Example Impact Assessment Methods at Wind Projects

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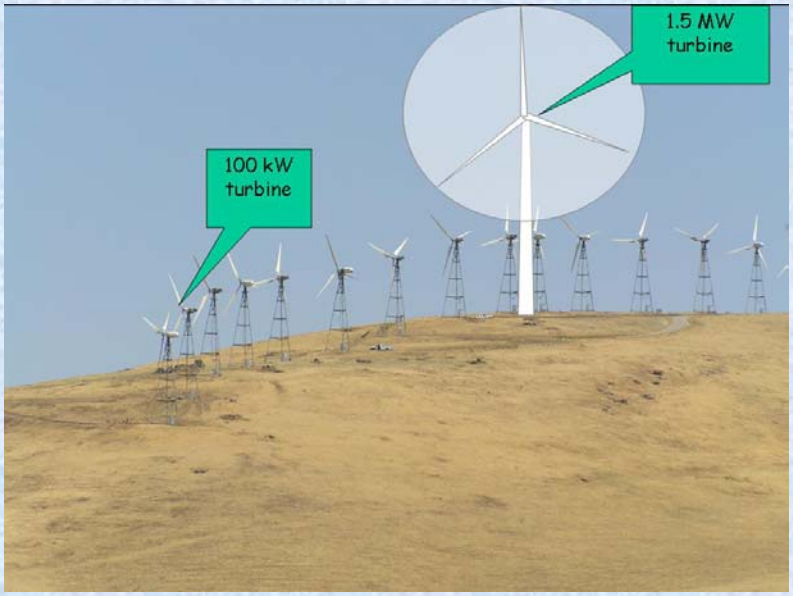
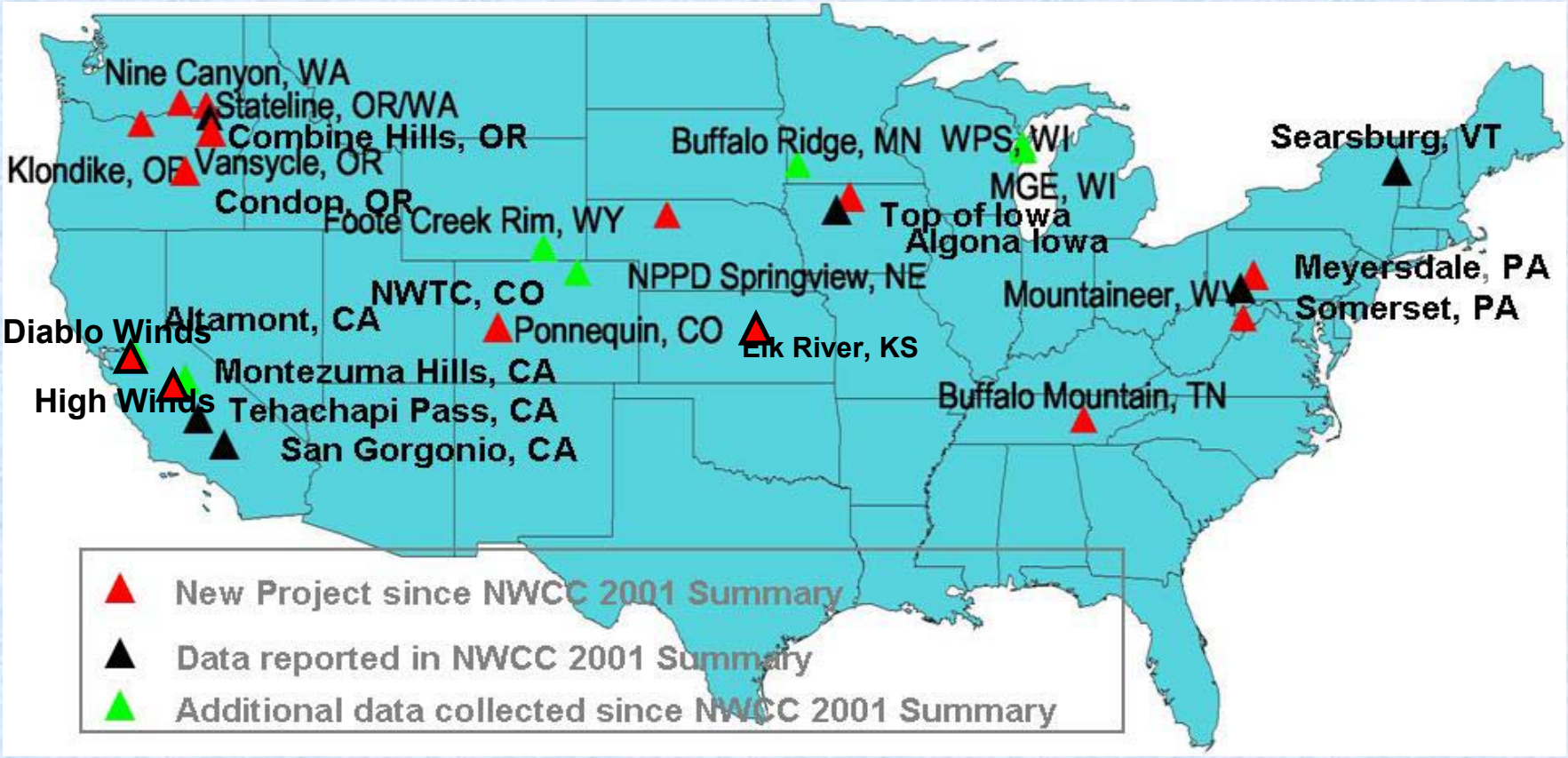
Outline

- Fatality Rates
  - Estimation
  - Prediction
- Exposure/Collision Risk
  - Indices
  - models
- Displacement/ Disturbance Impacts

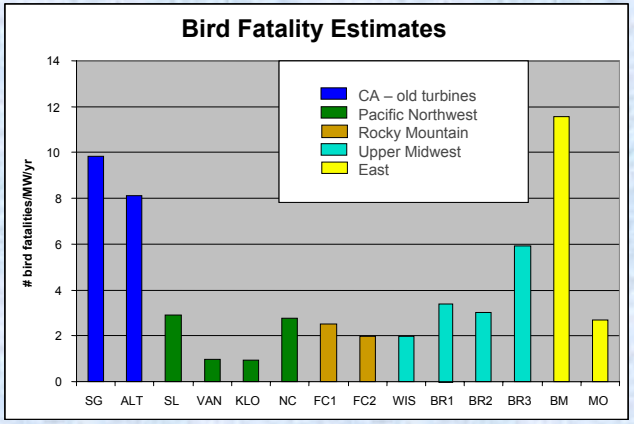




- 26 studies with standardized searches
- 14 conducted or applied scavenging and searcher efficiency biases

Fatality Monitoring Objectives

- determine whether overall avian and bat fatality rates are low, moderate, or high relative to other projects
- provide precise measures of overall avian and bat casualties attributable to collisions with wind turbines for the entire project
- Estimate the influence of physical and biological factors such as weather, topography and habitat on fatality levels

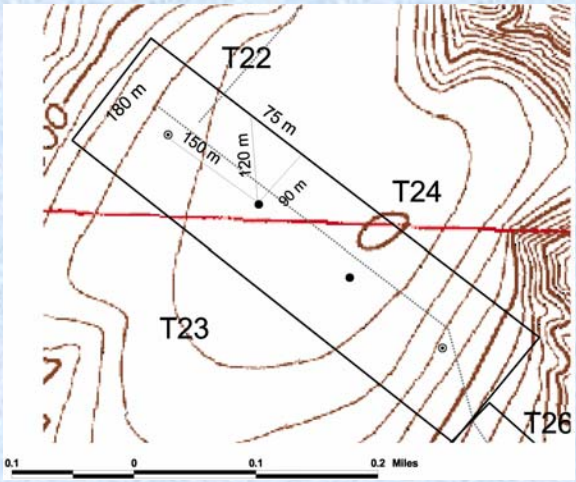


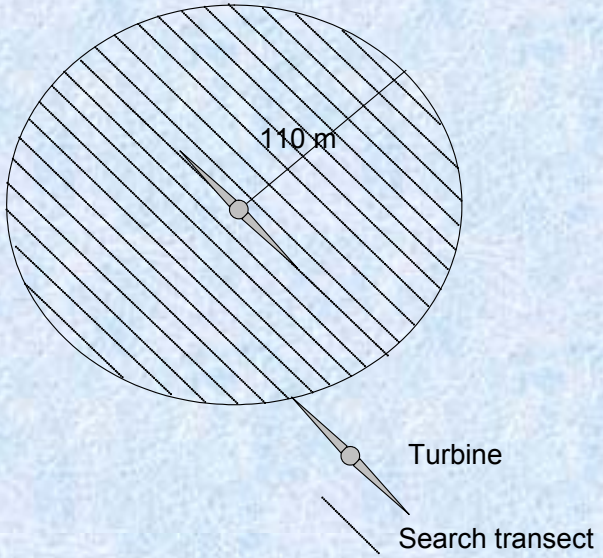
Standardized Carcass Searches

- Plot Size and Shape
- Search Effort
  - Sample versus Census of turbines and plots
  - Transect Width
- Search Frequency
- Definition of Fatalities/Reference Mortality

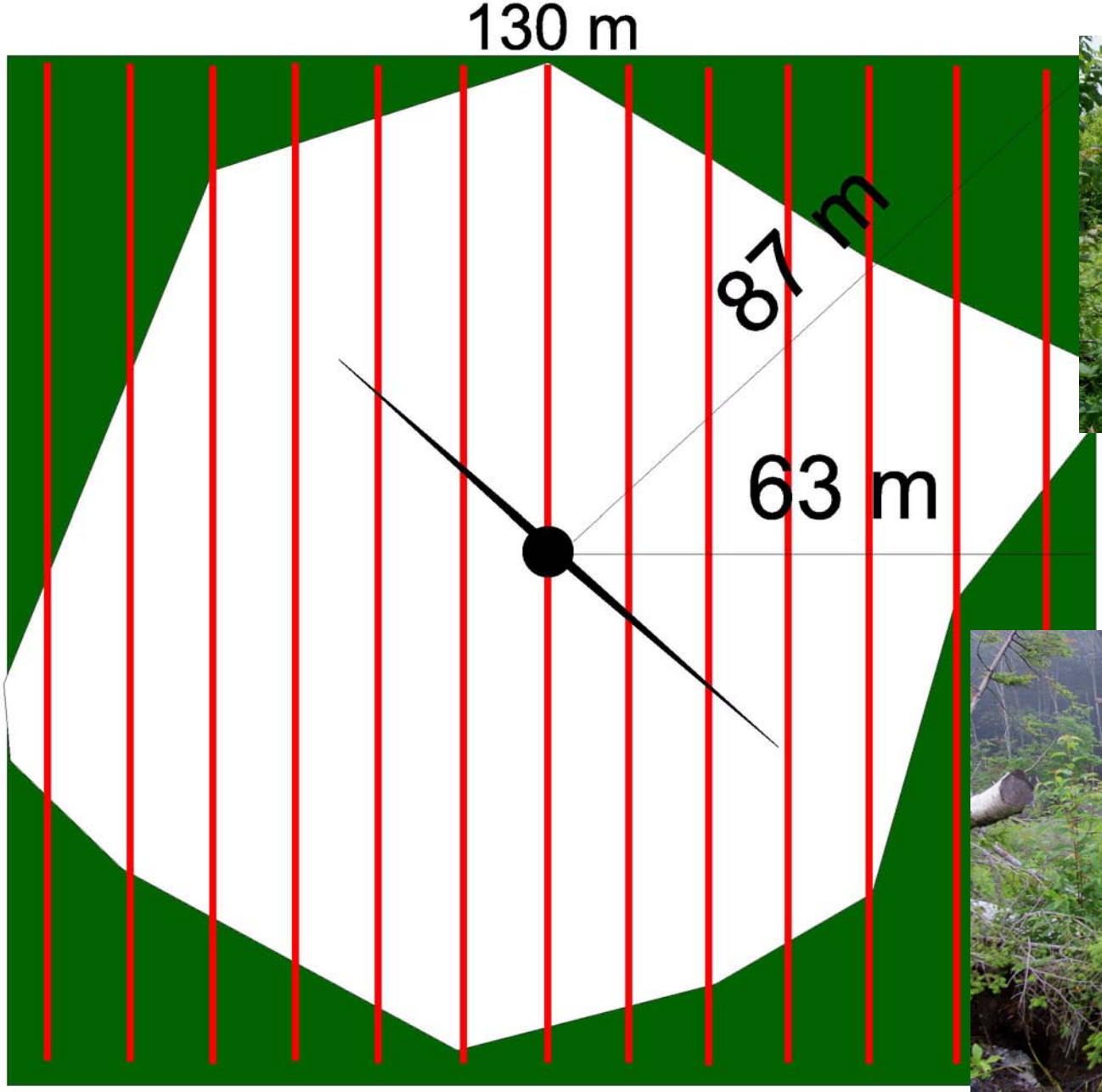
Plot Size and Shape

- Both circular and rectangular search plots have been used
- Plot size has varied by study
  - Decision based on turbine size, distribution data of fatalities, habitat, trade offs between searching more turbines, or more area at less turbines





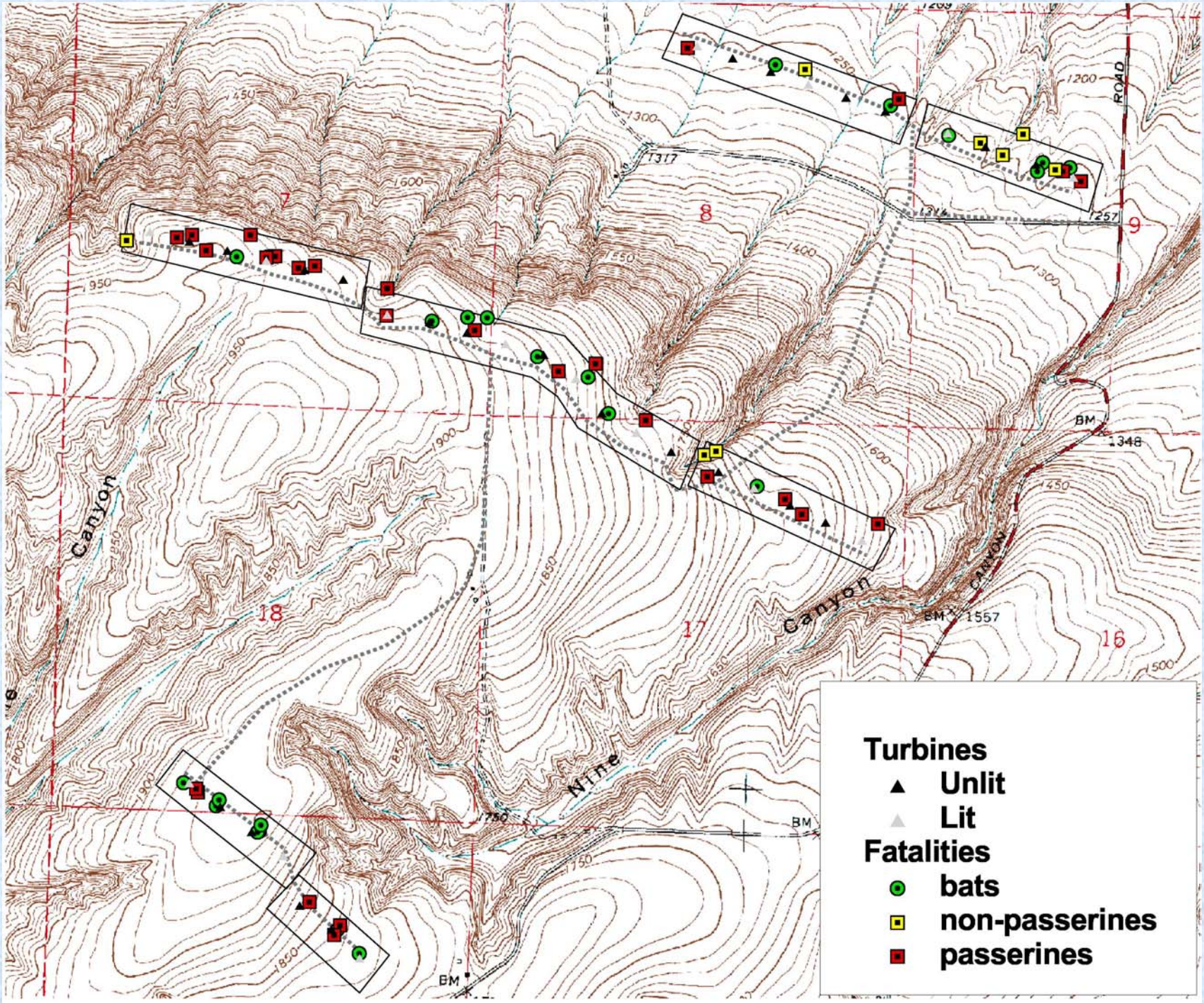
Example Carcass Search Plot



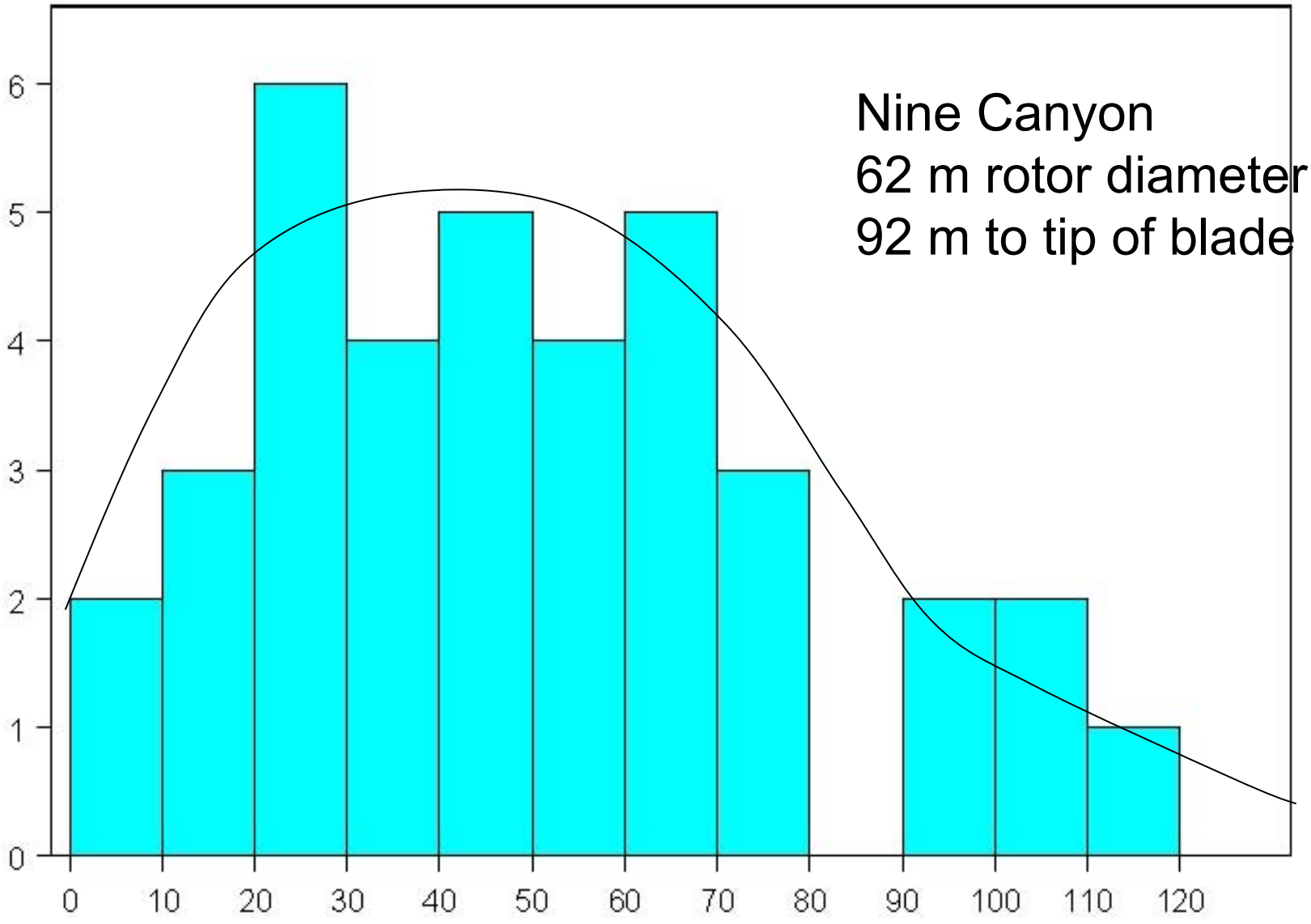
Transects

Sampled Area

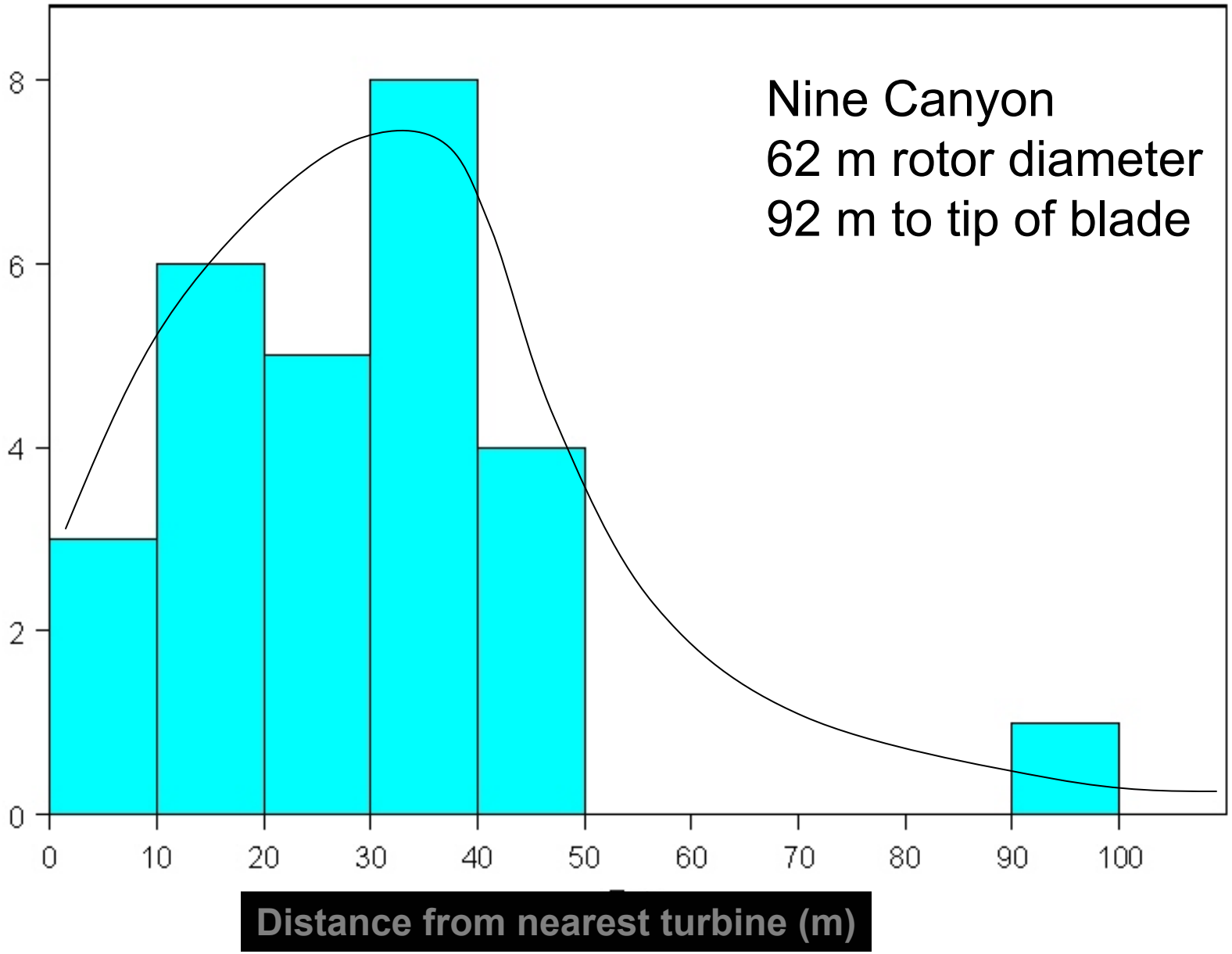
Unsampled Area


Turbines
Unlit
Lit
Fatalities
bats
non-passerines
passerines
Canyon
Canyon
Nine
CANYON
ROAD
BM
BM
BM
1557
1348
1317
1257
7
8
9
18
17
16

Distribution of Distances from Bird Fatalities to Nearest Turbine



Distribution of Distances from Bat Fatalities to Nearest Turbine



Search Frequency

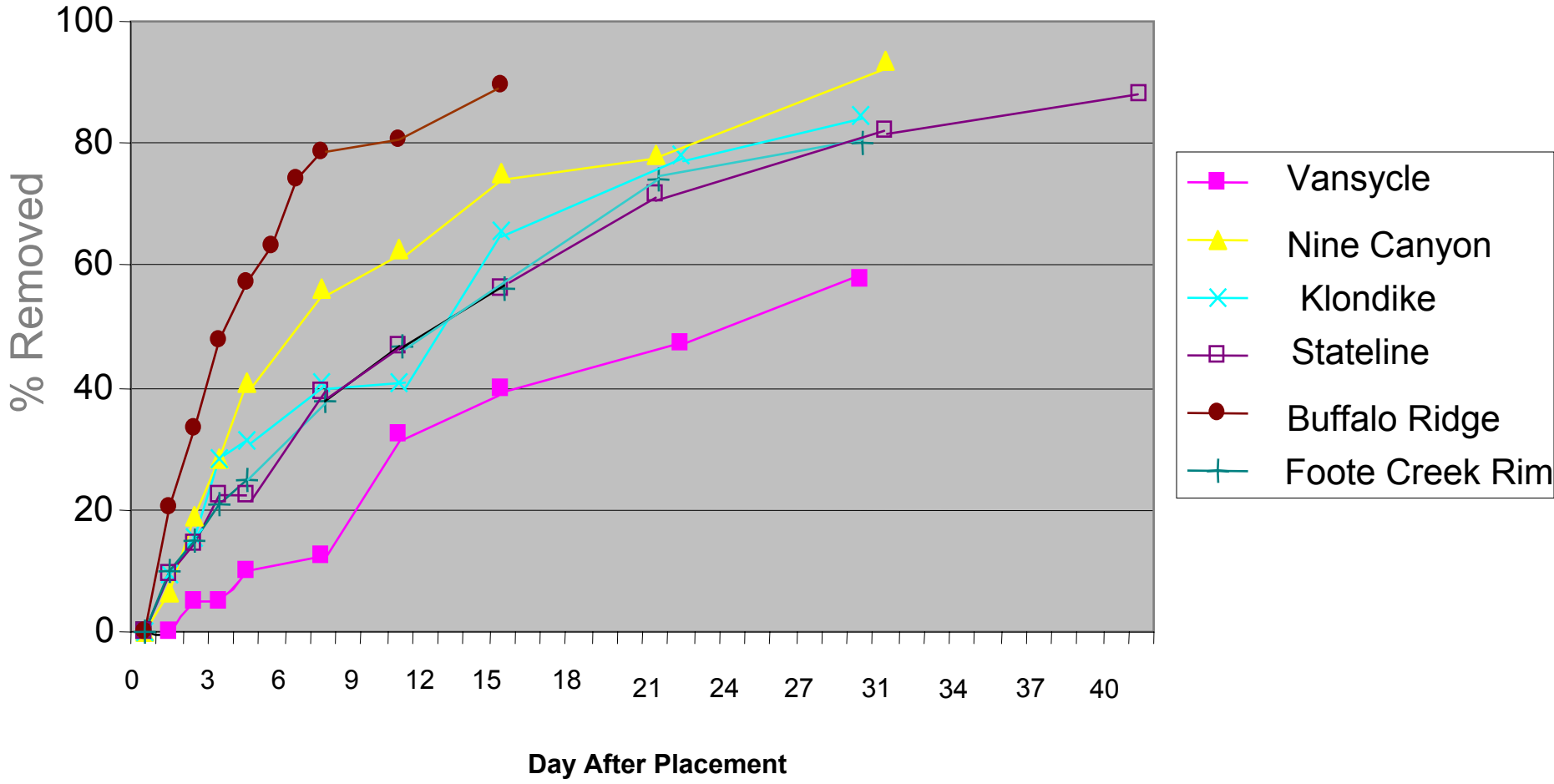
- Varies from daily to every 5 weeks
- Interval should depend on scavenging rates and objectives
- More uncertainty in estimates as ratio of interval to mean removal time increases
- Associations between fatality and weather, other factors require intensive searches
- One reasonable solution: one sample intensively, remaining sample less intensively

Reference Mortality

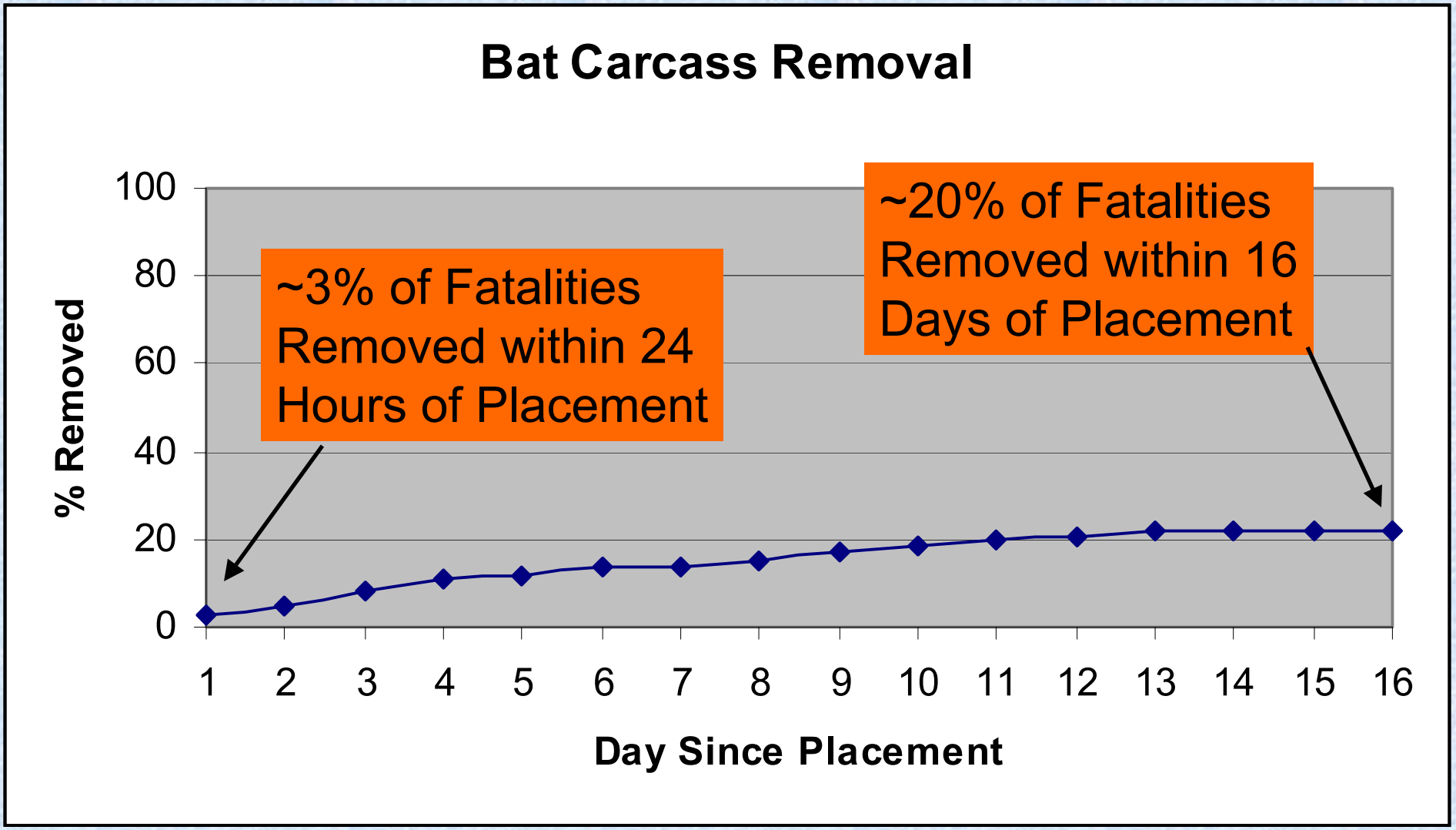
Reference Mortality

- Buffalo Ridge, MN
  - Estimates of fatality rate at plots without turbines 1/3 of estimate at turbines
- Note that without turbine, bird use is likely higher
- Johnson et al. (2002)

Small Bird Removal

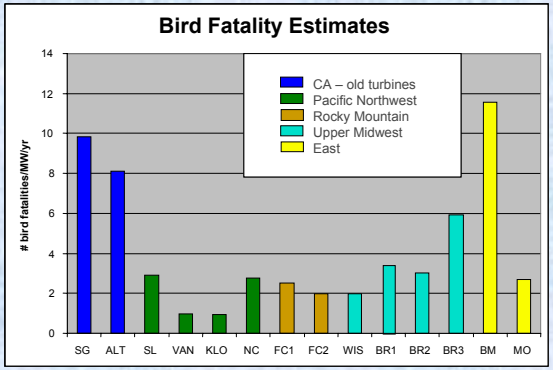


Meyersdale 2004



Fatality Rate Estimation

$$m = \frac{\bar{c}}{\hat{\pi}}$$

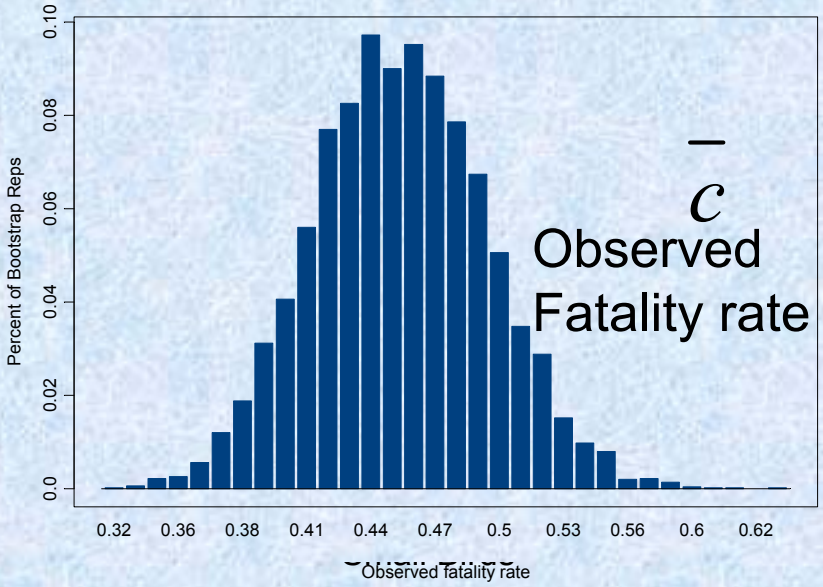


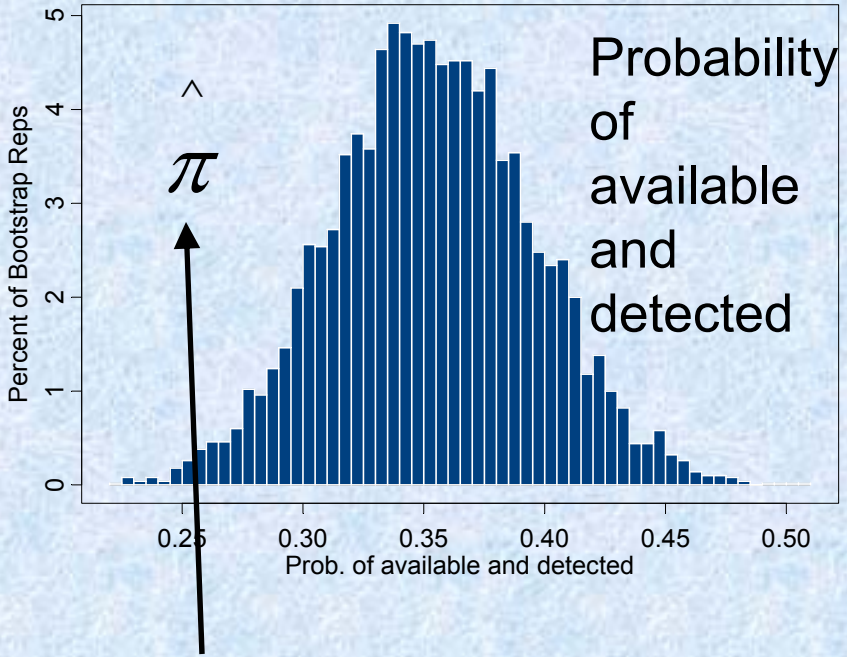
Where $\bar{c}$ is the estimated mean per MW fatality rate

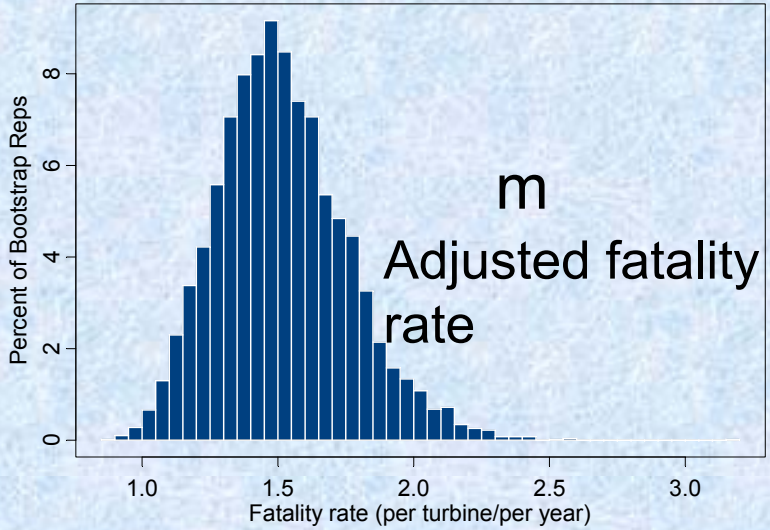
And $\hat{\pi}$ is the estimated average probability a carcass Is available during a search and is found

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I} \cdot \left[\frac{\exp\left(I / \bar{t} \right) - 1}{\exp\left(I / \bar{t} \right) - 1 + p} \right]$$

Estimation







Factors include searcher efficiency, carcass removal, search interval, search area

PRECISION EXAMPLES

# turbines	search eff.	mean rem.	search int.	CI 1/2 width	CV se/mean
25	0.3	3	7	69.9	0.42
50	0.3	3	7	57.3	0.34
25	0.3	7	7	57.2	0.34
50	0.3	7	7	46.3	0.28
25	0.5	3	7	53.7	0.32
50	0.5	3	7	43.1	0.26
25	0.5	7	7	41.5	0.25
50	0.5	7	7	33.9	0.20
25	0.9	3	7	40.5	0.24
50	0.9	3	7	31.9	0.19
25	0.9	7	7	30.7	0.18
50	0.9	7	7	24.1	0.14

Example: 4 birds/MW/yr +- 1 bird/MW/yr

Example: 4 birds/MW/yr +- 0.8 birds/MW/yr

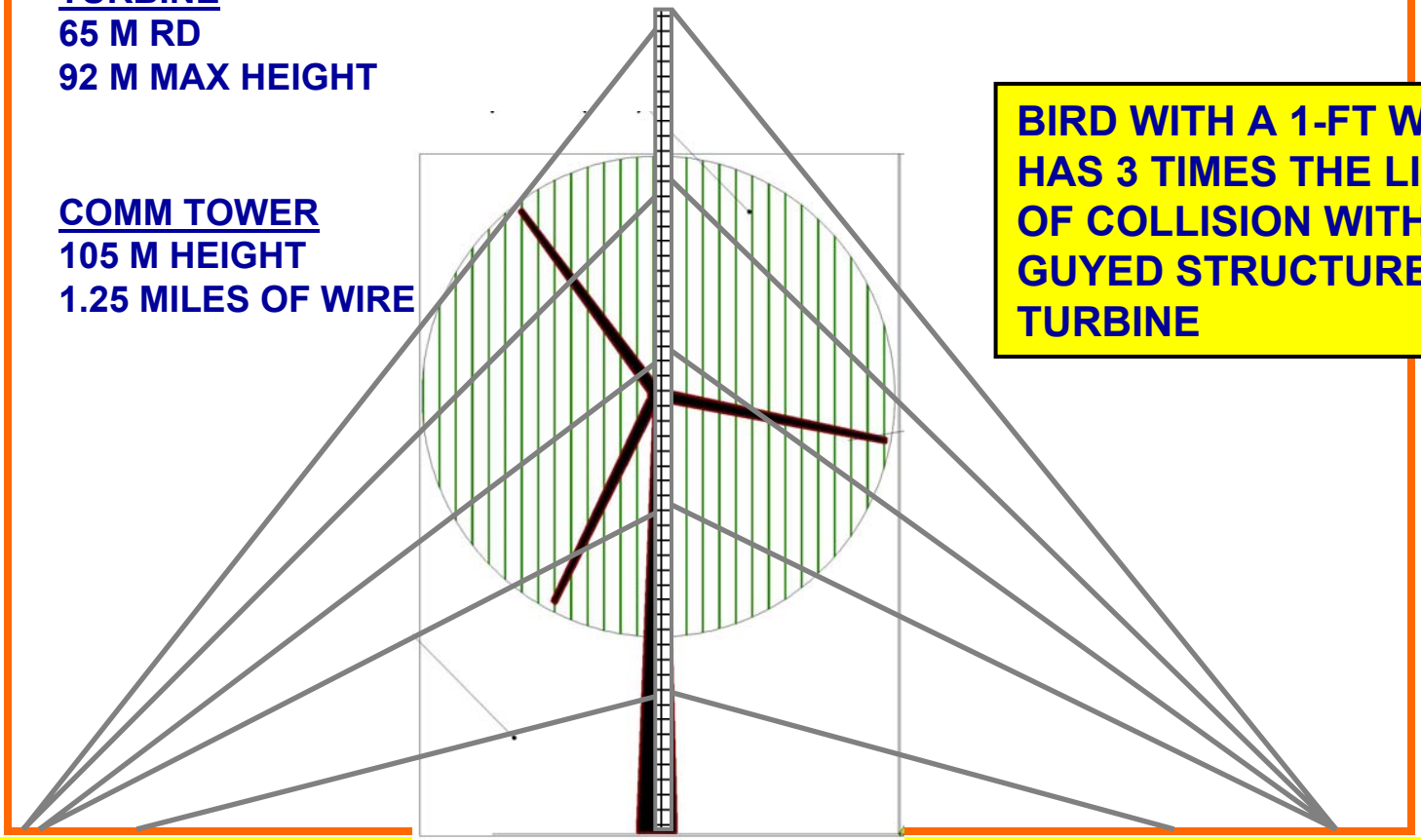
Modeling

- Dr. Box:
  - “Modeling is an art, not a science”,
  - “All models are wrong, some are useful, and we should seek out those.”
- John Stuart Mill:
  - “The guesses which served to give mental unity and wholeness to a chaos of scattered particulars, are accidents which rarely occur to any minds but those abounding in knowledge and disciplined in intellectual combinations”

Relative Collision Exposure Among Structure Types

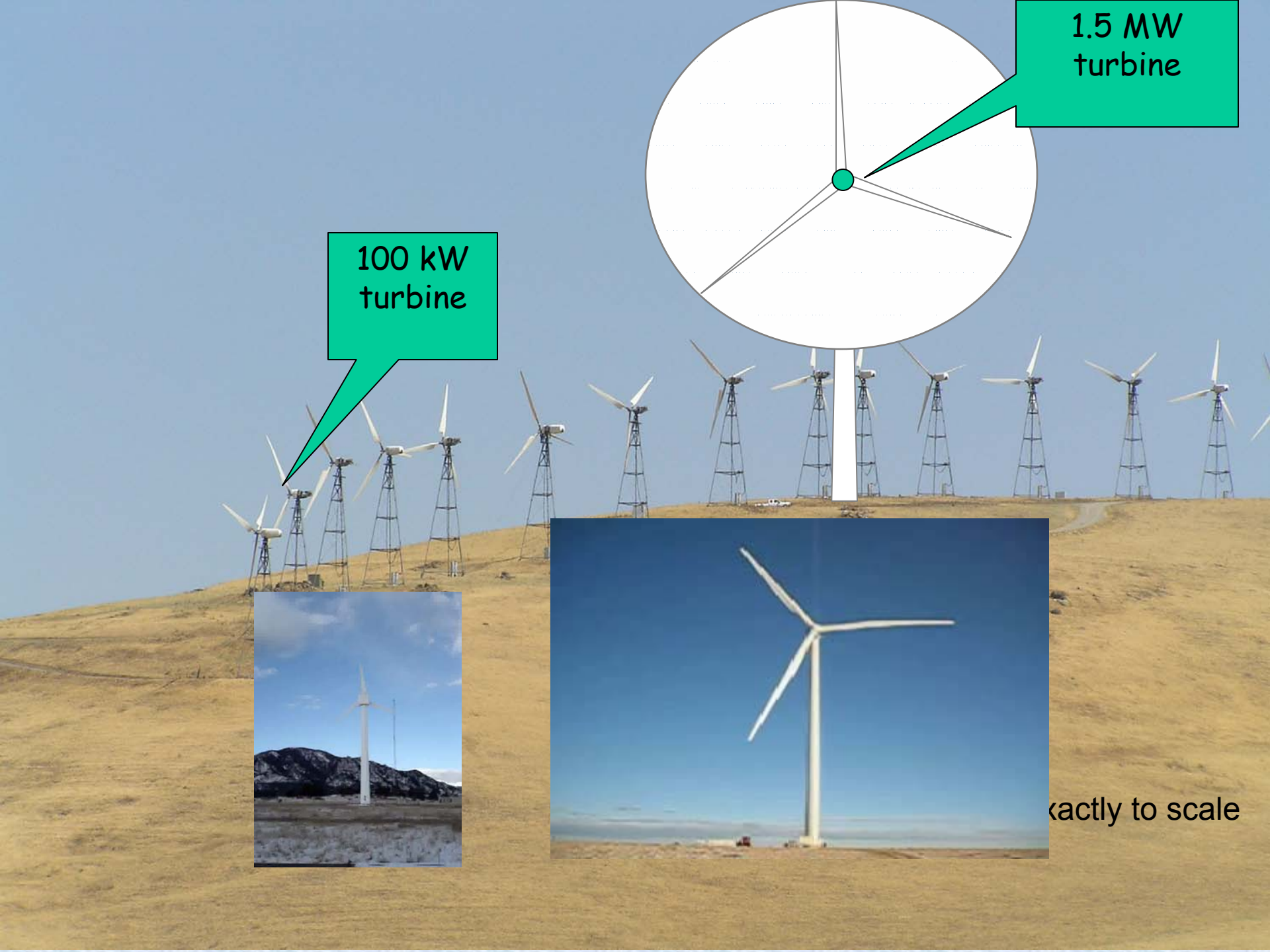
TURBINE
65 M RD
92 M MAX HEIGHT

COMM TOWER
105 M HEIGHT
1.25 MILES OF WIRE



BIRD WITH A 1-FT WINGSPAN HAS 3 TIMES THE LIKELIHOOD OF COLLISION WITH THE GUYED STRUCTURE THAN THE TURBINE

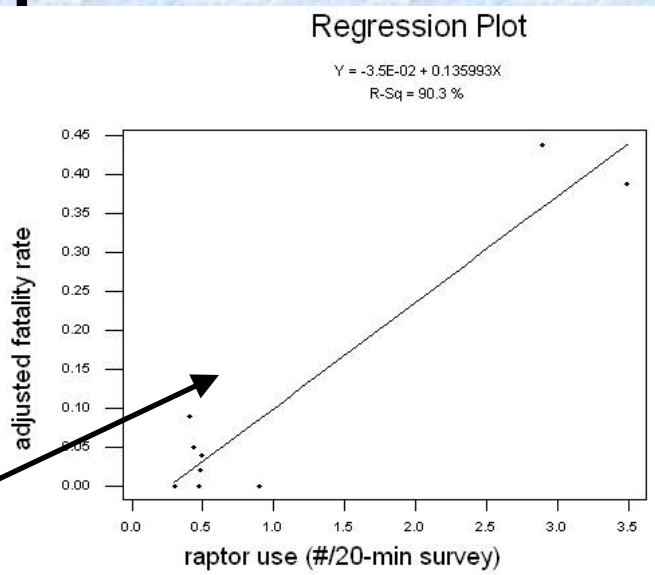
Major Assumptions: (1) Equal Avoidance Of Turbine And Guyed Structure, (2)Flight Perpendicular To Swept Area And 2 Directions Of Wires

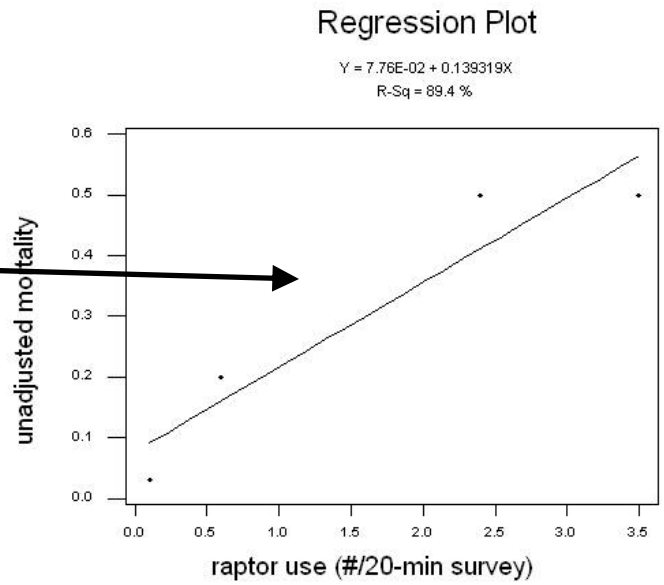


xactly to scale

Fatality Prediction

- Raptor Use correlates with raptor fatality rates for new generation projects and older projects

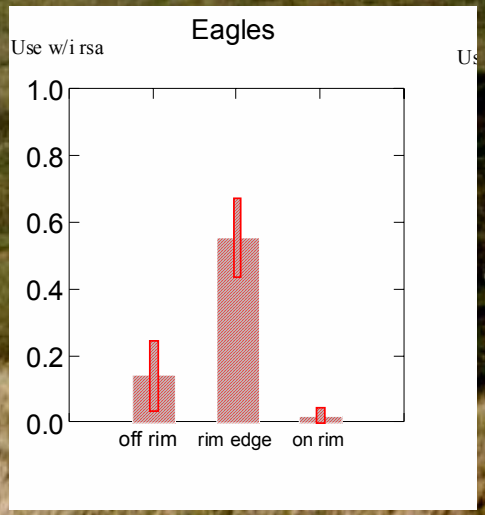




EAGLES

1999

FOOTE CREEK RIM WYOMING




1.5
0.25KM
PULSE1 S1P
HU RM
AUTO
MAIN
REL TRAIL
X-BAND
TTG
OWN SHIP (ANY)
CSE
IR1
CONTRAST1
EPFSSIGNAL MISSING
GAIN
A/C SEA
A/C RAIN
BRILL
WEST,Inc.

RESULTS OF RADAR STUDIES (X-BAND 10-12 kW)

- Numerous radar studies pre-construction
- Little post-construction fatality where radar has been conducted
- Hardly any radar data after the projects have been constructed

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)
Dairy Hills, NY	117	94	397	466	15	10	14	180	(Young *et al.* 2006)
Prattsburgh, NY	170	200	319	365	18	9	18	177	(Mabee *et al.* 2004, 2005)
Chautauqua, NY	395	238	528	532	4	5	29	199	(Cooper *et al.* 2004a,b)
Flat Rock, NY		158		415		8		184	(Mabee *et al.* 2005)
Wetherfield, NY		168						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	222	180	437	452	11.5	8	26	188	
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		15	8	23	181	(Mabee and Cooper 2000, 2001)
Buffalo Ridge, MN	93								(Hawrot and Hanowski 1997)
Mean – West Studies	80	29	548	517	5.5	5	16	167	

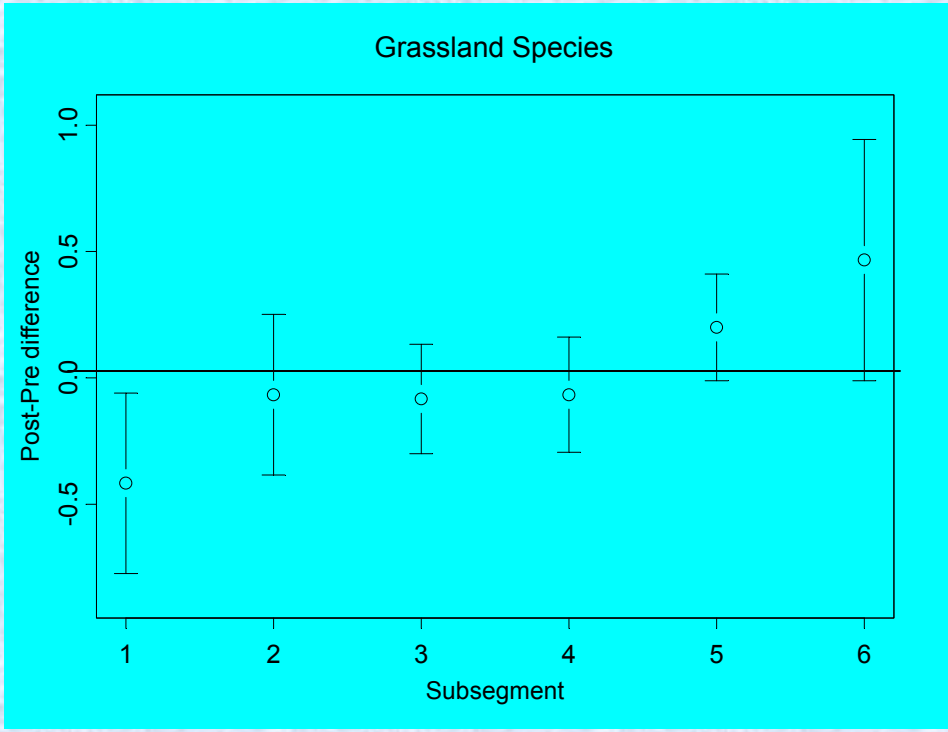
Comparison of Spring Target Rates and Migrant Fatality Rates

Parameter	Stateline OR/WA	Buffalo Ridge MN	Nine Canyon WA
Spring Nighttime Surveillence Radar Data			
sampling dates	3/15-5/15/01	3/26 – 5/12/96	3/15-5/15/01
Targets/hr/2.8 km (March 15- May 15)	140	260	273
Estimated % of targets below 100 m	13.0%	not collected	14.4%
Width of WRA (km)	16	27	2.4
Estimated Spring Night Target Passage Rate	576,000	1,805,143	168,480
Spring Nighttime Migrant Fatality Data			
Estimated Spring Nighttime Fatalities	34	104	6
Fatality Rate / Target Passage Rate	<0.01%	<0.01%	<0.01%

Major Assumptions: (1) 1 target = 1 migrating bird, (2) no detection bias, (3) targets counted are migrating birds

Disturbance/Displacement Effects

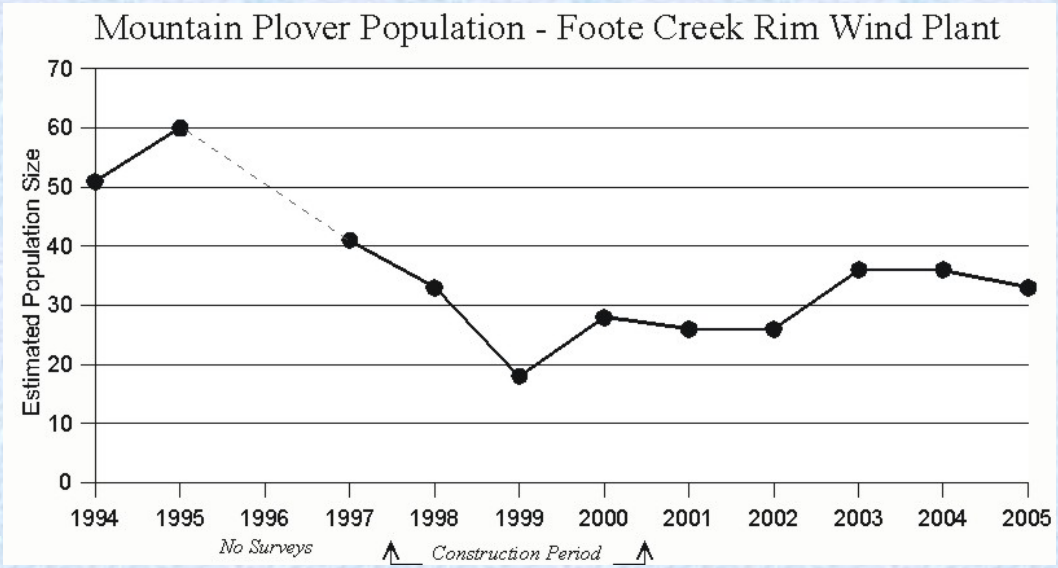
Need for reference sites, Pre-construction versus post-construction comparisons

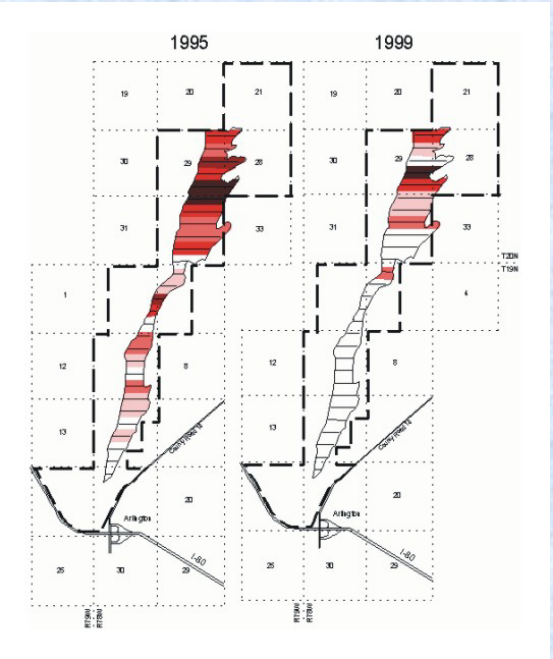


Mountain Plover
(*Charadrius montanus*)

Plover Results

- Initial impression is that construction of the Foote Creek Rim wind project may have displaced mountain plovers from the project area.
- Numbers inhabiting the wind plant site declined during construction:
  - mean of ~50 during 3 years prior to construction
  - mean of ~26 in the 3 years during construction
  - mean of ~31 in 5 years post construction
- Slow recovery – habituation? – post construction.





Disturbance/Displacement?
Change in distribution?
Indirect habitat loss?

How?

Model habitat use with radio/GPS relocations and create predictive maps.

Pinedale

Green River

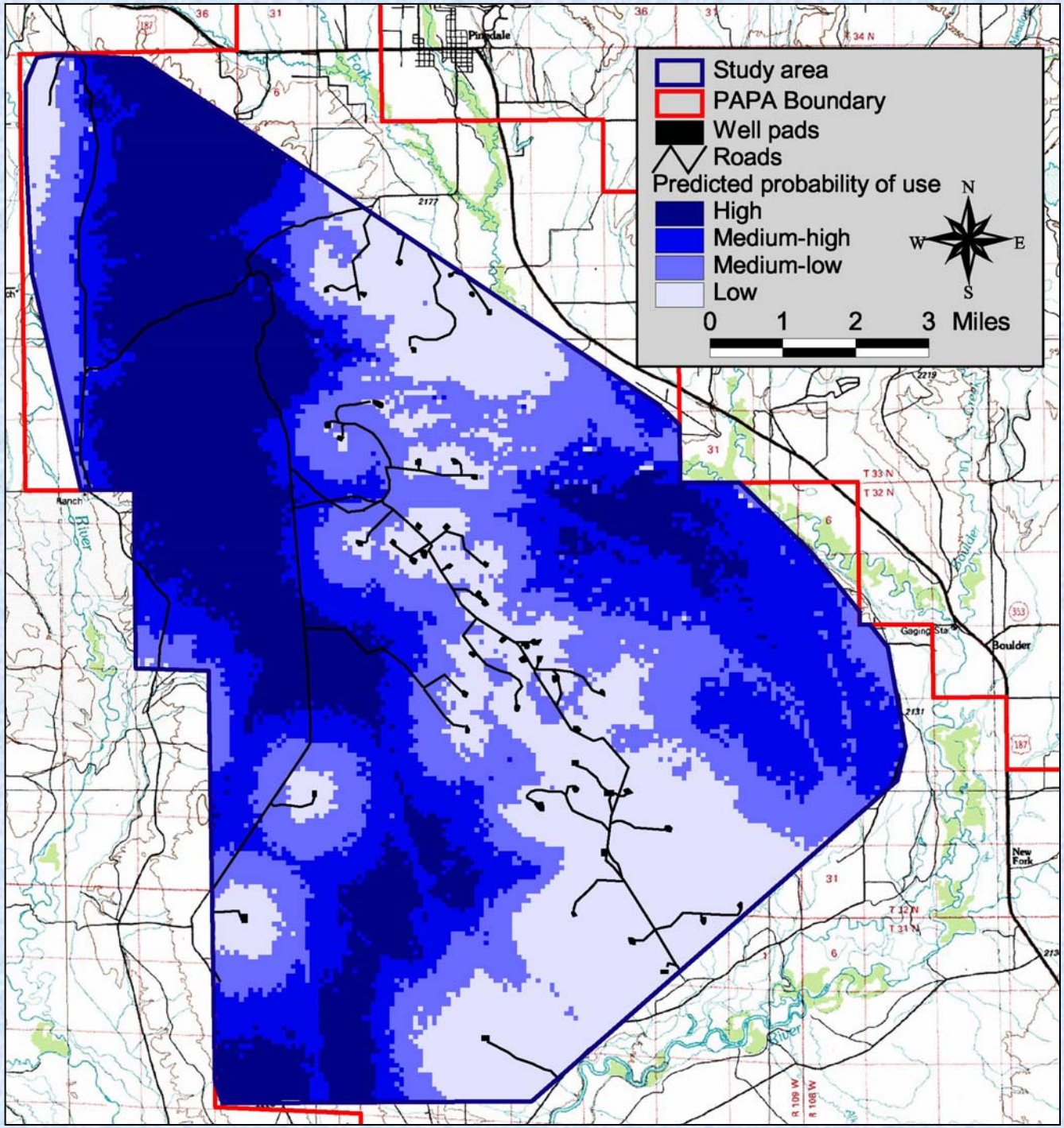
New Fork River

0 1 2 3 Miles

Probability of Deer Use Year 2 of Development (2001-02 winter)

Model based on 14,851 locations from 15 deer

Mean distance from well pad in high use areas = 1.9 miles



Concluding Remarks

- More properly designed fatality studies needed, especially in certain regions/habitats with limited/no data
- Some indirect measures of impacts correlate with actual impacts
- Other indirect measures have not been tested (e.g., radar passage rates, bat call rates)
- Better syntheses needed for existing information
- Need approaches to address cumulative impacts

Thanks

Ed Arnett

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David Young

Dale Strickland