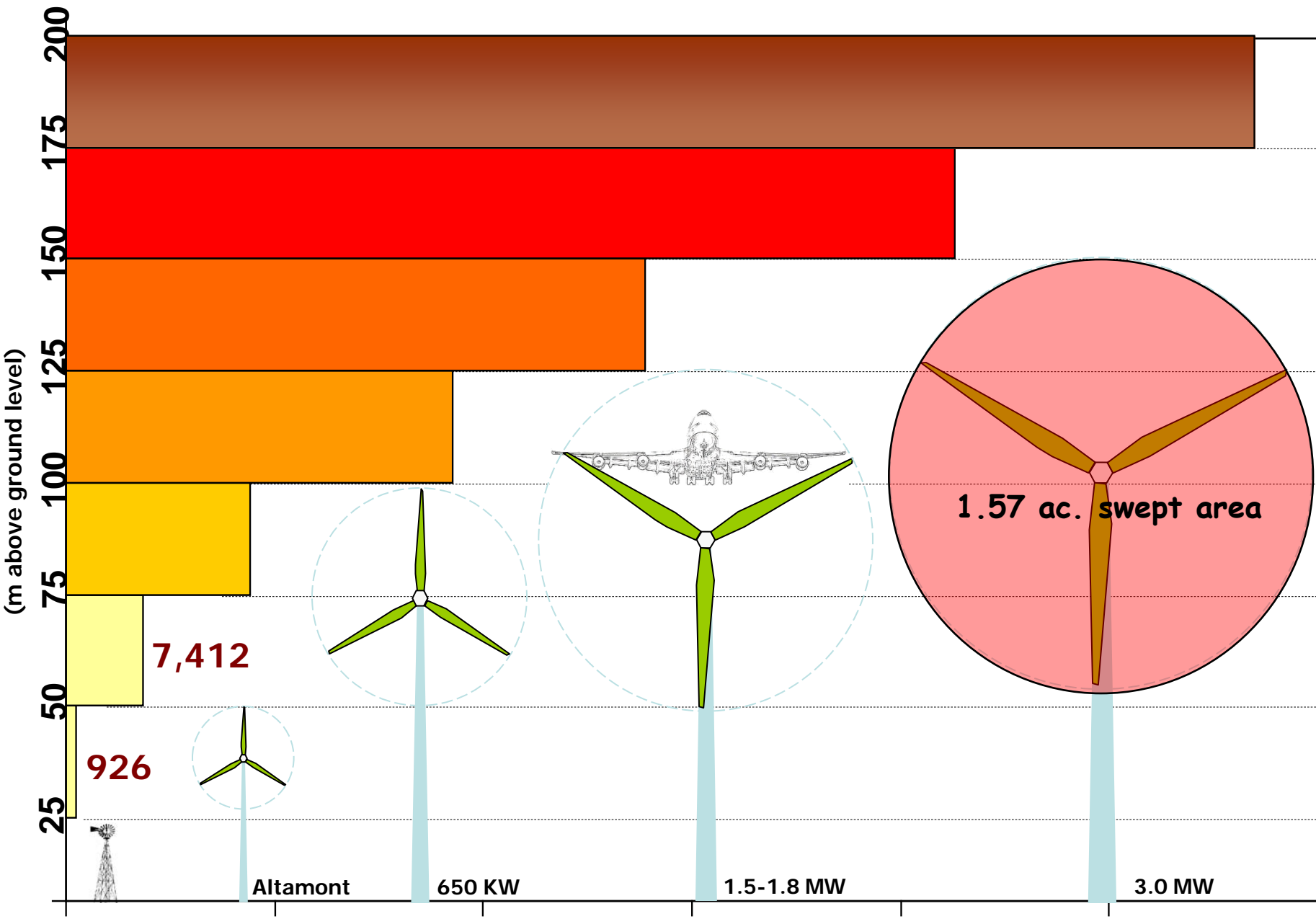


An Ecological Risk Assessment of Wind Energy Development in Montana

Brian Martin, Amy Pearson, Brad Bauer

The Nature Conservancy

Altitude of Nocturnal Migrants



Estimated number of birds and bats flying at different altitude zones

(Source: ABR, Inc., Fall Radar Study Final Report, April 2004.)

Summary of Wind Energy Development

- US production in 2009:
 - 35,159 Megawatts of Installed Capacity
 - Increase in 2009 of 9,922 MW
 - MT 375 MW
- Canadian production in 2009:
 - 3,319 Megawatts of Installed Capacity
 - Increase in 2009 of 950 MW

Energy Policy

- US policy: 20% of energy production from wind by 2030
 - Policy will require 241,000 MW more from land-based sources
 - Land area required – 12.3 million acres
 - Turbines will most likely range from 1.5 MW to 3 MW in size
 - Rough estimate – 160,000 to 80,000 more turbines
- Canadian policy: 20% of energy production from wind by 2025

Project Considerations

- Does not address migratory birds and bats
- Focused on species where wind development most likely, based on wind resource
 - Primarily east of the Continental Divide
- Consideration for industrial-scale wind farms, not small-scale generation
- Only considered the wind farm, not the associated transmission from the site
- First iteration, not the final analysis

Montana Wind Energy Ecological Risk Assessment Approach

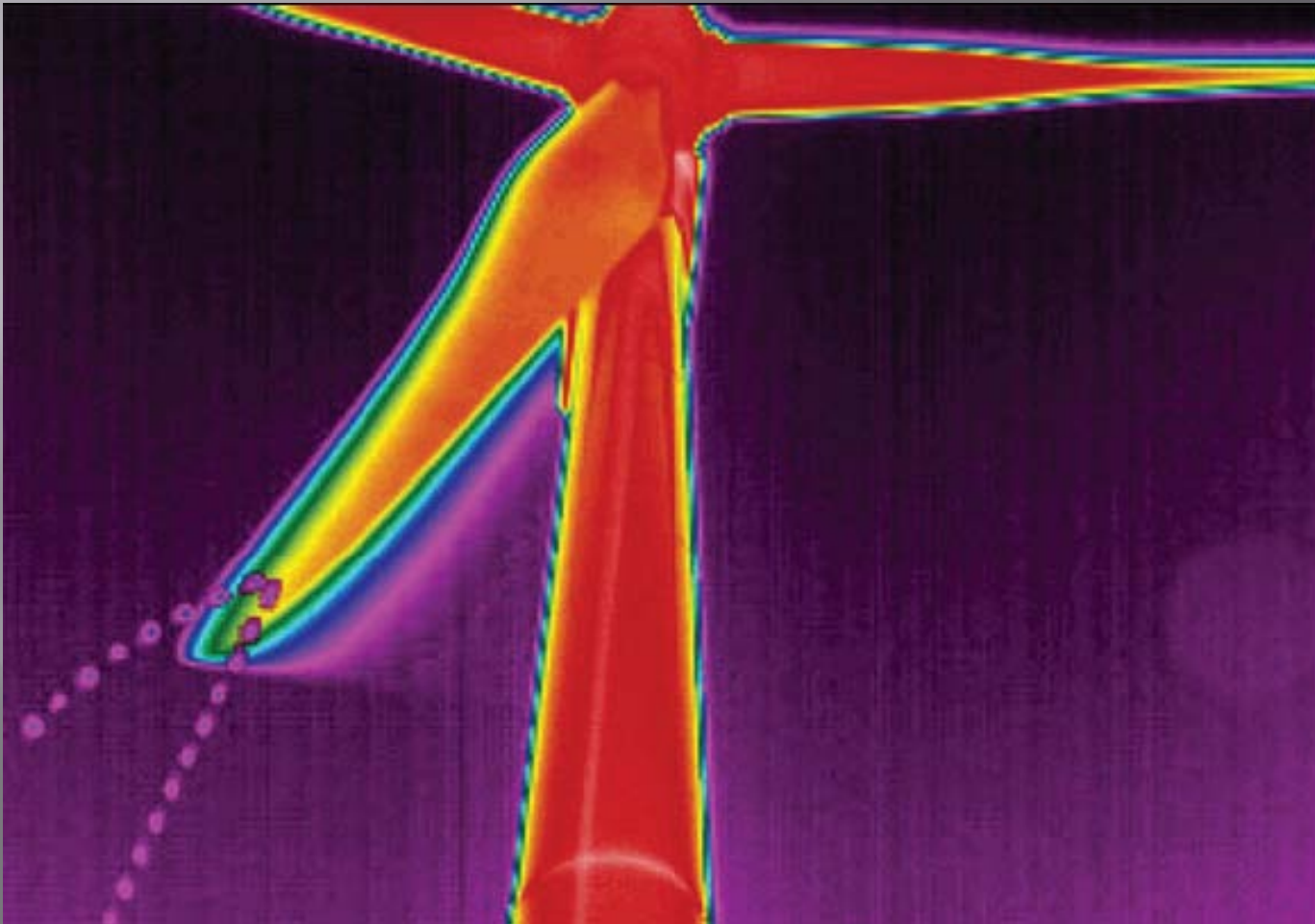
1. Use coarse filters (vegetation-based) and fine filters (species)
2. For species select those most at risk from wind energy development— based on literature of wind or other extensive industrial development
3. Must have spatial data on distribution or location
4. To determine risk use simple analysis of presence versus more sophisticated analysis using weighting by species
5. Cumulative score to determine “high risk” or “low risk”

Species Selected for Analysis

- Sage grouse
- Ferruginous hawk
- Mountain plover
- Long-billed curlew
- Marbled godwit
- Burrowing owl
- Sprague's pipit
- Lark bunting
- Baird's sparrow
- McCown's longspur
- Chestnut-collared longspur
- Piping plover
- Interior least tern
- Wetland dependent birds
- Big brown bat
- California myotis
- Eastern red bat
- Fringed myotis
- Hoary bat
- Long-eared myotis
- Long-legged myotis
- Pallid bat
- Spotted bat
- Silver-haired bat
- Townsend's big eared bat
- Little brown myotis
- Western small footed myotis
- Grizzly bear
- Mule deer winter range
- Antelope winter range
- Elk winter range

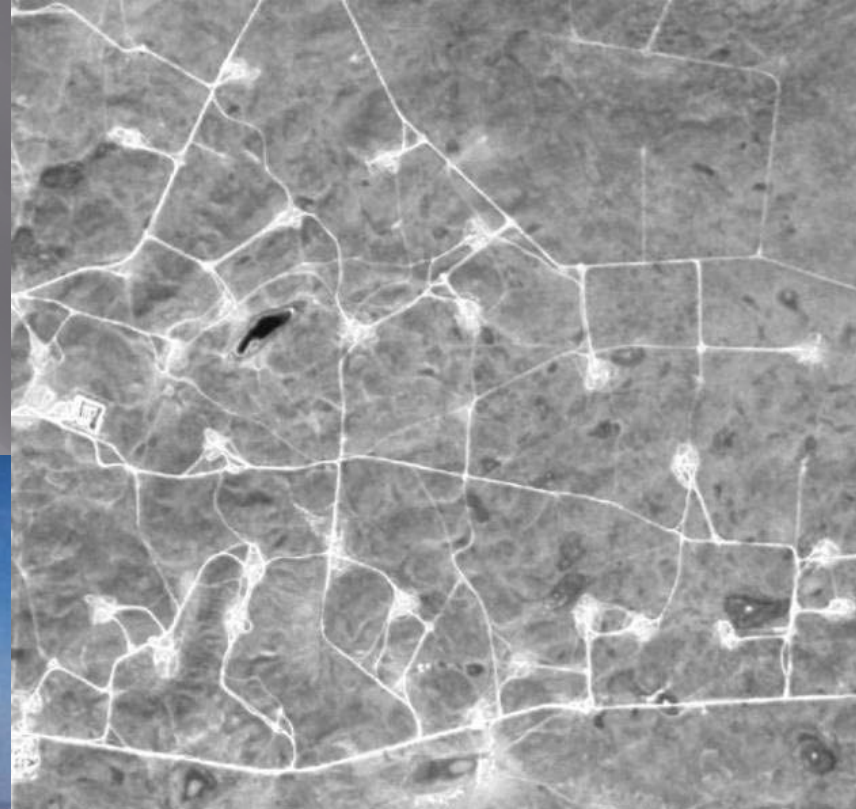
Ecological Risk: 1. Direct Mortality

Thermal infrared image showing the trajectory of a bat colliding with a moving blade (lower left)



Graphic from Kunz et al. 2007

Ecological Risk: 2. Fragmentation



Ecological Risk: 2. Fragmentation

Sawyer et al. 2006

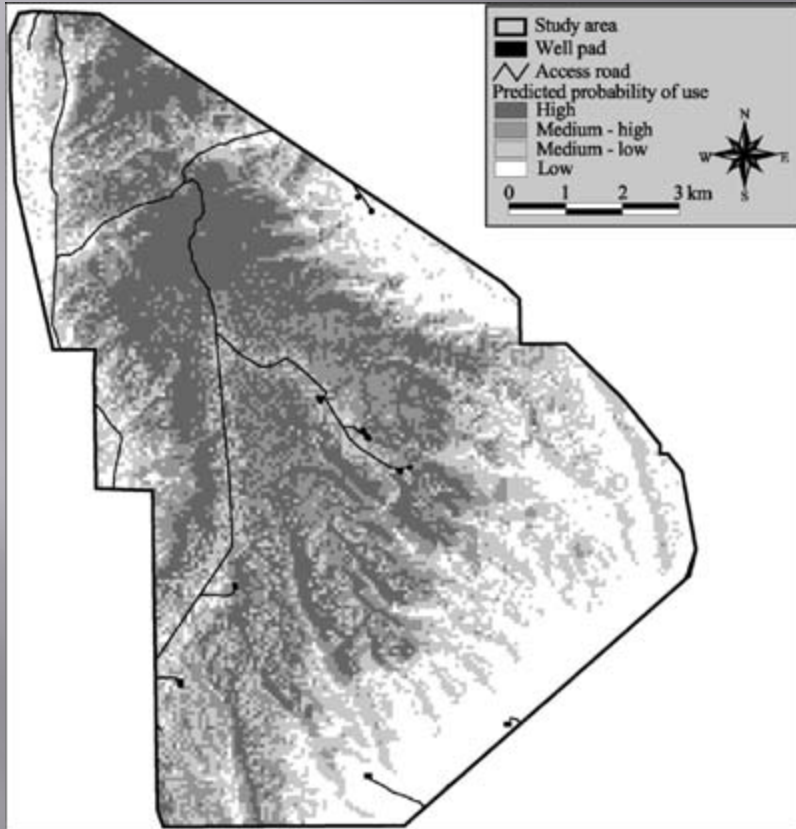


Figure 1. Predicted probabilities and associated categories of mule deer habitat use during 1998-1999 and 1999-2000 winters, before natural gas field development in western Wyo., USA.

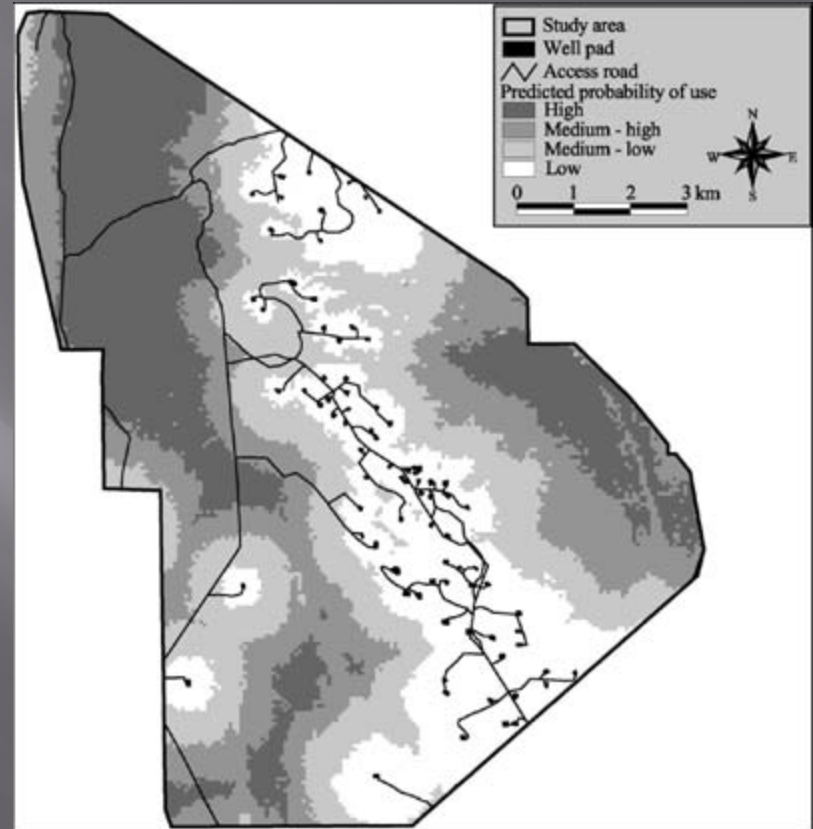
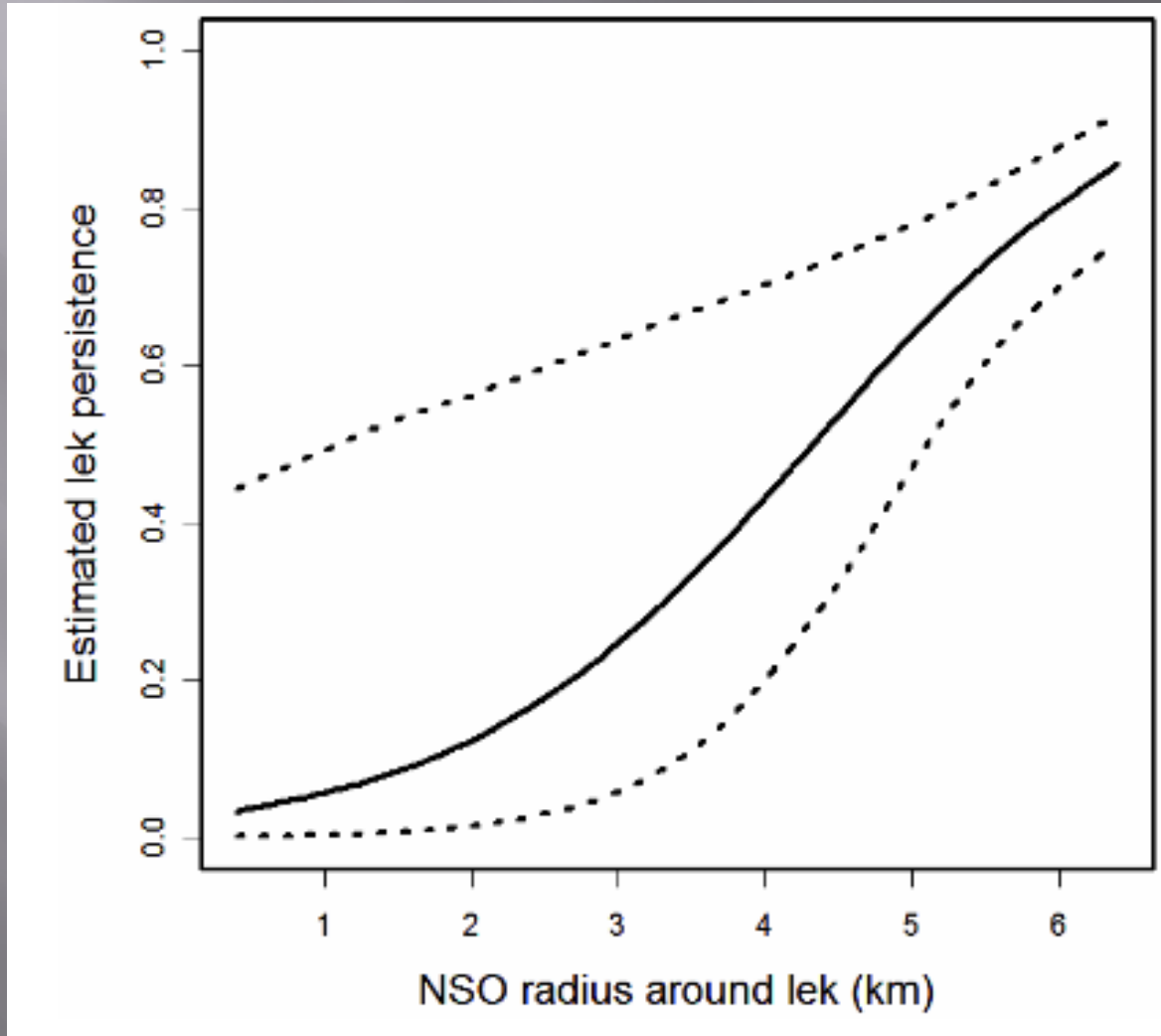


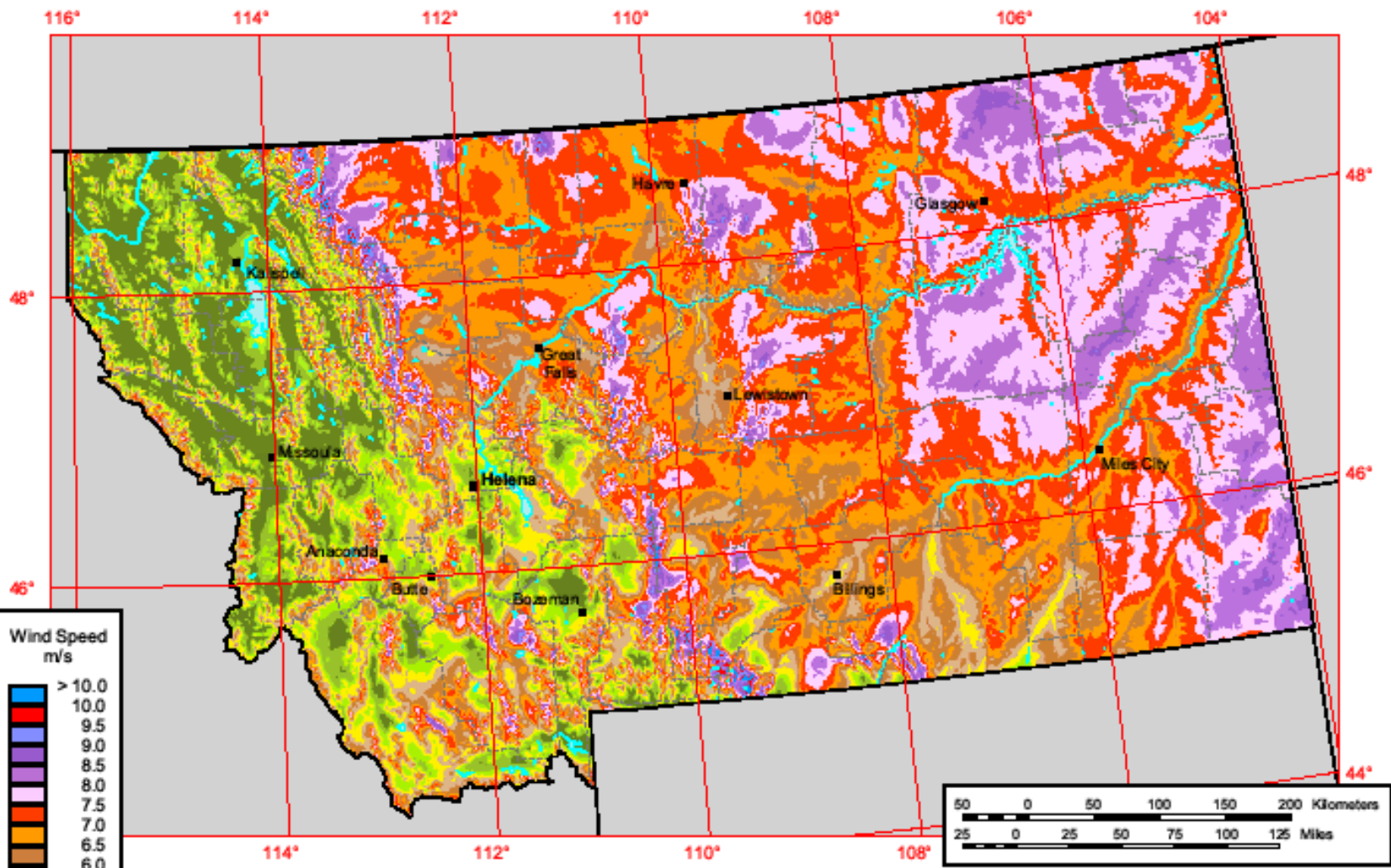
Figure 4. Predicted probabilities and associated categories of mule deer habitat use during year 3 (winter of 2002-2003) of natural gas development in western Wyo., USA.

Ecological Risk: 3. Avoidance/Displacement



Walker 2008

Montana - Annual Average Wind Speed at 80 m



Source: Wind resource estimates developed by AWS Truewind, LLC for windNavigator®. Web: <http://navigator.awstruewind.com> | www.awstruewind.com. Spatial resolution of wind resource data: 2.5 km. Projection: UTM Zone 11 WGS84.



Figure 1. Wind Energy Potential in Montana

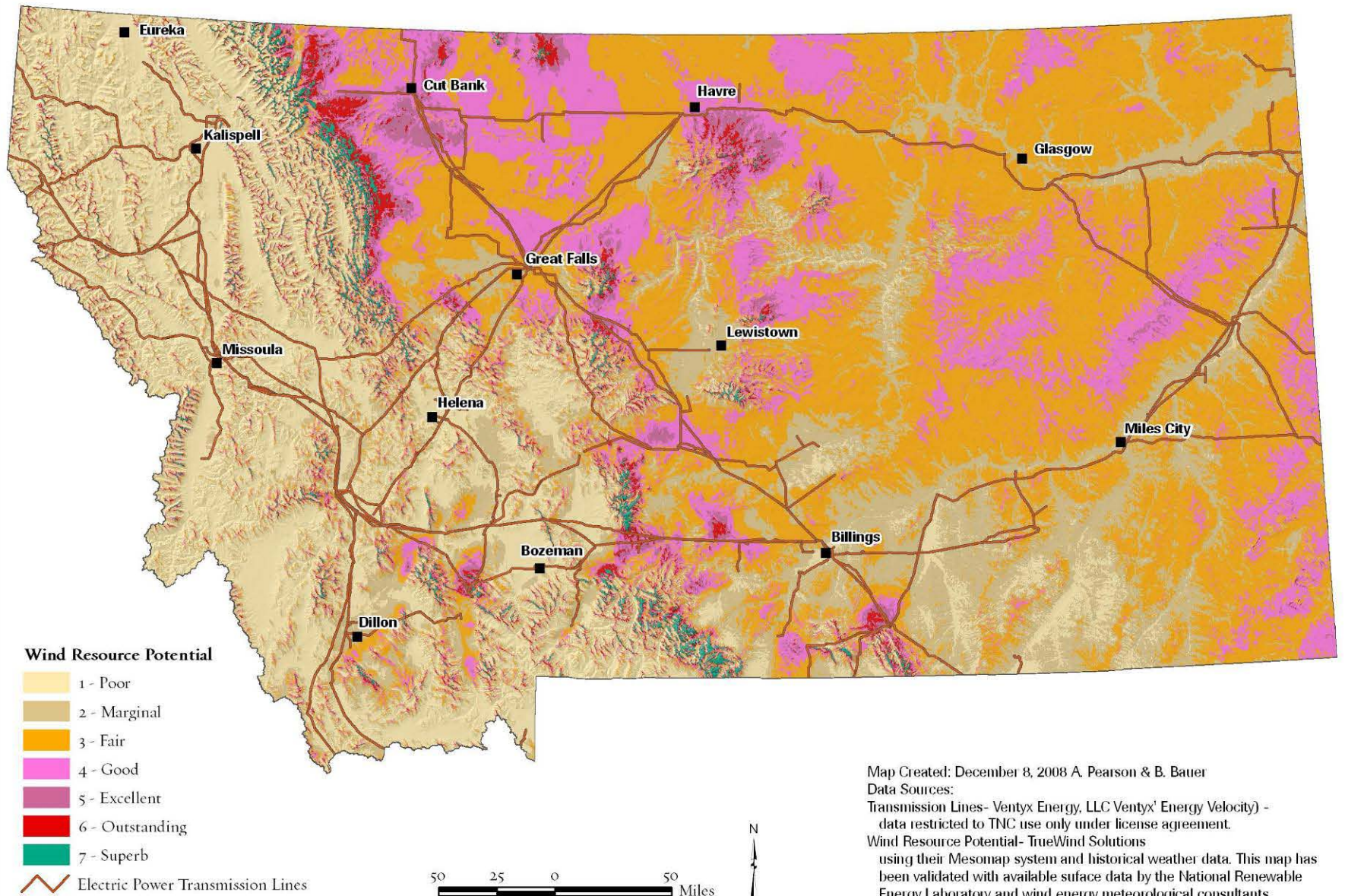
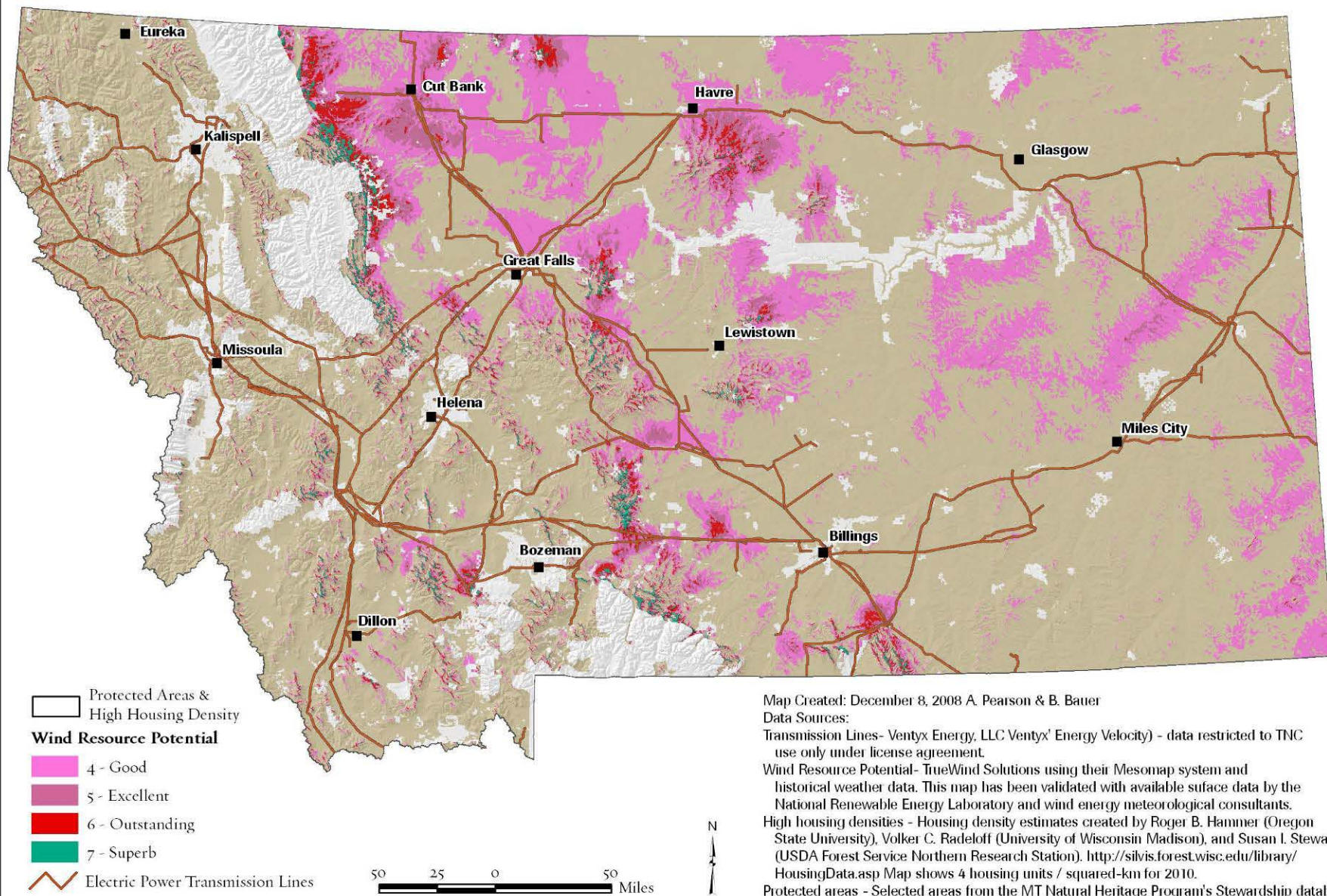


Figure 3. Lands Excluded from Wind Energy Development



Data for Risk Analysis: Coarse-scale Vegetation

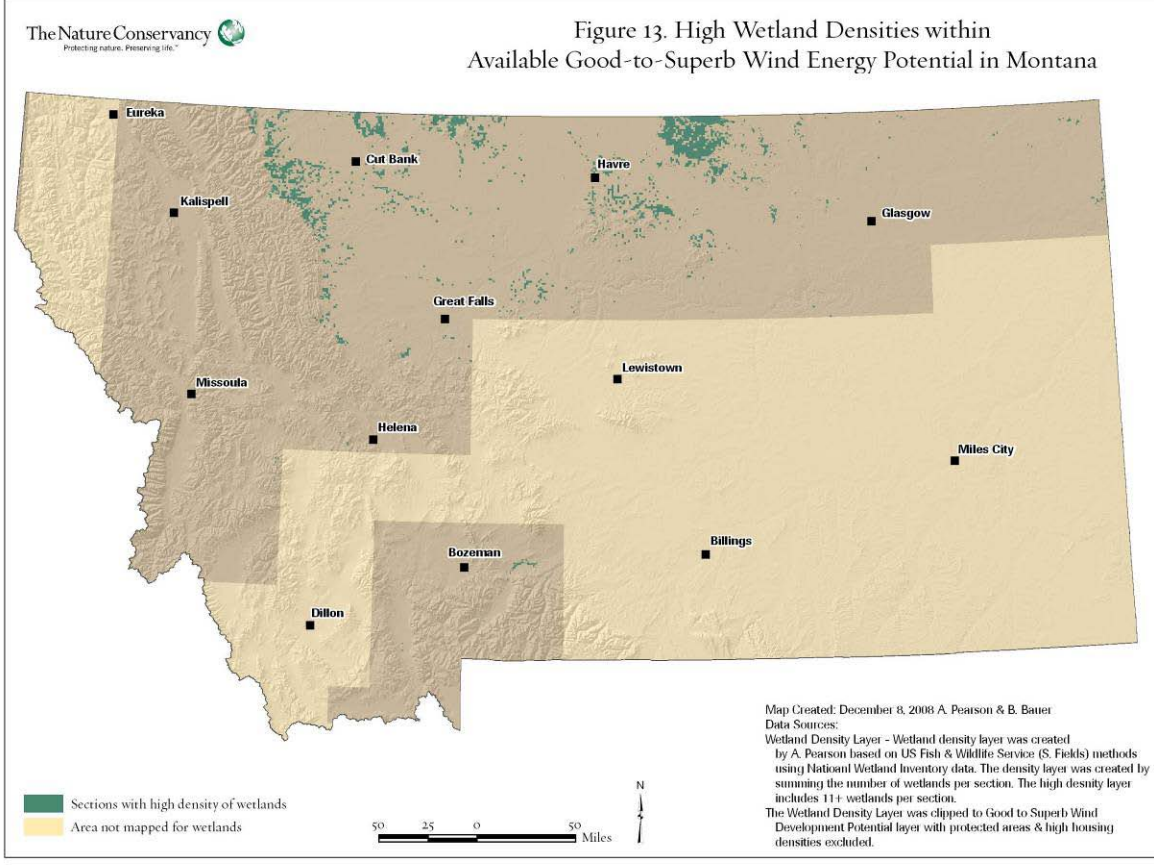
Figure 5. Relatively Intact Natural Habitat



Figure 12. High Wetland Densities in Montana



Figure 13. High Wetland Densities within Available Good-to-Superb Wind Energy Potential in Montana



Data for Risk Analysis: Sage Grouse

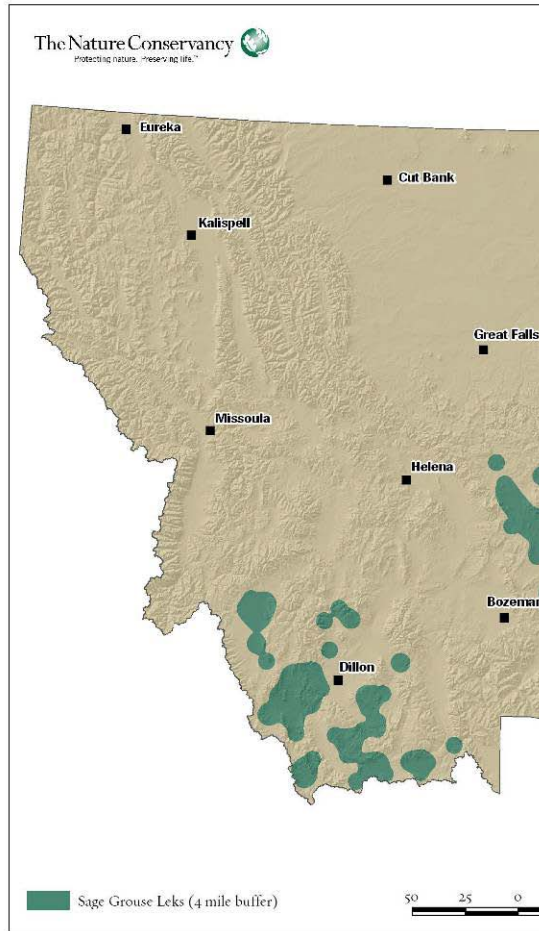
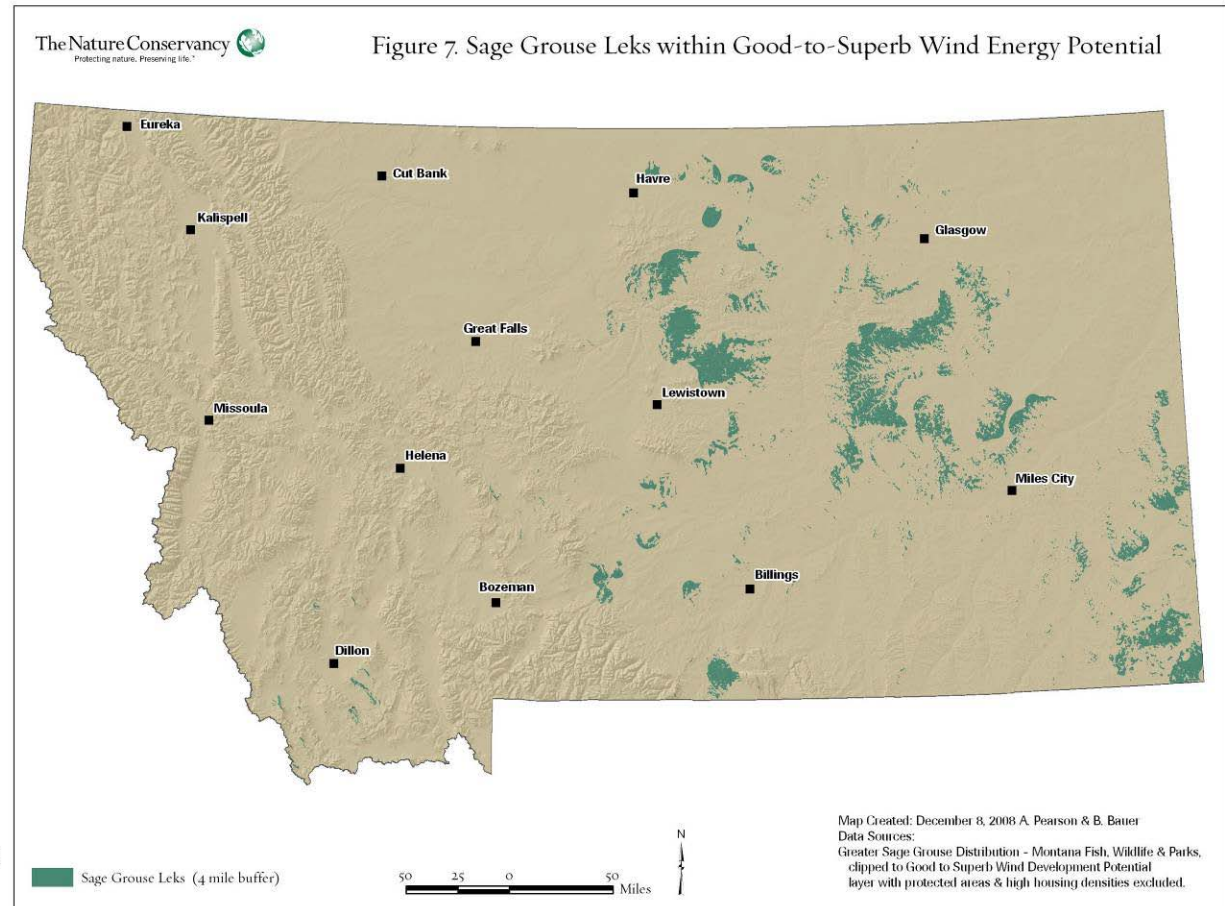


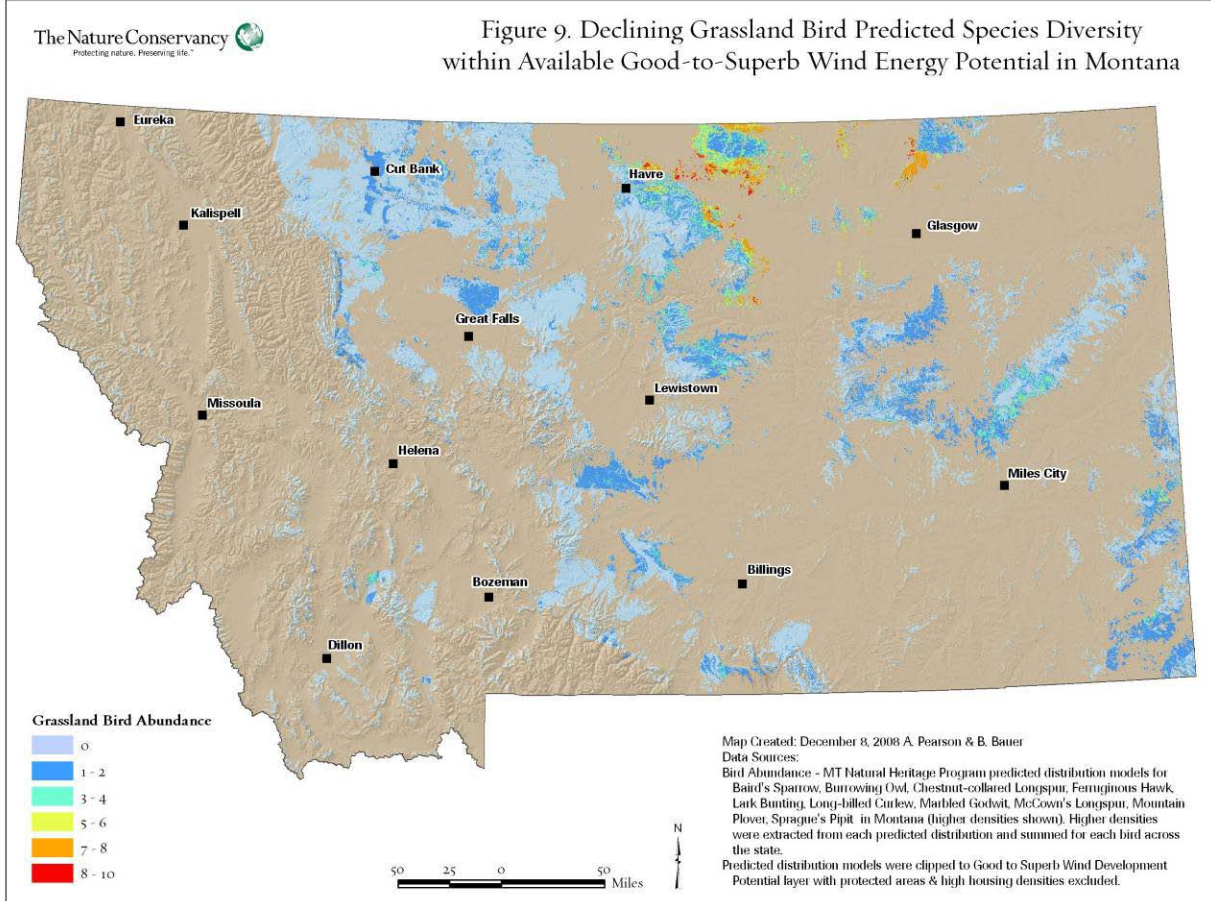
Figure 6. Sage Grouse Leaks in Montana



Bird Species Selected for Predicted Distribution

Species	Conservation Status	
	Partners in Flight or US Shorebird Conservation Plan (2004)	USFWS (2002)
Ferruginous hawk	Regional Concern	BCC
Mountain plover	Highly Imperiled	BCC
Long-billed curlew	Highly Imperiled	BCC
Marbled godwit	High Concern	BCC
Burrowing owl	Regional Concern	BCC
Sprague's pipit	Continental importance	BCC
Lark bunting	Continental importance	
Baird's sparrow	Continental importance	BCC
McCown's longspur	Continental importance	BCC
Chestnut-collared longspur	Continental importance	BCC

Data for Risk Analysis: Grassland Birds



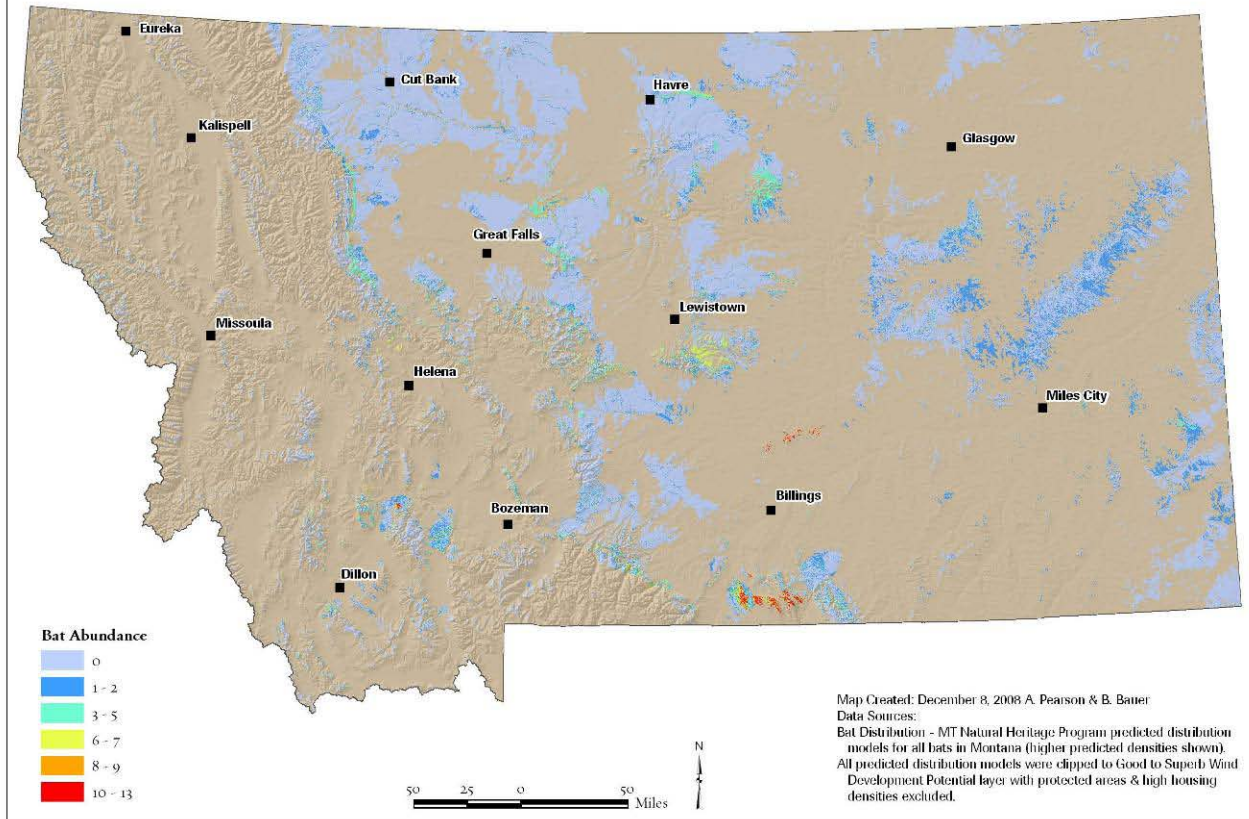
Bats Species Selected for Predicted Distribution

Species	Status
Big brown bat	
California myotis	
Eastern red bat	Species of concern
Fringed myotis	Species of concern
Hoary bat	Species of concern
Long-eared myotis	
Long-legged myotis	
Northern myotis	Species of concern
Pallid bat	Species of concern
Spotted bat	Species of concern
Townsend's big eared bat	Species of concern
Little brown myotis	
Western small footed myotis	

Data for Risk Analysis: Bats

The Nature Conservancy
Preserving nature. Preserving life.™

Figure 15. Predicted Species Diversity of 13 Species of Breeding Bats in Montana within Good-to-Superb Wind Energy Potential



Data for Risk Analysis: Grizzly Bears

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Figure 17. Grizzly Bear Modeled Habitat along the Rocky Mountain Front within Available Good-to-Superb Wind Energy Potential

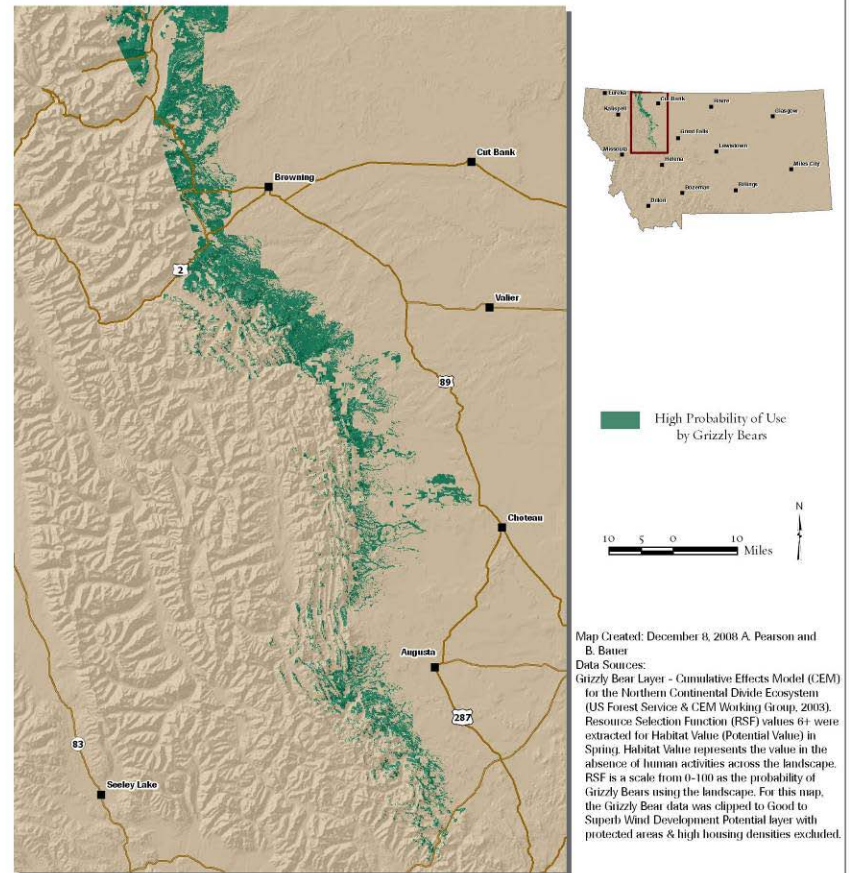
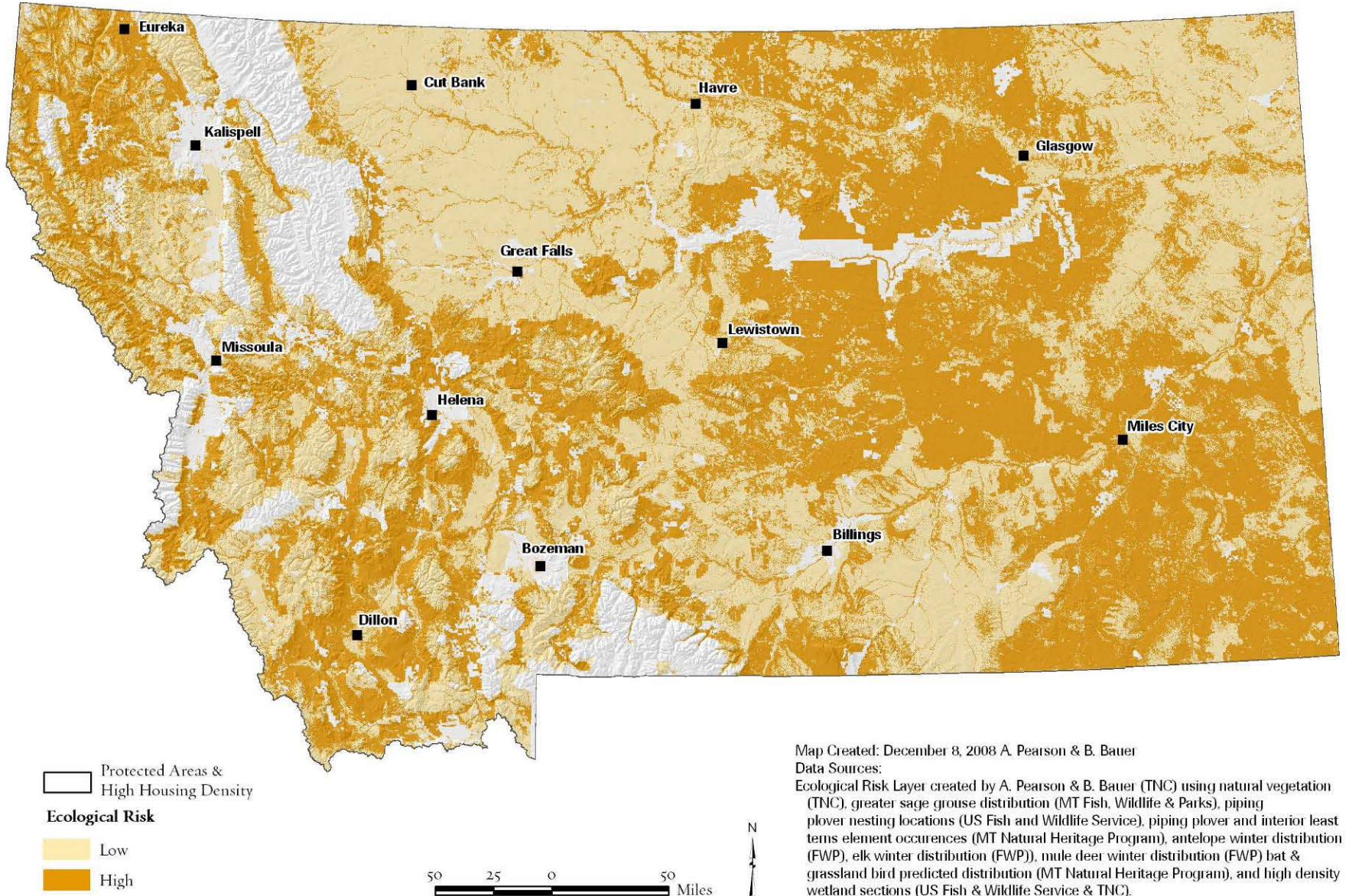


Figure 22. Ecological Risk Assessment for Wind Energy Development in Montana



CAPS: CRUCIAL AREAS PLANNING SYSTEM



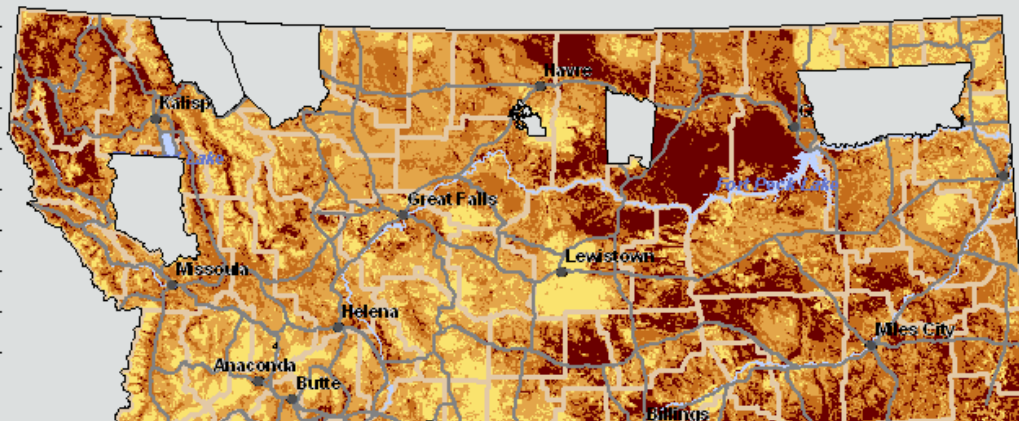
Tools

Reference

Imagery

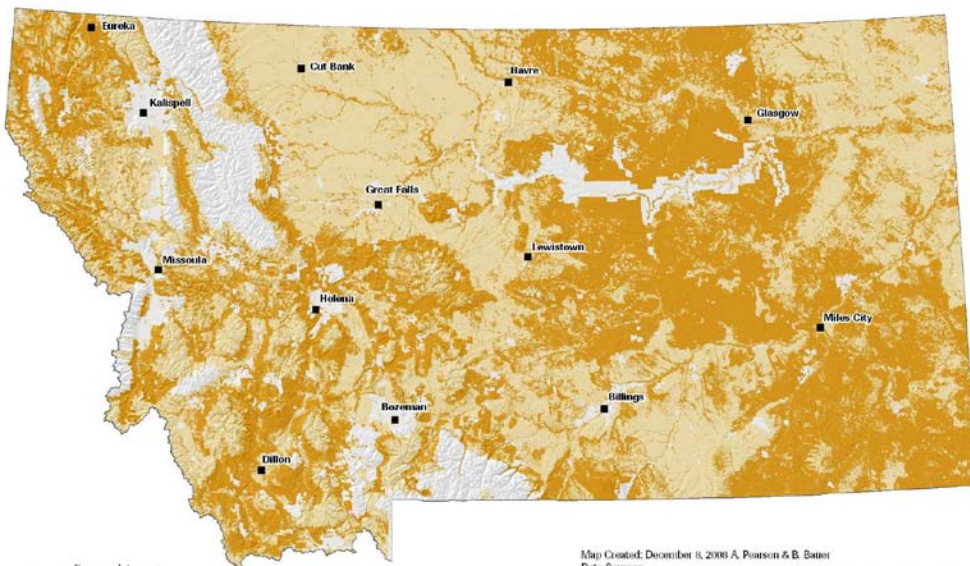
Highway/Topo

Relief



The Nature Conservancy
Protecting nature. Promoting life.

Figure 22. Ecological Risk Assessment for Wind Energy Development in Montana



Protected Areas & High Housing Density

Ecological Risk

Low

High

0 25 50 Miles

Map Created: December 8, 2008 A. Pearson & B. Bauer

Data Sources:

Ecological Risk Layer created by A. Pearson & B. Bauer (TRC) using natural vegetation (TRC), greater sage grouse distribution (MT Fish, Wildlife & Parks), piping plover nesting locations (US Fish and Wildlife Service), piping plover and interior least terns element occurrences (MT Natural Heritage Program), antelope winter distribution (FAP), elk winter distribution (FAP), mule deer winter distribution (FAP) but & grassland bird predicted distribution (MT Natural Heritage Program), and high density wetland sections (US Fish & Wildlife Service & TRC).

CRUCIAL AREAS PLANNING SYSTEM

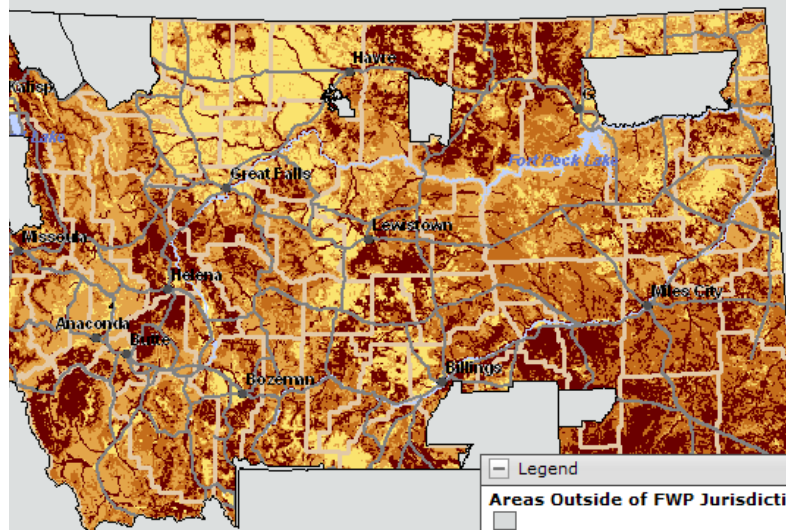
Tools

Reference

Imagery

Highway/Topo

Relief



Legend

Areas Outside of FWP Jurisdiction

Terrestrial Species Richness

Class 1 (Highest)

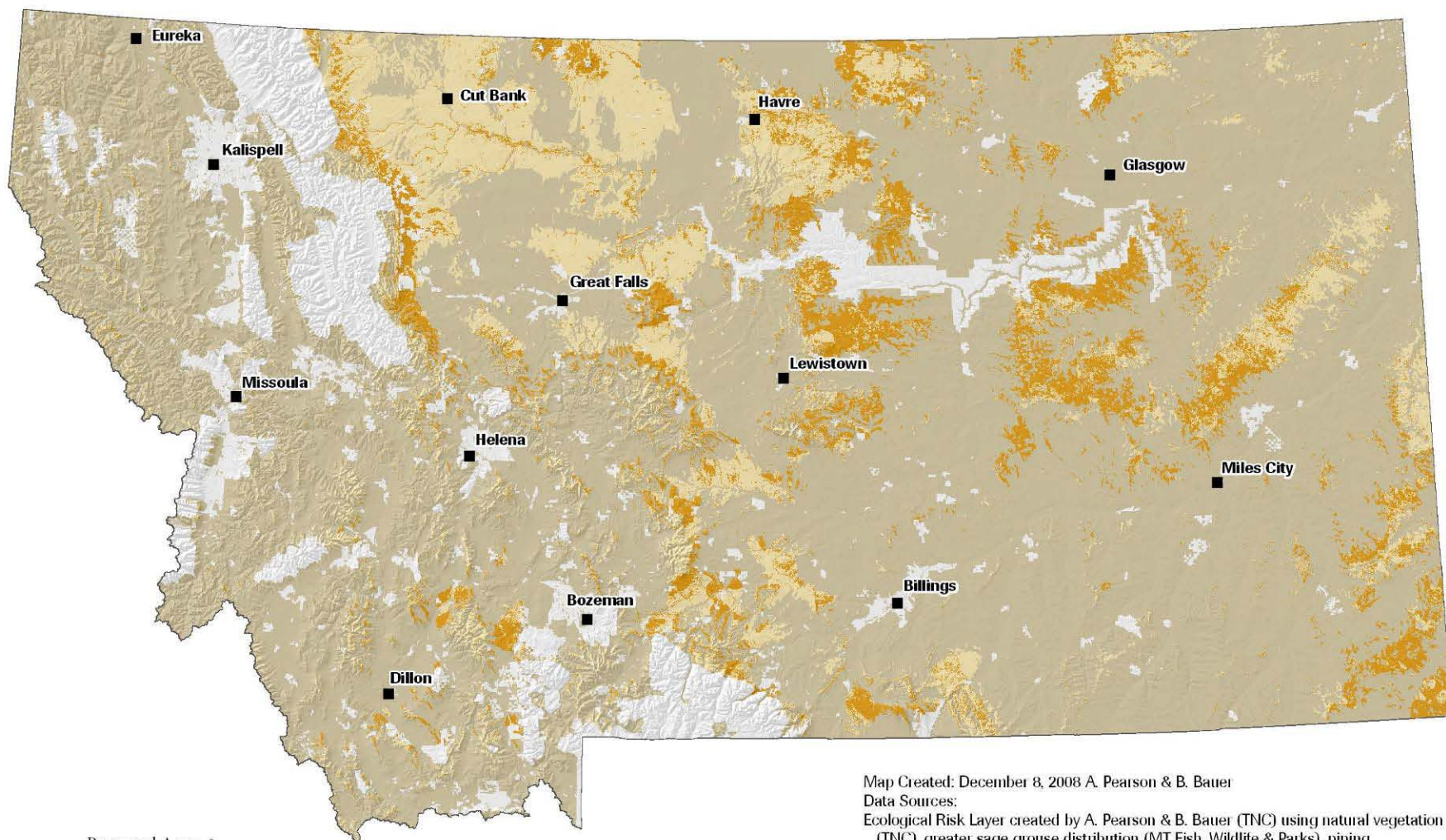
Class 2

Class 3

Class 4 (Lowest)

User Guide

Figure 23. Ecological Risk Assessment for Wind Energy Development within Available Good-to-Superb Wind Energy Potential in Montana



Map Created: December 8, 2008 A. Pearson & B. Bauer

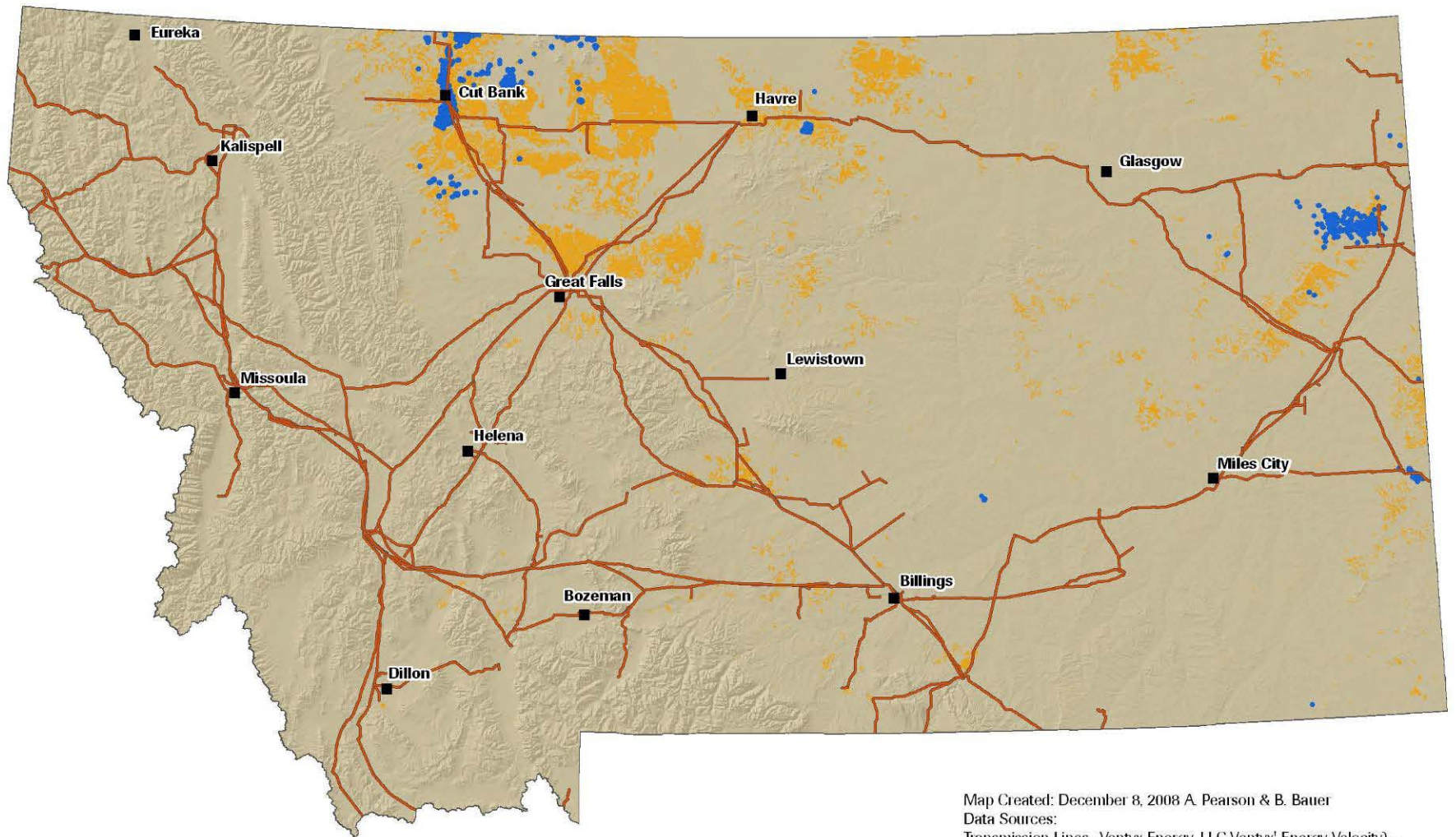
Data Sources:




Ecological Risk Layer created by A. Pearson & B. Bauer (TNC) using natural vegetation (TNC), greater sage grouse distribution (MT Fish, Wildlife & Parks), piping plover nesting locations (US Fish and Wildlife Service), piping plover and interior least terns element occurrences (MT Natural Heritage Program), antelope winter distribution (FWP), elk winter distribution (FWP), mule deer winter distribution (FWP) bat & grassland bird predicted distribution (MT Natural Heritage Program), and high density wetland sections (US Fish & Wildlife Service & TNC). For this map, Risk layer was clipped to Good to Superb Wind Development Potential layer with protected areas & high housing densities excluded.

Results

- 17 Million Acres of Good to Superb Wind Energy Potential in Montana
- ~ 8 Million Acres of High Risk to Multiple Resident or Breeding Species
- ~ 9 Million Acres of Low Risk
 - Primarily cropland, fragmented grassland, or oil fields

Figure 4. Low Ecological Risk Lands for Wind Energy Development



-  Oil Wells within Cropland
-  Cropland
-  Electric Power Transmission Lines

50 25 0 50 Miles



Map Created: December 8, 2008 A. Pearson & B. Bauer
 Data Sources:
 Transmission Lines - Ventyx Energy, LLC (Ventyx' Energy Velocity) - data restricted to TNC use only under license agreement
 Cropland - MT Department of Revenue
 Oil Wells - MT Department of Natural Resources & Conservation (used only active or previously active oil wells with 3-acre buffer - well locations on this map are enlarged for better display)
 Both layers were clipped to Good to Superb Wind Development. Potential layer with protected areas & high housing densities excluded.



Low Risk Examples

Report Available

[http://conserveonline.org/library/
mt-wind-analysis/view.html](http://conserveonline.org/library/mt-wind-analysis/view.html)