

# THE URBAN OPEN SPACE MANAGER

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## Nesting Florida Scrub-Jays

Does urbanization affect nest site selection and nesting success of Florida scrub-jays? This question was of interest to Reed Bowman and Glen Woolfenden of Archbold Biological Station, in Lake Placid, Florida. To answer the question, Bowman and Woolfenden compared nest site selection and nesting success of the bird in natural, fire-maintained scrub to site selection and success in suburban scrub islands.

The study was conducted in Highlands County, south central Florida. The natural scrub site was located on the Archbold Biological Station that had maintained a nearly natural fire regime for at least several decades. The suburban site was nearby Placid Lake Estates where development began in the late 1950s. Fire suppression was practiced at Placid Lake Estates and habitat fragmentation resulted from development there, factors that led to scrub being patchily distributed and overgrown. In 1993, all breeding activity of Florida scrub-jays was monitored at each site.

Four species of scrub oak accounted for > 80% of nest sites in each area: sand live oak (*Quercus geminata*), sandhill oak (*Q. inopina*), myrtle oak (*Q. myrtifolia*), and Chapman oak (*Q. chapmanii*). Oaks were selected over other species for nesting but individual oak species were used in proportion to availability.

Because of fire suppression, shrubs were taller at the suburban site and nests there tended to be located higher from the ground (nest height was proportional to shrub height in which nests were located). However, there was no difference in nest success between natural scrub (40.4%) and suburban scrub (47.8%). At both sites, nests built in oaks tended to be more successful than nests built in other vegetation. In conclusion, Bowman and Woolfenden stated "Oak shrubs appear to provide the best nest sites for Florida Scrub-Jays, regardless of whether they occur in natural fire-maintained scrub or in fire-suppressed suburban scrub."

Reference: Bowman, R., and G. E. Woolfenden. 2002.

Nest site selection by Florida scrub-jays in natural and human-modified habitats. *Wilson Bulletin* 114:128-135.

## Managing House Crows in Singapore

Roosting of Indian house crows (*Corvus splendens*) in Singapore is a recent phenomenon. The birds roost communally in large numbers, sometimes more than 20,000 individuals, and can create conflict with people by their noise and fouling of gardens, pedestrian paths, buildings, and vehicles with fecal droppings. Kelvin Peh and Navjot Sodhi of the National University of Singapore recently studied roost site characteristics of the birds in urban Singapore with a goal of developing management recommendations for controlling roosting activity. These researchers identified 30 roost sites and studied 324 roost trees on the sites. Fifty percent of roost trees were mature sized, 43% old growth, and 7% medium sized.

Seven tree species were used for roosting, most of which were angšana (*Pterocarpus indicus*) (92%), rain tree (*Samanea saman*) (4%), and yellow flames (*Peltophorum pterocarpum*) (2%). Trees used for roosting tended to be larger with more dense foliage than non-roost trees. Roost trees also tended to be located in highly urbanized areas that were more illuminated, closer to food centers, and more enclosed by larger buildings. According to the researchers "We recommend that well-spaced planting of tall trees [at least 18 m] should be avoided in urban areas such as housing blocks and food centers. On existing sites where tall, large tree species with dense foliage are already being used as roosts, management actions can include removal of these trees and their replacement with other tree species such as palms. Pruning to make the crowns less dense of existing roosts also may be effective. At the same time, it is important to create or maintain alternative roosting sites for crows in areas where conflicts with humans would be reduced."

Reference: Peh, K. S.-H., and N. S. Sodhi. 2002. Characteristics of nocturnal roosts of house crows in Singapore.

## More on House Crows in Singapore

The Indian house crow was introduced to the Malay Peninsula in the late 19<sup>th</sup> Century in hopes of controlling caterpillars. The bird spread to Singapore Island in the late 1930s or early 1940s. By the late 1960s, there were some 200-400 house crows in Singapore and in the year 2000 more than 130,000 birds were present. The house crow is now a major pest in Singapore where people dislike the noise and fecal droppings associated with large communal roosts, and the attacks on people by the birds aggressively protecting nests. There also is concern that house crows may serve as vectors of human pathogens and may displace native birds through predation and competition.

Barry Brook of the Northern Territory University, Darwin, Australia, and three of his colleagues of the National University of Singapore recently studied the ecology and behavior of the house crow on Singapore Island in an effort to provide the best possible guidelines to managers for controlling the species. To estimate size of the crow population, Brook and his associates established 30 random sites on the island. At each site, two 500- x 100-m strip transects were surveyed in one morning by one observer. Six counts were conducted at each site from 1 February 2000—20 February 2001. Movement of crows from and to the island was studied at six sites along the north coast and at five sites along the south coast. In addition, 29 roost sites and 68 nests were studied. A population model was developed to project the effect of culling intensity on the population.

From extrapolation of transect count data, the researchers estimated that some 130,195 house crows were present on Singapore Island. Moderate daily movement was noted to and from the island. The model predicted that at least 41,000 crows would need to be culled from the population the first year and an equivalent effort made each succeeding year to reach a management goal of reducing the population from 190 birds/km<sup>2</sup> to less than 10 birds/km<sup>2</sup> within a 10-year time period. Brook and his associates believe this is feasible because 25,000 crows were culled from the population the first 5 months of 2002. The best approach, however, is probably a combination of substantial culling along with nest destruction and measures to limit food supply and nesting sites. According to the authors "A substantial

reduction in carrying capacity might be achieved through minor adjustments to the design of existing bin centers (to prevent crows from entering to forage for food), regular pruning of trees with larger and denser crowns to discourage nesting and roosting, and the planting of alternative, less suitable tree species."

Reference: Brook, B. W., N. S. Sodhi, M. C. K. Soh, and H. C. Lim. 2003. Abundance and projected control of invasive house crows in Singapore. *Journal of Wildlife Management* 67:808-817.

## Dispersing American Crows from Urban Roosts

The American crow (*Corvus brachyrhynchos*) used to be considered a rural species, but in recent history the bird has become more and more numerous in metropolitan areas. Surveys indicate that overall populations are increasing. American crows typically roost communally and this activity can cause nuisance problems or damage in urban areas. Most citizen complaints relate to noise of the birds and fouling by fecal droppings of vehicles, buildings, walkways, and other areas.

Researchers and managers are looking for new techniques to help control roosting crows. One possible new technique is the use of lasers. Paul Gorenzel of the University of California and four of his colleagues recently tested lasers in this regard in the cities of Davis and Woodland, California. Two lasers were used in the study, the Desman™ Laser and the Laser Dissuader™. In Davis, five roosts, containing < 50 to > 500 birds, were studied in January 2001. Roosts were treated four nights with treatment beginning after sunset and the arrival of birds at a roost. In Woodland, 63 roost trees were studied to assess immediate and short-term reactions of crows to the laser. Individual roost trees were treated by a person standing under or to one side of the tree and sweeping a laser beam through the canopy. Trees were retreated if birds returned during the treatment period for a roost.

Short-term response to the laser beam was apparent. At all roosts in Woodland, crows reacted to the laser. For about half of the treatments, all crows immediately flew out of roosts and all crows eventually left roosts. Most left roost trees without vocalizing. In all cases, however, birds returned to roosts within 15 minutes. Crow behavior to treatment of Davis roosts generally was similar to that observed at

Woodland. In conclusion, lasers provided no lasting effect on crow dispersal. No roost was abandoned and crow numbers did not decrease at treatment sites. The researchers noted, however, that lasers might have application if used differently from the current study or if used with other devices. Further testing seems warranted.

Reference: Gorenzel, W. P., B. F. Blackwell, G. D. Simmons, T. P. Salmon, and R. A. Dolbeer. 2002. Evaluation of lasers to disperse American crows, *Corvus brachyrhynchos*, from urban night roosts. *International Journal of Pest Management* 48:327-331.

### Powerful Owls

The largest owl in Australia is the nocturnal powerful owl (*Ninox strenua*), which feeds primarily on medium-sized, arboreal marsupials. The bird is listed as endangered in the state of Victoria and threatened in the Greater Melbourne Area. Raylene Cooke, Robert Wallis, and John White of Deakin University, Australia, recently studied roost tree characteristics and features of roosts used by powerful owls in urban-suburban environments. In urban Melbourne, study sites were Yarra Valley Metropolitan Park (100 ha) and Warrandyte State Park (586 ha). Both sites had been extensively modified in the past and at the time of the study consisted of riparian areas and some patches of remnant trees surrounded by a matrix of revegetated woodlands. Urban fringe study sites were the One Tree Hill Reserve (143 ha), Smiths Gully (2.4 ha), and Steels Creek (21,600 ha). These sites were largely dry, open forests with different *Eucalyptus* species in the upper canopy. The sites were regularly visited by people. Beyond the urban fringe was Toolangi State Forest (35,000 ha), a relatively undisturbed wet sclerophyll forest also dominated by *Eucalyptus*.

Owls used 179 individual roost trees of 20 species in the six study sites. The most-used trees were *Eucalyptus* spp. (54%), *Acacia* spp. (18%), and *Leptospermum* spp. (15%). No obvious selection of tree species was apparent. Roost trees tended to be the most-common tree species at a site. No differences were noted in roost tree height, roost height, or tree dbh among sites, but birds used a small number of roost trees compared to the number of trees available at a site, which may indicate some selection of tree characteristics by owls. Tree height and perch height were positively correlated and birds always perched in the top one-third of a tree. Weather conditions

affected perch height. On non-rainy days, a negative correlation was noted between temperature and perch height (birds perched at lower heights as temperature increased). On rainy days, no consistent pattern was noted regarding perch height. Structural diversity within a site was important as birds did not just move up or down in the same tree due to changing weather conditions. Rather, they moved to different roost trees when they changed perch heights. The authors concluded "Therefore, management of the vegetation in the urban areas must ensure that there is structural diversity in the vegetation. Currently, the focus of vegetation management for the Powerful Owl has been on maintaining old eucalypts (canopy layer). However, this may not provide for the structural resource requirements of this species. Vegetation management for the Powerful Owls should, therefore, be expanded to include the obviously important mid-story species such as *Acacia* and *Leptospermum*."

Reference: Cooke, R., R. Wallis, and J. White. 2002. Use of vegetative structure by powerful owls in outer urban Melbourne, Victoria, Australia—implications for management. *Journal of Raptor Research* 36:294-299.

### Secondary Users of Woodpecker Nest Cavities in Japan

Woodpeckers are primary cavity nesters, meaning that they excavate their own cavities. These cavities, over time, become available to non-excavating species, or so-called secondary cavity users. Nobuhiko Kotaka of Osaka City University and Shigeru Matsuoka of Hokkaido Research Center, Sapporo, Japan, recently studied the availability of great spotted woodpecker (*Dendrocopos major*) cavities and their frequency of occupation by secondary cavity users in urban and suburban Sapporo. Sapporo is the capital city of Hokkaido in northern Japan. The 271-ha urban study site consisted of the campus of the University of Hokkaido in the center of Sapporo. The 380-ha suburban site was the Hokkaido National Agricultural Experiment Station and the Forestry and Forest Products Research Institute in southeastern Sapporo. The sites were searched for woodpecker nests in 1994-1998. Cavities were revisited during daylight hours at least twice in late May and June 1995-1999 and classified as occupied or not occupied. If occupied, user species was determined. Cavities also were classified as 1 year old or 2-4 years old. Birds at the study sites were surveyed by line transect in early

morning hours during late May.

Cavity-nesting birds made up 75.5% of the bird community at the urban site and 62.0% of the bird community at the suburban site. The great spotted woodpecker provided nesting cavities for a number of secondary cavity users. At the urban site, the tree sparrow (*Passer montanus*) and chestnut-cheeked starling (*Sturnus philippensis*) made up 94.1% of secondary cavity users. The nuthatch (*Sitta europaea*) also used great spotted woodpecker cavities there. At the suburban site, the flying squirrel (*Pteromys volans*) was the dominant secondary cavity user (61.5%) and secondary cavity using birds included the nuthatch, great tit (*Parus major*), and russet sparrow (*Passer rutilans*).

Competition for nest cavities was noted at the urban site. Starlings evicted five pairs of tree sparrows and one pair of great tits there and tree sparrows displaced two pairs of great tits. In addition, starlings took over 28.6% of newly excavated great spotted woodpecker cavities. No species competition for cavities was noted at the suburban site.

One-year-old cavities were occupied more frequently by secondary cavity users than were 2-4-year-old cavities. Older cavities became clogged with mushrooms and, in living trees, the size and shape of entrances changed as trees grew, both factors probably contributing to declining use of older cavities. Parasites may be more prevalent in older cavities and perhaps was another reason for avoidance of older cavities by secondary users. The authors concluded "To maintain the diversity of wildlife in urban areas, city planners should protect existing GSW [great spotted woodpecker] cavity trees and maintain a sustainable breeding habitat for continued production of new cavities." Human activity (primarily logging) was mostly responsible for loss of available cavities.

Reference: Kotaka, N., and S. Matsuoka. 2002. Secondary

users of Great Spotted Woodpecker (*Dendrocopos major*) nest cavities in urban and suburban forests in Sapporo City, northern Japan. *Ornithological Science* 1:117-122.

### Human Health Risks of Urban Canada Geese

Do large numbers of resident Canada geese in urban-suburban areas pose a public health risk? This question was of interest to researchers of Colorado State University and the National Wildlife Research Center, both in Fort Collins, Colorado. Heather Kullas and three of her colleagues studied the prevalence of *Escherichia coli* (*E. coli*), and virulence to humans, in Canada goose fecal droppings in Fort Collins. Four study sites were selected consisting of corporate and residential lawn areas with nearby water.

Three hundred ninety-seven samples of fresh fecal material were collected October 1998 through August 1999 and transported to the laboratory for analysis. Thirty-seven percent of samples tested positive for *E. coli*, with some 2% containing potential human toxins. There was no reported evidence of birds in Fort Collins posing health risks to humans. According to the authors "Ideally inferences of health risk of goose feces to humans should be based upon the probability of encounter rate with virulent forms of *E. coli*... Information about seasonal goose behavior, fecal distribution patterns, environmental conditions, prevalence of virulent strains of bacteria, and recreational use patterns of parks by humans are needed to estimate the probabilities for which humans may encounter virulent strains of bacteria."

Reference: Kullas, H., M. Coles, J. Rhyon, and L. Clark. 2002. Prevalence of *Escherichia coli* serogroups and human virulence factors in faeces of urban Canada geese (*Branta canadensis*). *International Journal of Environmental Health Research* 12:153-162.

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## Park Birds in Madrid, Spain

What factors explain the composition of bird communities in wooded urban parks? This question was of interest to Esteban Fernández-Juricic of the University Complutense of Madrid, Spain. He recently studied the effects of park age, size, and degree of isolation from the regional bird species pool and the role of regional and local bird densities on bird community structure in urban parks. The study was conducted in Madrid, Spain, during the spring of 1998. Madrid has an extensive network of wooded urban parks and 25 were selected for study. Selected parks ranged from 1 to 100 ha in size, from 8 to 367 years of age, and from 0.56 to 6.3 km from the regional bird species pool. The available regional species pool was represented by Casa de Campo, a 1,722-ha forest northwest of the city. The forest contained typical regional woodland vegetation of the area—coniferous forest and *Quercus* spp. stands with a savanna appearance. It was 17 times bigger than the largest urban park studied and contained all bird species of the urban parks plus about 10 more. Six to seven surveys were conducted in each park during early morning hours. For parks larger than 2 ha, birds were counted in 50-m by 100-m transects. Parks smaller than 2 ha were surveyed in their entirety.

Park age was positively related to habitat complexity, and park age and area were positively related to species richness. These two factors explained some 62% of the variation in species richness of parks. A high degree of nestedness of species was noted. That is to say that species in younger and smaller parks were subsets of species in older and larger parks and species richness appeared to increase in an orderly fashion in progressively older and larger parks.

Regional densities of bird species seemed to be important in accounting for species occurrence in young parks, whereas species occurrence was influenced more by local bird densities in older parks. The degree of isolation of an urban park from the large woodland was not a significant factor in explaining variation in species richness. The author speculated that this could have resulted from good

dispersal ability of species and/or the relative closeness of the parks to the regional species pool. Based on study results he concluded "...not only larger but also older parks deserve conservation priority, to ensure the persistence of rare species."

Reference: Fernández-Juricic, E. 2000. Bird community composition patterns in urban parks of Madrid: the role of age, size and isolation. *Ecological Research* 15:373-383.

## Bird Tolerance to Human Disturbance

With increased human outdoor activity, including ecotourism, there is some concern by conservationists about increased human disturbance of wildlife. The general fear is that too much human activity may negatively affect wildlife foraging behavior, habitat use, or reproduction. Flight distance often has been used in the past as a measure of human tolerance. This term defines the distance between an animal and a human at which the animal flees. It may not be a good criterion to use because by definition it allows disturbance of the animal. Some conservationists suggest that alert distance might be a more appropriate measure to lessen human disturbance of wildlife. This term defines the distance between an animal and a human at which the animal shows alert behavior (recognizes human presence), but does not flee.

Esteban Fernández-Juricic of the University Complutense of Madrid, Spain, and two of his colleagues recently evaluated alert distance as a measure of bird tolerance and related findings to park design. Work was conducted in five large wooded parks (18 ha to 110 ha), May to July 1998, in Madrid, Spain. The four species studied, ranging from smallest to largest, were house sparrow (*Passer domesticus*), blackbird (*Turdus merula*), woodpigeon (*Columba palumbus*), and magpie (*Pica pica*). Parks were visited randomly during weekdays and a least 1 day elapsed between consecutive visits to a park. Twenty-five observations were collected per species per park.

Alert distances differed significantly from flight distances and generally reflected size of bird, with

longest distances recorded for woodpigeon and magpie and shortest distances for house sparrow. This pattern supports other published research, but biologists do not understand the reason for the relationship. Based on the ground-foraging birds studied, these researchers formulated the following recommendations.

1. Use alert distance rather than flight distance for a more conservative measure of bird tolerance to human presence and to reduce human-wildlife conflicts. Increased habitat complexity might allow shorter distances.
2. Use size of bird to help guide establishment of distances. A plan based on large-sized species should accommodate smaller ones too.

The authors concluded "...based on these results, we encourage the application of alert distances in other natural areas. Alert distances can be used to design footpaths for visitors with enough undisturbed areas for birds to forage and breed and for pedestrians to enjoy their visit."

Reference: Fernández-Juricic, E., M. D. Jimenez, and E. Lucas. 2001. Alert distance as an alternative measure of bird tolerance to human disturbance: implications for park design. *Environmental Conservation* 28:263-269.

### **Bighorn Sheep in Southern California**

Bighorn sheep (*Ovis canadensis*) now inhabit the Santa Rosa Mountains of southern California in low numbers, and researchers are interested in learning more about the sheep in hopes of developing guidelines for better management practices. Esther Rubin of the University of California, Davis, and three of her colleagues recently studied two endangered subpopulations in the mountains, one group of which included urban areas in its home range and a second group that did not make use of urban habitat. The study focused on females as females form the basic unit of bighorn sheep social structure. Sheep were captured and fitted with radiocollars and between March 1994 and December 1995 marked animals were located and observed at about 30-day intervals. During 1996 and 1997, animals were located and observed less frequently.

Some differences were noted between the two populations. Home range sizes (95% utilization dis-

tributions) did not differ between the two groups but core activity areas (50% utilization distributions) were smaller in the group using urban habitat and sheep group size was smaller in that population. Sheep using urban habitat selectively favored such habitat. Thirty-five percent of animal locations were within urban areas but such areas made up only 5.8% of available habitat. Urban gardens that are watered and fertilized regularly may attract sheep. A constructed water source was established for sheep at the edge of one housing development in 1965 and sheep have been observed in urban areas since that time. Use of urban areas, however, may have negative consequences. Although the survival rate of urban inhabiting sheep was 81% compared to 76% for the exurban population in a previous study, lamb survival to 3 months of age was lower (43.5%) in the urban inhabiting population compared to the exurban population (86.9%). Reasons for the disparity are not understood. In addition to lower lamb survival, smaller core areas and repeated use of selected urban areas may facilitate disease transmission. Trichostrongyle parasites were found in the urban population but not in the exurban one. Conservation efforts are underway to reduce natural habitat loss and to restrict sheep use of urban areas. The effect of these practices on lamb survival and parasite loads in sheep should be studied.

Reference: Rubin, E. S., W. M. Boyce, C. J. Stermer, and S. G. Torres. 2002. Bighorn sheep habitat use and selection near an urban environment. *Biological Conservation* 104:251-263.

### **Bobcats and Coyotes in Southern California**

Seth Riley of the National Park Service and six of his colleagues recently studied bobcat and coyote use of a fragmented urban landscape. Their study area was the central Santa Monica Mountains and Simi Hills of southern California west of the city of Los Angeles. Land use was classified as: 1) natural areas—large, contiguous areas of natural vegetation; 2) developed areas—commercial and residential areas with at least one house per 0.4 ha; and 3) altered open areas—a category between natural areas and developed areas such as golf courses, landscaped lawns of office parks and city parks, and stream corridors. During 1996-2000, 50 bobcats and 86 coyotes were captured, fitted with radiocollars, and monitored at least weekly.

Survival rates were similar between the species (0.761 for bobcats and 0.742 for coyotes) and were not related to urban development. Major causes of death were vehicles, other carnivores, and anticoagulant rodenticides.

Home range size differed between the species with coyotes occupying larger ranges than bobcats. Males of both species had larger ranges than did females. Animals of both species with higher urban association had larger ranges, contrary to some other studies showing reduced home range size for urban mammals. Coyotes were more active at night than during the day but little difference between night and day activity was noted for bobcats. Both species tended to use more developed areas to a greater extent at night. Adult female bobcats had low levels of urban association and were more sensitive to development than were male bobcats and coyotes. Adult female bobcats were generally territorial and their home ranges averaged 1.7 km<sup>2</sup>. The authors concluded "For bobcats, preserving open space of sufficient quantity and quality for adult females is necessary for population viability. Educating local residents about carnivores is also critical for conserving populations in urban areas."

Reference: Riley, S. P. D., R. M. Sauvajot, T. K. Fuller, E. C. York, D. A. Kamradt, C. Bromley, and R. K. Wayne. 2003. Effects of urbanization and habitat fragmentation on bobcats and coyotes in southern California. *Conservation Biology* 17:566-576.

### **Managing Elk in Arizona**

Growing white-tailed deer populations in metropolitan environments of North America present challenges to wildlife managers, and considerable research has been devoted to the subject in recent years. Elk (*Cervus elaphus*), a larger member of the deer family, are even more challenging to manage in such environments. Martha Lee of Northern Arizona University and Rick Miller of the Arizona Game and Fish Department recently studied resident attitudes toward an urban elk herd in Flagstaff, a city of some 50,000 people. Much of the city is heavily forested and the elk population is estimated at 400 to 1,000 animals.

Lee and Miller surveyed Flagstaff residents with a mail questionnaire during fall and winter of 1998 and 1999. They sent the questionnaire to 714 randomly selected households, with a follow up mailing to non-respondents.

Sixty-eight percent of households responded to the questionnaire. Respondents averaged 47 years of age and 17 years of residency in the city. Fifty-seven percent were male (43% female) and 71% were non-hunters (29% hunters). Most (95%) respondents were aware of elk in the city and 47% had seen elk in their neighborhood. More than two-thirds enjoyed seeing elk in the city, although some concerns were expressed in that regard. Of most concern were elk-vehicle collisions and seeing children near elk. The altering of food habits and behavior of elk were of lesser concern.

Residents were asked their views on hunting elk in the city. Seventy-three percent indicated that the most important reason for doing so was to keep the herd in balance with available habitat. Other reasons were to provide a source of food (12%); recreation (6%); and to enhance human safety, help the local economy, and reduce property damage (1%). Public safety was the major concern expressed with regard to hunting the elk, and expanded law enforcement was the most desired management action expressed by respondents to reduce concerns about hunting elk in the city. The authors concluded "...wildland managers can lessen concerns about hunting urban elk by employing strategies such as providing a toll-free number to report violators and increasing law enforcement during hunts."

Reference: Lee, M. E., and R. Miller. 2003. Managing elk in the wildland-urban interface: attitudes of Flagstaff, Arizona residents. *Wildlife Society Bulletin* 31:185-191.

### **Conserving Asian Elephants in Sri Lanka**

Asian elephant habitat in Sri Lanka has been reduced some 50% over the past 100 years. Almost half of the population lives outside protected areas. Human use of the landscape continues to increase, with increasing loss and fragmentation of elephant habitat. Remaining elephants tend to be concentrated in smaller and smaller areas from which they sometimes leave to feed on cultivated crops in nearby settlements. Elephants sometimes injure and kill people during these feeding excursions. Debate continues on how to conserve and manage these mammals in the country. Public opinion is important in this regard and researchers Ranjith Bandara and Clem Tisdell of The University of Queensland, Australia, recently studied the attitudes of rural and urban residents relative to nature conservation in general and elephant conser-

vation in particular. In 2001, these investigators surveyed 300 randomly selected urban residents in the capital city of Colombo and 300 randomly selected farmers in northwestern Sri Lanka where human-elephant conflicts were high. Residents were personally interviewed with a mixture of open-ended and fixed-response questions.

The researchers found that both urban dwellers and farmers had positive attitudes about environmental conservation in general. Attitudes differed, however, regarding elephant conservation. Some 94% of farmers felt that the current elephant population should be reduced 50% to provide more land for agriculture and human settlement. About the same percentage of city residents felt that population reduction should not occur. Farmers (79%) also felt that they should be given more freedom to control problem elephants. Traditional methods of scaring and chasing do not work. Some 81% of urban dwellers were against giving farmers more freedom to control problem animals. Overall, both groups (78%) favored protection of elephants, although reasons for doing so differed. City residents gave greater weight to altruistic, bequest, and existence values, whereas farmers

placed emphasis on historical, cultural, and religious values. Some 82% of urban residents favored compensating farmers for damage caused by elephants and about 70% thought city dwellers should pay. The authors concluded "...the survival of elephants seems to depend on their use of both protected areas and non-protected areas. Socially acceptable strategies for an appropriate level of co-existence between farmers and elephants are needed. Such co-existence hinges on greater compensation for farmers to tolerate elephants to a greater extent than currently. A case exists for this compensation being financed by those who regard the elephants as an asset...It is encouraging that most urban residents favour the principle that net beneficiaries from the protection of elephants (urban dwellers, tourist operators and so on) should contribute funds for payment of this compensation."

Reference: Bandara, R., and C. Tisdell. 2003. Comparison of rural and urban attitudes to the conservation of Asian elephants in Sri Lanka: empirical evidence. *Biological Conservation* 110:327-342.

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## Urban Raccoons

Raccoons (*Procyon lotor*) are adaptable omnivorous mammals that commonly exhibit higher population densities in urban-suburban areas than in rural areas. Suzanne Prange of Colorado State University (formerly of the University of Missouri) and two of her colleagues are interested in the demographic mechanisms that may be responsible for elevated urban-suburban densities. They recently studied raccoon survival rates, reproductive rates, and site fidelity as possible factors contributing to different densities of raccoons in urban, suburban, and rural areas.

Prange and her associates studied raccoon populations in three protected open areas of northeastern Illinois. The rural study site was Glacial Park, a 1,052-ha public conservation area. The suburban site was Max McGraw Wildlife Foundation, a 495-ha managed natural area and private hunting preserve. The urban site was the 1,499-ha Ned Brown Forest Preserve where public picnic outings constituted a major use.

During spring and autumn of 1995-1997, the researchers trapped 794 raccoons 1,563 times. All animals were marked with individually numbered ear tags and about 20 adult females were fitted with radiocollars at each site.

As found in other studies, raccoon density estimates for urban and suburban sites were greater than estimated density at the rural site. Survival of adult females was highest at the urban site during the first 2 years of the study but dropped during the final year from an unknown disease. No differences were noted in reproductive rates at the three sites, but more juveniles relative to adult females occurred at urbanized sites, which could indicate larger litters there or to greater juvenile survival. Higher proportions of marked adults to unmarked ones tended to be found at the urbanized sites, indicating greater site fidelity in those areas. Disease was the greatest mortality factor at the urban site and vehicle-related mortalities most common at the suburban and rural sites. The researchers concluded "Our data suggest that multiple factors, including increased survival, higher an-

nual recruitment, and increased site fidelity, are jointly responsible for the density of raccoon populations in urbanized areas...High annual recruitment will require that direct control measures, such as a trapping and removal program, be continuous. Furthermore, since the urban matrix does not appear to restrict raccoon movement, high-quality habitat may be quickly repopulated if a trapping/removal program reduces the resident population. Therefore, the most effective control measure likely will be the reduction or elimination of anthropogenic food sources (e.g., covering refuse containers, removing refuse before dusk), which support raccoons at these densities."

Reference: Prange, S., S. D. Gehrt, and E. P. Wiggers. 2003. Demographic factors contributing to high raccoon densities in urban landscapes. *Journal of Wildlife Management* 67:324-333.

## Controlling Domestic Cat Colonies

Domestic cats (*Felis silvestris*) make attractive pets and their numbers continue to grow in the United States. Sometimes, however, human owners no longer want their pets and wind up abandoning them in the outdoors where the cats may form feral or semi-feral colonies. Biologists are concerned about the impact of these cats as predators on birds, small mammals, and other wildlife.

Daniel Castillo and Alice Clarke of Florida International University recently conducted a study to determine if trap-neuter-release (TNR) was a viable technique for reducing numbers of stray and feral cats. Their work was conducted in two Metro-Dade County parks, A. D. Barnes and Crandon Marina, Miami-Dade County, Florida. A. D. Barnes had a colony of 37 cats and Crandon Marina one of 91 cats. All cats were photographed and tracked over time.

These researchers found that TNR was not an effective technique and did not reduce numbers of cats in the two colonies. At A. D. Barnes, the original number of cats decreased over time but the overall cat colony increased. At Crandon Marina, the origi-

nal number of cats decreased over time but the overall cat colony showed no decline. Some of the original cats in both colonies were adopted, died, or disappeared but were replaced by illegal dumping of unwanted cats by humans and by attraction of strays to food provided by humans to the two colonies. According to the authors, "The high number of cats and kittens that were dumped at the colonies throughout the course of our study confirms that the establishment of cat colonies on public lands with unrestricted access encourages illegal dumping of cats and creates an attractive nuisance." The underlying problem is irresponsible pet owners who abandon their pets outdoors. Castillo and Clarke offered several recommendations that included: 1) educating the public about the impacts of cats on wildlife, 2) promoting policies that deal with irresponsible pet owners, and 3) removing cat colonies and feeding stations from parks.

Reference: Castillo, D., and A. L. Clarke. 2003. Trap/neuter/release methods ineffective in controlling domestic cat "colonies" on public lands. *Natural Areas Journal* 23:247-253.

### Controlling Free-Roaming Cats

Authors I. Gunther and J. Terkel of Tel Aviv University, Israel recently published a literature review of control methods for free-roaming cats. Their main focus was on the urban environment with a goal of making recommendations for Israel. The authors briefly discussed survival, social organization, and behavior of free-roaming cats and, in their view, the positive and negative aspects of free-roaming cats in urban environments.

The focus of the paper was on methods of regulating free-roaming cats, with approaches falling into two categories, eradication and reproductive regulation. Eradication methods include poisoning, infective agents, hunting, and trap and euthanasia. With regard to poisoning, Gunther and Terkel reviewed a study conducted in Australia where Compound 1080 was used on feral cats in a non-urban nature reserve. The researchers achieved a 74% reduction in the number of cats immediately following poisoning and 18 months later cat density was one-third that of the pre-poisoning population. The method can be fast, effective, and comparatively low cost, but can impact non-target animals and has other drawbacks.

Great caution must be exercised with use of infectious agents to control free-roaming cats. Potential

for affecting non-target species must be addressed. The method has been used in rural situations with relatively isolated cat populations but is not appropriate in urban areas where many pet cats are present.

Hunting is not feasible in most urban environments because of high human density. (Editor's note: the method also is not likely to have public support and cats are not traditional game species so it is unlikely that most hunters would be interested in shooting cats in urban areas.)

Reproductive regulation methods for controlling free-roaming cats include surgical sterilization (trap-neuter-release) and non-surgical sterilization (prolactin inhibitors to interrupt pregnancy or synthetic progesterone, which prevents pregnancy). Surgical sterilization is generally considered humane. One of two approaches is used. Removal of reproductive organs results in hormonal and behavioral changes in cats. The technique reduces negative and sexual interactions among cats. Vasectomy in males and tubal ligation in females is the second surgical approach. Reproductive organs remain intact resulting in no hormonal changes in the animals so animal behavior remains normal. Non-surgical sterilization also generally is considered humane although the synthetic progesterone megestrol acetate causes severe side effects in cats, including diabetes mellitus and mammary cancer and is not authorized for use in cats in the U.S. The technique is expensive and delivery of the anti-fertility agent must continue throughout the breeding season. Cats return to fertility when the fertility agent is removed.

In conclusion and with regard to recommendations for Israel, the authors state, "As a long-term strategy, the method of trap-neuter-mark-release should be adopted, in parallel with keeping garbage cans securely closed (reduction of vital resources) and dealing with specific complaints. Sterilisation (hysterectomy/gonadectomy or tubal ligation/vasectomy) as the method of choice should be appraised according to the environment inhabited by the cats and the expertise of the veterinary surgeons. Sterilisation by means of medication is recommended in cases where there is organised supervision and monitoring of a specific cat group; here too, however, it is necessary to examine the long-term effect of this sterilization on the numerical and compositional stability of the treated group. Use of methods to eradicate cat populations, particularly the method of trap-euthanasia, is recommended mainly in the case of individuals whose poor physical condition justifies euthanasia. In addition, it is necessary for public information and

education campaigns to be undertaken, for the benefit of pet cat owners whose pets also roam the streets, regarding the need both to mark their cats and to neuter them.”

Reference: Gunther, I., and J. Terkel. 2002. Regulation of free-roaming cat (*Felis silvestris catus*) populations: a survey of the literature and its application to Israel. *Animal Welfare* 11:171-188.

### **Nesting Sharp-shinned Hawks in Montreal**

Numbers of migrating sharp-shinned hawks (*Accipiter striatus*) in eastern North America declined during the 1980s and early 1990s. Biologists do not know the reason for the decline but some speculate that loss of suitable breeding habitat may be a factor as original habitat continues to be fragmented for urban and other development. Joanna Coleman of McGill University, Ste-Anne-de-Bellevue, Quebec, Canada, and two of her colleagues recently studied habitat use and productivity of the bird in southwestern Quebec. The Montreal metropolitan area covered 26% of the study area.

The investigators found that mean clutch size (4.4 eggs) and mean number of eggs hatched (3.8) were within the range for the species breeding in temperate climates (based on other published studies). Nesting success (successful fledging of at least one young), however, was lower (50%) than reported in studies from Oregon (91.7%), New Brunswick (95%), and Wisconsin (76%). Coleman and her colleagues reported that most nest failures occurred during the late and unseasonably cold and rainy summer of 2000 and the low nesting success reported may not reflect average conditions for the area.

All 16 nests found and studied were located in conifers. Thirteen of the nests were located in mixed stands of conifers that included a variety of hardwood trees. Birds in the Montreal area used stands with the least conifer cover and most deciduous cover of all studies examined. The authors point out that this could reflect regional differences in vegetation across North America. Montreal area birds also nested closer to openings (edges) than birds in Wisconsin or Arkansas. This may reflect a relative scarcity of large tracts of forest. The authors concluded, “Cities tend to support a lower diversity of raptors, as do smaller parcels of woodland. However, this population bred successfully in these fragments, which were wooded and had well-covered canopies. As

Montreal continues to develop outward, small fragments of forest are lost; their importance to local and regional wildlife populations may be unrecognized. We believe that remaining stands of forest should be considered as potential nest sites for Sharp-shinned Hawks and other raptors, and every possible effort should be made to protect them from being cleared.”

Reference: Coleman, J. L., D. M. Bird, and E. A. Jacobs. 2002. Habitat use and productivity of sharp-shinned hawks nesting in an urban area. *Wilson Bulletin* 114:467-473.

### **Bluetongue Lizards in Sydney, Australia**

The eastern bluetongue lizard (*Tiliqua scincoides*) is a large terrestrial lizard widely distributed in eastern Australia. It is active during the day and is common in suburban gardens in the Sydney metropolitan area. Many lizards in the region are killed by vehicles, dogs and cats, and by other means. Researchers Jennifer Koenig, Richard Shine, and Glenn Shea of the University of Sydney recently studied activity, injury, and mortality factors of urban-suburban lizards in Sydney. They analyzed an extensive database on bluetongue lizards rescued in the Sydney metropolitan area by the New South Wales Wildlife Information and Rescue Service from January 1989 to December 1998.

Two seasonal peaks were noted in the data. Highest numbers of rescued lizards occurred in spring and summer. During spring, mostly adults were collected, whereas juveniles made up most of the collection during summer.

Major known mortality factors of the lizards were dogs (42%), vehicles (12%), and cats (10%). Mostly adult lizards were killed by dogs, whereas cats killed primarily juvenile animals. Lizard mortality from dogs and cats was more common in garden suburbs than in the inner city. Survival rate of animals hit by vehicles or attacked by dogs was less than 25%, whereas lizards attacked by cats or birds had a 50:50 chance of survival. Habitat loss from construction activity was the most significant factor affecting lizard populations in the inner city.

With regard to using data from wildlife rescue groups for scientific purposes, the authors concluded “To improve the usefulness of such data, it would be helpful for wildlife rescue organizations to record additional information on date, time of day, place, sex, body size, reproductive condition, and weather conditions. Given the large numbers of people in

wildlife rescue groups, and the broad geographic distribution of such groups, there exists an exciting potential for scientists to make more extensive use of the resulting data. The first step is to communicate with community groups and explain the potential conservation advantages of rigorous and extensive data collection."

Reference: Koenig, J., R. Shine, and G. Shea. 2002. The dangers of life in the city: patterns of activity, injury and mortality in suburban lizards (*Tiliqua scincoides*). *Journal of Herpetology* 36:62-68.

### **Park Preferences and Behaviors of Urban Residents**

To meet the needs of the public and to manage parks effectively, park and recreation departments should understand the social and demographic characteristics of citizens residing in their jurisdictions. Researcher Laura Payne of the University of Illinois and two of her colleagues are interested in how age, race, and residential location influence preferences and behaviors of urban residents toward parks. They studied urban residents within a 11.3-km radius of Cleveland Metroparks' newly opened Ohio & Erie Canal Reservation near downtown Cleveland, Ohio. Eight hundred telephone interviews were conducted in December 2000. The researchers obtained a response rate of 77% with a sampling error of plus or minus 3.5%.

Age and race were the most important factors in predicting citizen attitudes and behaviors, with location of residence of lesser importance. Overall, residents were evenly split on the question of whether or not more parkland was needed. However, younger adults (under 50 years of age) indicated (55%) that more parkland was needed, whereas older adults (50 years of age and older) felt (45%) that more land was not needed. Blacks (African-Americans) also felt (58%) more parkland was needed, whereas Whites (Caucasians) felt (47%) more land was not needed.

Differences also were noted in attitudes regarding

conservation and recreation functions of parks. Overall, residents preferred conservation (56%) to recreation (44%). This preference also held for age, but not for race. Whites (67%) preferred a conservation function, whereas Blacks (62%) preferred recreation. Payne and her associates stated "This orientation poses a challenge to park agencies whose primary mission is to provide and conserve open space and manage wildlife. If attracting additional visitation from Black citizens is an important goal, natural resource agencies may have to make changes in the character of their recreation settings and types of activity opportunities offered." (Editor's note: Another consideration might be to improve programs and activities for African-Americans as a means of increasing their interest and participation in conservation efforts.) A majority of residents, regardless of age, race, or location of residence, preferred nature-based activities (e.g., picnic areas, fishing, hiking trails) to organized recreation (e.g., tennis courts, jogging tracks, ball fields).

More than 70% of residents, regardless of age, race, or location of residence, had visited a park in the last 12 months. However, younger adults were more likely to have done so (84%) than older adults (72%), and Whites (84%) more likely than Blacks (72%). The authors concluded "Race and age were found to play a significant role in recreation preferences and behaviors. Blacks were more likely to prefer that park land serve a recreation role (over a conservation role)... Age was the best predictor of the perceived need for additional park land and frequency of park visitation. Specifically, older adults were less likely to prefer additional park land and less likely to visit local parks than their younger counterparts." By better understanding peoples attitudes and behaviors with regard to parks, park managers should be better prepared to manage parks.

Reference: Payne, L. L., A. J. Mowen, and E. Orsega-Smith. 2002. An examination of park preferences and behaviors among urban residents: the role of residential location, race, and age. *Leisure Sciences* 24:181-198.

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# THE URBAN OPEN SPACE MANAGER

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## Long-nosed Bandicoots in Australia

The long-nosed bandicoot (*Perameles nasuta*) is a nocturnal omnivorous marsupial that feeds mostly on underground insects, plant material, and fungi obtained by digging. The species apparently has declined recently in the greater Sydney region. Lisa Chambers and Chris Dickman of the University of Sydney are interested in learning more about its habitat use and preference, hoping that greater knowledge of the species will lead to more effective conservation measures.

These researchers studied macrohabitat and microhabitat use and preference of long-nosed bandicoots within Sydney Harbour National Park, located about 10 km north of central Sydney. The study population was considered endangered. Habitat features were determined following standardized techniques. Wire cages were used to live trap animals. Traps, spaced at 25-m intervals, were randomly located in each macrohabitat type. Animals caught were ear-tagged and several measurements were taken. Thirteen animals were radio-tagged and tracked to supplement trapping data with regard to macrohabitat use and also to obtain diurnal habitat nest site preferences.

Seventy-nine bandicoots were captured (35 males, 44 females). Animals were captured in open and open-scrub habitats more often than expected and in forest and swamp habitats less often than expected based on number of traps located in each habitat type. Radiotracking showed similar trends in nocturnal macrohabitat use. Low understory and leaf litter densities were microhabitat features correlated with greater bandicoot captures. Open and semi-open habitats were used for foraging and short distances were maintained from cover. However, a dense understory with leaf litter was preferred for diurnal nest sites. The authors concluded, "The dependence of *P. nasuta* on dense undergrowth for refuge sites and on open areas for foraging indicates the importance of conserving a mosaic of open and dense vegetation, at least to ensure the continued persistence of the population at North Head."

Reference: Chambers, L. K., and C. R. Dickman. 2002. Habitat selection of the long-nosed bandicoot, *Perameles nasuta* (Mammalia, Peramelidae), in a patchy urban environment. *Austral Ecology* 27:334-342.

## Feeding Behavior of Cooper's Hawks

Tucson, Arizona supports a high density of nesting Cooper's hawks (*Accipiter cooperii*), and avian prey may be more abundant in the city than in the surrounding countryside. Researchers Wendy Estes and William Mannan recently studied feeding behavior of Cooper's hawks at urban and rural nests to learn more about causes of population density differences. These investigators collected data on frequency of prey deliveries to nests, approximate size and type of prey deliveries, and behavior of hawks during each delivery. Eighteen nests in Tucson and 18 nests in the surrounding countryside were studied from mid-April to mid-July 1999 and 2000. Nests were observed while young were 1-30 days of age. Observation periods lasted 4.5 hours and each nest was observed three times over the nesting season.

The rate of prey delivery was greater at urban than at rural nests, and urban nests received twice as much prey biomass compared to rural nests. At rural nest sites, it was typical for the female to go out and meet the hunting male to retrieve prey and return to the nest. At urban nests, males were 13.6 times more likely to deliver prey directly to nests, and prey was 2.5 times more likely to be refused at urban nests, both indicators of well fed young. All prey items delivered to urban nests were identified as birds and doves made up 57% of the total. A greater diversity of prey items was delivered to rural nests where reptiles made up 23% of the total, birds 71%, and mammals 5%. Doves made up 4% of the total at rural nests. The authors concluded, "...our results suggest that at least some behaviors associated with the delivery of food at nests, such as vocalizations and retrieval of prey from males by females, may vary conditionally with levels of food stress. Under what we perceive to be conditions of very low food stress in

the urban area, females rarely vocalized and often did not retrieve prey when males approached the nest with a prey item. We suspect that Cooper's Hawks in rural areas would respond similarly if food stress was low. Therefore, differences in the frequency of certain food-related behaviors may simply reflect differences in the prevalence of stimuli directly or indirectly associated with abundance of food. Experimental investigation into the nature of these behaviors and their relationship to food abundance could provide further insight."

Reference: Estes, W. A., and R. W. Mannan. 2003. Feeding behavior of Cooper's hawks at urban and rural nests in southeastern Arizona. *The Condor* 105:107-116.

### **Biodiversity Conservation Strategy**

Researchers Hillary Rudd, Jamie Vala, and Valentin Schaefer of Douglas College, New Westminster, British Columbia, are interested in improving biodiversity conservation in urban and urbanizing areas. Using methodology that combines island biogeography theory and metapopulation theory, they conducted a connectivity analysis that looked at habitat corridor connections among green spaces and analyzed the best potential networks to link them. The study was conducted in south Coquitlam and south Port Moody, British Columbia, both part of Greater Vancouver. Fifty-four green spaces, ranging from 0.10 to 174.17 ha, for a total area of 636.5 ha, were present in the 2,600-ha zone. Green spaces were weighted relative to size. The connectivity analysis assumed that larger and closer areas had greater interaction and it measured the level of interaction between each of the green spaces.

Three network models were tested and the best one, with a high degree of connectivity, used half of the green spaces (the larger ones). It would require 325 links between green spaces (theory maximum was 1,431 links), which the investigators considered reasonable because distances were small and could be created through habitat enhancement of backyards, boulevards, and utility rights-of-way. "Green corridors, utility rights-of-way, and backyard habitat are important parts of urban planning, because they increase biodiversity in cities and improve the quality of life for all residents...Strengthening such networks should work well to support the biota protected in urban parks and wildlife refuges and the seasonal migrants that sometimes depend on urban habitats for their survival...Backyard habitat can be

an invaluable food and habitat source for a wide range of urban species and is essential in developing the matrix that supports the large numbers of corridors required for connectivity. Public education on gardening with native plants and providing proper habitat is another tool to enhance the connectivity of the region and improve the viability of the corridors." The approach should be more effective than randomly selected networks because it considers habitat value of each green space (based on size and nearness to other green spaces). "The analysis presented here gives a solid foundation for developing a greenway network in urban areas. This can be applied to other areas throughout Greater Vancouver and cities around the world."

Reference: Rudd, H., J. Vala, and V. Schaefer. 2002. Importance of backyard habitat in a comprehensive biodiversity conservation strategy: a connectivity analysis of urban green spaces. *Restoration Ecology* 10:368-375.

### **Biodiversity in Berlin, Germany**

Stefan Zerbe and three of his colleagues at the Technical University of Berlin, Germany, are interested in plant biodiversity in the city. Between 1994 and 1997, all wild-growing vascular plants and cultivated woody species were documented in study grids (each about 8 km<sup>2</sup>) on a gradient from city center to the city's outskirts in southeast Berlin. Land use patterns and habitats also were recorded.

The number of vascular plant species was generally correlated with the diversity of land use patterns. Least heterogeneous land use patterns were found in built-up inner city areas and the outskirts of the city; most heterogeneous was the intermediate area between the two where open spaces such as parks, forests, and wastelands were more common. There was an increase of non-native plants and a decrease of rare species from the outskirts to the city center. Fourteen endangered species were recorded, mostly found in marginal less managed areas of lawns or tenant gardens. Rapid genetic changes and evolution of new taxa also were reported. Fourteen species, with closest relatives in Europe, North America, and Asia, were listed that probably evolved on human-disturbed sites, within and outside European settlements.

In summary, these researchers noted that the high level of biodiversity in Berlin resulted from:

“ ● the indigenous plants as a species pool of the

- given geographical area (northeast Germany),
- “ ● the structural heterogeneity of urban agglomerations, consisting of a variety of settlement and land use patterns,
  - “ ● the age of settlement areas,
  - “ ● the high percentage of non-native species, and
  - “ ● the evolution of new taxa, which occur especially on man-made sites within and outside settlements.”

Stefan and his associates concluded that “One of the main objectives of urban nature conservation strategies should be the avoidance of uniformity when managing traditional land use structures or creating new open spaces ... the use of seed material or plant species indigenous for the region for artificially created garden greenery in the city is recommended as far as possible. Lower gardening or management intensities can favor higher species numbers as is shown in habitat parcels such as tenant gardens in residential areas ... Especially in the inner city, temporary wasteland can provide space for a fairly large number of species and communities.”

Reference: Zerbe, S., U. Maurer, S. Schmitz, and H. Sukopp. 2003. Biodiversity in Berlin and its potential for nature conservation. *Landscape and Urban Planning* 62:139-148.

### **Biodiversity and Human Land Use**

The Rocky Mountain region of the United States is experiencing a high rate of human population growth. The growth rate is higher in rural areas than in metropolitan areas because of conversion of private ranchland and farmland to rural residential (exurban) use. Jeremy Maestas of Colorado State University and two of his colleagues are interested in the impact of this development on plant and wildlife communities in the region. Maestas and his associates studied three land use types: nature reserves, cattle ranches, and exurban development. Their study area was the north fork of the Cache la Poudre River watershed in northern Larimer County, 40 km northwest of Fort Collins, Colorado.

Maestas and his associates focused their research on breeding bird, medium-sized mammalian predator, and plant communities. Ninety-three points were randomly located over 20,000 ha for sampling these three communities. For birds, 75-m fixed-radius point counts were made during the breeding seasons

of 2000 and 2001. Distances to birds were estimated to calculate detectability-based density estimates. At each point, birds were counted for 8 minutes during a 3-hr time period after sunrise under good weather conditions. Each point was sampled twice each season. Predators were sampled with scent stations between May and August 2000 and 2001. Vegetation was sampled at 69 of the 93 points from late June to mid-July 2001. At each sample point, 12 microplots (20 x 50 cm) were established and canopy coverage of individual plant species was determined.

Fifty-eight species of birds were recorded in the study: 39 on reserves, 41 on ranches, and 52 on residential developments. Some species preferences were noted. For example, at exurban residential sites, greater densities of tree-nesting and human-commensal species were recorded, notably black-billed magpie (*Pica hudsonia*), European starling (*Sturnus vulgaris*), Brewer's blackbird (*Euphagus cyanocephalus*), American goldfinch (*Carduelis tristis*), house wren (*Troglodytes aedon*), broad-tailed hummingbird (*Selasphorus platycercus*), and Bullock's oriole (*Icterus bullockii*). Bird feeders probably influenced density of broad-tailed hummingbird and nest boxes densities of European starling and house wren. Bullock's oriole was probably attracted to residential areas by trees used for landscaping and black-billed magpie and Brewer's blackbird by presence of garbage at these developments. Greater densities of ground- and shrub-nesting birds were noted for reserves and ranches. On ranchland, greatest densities were recorded for spotted towhee (presumably *Pipilo erythrophthalmus*) and Brewer's sparrow (*Spizella breweri*). Brewer's sparrow and vesper sparrow (*Pooecetes gramineus*) are species of conservation concern because long-term declines are evident across their ranges.

Mammalian predators recorded in the study were coyote (*Canis latrans*), bobcat (*Lynx rufus*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), domestic dog (*Canis familiaris*), and house cat (*Felis catus*). Dogs and cats were recorded almost exclusively at residential developments. Coyotes were more common on ranches. A trend of increasing bobcat use of exurban to ranch to reserve was noted but differences in use were not statistically significant. Red fox and striped skunk were recorded too infrequently for statistical analysis.

One hundred sixty-two species of plants were recorded in the study. Twenty-six plant species were non-native: 23 located on residential developments, 11 on ranches, and 17 on reserves. Both reserves and

residential development were ranchlands prior to present land use and any influence that this might have had on present bird, mammal, and plant communities was unknown. The authors concluded "Our results support the notion that ranches are important for protecting biodiversity and suggest that future conservation efforts may require less reliance on reserves and a greater focus on private lands."

Reference: Maestas, J. D., R. L. Knight, and W. C. Gilgert. 2003. Biodiversity across a rural land-use gradient. *Conservation Biology* 17:1425-1434.

### Conserving Woodland Flora

In Europe, 1% of forests are "old forests," that is, have been woodland since about 1775. Sandrine Godefroid and Nico Koedam of the University of Brussels, Belgium recently studied the value of small forest patches and large forest patches for conserving forest plant species in the city of Brussels. These investigators studied 12 woodlots varying from 2 ha to 1,666 ha in size. Eleven of the forested tracts were less than 200 ha and considered "small" in the analysis. The remaining tract (1,666 ha) was considered "large." All woodlots were established on the same soil type and the forest canopies consisted of planted trees, mostly European beech (*Fagus sylvatica*) with English oak (*Quercus robur*) also usually present. A list of vascular plant species was compiled for each woodlot between 1992 and 1994.

The large woodlot was valuable with regard to species richness and composition. Twenty-three species had significantly higher frequencies there. Among such species, some were lacking from all small woodlots, including deer fern (*Blechnum spicant*), downy birch (*Betula alba*), queen's-veil maiden fern (*Oreopteris limbosperma*), bog chickweed (*Stellaria alsine*), and creeping velvetgrass (*Holcus mollis*). Six species had significantly higher frequencies in small woodlots: smoothleaf elm (*Ulmus minor*), English ivy (*Hedera helix*), Norway maple (*Acer platanoides*), European ash (*Fraxinus excelsior*), white-spot (*Stachys sylvatica*), and oxlip (*Primula elatior*). Species rarity was positively correlated with woodlot size. The authors stated "...we can conclude that, within the range of studied area categories, large refuges are essential to minimize extinction rates and to ensure certain species any chance of survival. Hence, in a conservation policy focused on woodland species, which are the most valuable species in forested ecosystems, large forests should be promoted." The authors went on to say, however, that small woodlots also have value for many species, may serve as stepping stones among larger woods, and provide human education and recreation benefits.

Reference: Godefroid, S., and N. Koedam. 2003. How important are large vs. small forest remnants for the conservation of the woodland flora in an urban context? *Global Ecology & Biogeography* 12:287-298.

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