RESERVE/PATCH SIZE: SINGLE LARGE OR SEVERAL SMALL (SLOSS)?

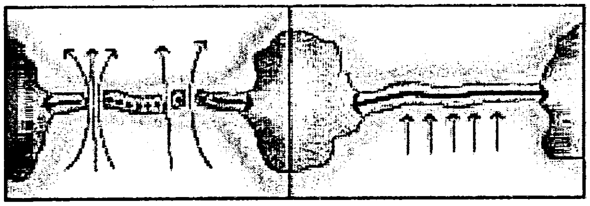
Although conservation corridors are the focus of this manual, a brief discussion of issues relating to reserve/ patch size is needed. Arguments among conservation biologists continue over whether a single large reserve or several smaller reserves (having the same total area) is best for preserving biological diversity at a regional level. Several small reserves may result in highest localized species richness, but this strategy may compromise the integrity of populations of area-sensitive species. Diamond (1976) suggests, "The question is not which refuge system contains more total species, but which contains more species that would be doomed to extinction in the absence of refuges."

Conservation corridors become an important part of this debate. If regional or watershed scale corridors are impossible or unlikely to succeed, a single large reserve may be the best choice. Edge and area effects are diminished, population sizes can be larger, and species diversity higher, resulting in greater diversity within the ecosystem. If several small reserves can be created and connected by corridors, a greater diversity of habitats may be preserved and a larger geographic distribution of populations maintained. Separate populations can exist in each reserve, isolated from local disasters affecting survival in other reserves, but acting as a functional metapopulation capable of sustaining the species across the landscape. The fragmented nature of most agriculturally dominated landscapes suggests that the concept of several small reserves will be most applicable.

At the conservation plan scale, the planning and design issue is generally not reserves but patches. Large patches, like large reserves, tend to support a greater diversity of species. However, if several small patches can be preserved (or created) and connected, the wildlife resource may be equally well served.

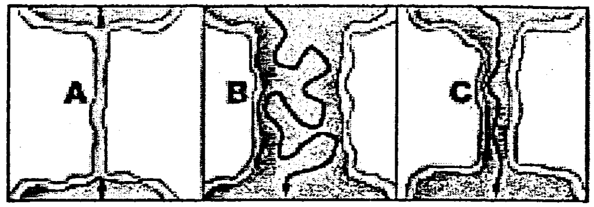
CORRIDOR PRINCIPLES

CONTINUOUS CORRIDORS ARE BETTER THAN FRAGMENTED CORRIDORS.



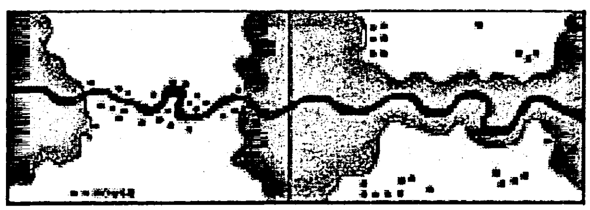
- *Conduit Functions:* Corridors facilitate movement of organisms through landscapes. Gaps in corridors disrupt movement, especially for interior-dwelling species. The ability of an individual to cross corridor gaps is dependent on its tolerance for edge conditions, its movement and dispersal characteristics (i.e., how fast it moves, and how far it moves at one time), the length of the gap, and the amount of contrast between the corridor and the gap.
- *Stepping Stones:* While a continuous corridor is better than a corridor with gaps, corridors with gaps may be preferable to no corridor at all. It is not an optimal situation, but a series of small patches between two larger patches can serve as a "stepping stone" corridor if the distance between patches is not too far (see "Nearness Is Better Than Separation" on pp. 5-4).
- *Filter/Barrier Functions:* Gaps in an otherwise solid corridor seriously diminish the effectiveness of the corridor as a filter or barrier. Gaps allow plants, animals, pollutants, wind, and wind-blown particles access across the corridor, and often result in localized concentration of these elements. However, in some instances passage through corridors may be desirable.

WIDER CORRIDORS ARE BETTER THAN NARROW CORRIDORS.



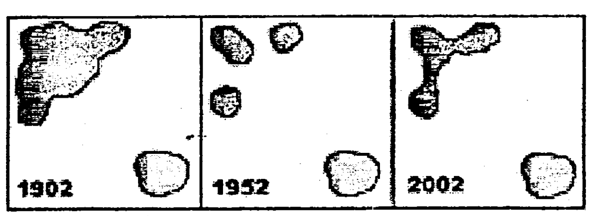
- *Habitat Functions:* Corridors at the regional and watershed scales typically serve as transitional habitat for populations moving through them. The longer it takes a species to move through the corridor, the more important its habitat function becomes. Wider corridors reduce area effects and edge effects within the corridor. Thus, a broader range of species, including interior species, is more likely to use the corridor. At the conservation plan scale, corridors often play an important role as habitat as well as a conduit. Wider corridors at this scale will thus increase the amount and diversity of habitat available and may accommodate interior species.
- *Conduit Functions:* Wider corridors reduce edge effects for individuals and populations moving through them. Optimum width is determined by the strength of the edge effect and species requirements. Corridor A above is too narrow – edge effects dominate the corridor and predation and parasitism may be increased. Some researchers suggest that corridor B may be too wide – edge effects are negligible, but animals may spend too much time "wandering" within the corridor, increasing overall mortality. This concern is generally not applicable in agricultural landscapes because landowners cannot afford to set aside overly wide blocks of land in corridors. Corridor C balances edge effects with navigability issues and represents a more desirable width.
- *Filter/Barrier Functions:* Wider corridors are more effective barriers to movement across them.
- *Source Functions:* Wider corridors are more likely to act as a population source (adding individuals) than as a sink (removing individuals).

NATURAL CONNECTIVITY SHOULD BE MAINTAINED OR RESTORED.



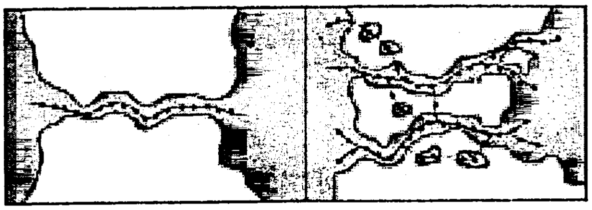
- Maintaining historical connections between patches is essential in maintaining species diversity and population viability within a watershed. Preventing fragmentation of existing corridors that connect patches is less expensive than restoring connections. In many cases, however, it may be necessary to restore historical connections between patches. Historical vegetation (the vegetation that existed prior to fragmentation) should be used in restoring corridor connections.

INTRODUCED CONNECTIVITY SHOULD BE STUDIED CAREFULLY.



- Connected is better than fragmented, but care must be taken to ensure that one is not linking historically disconnected patches. Long-separated populations of the same species often develop specialized genetic adaptations to their particular habitat conditions. Connecting such populations through a corridor could result in the loss of those adaptations. In agricultural landscapes, connectivity between corridors and patches benefits most endemic (native) species when historic vegetation is planted in the corridor.

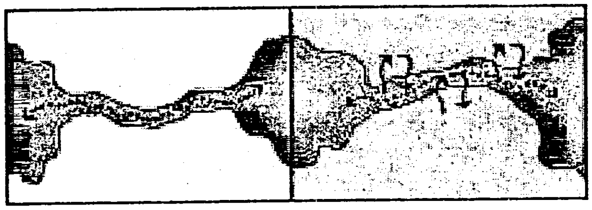
Two Or More Corridor Connections Between Patches Are Better Than One.



- *Alternate routes:* Redundancy should be built into the conservation corridor network, particularly at small scales. If multiple paths exist for an animal to get from one point to another, the animal is more likely to complete the journey. It is important to consider that animals may not recognize a corridor as a conduit to a destination. They recognize it as a continuation of attractive habitat, and once inside, their movement is restricted and channeled by the corridor's linearity. It is usually a chance occurrence that they make it from one end of the corridor to the other. The more chances there are for that movement to occur, the more likely it is to occur.
- *Insurance:* Multiple corridor connections between patches safeguard the system from disturbances and disasters. If management mistakes or natural occurrences such as fire temporarily destroy one of the corridors, other corridors will maintain the link between the patches while the disturbed corridor regenerates. It should be noted that periodic burning of corridors may be necessary for management.
- *Stepping stones:* Closely spaced stepping stone patches can be effective in providing alternate routes between larger patches. Species movement behavior, distance between stepping stones, and contrast between patch and matrix determine movement between stepping stones.

MATRIX PRINCIPLES

Manage The Matrix With Wildlife In Mind.



The matrix is often an important source of food and seasonal cover in agricultural landscapes. The full habitat value of both corridors and patches can only be realized when the adjacent matrix is managed for wildlife. If it is not managed with wildlife in mind, the consequences can be disastrous.

- Late spring mowing of forage crops can destroy nests and kill adults of ground nesting species like the ring-neck pheasant.
- Fall plowing may eliminate important food resources, critical to some species during the winter months. Conservation tillage practices leave waste grain on the surface, where it is available to wildlife. However, some conservation tillage systems rely on chemical weed control and could present a significant threat to certain species.
- Grazing practices can have a significant impact on the value of the matrix to wildlife. Heavily grazed pastures provide very little food or cover. However, managed grazing can be an important tool for maintaining healthy, vigorous grass/forb communities.

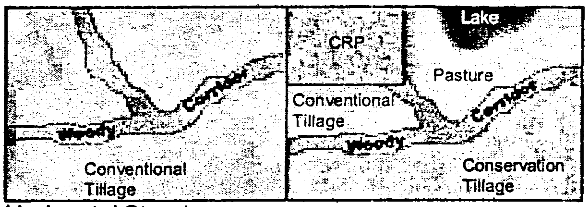
Managing the matrix to benefit wildlife can be as simple as how a hay field is mowed. Mowing from the center to the edge (toward cover) is preferable. Other techniques, such as using flush bars, rotation grazing, leaving turn rows adjacent to cover, and similar practices, can improve wildlife survival. Well-planned and designed corridors, in conjunction with a matrix managed for wildlife, should result in a great deal of wildlife movement between corridors and the matrix. Species living in corridors lying within a matrix of low value to wildlife will be restricted to the corridor, increasing competition for corridor resources.

STRUCTURAL PRINCIPLES

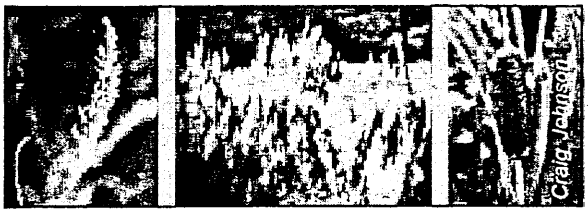
STRUCTURALLY DIVERSE PATCHES AND CORRIDORS ARE BETTER THAN SIMPLE STRUCTURE.

- *Vertical structure* refers to the "layers" of different plant forms and sizes in the plant community. Complex forested plant communities may have five or more layers; from top to bottom they are the *canopy*, the *understory*, the *shrub layer*, the *herbaceous layer*, and the *forest floor*. At the other extreme, a wheat field for example, usually has only one layer – wheat. These layers are best illustrated with a cross-section of the plant community (see diagram). Vertical structure has a significant influence on the diversity of wildlife species present in the community. Different layers offer food, water, cover, shelter, or breeding sites to different species, resulting in a rich diversity of wildlife utilizing one habitat type. Each species fills a *niche* or specialized position, in the habitat. However, some species that evolved in grassland habitat, like the lesser prairie chicken (*Tympanchus pallidianctus*), require simple vegetative structure with diverse plant species composition.


Vertical Structure



Horizontal Structure



Native Species

- *Horizontal structure,* at a watershed scale, refers to the arrangement of different habitat types as seen from above. Components of horizontal structure would include forests/woodlands, shrubby areas, grasslands, cropland, urban areas, lakes and streams, and wetlands. The intricacy with which these different features are woven together or *interspersed* affects the overall habitat quality of the landscape. For example, grasslands afford certain benefits to wildlife when they exist on their own. The same is true for a windbreak and a wetland. But when these three habitats are arranged in close proximity to each other, the overall habitat value for many species is greater than the sum of the parts. Wildlife can move safely between each habitat type, exploiting the benefits offered by each.

- *Additional benefits:* Both horizontal and vertical structure provide additional benefits on the agricultural landscape. For example, windbreaks are frequently employed to control wind erosion of soil. Maximizing the benefits of windbreaks employs proper spacing of windbreaks and rows within the windbreak (horizontal structure) and inclusion of several plant heights to block wind at ground level and direct it upward (vertical structure).

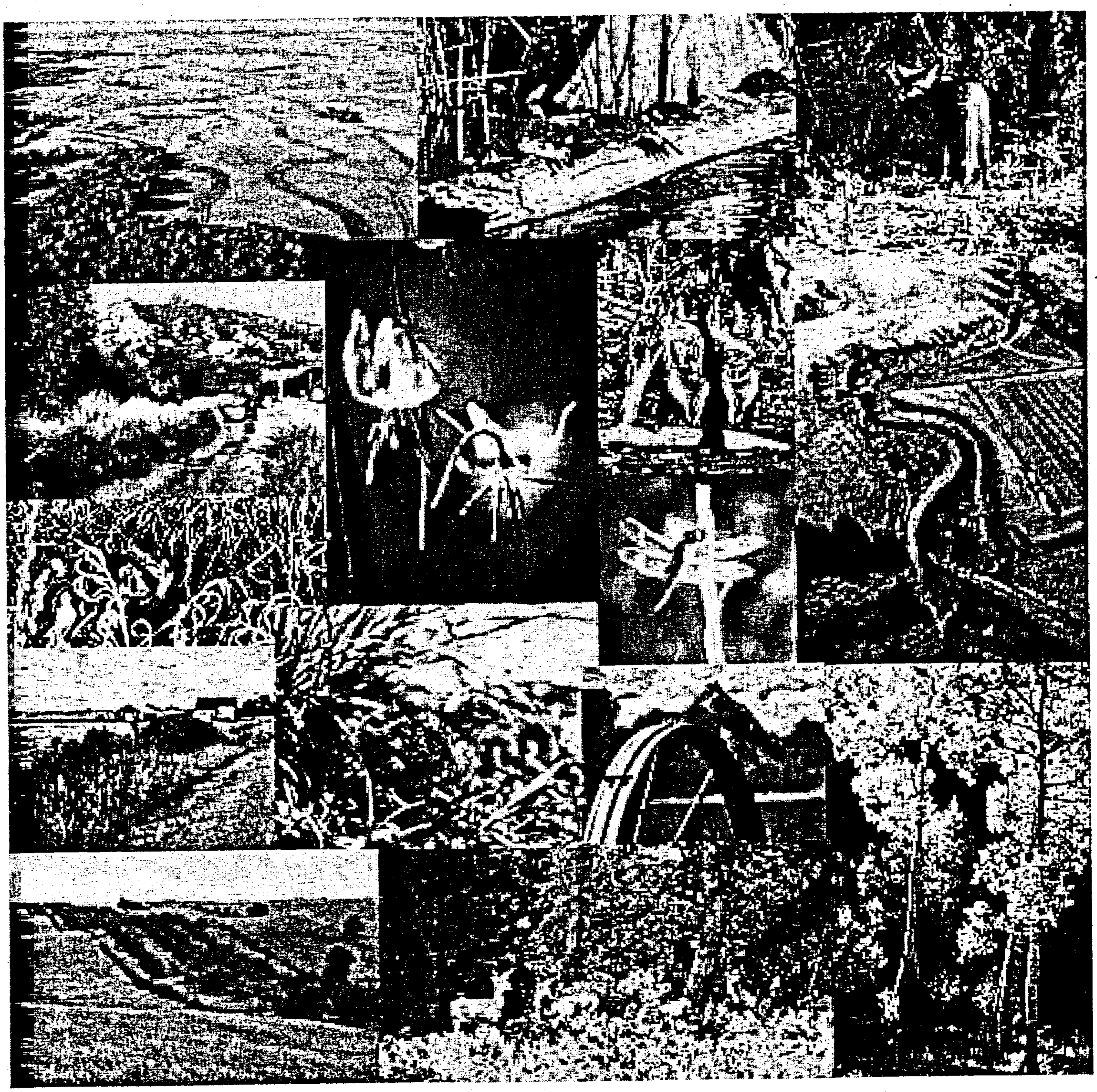
- *Native plants*: Corridors are usually intended to benefit native or desirable naturalized wildlife species. Native wildlife and plant species have co-evolved, each benefiting the other. If the goal is to provide habitat, for native *wildlife* species, as it often is, native *plant* species have the highest probability of providing their life requisites. There are other practical reasons to use native vegetation. For example, native grass communities, once established, are often better at preventing invasions of exotic weeds. Also, disturbances, such as plant diseases, are usually less damaging to native plant communities than they are to monocultures of introduced or cultivated species. They are also less water consumptive and are less likely to require expensive supplemental nutrients.

Applying Principles (An Overview)

A general approach to using these principles in a wildlife corridor planning project involves:

1. Review the historical pattern of patches and corridors, if available.
2. Study the existing pattern of patches and corridors in the landscape.
3. Identify locations where connectivity is both desirable and feasible.
4. Use the above principles to propose the most efficient means to reconnect the landscape in a way that produces the greatest benefits to wildlife while minimizing the land area taken out of production or suburban development.

Every landscape is unique. Land planners and managers should utilize those principles that apply to the specific conditions inherent in the area being planned. Applications of these principles within the NRCS planning process is discussed extensively in Chapters 6 and 7.



SCALE

"Because ecological processes and elements of biological diversity occur at a variety of scales, a comprehensive strategy to conserve these processes and elements must also encompass a diversity of scales." - Noss (1991).

Corridors exist in the landscape at a variety of scales, from individual fencerows to continentally important migration routes. Several researchers have explored the issue of scale as it applies to conservation corridors and in principle agree that there are three different scales at which corridors function in the landscape. For example: Reed Noss describes corridors at 1) the Regional or Continental scale, 2) the Landscape Mosaic scale, and 3) the Fencerow scale. While these are descriptive, easily understood terms, it is useful to redefine them in terms directly applicable to NRCS planning directives. The three scales of interest thus become:

- Regional scale
- Watershed scale
- Conservation plan and practice scale

A successful overall wildlife conservation effort must encompass all scales.

Regional Scale

Conservation corridors at the regional scale are large, loosely defined areas that connect large wildlife preserves or areas of high biodiversity. They are typically a diverse mix of natural and artificial plant communities, often tens of miles in width, that facilitate the movement of individuals and groups of individuals from one reserve to another. For example, neotropical birds and waterfowl make extensive use of riparian corridors during spring and fall migrations.

Regional corridors provide for the long-term health of populations and ecosystems and preserve biodiversity within the region by:

- Providing opportunities for wildlife populations and communities to adapt to environmental stress or change.
- Supporting genetic health of wildlife populations through occasional immigration and emigration of individuals between populations.
- Preserving opportunities for wildlife to meet basic life requirements such as seasonal migrations for breeding, birthing, or feeding.

Regional corridors are generally more important for larger, more mobile animals. Corridor length, speed of travel, and space and resource requirements of individual species determine which species will use the full length of the corridor. Generally, the corridor needs of larger animals also encompass those of smaller, less mobile species. By providing for movement of cougars, bear, elk, or other large, highly mobile species, the needs of many other species may also be met.

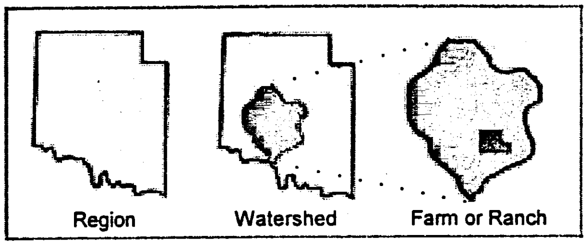


Figure 5-2: *Three scales are useful in corridor planning.*

In essence, regional corridors are narrower versions of reserves, often relatively devoid of human disturbances, which allow populations to move in response to environmental changes or other stimuli. Many regional corridors have been used by certain wildlife species for generations.

Mapping Scale and Methods

Wildlife conservation can be viewed at varying levels of detail. At the regional scale, a broad-brush approach or "coarse filter" can be used to identify wildlife problems and opportunities at the wildlife community level. Important types of information to map for "coarse filter" regional scale studies include:

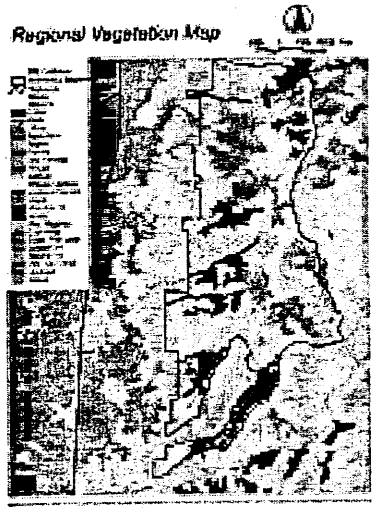
- Ecoregions
- Regional soils
- Surficial geology
- Vegetation types
- Air basins
- Topography
- Hydrology
- Major migration routes
- Special areas (winter range, etc.)
- Land cover types
- Roads, highways, railroads, and utilities
- Land ownership
- Existing wildlife preserves

"Much of the discussion about corridors leaves the impression that we are constructing something new in the landscape. We talk of 'establishing' corridors rather than 'maintaining' corridors... But the corridor strategy is fundamentally an attempt to maintain or restore natural landscape connectivity, not to build connections between naturally isolated habitats." -Noss (1991).

Map Scale

Common map scales for regional mapping vary from 1:100,000 to 1:1,000,000.

Figure 5-3: Regional vegetation analysis maps provide an excellent base for regional corridor planning efforts.



Methods

Mapping the necessary information can be completed either by hand or with the aid of computers. There is currently a strong push across the nation to inventory natural resources and make the information available in common digital formats. Geographic Information Systems (GIS) technology is being used as a tool to view, combine, and analyze large sets of spatial and tabular information. Much of these data are available for a small fee (often free) and are highly appropriate for use in regional corridor planning projects. Data are frequently interpreted from aerial photographs, aircraft-based sensors, or satellite imagery. GAP analysis is an excellent example of this approach (discussed below).

Computers allow for easier and more precise management of data. If a GIS is used for analysis and map generation, the habitat requirements of many species can be evaluated relatively quickly. If hand methods are used, a few key indicator species representing a broad cross-section of biodiversity in the region may be selected.

GAP Analysis

A GAP analysis is a "coarse filter" wildlife planning approach that provides a quick overview of the potential distribution and conservation status of wildlife species in a region or watershed.

GAP analysis is based on correlations between vegetation communities and potential wildlife distributions. It also considers land ownership and management practices. GAP is based on the premise that habitat for wildlife is generally related to vegetation composition and structure. Two products from this process are 1) a species richness map and 2) a GAP map. The species richness map highlights areas where there exists potential for rich diversity in wildlife species - "hot spots" of biodiversity. The GAP map compares the geographic location of biodiversity hot spots with the location of areas managed primarily for long-term maintenance of native populations; i.e. national parks, forests, rangelands, wildlife refuges, and wilderness areas. If the two layers do not coincide spatially, there is a "gap" in the protection of biodiversity. Action can then be taken to conserve currently unprotected habitats and hot spots. The next step is to examine connectivity between reserves. If they are fragmented, have they always been fragmented or is fragmentation a result of human activities? If the reserves were historically isolated, should they remain isolated? If they were historically connected, regional corridors should be considered to reestablish the link. A general outline for the GAP analysis process follows. Additional information can be found in "Gap Analysis: A Geographic Approach to Protection of Biological Diversity" in *Wildlife Monographs* 57 (1) 1993.

Outline for GAP Analysis Process

1. Determine those species that occur in the region that are of concern or interest.
2. Collect and compile habitat relationship and occurrence data for those species.
3. Create a map of where the habitats occur in the region based on existing vegetation.
4. Overlay the wildlife habitat data with the habitat map to determine areas of rich species diversity.

Product: *Species Richness Map*

1. Prepare a general land ownership map that classifies lands into public and private ownership.
2. Assign a management status of 1 to areas that are managed for wildlife such as wildlife refuges, Nature Conservancy lands, etc.
3. Assign a management status of 2 to areas that are managed for natural conditions such as USFWS refuges managed for recreational uses and BLM areas of Critical Environmental Concern.
4. Assign a management status of 3 to areas that are prevented from being permanently developed, including most BLM and USFS lands.
5. Assign a management status of 4 to private and public lands not managed for natural conditions.
6. Overlay this map with the habitat relationship data to determine habitats that are offered the least protection in the region, with 1 status lands providing the highest protection.

Product: *GAP Map*

This process can be completed by hand, but GIS software can add speed, flexibility, ease of duplication, and the ability to explore multiple alternatives. If the information produced will be used by many different people over a long period of time, GIS is clearly a superior choice.

Make full use of ecoregion GIS maps of soils, crop production, and other production oriented resources. This technology can be used to map wildlife corridors of significance at regional scales. These maps will be an invaluable resource for regional scale wildlife planning efforts. They would be an excellent complement to any GAP analysis study.

Watershed Scale

The width of corridors important to wildlife at the watershed scale tend to be measured in miles or fractions of miles; although an entire watershed or portion of a watershed may be part of a regional migration or dispersal corridor. Like regional corridors, watershed corridors facilitate seasonal migration and dispersal. Yearling beaver, for example, will use a stream corridor to disperse from the area in which they were born and reared into unoccupied habitat elsewhere in the watershed. Watershed corridors also connect populations and sub-populations into metapopulations. Many species use corridors in the watershed as travel lanes linking various habitat resources within their home range. Often these corridors are used primarily as habitat by some species, birds in particular. Bats often follow corridors to avoid predation from owls. The corridors' conduit function is of limited importance to these species. Where GAP analysis information is available, it should be integrated into area-wide corridor planning.

Mapping Scale and Methods

Mapping watershed scale corridors is similar to regional corridor mapping; however, the "coarse filter" used for regional corridors often needs to include more detail. More detail may be needed in defining the placement and shape of corridors as well as more specific information describing the wildlife uses and quality uses of landscape elements. For example, a large farm may be defined on a regional corridor map as simply "agricultural." On watershed scale maps, this same farm may be further categorized into "row crops," "small grains," and "pasture" to adequately plan for a particular species.

Important general types of information to be included on watershed scale corridor maps include:

- Soils
- Vegetation types by plant community
- Air basins
- Topography
- Hydrology
- Land use
- Migration and dispersal routes
- Special areas (winter range, etc.)
- Land cover types, including crops
- Roads, highways, railroads, and utilities
- Land ownership
- Locations of existing conservation practices or programs such as CRP, WRP, or CREP

For a more specific data list, see chapter 6, pp 6-17.

Map Scale

Depending on the size of the watershed planning area, mapping scales could vary considerably. For most projects, scales should fall between 1:24000 and 1:100,000. The 1:24000 scale was the overwhelming choice of NRCS biologists in a 1997 survey.

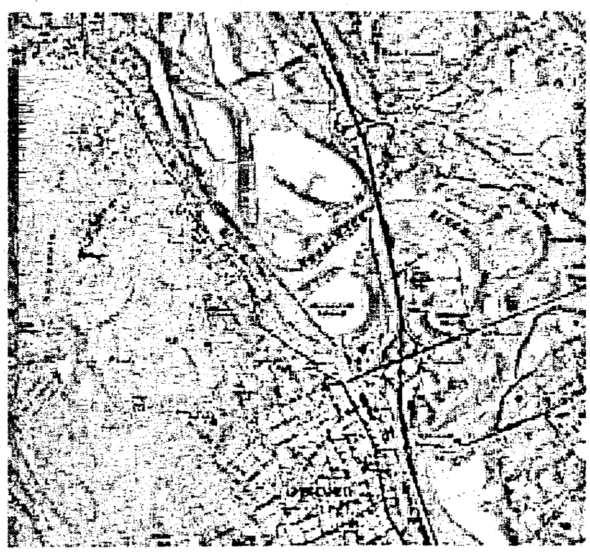


***Figure 5-4:** USGS 7.5 minute quad maps are frequently used for watershed scale corridor planning.*

Methods

Both computer and hand mapping methods are appropriate at the watershed scale. High resolution satellite imagery, aerial photographs, and USGS Quadrangle maps may be useful. If a statewide GAP analysis has been completed, much of that information can be used; however, it should be used with caution. Some states may use a relatively coarse mapping resolution in their GAP analysis, missing smaller features important at the watershed scale.

Conservation Plan & Practice Scale

This is the scale at which much conservation planning and technical assistance programs operate. The widths of corridors at the conservation plan scale (farm, ranch, or community) are typically measured in feet to hundreds of feet. However, a conservation plan would be more effective for some wildlife species if it were part of a watershed scale corridor or at a minimum the larger landscape context of the farm, ranch, or community were considered. The habitat function of corridors at the farm or ranch scale is often more important than the conduit function. For example, the cottontail rabbit may spend 80% of its time utilizing habitat resources within a windbreak. Corridors at this scale are, however, used by some species as travel lanes to access resources. Quail, pheasants, and turkeys, for example, will use hedgerows and fencelines to travel between cover types.

Mapping Scale and Methods

Mapping at the conservation plan scale includes many details that are not applicable at the regional or watershed scales. A "fine filter" approach is used to make sure that all data types and features needed to successfully design and install conservation practices are mapped.

Map Scale

Depending on the size of the farm or ranch, mapping scales could vary considerably. Typical scales will fall between 1" = 100' and 1" = 660'. Most conservation plans are drawn at a 1" = 660' scale. For small areas, a scale of 1" = 330' is typically used.

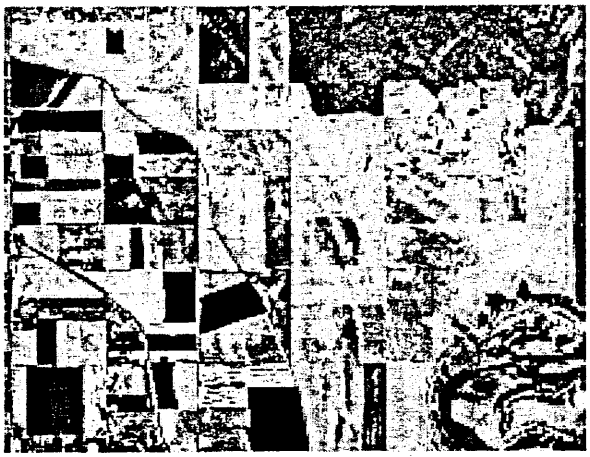


***Figure 5-5:** NRCS soil maps provide an excellent base for conservation plan and practice scale planning.*

Methods

Patches and corridors at the conservation plan scale will be inventoried and verified in the field. In some states, initial mapping of these features is typically done by hand on graph paper or on photocopies of soil survey aerial photos. Field maps can be transferred to the computer at a later date if desired. NRCS offices have increasing access to digital data, including soil surveys and digital orthophoto quads (DOQs), and from these data an extremely powerful GIS database will be created. These maps will show the location of all conservation corridors in the landscape, their age, condition, wildlife species known to use them, etc. Over time, this database would become useful at the watershed scale and possibly even the regional scale. Ground level photographs may be beneficial, in addition to plan view maps. Important general types of information for conservation plan and practice scale maps include:

- Soils
- Vegetation types and condition (health)
- Topography
- Hydrology
- Migration and dispersal routes
- Special areas (winter range, etc.)
- Special features (snags, etc.)
- Land use
- Land cover types, including crops
- Roads and highways
- Land ownership
- Locations of existing conservation practices
- Aspect
- Airflow patterns

For a more specific data list, see Chapter 7 pp. 7-5.

SUMMARY

Corridors exist in the landscape at three distinct scales. Functions and benefits of corridors vary with scale. A successful wildlife conservation strategy will address corridor, patch, and matrix issues at all three scales. The general principles and scale issues discussed and illustrated in this section need to be adapted to the unique resource circumstances of each region, watershed, farm, or ranch. They also must meet the particular habitat needs of wildlife communities, populations, and individual organisms. Care should be taken that activities intended to benefit one group of species does not compromise the ecological integrity of the entire community. The next section provides specific recommendations for wildlife enhancement of NRCS Conservation Practices.

CONSERVATION PRACTICE DESIGN RECOMMENDATIONS

Several planning concepts and principles were discussed earlier in this chapter. They presented a set of general guidelines to follow in most wildlife planning projects. However, with wildlife benefits as a goal, a secific set of recommendations is needed when designing each individual conservation practice.

About 150 conservation practice standards are published in the National Handbook of Conservation Practices (NHCP). Each standard is designed for a specific purpose and has specific design criteria. Each state decides which standards it will use. They adapt the standards for use in their state, adding appropriate technical detail, and issue them as state conservation practice standards. (NHCP state standards can be obtained from NRCS Field Offices and national standards are available for download from the NRCS homepage at http://www.ncg.nrcs.usda.gov/index.html.

Most conservation corridor practices can be grouped into either grass dominant or woody species dominant structures. They can also be grouped by their function or placement in the landscape. The inventory sheets in Appendix A provide the following categorization:

1. **Planted Grass/Forb Corridors**
   - Field borders
   - Field buffers
   - Filter strips
   - Grassed waterways
   - Grassed terraces
   - Vegetated ditches
2. **Natural Remnant Upland Corridors**
   - Grass and woody types
3. **Introduced Woody Corridors**
   - Windbreaks
   - Shelterbelts
   - Hedgerows
4. **Stream/Riparian Corridors**

The sections that follow give an overview of these four categories and present a series of recommendations for each category aimed at increasing its wildlife value. **It is extremely important to keep in mind that these are general recommendations; they will need further modification at the state level.** Equally important, recommendations should not interfere with normal and proper farming practices.

PLANTED GRASS/FORB CORRIDORS

A planted grass/forb corridor is a linear landscape element consisting primarily or exclusively of herbaceous vegetation. Most are relatively narrow in comparison to other corridor types. They are often typified by monotypical plantings of non-native grasses, such as smooth brome (*Bromus inermis*) or tall fescue (*Festuca ssp.*). However, recent emphasis has been placed on using mixtures that include as many native species as possible.

Purposes

Planted grass/forb corridors are installed for a variety of reasons.

- Wildlife habitat.
- Grassed waterways and vegetated ditches safely convey water through fields.
- Manage snow.
- Terraces and filter strips reduce erosion and filter sediments and chemicals from runoff.
- Reduce wind erosion.
- Field borders and buffers reduce competition from adjacent woodlands and provide space for maneuvering equipment.
- Provide commercial products.

Traditional Design Criteria

Grass/forb corridors intended to convey water must respond to water quantity, velocity, depth, duration of flooding, and outlet characteristics. The filter and erosion reduction functions of grass corridors are dictated by numerous criteria including width, sediment and nutrient storage capacity, flow depth, slope, and grass strength. Field border and buffer design must be wide enough to achieve their desired filter and sink effects. See appropriate national or state standards for specific criteria.

Recommendations to Enhance Wildlife Habitat

Planted grass/forb corridors generally constitute a relatively small proportion of the total acreage in agricultural regions, but their value per unit area to wildlife far exceeds that of adjacent cropland. There are several ways to protect and enhance the wildlife value of this type of corridor.

Add tall residual grasses and forbs in proposed seed mixes.

Most grassed waterways (and other types of introduced grass corridors) are currently planted in only introduced grass species such as smooth brome. Habitat quality could be enhanced with the addition of tall, persistent grasses and forbs. Biologists Bryan and Best found that tall, residual grasses are necessary or extremely beneficial for nesting for some species. The most appropriate grass mixes for wildlife will vary by region.

Bryan and Best also found that nests were 1.8 times more likely to occur in grassed waterways with greater forb coverage. In their study, more nests were built in forbs than in grasses. Inclusion of a variety of forb species (with grasses) should increase the value of all introduced grass corridors to nesting birds.

Plant trees and shrubs in grass/forb corridors.

Current NRCS practice standards specify removal of all trees, stumps, shrubs, rocks, and other objects that would impede channel flow or compete with adjacent crops. Retaining or planting occasional clumps of trees, shrubs, or forbs would enhance the habitat value of grass corridors by providing a wider variety of cover types and a diversified food supply. Careful thought should be given to placement or retention of woody vegetation so that it does not interfere with normal farming operations, water flow, or crop vigor. Generally, trees and shrubs should be located in the periphery of grassed waterways, field borders, and vegetated ditches.

Manage vegetation to retain plant community vigor.

Grasses and forbs may need to be mowed, burned, or disked periodically to maintain plant vigor. The most appropriate management technique, and the timing of its application, will vary from region to region. Untimely mowing, burning, or disking can decrease nesting densities, destroy nests, and kill adult birds and mammals. Mowing lowers the height and density of vegetation, reducing habitat value accordingly. As stated in NRCS job sheet #412, mowing should occur at a time when nesting and brooding will not be disturbed. Mowing should occur early enough so that new growth will exist for spring nesters, but late enough to avoid peak spring and summer nesting periods. For maximum wildlife benefit, only a portion of a patch or corridor should be treated in any one year. Unmowed corridors become even more important in late summer as other types of habitat, like roadsides, are mowed. State biologists will have region-specific information about the most appropriate management techniques.

Adopt farming practices that result in minimal disturbance of grass/forb corridors.

Unless absolutely necessary, avoid establishing cropping patterns that require farming equipment to be driven through grassed corridors. Bryan and Best found nesting to be more likely in grassed waterways that were not disturbed by farming activities. In general, avoid unnecessary travel through field buffers, field borders, and other grassed corridor types.

Increase corridor width as much as possible.

Increased corridor width directly increases the quantity of nesting sites, winter cover, escape cover, and food available to wildlife. It may also decrease overall edge effects, increasing the likelihood that the corridor will function as an effective travel route (Figure 5-6). The width of conservation practices will have to be balanced with the economics of crop production.

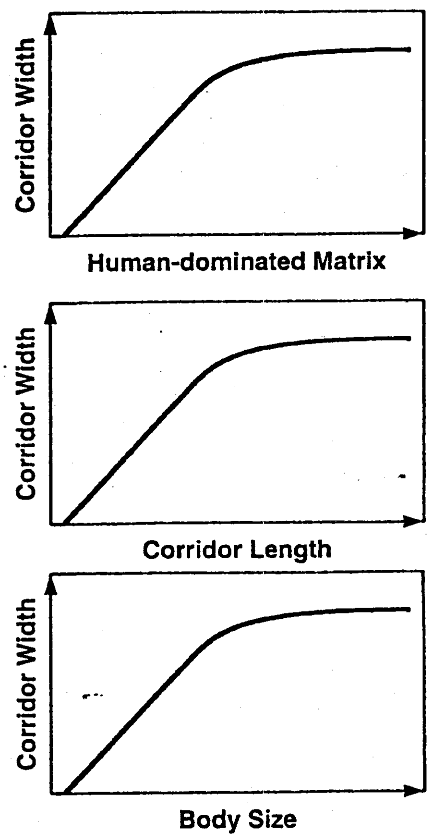


***Figure 5-6:** Effective corridor width for wildlife movement as related to human domination of the matrix, corridor length, and animal body size. Graphs from Dr. Richard Knight, republished with permission.*

Strive for connectivity.

Opportunities usually exist to connect different types of planted grass corridors. Grassed waterways frequently serve as outlet structures for grassed terraces. Waterways may flow through several field borders and field buffers before they terminate in filter strips or vegetated ditches, both of which continue across the landscape. What can result, with proper planning, is a network of connected habitat and travel routes for a variety of species across a large area.

Connections should be made to other types of natural and planted corridors, patches, or management practices such as constructed wetlands, natural wooded draws, riparian corridors, wetland complexes, and CRP land.

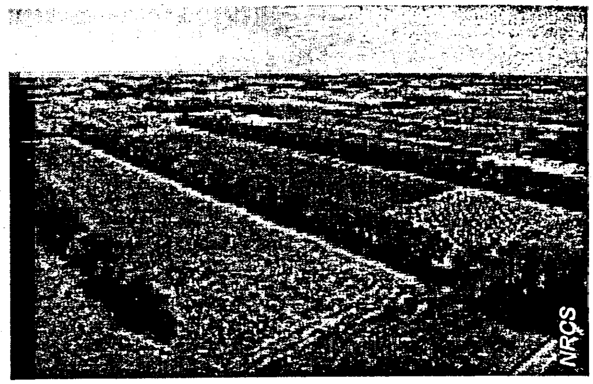
Natural Remnant Upland Corridors

Preserve the existence and health of natural remnant corridors.

Natural upland remnant corridors may be herbaceous, wooded, or a mixture of both. Size and configuration are highly variable. Whatever form they take, they are extremely important components of a corridor network. Natural remnant upland corridors often represent the last remaining patches of a pre-development ecosystem and are often crucial to the survival of native flora and fauna.

Appropriate management techniques for remnant patches will depend upon the composition of the plant community, patch size, and other site specific variables. Management recommendations should be coordinated with the NRCS field biologists from partnering agencies.

Introduced Woody Corridors



"Shelterbelts may be important habitats to species of wildlife that are dependent on permanent, woody vegetation in an area otherwise comprised of extensive fields of monoculture crops and pastures." (Yahner 1983)

A planted woody corridor is a linear element in the upland landscape consisting primarily or exclusively of woody vegetation. Woody corridor width varies considerably, from narrow hedgerows to multi-row shelterbelts. Planted woody corridors are used by numerous species of wildlife for food, nesting, winter cover, escape cover, and travel.

Purposes

Planted woody corridors provide a variety of benefits to wildlife, including:

- protective cover from adverse weather
- escape cover
- foraging and loafing sites
- reproductive / nesting habitat
- travel corridors for dispersing juveniles, travel between home range resources, and movement between larger natural habitats
- stepping stones for migrating birds

They also provide numerous other environmental services:

- reduce wind erosion
- protect and provide moisture for growing crops
- manage snow
- provide shelter for structures and livestock
- provide tree or shrub products
- provide living screens
- improve farm aesthetics
- improve irrigation efficiency

Traditional Design Criteria

The design of planted woody corridors is influenced by desired benefits. A windbreak designed to provide only wind protection is fairly simple; however, as additional benefits are added, the complexity of the design increases. The following is a brief discussion of the most important design elements.

- For all applications of windbreaks, one of the most important design elements is **orientation**. The windbreak should be oriented perpendicular to the direction of the troublesome winds (Figure 5-7).
- The area protected by the windbreak is generally agreed to be 10h (10 times the mature height of the tallest row in the windbreak). Due to the dynamics of wind patterns, the area protected is actually triangular in shape. This has important implications for design **height, density,** and **length** of the windbreak.
- Choice of plant **species** is based on desired function, wildlife needs, and other factors including: climate, soil, wind-firmness, density, height, crown spread, competitiveness, compatibility with adjacent crops, and pest and chemical resistance.

Forty-eight percent of farmers surveyed by Dishongh in six Midwestern states responded that one of the main reasons they planted windbreaks was enhancement of wildlife habitat.

Recommendations to Enhance Wildlife Habitat

Considerable research has been done on the habitat potential of windbreaks and hedgerows. Standard design criteria usually create a basic horizontal and vertical structure that produces valuable wildlife habitat. Several approaches can enhance woody corridor value as both habitat and travel corridor.

Increase corridor width as much as possible.

Modern windbreak planting practices are producing narrower windbreaks. Wildlife value is improved with greater width. Wider windbreaks provide a greater diversity of habitats, larger quantities of food and shelter, and greatly improved winter cover.

Design a complex vertical and horizontal structure.

Planting a variety of deciduous trees and shrubs provides a habitat structure with a large selection of vertical and horizontal nesting and foraging sites. Conifers should be added to provide additional nesting and foraging sites and winter wind protection.

In multiple-row woody corridors, more complex vertical and horizontal structure are possible. Structural diversity can be achieved in the following ways:

- Plant a core of tall deciduous and evergreen trees, tapered to small trees and shrubs on either side.
- Plant a mixture of grasses, forbs, and low shrubs to form a diverse understory after trees and shrubs are established.
- Add one or more shrub rows approximately 30 feet to either side of windbreaks.
- Add a wide band of herbaceous vegetation on either side of the windbreak outside the shrub row.
- Clump groups of shrubs on the lee side of woody corridors. Edge, cover, and food will be increased.
- Add vines to the planting. Choose species that do not harm the plants on which they climb.

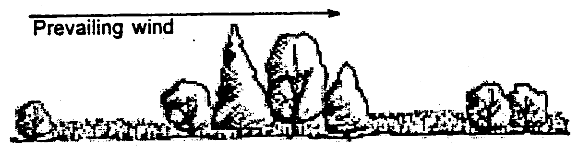


Figure 5-7a: Cross-section of a multi-row windbreak enhanced with diverse species composition, complex structure, windward and leeward shrub rows, and herbaceous vegetation.

Single row corridors such as field windbreaks and hedgerows typically have a simple structure. The structural diversity of these types of corridors can be enhanced in several ways:

- Alternate tree species within the row.
- Alternate deciduous and coniferous species within the row (consider alternating clusters).
- Alternate different forms (vase shaped, oval, or pyramidal) of trees within the row.
- Add a low row of shrubs beneath the tree row.
- Add a band of herbaceous vegetation beneath and on either side of the tree row out to the drip line after trees and shrubs are established.
- Add vines to the planting. Choose species that do not harm the plants on which they climb.
- Match growth rates of deciduous and evergreen trees.

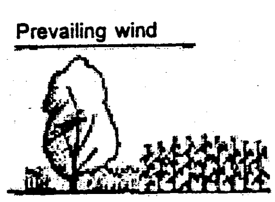


***Figure 5-7b:** Above: longitudinal section of a single-row windbreak enhanced by above recommendations. Left: cross-section of the same single-row windbreak.*

Keep wildlife needs in mind in the design phase.

Specific habitat components of corridors must be a deliberate design consideration.

- Provide food and cover over all seasons, especially during the winter months. Place herbaceous food plots or fruit bearing shrubs in the lee of a windbreak in areas with severe winters.
- Generally, native plant species should be used instead of introduced species. Occasionally, introduced species with high value to wildlife are appropriate. Always select species that provide food and/or cover for wildlife, but keep in mind that some introduced species highly valued by wildlife such as Russian Olive (*Eleagnus angustifolia*) may be targeted by state and local governments for removal. Special efforts should be made to insure that recommendations for introduced or adapted species are not in conflict with local regulations.
- The design should not cause snow to fill the entire windbreak. Snow covers food and habitat. Living snow fences can be planted 50 feet windward to prevent excessive snow accumulation within the windbreak.
- Perimeter and length are more important than area. Given limited available land, a long narrow windbreak would be preferable to a short, blocky one.
- Consider adding nest boxes and supplemental winter feeding stations.

Manage vegetation to promote plant vigor and longevity.

- Habitat quality increases dramatically with age. Stress longevity in the management of woody corridors.
- Manage livestock grazing within the windbreak. Grazing animals can severely damage ground vegetation as well as the trunks and lower branches of trees and shrubs. However, when managed properly, grazing can improve wildlife habitat within the windbreak by maintaining the desired plant community structure.
- Leave snags for cavity nesting birds and bats and insect eating species. If necessary, snags can be topped at approximately 20-25 feet to allow more light penetration for understory plant growth.

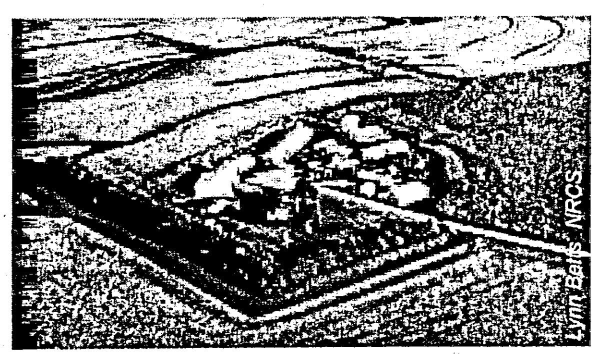
Manage the matrix as a complement to woody corridors.

Adjacent habitat and food resources are important. Minimum-till cropland provides sources of food and cover, while heavily grazed rangeland has little to offer most wildlife species. Fall plowing of croplands diminishes wildlife food and cover resources and should be avoided. Late spring mowing of forage crops can destroy nests *and* kill adults of ground nesting species like the ring-neck pheasant.

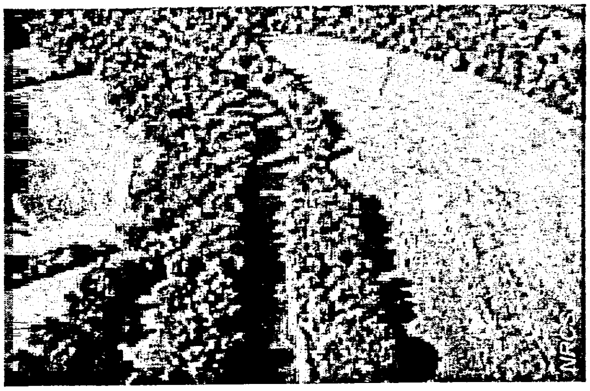
Techniques such as leaving turn rows adjacent to woody cover or unmowed strips adjacent to corridors can be very beneficial to wildlife

Strive for connectivity.

Where possible and appropriate, connect the windbreak to other conservation practices or natural habitats. The benefits of connectivity are discussed thoroughly in Chapter 2.



Stream/Riparian Corridors



Riparian corridors are composed of streams and the vegetation found on either side of them. Undisturbed, they normally include the entire floodplain and a portion of the upland at the edge of the floodplain. Width is extremely variable, depending on the width of the stream, flow characteristics, and topography.

Many riparian corridors naturally contain large amounts of woody vegetation. Introduced riparian corridors in the form of riparian forest buffers should be heavily planted to woody species as well.

Traditional Design Criteria

NRCS specifications for three-zone riparian forest buffers provide an excellent framework for quality wildlife corridors (Figure 5-8). Research conducted in Iowa by Schultz and colleagues supports these specifications and adds some detail:

Zone 1 is closest to the water and consists of water-loving tree and shrub species. Willows are used frequently because of their fast growth and tendency to sprout from the roots.

Zone 2 starts at the edge of zone 1 and extends further upland. It is planted with slower-growing hardwood tree species interspersed with shrubs.

Zone 3 is essentially a grass filter strip on the upland side of zone 2 and must conform to NRCS conservation practice specifications. Schultz and colleagues recommend that this zone be dominated by tall residual grasses like switchgrass (Panicum virgatum), though other grass and forb species can be included. This zone is essential for agricultural settings - crops next to streams. It may also be important in forested or urban settings.

See NRCS NHCP #391a for further information.

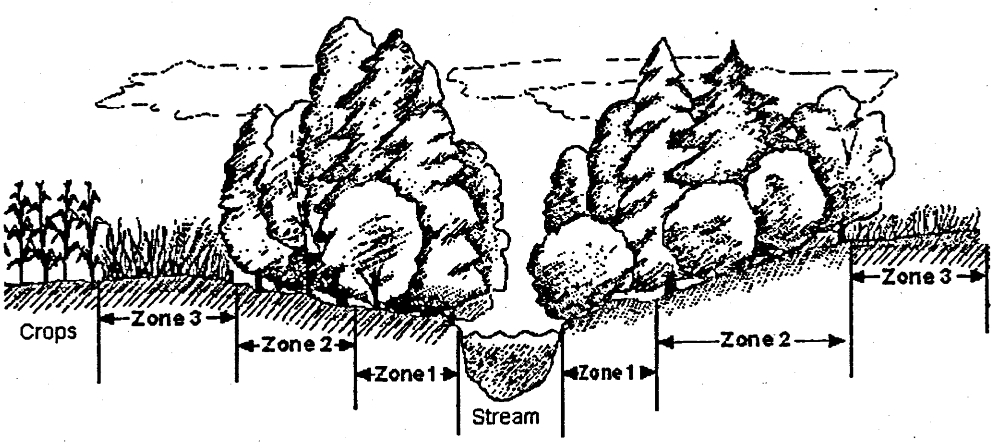


***Figure 5-8:** Cross-section of a three-zone riparian forest buffer.*

Purposes

Riparian corridors are perhaps the most valuable type of wildlife corridor per unit area. Most of the resources needed for a species to survive are located in and adjacent to the corridor. NRCS practice standards for riparian forest buffers state the following purposes:

- Create shade to lower water temperatures and improve habitat for aquatic organisms.
- Provide a source of detritus and large woody debris for aquatic organisms and habitat for wildlife.
- Reduce excess sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow.

Recommendations

Because most riparian corridors are composed mainly of woody vegetation, most of the recommendations cited in the Introduced Woody Corridors section will apply to riparian corridors as well. However, riparian corridors also require periodic flooding to maintain stand viability. Likewise, the recommendations in the Planted Grass/Forb Corridors section will apply to the grass zone on the outer edge of riparian buffer strips. For specific management directions reference the federal interagency publication *Stream Corridor Restoration: Principles, Processes, and Practices.*