

INTACT LANDSCAPES

Background and Identification of Interaction with Wind Development

In this BMP, the effects of fragmentation that are described refer to species that are area sensitive¹ (e.g. lesser prairie-chicken) or are habitat obligates² (e.g. sand dune lizard).

The Federal Advisory Committee Recommendations on Wind Energy Development defines fragmentation as “The separation of a block of habitat for a species into segments, such that the genetic or demographic viability of the populations surviving in the remaining habitat segments is reduced.”³ For the purposes of this BMP, habitat fragmentation represents two processes: conversion of native habitats to non-native types (e.g. native prairie to cropland, forest to housing development) and the breaking apart of continuous pieces of habitat (e.g. a road bisects a forest or native grassland). Wind development can potentially create fragmentation through the breaking apart of habitat (making less continuous) for species that avoid human disturbance, creating barriers to movement, or altering the way critical ecological processes occur.

Studies have reported that densities of some grassland birds such as grasshopper sparrow (*Ammodramus savannarum*) are lower near turbines^{4,5} indicating there is some aspect of turbines that birds find disturbing. Therefore, the turbines may be fragmenting the habitat simply by their presence. A similar situation can be found for transmission lines, which may be avoided by some species (lesser prairie-chicken⁶) and introduce edge effects through fragmenting connectivity and by introducing perches for avian predators (see #3 below).

Fragmentation can have multiple effects on the suite of species that rely on the habitat.⁷

1. Patch-size effects – Large patches contain a greater diversity of microsites that support a variety of species; smaller patches are less likely to contain that broad diversity of habitats.⁸ Smaller patches of habitat support fewer numbers of species that are habitat obligates and have lower species diversity (fewer numbers of different species).
2. Landscape scale – At landscape scales, amount of grassland in a defined area can also impact species reproductive success and/or survival.^{9,10} Effects of fragmentation at the landscape scale are often more pronounced than at the patch scale.¹⁰
3. Edge effects – Areas near edges of habitat patches have different microclimates than the interior portions (increased wind, higher temperatures, drier) and attract generalist predators and brood parasites.¹² In addition, habitat edges may favor generalist competitors that are more tolerant to human disturbance.^{13,14} The generalist competitors will out-compete and “push out” species that are less tolerant of human disturbance.
4. Patch shape – Patch shape is an important consideration for estimating fragmentation effects. Long, thin habitat patches and irregularly shaped patches experience increased effects of habitat fragmentation compared to more regularly shaped patches (i.e., circular or square).¹⁵ Long, thin and irregularly shaped patches have a greater perimeter to area ratio. In other words, they have more edge habitat compared to interior habitat, which can reduce the ability of the habitat patch to support individuals.¹⁵
5. Isolation effects – Isolated patches have lower species diversity than connected patches.

Wind energy development can cause the loss and fragmentation of native prairie, an important factor limiting the distribution and abundance of grassland-dependant wildlife. Habitat fragmentation can occur through construction and operation of turbines and associated infrastructure. Some grassland species, such as the lesser prairie-chicken, are area-sensitive, requiring large tracts of intact grassland for survival.¹⁶ Infrastructure associated with wind energy development, namely roads and turbines, can reduce the suitability of the grassland habitat for such area-sensitive species by fragmenting the habitat into smaller and less valuable patches.

Roads associated with wind energy development create intrusions of edge habitat into the interior of the prairie which can create conduits for invasion by exotic plant species.¹⁷ Roads can act as corridors for generalist predators and brood parasites into the interior of the prairie, which can increase predation and parasitism rates, thus lowering reproductive success for grassland dependent wildlife.

State of the Science

The effects of habitat fragmentation are well-documented for a variety of species and ecosystems. The degree to which wind energy development sites will contribute to fragmentation is unknown, although the effects of certain features (e.g. roads) are well-documented in a variety of ecosystems. The capacity of fragmentation to alter critical ecological processes is suspected but has rarely been documented or quantified.

Best Management Practices

The Federal Advisory Committee Draft Recommendations for wind energy development address fragmentation and provide an overview on identifying portions of the landscape vulnerable to fragmentation. (Chapter 3, pages 29-32; Draft Recommendations 3/2010).³

- We recommend consulting with experts to identify areas vulnerable to fragmentation in Colorado.

Avoid

Avoid placing wind energy development in the interior (as opposed to edge) of a large block of intact prairie. For prairie-chickens a large block may be 10,000 to 20,000 acres (4046 – 8093 ha). In addition, in some parts of eastern Colorado, large blocks of native grassland prairie types exist that are greater than 10,000 acres (4046 ha); these areas should be avoided due to their ability to host many populations of area sensitive species.

Minimize

1. Encourage the placement of a wind energy development on previously disturbed lands.
2. If placement of a wind energy development on a large block of prairie cannot be avoided, then siting the wind energy development at the edge of the block will help to curb fragmentation of the overall habitat block.
3. “Minimize, to the extent practicable, the area disturbed by pre-construction site monitoring and testing activities and installations.” (Chapter 3, page 44; Draft Recommendations 3/2010).³
4. “Minimize the number and length of access roads; use existing roads when feasible.” (Chapter 3, page 45; Draft Recommendations 3/2010).³
5. “Reduce vehicle collision risk to wildlife by instructing project personnel to drive at appropriate speeds, be alert for wildlife, and use additional caution in low visibility conditions.” (Chapter 3, page 46; Draft Recommendations 3/2010).³
6. “Use native plant species when seeding or planting during restoration.” Chapter 3, page 44; Draft Recommendations 3/2010).³
 - See the Rare Plant BMP for more information.
7. “Reduce the introduction and spread of invasive species by following applicable local policies for noxious weed control, cleaning vehicles and equipment arriving from areas with known invasive species issues, using locally sourced topsoil, and monitoring for and rapidly removing noxious weeds at least annually.” (Chapter 3, page 46; Draft Recommendations 3/2010).³

Conservation Offsets (Mitigation)

1. Conserving native prairie in an equal amount to that being strongly impacted by development [i.e. an area surrounding each turbine with a radius equal to the maximum height of the turbine (e.g. height of turbine + height of the blade)] in an already existing large block of grassland will help prevent further fragmentation of the prairie. To the extent possible, the area to be protected should be within the same area and protect the same types of habitats that would be impacted by the wind energy development.
2. Restoring an area in an equal amount to that being strongly impacted by development [i.e. an area surrounding each turbine with a radius equal to the maximum height of the turbine (e.g. height of

turbine + height of the blade)] plus an additional area equal to 50% of the strongly impacted area will help prevent further fragmentation of the prairie. Restoration can occur in one of two ways: 1) restoration of unsuitable habitat found within an already existing large block of habitat (see figure 1) or 2) restoration of habitat at the edge of a habitat block in order to expand the block. Working with local wildlife biologists or District Conservationists (e.g. from National Resources Conservation Service) to identify requests for habitat restoration in the area requiring a non-federal cost-share will increase leverage of conservation dollars. Ensuring that the restored land will be maintained in the future will minimize wasted conservation dollars.

3. Placing easements or other long-term conservation practices on pasturelands or other land enrolled in Farm Bill programs and providing funding for continued maintenance (e.g. burning) will increase the area of large blocks of grassland.
4. Taking steps to restore native vegetation (with species native to the site) and minimizing the abundance of invasive species will help maintain functionally larger blocks. Continued maintenance through monitoring and eradication (as needed) of non-native species introduced by the development will prevent exotic species invasion.

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Additional Information and Resources Consulted

1. In this context, area sensitive species are those that require a certain amount of contiguous habitat on the landscape to complete their annual cycle.
2. In this context, habitat obligates are those species that require a certain type of habitat to complete their annual lifecycle.
3. U.S. Fish and Wildlife Service Wind Turbine Recommendations Advisory Committee. March 4, 2010.
4. Leddy, K.L., K.F. Higgins, and D.E. Naugle. 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. *Wilson Bulletin* 11:100-104.
5. Osborn, R.G., K.F. Higgins, R.E. Usgaard, C.D. Dieter, and R.D. Neiger. 2000. Bird mortality associated with wind turbines at the Buffalo Ridge wind resource area, Minnesota. *American Midland Naturalist* 143:41-52.
6. Pruett, C.L., M.A. Patten, and D.H. Wolfe. 2009. Avoidance behavior by prairie grouse: implications for wind energy development. *Conservation Biology* 23(5):1253-1259.
7. Johnson, D.H. 2001. Habitat fragmentation effects on birds in grasslands and wetlands: a critique of our knowledge. *Great Plains Research* 11:211-231
8. Turner, M.G., R.H. Gardner, and R.V. O'Neill. 2001. *Landscape Ecology in Theory and Practice: Pattern and Process*. Springer-Verlag, New York, New York, USA.
9. Hokit, D.G. and L.C. Branch. 2003. Association between patch area and vital rates: consequences for local and regional populations. *Ecological Applications* 13:1060-1068.
10. Horn, D.J., M.L. Phillips, R.R. Koford, W.R. Clark, M.A. Sovada, and R.J. Greenwood. 2006. Landscape composition, patch size and distance to edges: interactions affecting duck reproductive success. *Ecological Applications* 15:1367-1376.
11. Stephens, S.E., D.N. Koons, J.J. Rotella, and D.W. Willey. 2003. Effects of habitat fragmentation on avian nesting success: a review of the evidence at multiple spatial scales. *Biological Conservation* 115:101-110.
12. Meffe, G.K. and C.R. Carroll. 1997. *Principles of Conservation Biology*. Sinauer Associates, INC. Sutherland, Massachusetts, USA.

13. Slater, G.L. 2004. Grasshopper Sparrow (*Ammodramus savannarum*): a technical conservation assessment. Updated October 7. USDA Forest Service, Rocky Mountain Region. Available: <http://www.fs.fed.us/r2/projects/scp/assessments/grasshoppersparrow.pdf>
14. Askins, R.A. 1994. Open corridors in a heavily forested landscape: impact on shrubland and forest-interior birds. *Wildlife Society Bulletin*. 22:339-347
15. Helzer, C.J. and Jelinski, D.E. 1999. The relative importance of patch area and perimeter-area ratio to grassland breeding birds. *Ecological Applications* 9(4):1448-1458.
16. Pittman, J.C., C. A. Hagen, R. J. Robel, T. M. Loughin, and R. D. Applegate. 2005. Location and success of lesser prairie-chicken nests in relation to vegetation and human disturbance. *Journal of Wildlife Management* 69:1259-1269.
17. Gelbard, J.L. and J. Belnap. 2003. Roads as conduits for exotic plant invasions in a semi-arid landscape. *Conservation Biology* 17:420-432.

Figure 1: A cartoon example of a large block of habitat. The green “patches” of habitat are surrounded by tan “matrix” or non-habitat. But the total aggregation of habitat in the landscape provides important benefits to species that live there. The purple shape indicates an area that could be restored and would increase connectivity among existing habitat patches and increase total amount of suitable habitat in the large block of habitat.

