Bird and Bat Impacts from wind energy Development

June 25, 2008
Wind Energy Public Forum
in Missouri

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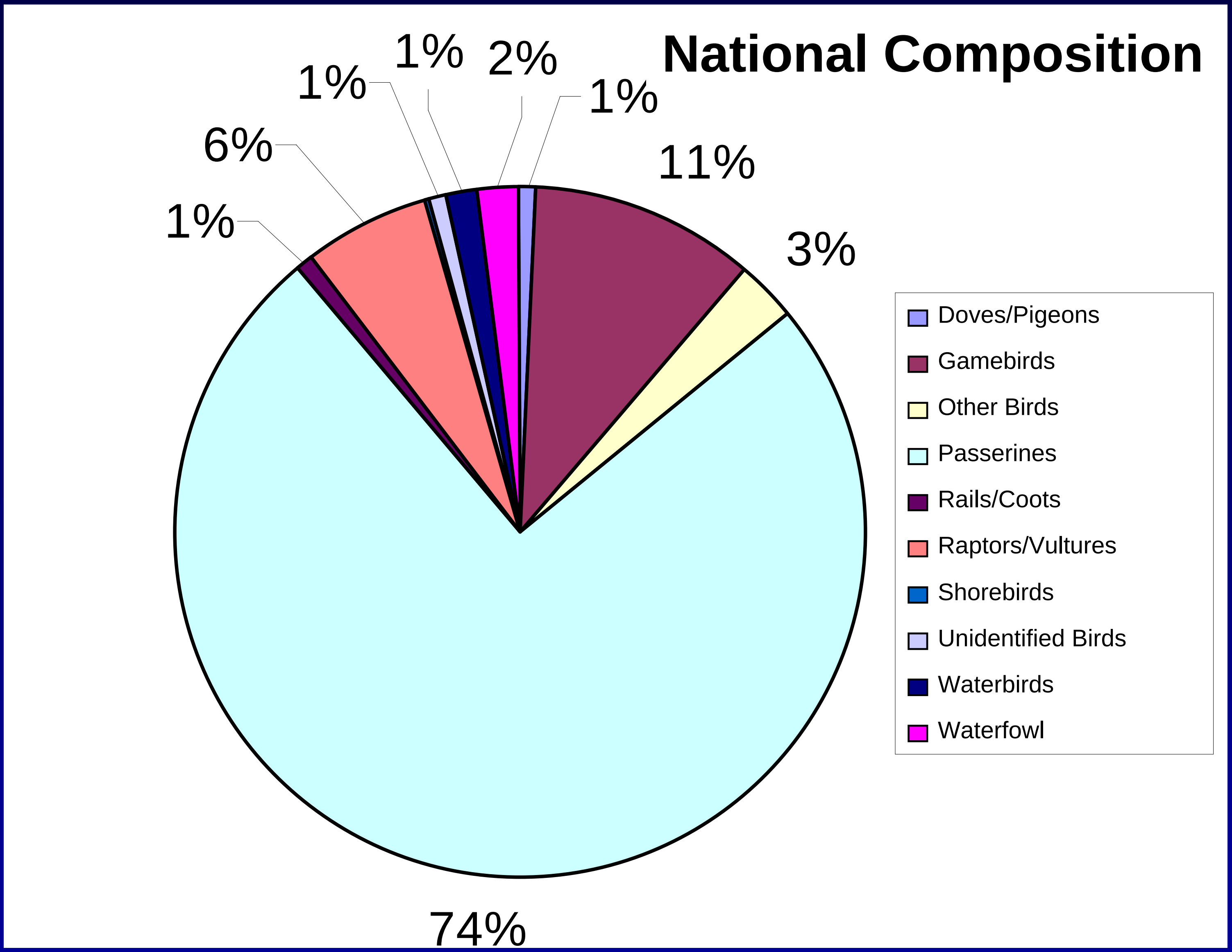

Proportion of fatalities at sites reporting fatalities by species, summarized for All Regions where studies have been conducted (Pacific Northwest, Mid-West, Rocky Mountains, and East).

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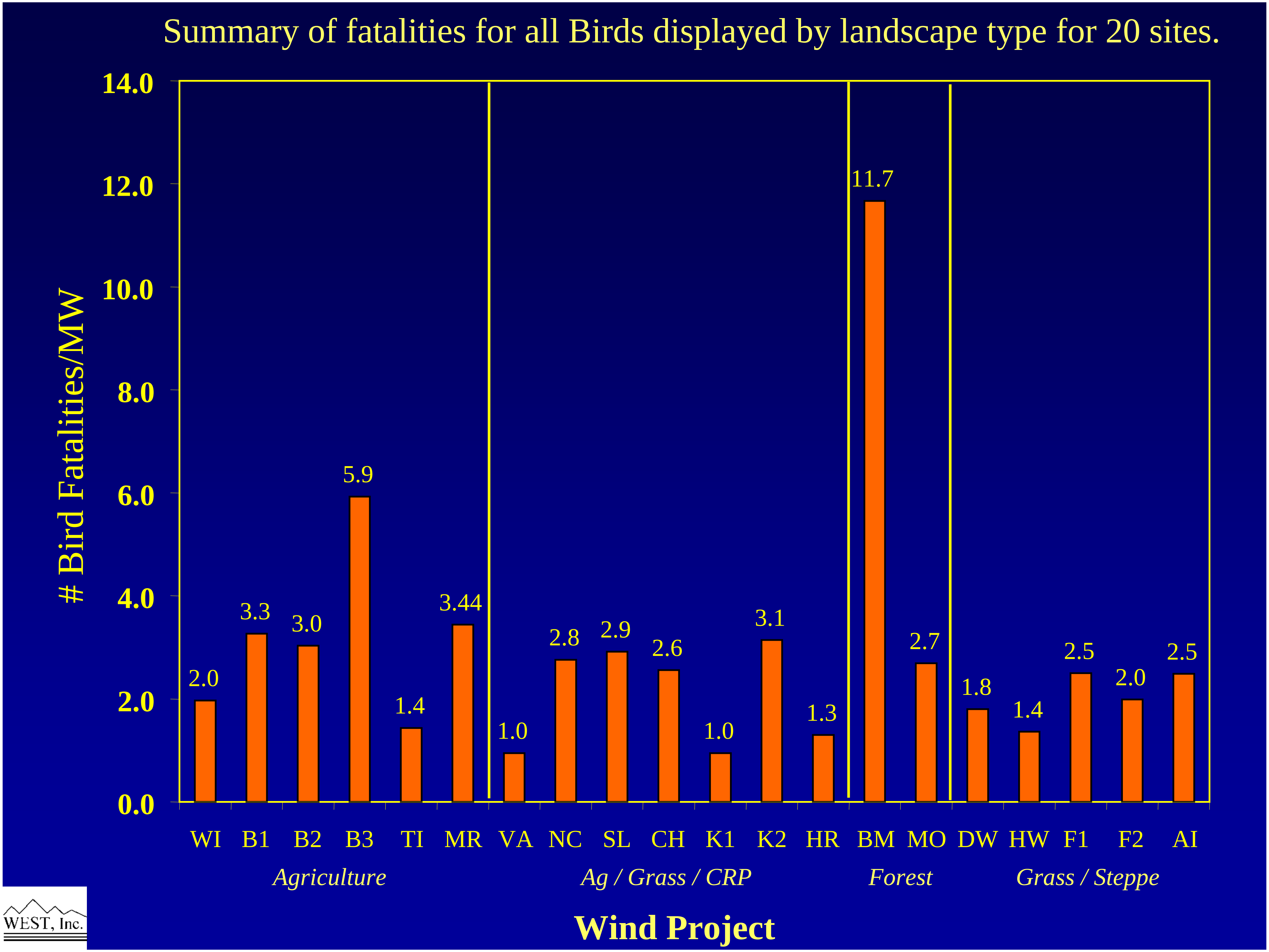
Top 10 fatalities by species ranked by number of carcasses[1]

Species	Pacific NW	Midwest	Rocky Mtns.	East	Grand Total	Rank
horned lark	90	1	18		109	1
unknown passerine	6	1	4	19	30	2
golden-crowned kinglet	20	3		5	28	3
ring-necked pheasant	24	2			26	4
European starling	7	4		8	19	5
western meadowlark	14	1	2		17	8
red-tailed hawk	9	2		4	15	7
gray partridge	13	1			14	6
white-crowned sparrow	10		1		11	9
unknown bird	3	1		7	11	10
Total for 132 Species	263	86	80	125	554	

[1] Assumes no background fatalities


Summary of fatalities for all Birds displayed by landscape type for 20 sites.
Bird Fatalities/MW
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2.0
3.3
3.0
5.9
1.4
3.44
1.0
2.8
2.9
2.6
1.0
3.1
1.3
11.7
2.7
1.8
1.4
2.5
2.0
2.5
WI B1 B2 B3 TI MR VA NC SL CH K1 K2 HR BM MO DW HW F1 F2 AI
Agriculture
Ag / Grass / CRP
Forest
Grass / Steppe
Wind Project
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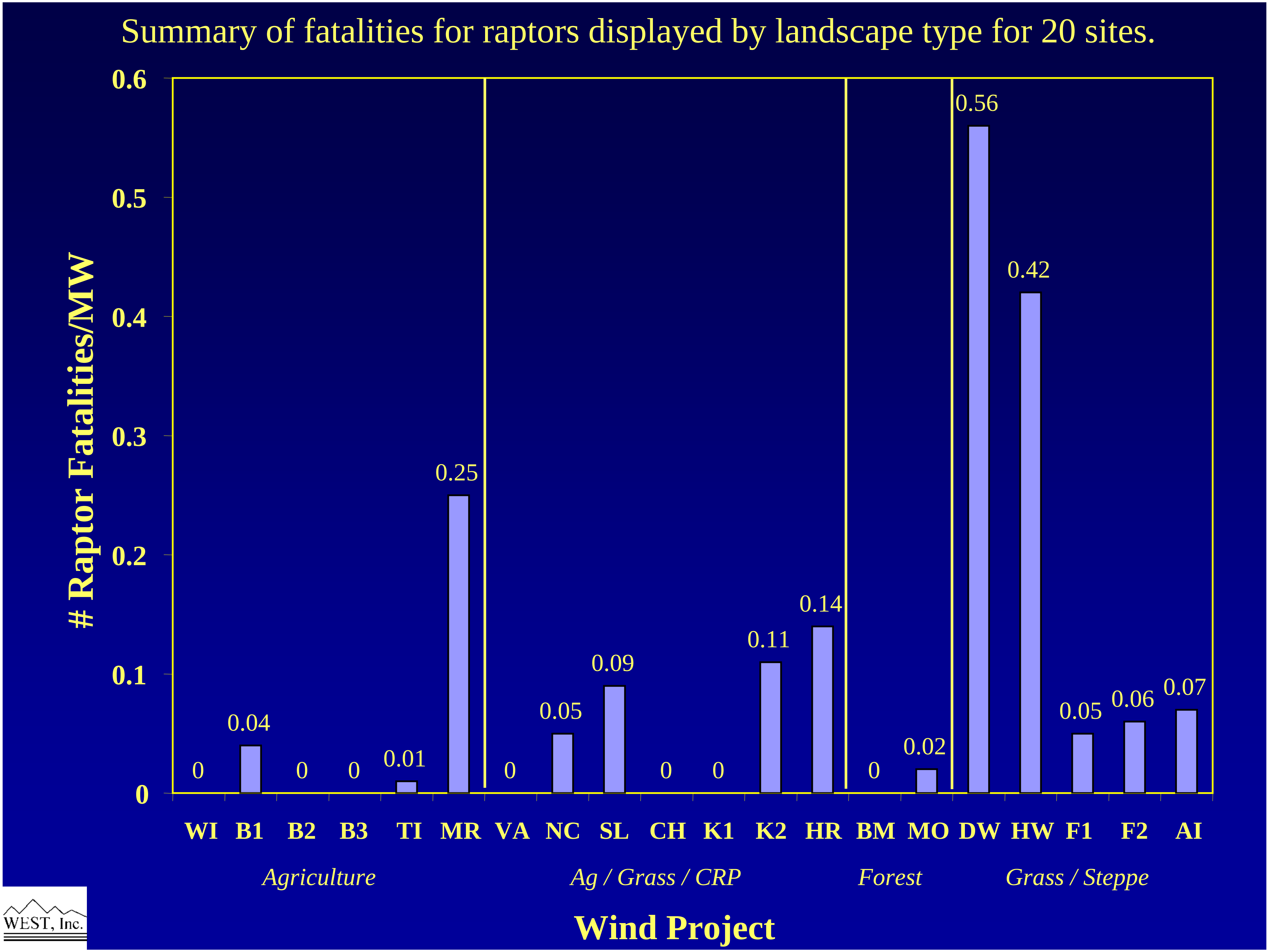

Summary of fatalities for raptors displayed by landscape type for 20 sites.
Raptor Fatalities/MW
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.04
0
0
0.01
0.25
0
0.05
0.09
0
0
0.11
0.14
0
0.02
0.56
0.42
0.05
0.06
0.07
WI B1 B2 B3 TI MR VA NC SL CH K1 K2 HR BM MO DW HW F1 F2 AI
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Nocturnal Avian Migration

- Many species migrate at night and risk to these species is a concern.
- Evidence supports ubiquitous nocturnal migration that occurs in variable pulses over time and space – often referred to as “broad-front”.
- Nocturnal migration appears correlated with favorable weather events that produce prevailing winds in the appropriate direction.
- Altitude of nocturnal migrants variable - probably by species, weather patterns, time of night, season, topography.
- Some migrants are at risk of collision with tall structures.

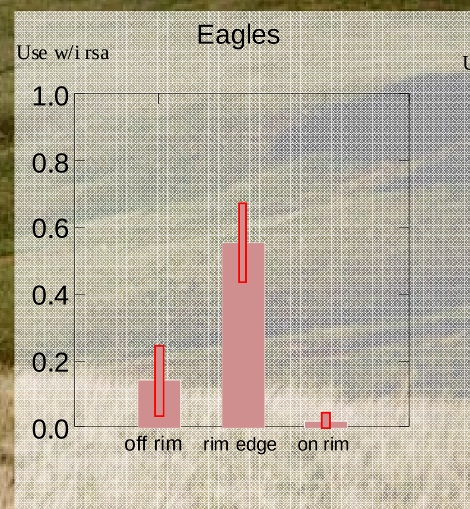
Results of Radar Studies at Proposed and Existing Wind Project Sites in the U.S.

Site	Passage Rates targets/km/hr)		Mean Flight Height m)		% Targets below 125 m		Mean Flight Direction		Reference
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	
Clinton County, NY	110	197	338	333	20	12	30	162	Mabee *et al.* 2006
Marble River, NY	254	152	422	438	11	5	40	193	Woodlot Alternatives 2005
Dairy Hills, NY	117	94	397	466	15	10	14	180	Young *et al.* 2006
Prattsburgh 1, NY	170	200	319	365	18	9	18	177	Mabee *et al.* 2004, 2005
Prattsburgh 2, NY	277	193	370	516	16	3	22	188	Roy et al. 2004, Woodlot 2005
Chautauqua, NY	395	238	528	532	4	5	29	199	Cooper *et al.* 2004a,b
Jordanville, NY	409	380	371	440	21	6	40	208	Woodlot Alternatives 2005
West Hill, NY	160	732	291	664	25	3	31	223	Woodlot Alternatives 2005a,b
High Sheldon, NY	112	197	418	422	6	3	29	213	Woodlot Alternatives 2005
Top Notch, NY	509	691	419	516	20	4	44	198	Gary, pers. comm. 2006
Flat Rock, NY		158		415		8		184	Mabee *et al.* 2005
Wetherfield, NY	170	168					21	179	Cooper and Mabee 2000
Harrisburg, NY		122						181	Cooper and Mabee 2000
Copenhagen, NY	192	225					12	184	Cooper *et al.* 1995
Cape Vincent, NY	192						18		Cooper *et al.* 1995
Martinsburg, NY		230						191	Cooper *et al.* 1995
Deerfield, VT	404	178	523	556	6	4	47	203	Roy and Pelletier 2005, 2005
Sheffield, VT	199	109	522	566	6	1	40	200	Roy *et al.* 2005, 2006
Martindale, PA		187		436		8		188	Plissner *et al.* 2005
Casselman, PA		174		448		7		219	Plissner *et al.* 2005
Mount Storm, WV		199		410		16		184	Mabee *et al.* 2004
Mean - East Studies	258	247	409	470	14	6.5	31	193	
Cotterel Mountain, ID		32		565		3		155	Cooper et al. 2004
Stateline, OR/WA	50	23	625	470	16	6	9	165	Mabee and Cooper 2002
Nine Canyon, WA	98	31	472	127	15	8	23	181	Mabee and Cooper 2000, 2001
Buffalo Ridge, MN	93								Hawrot and Hanowski 1997
Mean – West Studies	80	29	548	387	15.5	5	16	167	

Avian Avoidance/Mitigation - Location, Location, Location

FOOTE CREEK RIM WYOMING - Example

Lower apparent golden eagle and other raptor fatalities than predicted by the BLM EIS due to other confounding factors (i.e., turbine siting)



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Bat Fatalities

- 22 studies at 20 facilities
- 5 regions in US and Canada
- 0.9 – 53.3 bats/MW
- Highest fatalities in the east with exception of recent event in Alberta
- 11 of the 45 species occurring in US
- Heavily skewed to migratory foliage roosting species (hoary, eastern red, silver-haired bats)
- Fatalities peak during fall migration (mid-September)
- Little data from SW where Brazilian free-tailed bat most abundant

Possible Explanations Why Bats Are Being Killed by Wind Turbines?

- Linear Corridor
- Roost Attraction
- Landscape Attraction
- Low Wind Velocity
- Heat Attraction
- Visual Attraction
- Acoustic Attraction
- Echolocation Failure
- Electromagnetic-Disorientation
- Decompression
- Thermal Inversion (from Kunz et al. 2007)

Patterns of Bat Fatality:

Extent of the Problem

Bat fatalities have been documented at wind facilities worldwide across a wide range of habitats…

appear to be highest at sites on forested ridges in eastern U.S…but…

Recent studies have found higher than expected bat fatalities in open prairie in Alberta Canada…

And…in mixed agriculture/forest habitats in New York (several thousand bats likely killed)

Bat fatality in the East (Arnett et al. 2008)

Project	Bats/MW/yr
Buffalo Mt., TN	31.5 (phase 1) and 53.3 (phase 2) (0.66MW turbines) 38.7 (phase 2) (1.8MW turbines)
Maple Ridge, NY	14.9 in 2006 & 9.4 in 2007
Meyersdale, PA	15.3 in 6 weeks in 2004
Mountaineer , WV	32 in 2003; 25.3 in 6 weeks in 2004


MITIGATION OPTIONS
Operational mitigation…
during high risk periods
that may be predictable
Pre-Construction Assessment…
Determine and avoid high risk
areas
Technological…
Deter or alert the bats…

Predicted Impacts Due to Habitat Disturbance from planning documents (e.g. EIS)

- Temporary (construction) impacts from roads, pads, substation, etc. (estimated)
  - 0.4 to 3 acres/turbine
- Permanent (operations) impacts (estimated)
  - 0.7 to 1 acres/turbine
- Impacts and Reclamation success due to
  - Turbine type
  - Site characteristics
  - Reclamation plan
  - Climate
- Permanent footprint 5-10% of site (BLM 2005)

Completed and ongoing displacement Studies

- Buffalo Ridge, MN (Leddy et. al.1999, Johnson et al. 2000): Small scale displacement (~80-100m)

- South Dakota: 1 of 3 species (grasshopper sparrow) showed reduced density within 150m in the first year and no difference in the second year in South Dakota (Schaffer and Johnson 2007)
- Stateline: Grasshopper sparrow showed displacement effect within 50m

- Oklahoma: No displacement for grassland speci as a group (O'Connell and Piorkowski 2006)
- Ongoing and potential studies of bird displacement (e.g., Stateline, N & S Dakota, and prairie chicken in Kansas, Dr. Sandercock KSU)

Raptor nesting impacts reported in the literature

- No effect
  - Montezuma Hills, CA (Howell and Noone 1992)
  - Foote Creek Rim, WY (Johnson et al. 2000)
  - Altamont, CA (Hunt and Hunt 2006)
  - Nine Canyon, OR (Erickson et al. 2003)
- Effect
  - Buffalo Ridge, MI (Usgaard et al. 1997)
  - 261 Km^2 surrounding facility density of 5.94/100 Km^2
  - No nests present in the 32 Km^2 facility, 2 predicted
  - Assumes uniform distribution of nests

Habitat impacts report for other bird species

- Mountain Plover – Foote Creek Rim, WY declined at wind plant, a reference area, and regionally
- Canada geese – Top of Iowa no displacement in corn fields
- Europe
  - Some species unaffected while certain waterfowl, shorebirds, and songbirds avoid turbines (e.g., European golden plover, northern lapwing, Eurasian curlews)
  - Pink-footed goose displaced up to 600m

Potential Bird Population Effects

- 2,158 to 3,856 MW of projected capacity
- 33-58 facilities (i.e. local populations)
- Majority of fatalites passerines
- Maximum 35% from 1 individual species (from Mountaineer in WV)
- 50% local residents
- Maximum of 105 birds/year from one local population

(after NRC 2007)

Estimating Fatalities

- No big surprises with respect for birds where mortality data collected in the area/region
- We know a great deal about rates in some landscapes (e.g., Ag) and some regions (e.g., PNW)
- Lack of replication of fatality studies, particularly in the northeast for birds and nationally for bats (ongoing studies will be valuable additions)
- Lack of information in some areas already developed (e.g. SW) and proposed for development (e.g. coastal)
- Limited studies with pre-construction diurnal avian and bat use data and post-construction fatality limit predictive ability
  - Raptor use and mortality appear to be related

Fatality Estimation (continued)

- Reliability of predictors are being tested with fatality data, bats are a major uncertainty
- Better predictions will occur with more fatality data and data on influencing variables
- Suggest more emphasis on denominator of risk index (response/exposure = risk)
- Different ways to estimate the probability of availability and detection
- Most methods used to date do ok when interval between searches greater than mean removal time for carcasses
- Modifications forthcoming for the case when interval is short compared to mean removal time

Habitat

- Estimated direct habitat impacts are relatively small for birds and bats
- Displacement of grassland nesting birds is likely but the magnitude is uncertain and may range from near 0.0 to several hundred meters for song birds and even greater for other species (e.g., nesting effects may be much larger for prairie grouse)
- Wind project (macro) and wind turbine (micro) siting believed to be best way to minimize impacts
- Mitigation measures poorly evaluated
- Cumulative impacts poorly understood
- Data better for wind than other sources of impact


Questions?