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Domestic Cat Predation on Birds

What effect does domestic cat (*Felis catus*) predation have on populations of breeding birds? This question was of recent interest to Christopher Lepczyk, Angela Mertig, and Jianguo Liu of Michigan State University. These investigators studied cat predation on birds along three Breeding Bird Survey routes in southeastern Michigan where more than 90% of the land is privately owned. One route traversed a rural landscape, one a suburban landscape, and the third an urban landscape. Private landowners along the routes were surveyed in October – December 2000 with a mail questionnaire survey. Questions related to the number of cats owned that were given access to the outdoors, and numbers and species of birds that were brought home by cats.

Response rate to the questionnaire was 58.5%. Some 26% of landowners had cats that were allowed outside and cat density (number/ha) was calculated to be 1.19 for the rural route, 1.37 for the suburban route, and 3.43 for the urban route. Cats preyed on a minimum of 12.5% of the known breeding bird species in the area. The mean number of birds depredated per cat per week was 0.68 and most were ground or low shrub feeders. Greater cat density in the urban landscape resulted in greater predatory effect there but the impact of predation on breeding birds was unknown. Predation was not correlated with the number or density of bird feeders.

Reference: Lepczyk, C. A., A. G. Mertig, and J. Liu. 2003. Landowners and cat predation across rural-to-urban landscapes. *Biological Conservation* 115:191-201.

Prey of Domestic Cats in New Zealand

Domestic cats were introduced to New Zealand by Europeans in 1769. Since then, many declines and extinctions of native birds have been attributed to cats. Research to date in New Zealand has focused on feral cats and rural environments; no research has been conducted on predation of wildlife by domestic cats in urban habitats in the country. Craig Gillies of New Zealand's Department of Conservation and Mick Clout of the University of Auckland recently studied cat predation on wildlife in two suburban residential areas of Auckland. One site, Oratia, was bordered by several native forest stands. The second site, Browns Bay, had no adjacent native forests. The sites have undergone continuing development from farmland over the past 30 years and are 32.5 km apart.

Gillies and Clout hand-delivered a questionnaire to each of the 290 households in the two study areas (101 in Oratia and 189 in Browns Bay). Twenty-two households (34 cats) in Oratia and 30 households (46 cats) in Browns Bay agreed to participate in the 1-year study from January 1995 to January 1996.

Rodents were the most common group of animals taken in Oratia. Rats, both black (*Rattus rattus*) and brown (*R. norvegicus*) made up 61.5% of this group and the house mouse (*Mus musculus*) the remaining 38.5%. Invertebrates (largely crickets, lepidopterans, and cicadas) were the most common prey group in Browns Bay, probably because of the high proportion of juvenile cats there. Gillies and Clout found that cat age was the most important predictor of number of invertebrates caught, a finding also reported in other studies.

There was considerable variation in individual cats with regard to predation. Kittens and sub-adults brought home more prey than did older cats. A single 2-year-old cat was responsible for 59.7% of all rodents in Oratia and four cats less than 6 months of age caught 62.7% of all invertebrates in Browns Bay.

Birds were the second most important prey group at both sites with the house sparrow (*Passer domesticus*) being the most commonly taken species at both sites. Also taken at both sites were silvereyes (*Zosterops lateralis*), blackbirds (*Turdus merula*), and song thrush (*T. philomelos*). In Oratia, seven native birds (of five native species) were reported, but no native birds were reported caught in Browns Bay. No difference was found in the number of birds caught in each area. The researchers do not know what the

impact of urban cat predation is on wildlife but they state "The important conclusion from our study is that domestic cats living within foraging distance of an area of native forest are not very different from their feral counterparts in the prey that they take. The only difference is that they do not need to hunt to survive."

Reference: Gillies, C., and M. Clout. 2003. The prey of domestic cats (*Felis catus*) in two suburbs of Auckland City, New Zealand. *Journal of Zoology, London* 259:309-315.

Domestic Cats in Great Britain

In 2003, there were probably some 9 million domestic and feral cats in Britain. This was about 20 times the number of stoat and weasel predators and about 38 times the number of red foxes in the region. Michael Woods of The Mammal Society, London, and two of his colleagues recently completed a large-scale descriptive survey of prey animals brought home by domestic cats in Britain. They sent a questionnaire survey to 1400 households to collect data covering the time period 1 April – 31 August 1997.

Six hundred eighteen households (44%) responded to the questionnaire. Similar to other studies of this nature, considerable variation was noted among individual cats with regard to number of wild animals brought home. Younger cats seemed to be better predators than older cats. Cats with bells and cats kept inside at night brought home fewer mammals, but no effect of either practice was noted on numbers of birds, amphibians, or reptiles brought home. Households that fed birds reported that cats brought home fewer numbers of birds, amphibians, and reptiles, but the number of bird species brought home was higher than for households that did not feed birds. The authors concluded "...this survey confirms that cats are major predators of wildlife in Britain. Further investigation of the extent and nature of predatory behaviour among domestic cats is clearly warranted by this initial work. In particular, detailed observation of cats in the field and description of the numbers of animals they kill and the proportion they retrieve are essential...Although this was not an experimental study, there were differences in the numbers of wild animals brought home by cats subjected to different management regimes. Experimental studies of the effects of equipping cats with bells...or other devices, keeping cats indoors at night and feeding birds will all be essential for evaluating the desirability and likely success of attempts to reduce the numbers of animals killed by growing cat populations."

Reference: Woods, M., R. A. McDonald, and S. Harris. 2003. Predation of wildlife by domestic cats *Felis catus* in Great Britain. *Mammal Review* 33:174-188.

Urban Nature Conservation in Turkey

The human population in urban areas of Turkey increased from 3 million in 1950 (some 14.4% of the total population) to 47.5 million in 2000 (70.6% of the total population). To ensure public and environmental health, Fatih Evrendilek of Mustafa Kemal University, Alahan-Hatay, Turkey argues that ecologically significant habitats must be retained as urbanization proceeds. This investigator recently completed a study that assessed the ecologically significant habitats of Karşıyaka and ways to preserve and manage those habitats. Nineteen such habitats were identified based on habitat rarity, size and age of the habitat, stratification of vegetation (layering), and plant species richness. Ecologically significant habitats made up about 54 ha of the total urban green space of 289 ha in Karşıyaka and the 289 ha was 5.2% of the total city area. No clear laws or policies exist regarding nature conservation of urban habitats in Karşıyaka. Evrendilek calls for strengthening institutional efforts in this regard.

Reference: Evrendilek, F. 2003. Identification of ecologically significant habitats for urban nature conservation: a case study in Turkey. *Journal of Environmental Biology* 24:241-251.

Assessing Wildlife Habitats in Arizona

Margaret Livingston, Bill Shaw, and Lisa Harris of the University of Arizona recently developed a model for assessing wildlife habitat values of various land cover types in the greater Tucson, Arizona area. Land cover types were mapped as: natural open space (52% of study area); residential (13%); recreation (11%); agricultural land (7%); commercial-public facilities (6%); watercourses and ponds (6%); major transportation facilities (3%); and graded vacant land (2%). The model considered four vegetative features of land cover types: 1) percent of total vegetative

cover; 2) percent of native vegetative cover; 3) escape cover; and 4) structural diversity of vegetation. Escape cover was defined as percent of the land surface covered with plant stems or foliage at or near the ground that covered more than a 15.2-cm radius area. Structural diversity was quantified as an index of vertical layers (four maximum): 1) ground cover; 2) shrubs (up to 1.8 m); 3) desert scrub trees (1.8 - 6.1 m); and 4) riparian-exotic trees (more than 6.1 m). The model was:

> Habitat value = total vegetative cover + 2(native vegetation) + 2(structural diversity) + escape cover vegetation

Because of their importance to wildlife, native vegetation and structural diversity were given twice the weight of the other two variables.

Output from the model gave highest habitat values to riparian areas, low density housing (less than or equal to 1 residence/acre), natural open space, and federal-state parks and forests. Of intermediate value were medium-density housing (greater than 1 – 3 residences/acre); and schools, parks, golf courses, and cemeteries. Low habitat value was calculated for mining, abandoned agriculture, land fills, and railways. The technique provides a tool for linking quantitative assessment of vegetation with land cover types for integrating wildlife conservation into local planning activities.

The authors make four recommendations:

1. "Preserve an interconnected network of vegetated landscapes with the highest values as habitats for wildlife.
2. "...identify gaps and fragmentation in Tucson habitats and restore their vegetative continuity.
3. "...emphasize the use of native plant species.
4. "Utilize a diverse array of plant species and plant forms in planted landscapes."

Future research should test the validity of the index values.

Reference: Livingston, M., W. W. Shaw, and L. K. Harris. 2003. A model for assessing wildlife habitats in urban landscapes of eastern Pima County, Arizona (USA). *Landscape and Urban Planning* 64:131-144.

Deer-Vehicle Accidents

Can landscape features be managed to reduce deer-vehicle accidents in urban areas? This question was of interest to Clayton Nielsen of Kinetic Conservation Group and Holterra Wildlife Management and two of his colleagues. These investigators studied the effect of landscape factors on deer-vehicle accidents in two Minneapolis, Minnesota suburbs—Bloomington and Maple Grove. Nielsen and his associates obtained collision data from the two suburbs and classified areas as either: 1) deer-vehicle accident areas (DVA) if two or more deer-vehicle collisions had occurred, or 2) control areas if one or no deer-vehicle collisions had occurred between 1993 and 2000. Sixty variables were screened and five were retained for further testing and model building: 1) number of buildings, 2) number of forest cover patches, 3) number of public land patches, 4) proportion of forest cover, and 5) Shannon's diversity index of the landscape. Logistic regression analysis was used to determine variables best explaining the difference between the two areas.

Number of buildings and number of public land patches emerged from the analysis as the most important variables. DVA areas had fewer buildings and more public land patches than did control areas. Shannon's diversity index of the landscape was moderately important with greater landscape diversity (more cover types) in DVA areas. Proportion of forest cover and number of forest cover patches were of minor importance. The model that best explained differences in deer-vehicle accidents incorporated number of buildings and number of patches of public land. Public lands contained an interspersion of forest, shrub, grassland, and wetland cover types, an indication of good deer habitat. The model correctly classified 31 of 40 areas (77.5%) not used for model building into either high accident areas (two or more DVA) or low accident areas (zero or one DVA). The researchers did not know why proportion of forest cover and number of forest cover patches were not important in explaining differences in deer-vehicle accidents between the two area types.

Reference: Nielsen, C. K., R. G. Anderson, and M. D. Grund. 2003. Landscape influences on deer-vehicle accident areas in an urban environment. *Journal of Wildlife Management* 67:46-51.

Controlling Nuisance Squirrels

The eastern gray squirrel (*Sciurus carolinensis*) sometimes becomes a nuisance for urban-suburban homeowners and may cause damage to homes or other structures. In such instances, homeowners typically want the offending animal removed unharmed and generally support its live capture and translocation to a nearby park or other forested area. Researcher Lowell Adams of the University of Maryland and two of his colleagues recently studied the movement patterns and mortality of urban-suburban "problem" squirrels that were translocated to a large forest.

These investigators captured 39 male squirrels in the Baltimore-Washington Metropolitan Area during the summers of 1994-1997, fitted radio-collars on the animals, and released them in the interior of a large oak-pine wildlife refuge in the region. Squirrels were tracked on the day of release and once or twice weekly thereafter.

Translocated squirrels did not fare well. Most (97%) either died or disappeared from the refuge within 88 days of release. Mortality the first month was 41%; typical annual mortality for the species is about 50%. In addition to high mortality, movement of translocated squirrels was extensive. "...all squirrels but one (of 18) that were not found dead or classified as 'probable mortality' disappeared from the large forest with a median time to disappearance of 11 days." Mortality may have been high for these animals as well from exposure to avian and mammalian predators and roads and highways.

The authors concluded "We hope that practitioners and the public at large will become aware of the research reported here and begin to think twice before simply capturing unwanted animals and moving them to a nearby park or similar area...We believe that, where possible, one-way doors should be used to exclude animals from attics, basements, burrows under decks and porches, and similar situations. Animal access points should then be sealed to prevent re-entry. Compared to live capture and relocation, this approach would be preferable for solving many (but not all) problems. The offending animal would thus be removed from unwanted areas and be denied re-entry, but would remain in its home range. With this practice, no vacuum would be created for immigration of new animals. Increased effort should be made to educate the public regarding use of one-way doors."

Reference: Adams, L. W., J. Hadidian, and V. Flyger. 2004. Movement and mortality of translocated urban-suburban grey squirrels. *Animal Welfare* 13:45-50.

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Greenspace Planning in China

Most Chinese cities are intensively developed, but since the 1980s, Chinese planners have worked to incorporate greenspaces into new urban developments. C. Y. Jim of the University of Hong Kong and Sophia Chen of the Chinese Academy of Sciences are interested in providing the best possible advice on how to do this. They recently chose as a study area the ancient city of Nanjing (nearly 2,000 years old) in east China where new development and redevelopment is proposed and occurring. The city encompasses varied topography including mountains, low hills and terraces, plains, and rivers.

Jim and Chen reviewed three landscape scales and proposed the integration of landscape ecology principles into each. At the largest (metropolis) scale, they proposed five green wedges extending from beyond the city to within its boundary to serve as corridors between the inner city and countryside. At the city scale, they proposed a network of four major greenways to interconnect with the green wedges. A national ordinance calls for 25% of urban land for "greening" and the proposed greenway system could be used to meet the requirements of this ordinance. At the smallest (neighborhood) scale, small greenspaces should be provided with a focus on meeting peoples' need for contact with nature. These should be close to home, safe, and attractive. In addition to meeting human needs, the planting of more trees, particularly, in these areas would provide greater ecological benefits in the form of cooling (shading), wind breaks, pollution control, noise suppression, and wildlife habitat. The small greenspaces should be linked to greenways and green wedges to form a network. This could be done through riparian corridors, pedestrian ways, tree-lined streets, and perhaps with some new parks. The authors concluded "Interviews with some government greenspace planners of Nanjing suggested a lack of a theoretical basis or a holistic framework to guide greenspace distribution at different scales. This ad hoc approach has resulted in a piecemeal greenspace plan which is dictated by urban development, with scant consideration of location vis-à-vis other features, connectivity between venues, habitat and species diversities, and incorporation of environmental improvements. Such shortcomings have prompted this study for a comprehensive greenspace planning framework that involves practical applications of ecological and landscape-ecological principles."

Reference: Jim, C. Y., and S. S. Chen. 2003. Comprehensive greenspace planning based on landscape ecology principles in compact Nanjing, China. *Landscape and Urban Planning* 65:95-116.

Modeling Control of Rabies in Red Fox

Rabies has long been established on the European Continent but has not spread to the United Kingdom (UK). The UK is much concerned about controlling the disease if it does appear. Red fox (*Vulpes vulpes*) populations, particularly in urban areas, are typically dense enough to rapidly spread the disease. A computer model was developed in the mid-1990s to simulate disease spread and predict effectiveness of control strategies involving culling of foxes with poison baits and use of oral vaccination. G. C. Smith and D. Wilkinson of the Central Science Laboratory, York, UK recently presented an updated model with an additional option—fertility control through immunocontraception. These investigators studied the effect of fox population density on rabies outbreak and the probable effectiveness of three control strategies: 1) culling with poisoned bait, 2) oral vaccination with vaccine delivered through bait, and 3) oral vaccination plus fertility control by immunocontraception.

Smith and Wilkinson reported that a density of about 0.2 fox families/km^2 or lower would not create an epizootic of the disease. At a density of 0.25 fox families/km^2 a 20% bait uptake rate would likely control a disease outbreak, whereas at a density of 1.0 fox families/km^2 an 80% uptake rate would be needed. Bait uptake rates of 70% to 80% have been reported for rural areas but in urban areas, 40% is the norm.

At low fox density (0.25 families/km^2) all control methods predicted greater than 90% chance of eliminating the disease. As density increases, probability of disease elimination decreases. For 80% of control, regardless of fox density, culling was predicted to be most effective, followed by vaccination plus fertility control, and then vaccination alone. The use of all three methods yielded high probabilities of disease elimination throughout the year (treatment not season dependent). Culling that centered on the disease outbreak area plus an outer ring of vaccination, or vaccination plus fertility control, might be the best approach to control a point-source outbreak. The authors concluded "We do not suggest that culling takes precedence over vaccination as a wildlife disease control strategy, but efficient culling was more effective at high density, without seasonal disadvantages. However, we recognize that social acceptability and non-target species complications associated with poisons frequently hamper the use of poisons on a broad scale. If the goal is to eliminate an isolated focal outbreak as quickly as possible, then culling should be considered. It should be noted that in these simulations, failure to control disease occurred if the disease persisted for 4 yr or if it spread outside the simulation grid. For long-term control of enzootic rabies this definition of failure would not be relevant. Where contraceptives are available, their inclusion in vaccine bait should be further investigated."

Reference: Smith, G. C., and D. Wilkinson. 2003. Modeling control of rabies outbreaks in red fox populations to evaluate culling, vaccination, and vaccination combined with fertility control. *Journal of Wildlife Diseases* 39:278-286.

Nesting Activity of Australian Magpies

The Australian magpie (*Gymnorhina tibicen*) has become abundant in urban-suburban areas throughout much of Australia. Daniel Rollinson and Darryl Jones of Griffith University, Nathan, Queensland, Australia, recently studied nesting activity of both rural and suburban birds to better understand magpie success in metropolitan areas. These investigators studied birds in the greater Brisbane region of southeast Queensland during the breeding season (June-December) of 2000 and 2001. Suburban magpies were located in medium-density residential housing with some parkland in southern Brisbane. Rural birds were located in the Mt. Cotton area about 40 km southeast of the Brisbane Central Business District. The area consisted of low-intensity farmland interspersed with remnant native bushland.

Nesting phenology differed between suburban and rural birds. Suburban magpies started nest building activity about 13-17 days earlier than rural birds and egg laying for suburban birds began 15-18 days earlier than for rural magpies. More abundant food and warmer suburban temperatures are likely responsible for these observations. The majority of nests in suburbia were in native eucalypt trees. No nests were in or on artificial structures such as buildings or poles. All rural birds nested in native trees.

The incubation period was similar between suburban and rural sites. Also, no difference was noted in the fledging rate (young/pair) between rural and suburban magpies, but suburban birds required more effort to match the reproductive output of rural birds. Sixteen to 20% of suburban birds produced second clutches, most of which were replacements for failed first nesting attempts (in one instance two successful clutches were raised). No re-nesting occurred after failed nesting attempts in rural birds. The authors speculated that greater mortality in suburbia may have resulted from more roads and cats in suburbia. They concluded "From our study, it appears that magpies within the suburban sites studied here fared no better than their rural counterparts, and indeed, had to work harder (producing more clutches per female) for a similar or slightly worse reproductive output. Nonetheless, it is the magpie's ability to respond reproductively to environmental changes within the urban environment (such as improved food resources) that has allowed it to survive in such areas. Its ability to respond to environmental breeding cues and to initiate breeding early (thereby providing the potential for a second clutch should the first fail), may be a key component of the magpie's success within the suburban habitat."

Reference: Rollinson, D. J., and D. N. Jones. 2002. Variation in breeding parameters of the Australian magpie *Gymnorhina tibicen* in suburban and rural environments. *Urban Ecosystems* 6:257-269.

Patterns of Australian Magpie Attacks on Humans

Australian magpie attacks on humans are among the most significant human-wildlife conflict issues in suburban areas of Australia. Such attacks typically occur during the breeding season and represent defensive measures by the birds in protecting their nest

sites. Attacks have generally been portrayed as random events, but Rowena Warne and Darryl Jones of Griffith University, in Nathan, Queensland, Australia recently tested this general belief. They studied magpie attacks on three groups of people in suburban Brisbane: 1) pedestrians, 2) cyclists, and 3) mail deliverers on motorcycles.

Warne and Jones investigated 227 incidents during 1999 and 48 aggressive magpies (about 12% of all reported aggressive birds in the area) were selected for detailed observation. The selection process was not random but birds selected were considered representative of all aggressive birds in the area. The investigators conducted 30-min observation periods within the "attack zone," an area within 100 to 150 m of the nest tree, of each bird. All human intruders were recorded and placed into one of the three categories mentioned above.

The 48 birds selected for study were all males. Most (70.8%) attacked only one type of intruder. Of these birds, some 52.1% attacked pedestrians only, 8.3% focused only on cyclists, and 10.4% targeted mail deliverers only. The remaining birds (29.2%) attacked both pedestrians and cyclists.

Warne and Jones concluded that definite patterns are apparent in magpie attacks. They are not random events. Most attacks are by male birds and occur in an "attack zone" centered on the nest tree when chicks are in the nest. Attacks are most intense mid-to-late September just before chicks begin to fly. The investigators stated, "Magpie attacks remain a significant suburban wildlife-human conflict throughout Australia. Sound and effective management plans will depend on a more thorough understanding of all aspects of this phenomenon."

Reference: Warne, R. M., and D. N. Jones. 2003. Evidence of target specificity in attacks by Australian magpies on humans. *Wildlife Research* 30:265-267.

Managing Australian Magpies

Can aggressive magpies be relocated to reduce human-magpie conflicts? This question is of interest to Darryl Jones and Thomas Nealson of Griffith University, Nathan, Queensland, Australia. These investigators studied the issue in southeastern Queensland during 1999 and 2000.

Information about aggressive magpies reported by the public to the Queensland Parks and Wildlife Service was forwarded to Jones and Nealson at the university. Where possible, aggressive birds were captured and either released at new sites within 1-3 hours or placed in a large aviary for 1-3 days prior to relocation. Relocated distances were grouped into five categories (1-30 km, 31-50 km, 51-70 km, 71-90 km, and greater than 90 km from the capture site).

The majority of reports of aggressive birds were received during August to October (breeding season). Over the 2-yr study period, 141 aggressive birds were trapped and relocated. Distance from capture site to relocation site was an important factor in whether or not birds returned to their original territories. Including data from previous studies, the authors reported that all birds released within 25 km returned to original territories. One-half of birds released 26-30 km returned and very few birds returned when released at greater distances. Jones and Nealson concluded "We strongly advocate that translocation be regarded as one of a series of management options available to agencies, along with education as to the context of magpie attacks and the many simple but effective means to prevent injury...Finally, we suggest that agencies promote openly both translocation and euthanasia as methods to be used only in the most extreme situations."

Reference: Jones, D. N., and T. Nealson. 2003. Management of aggressive Australian magpies by translocation. *Wildlife Research* 30:167-177.

Wildlife Feeding in Australia

In Australia, wildlife feeding is discouraged by many wildlife agencies but feeding seems to be a common practice. The extent and types of practices in metropolitan Brisbane were recently studied by Daniel Rollinson, Rebecca O'Leary, and Darryl Jones of Griffith University, Nathan, Queensland. These investigators selected 20 suburban sites (each about 1 km^2) throughout southern Brisbane containing no high-rise buildings or industrial areas. A questionnaire survey was hand delivered to 20 houses randomly chosen within each area for a total of 400 houses.

One hundred thirty-four questionnaires were completed (34% response rate) and of these, 50 respondents (37%) reported feeding wildlife. Species fed tended to be typical suburban birds (20 species) plus one mammal (common brushtail possum, *Trichosurus vulpecula*), and one reptile (blue-tongued lizard, *Tiliqua scincoides*). Most commonly fed by two-thirds of household feeders were Australian magpie, butcherbirds (*Cracticus* spp.), laughing kookaburra

(*Dacelo novaeguineae*), and Torresian crow (*Corvus orru*). Interestingly, carnivores-omnivores predominate in Australia compared to mostly omnivores-granivores such as tits, finches, and buntings in the Northern Hemisphere. Lorikeets, cockatoos, and rosellas were fed by some 40% of households. Three introduced species (spotted turtle dove *Streptopelia chinensis*, rock dove *Columba livia*, and house sparrow *Passer domesticus*) were mentioned. Three species (Torresian crow, noisy miner *Manorina melanocephala*, and Australian white ibis *Threskiornis molucca*) are considered common pests/nuisance species. Specific feeding activity was directed to Australian magpies, common brushtail possums, and kookaburras. Bread was the most common food item offered and was reported by 58% of respondents, followed by seed (42%), and meat products (32%). Most households fed throughout the year on a daily or weekly basis.

Perceptions regarding wildlife feeding differed between those who engaged in the practice and those who did not. A majority of those who fed considered the practice acceptable, whereas a majority of those who did not feed felt the practice was not acceptable. Reasons for holding the latter view included concern about bird dependence on food handouts, proliferation of nuisance species, and behavioral changes of species. Most non-feeders did not perceive benefits to feeding, pointing out that the practice is unnatural and upsets the balance of nature. Feeders, however, felt the practice lessens the aggressive nature of certain species (notably the Australian magpie), and helps to make up for loss of natural food resulting from development. Both feeders and non-feeders felt that the practice altered abundance of local wildlife with most citing increases of certain species such as Torresian crow and Australian magpie.

Biologists raise some concerns about wildlife feeding. They point out that bread is associated with digestive and gut problems in birds. Meat products with high fat content and processed meats that may be deficient in calcium also may pose problems. Disease transmission may be facilitated at feeders where birds concentrate. Finally, feeding may bring about population changes in species, favoring some over others. Australian magpies, butcherbirds, kookaburras, and noisy miners are common at feeders. These are aggressive birds that may increase and negatively impact other species.

Rollinson and his colleagues point out that the public is presented with conflicting information regarding the practice of wildlife feeding. Many governmental agencies discourage the practice, whereas many private establishments encourage it. Publications, also, differ, some promoting the practice in association with wildlife gardens and others discouraging the practice. The authors conclude, "Wildlife feeding in some form is likely to continue in suburban Australia...we suggest that well researched guidelines, outlining acceptable practices and explaining the hazards, be developed and promulgated. Wildlife feeders should also be made aware of alternative methods of attracting wildlife to their gardens, in the form of native gardening. Finally further research aimed at identifying the actual influences (both positive and negative effects) of wildlife feeding is clearly needed."

Reference: Rollinson, D. J., R. O'Leary, and D. N. Jones. 2003. The practice of wildlife feeding in suburban Brisbane. *Corella* 27:52-58.

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Eastern Chipmunks in Urban Parks

Little research has been conducted on urban populations of eastern chipmunks (*Tamias striatus*). Mark Weckel and William Giuliano of Fordham University, Armonk, New York recently studied forest structure characteristics with regard to the distribution of chipmunks in New York City parks. These investigators focused on designated "Forever Wild Areas" of five city parks. The Forever Wild Areas were mostly forested (oaks were dominant overstory trees) and contained footpaths, but no large open fields, recreation areas, or human development. Weckel and Giuliano placed three live traps at selected survey stations in the parks. One Sherman trap was attached to the trunk of a tree 1.5-2 m from the ground. Another Sherman trap and a Tomahawk trap were set on the ground 1 m from the station in one of the cardinal directions. Traps were baited with peanut butter and sunflower seeds. Animals trapped were identified and released at the capture site. Twenty-two habitat variables were measured and work was conducted the summer of 2001.

Only a few of the 22 habitat variables measured were significant in explaining chipmunk distribution. Individually, two of the variables were strongly significant and two were marginally significant in explaining chipmunk presence in parks. Parks with chipmunks contained larger understory trees and lower densities of stumps and snags. When combined, two variables—shrub stem density and litter depth—best explained presence or absence of chipmunks in parks, with lower shrub stem density and greater litter depth found in parks with chipmunks. Within parks containing chipmunks, large overstory trees and more herbaceous ground cover best explained stations with chipmunks. The authors acknowledge that unmeasured factors, such as disease, predation, and inbreeding depression could help to explain chipmunk distribution in the parks. They recommended: "...land management practices promoting large mast-producing trees, open shrub layers, and abundant herbaceous ground and litter cover should be expanded to improve habitat in parks with viable chipmunk populations, and in other parks prior to any chipmunk population restoration efforts." Further research also should be conducted to better determine factors important to chipmunk population success in urban parks.

Reference: Weckel, M., and W. M. Giuliano. 2001. Forest structure in urban parks: effects on eastern chipmunk distribution. *Northeast Wildlife* 56:49-56.

Supplemental Food and Urban Raccoons

What effects do human-related supplemental food resources have on movements and spatial distribution of raccoons in urban areas? This question was of interest recently to Suzanne Prange of the University of Missouri and two of her colleagues. These researchers hypothesized that, compared to rural raccoons, urban raccoons would have smaller, more stable home ranges, and their distribution would be more aggregated (around food sources). Prange and her associates studied rural, suburban, and urban raccoon populations in northern Illinois 1995-1997. The rural population inhabited Glacial Park, a 1,052-ha public conservation area about 60 km northwest of Chicago. Although not measured directly at any site, supplemental food sources were judged to be limited at this site. Suburban raccoons were studied on the grounds of the Max McGraw Wildlife Foundation, a 495-ha managed natural area and private hunting preserve about 40 km northwest of Chicago. The site also had limited supplemental food. Urban raccoons were studied on the 1,499-ha Ned Brown Forest Preserve located about 20 km northwest of Chicago. Supplemental food was abundant at the site between April and November when the preserve was open to the public. The researchers ear tagged all raccoons captured in box traps and attached radiocollars to 39 rural adult females, 34 suburban adult females, and 29 urban adult females.

Home range size differed among sites and all seasons studied (spring, summer, and autumn). No dif-

ference was noted between urban and suburban raccoons but both of these populations exhibited smaller, more stable, home ranges than did the rural population. Urban and suburban populations also tended to be more aggregated. Urban-suburban densities ranged from 36.6 – 93.0 animals/km^2 compared to 3.1 – 14.6 raccoons/km^2 at the rural site. The authors concluded: "Abundant and relatively stable artificial resources typical of urbanized systems contributed to reduced size and increased stability of home ranges. Further, concentration of these resources into rich and separated patches resulted in an aggregated distribution. Similar responses to abundant and concentrated resources have been documented for solitary carnivores in other, more natural, systems."

Reference: 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* 85:483-490.

Bird Mortality at Glass Windows

Bird mortality resulting from glass window strikes is significant. Most deaths in North America occur during winter as birds are attracted to bird feeders. David Klem, Jr. of Muhlenberg College in Allentown, Pennsylvania has been interested in this subject for many years. Recently he and his colleagues studied the effect of window angling and feeder position on bird-glass collisions. The study was conducted at the Muhlenberg College Raker field site near Germansville, Pennsylvania.

For the window angling experiment, six wood-framed picture windows were constructed to simulate those in houses. Each one was 1.4 m wide by 1.2 m high and was mounted 1.2 m above the ground. Three windows were clear glass and three were tinted dark gray. Windows were placed in the same habitat and faced the same direction along the edge of a mixed deciduous forest and open field. Distance between windows was selected to simulate houses built on suburban lots in a field adjacent to a forest. Three angles were tested: 1) vertical (serving as a control); 2) a 20-degree angle downward from vertical; and 3) a 40-degree angle downward from vertical. Each day the three orientations were assigned randomly to tinted and clear panes. The number of detectable bird strikes was recorded. The study was conducted 20 January through 17 May 1991.

The feeder placement experiment was conducted 31 October through 17 December 1991 and 24 January through 29 February 1992. Flat tray feeders 30.5 cm by 61.0 cm were placed 1 m, 2 m, 3 m, 4 m, 5 m, and 10 m from windows. Feed consisted of a 1:1 mixture of black-oil sunflower seeds and either cracked corn or white millet.

In the window angling experiment, 53 bird strikes were detected, 12 of which were fatal. The number of bird strikes and fatalities decreased significantly with increased angling. No fatalities were detected at tinted glass and overall there were fewer strikes at tinted glass. In the feeder placement experiment, the proportion of strikes resulting in bird fatalities increased significantly from zero at 1 m to 35 at 10 m. Five meter and 10 m distances were particularly bad, totaling 52 of the 73 recorded fatalities. Only one fatality resulted from feeders placed within 2 m of windows. The authors concluded: "Although glass orientation does not eliminate the lethal hazard of windows, it is an effective bird-strike deterrent and should be considered by architects and others involved in planning new structures or in remodeling existing ones." Tinting of the glass also may help to reduce strikes and fatalities but this factor needs further study.

Reference: Klem, D., Jr., D. C. Keck, K. L. Marty, A. J. Miller Ball, E. E. Niciu, and C. T. Platt. 2004. Effects of window angling, feeder placement, and scavengers on avian mortality at plate glass. *Wilson Bulletin* 116:69-73.

Common Ravens and Urbanization

Common raven (*Corvus corax*) populations have increased along with the number of humans in the West Mojave Desert of California. Many biologists suspect that food subsidies from humans explain or contribute to the greater numbers of birds. William Kristan III of the University of California and two of his colleagues recently studied the diet of ravens in relation to roads and other human developments and to raven fledging success.

These investigators collected pellets (regurgitated non-digestible matter such as bone, feathers, and fur) from beneath known raven nests during the spring of 1999 and 2000. At the beginning of the breeding season (early March) each year, old pellets were removed from the vicinity of nest sites so that current-year collection would relate to a specific breed-

ing season. Pellets were dissected in a laboratory and all food items were identified. Items such as paper, plastic, or other nonfood items were placed in a "trash" category. Pellets were collected from beneath 42 nests in 1999 and 72 nests in 2000. Work was carried out within the western half of Edwards Air Force Base and the immediate vicinity in the West Mojave Desert of California.

A variety of food items was recorded in the study, reflecting the known characteristic of the bird as being an opportunistic generalist. Mammals were contained in 76.5% of pellets and found at 92.9% of nest sites, with *Dipodomys* sp. being the most common single food item. Arthropods were found in 37.4% of pellets and at 81.6% of nest sites, whereas trash was recorded in 24.2% of pellets and 57.1% of nests. Nests close to roads had more mammals and reptiles. Trash was found most commonly at nests close to food subsidies, such as landfills. Pellets from nests located far from roads and subsidies contained more plant material and arthropods.

Kristan and his associates found that raven diet composition was affected by proximity to human development and fledging success was affected by diet composition. Birds with subsidized diets (those near human developments) produced more chicks than did birds removed from human developments with little or no subsidized food. According to the authors: "Our results suggest that ravens forage opportunistically on foods available near their nests, and different kinds of human developments contribute different foods. Improved management of landfills and highway fencing to reduce road-kills may help slow the growth of raven populations in the Mojave."

Reference: Kristan, W. B., III, W. I. Boarman, and J. J. Crayon. 2004. Diet composition of common ravens across the urban-wildland interface of the West Mojave Desert. *Wildlife Society Bulletin* 32:244-253.

Deer-Exclusion Grates for Urban Roads

Deer-vehicle collisions are a major concern in many areas of the United States. Such occurrences can result in human injury and sometimes death, along with almost certain injury or death to the deer. Vehicle damage and associated economic loss also are of concern. Deer-vehicle collisions account for about 50% of the mortality of the endangered Florida Key deer (*Odocoileus virginianus clavium*) on Big Pine Key where some 65% of the Key deer reside. Big Pine Key comprises some 2,548 ha and is within the National Key Deer Refuge. Nils Peterson of Texas A&M University and five of his colleagues recently studied effectiveness of deer grates on roads to keep the animals from crossing these structures. Peterson and his associates evaluated three types of grates during the summers of 2001 and 2002. Each type consisted of 6.1- x 6.1-m bridge grating material that differed in grate pattern. Type 1 consisted of 10.1- x 12.7-cm openings with a diagonal cross member in each opening. Type 2 had 10.1- x 7.6-cm openings with no diagonal cross members, and Type 3 had 7.6- x 10.1-cm openings with no diagonal cross members. An automated deer feeder was placed within a 9.1- x 9.1-m area enclosed by a 2.4-m high chain-link fence adjacent to a grate and shelled corn was dispensed 4 times per day at 6-hr intervals. Infrared cameras were used to detect grate crossings or attempted crossings by deer to gain access to the corn.

Differences were noted in effectiveness of the three grate types. Grates 2 and 3 were similar in early trials so further testing of Grate 3 was dropped from the study. Grate 1 was 99.5% efficient in excluding deer from the baited area; Grate 2 was 75% efficient. The researchers recommended Grate 1 for use along urban roads and highways to exclude deer crossings. They stated: "It should be an effective tool for reducing economic and social costs associated with deer-vehicle collisions on urban highways."

Reference: Peterson, M. N., R. R. Lopez, N. J. Silvy, C. B. Owen, P. A. Frank, and A. W. Braden. 2003. Evaluation of deer-exclusion grates in urban areas. *Wildlife Society Bulletin* 31:1198-1204.

White-tailed Deer Capture Methods

Nils Peterson of Texas A & M University and four of his colleagues recently evaluated capture methods for white-tailed deer with specific reference to urban areas. The evaluation was based on personal experience with capture of Florida Key deer on Big Pine Key and No Name Key in Florida and on published accounts of other researchers.

For their own work, the authors evaluated a portable drive net, free-standing tension-release drop net, hand capture, net gun, and dart gun. For the first two methods, no more than three deer were captured at once. In total, 282 deer were captured with the five

techniques with no mortalities or serious injuries to the animals. Fawns were captured only with the drive net because they could be targeted individually (to avoid injury from struggling adults for example) and because fawns would not respond to bait used for the drop net. The drive net also was useful for "net-shy" deer that would not go under the drop net. To minimize potential for injury with use of the drive net, animals were slowly pushed toward the net and then startled so that they would rush into the net but not at full speed. Most adult deer were captured with the drop net or by hand (some deer were quite tame and easily approachable). Deer were physically immobilized and processed rapidly. Residents perceived the net gun and dart gun as weapons, making these methods less desirable than the others tested.

From their literature review, the authors reported low mortality (0-3.6%) with use of the drive net and net gun. Their analysis also showed higher mortality with use of chemical immobilizing agents, tranquilizers, or sedatives after deer were captured with other techniques than for deer only physically restrained post-capture. For this reason, they argue against using drugs to anesthetize or sedate deer after capture by other means. Drugs should be used only when absolutely necessary.

The drop net, drive net, hand capture, net gun, and dart gun all can be used with low mortality. The first three are better for urban areas. The authors concluded: "Modified drop nets and drive nets are appropriate methods for urban deer capture because they are passive, silent, fast, yield low mortality and injury rates, and are not associated by the public with weapons. Urban wildlife capture techniques with these attributes demonstrate respect for the public's individualistic view of wildlife and can be combined with education to generate support for research and management in urban areas."

Reference: Peterson, M. N., R. R. Lopez, P. A. Frank, M. J. Peterson, and N. J. Silvy. 2003. Evaluating capture methods for urban white-tailed deer. *Wildlife Society Bulletin* 31:1176-1187.

Ecological Light Pollution

What are the ecological effects of artificial night lighting? This question is of interest to Travis Longcore and Catherine Rich of The Urban Wildlands Group, Los Angeles, California, who recently reviewed scientific literature on the topic. Longcore and Rich distinguish between astronomical light pollution (degradation of the human view of the night sky) and ecological light pollution (alteration of natural light and dark patterns in ecosystems). Artificial light of urban areas contributes heavily to both types of light pollution.

Ecologists have focused little research effort on ecological light pollution. Some studies have shown that artificial night lighting may extend diurnal or crepuscular activity of animals into the nighttime environment. Examples include birds and reptiles foraging under artificial light and territorial singing in birds. Research documenting the disorientation of sea turtle hatchlings to artificial light has been well publicized. Under natural conditions, light reflecting off the sea at night attracts the hatchlings as they emerge from beach sand where eggs have hatched. Expanding beachfront development, however, creates artificial night lighting that attracts the hatchlings inland and away from the sea (and to their death). Migrating birds also can become disoriented by artificial night lighting. At the community level, artificial lighting may affect competition and predator-prey relationships. In turn, population and community level effects have potential for disrupting ecosystem functions. The authors concluded: "Our understanding of the full range of ecological consequences of artificial night lighting is still limited, and the field holds many opportunities for basic and applied research."

Reference: Longcore, T., and C. Rich. 2004. Ecological light pollution. *Frontiers in Ecology and the Environment* 2:191-198.

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Habitat Use by Florida Key Deer

Maintaining habitat for Florida Key deer (*Odocoileus virginianus clavium*), an endangered species, in the face of increasing development is critical to long-term survival of the species. Biologists, however, lack a good understanding of Key deer habitat requirements as well as likely deer response to increasing urbanization.

Roel Lopez of Texas A & M University and five of his colleagues recently added to our knowledge base in this regard. These investigators studied habitat use by Key deer on Big Pine Key and No Name Key where about 75% of the Key deer population resides. Cover maps were prepared for time periods classified as predevelopment, 1955, 1970, 1985, and 2000. During the 2-part study, December 1968-June 1972 and January 1998-December 2000, they captured and radiomarked 180 deer. Animals were monitored 6-7 times per week.

Deer generally preferred upland vegetation types (particularly pinelands and hammocks) and avoided lowlands. About 21% of the two islands are now developed and development pressure continues. The researchers concluded: "To ensure the long-term viability of Key deer, future land acquisitions should target upland habitats. We do not intend this recommendation to discourage purchase of tidal areas, but rather to prioritize land acquisition efforts at those habitats most critical to Key deer survival and those areas with less protection under current land-use law."

Reference: Lopez, R. R., N. J. Silvy, R. N. Wilkins, P. A. Frank, M. J. Peterson, and M. N. Peterson. 2004. Habitat-use patterns of Florida Key deer: implications of urban development. *Journal of Wildlife Management* 68:900-908.

Immunocontraception of White-tailed Deer

Does immunocontraception of female white-tailed deer (*Odocoileus virginianus*), by eliminating the energetic demands of pregnancy and lactation, result in better condition of female deer entering the winter season? This question was of interest to David Walter and two of his colleagues of the Connecticut Department of Environmental Protection, Wildlife Division.

To answer the question, Walter and his associates compared the body condition of pregnant and non-pregnant free-ranging deer in the residential community of Mumford Cove, Groton, Connecticut. They determined body weight, Kistner score, and kidney-fat index for deer harvested by hunters from the site in November and December 2000, after a 3-yr immunocontraception study. The Kistner score evaluates relative condition of deer by ranking fat deposits on internal and external fat storage tissues.

The investigators found no difference in any of the three measures between contracepted and non-contracepted deer. They concluded: "the lack of gestation and lactation due to immunocontraceptive treatment likely would not improve deer condition going into the forage-limited winter period."

Reference: Walter, W. D., H. J. Kilpatrick, and M. A. Gregonis. 2003. Does immunocontraception improve condition of free-ranging female white-tailed deer? *Journal of Wildlife Management* 67:762-766.

Localized Management of Suburban Deer

High white-tailed deer (*Odocoileus virginianus*) densities in urban-suburban areas are of concern to wildlife biologists and non-biologists alike. Many local jurisdictions have deer reduction programs underway or are contemplating such programs with the goal of sustaining lower densities of the animals. What scale is necessary to manage urban-suburban deer? Can they be managed on a local scale (5-10 km^2)? Or, is management needed on a large scale to sustain desired lower deer density? How quickly will deer move in from surrounding areas if density is reduced locally? Work in exurban areas indicates that female deer show low dispersal and high site fidelity to their

home ranges.

William Porter of the State University of New York, Syracuse, and two of his colleagues are interested in these questions and recently studied the home range, seasonal movements, site fidelity, survival, reproduction, and dispersal of female deer in a suburban environment. Work was conducted in the Town of Irondequoit, a suburb of Rochester, New York encompassing some 43 km^2. These investigators captured female deer between January and July 1997-1999 and fitted each with a radiocollar. During the various seasons, they studied between 12 and 35 animals. Twenty-two individuals were monitored during three or more seasons.

Porter and his associates found no difference between summer (average 90% home range size was 21.4 ha) and winter (22.4 ha) home ranges. Fifty percent core area size was 3.9 ha in summer and 5.3 ha in winter. High site fidelity was noted for all deer, with annual average dispersal rates of 14.3% for yearlings and 8.3% for adults. Average distance dispersed was 4.0 km. The automobile was the greatest mortality factor, causing some 44% of deer deaths.

Porter and his associates argued that small home ranges (compared to exurban home ranges), little seasonal movements, and strong site fidelity lends support to the notion that suburban deer can be managed effectively in localized areas. However, they cautioned that a dispersal rate of 14% in the current study complicates the issue. Managers need to be concerned with the immigration rate when local populations are reduced. The authors stated: "Movement behavior data and modeling results lend support to the use of a localized approach to management of females that emphasizes neighborhood-scale manipulation of deer populations, but our research suggests that dispersal rates in females could be critical to long-term success." More study is needed of immigration-emigration rates at low population densities in localized areas.

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

Managing Chronic Wasting Disease in Urban Mule Deer

In recent years, chronic wasting disease (CWD) has been of concern to wildlife biologists and others. The disease infects North American deer (*Odocoileus* spp.) and elk (*Cervus elaphus nelsoni*). CWD is a transmissible spongiform encephalopathy related to mad cow disease and Creutzfeldt-Jakob disease, both of which infect humans. There is no evidence that CWD infects people. CWD is found in relatively high prevalence in mule deer of urban-suburban areas along the northern Front Range of Colorado. How can the disease best be managed in these areas? There is a sensitive and specific test for CWD in mule deer that can be used on live deer under field conditions, and some researchers have suggested that selective culling of animals testing positive for the disease may be more effective than random culling of deer.

Lisa Wolfe of the Colorado Division of Wildlife and two of her colleagues evaluated the feasibility of conducting a "test-and-cull" program for managing the disease in an urban population. Work was performed in Estes Park, Colorado where the adult mule deer population was estimated at 300-350 animals during the winter of 2002-2003. Based on epidemic models, the goal of the study was to sample at least 55% of the adult deer population annually. This would involve marking (with ear tags and radiocollars) and testing at least 175 adult animals.

The investigators captured and sampled 113 deer in December 2002. In January 2003, test-positive deer were located, recaptured, and euthanized. During April-May 2003, 88 deer were captured and sampled, and test-positive animals were recaptured and euthanized by the end of May 2003. All deer were captured by chemical immobilization from a vehicle or on foot. The tonsils of captured deer were biopsied in the field. Following biopsy, deer were visually evaluated for bleeding and gel foam was applied to the tonsils to aid hemostasis. Tonsil samples were analyzed in a laboratory for test-positive and test-negative deer.

Twenty of the 201 samples were judged unusable, leaving 51 male and 130 female samples that were successfully tested. Nine males tested positive (18%) and six females tested positive (5%). Thirteen of these animals were culled from the population and two died of other causes. The reason for higher prevalence in males is not known.

Wolfe and her associates estimated costs for the work to run roughly $300 per animal, plus personnel time (about 5 hours/animal). These investigators concluded: "Given the success of our initial field study, we plan to continue to test and selectively cull animals that test positive from the Estes Park deer herd over the next 5 years to evaluate the effective-

ness of this approach in reducing CWD prevalence."

Reference: Wolfe, L. L., M. W. Miller, and E. S. Williams. 2004. Feasibility of "test-and-cull" for managing chronic wasting disease in urban mule deer. *Wildlife Society Bulletin* 32:500-505.

Bald Eagles in Suburbia

In Florida, the breeding population of bald eagles (*Haliaeetus leucocephalus*) increased from 1991-2001. Long-term welfare of the bird is of concern to many biologists, however, because of increasing development resulting from a growing human population. From 1997-2001, Brian Millsap of the Florida Fish and Wildlife Conservation Commission and six of his colleagues studied reproduction, survival, and dispersal of suburban and rural eagles in west-central Florida. Their humid, subtropical study area extended roughly from Tampa to Fort Myers on the Gulf Coast. Millsap and his colleagues classified nest sites as rural or suburban based on intensity of human use. They radiomarked 35 eaglets from rural sites and 35 from suburban sites during the course of the study.

The researchers found that most nests were in large, mature pine trees (primarily slash pine *Pinus elliotii*). One nest was located on a cellular phone tower, six on electric distribution poles, and two on artificial raptor nesting towers. Occupancy rates did not differ between rural and suburban sites, no difference was noted with regard to nest initiation, and number of young fledged did not differ between the two sites.

Some differences were noted between rural and suburban birds with regard to dispersal, survival, and population growth rates. Young birds from rural nests dispersed earlier than young from suburban nests. Birds dispersed northward as far as Canada but centered on the Chesapeake Bay and the Coastal Plain of North Carolina. On return to Florida for the winter, birds concentrated in Central Florida. Survival during the first year was 17-24% higher in rural birds but there was no clear reason for this. Six suburban eagle deaths were human-related compared to two for rural sites but all six suburban birds died in rural areas. The authors speculated that perhaps the suburban birds were not as cautious as were rural birds. No difference was noted in survival after the first year when survival in both groups was 84-90%. The mean population growth rate for rural birds (r = 0.083) was higher than for suburban birds (r = 0.035) although both groups of birds experienced positive population growth.

The authors concluded: "Our results paint a generally optimistic picture for the future of bald eagles in west-central Florida. The demographic characteristics we observed would be expected to yield positive population growth and, in the absence of catastrophes, bald eagle populations in our study area likely are limited only by the carrying capacity of the environment." Other research has shown that suburban eagles actively seek refuges from human activity so Millsap and his colleagues recommend that this be considered in design of developments. They suggest: "Greenspaces would be most beneficial if human entry was prohibited while bald eagles were nesting, especially during the post-fledgling period."

Reference: Millsap, B., T. Breen, E. McConnell, T. Steffer, L. Phillips, N. Douglass, and S. Taylor. 2004. Comparative fecundity and survival of bald eagles fledged from suburban and rural natal areas in Florida. *Journal of Wildlife Management* 68:1018-1031.

Suburban Coyotes

Coyote populations are increasing in the eastern United States, and the animals are frequently seen in urban-suburban areas. Little study, however, has focused on eastern coyotes and little is known about their behavior and ecology. Recently, Todd Atwood of Purdue University, in West Lafayette, Indiana, and two of his colleagues investigated coyote movements and resource selection along a habitat gradient from rural agricultural to suburban residential land use. These investigators determined coyote home range size, activity patterns in relation to human disturbance, and use of spatial elements of the landscape. Work was conducted in west-central Indiana February 2000 – December 2001.

Atwood and his colleagues captured, radiomarked, and released twenty-five coyotes. The animals used available habitat in a nonrandom manner. Greater use was made of fence, ditch, and grassland elements than expected based on proportion of those elements in the study area. Also, forested habitat was used more than agricultural habitat or the urban matrix habitat. Coyotes preferred corridor habitat when available and both rural and suburban animals established home ranges to minimize exposure to human development. Atwood and his colleagues concluded: "Coyotes used corridor habitat extensively and avoided urban and crop-field habitats. Forested habi-

tat was used extensively for diurnal cover...Coyotes appeared to assess habitat quality at the landscape scale and exploited small, disjunct resource patches present in developed landscapes. We believe that the availability of foraging habitat and travel corridors is critical to movement of coyotes in areas of high human activity."

Reference: Atwood, T. C., H. P. Weeks, and T. M. Gehring. 2004. Spatial ecology of coyotes along a suburban-to-rural gradient. *Journal of Wildlife Management* 68:1000-1009.

Reducing Public Health Risks of Red Foxes

Since the 1960s and 1970s, red foxes (*Vulpes vulpes*) have become increasingly abundant in many continental European cities. The trend is similar to ones occurring in Great Britain and the United States. In Europe, red foxes transmit two dangerous zoonotic diseases: rabies and alveolar echinococcosis, the latter caused by a parasite that infects the liver of humans. In Zurich, Switzerland, 47% of foxes are infected with the *Echinococcus* parasite, and parks and other areas contain fox feces with the parasite. Control strategies may be advisable to protect public health.

Daniel Hegglin of the University of Zurich and six of his colleagues recently studied use of baits containing the anthelmintic praziquantel for control of the parasite. These investigators documented bait uptake by foxes and other species in developed areas of Zurich. Fox density in the city is more that 10 adult foxes/km^2. A threshold density of 0.25 – 1.0 foxes/km^2 will maintain a rabies outbreak. Reducing fox populations below this number is difficult, thus the interest in other strategies for protecting human health.

Baiting strategies for vaccinating animals against rabies or for delivering toxins to kill parasites must be effective and selective. Vaccination rates of 50% - 80% can eliminate rabies in medium to high fox densities.

Hegglin and his colleagues used camera traps to document bait acceptance by foxes and other species. They found that 36.1% of the baits disappeared within 3 days and about half were removed by foxes. Other animals taking baits were hedgehogs, dogs, mice, and snails. Foxes and dogs took baits at about the same rate; hedgehogs took baits at about twice the rate of foxes. Rodents and snails were particularly troublesome during summer. The authors made the following recommendations for an efficient and selective baiting strategy:

"(1) Baits should be slightly buried to increase the proportion consumed by red foxes.
"(2) Bait distribution during winter prevents bait uptake by hedgehogs and snails.
"(3) Baiting places should be selected where domestic dogs have no or restricted access.
"(4) Selecting particular location types and baiting periods (e.g., fox dens during early summer) can increase the uptake rate of baits.
"(5) A short pre-baiting period does not increase the uptake of baits by foxes.
"(6) Praziquantel does not impair the uptake of baits by foxes. Hence, a combination of a rabies vaccine and praziquantel in 1 bait should not lower the efficiency of an oral vaccination campaign against rabies."

Reference: Hegglin, D., F. Bontadina, S. Gloor, J. Romer, U. Müller, U. Breitenmoser, and P. Deplazes. 2004. Baiting red foxes in an urban area: a camera trap study. *Journal of Wildlife Management* 68:1010-1017.

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