Michigan State Police Communication Tower Study:

Results applicable to wind turbines

Joelle Gehring
Michigan Natural Features Inventory

10,000 - 40,000
Photo: BLM

4 - 50 million

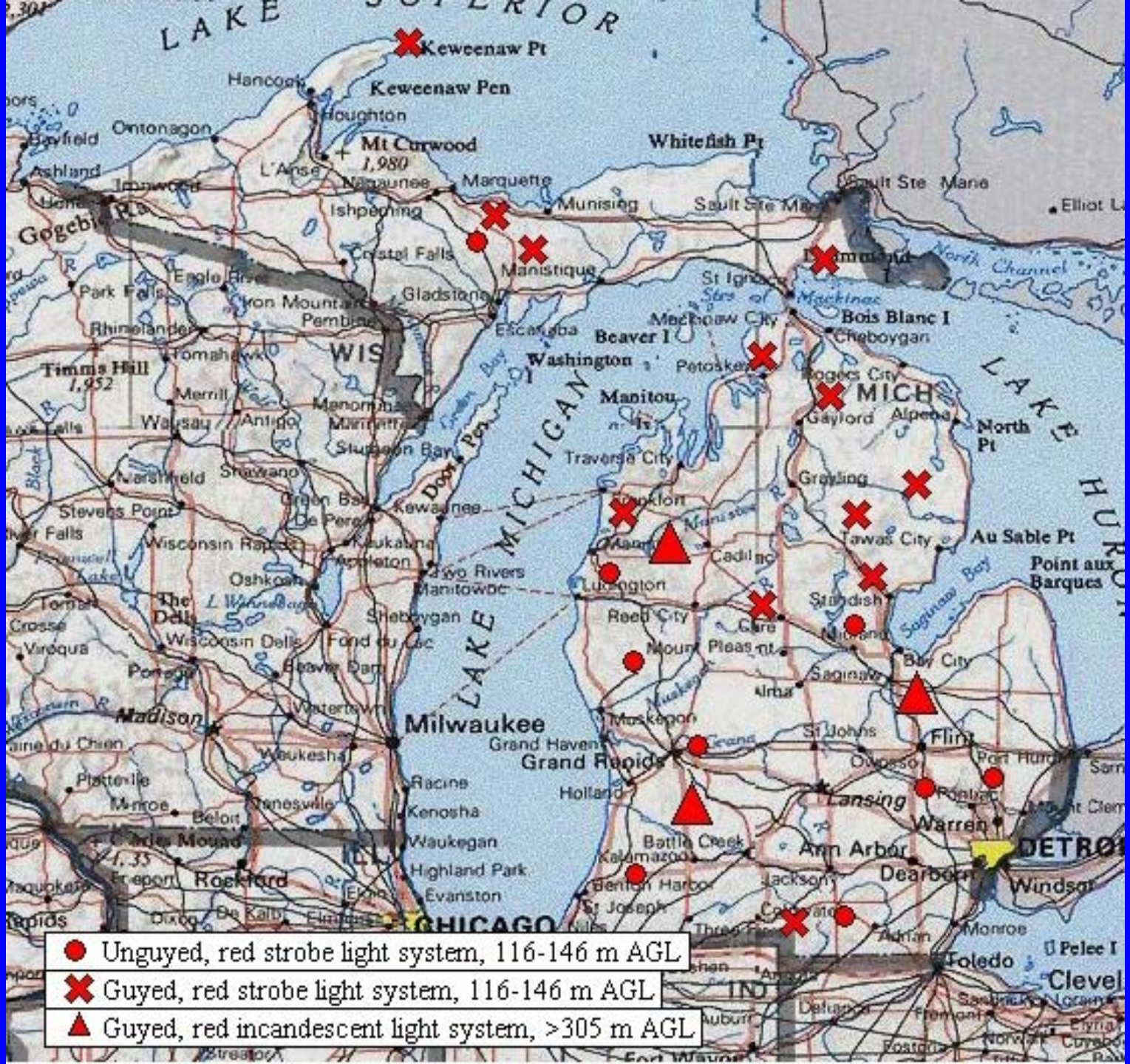
B. Sullivan

16 Sep 99
New York State
Tawrkill
Ovenbird
Bay-breasted Warbler
Magnolia Warbler
Black-throated Blue Warbler
Black-and-white Warbler
Tennessee
Blackburnian Warbler
Chestnut-sided Warbler
Common Yellowthroat
Nashville Warbler
Red-eyed Vireo
Blue-headed Vireo
Rose-breasted Grosbeak
Photo: Cornell Univ.

I. Jeklin

Objectives

- Tower support systems
- Tower heights
- Tower light systems

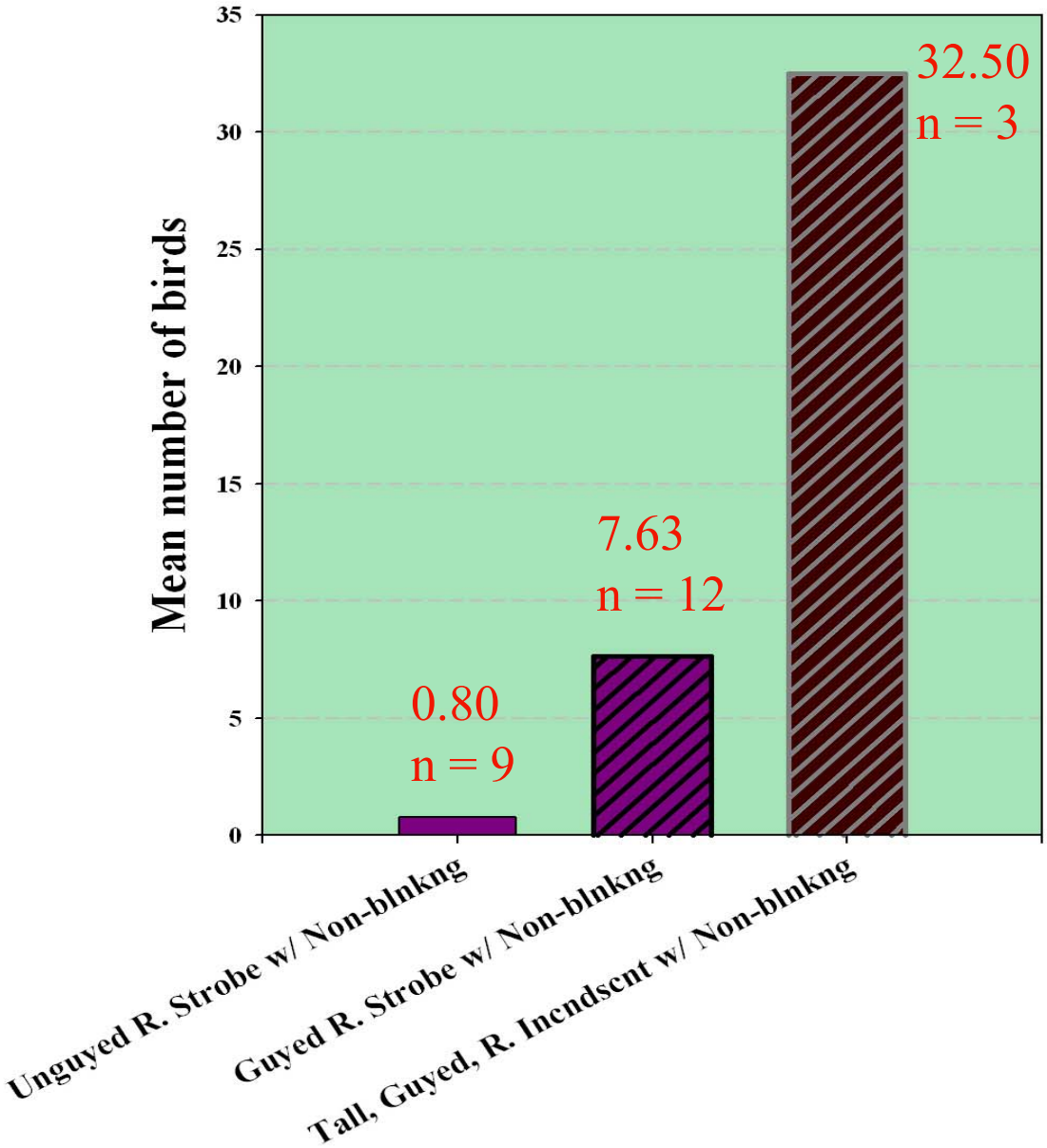

LAKE SUPERIOR
Keweenaw Pt
Keweenaw Pen
Hancock
Houghton
Mt Curwood
1,980
Ontonagon
Bayfield
Ashland
Ironwood
L'Anse
Negaunee
Marquette
Ishpeming
Munising
Whitefish Pt
Sault Ste Marie
Elliot L
Gogebic Ra
Crystal Falls
Manistique
Park Falls
Eagle River
Iron Mountain
Gladstone
Pembine
Rhinelander
Escanaba
Beaver I
Washington
Timms Hill
1,952
Tomahawk
WIS
Merrill
Wausau
Antigo
Menominee
Marinette
Sturgeon Bay
Green Bay
Door Pen
Marshfield
Stevens Point
Wisconsin Rapids
Kewaunee
De Pere
Keukauna
Appleton
Oshkosh
Two Rivers
Manitowoc
The Dells
Wisconsin Dells
Sheboygan
Fond du Lac
Beaver Dam
Portage
Madison
Watertown
Milwaukee
Waukesha
Racine
Kenosha
Waukegan
Highland Park
Evanston
Rockford
Freeport
Dixon
De Kalb
CHICAGO
LAKE MICHIGAN
Manitou Is
Traverse City
Frankfort
Manistee
Cadillac
Ludington
Reed City
Mount Pleasant
Muskegon
Grand Haven
Grand Rapids
Holland
Battle Creek
Kalamazoo
Benton Harbor
St Joseph
Niles
Three Rivers
Adrian
Toledo
Pelee I
Clevel
Fremont
Norwalk
Elyria
Fostoria
Auburn
Defiance
Fort Wayne
Sault Ste Marie
Drummond I
North Channel
St Ignace
Mackinac
Mackinaw City
Bois Blanc I
Cheboygan
Petoskey
Rogers City
MICH
Gaylord
Alpena
North Pt
Grayling
Tawas City
Au Sable Pt
Point aux Barques
Standish
Midland
Saginaw Bay
Bay City
Saginaw
Alma
St Johns
Owosso
Flint
Port Huron
Lansing
Pontiac
Warren
Ann Arbor
Dearborn
DETROIT
Windsor
Jackson
Monroe
LAKE HURON
Unguyed, red strobe light system, 116-146 m AGL
Guyed, red strobe light system, 116-146 m AGL
Guyed, red incandescent light system, >305 m AGL

Methods

- 20 predawn, simultaneous, searches / season
- Technicians walked 45-60 m / minute, searching 5 m on either side of transect

- Circular area under each tower (90% tower height)
- Birds bagged, labeled and frozen for later ID

Mean number of birds found under communication towers



LAKE SUPERIOR
Keweenaw Pt
Keweenaw Pen
Hancock
Houghton
Mt Curwood
1,980
L'Anse
Marquette
Whitefish Pt
Munising
Sault Ste Marie
Ishpeming
Crystal Falls
Manistique
Gladstone
Iron Mountain
Pembine
Escanaba
Beaver I
Washington
Manitou
Petoskey
Bois Blanc I
Cheboygan
Rogers City
MICH
Gaylord
Alpena
North Pt
Traverse City
Grayling
Tawas City
Au Sable Pt
Point aux Barques
Standish
Bay City
Saginaw
Alma
Muskegon
Grand Haven
Grand Rapids
Holland
Flint
Lansing
Warren
Ann Arbor
Dearborn
Windsor
Battle Creek
Kalamazoo
Benton Harbor
St Joseph
Jackson
Toledo
Monroe
Pelee I
Clevel
Milwaukee
Racine
Kenosha
Waukegan
Highland Park
Evanston
Rockford
Madison
Beloit
Janesville
Watertown
Sheboygan
Manitowoc
Two Rivers
Appleton
Oshkosh
Green Bay
Kewaunee
Sturgeon Bay
Menominee
Antigo
Merrill
Wisconsin Dells
Beaver Dam
Fond du Lac
Platteville
Minnesota
Lake Michigan
Lake Huron
Unguyed, red strobe light system, 116-146 m AGL
Guyed, red strobe light system, 116-146 m AGL
Guyed, red incandescent light system, >305 m AGL

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Keweenaw Pt
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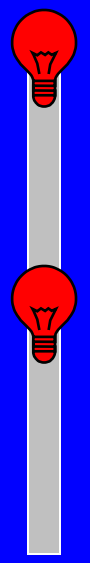
St Johns
Monroe
Toledo
Pelee I
Clevela
Windsor
DETROI
LAKE MICHIGAN
LAKE HURON
North Channel
Strs of Mackinac
Guyed tower, white strobe lights
Unguyed tower, white strobe lights
Guyed tower, red strobe lights
Unguyed tower, red strobe lights
Guyed tower, incandescent lights
Unguyed tower, incandescent lights
Guyed tower, red strobes with solid-on lights
Guyed tower, red strobes with solid lights, 1,000 ft AGL

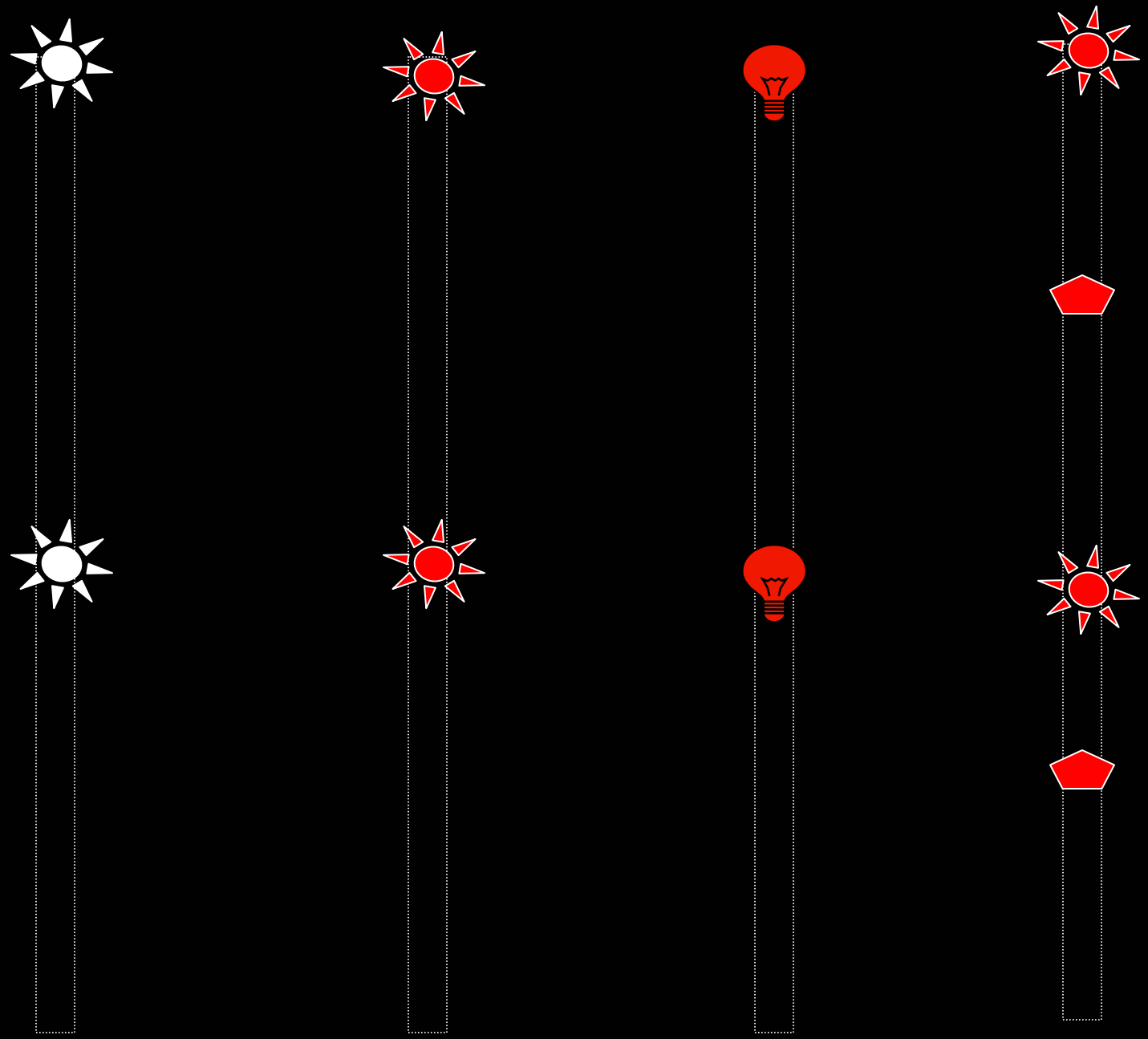
- 3 guyed towers (116–146 m AGL) with 2 levels of **white** strobes and no solid-on lights
- 3 unguyed towers (116–146 m AGL) with 2 levels of **white** strobes and no solid-on lights

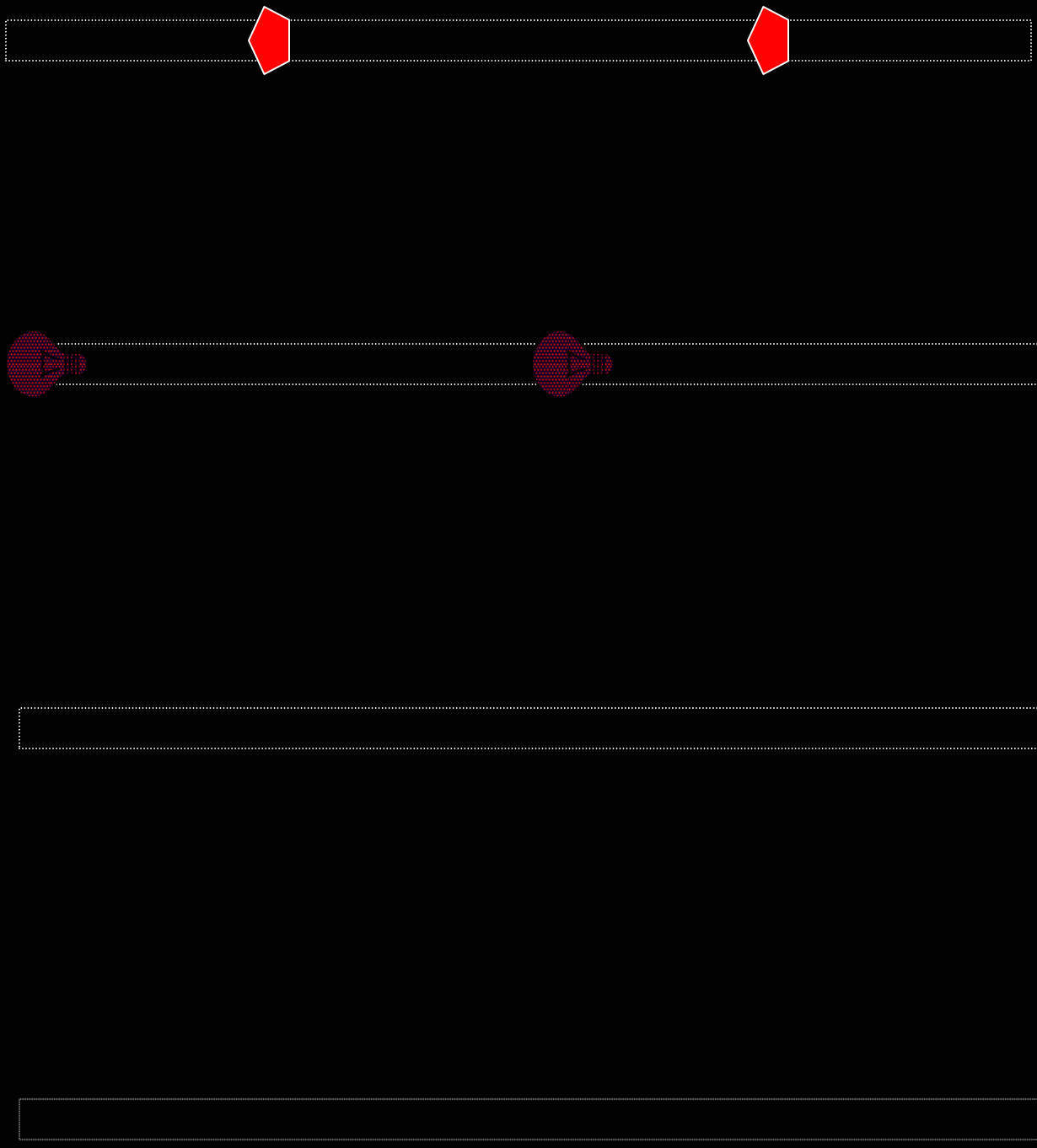
- 3 guyed towers (116–146 m AGL) with 2 levels of **red** strobes and no solid-on lights
- 3 unguyed towers (116–146 m AGL) with 2 levels of **red** strobes and no solid-on lights

- 3 guyed towers (116–146 m AGL) with 2 levels of **red**, blinking, incandescent lights and no solid-on lights
- 3 unguyed towers (116–146 m AGL) with 2 levels of **red**, blinking, incandescent lights and no solid-on lights



- 3 guyed towers (116–146 m AGL) with 2 levels of **red** strobes and 2 levels of **red** solid-on lights

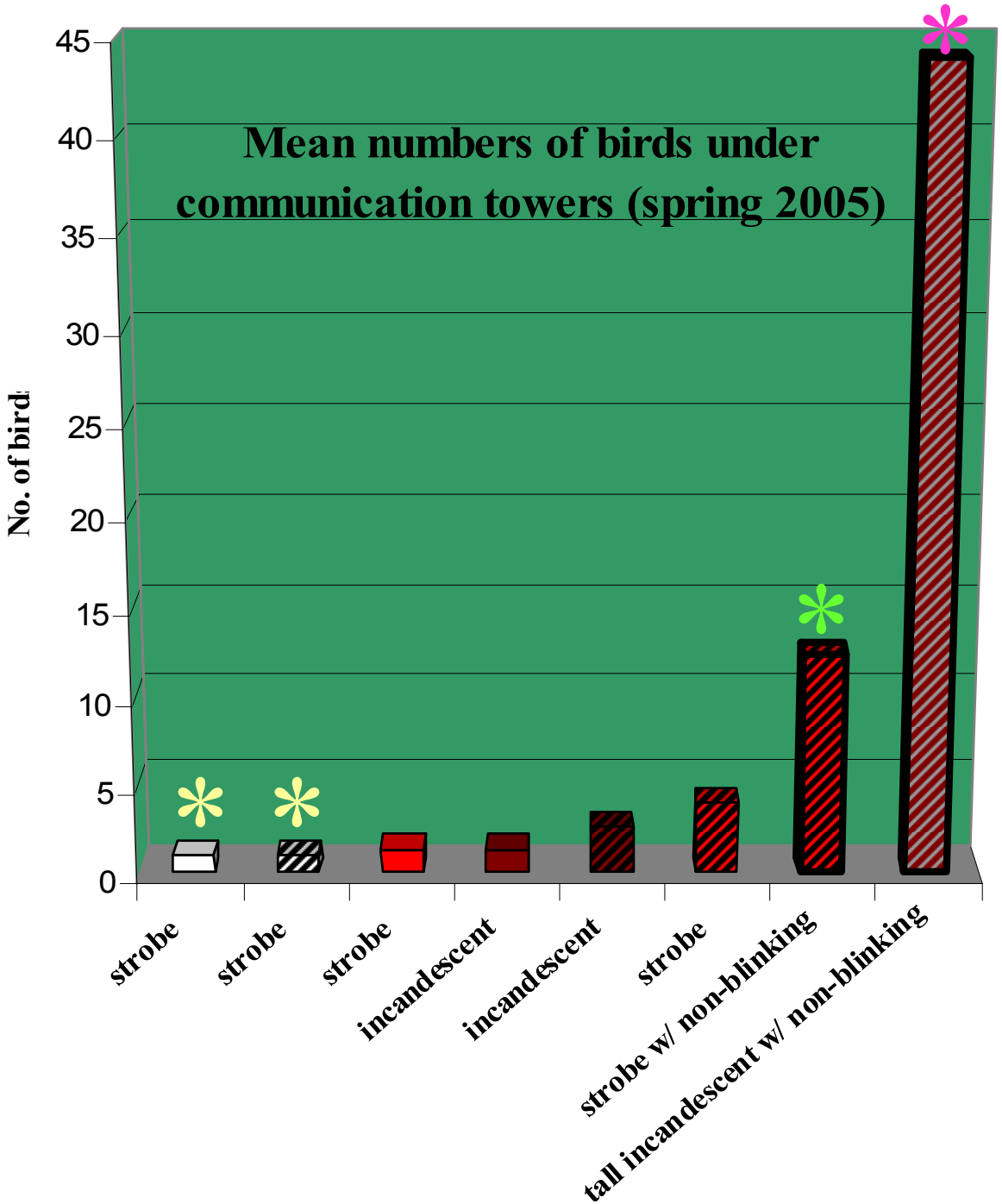


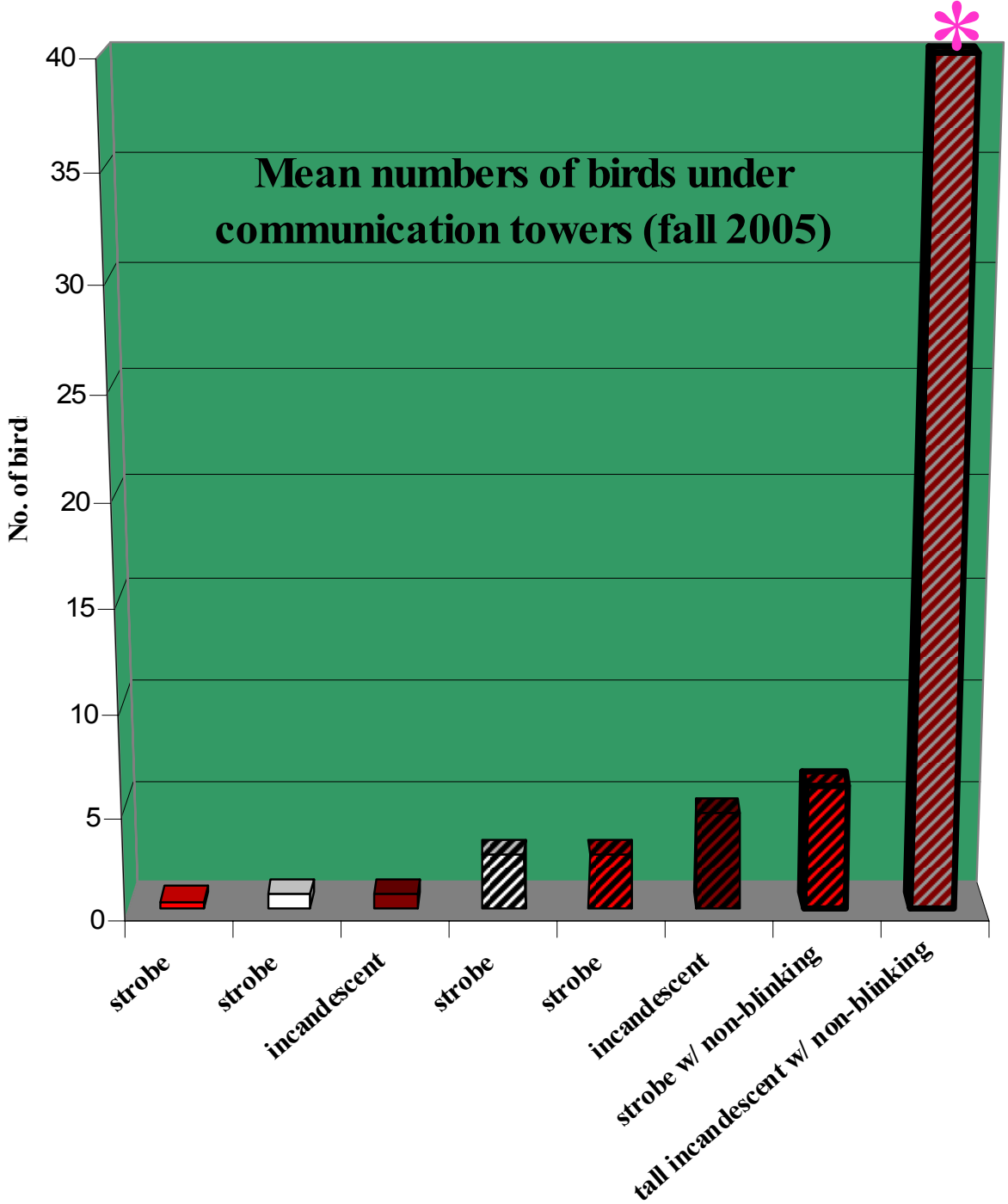


Analysis

Kruskal-Wallis ANOVA for ranks, Least Significant Differences multiple comparisons

- Number of bird carcasses observed at towers with different height categories, lighting systems and support systems ($P = \leq 0.10$)


Mean numbers of birds under communication towers (spring 2005)
No. of birds
45
40
35
30
25
20
15
10
5
0
strobe
strobe
strobe
incandescent
incandescent
strobe
strobe w/ non-blinking
tall incandescent w/ non-blinking


Mean numbers of birds under communication towers (fall 2005)
No. of bird
40
35
30
25
20
15
10
5
0
*
strobe
strobe
incandescent
strobe
strobe
incandescent
strobe w/ non-blinking
tall incandescent w/ non-blinking

Photography AcclaimImages.com Photography
Photography AcclaimImages.com Photography

Adjustments

(Fall 2005)

- Technicians placed 15 Brown-headed Cowbirds near search area edges } ***Carcass removal rate***

  mean = 6.69 days (SD = 2.98)

- I placed 10 painted Brown-headed Cowbirds within search area of technicians} ***Observer detection rate***

  mean = 0.24 (SD = 0.31)

  via bootstrapping (5,000 iterations)

- ***Multipliers*** specific to each tower ranged between:

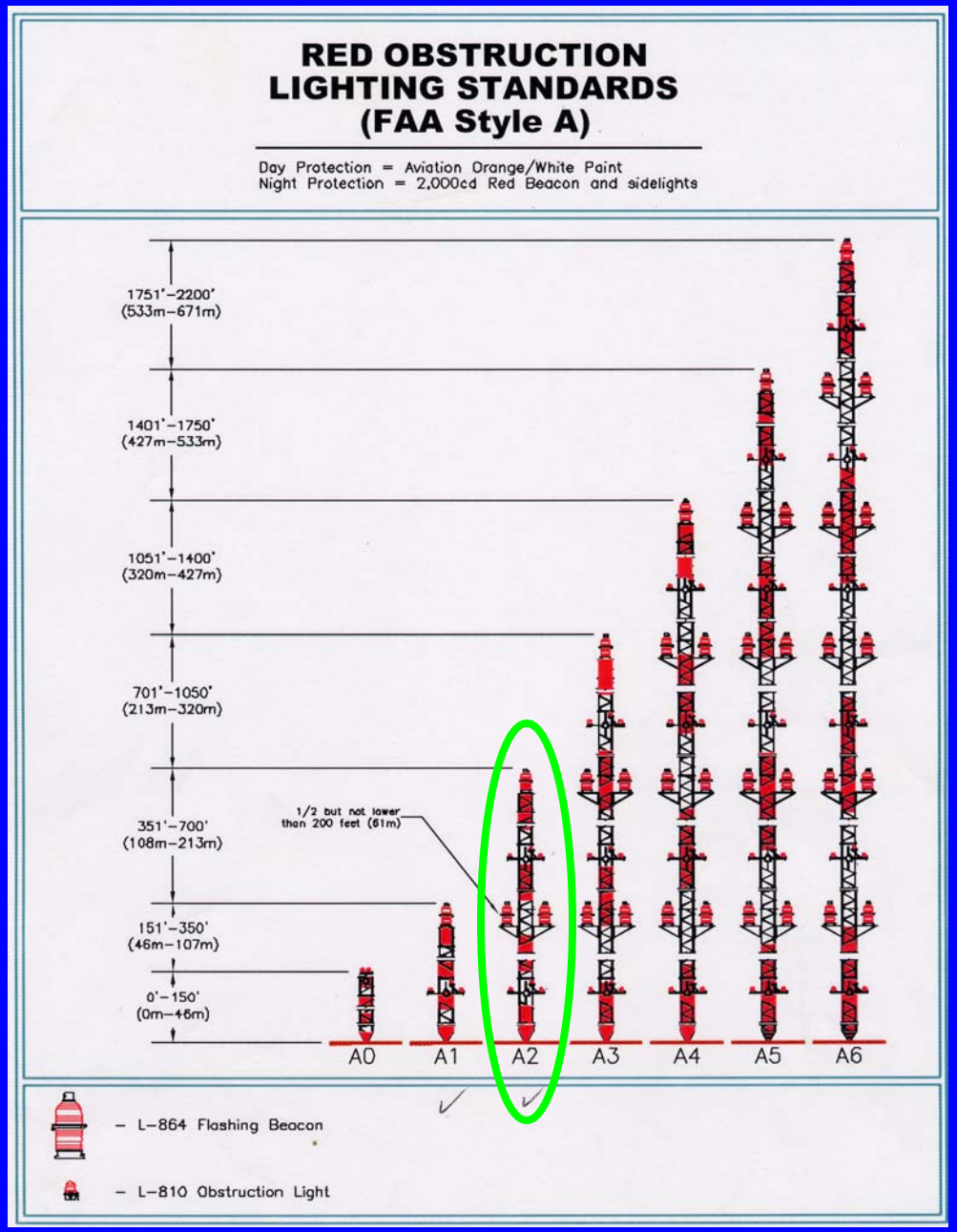
  1.58 and 5.07 (mean = 2.45, SD = 0.87)

FAA Obstruction Lighting Guidelines

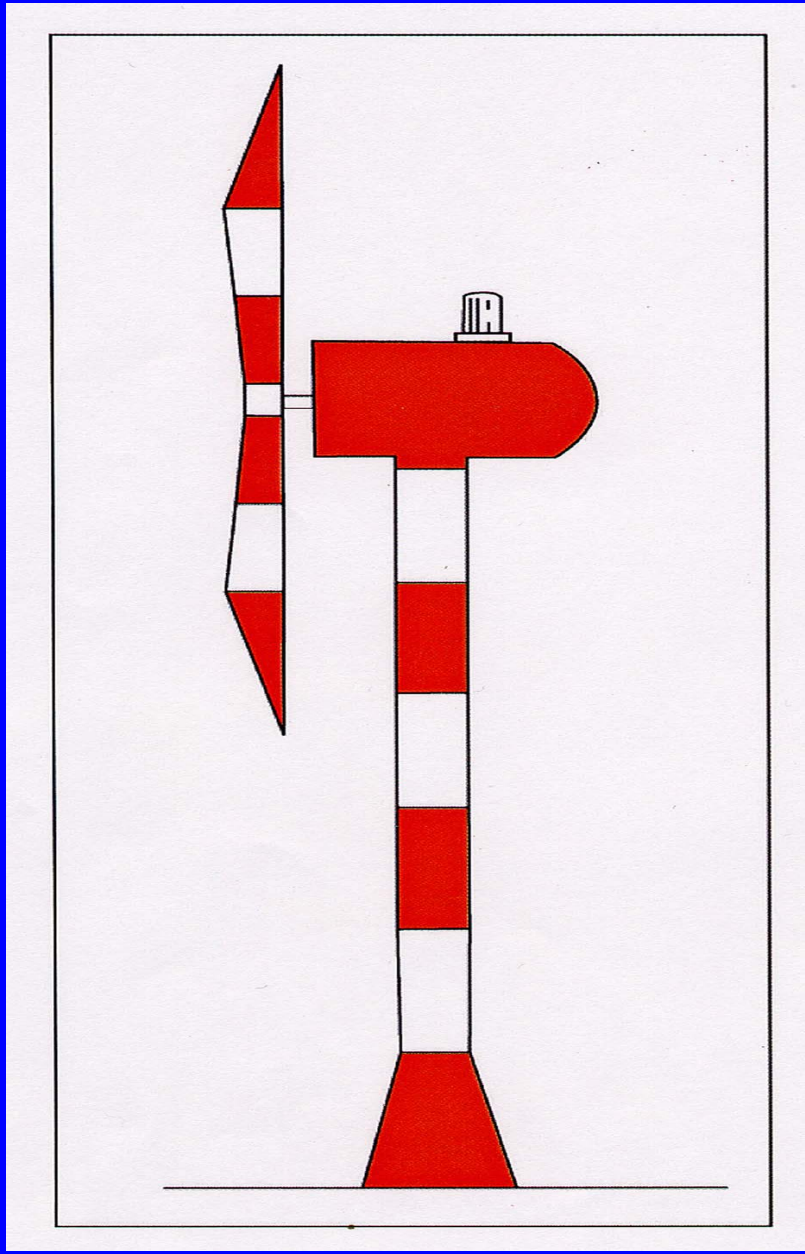
- USDOT – FAA Advisory Circular AC 70/7460-1K (2000): Specs for lighting towers, turbines, bridges…

- communication towers
  - L-864 flashing red and L-810 steady red for night – most commonly used (some with white strobes)

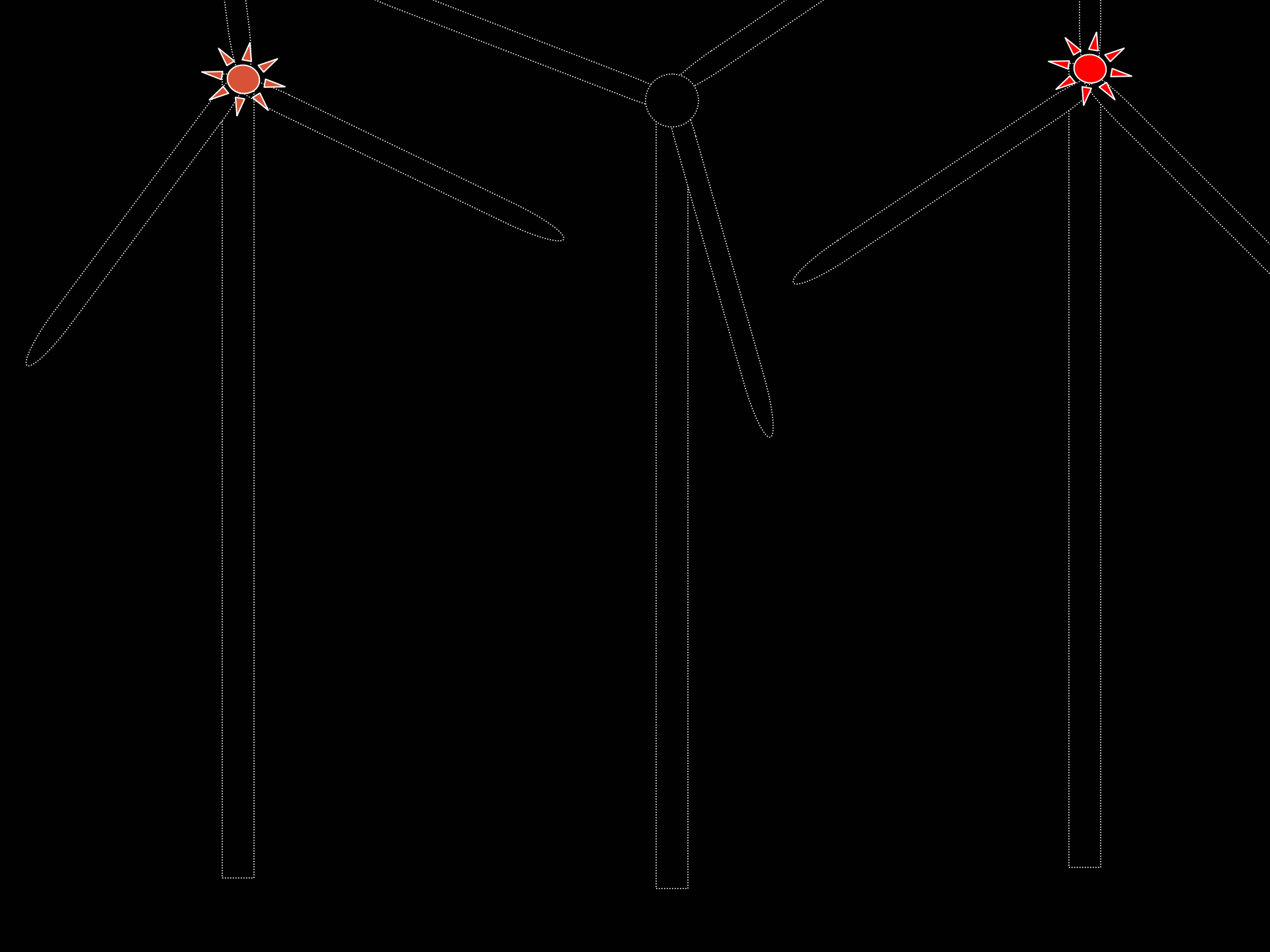
- wind turbines
  - 2 - L-864 flashing red (usually strobe-like or incandescent) – or 1 if turbines flash synchronously
  - Not all turbines need to be lit (1 in 3 or 4)
  - No steady burning red L-810 lights (except in MN) and some blinking red L-810 lights (CA, etc.)

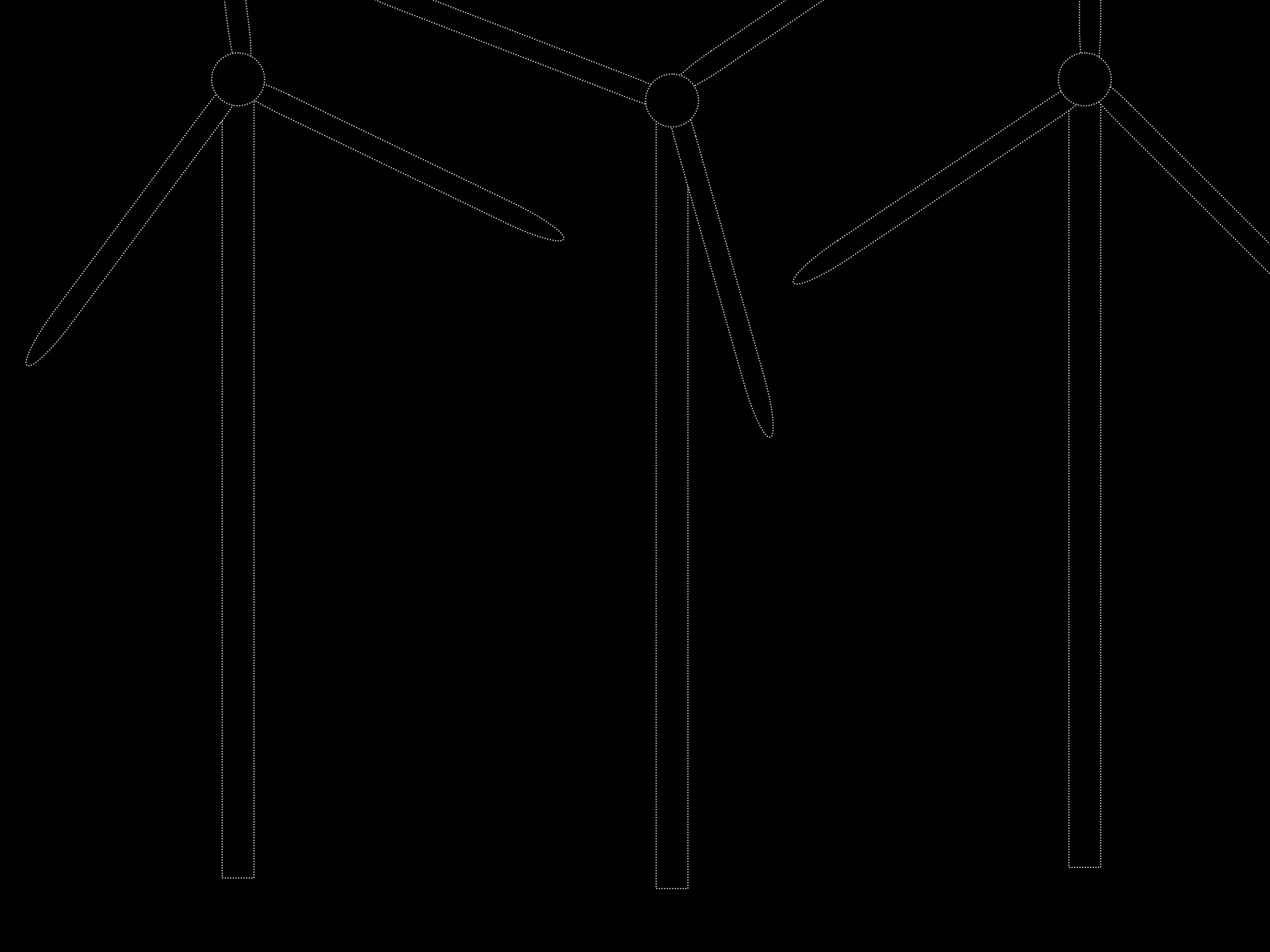


L-864 red flashing
L-810 steady red



L-864 flashing red (usually Strobe-like, ~24 cycles per minute) – not all turbines lit





USFWS Guidelines

- Unless otherwise requested by the FAA, only white strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. Solid red or pulsating red incandescent lights should not be used, as they appear to attract night-migrating birds at a much higher rate than white strobe lights.

Summary

- Birds appear to be attracted to steady burning lights.
- FAA (red flashing, strobe-like, L-864) lights on wind turbines do not appear to attract as many night migrants as the lighting systems on communication towers. Further studies needed!!

Lighting issues to consider

- Would an increase in turbine height result in an increase in turbine lighting?
- Would off-shore wind development require additional lights (i.e., navigational hazard)?

Acknowledgements

- Field technicians
- Private tower owners / engineers
- Michigan State Police
- U.S. Fish and Wildlife Service
- Curry & Kerlinger, LLC
- Michigan Dept. of Natural Resources
- National Fish and Wildlife Foundation
- Michigan Natural Features Inventory
- U.S. Forest Service
- Michigan's Office of the Attorney General
- Federal Aviation Administration
- Federal Communications Commission
- Central Michigan University
- Ornithological Council and 2 reviewers
- American Bird Conservancy
- R. Diehl (Univ. S. Miss.), W. Erickson (WEST, Inc.)

- The views and conclusions contained in this presentation are those of the author and should not be interpreted as representing the opinions or policies of the U.S. Government or the National Fish and Wildlife Foundation. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Government or the National Fish and Wildlife Foundation.

Oh Jeez…
Just take the *#% picture!!
An extra special thanks to:
Paul Kerlinger
(Curry & Kerlinger, LLC)
and
Al Manville
(USFWS-OMB)

Joelle Gehring
GehringJ@michigan.gov
517-241-4912

Detected bird mortality

- 5 most frequently detected species in the spring of 2005
  - Red-eyed Vireo (26 birds, 13%)
  - Gray Catbird (22 birds, 11%)
  - Ovenbird (17 birds, 8%)
  - Common Yellowthroat (15 birds, 7%)
  - Yellow Warbler (12 birds, 6%)

47 species total

Detected bird mortality

- 5 most frequently detected species in the fall of 2005
  - Blackpoll Warbler (20 birds, 12%)
  - Mourning Dove (13 birds, 8%)
  - Red-eyed Vireo (12 birds, 7%)
  - Nashville Warbler (10 birds, 6%)
  - Ovenbird (5 birds, 3%)

42 species total

Tower support	Height Category	Light System	# of towers	Mean # of carcasses / 20 days of migration
Unguyed	Medium	White Strobe	3	1.00 (SE = 1.00)
Unguyed	Medium	Red Strobe	3	1.33 (SE = 0.88)
Unguyed	Medium	Red, blinking, incandescent	3	1.33 (SE = 0.67)
Guyed	Medium	White Strobe	3	1.00 (SE = 0.58)
Guyed	Medium	Red Strobe	3	4.00 (SE = 1.00)
Guyed	Medium	Red, blinking, incandescent	3	2.67 (SE = 0.33)
Guyed	Medium	Red strobe w/ non-blinking	3	12.3 (SE = 4.84)
Guyed	Tall	Red, blinking, incandescent w/ non-blinking	3	44.00 (SE = 11.55)

Tower support	Height Category	Light System	# of towers	Mean # of carcasses / 20 days of migration
Unguyed	Medium	White Strobe	3	1.00 (SE = 1.00)
Unguyed	Medium	Red Strobe	3	1.33 (SE = 0.88)
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Guyed	Tall	Red, blinking, incandescent w/ non-blinking	3	44.00 (SE = 11.55)

Results

Kruskal-Wallis ANOVA for ranks, Least Significant Differences multiple comparisons

- Number of bird carcasses observed at towers with different height categories, lighting systems and support systems ($P = \leq 0.10$)

Unguyed, medium, white strobe

Guyed, medium, white strobe

Guyed, medium, red strobe w/ non-blinking

Guyed, tall, red blinking incandescent w/ non-blinking

Tower support	Height Category	Light System	# of towers	Mean # of carcasses / 20 days of migration
Unguyed	Medium	White Strobe	3	0.67 (SE = 0.67)
Unguyed	Medium	Red Strobe	3	0.33 (SE = 0.33)
Unguyed	Medium	Red, blinking, incandescent	3	0.67 (SE = 0.33)
Guyed	Medium	White Strobe	3	2.67 (SE = 2.19)
Guyed	Medium	Red Strobe	3	2.67 (SE = 2.19)
Guyed	Medium	Red, blinking, incandescent	3	4.67 (SE = 0.33)
Guyed	Medium	Red strobe w/ non-blinking	3	6.00 (SE = 2.65)
Guyed	Tall	Red, blinking, incandescent w/ non-blinking	3	40.00 (SE = 18.03)

Tower support	Height Category	Light System	# of towers	Mean # of carcasses / 20 days of migration
Unguyed	Medium	White Strobe	3	0.67 (SE = 0.67)
Unguyed	Medium	Red Strobe	3	0.33 (SE = 0.33)
Unguyed	Medium	Red, blinking, incandescent	3	0.67 (SE = 0.33)
Guyed	Medium	White Strobe	3	2.67 (SE = 2.19)
Guyed	Medium	Red Strobe	3	2.67 (SE = 2.19)
Guyed	Medium	Red, blinking, incandescent	3	4.67 (SE = 0.33)
Guyed	Medium	Red strobe w/ non-blinking	3	6.00 (SE = 2.65)
Guyed	Tall	Red, blinking, incandescent w/ non-blinking	3	40.00 (SE = 18.03)

Results

Kruskal-Wallis ANOVA for ranks, Least Significant Differences multiple comparisons

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Guyed, tall, red blinking incandescent w/ non-blinking