ment. Nest boxes should be designed and constructed to proper dimensions, placed in appropriate habitat, erected at the proper height above ground, and maintained properly from year to year to assure continued use. In addition, boxes should be durable, predator-proof, weathertight, lightweight, and economical to build. By adhering to these guidelines, artificial nesting structures can substitute for a deficiency of natural sites in otherwise suitable habitat in urban areas for a wide diversity of species.

Many of the same species that use nesting structures in the countryside also will use the structures in town. The wood duck is one such species. Several wood duck boxes were erected on a residential lot of about 2.5 acres (one hectare) in Burlington, Iowa, in 1943 (more boxes were added later). As of 1988, some 6,000 ducklings had been produced. Hatching success in Burlington averages more than 80%, whereas the average success rate in the wild is less than 50% (Leopold 1951 and 1966 as cited in Hawkins et al. 1990). Such boxes are of most value to wood duck populations when (1) suitable breeding habitat is present but nesting cavities are absent or scarce, (2) nesting boxes are protected from predators, (3) new habitats are developed in areas with few cavities, and (4) competition for nest cavities is high (Hawkins et al. 1990). I believe these considerations apply to other species as well.

Chapter 8
Managing Urban Habitats for Wildlife

Nature of Urban Habitats

Urban habitats vary from densely built cores downtown to suburbs with large yards and considerable open space. In comparison with the rural countryside, however, urban habitats are relatively small patches of land. Most of the ground surface has been disturbed. Even so, many cities still retain remnants of natural habitat, sometimes well encompassed by concrete, but most often located nearer the urban–rural fringe zone. Such sites frequently are preserved as city or county parks, nature centers, or natural areas and provide tremendous recreational and educational opportunities. If managed properly, these lands also offer the best opportunity for maintaining native plants and animals of the region.

There are other habitats in the city. Business parks and industrial parks contain landscaped grounds and sometimes larger open space areas, such as wetlands and steep slopes, where development is restricted or prohibited. Institutions such as schools, hospitals, and churches (including cemeteries) occupy considerable land area and can be landscaped for people and wildlife. Neighborhood and community open spaces (and vacant lots) represent important urban habitats. Many such areas buffer streams, lakes, ponds, and wetlands from development. Backyards of individual residences offer habitat potential if managed with an eye toward wildlife. Running throughout the metropolitan environment are roads and railways that can
serve as corridor links between urban habitat and the countryside. All of these areas provide opportunities to consider wildlife in management schemes. They offer occasion for people to interact with nature and to get away from the hustle and bustle and stress of city life, if only for brief times.

Nature of Management

Managing the habitats of wildlife is the most important and most basic approach to wildlife management. This activity involves manipulating food, cover, water, and space in proper amounts and distribution for species of interest. Although simple in concept, the task is often difficult in practice because little is known about the specific habitat requirements of most species. With regard to food and cover, however, management generally means manipulating succession and the compositional makeup of vegetation to achieve suitable vegetation structure and food plants. Species such as white-tailed deer, ruffed grouse, and cottontail rabbit prefer midsuccession stages and edge habitat. Others, such as the northern spotted owl and the hooded warbler, require large blocks of late-succession mature forests. Denuded sites can be revegetated with plants beneficial to wildlife.

Providing unpolluted drinking water in adequate quantity is necessary for most terrestrial species. This is not generally a problem in high-rainfall areas but in drier regions such as the southwestern United States, drinking water for terrestrial wildlife is scarce and more attention is given to this habitat component. Many aquatic and semiaquatic species are water dependent, such as ducks, geese, swans, and numerous marsh birds and shorebirds. Mammals such as muskrat, beaver, and mink also are included, along with amphibians, reptiles, invertebrates, and fish.

Because of their productivity and the diversity of wildlife supported, wetlands are the focus of considerable current emphasis. Over half of the original wetlands have been lost in the United States (Tiner 1984), and much present effort is underway to preserve, create, restore, and manage the remaining wetland habitats. Just as terrestrial plant communities go through succession, so too do aquatic communities. Wildlife managers attempt to control succession and to maintain it at a stage most desirable for wildlife. An interspersion of vegetation and open water is best, and desired results generally can be obtained through regulation of water levels.

Space is a critical component of wildlife habitat. Although food, cover, and water may be present in a given habitat, adequate space is essential for wildlife populations to survive. As with the other elements of habitat, space requirements differ for different species. For example, the wolverine, North America's largest terrestrial mustelid (sometimes called the "skunk bear"), is perhaps a true wilderness species. It may require a home range of some 25,000 acres to more than 100,000 acres (10,000 to more than 40,000 hectares). As you might expect, habitat suitable for wolverines has shrunk considerably with human settlement of North America. White-tailed deer, on the other hand, may coexist with certain levels of development. The home range for deer is on the order of 375 to 750 acres (150 to 300 hectares). cottontails need less than 25 acres (10 hectares) and meadow voles and white-footed mice less than 2.5 acres (one hectare). Thus, smaller animals generally can occur in urban areas if adequate food, cover, and water are present.

The type and degree of habitat management in metropolitan areas depend on one's objectives and the characteristics of the habitat itself. Small pocket parks and corner plazas downtown generally must be managed intensively. At the other extreme, natural areas will receive little or no management.

Before implementing management practices, it is important to inventory the site of interest and assess its value to wildlife. A first step is to map the various habitats and record characteristics useful to wildlife. At what successional stage is the vegetation? What plant species are present? Do they provide food and cover to wildlife? What are the structural properties of the vegetation? If the area is woodland, is leaf litter present on the forest floor and is an understory of shrubs present beneath the tree canopy? How many snags are present for cavity-nesting species, and how are they distributed over the site? Is the site homogeneous, or does it consist of several distinct habitat types? In case of the latter, how are the types interspersed? Finally, it is essential to record the type of water present on site—stream, pond, lake, or wetland. In practice, managing urban habitats usually will involve one or more of the following approaches.
Hands-off Management

In some instances, the management goal may be to "let nature take its course." If this decision is made, plant communities will, through natural succession, slowly change over time until the climax vegetation type for the region is reached. An oak-hickory forest may develop in the eastern United States, beech-maple in the Midwest, and hemlock-fir-cedar in the Pacific Northwest. Unless disturbed by natural catastrophe such as fire or disease, or unless cut by humans, these vegetation types will perpetuate themselves.

In the United States, most of the climax vegetation types have been destroyed. There are few places in the East where "old growth" or ancient forests remain, and efforts to maintain some of the old growth forests in the Pacific Northwest are meeting stiff resistance. The value of these areas as wildlife habitat increases as they become rarer because once they are gone so are the animal communities they support. The value of habitat also usually increases with the length of time needed to establish the habitat. For these reasons, hands-off management most typically applies to climax vegetation types or to situations where natural forces are being encouraged and perhaps studied.

In the metropolitan environment, such management generally is most applicable to urban forest or park natural areas. However, strictly hands-off management may not protect a site. Too many deer may impact the area by heavily overbrowsing it, inhibiting plant regeneration. So, if the management objective is to maintain and perpetuate the plant community, the deer may have to be controlled through active management, partly because natural predators are no longer present. Likewise, so-called invasive exotic species may encroach on the site—plants such as kudzu, Japanese honeysuckle, and purple loosestrife. Insect or disease outbreaks may occur, also threatening the community. If these are not controlled through active management, the habitat of interest may be lost or seriously degraded.

In summary, simply protecting a site from human intrusion may not guarantee perpetuation of that site. Strictly hands-off management seldom is practical in urban areas because human influence is now so pervasive and the natural habitats we want to protect are so small. Thus, although such management may be the approach of

Wide expanses of closely mown lawn provide little habitat to wildlife. Metropolitan homeowners can do much to improve front and backyards by planting trees, shrubs, and other vegetation of value to wildlife. (Photo: Carol Henderson, Minnesota Department of Natural Resources.)

choice, it may very well turn into minimum active management on an area struck by lightning, infested with gypsy moths, or threatened in some other way.

Advancing Succession

Wide expanses of open lawn, perhaps with scattered trees and shrubs, are typical in the postdevelopment landscape. Such areas have little value to wildlife. A few species, such as robins and starlings, will feed on earthworms and other invertebrates near the soil surface, but wildlife diversity is severely restricted. To enhance the habitat value of such areas, more advanced successional stages are needed. One could take a hands-off approach and let succession occur naturally. Simply not mowing would allow the process to evolve. But this approach is slow, and the vegetation that grows may
not be what the manager wants. As an alternative, one could speed up succession by planting trees, shrubs, vines, and herbaceous vegetation. Before doing so, it is important to know what kind of wildlife will benefit from various successional stages and thus what stage of advancement is desired. Meadow habitat (an early successional stage) will be attractive to a wide variety of butterflies and to birds and mammals such as meadowlarks, field sparrows, bluebirds, meadow voles, and, near the brushy edges, cottontails. Advancement to mature forest (a late successional stage), however, will be needed for vireos, thrushes, squirrels, chipmunks, and other woodland species.

Planting for landscape aesthetics and wildlife can be done in cities, towns, villages, and suburbs. Because of generally low-quality soils, altered climate, and other factors, however, it is sometimes difficult to get plants to grow that are desired in the landscape. Some species, such as dandelions and tree of heaven, are well adapted to the harsh urban environment, and many such plants have wildlife value. But a broader diversity of vegetation often is of interest. Therefore, it is essential to know the physical characteristics of the soil and its nutrient content. With such knowledge, one can match suitable vegetation with existing soil or treat the soil with fertilizers and other amendments to match the requirements of desired plants. Local county extension service personnel can explain the proper procedure and locations for having soils tested.

Giving preference to native species in the landscape planting scheme will help to ensure survival of the native plants and their associated wildlife communities. Unfortunately, most urban landscaping in the past incorporated exotic plants, and these still dominate local nurseries, although interest in native plants is growing.

In a landscape planting scheme for wildlife, it is also important to consider vegetation structure, arrangement (pattern), and species composition. With regard to vegetation structure and arrangement, both vertical layering and horizontal pattern are critical factors. For horizontal pattern considerations, clumping of vegetation to maximize patch size, rather than planting in rows, is best for birds (DeGraaf 1987) and probably for other species as well. Connecting patches with corridors also is important.

Creating various vertical layers of vegetation, from ground covers to low and tall shrubs to trees, is essential to sustain a diversity of species (MacArthur and MacArthur 1961, Karr and Roth 1971). A mowed grass carpet beneath a tree canopy with no shrub layer is devastating to ground- and shrub-nesting birds. The wood thrush is a highly desirable bird and will live in urban areas—if habitat conditions are right. The bird requires a dense tree canopy with a shrubby understory and leaf litter on the forest floor (Roth 1987). This woodland bird is a low nester and forages primarily in leaf litter for invertebrates.

With regard to species composition, it is desirable to plant trees, shrubs, and other vegetation of known food and cover value to wildlife. (Appendices A and B provide some help in this regard.) Moreover, consideration should be given to wildlife use through the different seasons. For example, mulberry, cherry, and elderberry are
good native summer plants for songbirds. Trumpet vine, hollyhock, and phlox provide food for hummingbirds. Throughout the growing season, diverse plants such as pussy willow (in the spring), hollyhock, butterfly bush, and asters (in the fall) are important to butterflies. Also during fall, dogwood and mountain ash are excellent wildife plants. Through winter, Hawthorn, red cedar, sumac, and trees such as hickory and oak provide food in the form of nuts, acorns, and persistent fruits. Conifers such as cedar, pine, and hemlock provide important winter cover. Once the desired stage of succession is reached, management may be required to maintain it.

If managers recognize the limitations posed by development, succession can be advanced on a small scale even in metropolitan centers. A 2.5-acre (one-hectare) redevelopment project in downtown Baltimore, Maryland, was landscaped with a variety of shrubs of value to birds. Included were two species of rose, barberry, pyracantha, flowering quince, and autumn olive. Pigeons, starlings, and house sparrows declined from 94% of the bird community to 52% over the three-year study period. Birds that increased included mourning dove, mockingbird, cardinal, house finch, northern junco, and American crow (Franklin and Adams 1980).

Plant community advancement also can be practiced on urban and suburban residential lots. In 1979, a half-acre (0.2-hectare) lot and a one-acre (0.4-hectare) adjoining pasture in Cedar Rapids, Iowa, were mowed or grazed to maintain lawn. The only other plants present were several large white oaks, a few box elders and elms, and one or two locusts. After 1979, 70 different plant species attractive to wildlife were added, mostly in clumps to enhance their wildlife value. Large conifers planted for winter cover included white pine, red pine, and eastern hemlock. Deciduous trees for food, cover, and nest sites included black cherry, mulberry, black walnut, black oak, and sugar maple. To develop a shrub layer, highbush cranberry, elderberry, gray dogwood, blackberry, and raspberry were planted. For the ground layer, bluestem, coneflowers, strawberry, butterfly weed, asters, and goldenrods were encouraged. In addition, a small pond was built. Over the years, some 65 bird species have been observed using the area. Included have been seven species of woodpeckers, seven species of warblers, great horned owl, ring-necked pheasant, and scarlet tanager. Among the mammals have been gray squirrel, fox squirrel, white-tailed deer, red fox, raccoon, opossum, chipmunk, woodchuck, cottontail, and two species of bats. The property has been registered as an urban wildlife sanctuary by the National Institute for Urban Wildlife.

Setting Back Succession

"Arresting" succession is the most widely practiced management technique in the metropolitan environment. It generally involves some mechanical means of cutting grass or trees and shrubs, with use of herbicides also quite common. Controlled fires (also called prescribed burns) are used frequently in rural areas, but fire has limited use in the urban environment.

Mechanical lawn mowers are most popular for maintaining succession in the short-grass stage. However, weekly cutting of lawns throughout the growing season does not provide much food or cover for wildlife. A better approach to assist wildlife would be to reduce the extent of closely mown lawn. Doing so does not necessarily mean loss of openness. If an open (or savannalike) characteristic is desired, an area can be maintained as meadow habitat. Simply mowing once a year, or better yet, once every two or three years, will eliminate shrub and tree seedlings and maintain succession in a grass-forb meadow stage of much greater value to wildlife than a lawn mown weekly. To retain some meadow habitat at all times, an area managed in this fashion should not be cut completely at any given time. To do so would deplete valuable food and cover. A much better practice would be to mow half the area one year and the other half the following year. If a three-year cycle is used, mow one-third of the area in any given year. This technique will always leave some habitat for wildlife while keeping the area in a dynamic state of early succession. Mowing in late winter–early spring will provide overwinter cover for wildlife and is preferable to summer or fall mowing. Late spring mowing should be avoided as it will interfere with the breeding season of many wildlife species.

This mowing scheme is most applicable to larger open space areas managed by city or county park and recreation departments, or similar authorities, with equipment capable of cutting down small shrubs and trees that sprout between mowing cycles. Small property owners with light mowers might find a single annual mowing difficult and a two- or three-year cycle impossible. However, such own-
ers can easily remove any unwanted shrub or tree sprouts by hand. Meadows maintained in such fashion not only provide better wildlife habitat, but also do not require the enormous quantities of pesticides and fertilizers needed to maintain artificial stands of manicured grass. Meadows also are economical to maintain. I believe their use could be expanded in the metropolitan environment, but I do not advocate eliminating all formalized landscaping.

Another method of holding back succession that is applicable to urban areas is the cutting of woody growth with a power saw, handsaw, or ax. Normally, in most urban areas of North America, this will involve selective tree and shrub removal. Removing the overstory vegetation allows more light to penetrate to lower levels, resulting in more vigorous growth of herbaceous vegetation and lower shrubs. Depending on the manager’s objective, trees alone may be removed, in which case a shrub community may develop, or both trees and shrubs may be cut, in which case an herbaceous meadow will be perpetuated (as I have described).

Many rights-of-way of highways, railways, pipelines, power lines, and underground cables offer opportunities for managing meadow or shrub communities. Past management of most rights-of-way consisted largely of maintaining grass cover by regular mowing throughout the growing season. Although, for good reason, trees cannot be allowed to grow on many of these areas, there are alternatives to frequent grass mowing. One good alternative is to maintain succession in a shrubland stage. Research has shown that such communities are relatively stable and can be maintained for long periods of time with minimal management, which generally consists of selective herbicide spraying of individual trees in early growing stages. Shrubs useful in this regard that also have good wildlife value include huckleberry, greenbrier, blueberry, speckled alder, gray dogwood, and nannyberry (Niering and Goodwin 1974). There are now many examples of cooperative efforts between power companies, highway departments, and government and private conservation groups in managing rights-of-way with greater consideration to wildlife. One good example is Patuxent Wildlife Research Center, near Laurel, Maryland. In 1960, the U.S. Fish and Wildlife Service (which operates the research center) and Potomac Electric Power Company agreed to implement a management program that would develop a shrubland community on a newly con-

structed right-of-way on the property. Mowing was halted and selective applications of herbicide were periodically applied to stems of unwanted species. After 30 years, the right-of-way was dominated by a shrub community rich in botanical diversity and heavily used by wildlife (Obrecht et al. 1991). Success of the program has led to greater use of the technique by the power company.

Fire is frequently used in rural areas to set back succession, but its use in the urban environment generally is not practical and often is illegal. Risk of property destruction is great in the urban complex, and smoke from fire adds to air pollution. Natural lightning fires occasionally do sweep through residential communities of southern California, sometimes causing great economic loss. Ironically, small periodic fires historically kept the fuel supply in check, lessening the probability of a major conflagration. With the suppression of all fires today, however, the fuel supply builds up and the potential for large-scale destruction of property is increased.

Other forces that set back succession include insects and disease, but I am unaware of either’s being used purposefully for management. Their occurrence does, however, present another management question: Should chemical sprays be used in an effort to control insects and disease? Managers must weigh this question carefully, considering the potential benefits of spraying in controlling the target organism, the impact of spraying on other species (including food chain effects and hazards to humans), the likelihood of contaminating surface and ground water supplies, and the possible alternatives such as “integrated pest management.” Integrated pest management is a biological control approach to pest management that relies on parasites, predators, and pathogens, in addition to selective pesticides, to maintain lower densities of an unwanted species.

Managing Edges

Habitat edge was defined earlier as the interface between two or more structural types of vegetation. Urban areas have a lot of edge habitat. Edges demark private property boundaries, occur along streams, power lines, and transportation corridors, and are found in cemeteries, on golf courses, and in community and neighborhood parks where they separate active-use areas from passive-use areas.
Edges can serve multiple purposes. For people who find fences along property boundaries unsightly, "living fences" of trees or shrubs with wildlife value can be substituted that are aesthetically pleasing as well as functional for screening and privacy. A dense planting of hawthorn will be impenetrable to people, but will provide food and cover for wildlife. Combining taller trees and shrubs as background with shorter ones in the foreground also is aesthetically more pleasing and provides better habitat for wildlife. Such a design creates soft edge rather than hard edge (Fig. 9).

The open nature and numerous edges of urban areas offer good opportunity to manage habitat for butterflies. Such an objective is of value because past habitat destruction and widespread use of pesticides have decreased many butterfly populations. Also, meadows and soft edges are early successional stages and thus can be created in a relatively short period of time.

In establishing vegetation for butterflies in meadows and along edges, it is important to remember that butterflies need sun and protection from the wind. To be of most value, the habitat must provide food plants for both larvae and adult butterflies throughout the growing season from spring to fall. From a management standpoint, selection of perennials that will bloom successively from spring to fall will minimize management requirements (Mitchell 1986). Also, it is useful to visualize three different levels of vegetation and to select plants valuable to butterflies for each level (Booth and Allen 1990). Background vegetation is the tallest and may consist of a forested edge along a property boundary. If a wall or fence marks the property boundary, background vegetation will need to be planted. Pussy willow blooms in early spring and is attractive to adults of such butterfly species as mourning cloak, comma, and question mark. Other early-blooming trees attractive to adults include plum, peach, and cherry. Trees representing good food sources for larvae include dogwood, spicebush, and various fruit trees. Caterpillars of the tiger swallowtail prefer to feed on leaves of the tulip tree, wild cherry, and white ash. American elm is attractive to the mourning cloak, question mark, and comma, and the silver-spotted skipper shows preference to black locust.

Attractive low shrubs should be planted in front of the taller background trees or woody vegetation. In late spring, shrubs such as lilacs attract swallowtails and monarchs. Throughout summer and into fall, smooth sumac, dwarf sumac, sweet pepperbush and butterfly bush are excellent selections. Shrubs supporting larvae include abelia, butterfly bush, and wax-leaf privet. In open woods, an understory of spicebush, sassafras, papaw, shadbush, and flowering dogwood is desirable.

Plant herbaceous vegetation in front of the shrubs. In early summer, butterfly weed is particularly attractive to adult fritillaries. Throughout the summer and into fall, phlox, fernleaf yarrow, black-eyed Susans, Saint-John's-wort, impatiens, marigolds, and asters are excellent nectar-producing plants for adults. Larval fritillaries feed on violets. Other good herbaceous food plants for caterpillars include milkweed and asters.

Although this discussion specifically concerns butterflies, the principles are sound for other kinds of wildlife as well. Meadow habitat and soft edges as substitutes for grass lawn and hard edges will benefit mammals such as meadow voles and cottontails and birds such as meadowlarks, field sparrows, and bluebirds. Planting edges that follow a curvilinear pattern present a more natural appearance that generally is more aesthetically pleasing than the effect created by straight edges.
Managing Water

Water is a vital natural resource. Not only is it required for wildlife, but it is necessary for human life as well. It is probably fair to say that we are still not managing water wisely. For example, many aquifers continue to be depleted and not to be adequately recharged. Numerous bodies of water are still considered by too many individuals as common dumping grounds for various by-products of present-day society. In financial terminology, water might best be considered a capital asset, and everyone knows that it is not wise to continue depleting your capital. Yet that is what we have done in the past with respect to water, and to a lesser extent are continuing to do today.

How can better management reduce these negative environmental effects and provide greater benefit to wildlife? To the extent possible, an overall management goal should be to maintain the hydrology of the area as it was before development. The first step toward this goal should be to start with better protection of water resources as development occurs. Valuable habitats should be identified, and protective measures implemented early. Building should not occur in floodplains. These areas are important for maintaining local hydrology and provide valuable riparian habitat to wildlife. They also can be used in the postdevelopment landscape as recreational open spaces—and marketed as community assets (Réau 1986). Thus, retaining vegetated buffer strips along streams and wetlands will help to maintain the functional integrity of these aquatic systems, including maintenance of wildlife communities.

Placement of fabric fences around construction sites and straw or hay bales in small drainages can help to minimize erosion during construction. Temporary sediment ponds can be used to detain water runoff, thus allowing time for much of the sediment to settle out. Permanent storm-water control impoundments also are effective in reducing sedimentation downstream and in controlling the flow of water from construction sites. Increased use of porous pavement and other means of increasing water infiltration in the postdevelopment landscape also will help.

Aquatic habitats already degraded by urbanization require more intensive management. With regard to streams, many of the techniques mentioned for maintaining stream integrity in the face of development also will assist in restoring degraded ones. Planting trees, shrubs, and other vegetation along a stream will help to buffer the impact of urbanization.

Restoring an urban stream may start with identifying any pollution sources contributing to its degradation and with taking corrective action to eliminate or reduce such pollution. Simply removing trash and debris also may be an early requirement. In addition, removing accumulated sediment from sections with large depictions and replacing that sediment with gravel beds will enhance fish habitat by providing spawning sites.

Where erosion of the stream bank is severe, riprap, gabions, or “root wads” may be needed. Riprap refers to large broken stones loosely placed along the stream bank to reduce or eliminate the erosive power of water. Gabions are wire cages filled with stones that may be used for the same purpose. Root wads, too, function to reduce stream bank erosion, but are somewhat more “natural appearing” than riprap or gabions. They are currently being used in reconstruction of streambeds and essentially are uprooted trees from which the tree crowns have been removed. The trunk and attached “root wad” are placed perpendicular to the flow of water, and earth is placed over the trunk, with the root wad thus providing support to the stream bank. Several root wads may be placed together along a stream.

Other techniques may be effective in restoring stream habitat. Small dams called check dams, perhaps no more than a log across the stream, sometimes are used to reduce water velocity and its erosive capabilities. Care must be taken in the design and construction of such dams to ensure that migratory fish can continue to use the stream unimpeded by the dam. Artificial riffles and pools may be constructed, if lacking in the stream. Stone boulders can be used to create riffles that help to oxygenate the water. Quiet, deeper pools provide cool retreats for fish. Restoring degraded streams is expensive. It is far better to protect such habitat as development expands than to institute corrective measures at a later date.

Many degraded wetlands also can be restored, and new ones created (Adams et al. 1986, DeMigen 1988, Morrison and Williams 1988, and Zentner 1988). Excessive sediment deposited with the progression of development can be removed. If, through neglect, vegetation is too rampant, management practices can be instituted to benefit wildlife. The guidelines that follow can serve both for wetland res-
Streams often are heavily impacted by urbanization. A common scene in the metropolitan environment is stream bank erosion. Following rains, excess water from rooftops, parking lots, and streets is diverted to nearby stream channels. Thus, even small rainstorms can create flood conditions, and the high volume and velocity of water can erode the stream bank. (Photo: L. W. Adams.)

Restoration and for wetland creation in the metropolitan landscape. If the hydrology is too severely altered during development, however, what previously was a well-functioning wetland providing excellent

Gabions (wire cages containing stones) sometimes are used to protect urban stream banks from erosion. (Photo: L. W. Adams.)

wildlife habitat may never be fully restored in the postdevelopment landscape.

Shallow water wetlands developed in association with the construction of storm-water control impoundments, gravel quarries, and sewage treatment lagoons can, with a little consideration, provide wildlife habitat. To be of greatest value as wetland habitat, impoundments should be constructed with irregular shorelines, gently sloping sides, and islands if the impoundment is larger than about five acres (two hectares). Irregular shorelines increase the amount of edge habitat and provide numerous nooks and crannies for waterfowl and other species. Among other things, this reduces the sight line of breeding ducks and thus decreases territorial fights among males. Irregular shorelines also help to reduce wave action at the shore-water boundary, reducing erosion and encouraging vegetation establishment.

Gently sloping sides, on the order of ten to one, will provide a littoral shelf, or bench, of shallow water habitat around the impoundment. About 25% to 50% of the water surface area should be two
Drawdown refers to periodic removal of water from a wetland or water impoundment. It may be partial or complete. Maintaining a series of wetland sites in various stages of drawdown is best. Such moist-soil vegetation management is receiving considerable attention by wetland biologists. It is a sophisticated management technique as plant communities are dynamic and ever changing, and new knowledge continues to be gained. We do know that such management benefits a diversity of waterfowl, songbirds, shorebirds, marsh birds, mammals, amphibians, and reptiles.

As a final consideration for constructed impoundments, such facilities should be located near existing wetlands whenever possible. This will enhance their wetland wildlife value and ensure a seed source for vegetation establishment.

Better management of water will require public support. Public education programs can help to remind local citizens not to dispose of used motor oil, antifreeze, household cleaners, paints, solvents, pesticides, or other chemicals down household or storm drains. Such programs also are helpful for presenting guidelines for lawn and garden fertilization. For example, fertilizing after spring rains and not fertilizing to the water’s edge will result in less nutrient flow into waterways and fewer adverse effects on the aquatic community.

Managing Human Activity

An important element of managing urban wildlife habitats is managing human activity in those habitats. This is particularly true for public open space areas and urban parks. Unlike in rural areas, in the metropolitan environment hunting generally is not allowed and management of that activity is not a significant concern, but other factors must be considered and evaluated. One such factor is human theft of vegetation. In a small nature reserve in Florida, six of 17 orchid species were extirpated due to robbery by humans (Dawson 1991).

Another factor not to be overlooked is significant disruption of the behavior and activity of animals. Some evidence indicates that intense human recreational use of forested areas reduces the density and diversity of breeding birds (van der Zande et al. 1984). This may be particularly true for ground and low-shrub nesters. Disturbance of breeding activity may result from the simple presence of large num-
bers of people in an area, or it may be more direct. Destruction of
bird nests by children has been noted in some instances (Burr and
Jones 1968).

Other potential impacts of humans should be considered. Heavy
human use of an area may trample vegetation and compact the soil,
leading to loss of plants and soil erosion. Particularly during dry
conditions, discarded cigarettes and children playing with matches may
increase the potential for accidental fire. People also may introduce
undesirable exotic plants and animals to an area.

Although humans may indeed negatively impact urban wildlife
habitats, urban parks and open space areas (and also state and national
parks) are designed primarily for people. The public should be
encouraged to use and enjoy such areas. This, however, does not mean
that wildlife should be neglected. Part of a park’s attraction to people
is the wildlife it supports. The real issue then is how to balance
human use of such areas with the needs of wildlife. An appropriate
balance can only be achieved through effective management. An
excellent example of such an approach is the natural resources
management program recently established in Montgomery County,
Maryland (Hench et al. 1987). In this suburban county adjoining
Washington, D.C., at least 66% of each regional park (a park of at
least 200 acres [81 hectares]) is to be maintained as natural or conser-
vation areas. The remaining 33% may be developed for recreational
activities (active-use area). Natural areas enhance active-use areas by
contributing to the character of the latter, by serving as outdoor
classrooms for nature study and as outdoor laboratories for scientific
research, and by providing the tranquil environment that many park
users seek. Carefully designed trails—including those for walking,
jogging, and horseback riding—can penetrate the nature conserva-
tion areas. Wildlife observation platforms, study blinds, food and
cover plots, and feeding stations can facilitate a safe and enjoyable in-
teraction between people and wildlife. In turn, active-use areas can
positively impact nature conservation areas by providing a broad
constituency of park users who can be called on to politically support
the agency managing the park when alternative land-use proposals
threaten a park’s integrity.

There are other ways of minimizing detrimental impact on wild-
life while providing human use and enjoyment. An on-site naturalist
or warden has proven effective in reducing vandalism and other mis-
use by people. If a full-time position is not possible, regular inspec-
tion will help. Maintaining a certain degree of use by the public also
will help to reduce misuse by a few individuals. During the breeding
season, restrictions on human access may be necessary in certain ar-
eas. Finally, continuing public education is important. This can be
through on-site signs, brochures, and programs and through the
print, radio, and television media, as well as formally through local
school systems. Only through such an approach can park managers
meet the needs and desires of people while maintaining a responsi-
bility to the wildlife resource, too.