COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

A Guide to Urban Habitat Conservation Planning

Thomas G. Barnes, Extension Wildlife Specialist
Lowell Adams, National Institute for Urban Wildlife

Kentuckians value their forests and other natural resources for aesthetic, recreational, and economic significance, so over the past several decades they have become increasingly concerned about the loss of wildlife habitat and greenspace. Urban and suburban development is one of the leading causes of this loss: A recent study indicated that every day in Kentucky more than 100 acres of rural land is being converted to urban development.

Because concern for loss of greenspace is not new, we have for some time created attractive urban greenspace environments with our parks and backyards. These greenspaces have been created not so much for wildlife habitats as for people to enjoy, but the potential for wildlife habitat exists in these scattered habitat patches.

An effective planning strategy is needed to create and link these isolated patches. The goal is more than just to connect parcels—it is to develop land in a way that allows for the natural distribution of our urban wildlife species. Although complete and easily applied answers are not yet available, much has already been learned, and a consensus is emerging among landscape ecologists.

This publication is designed for the planner, landscape architect, urban government regulator, policy maker, and concerned citizen. It introduces landscape ecology concepts and looks at how geographic information systems (GIS) technology can be used to develop and monitor local land-use policy to maintain wildlife habitat and greenspaces.

Guidelines for Considering Wildlife in the Urban Development Process

Promote habitats that will have the food, cover, water, and living space that all wildlife require by following these guidelines:

- Before development, maximize open space and make an effort to protect the most valuable wildlife habitat by placing buildings on less important portions of the site. Choosing cluster development, which is flexible, can help.
- Provide water, and design stormwater control impoundments to benefit wildlife.
- Use native plants that have value for wildlife as well as aesthetic appeal.
- Provide bird-feeding stations and nest boxes for cavity-nesting birds like house wrens and wood ducks.
- Educate residents about wildlife conservation, using, for example, information packets or a nature trail through open space.
- Ensure a commitment to managing urban wildlife habitats.

The publication can also be useful to the average homeowner in understanding the complex issues involved in landscape planning and wildlife conservation and to the average citizen who wants to more fully participate in community planning that addresses these issues.

For both professionals and the general public, the publication will introduce ways to minimize the adverse impact of residential development that has already taken place.

Landscape Ecology

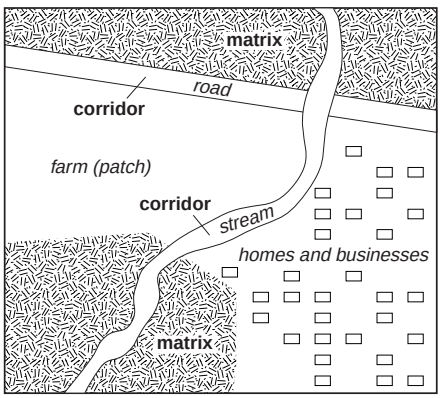
To understand basic landscape ecology and relate its concepts to urban wildlife management, it is necessary to define some terms and discuss their importance.

Landscape ecology is the study of the structure, function, and change of the landscape over large areas. It is an interdisciplinary science that studies the interrelationship among human society and our living space and the natural processes within that living space.

A landscape is a large area composed of ecosystems (the plants, animals, other living organisms, and their physical surroundings). Landscapes often contain patches of both human development and wildlife habitat, and they vary considerably in size, shape, and structure. Another way of looking at a landscape is as a mosaic of patches across which organisms move, settle, reproduce, and die.

A landscape consists of three main components: a matrix, patches, and corridors (Figure 1).

Figure 1. Landscape components.



The *matrix*, the dominant component in the landscape, is the most extensive and connected landscape element.

A *patch*, a surface of the landscape that looks different from its surroundings (the matrix), may arise from natural factors such as soil type or human-induced factors such as housing development.

Wildlife habitat patches are basically islands in a sea of homes and businesses. Small patches are typically too small or too isolated to provide resident wildlife with the basic necessities of life: food, water, and cover.

What is a corridor, and what is its value to wildlife? A *corridor* is a landscape linkage that unites patches. Natural and human-designed corridors can connect two or more patches of habitat. Maintaining or creating corridors in order to link patches can increase use of wildlife habitats, provide avenues for dispersal and migration, facilitate gene flow between populations, and increase likelihood the patches will be inhabited.

A path followed by a river or stream is an example of a natural habitat corridor—strips of vegetation along streams are especially important to migrating wildlife.

Roads (both rural and urban), windbreaks, and railroad rights-of-way can also function as corridors, but unfortunately, these human-made corridors are often avenues by which exotic plants invade natural ecosystems.

To be most effective, a corridor must be wide enough to provide food, water, and shelter for an animal as it moves through the corridor.

Habitat Conservation Plans: A New Tool for Protecting Endangered Species?

Added in 1982 to the federal Endangered Species Act, habitat conservation plans are an attempt to protect threatened and endangered species from encroaching development.

A habitat conservation plan allows some development of a habitat critical to the survival of a species or group of species. At the same time, the plan better protects the remaining habitat—through formal creation of habitat reserves, for example. A number of such plans exist in the United States, but it is too early to tell how well they will work. A steering committee for the plan is usually set up first, representing developers, the environmental community, government officials, and state and federal resource agencies. Frequently, a technical or biological committee is also set up. Finally, a consultant is hired to collect needed data.

Following these guidelines can help assure that a habitat conservation plan is successful:

1. Include representatives of all affected stakeholder groups in the process.
2. Compile the best possible base of biological and scientific information.
3. Integrate the habitat conservation plan into local and regional long-range planning.
4. Develop an equitable, long-term funding program that spreads the financial burden of habitat conservation over groups that will benefit (e.g., developers, general public, property owners).
5. Protect multiple species and broader patterns of diversity rather than focusing on single species protection.
6. Seek ways of combining habitat conservation with other community goals, such as establishment of public recreation lands, open space, and water quality protection.

Source: Beatley (1994).

How Does Patch Size and Shape Affect Wildlife?

The size of a habitat patch affects the kinds and numbers of animals within it. The species profile within a patch at least partly depends on how we reduce and enlarge habitats as a consequence of designing and building on the landscape.

With habitat fragmentation, contiguous habitat is broken or sliced into smaller pieces (or patches) by housing and industrial development, intensive agriculture, roads, and other human activities.

Edge habitats—outer zones that differ from patch interior—are increased by fragmentation, and because the smaller patches provide relatively more edge habitats, they promote edge species at the expense of interior wildlife species.

Imagine a woodland patch of 16 acres divided into four smaller patches and then divided further into 16 one-acre patches. The amount of edge increases dramatically, while the amount of interior habitat decreases until finally, the patch is all edge.

Wildlife Best Adapted to Urban Settings in Edge and Interior Habitats

Edge habitat, which can be up to several hundred feet wide, benefits only certain kinds of edge species wildlife—opossums, raccoons, deer, skunks, cowbirds, red-tailed hawks, white-tailed deer, and northern cardinals—often at the expense of interior habitat species. Most wildlife species inhabiting edges are considered habitat generalists.

Interior habitat is the area inside a patch that is removed from an edge habitat or can be viewed as the patch's core—that is, the area unaffected by its edge. Interior habitats are necessary for certain interior species like bobcats, wood thrushes, bobolinks, and ovenbirds.

These interior habitats provide insulation from edge effects such as noise, wind, solar radiation, and increased predation. An interior habitat begins to develop approximately 150 feet from the edge of the patch, although habitats for some species may need to be up to 1,800 feet from the edge.

Effect of Landscape Size: What Is the Smallest Habitat Patch Wildlife Requires?

Many animals require a variety of habitat patches in close proximity to meet their daily and seasonal needs. A deer may bed down beneath the canopy of an oak, seek cover from predators within the thickets of riparian willows, drink from a nearby stream, and leave the shelter of the trees to forage in adjacent grassland. This variety of vegetation types forms a patchwork quilt across the landscape. The size, vegetation diversity, and interconnectedness of patches that make up the landscape determine the population size and kinds of animals found within it (Figures 2, 3, and 4).

Landscape-size categories (less than 250 acres, 250 to 12,000 acres, and more than 12,000 acres) have been developed based on interviews with specialists who research wildlife habitat size requirements and landscape ecology concepts in the eastern United States and southern California.

Landscapes of less than 250 acres: Landscapes of this size may support only a certain set of species and may not be large enough to include a diversity of habitat patches. Smaller, less-mobile animals may be able to survive because their home-range requirements are small; however, survival of medium-size animals is compromised over time, and large animals can be rare or transient.

Furthermore, when development activities isolate small areas of a wildlife habitat of this size, loss of a species from an area becomes a real possibility due to small population size and the effect of random events.

Research studies point out how important patch size is for wildlife. Tilghman found that habitat size was the most critical factor in determining which bird species will be found in urban environments. Vizyova demonstrated that the relative isolation of the habitat, as well as the size, influences mammalian populations in urban woodlots.

A local example illustrates this point further: the Lexington Cemetery consists of more than 100 acres of mature trees with several large ponds, and it reports 42 common or abundant resident birds using the area. The cemetery bird list also includes 41 migratory birds that might be seen in April or May and September through November. On the other hand, in a typical quarter-acre yard in a Lexington subdivision, one might observe 12 to 15 resident bird species and five to 10 migratory songbirds.

Landscapes of 250 to 12,000 acres: A landscape of interconnected patches of 250 to 12,000 acres begins to be large enough to support populations of medium-size animals such as coyotes, bobcats, and hawks. At this size, the region may encompass the variety of habitats these animals need to live and reproduce.

Landscapes greater than 12,000 acres: Landscapes of this size begin to protect ecosystem integrity and function. These large areas not only supply a multiplicity of diverse habitat types for large mammals and birds, they also provide habitat for a full range of small and medium-size animals.

The shape of a habitat patch affects wildlife much as its size does, since it influences the relative amounts of edge and interior habitats. As a patch is reshaped from circular to linear (Figures 4 and 5), the distance from the interior to the edge decreases, as it does when a patch becomes smaller. For example, a long, thin patch caters almost exclusively to edge species because it provides little or no interior habitat. In contrast, a round patch of equal area may provide interior habitat for some species.

Figure 2. Patch size and shape considerations are important when planning for wildlife. Large circular patches are best for wildlife and are even better when connected by a corridor *(adapted from Soule 1991).*

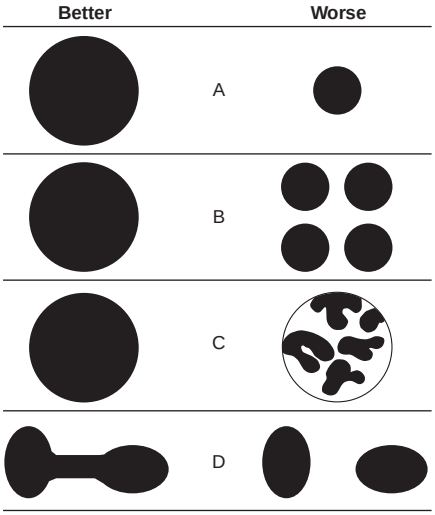


Figure 3. Large patches provide habitat for interior wildlife species. Fragmentation shown in B and C decreases the amount of interior habitat and increases the amount of edge *(adapted from Soule 1991).*

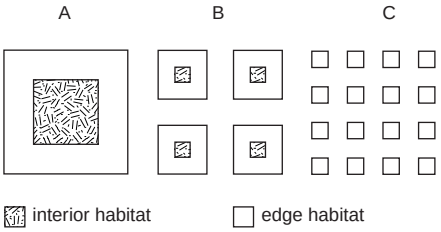


Figure 4. A patch's size and shape affect the amount of habitat available for interior wildlife species. Large areas are better than small areas, and circle-shaped areas are better than square-shaped or rectangle-shaped ones *(adapted from Forman 1981).*

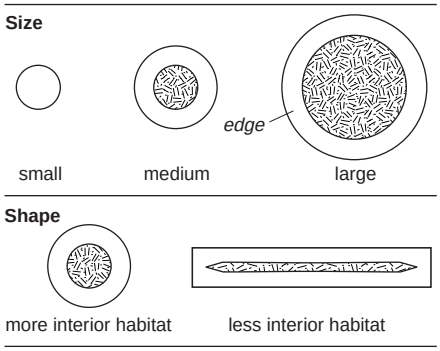
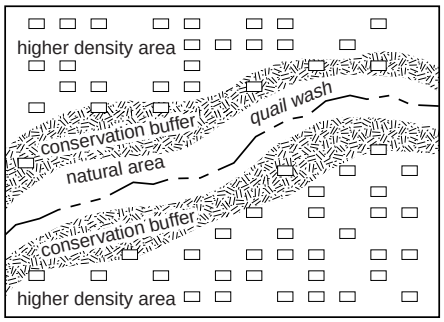


Figure 5. Conservation buffers that have little or no development adjacent to streams or other significant natural areas help protect wildlife habitat from development *(adapted from Shaw, Burns, and Stenberg, Univ. of Arizona).*



Using Technology to Help Manage Urban Landscapes

Natural resources professionals have always recognized the need for spatial information and have spent substantial time and money to acquire spatial representations, which are stored on paper maps.

Those general-purpose maps do not, however, provide all the spatial data needed for planning, because paper maps have limitations. Unless data is condensed, paper maps cannot represent a great amount of detail on one sheet. Data must be condensed, or multiple maps—specialized, thematic maps of vegetation, soils, or other forest features—must be printed.

Paper maps are also costly to produce and distribute, and, because they are static representations, it is very expensive to change scale, add or delete data, or modify representation.

Given these problems, the fact that natural resources managers use paper maps as much as they do shows the value of spatial information. But geographic information systems (GIS) technology can make spatial data more accessible than paper maps. Because GIS automates cartographic and spatial analysis functions, it also makes the manipulation process less costly and time consuming.

Anyone in forestry, natural resources, or any related land-management profession has heard about GIS. To many, GIS is another high-tech computer buzzword that experts and university researchers throw about at meetings, creating the impression that GIS technology is beyond the typical professional land-resource manager or landowner. Not so!

Simply put, a GIS is composed of computer hardware, software (programs), and data. It enables you to manipulate maps in much the same way a database enables you to manipulate numbers or words so you can collect, store, and analyze spatial information about topographical features such as forests, soil, water, buildings, and roads.

Special thematic maps can be created quickly with GIS, containing only the necessary data. But the real power of GIS is in spatial analysis. Because the maps are represented digitally and can be manipulated, each simple thematic map can be altered, copied, and combined with others to produce new, very specialized spatial information about an area of interest. Maps can be created to answer a single question about a forest area. For example, the query "location of all forest land less than 1 mile from any road or motorized trail that is also within 200 feet of water and has a slope of less than 10 percent" can be completed easily within minutes on a GIS, but might take days with paper maps.

A GIS, like any computer database, has the capability to gather, store, manipulate, and output data. A GIS, however, also allows the user to model and visualize data. With a GIS, land-use planners can look at layers of information, such as vegetation type, patch size and shape, stream corridors, roads, and zoning designations, and explore their spatial relationships across a landscape. GIS data layers that may be useful to planners include:

- trees—species, canopy cover, and area (or ecological community)
- roads—primary, secondary, and tertiary
- hydrography—rivers, streams, lakes, reservoirs, etc.
- census data—boundary lines and tabular data
- wetlands—description of ecological taxa in a form useful to resource managers
- farmland classifications—primary, secondary, etc.
- physical geography information—slope, contour, elevation, aspect
- rare and endangered species—nesting sites, range, etc.
- soil types
- vegetation types
- urbanized regions.

GIS technology will affect every resource professional, landowner, and land manager in the near future, even those who do not own and operate a GIS. Planners even now can take advantage of GIS technology and landscape ecology concepts to:

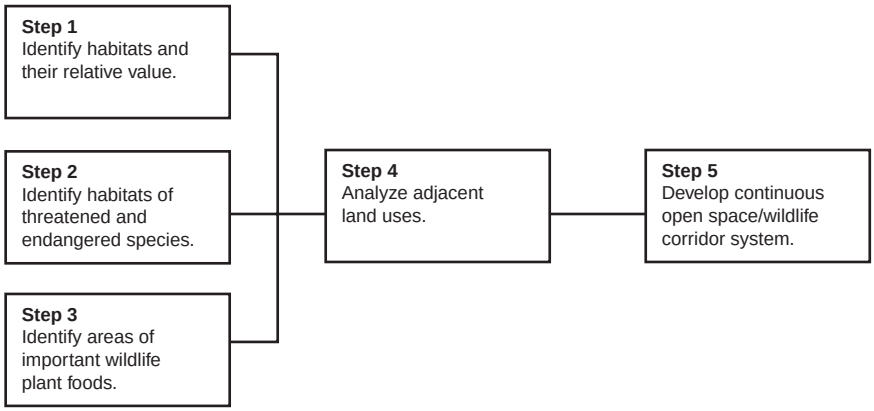
- Make maps that demonstrate existing environmental conditions to decision makers in a meaningful manner
- Identify and demonstrate the spatial relationships between habitat boundaries, natural and created habitat features, and development
- Model comparisons between natural resources and zoning or general plan designations
- Identify areas where habitats can be connected or restored.

Conservation Goals for Urban Sites

Planners, builders, developers, landscape architects, biologists, and ecologists should work together to conserve wildlife, habitats, and significant natural areas. A broad conservation strategy for urban and urbanizing areas should strive to maintain diversity in regional species while also accommodating human needs and desires.

Regional planning should focus on preserving and incorporating, in a continuous, open-space network, unique habitats and those habitats limited to the region (Figure 6). A patchwork of different habitat types and those under development may well maximize richness of local species, but perhaps at the expense of species and wildlife communities most in need of protection at the regional level. If habitat patches become too small, many species will be lost.

Figure 6. This flow diagram illustrates basic wildlife planning procedures at the regional level *(adapted from Leedy, Adams, Jones, and Dove, National Institute for Urban Wildlife).*



Bring Back the Birds: An Action Plan

Neotropical, or New World, migratory birds breed in North America and winter in Mexico, the Caribbean, and Central and South America. These birds include warblers, swifts, hummingbirds, tanagers, shorebirds, and thrushes. Neotropical migratory birds are declining in population, primarily because of a loss of habitats in which to breed or winter.

Partners in Flight is a coordinated international effort of concerned people who want to find solutions to the problem of the declining populations of neotropical migratory birds.

The aim of Partners in Flight is to determine the status and underlying causes for the population declines, maintain stable populations, and use habitat restoration and enhancement to reverse the decline. To learn more, contact Partners in Flight, National Fish and Wildlife Foundation, 1120 Connecticut Avenue, NW Suite 900, Washington, DC 20036.

Landowners can, however, take some immediate steps to retain these forest-interior bird species:

- Plan cooperatively with adjacent landowners so maximum repopulation potential can be achieved for those species requiring extensive mature or nearly mature forest.
- In areas where mature forest is limited, consider preserving one or more strategically located mature tracts to serve as stopover points for migrating songbirds.
- Retain vegetational diversity to the extent feasible.
- In smaller tracts (even down to five acres or less), maintain the maximum contiguous woodland with the least amount of edge.
- Use management units approaching the shape of a square, since that shape is more effective in preserving forest-interior birds than is a long, narrow one—especially when managed tracts are small.
- If wooded fragments must be isolated from the forest proper, retain a connecting corridor—along a stream, for example. If a forest tract has already been separated, consider planting a corridor to reconnect it.
- When possible, retain large woodlands. More than 62.5 acres is necessary to maintain a high diversity of bird species and provide urban dwellers the opportunity to see a wide variety of birds typical of more rural forests of the region.
- Maintain natural vegetation in the shrub layer to provide an increased number of niches for an increased number of bird species.
- Retain woodlands with a variety of microhabitats, such as small, scattered openings and some form of water in or adjacent to the woods. Such microhabitats provide nesting and feeding sites for a variety of birds. Patches of pines or hemlocks and wetland areas within the woods can also increase the number of birds in the area.
- Whenever possible, keep to a minimum any building within 270 feet of the woodlands.
- Limit the scope of trail systems. Instead of a fine network of trails throughout the woods, maintain a few well-marked trails for human access to particular portions of the woods.
- Retain, insofar as possible, some of the predevelopment woodlots. Planted trees, no matter how mature or abundant, apparently do not replace natural forest stands as a habitat for insectivorous birds.
- Maximize the patch size of woody vegetation (the crown volume of trees and shrubs). Breeding bird species are more likely to increase in richness from this one practice than from any other management action.
- Plant trees, shrubs, and other vegetation of known food or cover value to birds.

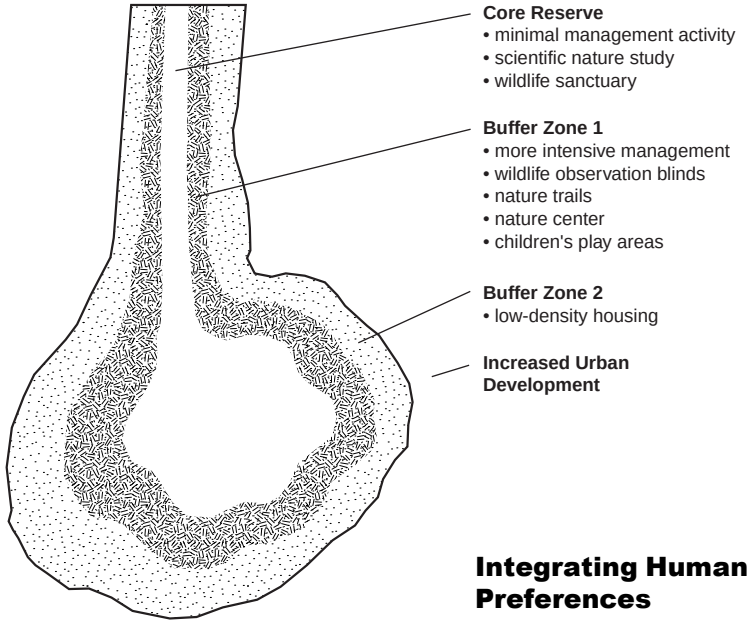
For the most part, focus in the past has been on numbers of species rather than species composition. Diamond (1976), in discussing human-dominated landscapes, addressed this point: "The question is not which refuge system contains more total species, but which [system] contains more species that would be doomed to extinction in the absence of refuges."

Natural resources are not distributed randomly throughout a landscape. Every landscape, whether pristine or developed, has nodes of unusually high conservation value that span the entire range of biological hierarchy, not only particular physical habitats. For example, such nodes would include a champion tree, a population of running buffalo clover, an undrained swamp, a county park, or a national forest. These nodes should receive top priority for protection, but to function in perpetuity, sites must be buffered, interconnected by corridors, and permitted to interact with surrounding natural habitats.

Professionals and community groups concerned about landscape conservation should examine existing patterns of high-quality nodes for potential travel corridors and dispersal barriers. They could then develop those patterns into conservation plans that minimize artificial barriers and maximize corridor connectivity. For example, the Kentucky chapter of The Nature Conservancy and the Kentucky State Nature Preserves Commission have begun protecting the Kentucky River Palisades and surrounding forest, which represents the only significant wild land remaining in central Kentucky.

The multiple-use module (MUM) has been proposed as a means to link together high-quality nodes of diversity (Figure 7). The core area of a MUM is a node of diversity surrounded by a multiple-use buffer zone of appropriate type, scale, and intensity of use. Planners and developers must ask themselves: What is the minimum size of buffers needed around patches and corridors to minimize the impact of residential development?

Figure 7. A potential design for a multiple-use module (MUM) or an urban wildlife reserve should have connecting corridor(s) and buffer zones to provide wildlife habitat and other benefits *(adapted from Harris and Noss, Univ. of Florida).*



Communities need to develop conservation strategies that emphasize:

- Comprehensive planning for threatened elements or nodes of diversity
- Integration of nodes into networks of protected and buffer areas
- Integration of conservation and development planning for long-term environmental quality.

Planning efforts in Great Britain, for example, have resulted in a wildlife conservation program for metropolitan areas that includes protection of established sites, secure linkages between sites, and availability of wildlife sites to everyone.

Planners need to establish the basic framework in collaboration with neighboring authorities to ensure both a wider context for site evaluation and continuity of wildlife corridors. A whole-city approach would be ideal.

Integrating Human Preferences

With wildlife use, it is important to integrate human preferences and use of urban reserves and corridors.

Little research has dealt with balancing these uses, although some interesting work has been conducted on how children (ages 6 to 10) relate to wildlife and wildlife habitats in urban-suburban areas. Children are among the most frequent users of the neighborhood open space. They play close to home and among their favorite areas are "wild lands" and vacant lots. They place high value on outdoor places for play that allow personal investigation and manipulation of materials.

Large areas are not required, but wildlife habitats that work for children should be centrally located in residential developments and buffered by residences instead of roads. Both social and physical safety issues should receive attention.

Ideally, a variety of habitats is desirable, including aquatic, forest, field, and edge. One authority says: "If one were forced to choose a single neighborhood open space that best suits wildlife and kids simultaneously, it should be a greenbelt park along a stream corridor with small patches or clumps of vegetation and pathways that accommodate bicycle travel. The closer to home, the better." (Schicker 1987).

A major portion of all outdoor activity for children may directly involve wildlife (e.g., collecting, observing, etc.). Unlike adults, who usually like birds and mammals, children are more interested in "creepy-crawly" varieties such as amphibians, reptiles, and insects.

These findings have important implications about how to interest children in wildlife conservation at an early age. Schicker says that giving children a challenging and naturally beautiful place to grow up "can only make them better decision makers about our environmental future."

Without a doubt, public knowledge, attitudes, and preferences regarding wildlife habitats are important contributing factors to habitat conservation in the metropolitan environment. Some research has shown that good wildlife habitats can be incorporated into residential open-space systems in a visually pleasing manner, which is best accomplished through support of urban planners and managers and integration of good design concepts by landscape architects and wildlife biologists.

In another study, 94 percent of respondents to a citywide survey said that wetlands add to the beauty, diversity, and quality of the human living environment. They also said it would be desirable to design and manage stormwater control basins for fish and wildlife as well as for flood and sediment control, if this were feasible technically and economically.

Residents of another city (in a third study) appeared to be able to recognize relative values of various habitats for wildlife. However, they preferred that the natural landscape not be close to their own homes. There was some indication that the more residents knew about wildlife and its habitat, the more they preferred a natural landscape. If residents knew still more, they could have even stronger conservation goals for remnant urban habitats.

How to Include Wildlife Habitat in Urban Planning

An urban wildlife conservation program should begin by attempting to minimize negative impacts from development, which can be accomplished by involving a qualified ecologist/biologist early in the planning process.

Biologists should determine habitat-types in the area to be developed, wildlife associated with those types, and relative value of different habitat-types to wildlife. In practice, it may be difficult to determine relative values of various habitat-types. It may help to use databases for fish and wildlife and natural heritage programs. Certainly, a critical habitat of a threatened or endangered species should be highly valued. Regionally limited or unique habitats also should rank highly, as should habitats that support large numbers of native species or exceptional species diversity, such as wetlands.

Efforts should be made to avoid developing high-value habitats—the forests surrounding the Kentucky River, for example—by developing lower-value habitats, such as the undeveloped agricultural crop fields in the same area.

Use of computerized fish and wildlife information systems and databases for natural heritage programs may make it easier to make decisions about habitat value.

The Kentucky Department of Fish and Wildlife Resources and the Kentucky State Nature Preserves Commission make available to the public through their databases information on:

- distribution—where species are found
- abundance—whether species are endangered, rare, common, etc.
- habitat-type—types of wildlife associated with various habitats.

This type of information can be fed into a GIS to determine 1) where development may or may not be appropriate or 2) whether proposed developments need design modifications to minimize impact on wildlife. The social value and potential value of identified resources should be considered at this stage of the planning process.

Once the assessment has been completed, the local governing body should have in place policies regarding wildlife conservation, protection of natural areas, and development. These policies should be integrated, where appropriate, with other community or county objectives to form a comprehensive greenspace plan with well-defined steps on how to accomplish wildlife conservation, including how to get the necessary commitments from leaders who control needed resources.

Specific objectives of the plan should be to:

- Protect habitats of greatest value
- Minimize impact of development on other sites through design modifications, creation of a new habitat, or both
- Integrate the plan where appropriate with rural conservation areas
- Maximize the wildlife potential of land within local authority ownership or control
- Provide for public use and encourage local people to use the habitat network. However, not every site can sustain free and regular access, so controls may be necessary through site design, location of access points, footpath networks, or, if needed, more rigorous methods.
- Promote wildlife conservation in general.

Some innovative designs related to conservation strategy have been proposed, such as altering the shape of building lots from rectangles to triangles in order to more effectively create large patches of vegetation on private lots.

Can Development Minimize Impact to Wildlife?

Cluster development is another innovative design that may offer greater flexibility than traditional development for maintaining some natural land features and habitats. Lot sizes, setback requirements, and road rights-of-way are typically reduced with cluster development, and development is grouped on portions of the site most favorable to building. The remainder is preserved as open space. Generally, clustering allows the same building density throughout a site, in contrast to traditional lot development.

Other recommendations to ensure the area's natural resources:

Protect critical habitats in public ownership by outright purchase of the land. Such areas are usually protected for multiple purposes, particularly riparian areas that are unsuitable for development but are valuable for recreation, flood control, and open space. If critical areas cannot be purchased outright, consider purchasing development rights to the properties to protect against future development and protect habitat values. The landowner still owns the property under this arrangement, but it has been reduced in its potential development value.

Offer incentives to landowners who protect valuable wildlife habitats. One potential incentive might be tax benefits for conservation easements. Another incentive might be allowing a landowner to increase density of housing units in an area of no particular wildlife value in exchange for not developing an area that is critical.

Resist temptation to allow subdivisions or developments featuring lots of one to 10 acres. This range is the worst type of zoning for wildlife and natural resources. It significantly fragments the landscape into small parcels, reduces vertical stratification (thus eliminating forest layers), and increases use of exotic plant landscaping material in rural areas. All these factors can have significant impact on the remaining natural areas.

Encourage developers to design around sensitive natural site features, using ecological principles to reduce impact on critical wildlife habitats. These principles include disturbing as little natural vegetation as possible; protecting natural vegetation when it is found in continuous corridors; and whenever possible, protecting riparian (streamside) vegetation. An open space system developed early in the planning process will ensure that the most valuable habitats are protected.

Plant or transplant additional native plants in the developed landscape to enhance or restore wildlife habitats. Revegetation techniques linking open spaces and providing vegetative diversity are particularly effective in creating corridors. Bodies of water with nearby vegetative cover are more valuable than ponds without plants, and, by revegetation, degraded watercourses can also be converted into hospitable sites for both wildlife and people.

Minimize disturbances by people to sensitive wildlife areas by creating buffer zones of adjacent low-density housing. Although not a substitute for careful planning, such zones create a gradual transition from a protected natural area to a heavily developed one.

Use cluster development or triangular lots to protect more open space for wildlife. Ideally, open space within developments should be integrated with corridors and reserves of open space beyond the site's boundaries.

Protect wetlands and develop stormwater control ponds. The Natural Resources Conservation Service can provide you information on how to design a stormwater control pond.