



Environmental  
& Statistical  
Consultants



# A Comprehensive Analysis of Small-passerine Fatalities from Collision with Turbines at Wind Energy Facilities

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# Small Passerines

- Small passerines, sometimes referred to as perching birds or songbirds,
  - Excludes large corvids (ravens, crows, magpies)
  - most abundant bird groups in the United States (US) and Canada,
  - Most common fatality from collisions with anthropogenic sources
  - Most species receive protection under the MBTA



# General Biology – Small Passerines

- Short-lived
  - Average lifespan
    - typically 1 – 3 years old
- High reproduction
  - Typically 2 – 5 eggs
- High annual mortality rates
  - Typically 30-60% annual mortality



# Sources of Mortality

- Numerous anthropogenic sources of mortality
  - Habitat loss/climate change
  - Collision with manmade structures
  - Cats
  - Contaminants
- Other
  - Natural predators
  - Natural disasters
  - disease
  - old age



# Research Question and Steps

- Estimate mortality of small passerines from N.A. wind energy
- Steps:
  - Find Appropriate Studies
  - Calculate Bias-corrected Estimates and apply to Species Composition
  - Apply Results to Bird Populations Estimated from BBS data



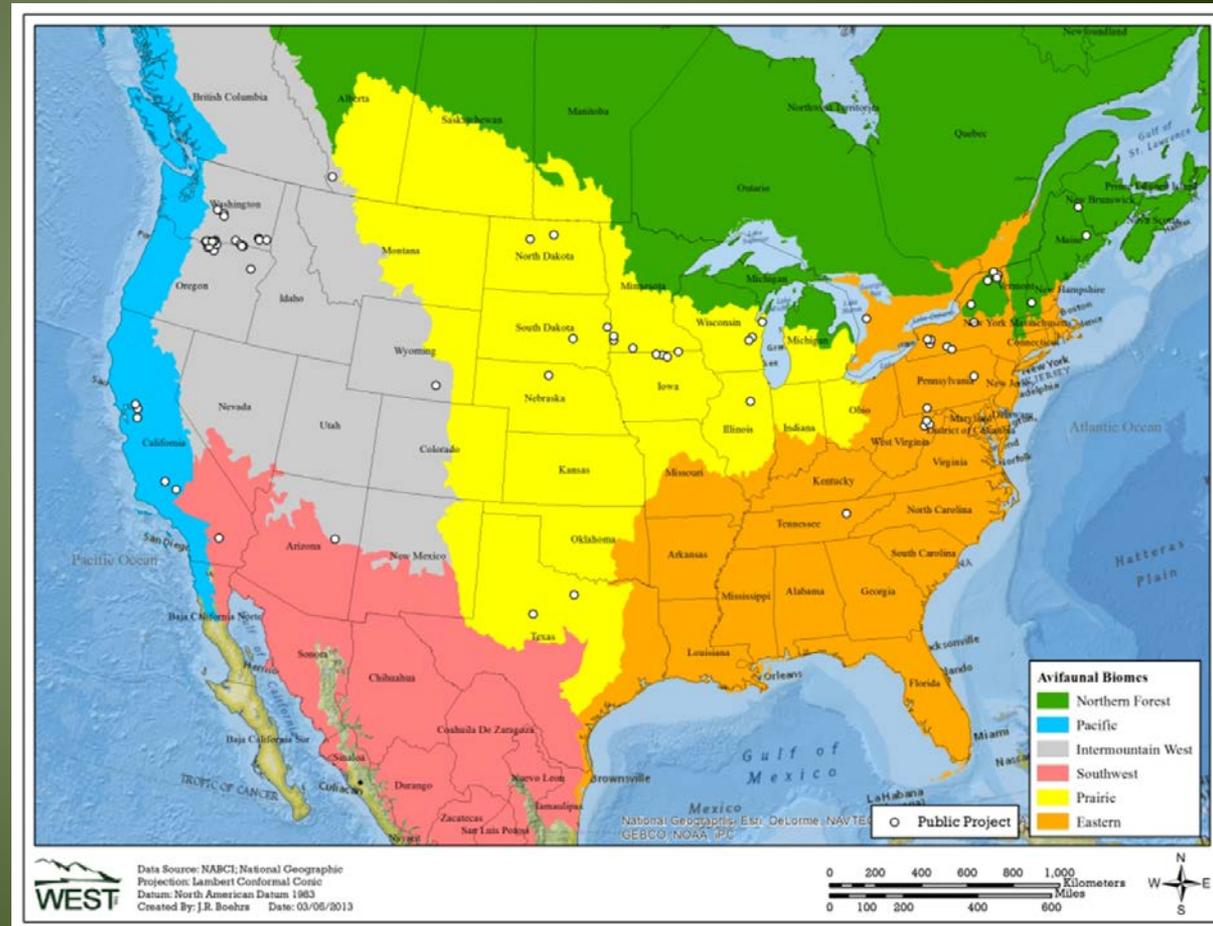
# Step 1: Select Adequate Studies

- Reports included:
  - searcher efficiency
  - carcass removal
  - standardized to fatalities/MW/yr
- Not selected:
  - lack of standardization
  - Only one or two seasons
  - poor methods of study



# Wind Energy Post-Construction Studies

- 116 studies at over 70 wind energy facilities across North America.



## Step 2&3: Adjust All bird estimates to small bird and adjust for estimator bias

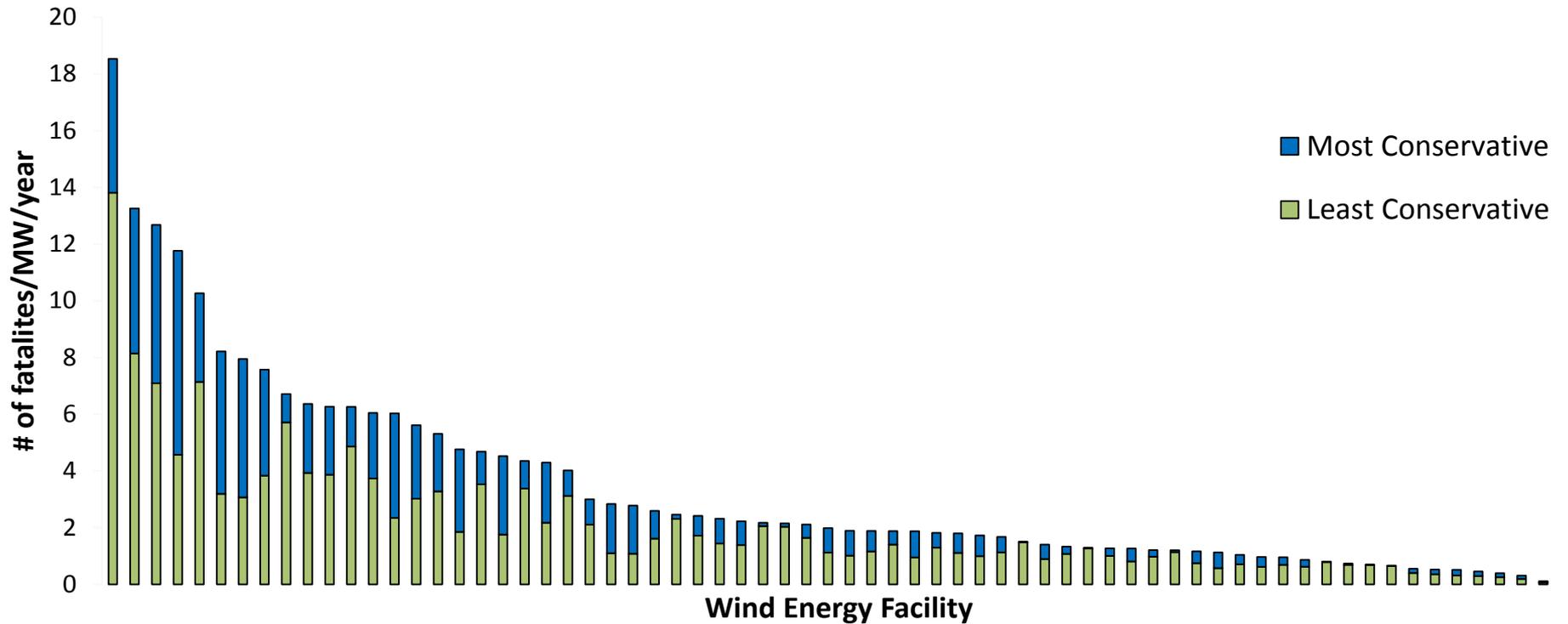
- 35 studies with only all bird fatality rates
- Small bird estimate calculated by adjusting species composition by searcher efficiency and carcass persistence ratio

$$m_{SB} = m_{allbirds} \div \left[ 1 + \frac{\%compLB}{\%compSB \times \frac{\hat{\Pi}_{LB}}{\hat{\Pi}_{SB}}} \right]$$

- Some estimators lead to biased estimates
  - Adjustments made for type of estimator
    - 0.39 to 2.77

# Bias Adjusted Estimates – Eastern US

## Eastern Biome Small Passerine Fatality Rates



## Step 4: Calculate rates by biomes

Avifaunal Biome	# Projects by Biome
Eastern	20
Intermountain West	41
Northern Forest	16
Pacific	7
Prairie	31
Southwest	1
<b>Total Projects</b>	<b>116</b>

# Step 5 – Calculate Species Rates using Species Composition of Small Passerines

<b>Common name</b>	<b># Fatalities</b>	<b>% fatalities</b>
horned lark	681	21.9
red-eyed vireo	265	8.5
western meadowlark	159	5.1
golden-crowned kinglet	158	5.1
European starling	103	3.3
red-winged blackbird	70	2.3
magnolia warbler	60	1.9
yellow-rumped warbler	57	1.8
ruby-crowned kinglet	55	1.8

## Compare to North American Population Estimates

- PIF Landbird database used to calculate North American Population Estimates
- Partners in Flight Science Committee (2013) Population Estimates Database, version 2013. Available at <http://rmbo.org/pifpopestimates>. Accessed on 31 December 2013.

# Findings



# Estimated Annual Fatality Rates by Biome (through 2012)

Avifaunal biome	Ave est (MW/year) highest correction	Ave est (MW/year) lowest correction	Total MW in biome	est annual fatalities highest correction	est annual fatalities lowest correction
Eastern	3.83	2.58	6,524	25,010	16,853
Intermountain West	3.35	2.09	9,501	31,871	19,896
Northern Forest	1.43	1.15	3,694	5,293	4,257
Pacific	3.27	2.55	1,857	6,082	4,743
Prairie	3.96	2.15	37,028	146,477	79,478
Southwest			4,419		
<b>All Biomes</b>	<b>3.35</b>	<b>2.10</b>			

# Cumulative

- 15% of continental operating capacity represented
- Continental Rate: 2.10 to 3.35 small-passerines/MW/year
- 134,000 to 230,000 small-passerine fatalities per year

# Most Carcasses by Family

Bird type	# Fatalities	% Composition
Grassland/Sparrows (Emberizidae)	985	19.8
Wood-warblers (Parulidae)	536	10.8
Vireos (Vireonidae)	322	6.5
Blackbirds/Orioles (Icteridae)	302	6.1
Kinglets (Regulidae)	221	4.4
16 other families		2.5 or less

# Species Composition of Small Passerines

Common name	# Fatalities	% fatalities
horned lark	681	21.9
red-eyed vireo	265	8.5
western meadowlark	159	5.1
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# Most Effect on Population

Species	Ave est (low value)	Ave est (high value)	Pop est for North America	% pop affected (low value)	% pop affected (high value)
black-throated blue warbler	895	610	2,100,000	<b>0.043%</b>	<b>0.029%</b>
tree swallow	7,390	4,102	17,000,000	<b>0.043%</b>	<b>0.024%</b>
horned lark	30,591	18,029	80,000,000	<b>0.038%</b>	<b>0.023%</b>
brown thrasher	1,722	935	4,900,000	<b>0.035%</b>	<b>0.019%</b>
yellow-throated vireo	1,218	670	3,500,000	<b>0.035%</b>	<b>0.019%</b>
spotted towhee	716	402	2,200,000	<b>0.033%</b>	<b>0.018%</b>
sedge wren	1,722	935	6,200,000	<b>0.028%</b>	<b>0.015%</b>
bushtit	574	312	2,300,000	<b>0.025%</b>	<b>0.014%</b>
western meadowlark	6,147	3,790	30,000,000	<b>0.020%</b>	<b>0.013%</b>
rose-breasted grosbeak	826	486	4,100,000	<b>0.020%</b>	<b>0.012%</b>

# Species of Conservation Concern

## Fatalities

- bay-breasted warbler,
  - Bell's vireo,
  - Bewick's wren,
  - blue-winged warbler,
  - Canada warbler,
  - cerulean warbler,
  - dickcissel,
  - gray vireo,
  - Kentucky warbler,
  - loggerhead shrike,
  - prairie warbler,
  - tricolored blackbirds,
  - wood thrush.
- 0.016% or less of estimated population per year or 1.6 per 10,000 birds

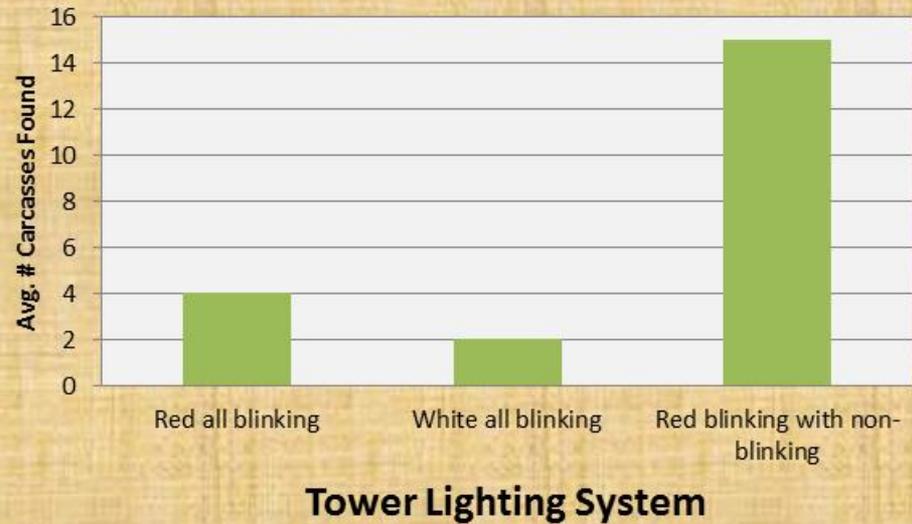
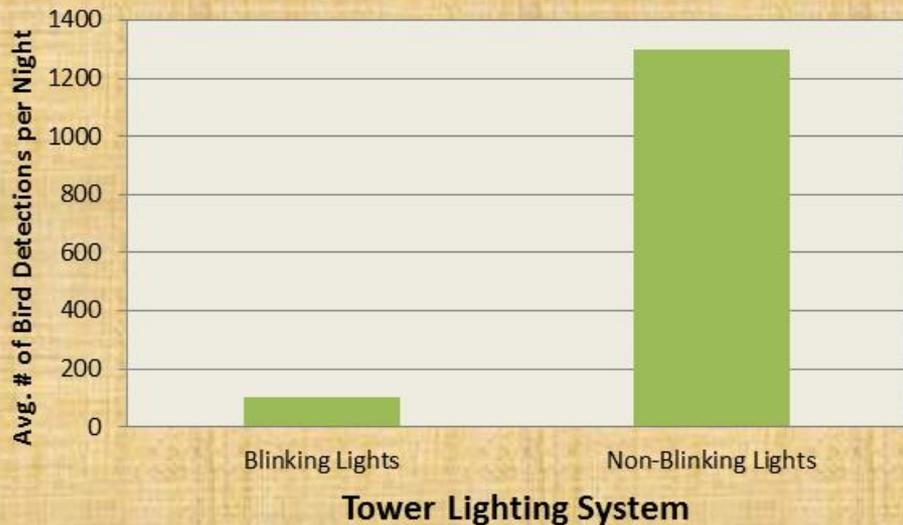
# Other Information - Lighting

- There have been no apparent effects related to wind turbine FAA lighting.
  - No difference in fatality rates for FAA lit turbines vs. unlit turbines (Kerlinger et al. 2010)
  - Few large events
    - Substation lighting
    - Nacelle lighting
    - Poor weather



# Communication Tower Lighting – Gehring et al. Research

- Significantly lower fatalities for blinking lights compared to solid red lights



- Significantly lower live bird detection rate at towers with blinking lights

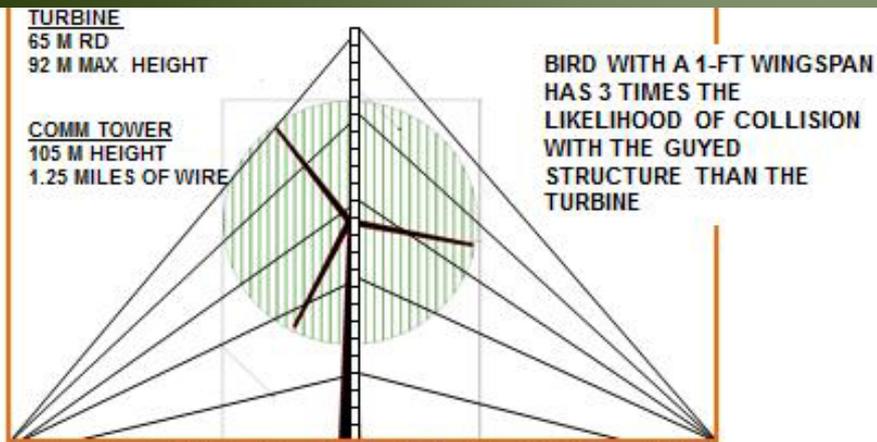
# Best Avoidance Measures

- large fatality events of small passerines can be avoided/minimized by:
  - Minimize lighting on turbines, blinking white or red
  - Avoid substation lighting
  - Turn the lights off in the nacelle
- Other measures that have reduced mortality
  - Unguyed permanent met towers



# All Bird Mortality Comparison

- Wind turbines:
  - ~214,000 to 368,000 total bird collision fatalities per year from turbines
- Communication towers:
  - 6.8 million\*
  - ~97% passerines
- Vehicles: 60 – 80 million
- Cats:
  - 1.4 to 3.7 billion\*
  - ~65% passerines



\*Longcore et al. 2012, 2013; Loss et al. 2013

# Comparison to Communication Towers

	Percent	
	Wind Turbines	Communication Towers*
Black-throated blue warbler	0.029 – 0.043% of population/year	4.9% of population/year
Grassland/Sparrows (Emberizidae)	19.8% of total fatalities	5.8% of total fatalities
Wood-warblers (Parulidae)	10.8% of total fatalities	58.4% of total fatalities

\*Longcore et al. 2013

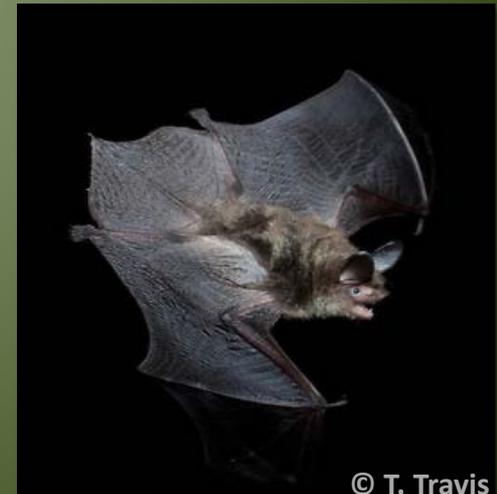
# Conclusions

- More data available for understanding bird impacts from wind energy than any other sources
- Rates vary among biomes
- Proportion of continental populations affected by collisions with turbines is small
- cumulative impacts of all sources on songbirds is still a concern



# Management Implications and Next Steps

- With limited resources, focus most monitoring, research & resources away from songbirds, more on raptors, bats & sensitive species
- Using this approach and database, estimate other groups (raptors) and species mortality



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