

Wildlife Management Notes

No.10 Edge and Other Wildlife Concepts



The “edge effect,” where wildlife abundance is considered to be related to inherent beneficial aspects of edge, has been a major tenet of wildlife management for several decades. Some biologists have even referred to the “edge effect” as a fundamental concept in ecology. Edge refers to the boundary between two different plant communities or successional stages. Many misconceptions about the value of edge to various wildlife species have arisen from this simple definition. Some observers have gone so far as to say that to increase wildlife abundance or the number of species, just increase edge.

This is not necessarily true. In 1933, Aldo Leopold, the “father of wildlife management,” originally applied the concept of edge to “game animals of low mobility” or small home ranges. Yet many purported benefits of edge ascribed to Leopold in the popular and in some scientific literature were in fact never claimed as benefits of edge by Leopold. Rather, the value of edge to wildlife was a hypothesis that grew to become a theory and later a paradigm through decades of use and misunderstanding of how different species of wildlife associate with, use, or avoid edge. Widespread acceptance of the “edge effect” as fact led to a failure to scientifically test edge concepts for a long period of time. However, our understanding of edge and its effects on wildlife have improved considerably since Leopold’s time as the result of recent research.

As our understanding of various species of wildlife and their association with edge has increased, some biologists have erroneously broadened the definition of edge to include differences in habitat structure within a given cover type. For example, consider plum thickets interspersed in tallgrass prairie or a patch of pure pine in an otherwise mixed pine-hardwood forest. Also consider individual clumps of bunchgrass or other plants with bare ground between them. Are these examples of edge? Matters of scale and the wildlife species under consideration then become important when defining edge. Leopold had qualifications placed on his definition of the principle of edge and the species to which it applied. To extend the definition beyond the original qualifiers clouds the issue and has created a nebulous concept that has no meaningful definition.

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To date, little if any research has documented the importance or effects of edge to any species at fine scales. However, at coarse scales, such as vegetation cover type, some associations seem apparent for relatively few species. In most cases, it is not practical or realistic to map as cover types individual clumps of bunchgrass associated with bare ground, or a grouping of a few trees of slightly different mix in a forest mosaic. As well, this violates the qualifications that Leopold placed on his principle of edge. Suffice it to recognize that broader cover types have an inherent range of imbedded structure and plant species composition; and, if taken too far, the utility of the concept of edge breaks down.

Is Edge Important to Wildlife?

It depends on whether the definition offered above is accepted. Until recently, some wildlife ecologists and managers believed that edge in and of itself was attractive to wildlife. Wildlife species could realize the benefits of two or more adjoining habitats without traveling great distances. Undoubtedly, some wildlife species may benefit from the proximity of habitats or possibly edge itself; but, to others, edge is either unimportant or may be detrimental.

Edge has long been valued as an important component of habitat for game species. Leopold originally applied the “edge effect” concept to game animals contingent upon two characteristics of the species under consideration. First, the animal under consideration must be relatively nonmobile, and, second, the animal must require two or more habitat types to meet life requirements. Deer, turkey, quail, and rabbits have in the past been termed edge species. Note that these species require more than one succession stage or vegetation type. Therefore, an edge must be associated with their specific habitat requirements. It is important to note that this does not say or even imply that any of these species have specific needs for edge as a habitat requirement. In these cases, edge is simply an artifact of their need for more than one habitat cover type to meet life requirements.

In some cases edges can be an important component of wildlife habitat in an area because edges may have characteristics that differ from adjoining habitat types. In addition to containing plant species from both adjoining habitats, they may contain additional species because of the unique microclimate found along edges; but, this is not well documented across a range of plant community types. For example, wind velocity is greater along forest edges than interiors and sunlight is better able to penetrate to the forest floor along an edge. Wind and sunlight cause humidity to drop. Increased wind will cause humidity to decrease, while increased sunlight will cause temperatures to increase, thus shifting the microclimate toward that of a more open habitat. These climatic changes may help increase the width of the surrounding ecotone and affect movement of habitat elements from one habitat into the other.

As a result, plant richness (the total number or species) may be greatest along an edge or transition zone. Also, growth forms (i.e., grass, forbs, shrubs, trees) of plants



Figure 1. High contrast edge.

along an edge may differ from adjoining habitats, resulting in structural variation unique to that border. An edge is a floral community with different vegetation structure and composition than the two adjoining habitats whose common border was its creation. As a result, an edge may be a unique habitat and possibly support a unique faunal community, or so the theory goes.

Because of the presence of adequate sunlight, abrupt edges between forest and grassland (See Figure 1.) may change over time to become dominated by shrubs and woody sprouts that include commonly preferred forages of deer and rabbits. These brushy areas also make excellent hiding cover for deer and rabbits and nesting cover for turkeys. Some non-game species also may benefit from the presence of edge. For example, some songbird species can be found at high densities along low-contrast shrubby edges (See Figure 2.) because of the vegetation structure of these habitats. Some raptors may spend considerable time along high-contrast edges because of high visibility, the presence of suitable perches for hunting, and the presence of prey.



Figure 2. Low contrast edge.

Recent studies have demonstrated that many wildlife species are not attracted to edge, but rather to certain characteristics of vegetation that edges *sometimes* may offer. The actual presence of edge is not important; it is the arrangement or structure of vegetation that may happen to be in an edge zone. For example, a medium-contrast edge between a riparian oak stand and tallgrass prairie might be composed of an interspersion of shade-intolerant, shrub-sized vegetation with high stem density with some forbs and grass cover underneath, a perfect nesting habitat for turkeys.

However, a 400-acre patch with similar vegetation structure would provide the same nesting benefits to turkeys. In fact, the 400-acre patch may be of greater benefit because of greater area of potential nesting habitat. Patch composition, whether it be a 400-acre contiguous tract or a 30-foot wide, linear transition zone between larger patches (e.g., edge), is most important to wildlife. If these habitats match the particular search image a wildlife species has for identifying suitable habitat, the given habitat patch will be used as habitat regardless of the presence or absence of edge.

While it has long been presumed in the popular literature that edge is beneficial for all wildlife species, edge can be detrimental to some species. When large, contiguous patches of habitat are fragmented or divided into many different land uses, the amount of edge is increased as an artifact. Fragmentation greatly impacts wildlife species that need large unbroken areas in certain successional stages or vegetation cover types to provide some or all of their habitat requirements. These species are often referred to as area sensitive species. The greater prairie chicken is one example of a species that requires large unbroken blocks of suitable habitat - in this case, tallgrass prairie.

Forest interior songbirds that benefit from unbroken mature forest include some of the wood warblers, the scarlet tanager, and the ovenbird. These songbird species require large areas of unbroken forest to reproduce successfully due, in part, to the high incidence of nest predation and nest parasitism near edges. Common species often classified as edge dwellers are nest predators such as crows, grackles, blue jays, and raccoons, as well as the nest parasite, the brown-headed cowbird. Some studies have documented greater rates of nest predation among songbirds near edges than those in forest interior, however other studies have found no effect. The value of an edge is different for each species, and management prescriptions should be planned accordingly.

Recent research by Dr. Fred Guthery and others in south-central and western Oklahoma provided an excellent example of problems associated with the uncritical acceptance of an "edge effect." They examined a range of sites from tallgrass prairie to cross timbers habitat types, and from areas dominated by agriculture to those without agriculture. They found that the greatest abundances of northern bobwhite were in areas composed primarily of brushy prairie with minimal amounts of edge. Edge was defined in a broader context as a vegetation cover type. However, they also found lowest abundance of bobwhites in areas without edge that were composed of extensive wheat fields. Areas with high amounts of edge versus areas with low amounts of edge had bobwhite abundances ranging from low to high irrespective of the amount and type of edge.

One might question whether the results are a question of the scale at which edge is defined. Even if the brush-grass interfaces were defined as edges, one must consider

whether quail abundance was high because of edge or because the imbedded brush provided a needed component of overhead cover while the grass dominated areas provided feeding and brood-rearing habitat. This study illustrates that vegetation composition and structure of a given habitat patch is more important than simply providing edge.

Edge Concepts

Edges can be classified into two types: inherent and induced. Inherent edges result from permanent features in the landscape, such as abrupt changes in soil, topography, or microclimate, and tend to be relatively stable. In contrast, induced edges are constantly changing because of vegetation growth and succession, and are caused by human activities such as agriculture, timber harvest, and development, or natural events such as fire, disease, insect damage, or wind-throw.

Edge has specific characteristics depending on the particular stage (sere) of plant succession which with one is dealing. High-contrast edge is produced when two structurally different stages of plant succession meet. (See Figure 1.) One example is a mature forest that abuts a pasture or other area of annual and perennial grasses and forbs. Another example would be a recent clearcut adjoining a mature forest. On the other hand, low-contrast edge is formed when structurally similar stages of plant succession are adjacent to one another. (See Figure 2.) The transition area between the two seres (a stage in plant succession) may have elements that are characteristic of both. One example would be a patch of sparsely wooded cross timbers bounded by oak and sumac sprouts and interspersed with tall grasses that gradually grade into tallgrass prairie. Another example of low-contrast edge would be where an old, fallow agricultural field dominated by annual forbs and grasses that lies adjacent to a prairie patch dominated by perennial grasses and forbs.

Management decisions that involve edge require an understanding of edge geometry, or how the length of edge changes with patch shape and size. For example, forest managers must decide what shape to make a clearcut to produce the desired amount of edge. A circle is the shape that has the least amount of edge per unit area. The more the clearcut diverges from a circle, the more edge will be produced per unit area. Figure 3 illustrates this concept by showing several figures, each with the same area and corresponding length of edge. Squares have slightly more edge than circles, and rectangles have considerably more edge if the long axis is much longer than the short axis. However, shapes that usually have the most edge are convoluted and irregularly shaped.

The second factor that affects the amount of edge is patch size. Obviously, as a patch of a fixed shape, increases in size the amount of edge will increase. However, edge does not increase on a linear basis with area. For example (See Figure 4.), an 80-acre square patch would have 7,467 feet of edge. But if created two 40-acre patches (80 total acres), the total amount of edge would be 10,560 feet. As we reduce patch size and increase the number of patches, we maintain the same total area, but significantly increase total length of edge.

Figure 3. Each of the five shapes has an area of 40 acres, but total edge changes with figure shape. The circle has the least amount of edge, but as the shape becomes more elongated and convoluted, total edge increases.

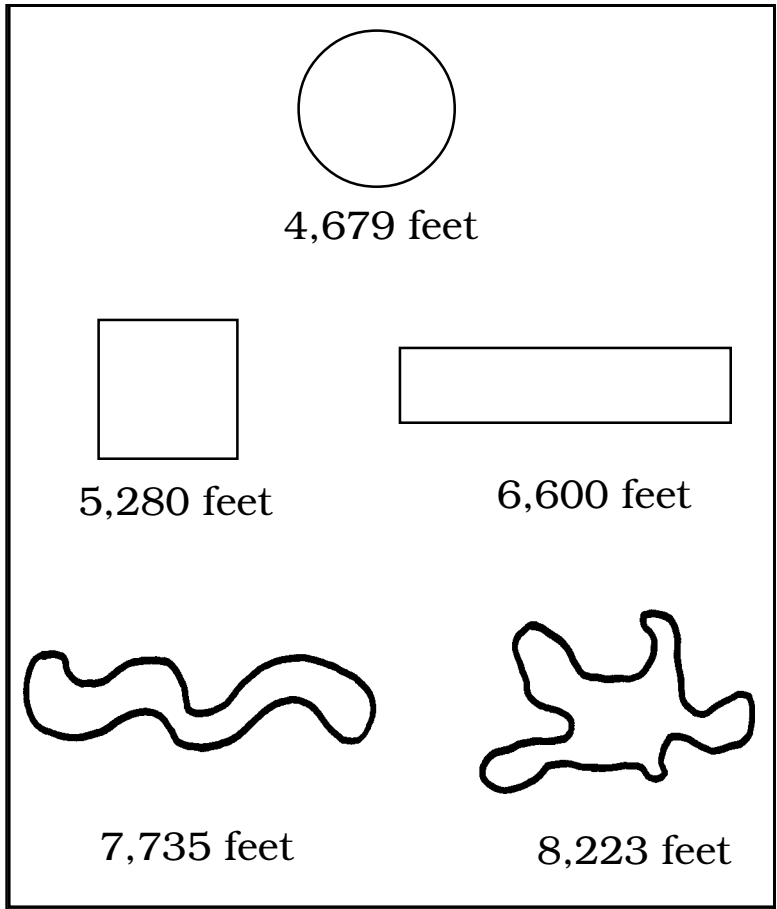
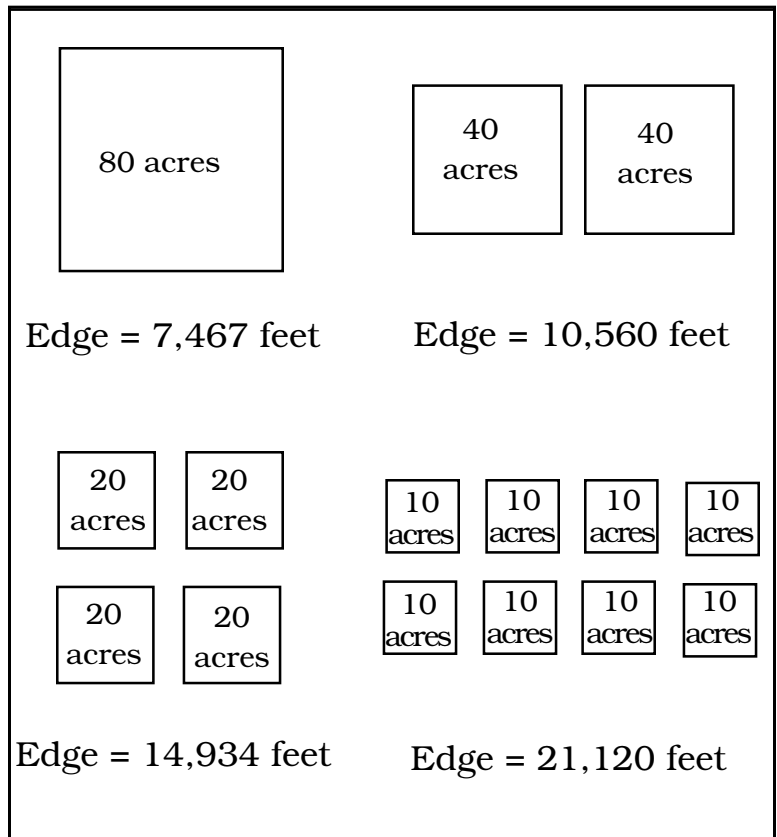


Figure 4. Each of the four sets of squares represents different arrangements of clearcuts to total 80 acres. As patch size decreases and number of patches increases, total edge increases while area stays the same.



It also is important to understand how interspersions and juxtapositions of vegetation cover types or habitats can affect animal abundance. Interspersion and juxtaposition refer to arrangement, relationship, and proximity of different habitats. Interspersion describes scattering and dispersion, and increases as various habitats become more randomly placed and mixed across the landscape. Juxtaposition refers to habitat proximity and increases as more different combinations of habitats are found adjacent to one another. The edge habitat that is produced depends upon the type of habitats that adjoin to define composition of that edge. For example, a pine forest that abuts a tallgrass prairie will create a different edge habitat than a hardwood forest bordering a wetland. Figure 5 illustrates ecosystems with varying levels of interspersion and juxtaposition. Note that landscapes with high degrees of interspersion and juxtaposition are not beneficial to all wildlife species. Even those species that do well in a landscape with a high degree of interspersion and juxtaposition have an upper limit of the degree of mixing and fragmentation that they can tolerate.

Always remember, some species will benefit from an increase in edge and the variety created by imaginative landscape designs, but others may be influenced negatively. Habitat generalist wildlife species - those that require a variety of habitats or habitat conditions, such as white-

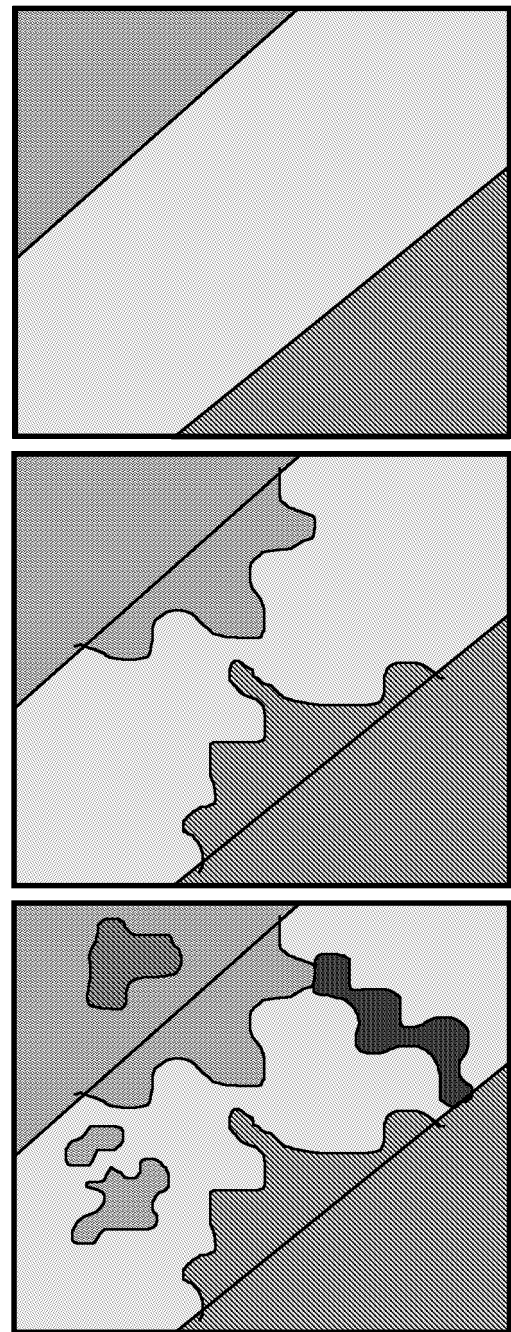


Figure 5. The three landscapes depicted represent varying degrees of interspersion and juxtaposition. Different shades represent differing cover or habitat types. The first landscape has little interspersion or juxtaposition and is common among agricultural landscapes. The second landscape has more interspersion and juxtaposition than the first and was accomplished by creating meandering rather than straight edges. The third landscape has the most interspersion and juxtaposition. It includes travel corridors and patches within heterogeneous habitats.

tailed deer - are often benefited while habitat specialists - those that have very specific habitat requirements, such as the red-cockaded woodpecker - are often disadvantaged. In some landscape contexts, **it is possible to add or delete edge and not affect population abundance of the target species whatsoever.** Herein lies the major problem of considering edge a tenant of wildlife management: Before physically altering landscapes, potential impacts of proposed management should be assessed for target species in order to understand costs and benefits that may be experienced.

Management Options

A variety of habitat management techniques exist to decrease or increase edge on a parcel of land. The manner in which each of these techniques will influence wildlife populations will vary depending upon the mix of floral and faunal species present in the area. Again, it is important to recognize that in some landscape contexts, the addition or subtraction of edge may have little or no effect. Landscape characteristics also will have a strong influence on how changes in edge will influence wildlife populations. Before habitat modification begins, managers should have clearly written objectives that list the target species or target plant community to ensure that the desired objectives are attained. Use the U.S. Department of Agriculture's Natural Resource Conservation Service Ecological Site Guide to determine the native plant community.

The below techniques for modifying edge are offered as possible solutions where issues about edge may arise. Even though many have not been tested, these techniques are offered as conventional wisdom from sources listed in the Acknowledgments section of this document. We hope that managers will begin testing edge concepts and these management techniques and critically examine ideas about edge.

Management Techniques to Decrease Edge

- Avoid land use practices that fragment large areas of native vegetation into small parcels. Examples include conversion of forest to introduced pasture and use of introduced pasture grasses in so-called "pasture improvement" programs. These types of programs typically degrade wildlife habitat. Also avoid conversions of shrublands and prairie to cropland or planting trees on prairie sites.
- Control cedar encroachment into native prairies, shrublands, and forests.
- Reseed cropland to native plant communities. This may be accomplished through a variety of cost share programs such as CRP, EQUIP, or WHIP administered through the Natural Resource Conservation Service.
- When timber harvest is necessary in forested areas, use large scale units (40 to 100 acres) to meet the needs of area sensitive wildlife species.
- Use timber harvest techniques such as shelterwood or selective cutting that retain forest cover. Or when necessary, clearcut tracts up to 100 acres to provide early successional habitat for area sensitive wildlife species associated with early stages of plant succession.

- Prescribed fire also can be used to decrease edge in areas of prairie that are experiencing woody encroachment. It also can be used to maintain a particular forest type such as pine-dominated forests or cross timbers forest types.

Management Techniques to Increase Edge

- Timber harvest is a common way to increase edge on a parcel of land. In addition to increasing the amount of edge, a new habitat type is produced within the harvested patch. Timber removal can create edges with great variability between bordering habitats, and edge habitats created by timber removal support faunal communities that can be very diverse. When creating edge by removing timber, irregularly-shaped cuts should be used to maximize interspersion and length of edge.
- Use small patch clearcuts or group selection management systems to break up contiguous forested areas.
- Woodlots with straight edges can be “feathered” by selectively removing trees within 100 feet of the edge. This will increase the width of the edge habitat. Felled trees can be left on the ground, and care should be taken to avoid trees that are valuable to wildlife as food or nesting cover.
- Fire can be a very effective tool for creating a landscape with high interspersion and juxtaposition of habitats, and increasing the amount of edge. However, care should be taken to leave some patches unburned, as this will maintain brushy areas. A variety of firing techniques and seasons of burning should be used.
- Patch grazing in prairie or shrubland dominated ecosystems. A combination of patch burning and patch grazing will create an interspersion of successional stages in prairie systems.
- Riparian areas should be maintained in native vegetation because these areas are valuable to wildlife for food and as nesting habitat. Mobile species such as deer, turkeys, and songbirds often rely upon these areas as travel corridors. Remove cedar trees in these areas.
- Agricultural areas, if not well interspersed with areas of native vegetation, can be critically deficient in edge habitat. Fencerows and roadsides can be converted into edge habitat by allowing native vegetation to encroach along these areas. These areas, in addition to serving as nesting cover for many avian species, can be valuable to many species of wildlife as travel corridors.
- Brush piles in native grasslands, introduced pastures, clearcuts, and meadows improve interspersion and juxtaposition of habitats and increases edge and will benefit some species.
- Mowing and strip-disking of open areas in forested habitats and in shrublands can set back succession to maintain induced edges. These two practices can be applied in prairie habitats but are not recommended on sandy soils. Note that patch grazing and burning are more preferred techniques to accomplish the same thing.

These management techniques can increase the amount of edge in an area; however, large sections of contiguous forest, shrubland, or prairie should be maintained because of their value to area sensitive wildlife species. Excessive fragmentation may negatively affect some wildlife species due to the possible increase in predation or brood parasitism. Whenever considering promoting edge as a form of habitat or wildlife management, it should be remembered that there are tradeoffs associated with these practices. While some species will undoubtedly benefit from edge management, it is likely that populations of some wildlife species will decline. See previous issues of Wildlife Management Notes for habitat requirements of specific species.

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