possibility of infectious disease transmission. The company instead hand-captures the animal and releases it in familiar territory in order to allow it continued access to existing food sources and secondary shelter. The operators deodorize the entry holes or living space that they removed the animal from in order to remove its scent and thus render the space unattractive to other wildlife. They then secure the active and potential entry holes with steel screening to prevent reentry and reoccurrence of the problem (AAA 2002).

Translocation does not seem to be an efficient option for squirrel management either. Van Vuren et al. (1997) trapped, anaesthetized, translocated, and hard-released 65 adult California ground squirrels at a range of distances from the trap site. 18 days after the relocation, 23 squirrels returned to their home ranges, seven out of the non-returning 42 died, eight out of the non-returning 42 had unknown fates, and 13 of the non-returning 42 had settled away from the release site. No squirrels returned home from translocation distances greater than 1,500 meters. All squirrel mortality was from translocation distances of 750 meters or greater. So, in order to try to ensure that translocated squirrels do not return home, they would have to be released at least 1,500 meters from their home; this translocation distance would probably result in mortality of some of the relocated squirrels; and surviving squirrels may establish home ranges in a place where they become a nuisance to another residential area. However, the use of a soft release, where animals are allowed to adjust to the release site (e.g., in a holding pen) results in better site fidelity than does hard release, as found for marten and dormice (Davis 1983; Bright and Morris 1994). Finally, Van Vuren et al. found the ground squirrels difficult to trap, even with the use of baited traps.

Translocation of carnivores is generally not recommended unless it is possible to relocate the animal far enough away that it cannot return home and to place the individual into a suitable habitat with territorial vacancy. If neither of these is possible, the individual may return to its original territory, or it may cause social disruption and aggression amongst conspecifics already established in the destination habitat. Effort, expense, and sometimes-high mortality make translocation a less-than-optimal solution for most situations (Treves and Karanth 2003).

Nuisance birds may need to be anesthetized prior to translocation, and questions exist regarding the safety of the anesthetic procedure. Belant et al. (1999) studied the efficacy of the use of alpha-chloralose to temporarily incapacitate nuisance birds, including pigeons, American coots, and various waterfowl. The method has drawbacks in its incidental mortality possibilities, as alpha-chloralose (AC) in larger doses is lethal. The correct dosage of AC must be determined for each target species of bird, because too high of a dose will result in high mortality, and too low of a dose will fail to incapacitate the birds. Non-target birds may take the bait too, which can be in the form of seed on the ground or bread tossed on a lawn; this may result in an overdose and the death of non-target birds. This method of incapacitation seems to be too experimental at this point, and quite risky if non-target birds with lower tolerances can access the bait.

O'Bryan and McCullough (1985) conducted a study on the translocation of 203 black-tailed deer. 215 had been captured, but 12 died prior to translocation. They radio-collared 13 of the animals for reliable monitoring, and found that only two of the 13 survived one entire year following relocation. They also noted deaths of fawns and yearlings due to causes including malnutrition. They found that members of the translocated population of deer typically established home ranges in habitats favored by resident conspecifics, though they did not report whether this caused any mortality (e.g., through starvation) of resident deer. The researchers felt that it would be difficult to describe translocation as a humane control method, given the low survival rate, and also reported that the method is quite expensive – it cost $87,568 to move the 203 deer.

3. Reproductive control

a. Immunocontraception

Immunocontraception is a wildlife management tool that is undergoing much research and development. It is applicable to a range of vertebrate wildlife species, including but not limited to birds, coyotes, deer, and rodents (Miller et al. 1998). It works to control fertility by stimulating the production of antibodies to destroy proteins and hormones essential to reproduction. When the immune system detects a foreign substance, it attacks the substance with antibodies; when the immune system detects a familiar substance, it is unresponsive. By coupling one type of an animal's self reproductive antigens (hormones and proteins) with a foreign protein, and administering this conjugated protein to the animal, the animal's immune system will produce antibodies to destroy this conjugation. These antibodies will also destroy the self reproductive antigen naturally occurring in its body, and this will induce infertility (Miller et al. 1998).

Two general delivery systems exist for administering immunocontraception: non-disseminating (bait) and self-disseminating micro- or macroparasites (vector) (Barlow 2000). In non-disseminating systems, individual animals must consume bait containing an immunocontraceptive drug in order to be treated. Baits do not disseminate an immunocontraceptive agent throughout a population; they only affect the animal that consumed the bait. Darts and biobullets are alternatives to bait, though Miller et al. (1998) feel that vaccines would have to be administered orally to effectively control free-ranging animal populations, as the use of darts or biobullets may be impractical for vaccinating animals in large open areas.

Virus-vectored immunocontraception (VVIC) does disseminate an immunocontraceptive agent throughout a population. A genetically engineered infectious vector is introduced to individuals in a population, and is transmitted to conspecifics through mating activity. One release of VVIC may impact a population for a longer period of time than one application of bait because the vector offers the possibility of multiple infection cycles (Barlow 2000). Individuals infected with an immunocontraceptive virus ideally are rendered permanently infertile (Hood et al. 2000); however, individuals that recover reproductive capacity seemingly could become re-infected through mating activity. Immunocontraceptives applied via bait, on the other hand, may result in one or two years of infertility, dependent upon the length of time that sufficient antibodies exist to destroy the targeted self reproductive antigen (Miller et al. 1998).

European starlings (*Sturnus vulgaris*)

There are several ways to block reproduction during the reproductive process. One way to shut down reproductive activity in both sexes is for an immunocontraceptive vaccine to stimulate the production of antibodies that block gonadotropin-releasing hormones (GnRH). If GnRH levels are reduced, then release of the hormones that control the functions of the testes and ovaries is reduced, which results in gonad atrophy and infertility. GnRH has been successfully used to induce infertility in Norway rats, companion animals, and bulls (Miller et al. 1998; Ladd et al. 1994, Robertson 1982 in Miller et al. 1998). Miller et al. (1998) also report that GnRH vaccines have reduced testosterone to non-breeding levels in male starlings and brown-headed cowbirds. However, concerns exist regarding alterations to behavior, physiology, and body form that GnRH contraceptives may produce (HSUS 2004b). Modification of hormonal systems may impact territorial defense, aggression, pair-bond formation, and scent-marking behavior (Asa et al. 1990, Asa 1995 in Bromley and Gese 2001a); unexpected population dynamics may result, which could render immunocontraception a useless management strategy (Saunders et al. 2002.)

Contragestion, or interfering with gestation, is one way to prevent reproduction in females. The chorionic gonadotropin (CG) hormone induces continued production of progesterone when a female carries a fertilized egg. By inducing a female to produce antibodies to CG, progesterone level drops and the fertilized egg is not successfully implanted and thus cannot develop. Not all species have CG to regulate progesterone production though (Miller et al. 1998). Another approach to contragestion is to block riboflavin transport, facilitated by the riboflavin carrier protein (RCP), to a developing embryo. Riboflavin is a vitamin essential to embryo development. Mammalian and avian species utilize RCP, and RCP antibodies have successfully inhibited embryo development in mammals; they may prove effective for birds as well (Miller et al. 1998).

Preventing reproduction in females may also be achieved by stimulating the production of antibodies that inhibit sperm penetration of an ovulated egg. One way to inhibit sperm penetration is to induce a female to produce antibodies to proteins in sperm. Another way is to induce a female to produce antibodies that bind to the zona pellucida (ZP), which is a glycoprotein layer on the surface of an egg. Incoming sperm must bind to a receptor on the ZP and break the ZP down with an enzyme in order to enter the egg. The antibodies bound to the ZP block the sperm from binding to and breaking down the ZP (Dunbar and Schwoebel 1988 in Miller et al. 1998). This technique has sterilized white-tailed deer for over one year (Turner et al. 1996). It is a very widely tested vaccine in both captive and free-ranging wildlife (Muller et al. 1997; HSUS 2004b).

Rudolph et al. (2000) applied dart vaccinations of porcine zona pellucida (PZP) to female white-tailed deer. The authors discuss management implications for preventing reproduction in female deer after conducting the vaccination effort. Among other things, they believe that the use of immunocontraception will be constrained to the treatment of deer populations that are at between 30 and 70% of their ecological carrying capacity (K), although populations at this K have high biotic potential. It may be too difficult to achieve zero population growth in populations beneath 30%K because efficacy is likely to be below 100%; it will be more difficult to encounter all females that need to be vaccinated because of low population density; and consequently the required effort will be quite high. They believe that managing populations that are above 70%K will not sufficiently resolve conflicts between humans and deer. Finally, use of PZP under some protocols may require individually identifying each treated animal, which can be accomplished using eartags which necessitates handling each animal each year; they recommend the use of radiocollars for mid-density populations to increase ease of locating and identifying individuals.

Female white-tailed deer treated with PZP have been observed to undergo extended breeding seasons (Turner et al. 1996 in Muller et al. 1997). Knox et al. (1988, in Muller et al. 1997) found that the breeding season may be lengthened as a result of the stimulus of breeding without the occurrence of conception. Beside changing female reproductive behavior, this phenomenon may have ramifications for the health of males in a population. During a normal breeding season, bucks reduce food intake and lose body weight; an extended breeding season may result in males maintaining a reduced food intake for a longer period of time, which could lead to increased winter mortality rates (Muller et al. 1997). However, McShea et al. (1997, in Muller et al. 1997) found that larger bucks in populations with ZP-treated does ceased to breed as the winter progressed, though smaller bucks continued breeding attempts during the lengthened estrous cycle.

Infectious immunocontraceptive agents are possible alternatives to baiting and darting application methods. In a study that documented prolonged estrous cycles in surgically sterilized female opossums, Ji et al. (2000) found that males from peripheral areas were attracted to the study site for impermanent visits. This exhibition of transience may mean that an infectious, or virus-vectored, immunocontraceptive agent could be introduced to local females and spread to visiting males, who would return to their core population area and infect those females. The effectiveness of virus-vectored immunocontraception (VVIC) over a large geographical area for any species will depend upon, among other things, the distance that breeding individuals tend to roam from their core population or home range (Ji et al. 2000).

Hood et al. (2000) include in their host-parasite VVIC modeling some thoughts about the virulence of the parasites used to act as the vector of contraceptive agents. They advise the use of benign parasites as vectors rather than virulent parasites, because although virulent parasites are highly transmissible, they may kill off many of the infected individuals of a target population. They believe that the pay-off from infectious application techniques will be higher if the immunocontraceptive agent is spread by benign parasite, allowing the target hosts to live and infect other individuals. Courchamp and Cornell (2000) discuss the use of VVIC for the control of feral cats on islands. They used modeling to come to the conclusion that VVIC would almost always be a more effective and time-efficient method of inducing sterility than the use of baits. They suggest that using baits as a transmission mechanism for a self-disseminating virus at the same time that a VVIC introduced by vaccination is disseminating within a population may be the most efficient strategy, in most cases. The authors include several concerns about VVICs, however. Some of these general disadvantages include irreversibility (if individuals are in fact permanently sterilized); inability to control a released vector (e.g., it could affect non-target conspecific populations); risk of transfer of the vector to another species (e.g., the virus loses specificity over time, or the target species has sexual contact with heterospecific but closely genetically related individuals); risk of genetic alteration of the target population through selection; and development of resistance to the virus (Courchamp and Cornell 2000). Barlow (2000) reminds us that VVIC shares all of these problems with non-disseminating immunocontraception, except for the irreversibility.

There are additional problems or issues concerning immunocontraception in general. The amount of effort (time needed each year to apply a contraceptive treatment, perhaps including the capture and marking of animals) required to achieve a population-level effect with immunocontraception methods must be considered to decide whether this avenue of population control is feasible (Rudolph et al. 2000). This estimation will depend upon resources available, community values and current practices, and characteristics of and access to the target species. For example, is the community using culling methods in concert with immunocontraception? Does the community wish to continue to reduce population through immunocontraception or to maintain a stable population? How dense is the target animal population (Rudolph et al. 2000)? What are the mating system, site fidelity, dispersal rate, and scale of individuals' movements within a population's geographic range (Porter et al. 2004; Twigg et al. 2000)? What is the efficacy of the contraceptive treatment (meaning that a treatment was applied completely and correctly)? How approachable are individual animals (relevance of this question depends on the method of application)? What level of access is to public and private lands is afforded to population managers (Rudolph et al. 2000)?

Miller et al. (1998) address the concern of the implications that immunocontraception has for the food chain. They state that the antibodies produced from immunocontraceptive vaccinations, just like all other antibodies in any individual's body, are harmless to the organism that consumes a vaccinated individual. This report's author did not find other mentions of this concern in the literature, but believes that it deserves more investigation, especially in the case of virus-vectored immunocontraception.

Some target populations have been capable of compensating for induced infertility by increased immigration into the population; increased fecundity of fertile females; or through increased survival and recruitment (offspring joining the adult population) of produced offspring (Saunders et al. 2002;

Bomford 1990 in Twigg et al. 2000). These compensatory possibilities underscore the need for species-specific immunocontraception research.

Some researchers wonder whether immunocontraception selectively allows weak animals to multiply and sterilizes strong animals. Will strong animals with robust immune systems produce the antibodies that vaccination is intended to provoke, thus facilitating immunosterilization, and will weak animals with less-responsive immune systems then become the primary contributors of offspring to a population (Miller et al. 1998)?

Other researchers have entertained the possibility that individuals may develop resistance to the contraceptive applied to their population, and that individuals with that resistance adaptation will be selected for, thus threatening the prospect for use of immunocontraception as a control method (Courchamp and Cornell 2000; Magiafoglou et al. 2003). Magiafoglou et al. (2003) conducted an examination of immunocontraception literature and concluded that relevant data is not yet available to build rigorous quantitative models to predict resistance evolution. They do suggest from some available data about the relationship between antibody response to vaccines and fertility levels that contraception resistance would evolve slowly rather than speedily. They also suggest that populations may need to be managed by rotating the use of multiple differently-working vaccinations, in order to minimize resistance evolution.

b. Surgical sterilization

Surgical sterilization is another method of reproductive control. Its advantage over many immunocontraceptive techniques is that it does not need to be repeated in subsequent years (Hungden et al. 2000). To implement this method of reproductive control, surgeons should use anesthetic and monitor the animals for as long as necessary to ensure that a healthy, self-supporting individual is being released.

It is important to bear in mind that the behavioral response information gleaned from surgical sterilization experiments may also be relevant to some methods of immunocontraceptive control; indeed, several studies mentioned below used surgical sterilization to test the concept of immunocontraception on a particular species. Information may be shared between techniques that do not impair normal endocrine function and reproductive, territorial, and social behaviors of individual animals (Saunders et al. 2002). There is a significant difference between sterilization methods that alter hormonal systems (e.g., castration and spaying) and those that keep hormonal systems intact (e.g., vasectomy and tubal ligation). So, for instance, behavioral results from the tubal ligation of female deer may be extended to theorizing about the effects of treating does with ZP, though it most likely would not be accurate to extend those results to treating does with GnRH.

Researchers tested the effects of surgical sterilization via tubal ligation of females on European rabbit populations over a four-year period. They imposed sterility upon 0%, 40%, 60%, and 80% of females at different sites. A significantly lower number of kittens was produced at the 80% sites than at the 40% and 0% sites. The mean proportion of kittens recruited each year correlated positively with sterility level, although the number of kittens recruited each year correlated negatively with sterility level. Survival of rabbits during the breeding season was overall better on the 80% sites. The 80% sites had a larger proportion of immigrants than the other sites. The authors concluded that high sterility levels effectively reduced seasonal peaks of rabbit abundance, but populations were not smaller after the four year period than they were beforehand (Twigg et al. 2000).

Canada goose (*Branta canadensis*)

The vasectomization of male Canada geese has been found effective in reducing population growth over a five-year study. Female geese paired with vasectomized males laid 340 eggs, 12% of which were fertile; female geese paired with non-vasectomized males laid 526 eggs, 90% of which were fertile. Researchers attributed at least part of the 12% fertility of the eggs produced by females coupled with vasectomized males to incomplete vasectomies. In most of the years, there were fewer vasectomized males paired with females than there were non-vasectomized males paired with females, so the lower amount of eggs produced by females coupled with vasectomized males should not necessarily be interpreted to have resulted from smaller clutch sizes (Hungden et al. 2000).

Bromley and Gese (2001b) surgically sterilized coyotes to determine whether surgical sterilization of coyote packs would modify predatory behavior and reduce livestock predation rates, as compared to coyote packs with pups. Males were sterilized by vasectomy and females by tubal ligation, with hormonal systems left intact. The researchers found that sterilized coyote packs without pups to provide for did modify their behavior. Sterilization reduced (but did not eliminate) coyote predation on sheep. Prices for sterilization were provided in this paper: per animal, surgery cost $75, supplies cost $10, and personnel cost $55; the coyotes in this project were transported by flight and presumably by car to a veterinary clinic, which added $420 for all flight/travel segments.

Bromley and Gese's (2001a) research on coyote sterilization also sought to answer questions about the effects of sterilization on the territorial and affiliative behaviors of pack members. Their purpose

Coyote (*Canis latrans*)

in this comparison was to determine whether sterilized coyote packs retain the same territorial and social behaviors, which would mean that packs in the vicinity of livestock could be sterilized to reduce livestock predation (see Bromley and Geese 2001b), and the sterile packs would maintain their territory, thus excluding predatory non-sterilized packs from livestock areas. They compared sterile packs (in which as many members as possible were caught and sterilized) with intact (not sterilized) packs; both males and females in sterile packs were sterilized. The researchers found no apparent behavioral differences between sterile and intact packs. Sterile coyotes maintained pair bonds similarly to intact coyotes. Sterile packs exhibited no difference from intact packs in territory size and degree of territory overlap. Sterile coyotes exhibited territory fidelity similar to that of intact coyotes, meaning that sterile coyotes were not more likely to leave packs that were not producing pups. Core social unit size remained unchanged between sterile and intact packs; pack size was measured after the young of intact packs dispersed and before pups were born. Bromley and Gese (2001a) concluded that sterilization did not modify the behaviors in question, and therefore sterile coyotes could be used to exclude from livestock areas intact coyotes with pups to provide for.

Bromley and Gese recommend making the effort to identify and target for sterilization the breeding pair within a coyote pack (their approach was to capture and operate on as many individuals from target packs as possible to attempt to halt pup production). However, they were not able to determine whether intact coyotes would replace sterile alpha coyotes within the same pack, or whether intact coyotes belonging to a pack with some sterilized members would reproduce (Bromley and Gese 2001a). This information on pack hierarchy and relationships could be quite significant.

Saunders et al. (2002) surgically sterilized female red foxes via tubal ligation to determine whether sterilization caused any change in survival and in territorial behaviors. They found that nonsterile females maintained slightly larger home ranges (possibly in order to provide for cubs) and that sterile females were more likely to share their territory with other sterile females (which would possibly allow nonsterile females to have more territory and therefore more resources for their cubs). The researchers did not find consistent differences in survival or in dispersal between sterile and nonsterile females. The finding that sterilization did not result in greater dispersal of sterile females may be positive, as it may mean that sterile females would remain in the target population, maintaining their territory and excluding nonsterile females from land on which to glean resources for offspring. Saunders et al. (2002) believe that reproductive control is feasible for fox populations.

Ji et al. (2000) studied the effects of the presence of surgically sterilized female brushtail opossums on male conspecifics. As in ZP treatments of white-tailed deer, the researchers found that sterilization caused female opossums lengthen their estrous cycles past the end of the normal breeding season, thus extending the breeding season for local opossums. Two consequences of an extended breeding season were noticed: first, male opossum body condition was significantly poorer in the winter following the fall breeding season; second, more adult males were found at the study sites during the mating and post-mating period after the sterilization treatment, changing the sex ratio to a male-biased one. The researchers connected the degraded male body condition with prolonged breeding activity in the presence of sterilized female possums. They believe that this could result in increased male mortality. Ji et al. think that the lengthened estrus of sterilized females contributed to a shift in the normal sex ratio by attracting males from peripheral areas into the study area. The researchers differentiate between immigration and impermanent attraction, stating that the lengthened estrous cycles of females probably attracted males for temporary visits only.

c. Egg manipulation for avian populations

Egg oiling is a form of reproductive control specifically used to reduce bird populations. This method involves applying oil-based products to eggs in order to suffocate the embryo before hatching. It requires a wildlife agency permit. Egg oiling5 has been found successful for herring gulls, and is suggested for Canada geese (Blackwell et al. 2000). Blackwell et al. found that oiling eggs 21-27 days prior to the expected hatching date (EHD) resulted in only 20% of 100 nests producing chicks; and oiling eggs 7-15 days prior to EHD resulted in only 1% of 100 nests producing chicks. Other reproductive control includes egg puncturing, where a needle inserts bacteria into an egg; and egg addling, where an egg is forcibly shaken to destroy the embryo. The former technique is considered time-consuming (Hungden et al. 2000). Moreover, the humane nature of these techniques is deeply questionable as well (HSUS 2004a).

CONCLUSION

Forging a peaceful coexistence among the wildlife and humans that inhabit the southern California region is a goal of the Green Visions Plan. To this end, many nuisance wildlife situations may be avoided by taking simple preventative measures, and may be resolved through nonlethal reactive ones. Most of these practical measures may be undertaken by business owners, homeowners, and other private citizens, as they are simple building maintenance techniques or landscaping decisions. Other measures may rely upon the assistance of trained public animal service officers or private-industry wildlife control operators. The amendment of human habits, behaviors, and aesthetic preferences is key in creating an environment void of human-wildlife conflict.

Lethal control, on the other hand, is a drastic and often ineffective solution to human-wildlife conflicts. As discussed in the body of the report, eradicating a nuisance animal merely creates a niche for a conspecific to fill. Additionally, there is no guarantee that the target animal will be the individual actually affected by the lethal control method. The more effective response to a nuisance situation is the elimination of the food source or living space being utilized by this animal, which would render the contested space unattractive to that individual. Lethal control is also by and large an unethical solution to human-wildlife conflict, given the suffering that may be experienced by trapped, shot, or poisoned individuals that do not perish instantaneously. The majority of nuisance wildlife situations entail animals seeking shelter or sustenance; painfully ending such an individual's life is unjust. Thus, lethal control methods are generally discouraged in favor of responsible, innovative, nonlethal approaches to problem-solving.

Our subsequent report (Seymour, forthcoming) will focus on policy and legal aspects of nuisance wildlife control, including the California laws that regulate this vein of wildlife management and local animal services policy on nuisance wildlife control. It will also review some best-practice urban wildlife ordinances in effect across the United States. Combining that information with the control method information in this report, Green Visions planners will create a set of model ordinances focused on commonsense nonlethal avoidance and resolution of human-wildlife conflict, for use by community members, agencies, and jurisdictions inside of the plan area.

APPENDIX

Item 1

A. Wildlife, common conflicts they are involved in, and suggested resolution tactics.

Problem / *Wildlife*	Frequently visiting property	Entering building	Stuck in building	Denning in/under building	Digging in/foraging on lawn	Foraging in garden	Raiding trash can	Roosting atop structure
Raccoon	A, B	G	H	I	L, M, N	P, Q	T	
Opossum	A, B	G	H	I			T	
Coyote	A, B, C, D, F						T	
Bear	A, B, C, D, F						T	
Skunk	A, B	G	H	I	L, M, N	P, Q	T	
Fox	A, B, C, D			I			T	
Feral cat	A, B						T	
Deer	A, B, D					O, P, Q, R, S		
Squirrel	A, B	G	H	I		P, Q		
Rabbit	A, B				L	O, P, Q, S		
Mouse	A, B	G		J			T	
Rat	A, B	G		J			T	
Gopher	B					Q, S		
Mole	B				L, M, N	P, Q		
Bat		G	H	I, K				
Goose	B, D, E				L, O, P			
Misc.birds	A, B	G	H			Q, R	T	U
Mountain lion	A, B, C, D, F							
Bobcat	A, B, C, D, F							
Snake	F, G	H	I					

B. Key

A – Remove ground cover (vegetation, wood piles) and remove or wildlife-proof food and water sources (feed pets indoors or clean up immediately after outdoor feedings; install bafflers on bird feeders, use spill-proof feeders, and hang feeders out of range of a jumping animal; use secure compost containers; remove ripe/fallen fruit; remove or fence in ponds)
B – Do not provide handouts
C – Keep BBQ clean; keep unattended pets indoors; erect fencing
D – Practice hazing
E – Restrict access to water habitats
F – Practice vigilance when outdoors
G – Proper building maintenance: keep doors shut; eliminate/lock pet doors; patch screen doors; patch cracks in walls and floors; cap chimneys; affix screens to vents; seal off space beneath buildings; trim tree branches back from roof; remove climbing vines from walls
H – Isolate animal in room with open doors/windows to outside; wait for animal to leave
I – Use harassment techniques to induce parent(s) to remove the young; or, install one-way door over entrance hole after the young begin following parent(s) on daily outings and seal door once all individuals have left
J – Clean the building to eliminate food supply; use harassment techniques
K – Provide bat box
L – Eliminate grass lawn
M – Water lawn less
N – Chemical treatments
O – Plant unpalatable flora
P – Repellents (Auditory, visual, oral, and/or olfactory)
Q – Erect fencing; include underground L-shaped barrier
R – Drape netting over trees/bushes
S – Cover tree trunks with wire
T – Keep cans inside a shed or garage; or, use secure-lid cans, tethered to a stake
U – String wire, coils, or round-tipped spikes over landing surfaces; create angular surfaces on flat ledges

Item 2, courtesy of The Fund for Animals

DEER-RESISTANT PLANTS

Annuals and Biennials

Ageratum
Alyssum
Annual Periwinkle
Blanket flower
Blue salvia
California poppy
Cornflower
Dahlia*
Dusty miller
Flowering tobacco
Forget-me-not
Heliotrope
Lobelia
Marigold
Melampodium
Morning glory
Nasturtium
Parsley
Pansy*
Plectranthus (fuzzy leafs)
Polka-dot plant
Snapdragon
Spiderflower
Sweet basil
Sweet pea
Thorn apple
Tickseed (Coreopsis)
Verbena
Vinca
Wax begonia
Zinnia
Zonal geranium

Groundcovers/Vines

Bittersweet
Bugleweed
Carolina jessamine
Cherokee rose
Dead nettle
Honeysuckle
Myrtle
Pachysandra
Periwinkle
Sweet woodruff
Trumpet vine
Virginia creeper
Wild ginger
Wisteria

Perennials/Bulbs

Adam's needle
Alyssum
Amaryllis
American bittersweet
Americana mountain mint
Angelica
Anise
Anise hyssop
Astilbe
Avens
Baby's breath
Balloon flower
Barrenwort
Basket-of-gold
Bearberry
Bee balm
Bergenia
Bishop's weed*
Bleeding heart
Blue star
Bluebeard
Bolton's aster *
Bugbane
Buttercup*
Butterfly weed
Calamint
Cardinal flower*
Catmint
Christmas fern
Cinnamon fern
Cinquefoil
Clematis
Colchicum
Columbine
Common dill
Coneflower*
Cranesbill (Geranium)
Crinum lily
Daffodil garlic
Daffodil
Dame's rocket
Daphne
Delphinium
Dropwort
Euphorbia
Evening primrose
False indigo
Ferns
Feverfew
Foam flower
Four o'clock
Foxglove
Fritillary
Gaillardia
Garden sage
Garlic chives
Gas plant
Gerbera daisy
Germander
Globe thistle
Gloriosa lily
Glory lily
Goatsbeard
Golden ragwort
Goldenrod
Hay-scented fern
Heath
Heather
Hellebore
Hen & chicks
Herb of grace
Hungarian speedwell
Hyacinth
Interrupted fern
Iris
Jack-in-the-pulpit
Jacob's ladder
Joe-pye weed
Lady's mantle
Lamb's ear
Lantana
Larkspur
Lavender
Lavender cotton
Lenten rose
Lily leek
Lily-of-the-valley
Lungwort
Lupine
Mayapple
Meadow sage
Mint
Monkshood
Montauk daisy
Montbretia
Moss pinks
Mullein
New York fern
Oregano
Oriental poppy
Ornamental chives
Ornamental grass
Ornamental onion
Ornamental rhubarb
Ostrich fern
Painted daisy
Partridgeberry
Pennyroyal
Perennial blue flax
Perennial sunflower*
Pinks
Plumbago
Poppy
Primrose
Queen of the prairie
Rhubarb
Ribbon grass
Rock-cress
Rose champion
Rosemary
Sage
Scarlet sage
Scilla
Sensitive fern
Shasta daisy*
Siberian Iris
Silvermound
Snakeroot
Snowdrop
Soapwort
Society garlic
Spiderwort
Spike gayfeather
Spurge
Squill
St. John's wort
Star of Bethlehem
Star of Persia
Statice
Stella de Oro daylily
Summer snowflake
Sundrops
Sweet Cicely
Sweet William
Tansy
Thyme
Tiger lily
Toadflax
Turtlehead
Tussock bellflower
Wild indigo
Windflower (Anemone)
Winter savory
Wintergreen
Wormwood
Yarrow
Yucca* (Adam's needle)

Item 3, courtesy of The Fund for Animals

REPELLENTS

TRADE NAME	ACTIVE INGREDIENT(S)	COST OF ONE QUART OF READY-TO-USE	SOURCE	COMMENTS
***Deer Away Big Game Repellent** (comes as a concentrate, powder, or a RTU form called **"Deer and Rabbit Repellent"**)	Putrescent eggs 4.63% in RTU, 37% in concentrate	**Ready-to-use** $17.99 **Concentrate** $9.95 **Powder: 1 lb** $24.95	Intagra 8906 Wentworth Ave. S. Bloomington, MN 55420 (800) 468-2472 www.intagra.com	This putrescent egg-based repellent scores most highly in repellent studies. Powder form of product seems most effective. Odor based. Reapply every 4 weeks.
***Deer Off**	.7813% egg solids; 0.0006% capsaicin and 0.0006% garlic in RTU	$18.99	Deer Off 1492 High Ridge Rd. Suite 5 Stamford, CT 06903 (203) 968-8485 www.deeroff.com	This product combines taste (capsaicin) and odor (egg) for repellency effect. Reapply every 3-4 weeks.
***Liquid Fence**	Contains egg solids (co. won't reveal %); 3% garlic powder	$11.95	Liquid Fence Inc. PO Box 300 Broadheadsville, PA 18322 (888) 923-3623 www.liquidfence.com	Odor and taste-based repellent. Reapply after one week and then monthly.
***Plantskydd**	87% edible animal protein (bloodmeal); 3% vegetable fat; 5% salt; 5% water	$27.00	Tree World 4466 Stalashen Dr. Sechelt BC, Canada V0N 3A1 (800) 252-6051 www.plantskydd.com	A new product from Scandinavia, odor-blood-based ingredients. Scored highly in studies.
Miller's Hot Sauce	2.5% capsaicin	$98.00 per half gallon (not sold by RTU quart)	Miller Chemical PO Box 333, 120 Radio Rd. Hanover, PA 17331 (800) 233-2040 www.millerchemical.com ** company will consult with you to make sure product fits your problem specifics*	Be sure to add a sticker (ex: *Vapor Gard*). **This product must be handled very carefully due to capsaicin (hot pepper)!** Manufacturer suggestion for heavy deer browsing: Apply at ratio of 1-2 quarts repellent, 1-2 quarts sticker (ex: *Vapor Gard*), to 100 gallons water.
***Deer Stopper**	Mint oil, rosemary oil, sodium chloride Egg solids: 1.52% in RTU, 15.2% in concentrate	$16.99	Landscape Plus PO Box 122 Chester, NJ 07930 (908) 832-0711 www.deerstopper.com	A new formulation containing herbal oils.
DeerBusters Deer and Insect Repellent	3.33% garlic	$19.95 with hose-end sprayer attachment	DeerBusters 9735A Bethel Rd. Frederick, MD 21702 (888) 422-3337 www.deerbusters.com	This garlic-based repellent doesn't persist long so it must be re-applied every 7 days and after rain.
Get-Away Animal Repellent	.625% capsaicin, .21% allyl isothiocyanate (mustard)	$17.99	Intagra 8500 Pillsbury Ave. Minneapolis, MN 55420 (800) 468-2472 www.intagra.com	This product scored fairly well in a recent study. Taste/pain based repellent. Reapply every 2 weeks.
***Hinder**	RTU: consists of .66% ammonium salts of higher fatty acids Concentrate:13.8% ammonium salts of higher fatty acids	RTU 24 ounce $12.99 $25.00 for one gallon of concentrate	E. M. Matson Jr. Co. Inc. PO Box 1820 North Bend, WA 98045 (425) 888-6212	One of the few products registered for use on edible plants. Reapply every 2 weeks.
***Deerbusters Deer and Rabbit Repellent**	Concentrate: 13.8% ammonium salts of higher fatty acids	$33.95 for concentrate	DeerBusters 9735A Bethel Rd. Frederick, MD 21702 (888) 422-3337 www.deerbusters.com	This product can be used on edible plants. Reapply every 2 weeks.

REFERENCES

[AAA] AAA Wildlife Control of Canada. 2002. Prevention; Removal; Services. http://www.aaawildlife.com/default.html.

Andelt, W.F., K.P. Burnham, and D.L. Baker. 1994. Effectiveness of capsaicin and bitrex repellents for deterring browsing by captive mule deer. Journal of Wildlife Management 58(2): 330-334.

Andelt. W.F., K.P. Burnham, and J.A. Manning. 1991. Relative effectiveness of repellents for reducing mule deer damage. Journal of Wildlife Management 55: 341-347.

[API] Animal Protection Institute. 2000, 2003. Brochures: Humane Ways to Live with Coyotes; Deer; Geese; Wildlife. http://www.api4animals.org/14.htm.

Asa, C.S. 1995. Physiological and social aspects of reproduction of the wolf and their implications for contraception. In Ecology and conservation of wolves in a changing world. Edited by L.N. Carbyn, S.H. Fritts, and D.R. Seip. Occas. Publ. No. 35, Canadian Circumpolar Institute, University of Alberta, Edmonton. Pp. 283-286. In Bromley, C. and E.M. Gese. 2001a. Effects of sterilization on territory fidelity and maintenance, pair bonds, and survival rates of free-ranging coyotes. Canadian Journal of Zoology 79(3): 386-392.

Asa, C.S., L.D. Mech, U.S. Seal, and E.D. Plotka. 1990. The influence of social and endocrine factors on urine-marking by captive wolves (Canis lupus). Hormonal Behavior 24: 497-509. In Bromley, C. and E.M. Gese. 2001a. Effects of sterilization on territory fidelity and maintenance, pair bonds, and survival rates of free-ranging coyotes. Canadian Journal of Zoology 79(3): 386-392.

Barlow, N.D. 2000. The ecological challenge of immunocontraception: editor's introduction. The Journal of Applied Ecology 37(6): 897-902.

Bat Conservation International. 2002. US Bats by State – California. http://batcon.org/ discover/species/ca.html.

Belant, J.L., L.A. Tyson, and T.W. Seamans. 1999. Use of alpha-chloralose by the Wildlife Services program to capture nuisance birds. Wildlife Society Bulletin 27(4): 938-942.

Belant, J.L., T.W. Seamans, and L.A. Tyson. 1998. Evaluation of electronic frightening devices as white-tailed deer deterrents. Vertebrate Pest Conference 18: 107-110.

Belant, J.L. 1997. Gulls in urban environments: landscape-level management to reduce conflict. Landscape and Urban Planning 38: 245-258.

Belant, J.L., T.W. Seamans, and C.P. Dwyer. 1996. Evaluation of propane exploders as white-tailed deer deterrents. Crop Protection 15: 575-578.

Beringer, J., K.C. VerCauteren, and J.J. Millspaugh. 2003. Evaluation of an animal-activated scarecrow and a monofilament fence for reducing deer use of soybean fields. Wildlife Society Bulletin 31(2): 492-498.

Beringer, J., L.P. Hansen, R.A. Heinen, and N.F. Geissman. 1994. Use of dogs to reduce damage by deer to a white pine plantation. Wildlife Society Bulletin 22: 627-632.

Bhat, M.G., R.G. Huffaker, S.M. Lenhart. 1996. Controlling transboundary wildlife damage: modeling under alternative management scenarios. Ecological modeling 92: 215-224.

Blackwell, B.F., G.E. Bernhardt, and R.A. Dolbeer. 2002. Lasers as nonlethal avian repellents. Journal of Wildlife Management 66(1): 250-258.

Blackwell, B.F., T.W. Seamans, D.A. Helon, and R.A. Dolbeer. 2000. Early loss of herring gull clutches after egg-oiling. Wildlife Society Bulletin 28(1): 70-75.

Blejwas, K.M., B.N. Sacks, M.M. Jaeger, and D.R. McCullough. 2002. The effectiveness of selective removal of breeding coyotes in reducing sheep predation. Journal of Wildlife Management 66(2): 451-462.

Bomford, M. 1990. A Role for Fertility Control in Wildlife Management? Bulletin no. 7. Canberra, Australia: Australian Government Publishing Service. In Twigg, L.E., T.J. Lowe, G.R. Martin, A.G. Wheeler, G.S. Gray, S.L. Griffin, C.M. O'Reilly, D.J. Robinson, and P.H. Hubach. 2000. Effects of surgically imposed sterility on free-ranging rabbit populations. Journal of Applied Ecology 37(1): 16-39.

Bosland, W.K. and P.W. Bosland. 2001. Preliminary field tests of capsaicinoids to reduce lettuce damage by rabbits. Crop Protection 20(6): 535-537.

Bright, P.W. and P.A. Morris. 1994. Animal translocation for conservation: performance of dormice in relation to release methods, origin and season. Journal of Animal Ecology 31: 699-708.

Brittingham, M.C. and L.M. Williams. 2000. Bat boxes as alternative roosts for displaced bat maternity colonies. Wildlife Society Bulletin 28(1): 197-207.

Brody, A.J. and M.R. Pelton. 1989. Effects of roads on black bear movements in western North Carolina. Wildlife Society Bulletin 17: 5-10.

Bromley, C. and E.M. Gese. 2001a. Effects of sterilization on territory fidelity and maintenance, pair bonds, and survival rates of free-ranging coyotes. Canadian Journal of Zoology 79(3): 386-392.

Bromley, C. and E.M. Gese. 2001b. Surgical sterilization as a method of reducing coyote predation on domestic sheep. Journal of Wildlife Management 65(3): 510-519.

California Department of Fish and Game Code. http://www.leginfo.ca.gov/cgi-bin/ calawquery?codesection=fgc&c odebody=&hits=20.

Californiaherps.com. 2004. California Snakes List. http://www.californiaherps. com/snakes/snakes.html.

Caslick, J.W. and D.J. Decker. 1979. Economic feasibility of a deer-proof fence for apple orchards. Wildlife Society Bulletin 7: 173-175.

Castelli, P.M. and S.E. Sleggs. 2000. Efficacy of border collies to control nuisance Canada geese. Wildlife Society Bulletin. 28(2): 385-392.

[CDEP] Connecticut Department of Environmental Protection. 2000. Mammal Fact Sheets. http://dep.state.ct.us/burnatr/wildlife/learn/isfact.htm.

Conover, M. 2001. Effect of hunting and trapping on wildlife damage. Wildlife Society Bulletin 29(2): 521-532.

Conover, M. 1999. Can waterfowl be taught to avoid food handouts through conditioned food aversions? Wildlife Society Bulletin 27(1): 160-166.

Conover, M. 1991. Herbivory by Canada geese: diet selection and effect on lawns. Ecological Applications 1(2): 231-236.

Conover, M. and G.G. Chasko. 1985. Nuisance Canada goose problems in the eastern United States. Wildlife Society Bulletin 13: 228-233.

When Bambi eats your flowers. October 1998. *Consumer Reports*. Pp.32-33. In [Fund] The Fund for Animals. 2002. Coexisting with Wildlife Fact Sheets. http://www.fund.org/urbanwildlife/.

Courchamp, F., and S.J. Cornell. 2000. Virus-vectored immunocontraception to control feral cats on islands: a mathematical model.

Cowan, D., G. Dunsford, E. Gill, A. Jones, G. Kerins, A. MacNicoll, and R. Quy. 1995. The impact of resistance on the use of second-generation anticoagulants against rats on farms in southern England. Pesticide Science 43: 83-93.

Davis, M.H. 1983. Post-release movements of introduced marten. Journal of Wildlife Management 47: 59-66.

Dorney, R.S. 1986. Bringing wildlife back to cities. Technology Review 89: 48-54.

Dunbar, B.S. and E. Schwoebel. 1988. Fertility studies for the benefit of animals and human beings: development of improved sterilization and contraceptive methods. Journal of the American Veterinary Medical Association 193: 1165-1170. In Miller, L.A., B.E. Johns, and D.J. Elias. 1998. Immunocontraception as a wildlife management tool: some perspectives. Wildlife Society Bulletin 26(2): 237-243.

Dunn, Matt. 1999. Chemical warfare for NYC's birds. The Animals' Agenda 19(1): 13-14.

El Hani, A., D.L. Nolte, J.R. Mason, and S. Bulkin. 2002. Response of nontarget species to underground strychnine baiting for pocket gopher in southwest Oregon. Western Journal of Applied Forestry 17(1): 9-13.

El Hani, A. and M.R. Conover. 1997. Comparative analysis of deer repellents. In Repellents in Wildlife Management Conference Proceedings. National Wildlife Research Center, Fort Collins, CO: pp. 147-155. In [Fund] The Fund for Animals. 2002. Coexisting with Wildlife Fact Sheets. http://www.fund.org/urbanwildlife/.

Evans, W. 1983. The cougar in New Mexico: biology, status, depredation of livestock and management recommendations. New Mexico Department of Game and Fish, Santa Fe.

Fox, C. Personal email communication, 26 July 2005.

Fox, C. 2004. Wildlife control out of control. Animal Issues 35(2): 15-18.

Fox, C. and C.M. Papouchis. 2005. Coyotes in Our Midst: Coexisting with an Adaptable and Resilient Carnivore. Sacramento: Animal Protection Institute.

[Fund] The Fund for Animals. 2002, 2004, nd. Coexisting with Wildlife Fact Sheets. http://www.fund.org/urbanwildlife/.

Gallagher, G.R. and R.H. Prince. 2003. Negative operant conditioning fails to deter white-tailed deer foraging activity. Crop Protection 22: 893-895.

Gilsdorf, J. 2002. Effectiveness of frightening devices for reducing deer damage to corn fields. Thesis, University of Nebraska, Lincoln, USA. In Beringer, J., K.C. VerCauteren, and J.J. Millspaugh. 2003. Evaluation of an animal-activated scarecrow and a monofilament fence for reducing deer use of soybean fields. Wildlife Society Bulletin 31(2): 492-498.

Gregory, N.G., G.M.B. Orbell, and D.R.K. Harding. 2000. Poisoning with 3Nitropropionic acid in possums (*Trichosurus vulpecula*). New Zealand Veterinary Journal 48: 85-87.

Gullo, A., U. Lassiter, and J. Wolch. The Cougar's Tale. In J. Wolch and J. Emel, eds. Animal Geographies. London and New York: Verso, 1998, pp. 139-161.

Henderson, R.J., C.M. Frampton, D.R. Morgan, and G.J. Hickling. 1999. The efficacy of baits containing 1080 for control of brushtail possums. Journal of Wildlife Management 63(4): 1138-1151.

Henderson, D.W., R.J. Warren, J.A. Cromwell, and R.J. Hamilton. 2000. Responses of an urban deer herd to reduction in local herd density. Wildlife Society Bulletin 28(4): 902-910.

Hickling, G.J., R.J. Henderson, and M.C.C. Thomas. 1999. Poisoning mammalian pests can have unintended consequences for future control: two case studies. New Zealand Journal of Ecology 23(2): 267-273.

Hood, G.M., P. Chesson, and R.P. Pech. 2000. Biological control using sterilizing viruses: host suppression and competition between viruses in non-spatial models. The Journal of Applied Ecology 37(6): 914-925.

Hough, M. Cities and Natural Processes. London, New York: Routledge, 1995: pp. 165-202.

[HSUS] The Humane Society of the United States. 2004a. Solving Problems with Your Wild Neighbors. http://www.hsus.org/wildlife/urban_wildlife_our_wild_neighbors/solving_problems_with_your_wild_neighbors/.

[HSUS] The Humane Society of the United States. 2004b. Other Fertility Control Agents. http://www.hsus.org/wildlife/issues_facing_wildlife/immuno contraception/other_fertility_control_agents.html.

Hungden, K., B. Raphael, and C. Sheppard. 2000. Egg fertility among vasectomized and non-vasectomized male resident Canada geese at the Wildlife Conservation Park/Bronx Zoo. Zoo Biology 19: 35-40.

Hygnstrom, S.E. and S.R. Craven. 1988. Electric fences and commercial repellents for reducing deer damage to cornfields. Wildlife Society Bulletin 16: 291-296.

Ji, W., M.N. Clout, and S.D. Sarre. 2000. Responses of male brushtail possums to sterile females: implications for biological control. Journal of Applied Ecology 37: 926-934.

Jorgensen, C.J. 1979. Bear-sheep interactions, Targhee National Forest. International Conference on Bear Research and Management 5: 191-200.

Kilpatrick, H.J. and W.D. Walter. 1999. A controlled archery deer hunt in a residential community: cost, effectiveness, and deer recovery rates. Wildlife Society Bulletin 27(1): 115-123.

Koehler, A.E., R.E. Marsh, and T.P. Salmon. 1990. Frightening methods and devices/stimuli to prevent mammal damage – a review. In Davis, L.R. and R.E. Marsh, eds. Proceedings Fourteenth Vertebrate Pest Conference, Sacramento, California, pp. 168-173.

Knox, W.M., K.V. Miller, and R.L. Marchinton. 1988. Recurrent estrous cycles in white-tailed deer. Journal of Mammalogy 69: 384-386. In Muller, L.I., R.J. Warren, and D.L. Evans. 1997. Theory and practice of immunocontraception in wild mammals. Wildlife Society Bulletin 1997 25(2): 504-514.

[LACDACC] Los Angeles County Department of Animal Care and Control. nd. Living with Wildlife. http://animalcontrol.co.la.ca.us/html/Main1.htm.

[LACDHS] Los Angeles County Department of Health Services. The Norway Rat in Downtown Los Angeles. http://lapublichealth.org/eh/progs/consumer /vectman/vcdocs/nratsla.pdf.

Ladd, A., Y.-Y. Tsong, A.M. Walfield, and R. Thau. 1994. Development of an antifertility vaccine for pets based on active immunization against luteinizing hormone-releasing hormone. Biology of Reproduction 51: 1076-1083. In Miller, L.A., B.E. Johns, and D.J. Elias. 1998. Immunocontraception as a wildlife management tool: some perspectives. Wildlife Society Bulletin 26(2): 237-243.

Landau, D. and S. Stump. Living with Wildlife. San Francisco: Sierra Club Books, 1994.

Larkin, R.P., T.R. VanDeelen, R.M. Sabick, T.E. Gosselink, and R.E. Warner. 2003. Electronic signaling for prompt removal of an animal from a trap. Wildlife Society Bulletin 31(2): 392-398.

Lesniak, S. 2004. Trapping destroys families. Animal Issues 35(2): 8-9.

Lopez, B. Arctic Dreams: Imagination and Desire in a Northern Landscape. Vintage: 1986. In Meyers, Gary. 2003. Variation on a theme: expanding the public trust doctrine to include protection of wildlife. Issues in Legal Scholarship article 7.

Los Angeles Audubon Society. 2000. Field List of the Birds of Los Angeles County. http://www.laaudubon.org/index.php?option=com_birdList&Itemid=109.

Lutz, J. and B. Swanson. 1997. Comparative analysis of deer repellents. In Repellents in Wildlife Management Conference Proceedings. National Wildlife Research Center, Fort Collins, CO: pp. 147-155. In [Fund] The Fund for Animals. 2002. Coexisting with Wildlife Fact Sheets. http://www.fund.org/urbanwildlife/.

Magiafoglou, A., M. Schiffer, A.A. Hoffmann, and S.W. McKechnie. 2003. Immunocontraception for population control: Will resistance evolve? Immunology and Cell Biology 81: 152-159.

McGranahan, G. and D. Satterthwaite. 2003. Urban centers: an assessment of sustainability. Annual Review of Environment and Resources 28: 243-274.

McKinney, M.L. 2002. Urbanization, Biodiversity, and Conservation. Bioscience 52(10): 883-890.

McKinney, M.L. 2000. There goes the neighborhood. Forum for Applied Research and Public Policy 15(3): 23-27.

McShea, W.J., S. L. Monfort, S. Hakim, J. Kirkpatrick, I. Liu, J.W. Turner, Jr., L. Chassy, and L. Munson. 1997. The effect of immunocontraception on the behavior and reproduction of white-tailed deer. Journal of Wildlife Management 61: 560-569. In Muller, L.I., R.J. Warren, and D.L. Evans. 1997. Theory and practice of immunocontraception in wild mammals. Wildlife Society Bulletin 1997 25(2): 504-514.

Meyers, Gary. 2003. Variation on a theme: expanding the public trust doctrine to include protection of wildlife. Issues in Legal Scholarship article 7.

Michelfelder, D.P. 2003. Valuing wildlife populations in urban environments. Journal of Social Philosophy 34(1): 79-90.

Miller, L.A., B.E. Johns, and D.J. Elias. 1998. Immunocontraception as a wildlife management tool: some perspectives. Wildlife Society Bulletin 26(2): 237-243.

Misenheimer, T.M., M. Lund, A.E.M. Baker, and J.W. Suttie. 1994. Biochemical basis of warfarin and bromadiolone resistance in the house mouse, *Mus musculus domesticus*. Biochemical Pharmacology 47: 673-678.

Morris, M.C. and S.A. Weaver. 2003. Minimizing harm in possum control operations and experiments in New Zealand. Journal of Agricultural and Environmental Ethics 16(4): 367-385.

Mosillo, M., E.J. Heske, and J.D. Thompson. 1999. Survival and movements of translocated raccoons in northcentral Illinois. Journal of Wildlife Management 63(1): 278-286.

[MSPCA] Massachusetts Society for the Prevention of Cruelty to Animals. 2001. Living with Wildlife. http://www.livingwithwildlife.org/.

Muller, L.I., R.J. Warren, and D.L. Evans. 1997. Theory and practice of immunocontraception in wild mammals. Wildlife Society Bulletin 1997 25(2): 504-514.

Murphy, G., B. Lindley, and P. Marshall. 2003. Controlling mouse infestations in domestic properties. Structural Survey 21(5): 190-195.

[OTE] On the Edge community presentation. Sponsored by the Puente Hills Landfill Native Habitat Preservation Authority. 7 October 2004. Orange Grove Middle School, Hacienda Heights, CA.

O'Bryan, M.K. and D.R. McCullough. 1985. Survival of black-tailed deer following relocation in California. Journal of Wildlife Management 49(1): 115-119.

O'Connor, C.E., L.M. Milne, D.G. Arthur, W.A. Ruscoe, and M. Wickstrom. 1999. Toxicity effects of 1080 on pregnant ewes. Proceedings of the New Zealand Society for Animal Production 59: 250-253.

Peine, J.D. 2001. Nuisance bears in communities: Strategies to reduce conflict. Human Dimensions of Wildlife 6: 223-237.

Phillips, R.L. 1996. Evaluation of three types of snares for capturing coyotes. Wildlife Society Bulletin 24(1): 107-110.

Porter, W.F., H.B. Underwood, and J.L. Woodard. 2004. Movement behavior, dispersal, and the potential of localized management of deer in a suburban environment. Journal of Wildlife Management 68(2): 247-256.

Porter, W.F. 1983. A baited electric fence to reduce deer damage to orchard seedlings. Wildlife Society Bulletin 11: 325-327.

Prange, S., S.D. Gehrt, and E.P. Wiggers. 2004. Influences of anthropogenic resources on raccoon (*Procyon lotor*) movements and spatial distribution. Journal of Mammalogy 85(3): 483-491.

Robertson, I.S. 1982. Effect of immunological castration on sexual and production characteristics in male cattle. Veterinary Record III: 529-531. In Miller, L.A., B.E. Johns, and D.J. Elias. 1998. Immunocontraception as a wildlife management tool: some perspectives. Wildlife Society Bulletin 26(2): 237-243.

Root, B.G., E.K. Fritzell, and N.F. Giessman. 1988. Effects of intensive hunting on white-tailed deer movement. Wildlife Society Bulletin 16: 145-151.

Rosell, F. Effectiveness of predator odors as gray squirrel repellents. 2001. Canadian Journal of Zoology 79(9): 1719-1723.

Rosenberry, C.S., L.I. Muller, and M.C. Conner. 2001. Movable, deer-proof fencing. Wildlife Society Bulletin 29(2): 754-757.

Rudolph, B.A., W.F. Porter, and H.B. Underwood. 2000. Evaluating immunocontraception for managing suburban white-tailed deer in Irondequoit, New York. Journal of Wildlife Management 64(2): 463-473.

Ruxton, G.D., S. Thomas, and J.W. Wright. 2002. Bells reduce predation of wildlife by domestic cats (*Felis catus*). Journal of Zoology 256(1): 81-83.

Sacks, B.N., K.M. Blejwas, and M.M. Jaeger. 1999. Relative vulnerability of coyotes to removal methods on a northern California ranch. Journal of Wildlife Management 63: 939-949.

Saunders, G., J. McIlroy, M. Berghout, B. Kay, E. Gifford, R. Perry, and R. Van de Ven. 2002. The effects of induced sterility on the territorial behaviour and survival of foxes. Journal of Applied Ecology 39: 56-66.

[SCAG] Southern California Association of Governments. nd1. SCAG Region Data. http://www.scag.ca.gov/census/pdf/regionweb.pdf.

[SCAG] Southern California Association of Governments. nd2. Population Growth by County for California

1990-2000. http://www.scag.ca.gov/census/pdf/ CaliforniaCountyGrowth.pdf.

Seamans, T.W. and J.L. Belant. 1999. Comparison of DRC-1339 and alpha-chloralose to reduce herring gull populations. Wildlife Society Bulletin 27(3): 729-733.

Sullivan, T.P., D.S. Sullivan, E.J. Hogue. 2001. Reinvasion dynamics of northern pocket gopher (*Thomomys talpoides*) populations in removal areas. Crop Protection 20: 189-198.

Sullivan. T.P. 1979. Repopulation of clear-cut habitat and conifer seed predation by deer mice. Journal of Wildlife Management 53: 861-871.

Suminski, H.R. 1982. Mountain lion predation on domestic livestock in Nevada. Vertebrate Pest Conference 10:62-66.

Sunde, P., K. Overskaug, and T.Kvam. 1998. Culling of lynxes *Lynx lynx* related to livestock predation in a heterogeneous landscape. Wildlife Biology 4: 169-175.

Swenson, J.E. 1982. Effects of hunting on habitat use by mule deer on mixed-grass prairie in Montana. Wildlife Society Bulletin 10: 115-120.

Thurber, J.M., R.O. Peterson, T.D. Drummer, and S.A. Thomasma. 1994. Gray wolf response to refuge boundaries and roads in Alaska. Wildlife Society Bulletin 22: 61-68.

Treves, A. and K.U. Karanth. 2003. Human-carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology 17(6): 1491-1499.

Tribe. 1974. Ways not to think about plastic trees: New foundations for environmental law. Yale Law Journal 83: 1315. In Meyers, Gary. 2003. Variation on a theme: expanding the public trust doctrine to include protection of wildlife. Issues in Legal Scholarship article 7.

Turner, J.W., J.F. Kirkpatrick, and I.K.M. Liu. 1996. Effectiveness, reversibility, and serum antibody titers associated with immunocontraception in captive white-tailed deer. Journal of Wildlife Management 60: 45-51.

Twigg, L.E., G.R. Martin, and T.J. Lowe. 2002. Evidence of pesticide resistance in medium-sized mammalian pests: a case study with 1080 poison and Australian rabbits. Journal of Applied Ecology 39: 549-560.

Twigg, L.E., T.J. Lowe, G.R. Martin, A.G. Wheeler, G.S. Gray, S.L. Griffin, C.M. O'Reilly, D.J. Robinson, and P.H. Hubach. 2000. Effects of surgically imposed sterility on free-ranging rabbit populations. Journal of Applied Ecology 37(1): 16-39.

[USCB] US Census Bureau. 2001. Statistical Abstract of the United States. Washington (DC): Government Printing Office. In McKinney, M.L. 2002. Urbanization, Biodiversity, and Conservation. Bioscience 52(10): 883-890.

[USGS] United States Geological Survey, Western Ecological Research Station, San Diego Field Station. 2003. Snakes of Coastal Southern California. http://www.werc.usgs.gov/fieldguide/snak.htm.

Van Vleck, D.B. 1968. Movements of Microtus pennsylvanicus in relation to depopulated areas. Journal of Mammalogy 49(1): 92-103.

Van Vuren, D., A. J. Kuenzi, I. Loredo, A.L. Leider, and M.L. Morrison. 1997. Translocation as a nonlethal alternative for managing California ground squirrels. The Journal of Wildlife Management 61(2): 51-359.

Verts, B.J. and L.N. Carraway. 1986. Replacement in a population of *Perognathus parvus* subjected to removal trapping. Journal of Mammalogy 67(1): 201-205.

Vosburgh, T.C. and L.R. Irby. 1998. Effects of recreational shooting on prairie dog colonies. Journal of Wildlife Management 62: 363-372.

Wagner, K.K. and D.L. Nolte. 2001. Comparison of active ingredients and delivery systems in deer repellents. Wildlife Society Bulletin 29(1): 322-330. In [Fund] The Fund for Animals. 2002. Coexisting with Wildlife Fact Sheets. http://www.fund.org/urbanwildlife/.

Warburton, B. 1998. Evaluation of escape rates by possums captured in Victor No. 1 Soft Catch Traps. New Zealand Journal of Ecology 25: 99-103.

White, R.J. and B.F. Blackwell. 2003. Ineffectiveness of sulfur-based odors as nesting deterrents against European starlings. Ohio Journal of Science 103(5): 126-128.

White, P.J., T.J. Kreeger, U.S. Seal, and J.R. Tester. 1991. Pathological responses of red foxes to capture in box traps. Journal of Wildlife Management 55: 75-80. In Larkin, R.P., T.R. VanDeelen, R.M. Sabick, T.E. Gosselink, and R.E. Warner. 2003. Electronic signaling for prompt removal of an animal from a trap. Wildlife Society Bulletin 31(2): 392-398.

Wolch, J. 2002. Anima urbis. Progress in Human Geography 26(6): 721-742.

Wolch, J., T. Longcore, J. Devinny, and J.P. Wilson. 2004. *Green Visions Plan for 21st Century Southern California: A Guide for Habitat Conservation, Watershed Health, and Recreational Open Space. 1. Analytic Frameworks for the Green Visions Plan.* University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California.

Wolch, J., S. Pincetl, and L. Pulido. Urban Nature and the Nature of Urbanism. In Dear, M., ed. From Chicago to LA: Making Sense of Urban Theory. Thousand Oaks, CA: Sage 2001: pp. 367-402.

Zinn, H.C. and C.L. Pierce. 2002. Values, gender, and concern about potentially dangerous wildlife. Environment and Behavior 34(2): 239-256.