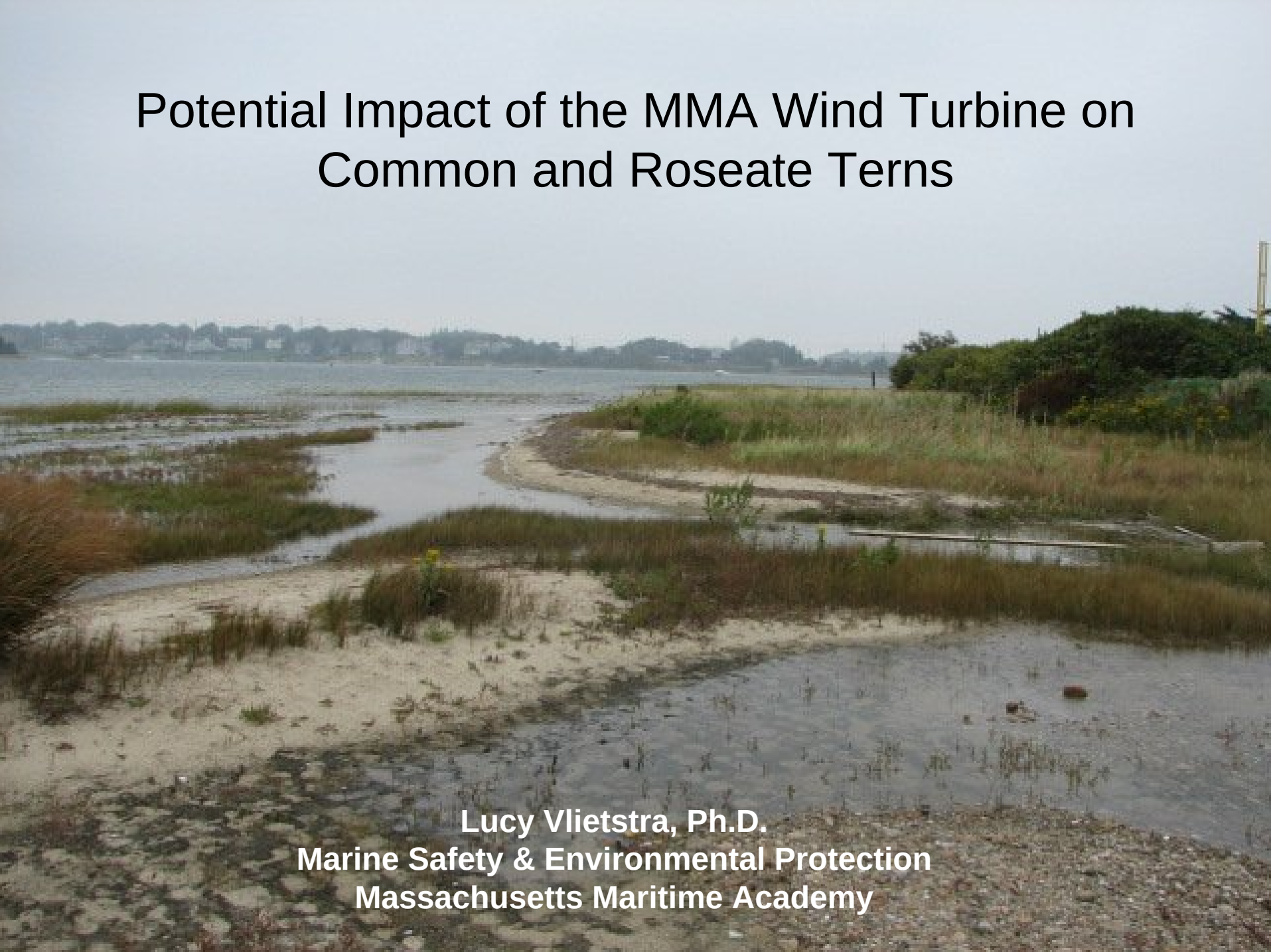
Potential Impact of the MMA Wind Turbine on Common and Roseate Terns



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Installed April 2006

Vestas V47-660 kW

- Tower ht = 50 m
- Rotor-tip ht = 73.5 m
- Max velocity = 28.5 rpm

Located 100 m from Buzzards Bay

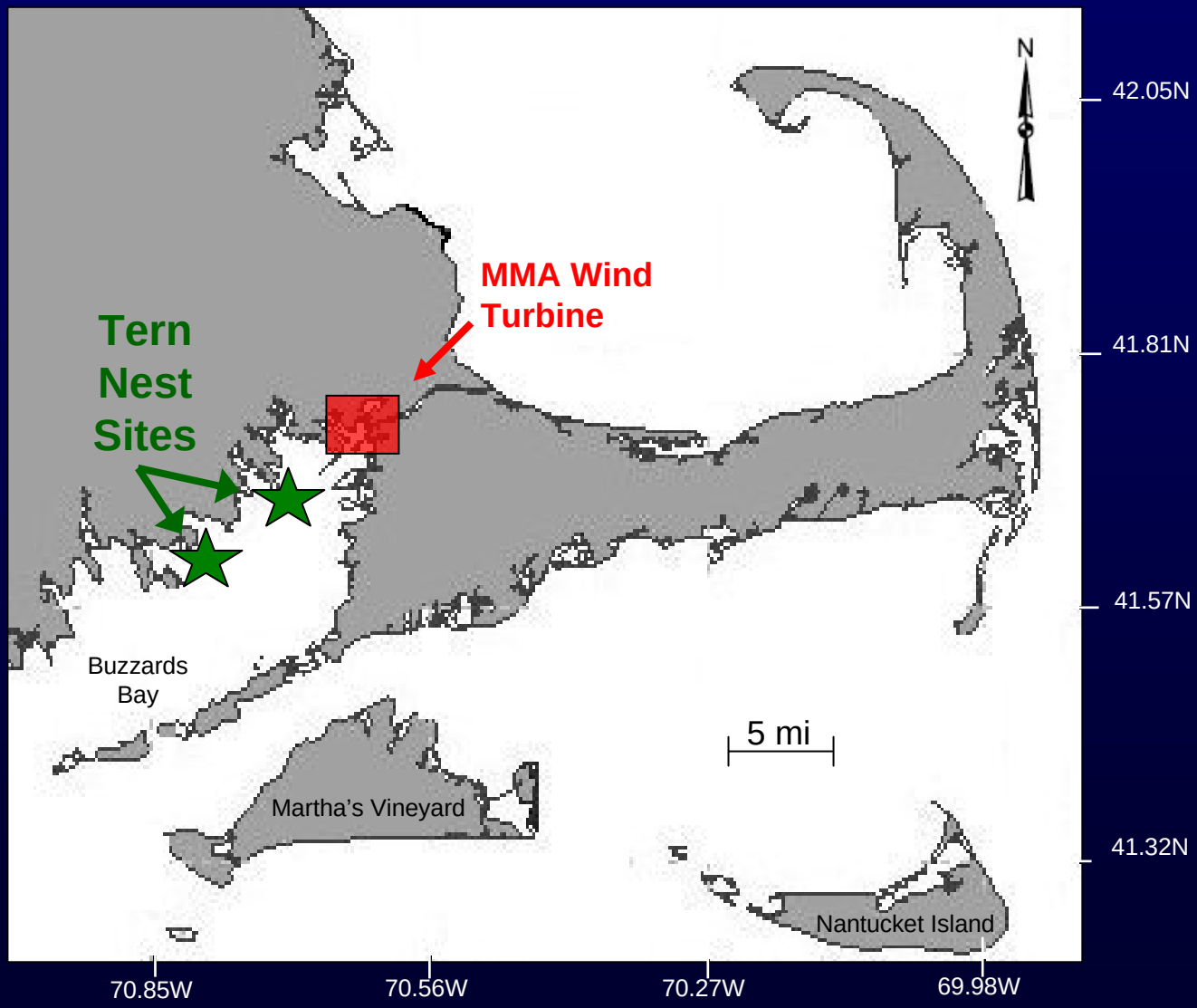
Common tern (*Sterna hirundo*)

Status: Special concern

Roseate tern (*Sterna dougallii*)

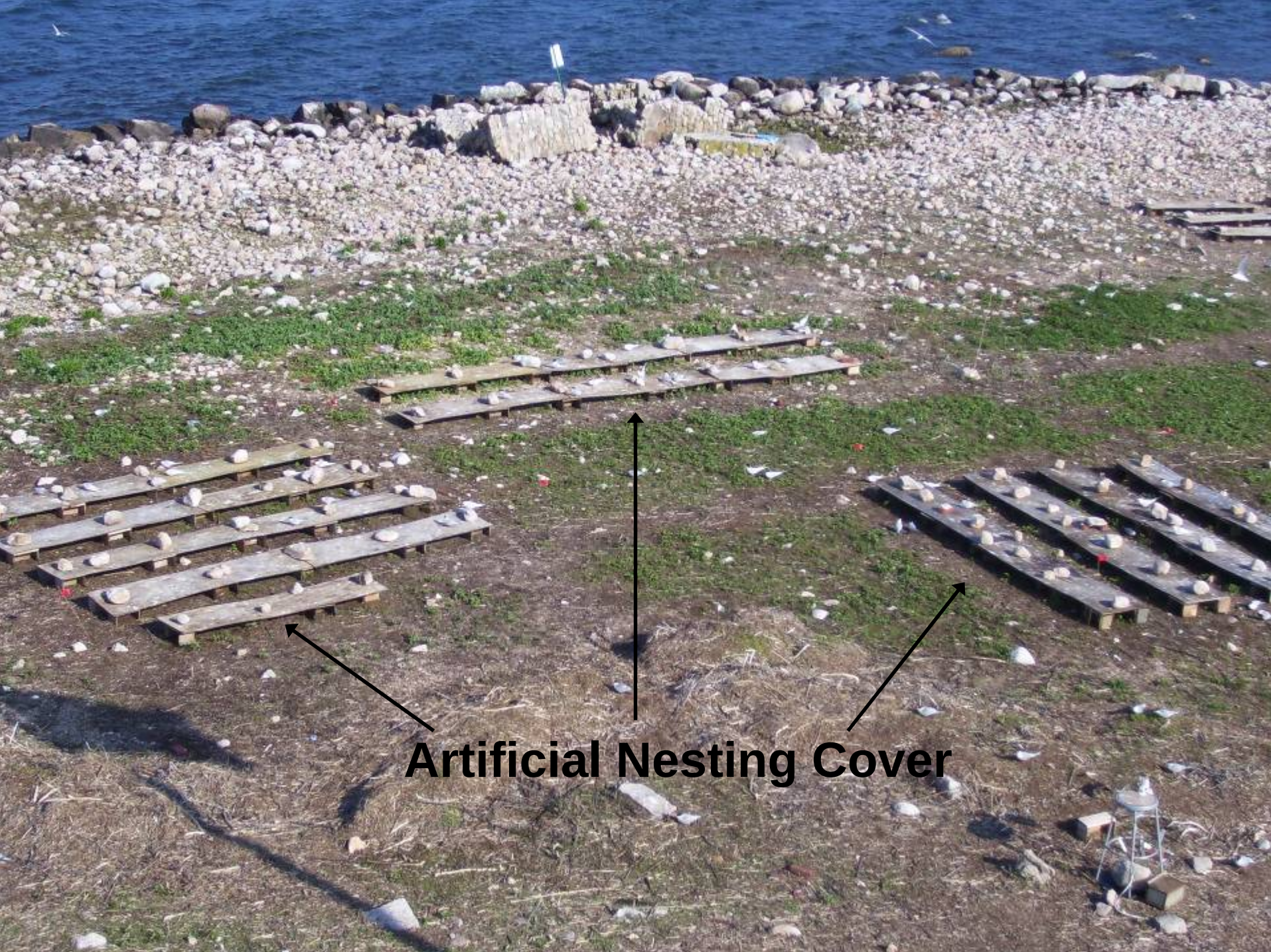
Status: Endangered

Massachusetts Maritime Academy



Bird Island, Mass.

Breeding season: April-November

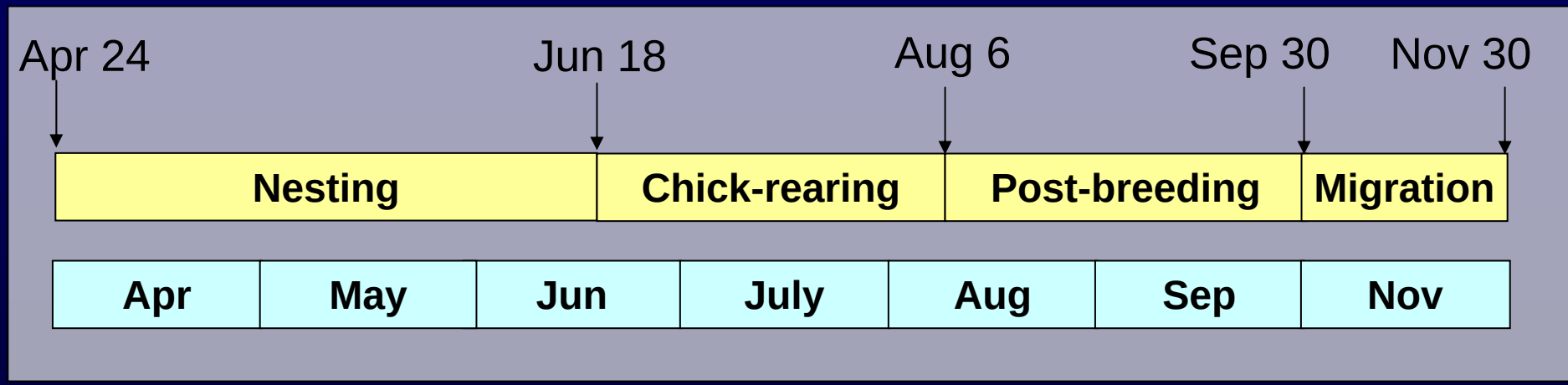

Artificial Nesting Cover

We conducted a study to determine the potential impact of the wind turbine on the local tern population.

Objectives:

- Determine the abundance of terns in water near campus
- Determine extent to which terns were exposed to the wind turbine
- Characterize avian mortality resulting from collisions with the wind turbine rotor

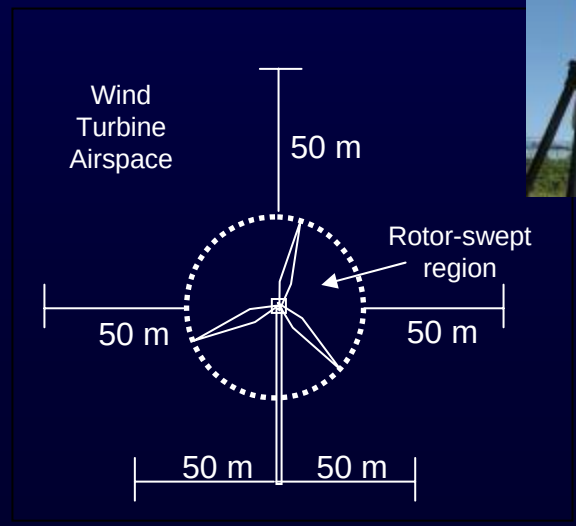
Tern Breeding Season



Methodology

- Water scan surveys
  - Surveys conducted 24-30 hrs/wk
  - Every 20 minutes
  - Recorded all birds present

- Monitored “wind turbine airspace”
  - Space within 50 m of turbine
  - Recorded all birds present
  - Recorded flight altitude
  - Not operated 3-4 days/wk



Methodology

- Mortality surveys

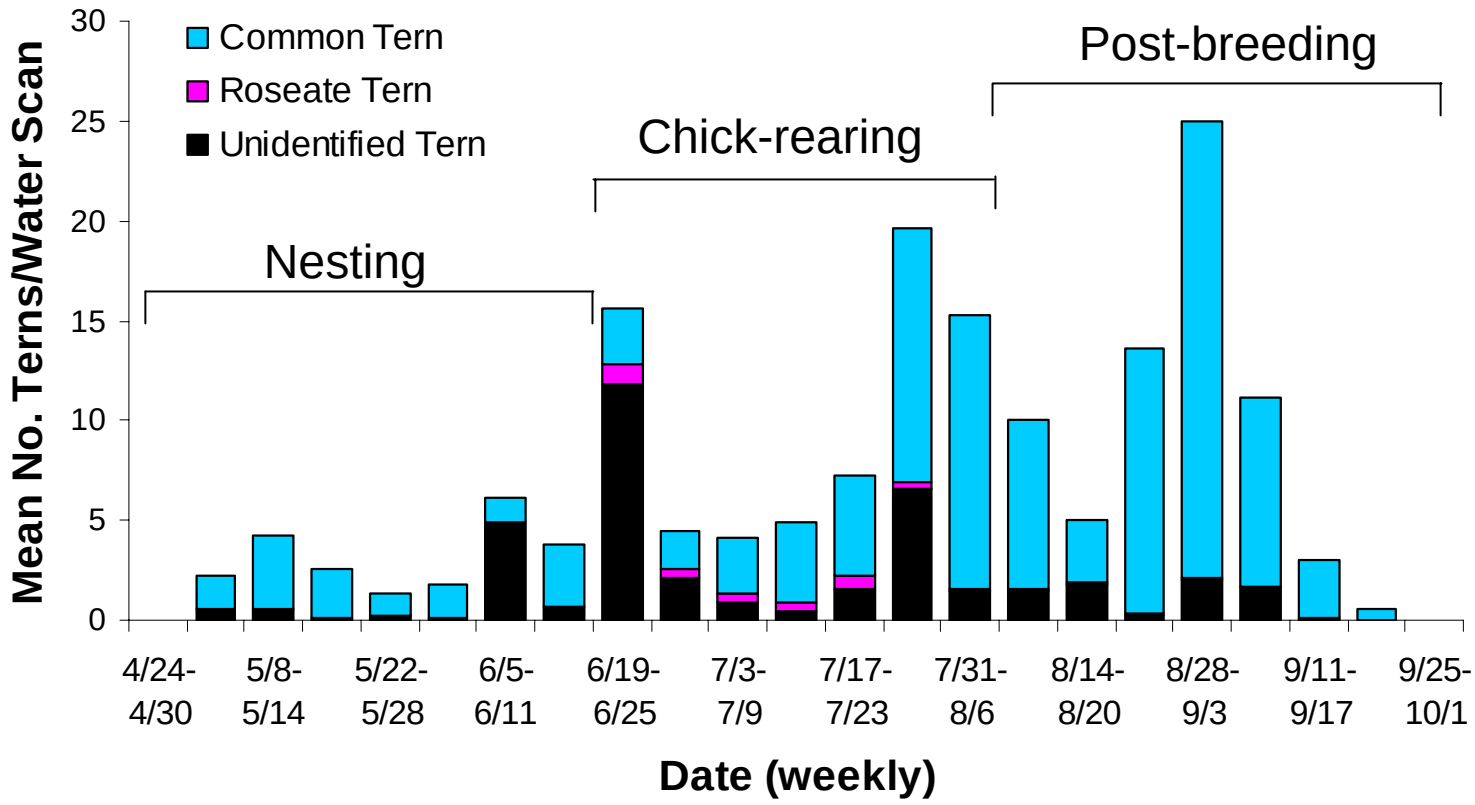
  Searched pre-defined area around turbine 4-12 times/week

  Corrected for carcasses missed due scavenging activity and searcher detection efficiency

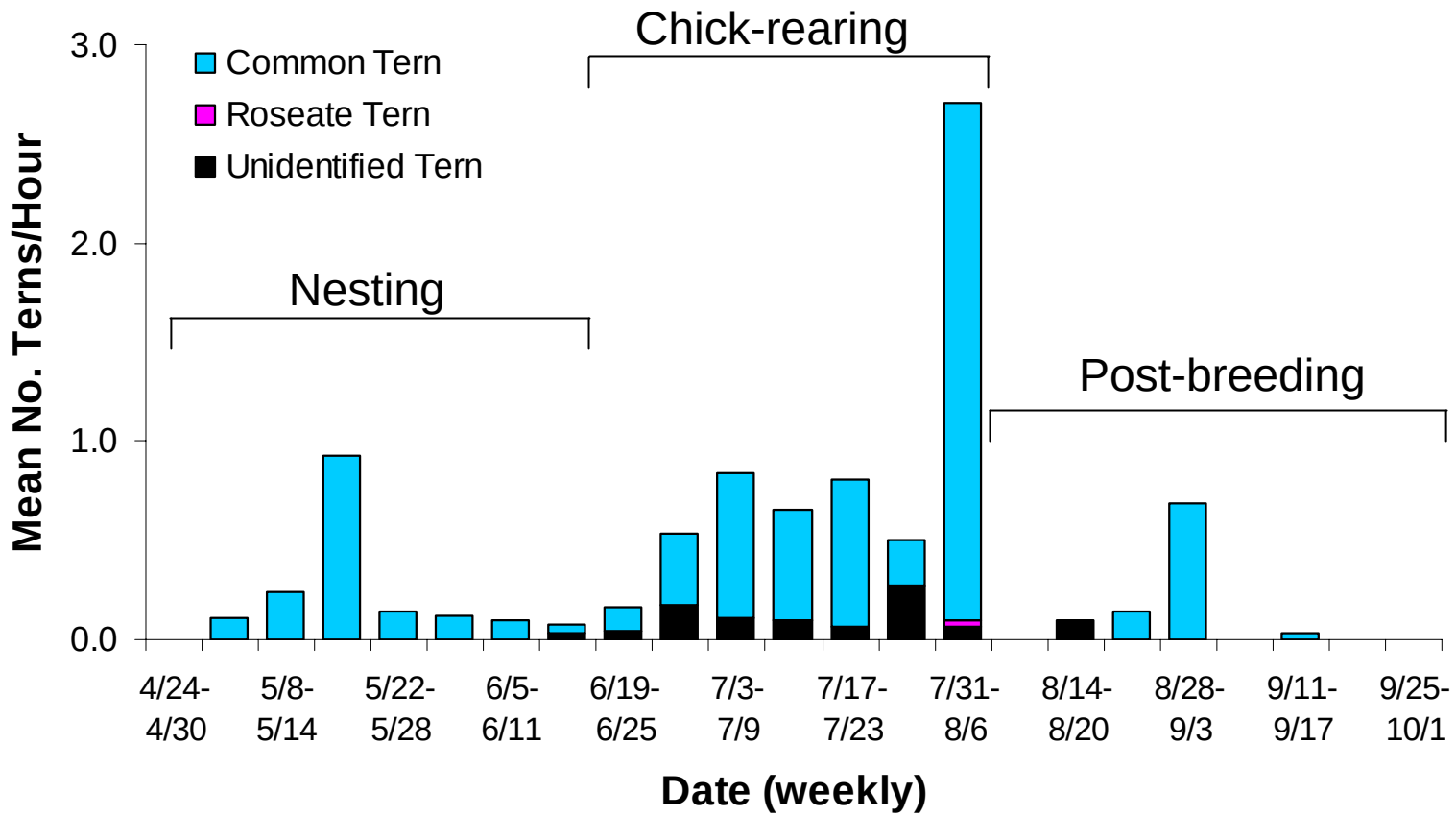
Sampling effort (no. hours) in MMA Avian Study, Apr 24-Sep 30, 2006

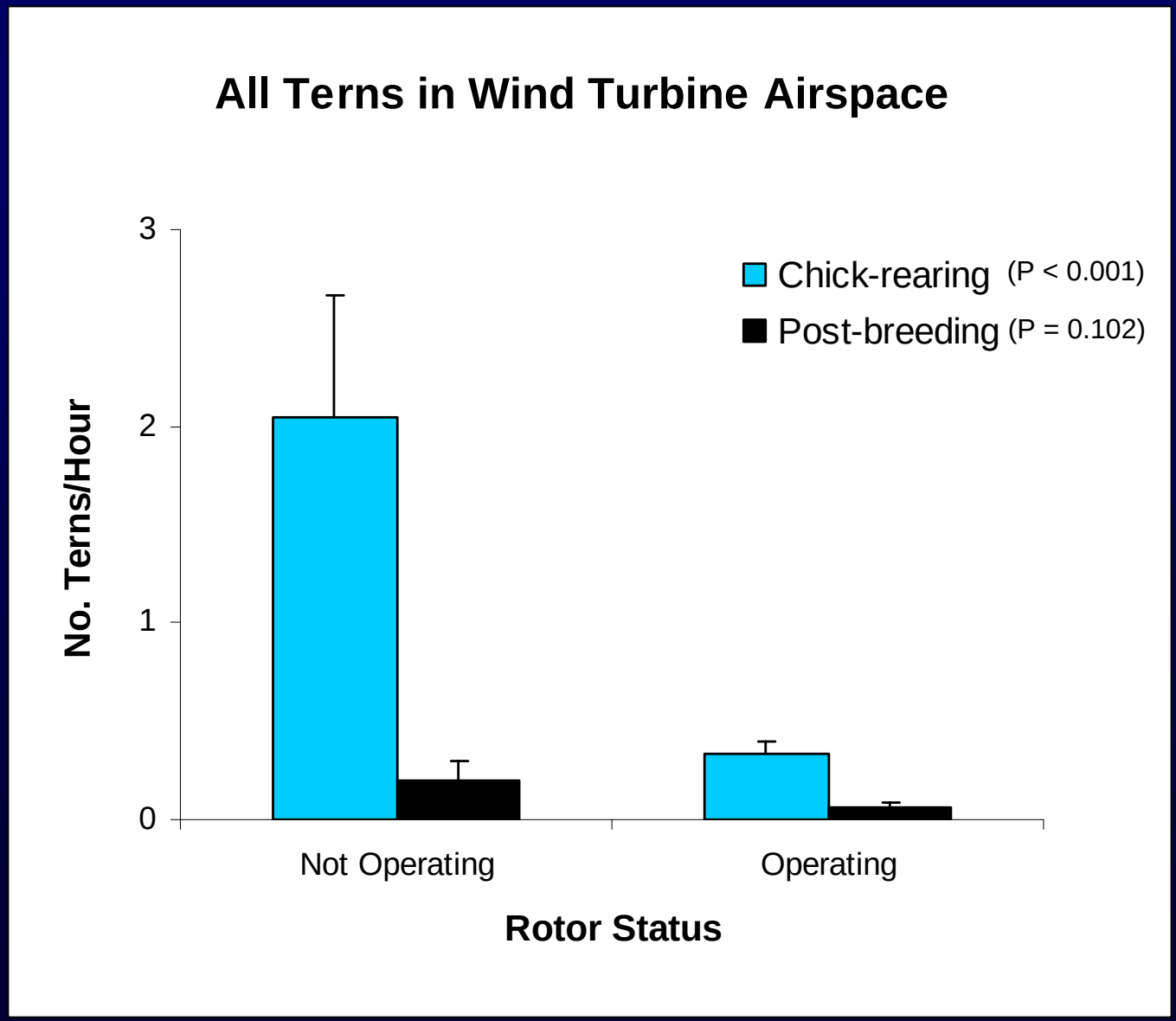
Time of Day	Breeding Stage			
	Nesting	Chick-rearing	Post-breeding	TOTAL
0530-1100	56.6	61.6	76.3	194.5
1100-1600	61.0	75.3	83.5	219.8
1600-2100	66.5	60.1	61.1	187.7
TOTAL	184.1	197.0	220.9	602.0

Terns on Water Adjacent to Campus

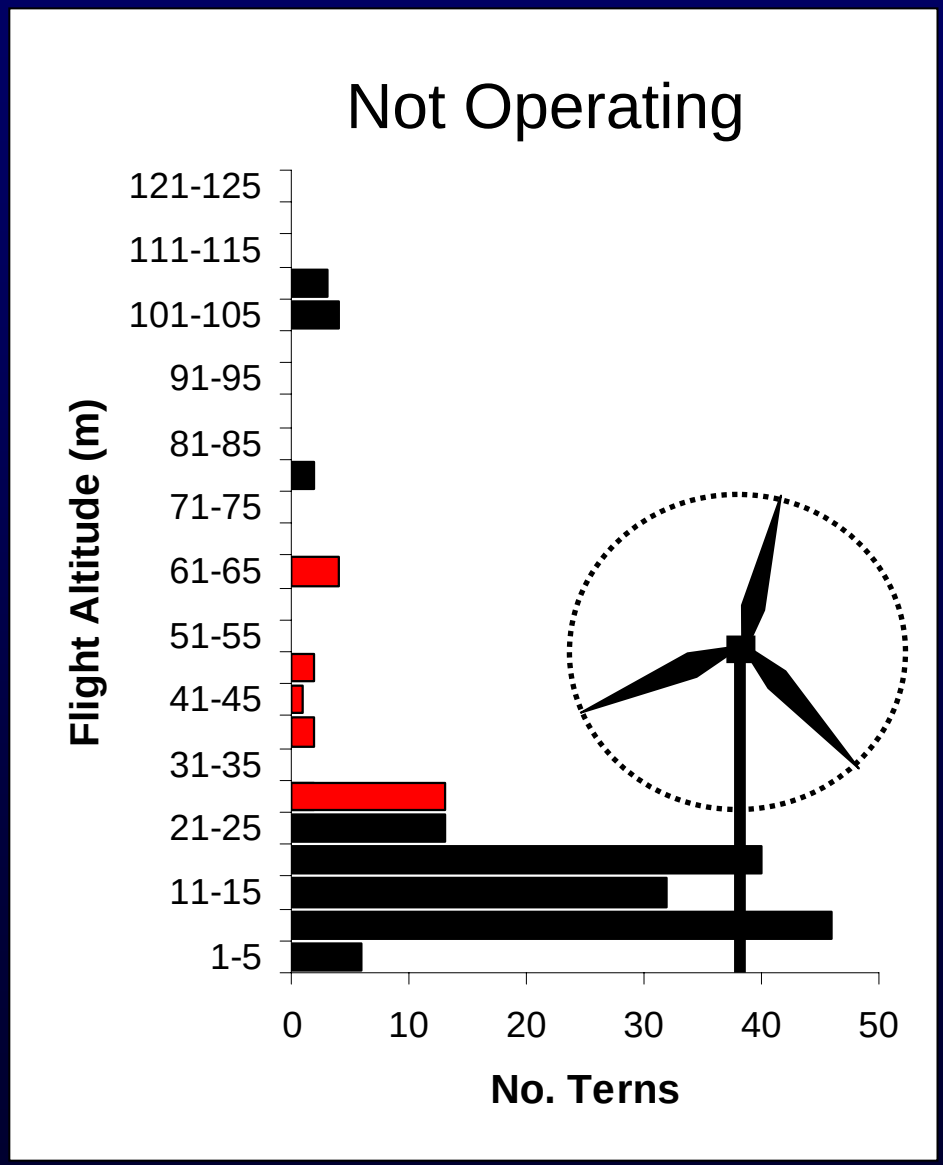


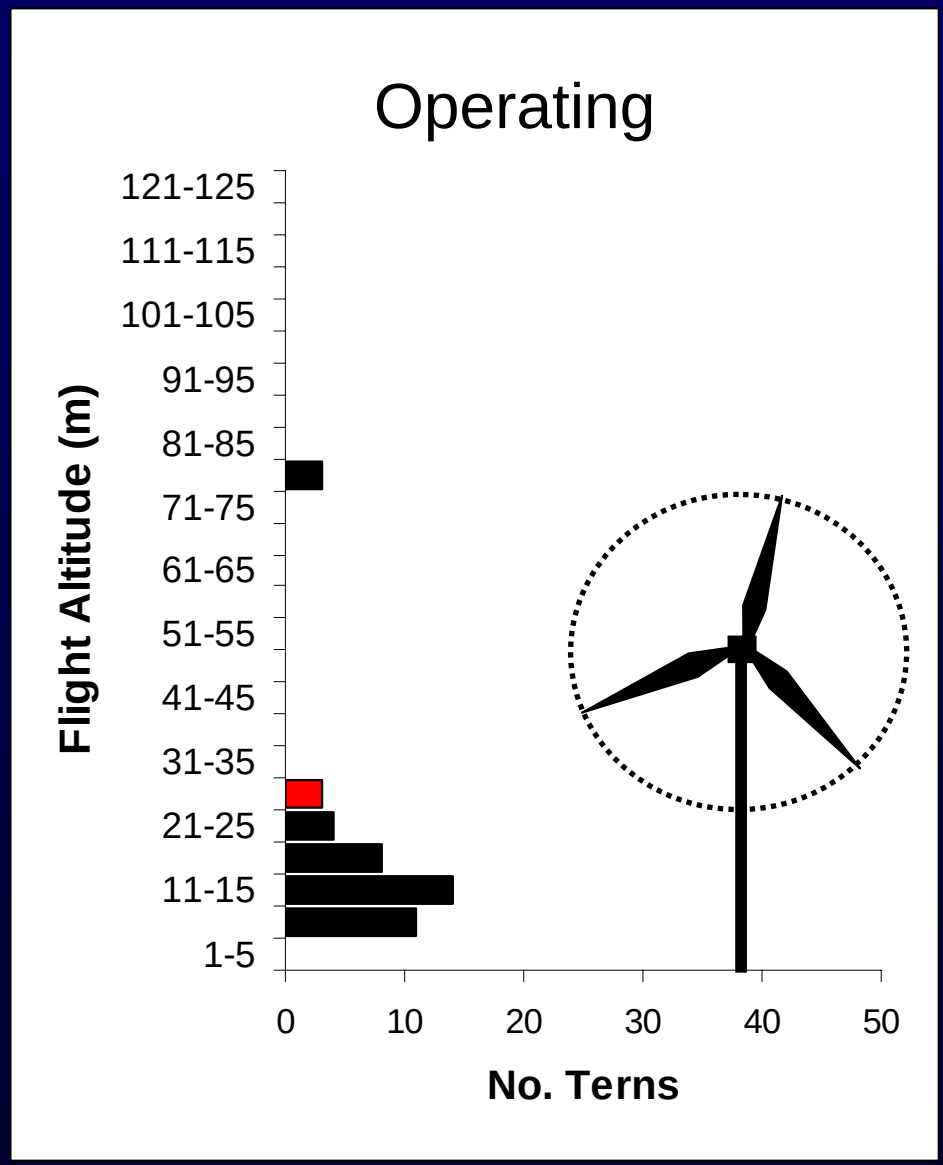
Terns in Wind Turbine Airspace




All Terns in Wind Turbine Airspace
3
2
1
0
No. Terns/Hour
Chick-rearing (P < 0.001)
Post-breeding (P = 0.102)
Not Operating
Operating
Rotor Status

Flight Altitude of Birds in Wind Turbine Airspace





Birds in Rotor-Swept Region of MMA Wind Turbine

Species	Date	# Birds	Rotor Velocity (rpm)
Double-crested cormorant	Sep 26	1	0.3
Osprey	Aug 6	1	0.0
American oystercatcher	May 17	2	0.0
Herring gull	Aug 13	1	28.5
	Aug 30	1	0.1
Great black-backed gull	May 12	1	0.0
	Jun 28	1	0.0
	Jul 12	1	0.0
	Jul 19	1	0.2
	Aug 30	1	0.1
Laughing gull	Aug 30	1	0.1
	Aug 30	1	0.1
	Sep 25	3	0.0
Common tern	May 19	4	0.0
	Jul 25	2	0.4
Rock dove	Jul 12	1	0.3
Common grackle	Jun 25	1	0.0
European starling	Jun 25	1	0.0
	Jun 25	1	0.0
	Jul 4	1	0.0
	Sep 10	8	0.5

Avian Mortality at MMA Study Site

Species	Date	Suspected strike?
Black-crowned night heron	Jun 15, 2006	No
Herring gull	Jun 16, 2006	No
Laughing gull	Sep 17, 2006	Possible
Osprey	Apr 19, 2007	Yes

N = 209 mortality surveys in 2006

Annual Mortality Rate (AMR)

$$= (X) \times (1 + Y) \times (1 + Z)$$

X = # carcasses corrected for proportion of year not surveyed
Y = proportion of carcasses removed by scavengers
Z = proportion of carcasses overlooked by searchers

Year	X	Y	Z	AMR
2006	1.39	0.2	0.29	2.2 birds/turbine/yr
2007	1.70	0.2	0.29	2.6 birds/turbine/yr

Annual Mortality Rate (AMR) at Other Wind Turbines

Location	# Turbines	Mortalities/turbine/year	Source
Altamont, California	5,400	1.2	(1)
Buffalo Ridge, Minnesota	73	<1.0	(2)
Codrington, Australia	14	<2.7	(3)
Straits of Gibraltar	66	0.3	(4)
Buffalo Mountain, Tennessee	--	7.5	(5)
Klondike, Oregon	16	0.5	(5)
Vansycle, Oregon	38	0.6	(5)
Nine Canyon, Washington	37	1.0	(5)
Foote Creek Rim, Wyoming	133	1.5	(5)
Mountaineer, West Virginia	44	0.6	(5)
Zeebruge, Belgium	25	19.1	(6)

Sources: (1) Thelander, C. 2004. pp. 25-29. In Proceedings of the Wind Energy and Birds/bats Workshop: Understanding and Resolving Bird and Bat Impacts. Washington D.C., May 2004. (2) Osborn, R.G., K.F. Higgens, R.E. Usgaard, C.D. Dieter, & R.D. Neiger. 2000. American Midland Naturalist 14:41-52. (3) Environment Victoria. 2004. www.envict.org.au/ (accessed April 12, 2006). (4) Barrios, L., & A. Rodriguez. 2004. Journal of Applied Ecology 41 72-81. (5) Erickson, W. 2004. Pages 29-33. In Proceedings of the Wind Energy and Birds/bats Workshop: Understanding and Resolving Bird and Bat Impacts. Washington D.C., May 2004. (6) Everaert, J., & E. W. M Steinen. 2006. Biodiversity and Conservation.

Summary

- Both common and roseate terns present in water adjacent to campus
- Most abundant in airspace during chick-rearing period
- Avoid wind turbine airspace during operation –or– avoid rotor-swept altitudes
- Mortality has not included terns but averages 2-3 birds per year
- Future work will assess avian exposure during periods of heavy fog and rain

Acknowledgements

1/c Abigail Hine

1/c Christopher Williams

1/c Vanessa Landolina

Trisha Gilbert ‘06

2/c Betsy Hackley

2/c Lauren Legendre