Chapter 2

Community Wildlife and Habitat Conservation Framework and Principles

Photo Courtesy of David Moynahan Photography

Numerous models, frameworks and principles have helped to shape approaches to wildlife conservation in the United States. From the original North American Model of Wildlife Conversation to modern ecosystem management, wildlife conservation has evolved to include the seminal works of E.O. Wilson, Michael E. Soule, Richard Forman, Larry Harris, Reed Noss and others. To meet the future challenge of sustaining wildlife, habitat and ecological systems, a wildlife and habitat conservation framework must be incorporated into land use planning and land-management decisions.

THE NORTH AMERICAN MODEL OF WILDLIFE CONSERVATION

Underpinning the approach to wildlife management in the United States and Canada is the *North American Model of Wildlife Conservation*. This model has evolved over the last 175 years and is based on two basic principles – that our fish and wildlife belong to all citizens of North America, and that they should be managed in such a way that their populations will be sustained forever.

It is rooted in the Public Trust Doctrine, derived from the 1842 U.S. Supreme Court case, Martin v. Wadell, where wildlife was held in common ownership by the state for the benefit of all. Thanks to this foundation, modern wildlife management has been hugely successful in restoring populations of game animals and their habitats. Species once generally regarded as nuisances, such as alligators, eagles and bears, are now revered by the public and have become icons for wild lands.

ECOLOGICAL PRINCIPLES FOR MANAGING LAND USE

The Ecological Society of America, a scientific non-profit established in 1915, released a report in 2000 entitled *Ecological Principles for Managing Land Use*. This includes a series of five ecological principles for managing land use to ensure that the "fundamental processes of Earth's ecosystems are sustained." According to the society, the responses of the land to changes in use and management by people depend on expressions of these fundamental principles:

1. **Time Principle** – In order to effectively analyze the effects of land use, it must be recognized that ecological processes occur within a temporal setting, and change over time. In other words, the full ecological effects of human activities often are not seen for many years, and the imprint of a land use may persist for a long time, constraining future land use for decades or centuries even after it ceases. Also under the time principle, given time, disturbed ecosystem components can often recover. This should guide a community to take a long view when striving to create and maintain habitat linkage corridors.
2. **Species Principle** – Individual species and networks of interacting species have strong and far-reaching effects on ecological processes. These focal species affect ecological systems in diverse ways:
   - Indicator species tell us about the status of other species and key habitats or the impacts of a stressor. Many amphibians and bird species are often considered indicator species. For example the Green Treefrog (Hyla cinerea) and Squirrel Treefrog (Hyla squirella) in Florida have served this function. Native indicator species are often used to assess system-wide ecological responses to land use changes, analogous to the canary in the coal mine.

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WHAT IS THE NORTH AMERICAN MODEL OF WILDLIFE CONSERVATION?

Derived from our rich national hunting heritage, the North American Model of Wildlife Conservation includes a set of guidelines known as the "Seven Sisters for Conservation." These serve as a basis for the conservation of both game and non-game wildlife. They are:

1. **Wildlife is a public resource.** It is held in common ownership by the state for the benefit of all people.
2. **Markets for trade in wildlife have been eliminated or publicly managed.** Generally, it's illegal to buy and sell meat and parts of game and non-game species.
3. **Allocation of wildlife by law.** States allocate wildlife use and taking by law, not by market pressures, land ownership or special privilege. The process fosters public involvement in managing wildlife.
4. **Wildlife can only be killed for a legitimate purpose.** The law prohibits killing wildlife for frivolous reasons.
5. **Wildlife species are considered an international resource.** Some species, such as migratory birds, transcend boundaries and one country's management can easily affect a species in another country.
6. **Science is the proper tool for discharge of wild–life policy.** The concept of science-based, professional wild-life management is central.
7. **The democracy of hunting.** In the European model, wildlife was allocated by land ownership and privilege. In North America, anyone in good standing can participate.

The enduring strategies of the North American Model include collaboration, partnerships, coalition building, professional development, science, political savvy, persistence, and open-minded approaches.

Source: "The Zoo without Bars, Wildlife Management for the New Millennium", Tim Breault, FFWCC, 2007.

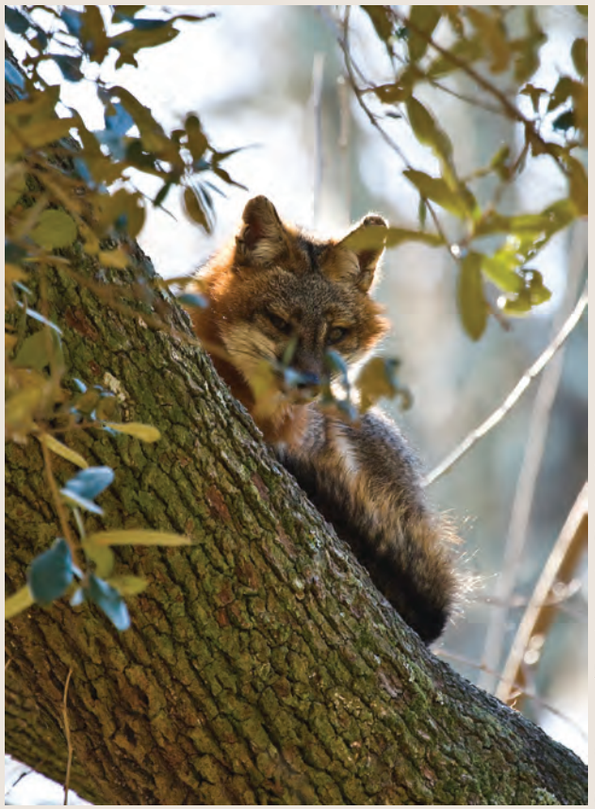

Photo Courtesy of David Moynahan Photography




- Keystone species have greater effects on ecological processes than would be predicted from their abundance or biomass alone. In Florida, the gopher tortoise can be considered a keystone species.
- Ecological engineers alter the habitat and, in doing so, modify the fates and opportunities of other species. Florida examples include the gopher tortoise and beaver.
- Umbrella species either have large area requirements or use multiple habitats and thus overlap the habitat requirements of many other species. These can include the panther and black bear.
- Link species are those that perform an important ecological function or provide critical links for energy transfer within or across complex food webs. Their removal from the system would affect one or multiple other species (e.g., alligators and their role in the creation and maintenance of ponds and wet areas during times of drought).

3. **Place Principle** – Each site or region has a unique set of organisms and aboiotic conditions influencing and constraining ecological processes.
4. **Disturbance Principle** – Disturbances are important and ubiquitous events whose effects may strongly influence population, community, and ecosystem dynamics. Disturbances can include natural events such as fires, drought and inundation, as well as man-made disturbances including building roads, drawing down water tables, adding night lighting, or clearing land for development. Land use changes that alter natural disturbance regimes or initiate new disturbances are likely to cause changes in species abundance and distribution, community composition, and ecosystem function.
5. **Landscape Principle** – The size, shape, and spatial relationships of habitat patches on the landscape affect the structure and function of ecosystems. Settlement patterns and land use decisions fragment the landscape and alter natural land cover patterns. Habitat fragmentation decreases in the size or wholeness of habitat patches and can increases in the distance between habitat patches of the same type. This can greatly reduce or eliminate populations of organisms, as well as alter local ecosystem processes.

Two other commonly accepted principles can perhaps be added to this list of ecological principles (Dr. T. Hoctor, University of Florida, Geoplan):

1. **Ecological Complexity Principle** – Ecosystems are not only more complex then we think, but they may be more complex than we can think.

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Photo Courtesy of: Panther in Tree: Mark Lotz, FWC; Manatee in Canel: Eric Weber; Cow-Nosed Rays: Jeffrey Pennington; Snake: Matt Aresco

Chapter 2

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In Florida, some commonplace applications include avoiding sprawling development and minimizing the need for new roads and other infrastructure. Additionally, when planning new or retrofitting old development, it is important to maintain or restore linkages between sizable patches of critical areas, and minimize or compensate for the effects of development on ecological processes.

2. **Precautionary Principle** – When there is uncertainty in land planning and wildlife and habitat conservation needs (which is most always), err toward protecting too much instead of too little. It is difficult and, at times, impossible to restore what has been lost.

The *Ecological Principles for Managing Land Use* report also includes a series of guidelines to incorporate ecological principles into land use decision making. The society recommends that land managers should:

1. Examine the impacts of local decisions in a regional context.
2. Plan for long-term change and unexpected events.
3. Preserve rare landscape elements and associated species.
4. Avoid land uses that deplete natural resources.
5. Retain large contiguous or connected areas that contain critical habitats.
6. Minimize the introduction and spread of nonnative species.
7. Avoid or compensate for the effects of development on ecological processes.
8. Implement land-use and management practices that are compatible with the natural potential of the area.

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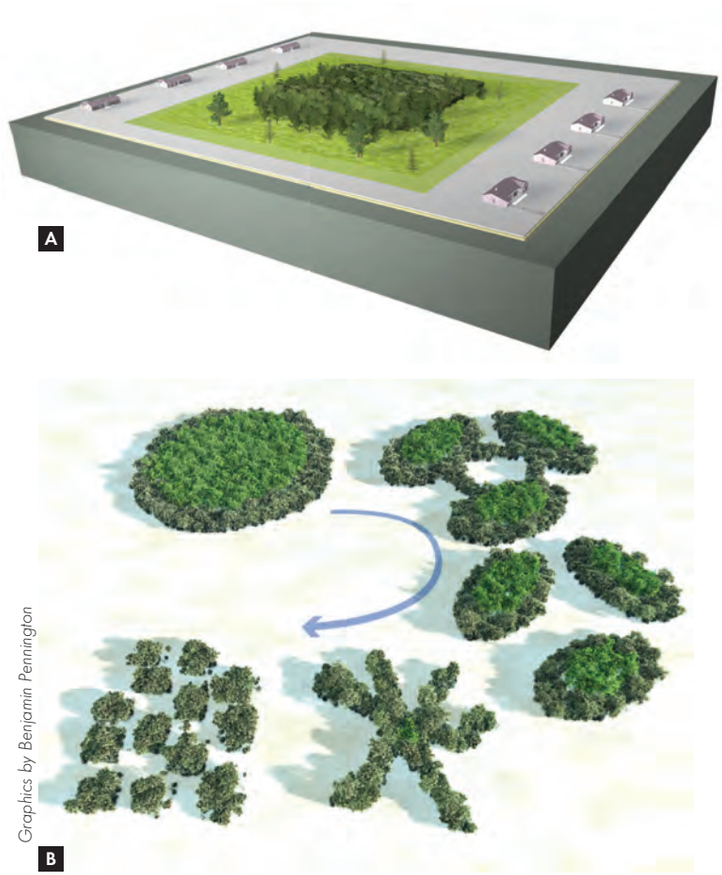
DESIGNING FUNCTIONAL GREEN INFRASTRUCTURE FOR WILDLIFE

Our understanding of how to design wildlife-sustainable green infrastructure has its roots in a field known as island biogeography. Scientists observed that islands and peninsulas around the world generally hold fewer species than expected when compared to larger land masses. In their 1967 book, *The Theory of Island Biogeography*, Edward O. Wilson and R.H. MacArthur propounded that the number of species found on an island is determined by the distance from the mainland and the size of the island, both of which would affect the rate of extinction on and immigration to the island. Thus, a larger island closer to the mainland would likely have a greater diversity of species than a smaller island farther from the mainland. Later studies have expanded this to include that habitat diversity may be as, or more important than, the island's size.

An "island" can include any area of habitat that is surrounded by areas unsuitable for species on the island – including forest fragments, reserves and national parks surrounded by human-altered landscapes. This theory has proven remarkably accurate and has become an important foundation of modern landscape ecology. It also has led to development of the habitat corridor as a conservation tool to increase the connections between habitat islands. These corridors can increase the movement of species between protected lands, helping to increase the number of species that can be supported.

As landowners and local governments work together to create wildlife-friendly communities, it is important to understand more about the key concepts of patches, corridors, and edge effects which have evolved out of the study of biogeography. In his 1995 book, *Land Mosaics: The Ecology of Landscapes and Regions*, noted Harvard Professor of Landscape Architecture Richard T.T. Forman described these important concepts in great detail.

Patches – Forman defined a patch as a relatively homogenous area that differs from its surrounding. From a wildlife perspective, patches are discrete landscape areas which offer better survival prospects for wildlife, and regularly meet living prerequisites, including food, cover, water, living space, and limits on disturbances. Human impacts tend to lead to smaller and smaller



Graphics by Benjamin Pennington

A) A small patch of habitat, cut-off from similar habitat areas, is depleted overtime of wildlife and the opportunities for wildlife replenishment.; B) Habitat patch shape, size and connectivity can be important to wildlife survival. A large patch with a coherent interior environment is best for many species. Several smaller habitat patches with reasonable cross-connections may sustain desired wildlife. Several patches in relative close proximity are often better than stretched-out or smaller chopped-up patches that lose unique interior habitats and micro climates.

patches – or islands–of living space. Patches are further fragmented by development impacts including roads and subdivisions. Agricultural practices leading to increased fragmentation include tilling for crops, burning, over and under watering, dosing with fertilizers and pesticides, and livestock ranging.

Habitat fragmentation can lead to changes in physical factors, shifts in habitat use, altered population dynamics, and changes in species composition. Patch (or island) size has been identified as a major feature influencing the health and sustainability of plant and animal communities (Monica Bond, Center for Biological Diversity, *Principles of Wildlife Corridor Design, 2003*). There are a few exceptions. For example, raccoons and mockingbirds have adapted to human-dominated landscapes and discontinuous habitats.

The composition and diversity of patches, as well as their spatial relationship with one another, will determine the relative sustainability of a community's green infrastructure. Patches may or may not be self evident, so it is important to have experienced input into the design of the community plan.

Corridors – A corridor can be defined as a strip of land that aids in the movement of species between disconnected patches of their natural habitat. This habitat typically includes areas that provide food, breeding ground, shelter, and other functions necessary to thrive. Not only can human impact affect the size of patches, as described earlier, but it can also cause animals to lose the ability to move between the patches. Because they allow for long-term genetic interchange, corridors can also reduce inbreeding, facilitate patch re-colonization, and increase the stabilities of populations and communities.

Planners, landscape architects, land managers and conservation biologists are faced with the task of reconnecting existing fragmented landscapes. Strategic conservation decisions need to be made within a larger community context. Clear financial

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Wildlife corridors appear to benefit not only wildlife but also plants. A six-year study at the world's largest experimental landscape devoted to the corridors has found that more plant species – and specifically more native plant species – persist in areas connected by the corridors than in isolated areas of the same size. The results suggest that corridors are an important tool not only for preserving wildlife but also for supporting and encouraging plant biodiversity.

CASE STUDY

Wildlife Corridors Benefit Plant Biodiversity

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Researchers created a massive outdoor experiment at the Savannah River Site National Environmental Research Park on the South Carolina – Georgia line. In two earlier studies, the researchers concluded that corridors encourage the movement of plants and animals across the fragmented landscapes. They also found that bluebirds transfer more berry seeds in their droppings between connected than unconnected habitat patches, suggesting that the corridors could help plants spread.

The latest research tackled a much broader question: Do corridors increase plant biodiversity overall? The difference between the habitats studied was similar to the difference between urban and natural areas, where corridors are most often used. The experimental sites were created in 1999, and there was little difference between connected and unconnected patches of habitat one year later. But a different pattern became clear in ensuing years. Not only were there more plant species in connected than unconnected patches, there were also more native species. The difference arose because unconnected patches gradually lost about 10 native species over the 5 years, whereas the natives persisted in connected patches.

Photo Courtesy of U.S. Forest Service

An aerial photograph of one experimental landscape showing habitat patch configurations.

Meanwhile, the corridors seemed to have no impact on the number of exotic or invasive species in the connected and unconnected patches. It seems that either exotic species already were widespread, and did not rely on corridors for their spreading, or they remained in one place. The scientists think that invasive species, which by definition are good at spreading, are little affected by corridors. Native species, by contrast, are less invasive in nature and appear to be assisted more by the corridors and the linkages they provide. The researchers suggest it may be that corridors play to the strengths of native species.

Source: University of Florida News, 2006; Writer, Aaron Hoover, reporting on work by Douglas J. Levey, et al, Science, 2005 "Effects of Landscape Corridors on Seed Dispersal by Birds."

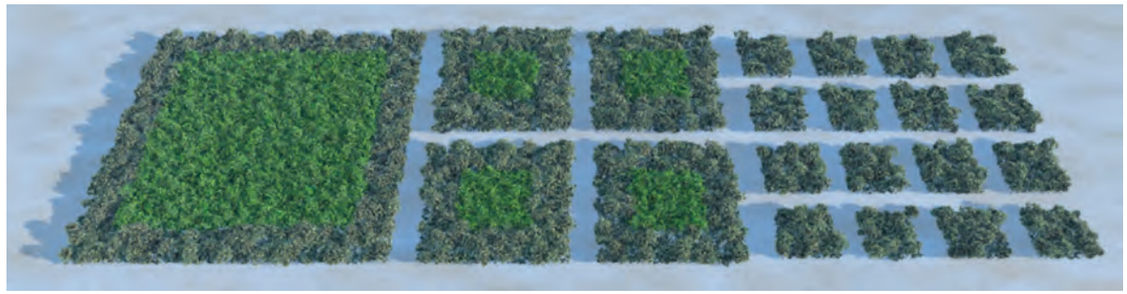
limitations related to land purchases, restoration options, easements and other tools will shape the final outcome.

Facilitating connections between Florida's already protected lands and outlying patches can be a valuable tool. Through careful planning and design, wildlife corridors can lessen the negative effects of habitat fragmentation by linking patches of remaining habitat. Corridors can be incorporated into the design of a development project either by conserving an existing landscape linkage, or by restoring habitat to function as a connection between protected areas onsite, off-site and through-site.

There is still considerable debate over the effectiveness of corridors and how they should be configured and sized. The answer depends on the species under conservation consideration. The level of connectivity needed to maintain a population of a particular species will vary, and depends on such issues as the size of the population, survival and birth rates, the level of inbreeding, and other demographics which can serve as baseline data to determine whether a corridor is likely to be functional.

In 1992, forestry experts Paul Beier and Steve Loe drafted, *In My Experience: A Checklist for Evaluating Impacts to Wildlife Movement Corridors*. They identified six steps for evaluating corridor practicality, including to:

1. Identify and select several target species for the design of the corridor (e.g., select "umbrella species" and the associated benefiting species).
2. Identify the habitat patch areas the corridor is designed to connect.
3. Evaluate the relevant needs of each target and associated species such as movement and dispersal patterns, including seasonal migrations or environmental variations (e.g., some species depend on there being season wetlands available).
4. For each potential corridor, evaluate how the area will accommodate movement by each target species.



Protected interior environment (brighter green), progressing to those that essentially become all edge environment and no interior.

Graphic by Benjamin Pennington, remade from illustrations in Micheal E. Soule, Journal of the American Planning Association, "Land Use Planning and Wildlife Maintenance, Guidelines for Conserving Wildlife in an Urban Landscape," 1991

5. Draw the corridor on a map and work with community to establish a pragmatic plan to sustain or restore the connections.
6. Design a monitoring program to gauge corridor viability, human community interface impacts and modification needs.

When evaluating a potential corridor, it is important to consider how likely the animal(s) will encounter the corridor's entrance, actually enter the corridor, and follow it. Factors to evaluate include whether the corridor contains sufficient cover, food, and water, or whether these features need to be created and maintained. It is also important to determine if the new development contains or creates impediments to wildlife movement. These may include topography, the introduction of new roads, and the types of road crossing, fences, outdoor lighting, domestic pets, and noise from traffic or nearby buildings, exotic plant migration, and other human or disturbance impacts.

Edges – The "perimeter zone" of a patch can have a somewhat different environment from the interior of the patch, due to its proximity to adjacent patches, changes in light penetration, noise, microclimate, and other factors. This "edge effect" can have implications when planning for conservation areas. For example, a long, thin, habitat patch could essentially be all edge, while a circle has the minimum perimeter for a given area, and

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Edge effects have implications when planning the major components of a community's green infrastructure such as deciding whether to work toward a single large or several smaller interconnected reserves. In more developed areas, a carefully considered network of varying sized habitat patches with appropriately designed linkage corridors may be appropriate.

CONSIDERATIONS OF CORRIDOR DESIGN

- The corridor should be as wide as possible. The corridor width may vary with habitat type or target species but a rule of thumb is wider and larger areal extent is better.
- The longer the corridor the wider it may have to be.
- Maximize land uses adjacent to the corridor that reduce human impacts to the corridor. Essentially, corridors surrounded by intensive land uses should be wider than those surrounded by low intensity uses.
- To lessen the impact of roads, maintain as much natural open space as possible next to any culverts and bridge under/overpasses to encourage their use.
- Do not allow housing or other impacts to project into the corridor or form impediments to movement and increase harmful edge effects.
- If buildings or housing are to be permitted next to the corridor, establish a buffer and place a conservation easement over this area.
- Where the hydrology supports it, place the development's stormwater retention/detention facilities between the managed land and conservation land as an added buffer.
- Develop strict lighting restrictions for the houses adjacent to the corridor to prevent light pollution into the corridor. Lights must be directed downward and inward toward the home. (This may involve adopting local "Dark Skies" lighting ordinances).

Source: Adapted from Monica Bond, Center for Biological Diversity, Principles of Wildlife Corridor Design, 2003.

thus the least edge. Some species, such as white-tailed deer, eastern cottontail, bobwhite, are edge-adapted and are not harmed by the edge effect. Many other common species have not adapted to the edge zone.

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MERGING BIOLOGY WITH PLANNING

In 2003, Karen Williamson of the Heritage Conservancy produced *Growing with Green Infrastructure*, which pulls together biology and planning studies. She describes a network of lands that can make up green infrastructure. These lands can range in size and shape, and require differing levels of conservation and protection from human impact, according to the type of resources being protected.

These include hubs, generally larger tracts of land which act as an 'anchor' for a variety of natural processes and provide an origin or destination for wildlife. These can include wildlife reserves, managed native lands, working lands including farms, forests, and ranches, parks and open spaces, and recycled lands including mines, brownfields, and landfills that have been reclaimed. Links "interconnect the hubs, facilitating the flow of ecological processes." These may include linear conservation corridors such as river and stream corridors and greenways, and buffer lands such as greenbelts. Landscape linkages are "open spaces that connect wildlife reserves, parks, managed and working lands, and provide sufficient space for native plants and animals to flourish." These may also include cultural resources, recreational areas and trails, scenic viewsheds, and even streetscapes.