



Results of Infrared Deer Surveys in Solebury Township, PA



Solebury Township

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Spotlight Surveys



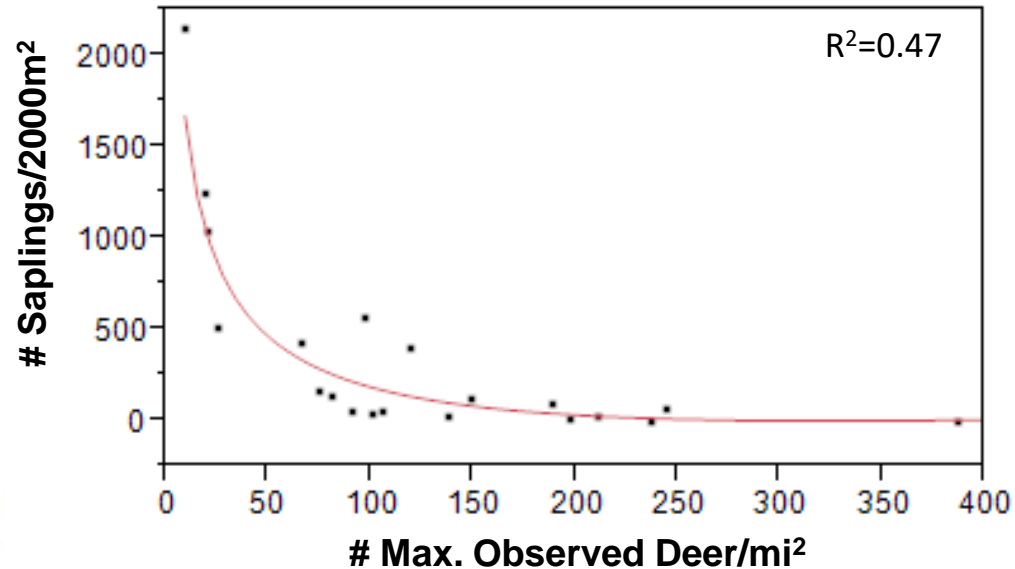
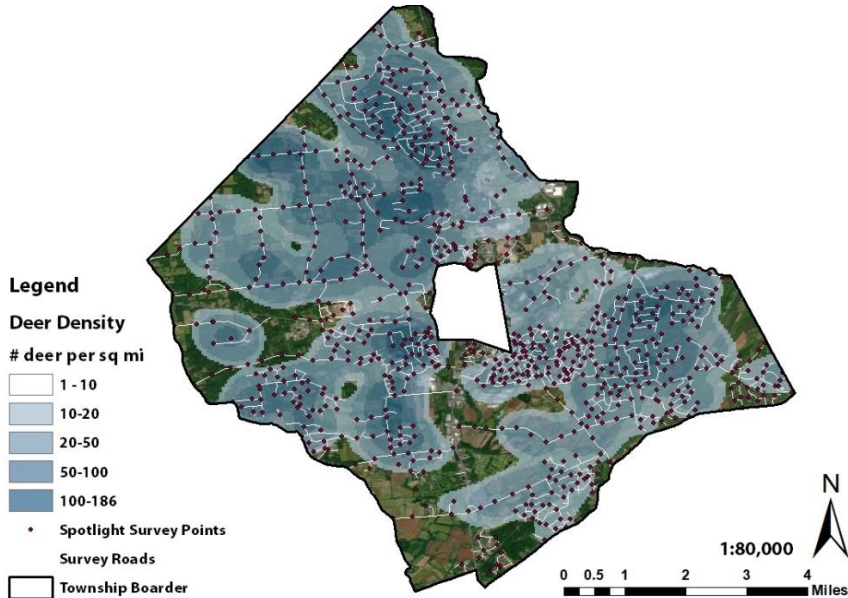
RVCC Spotlight Surveys 2015-2018

Drake et al. (2005) – Duke Farms

Comparable results of spotlight and infrared

Kelly (2017) and Vision Air Research (2017)

Watchung Borough





Spotlight Surveys –

Limited to deer visible from road

Problem:

deer density varies in relation to landscape contexts

road density varies in relation to those landscape contexts

visibility varies by landscape contexts, vehicle, observer, etc.

Plot-Based Sampling

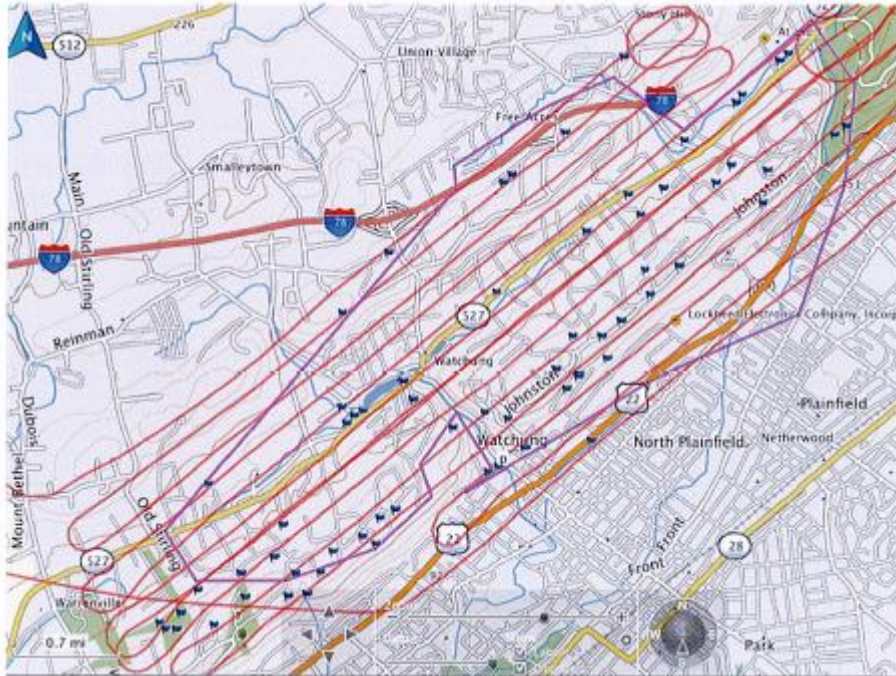
Distance Sampling

Average = 31% of Mean!!!

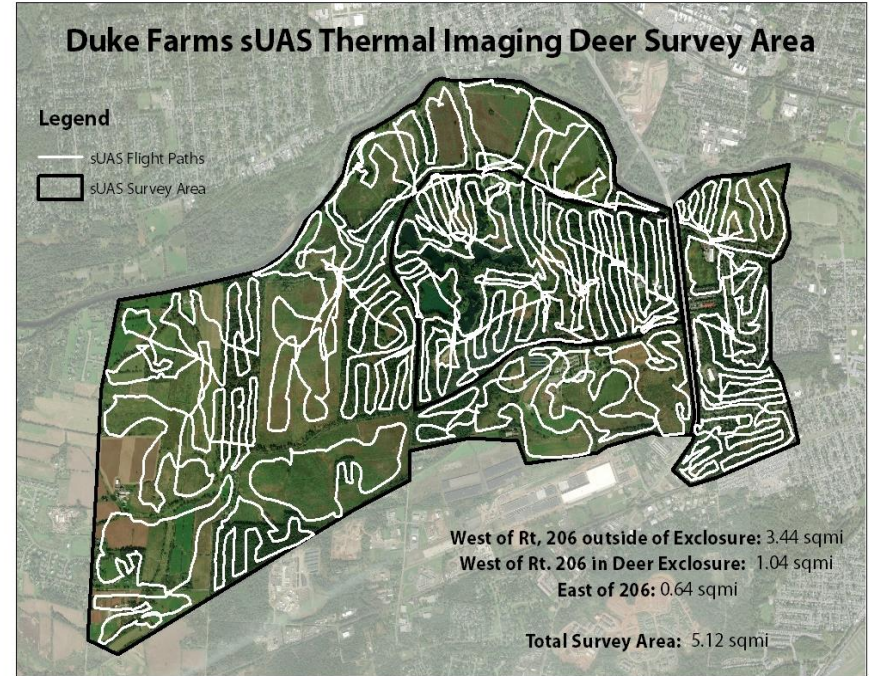
Location	Year	Density	Range	Standard Deviation as % Mean
Watchung	2019	61±15	(47-76)	25%
	2018	41±12	(29-53)	29%
Raritan	2019	112±13	(99-124)	12%
	2018	81±13	(68-95)	16%
Readington	2019	132±39	(93-170)	30%
Princeton	2015	36±11	(27-48)	31%
(deNicola	2014	45±17	(31-65)	38%
Unpubl.data)	2011	39±27	(20-74)	69%

Complete Spatial Coverage – Fixed Wing vs. Drone

Watchung Borough (Vision Air Research 2017)



Duke Farms (RVCC 2020)



Comparison of Deer Survey Methods

Complete Coverage

- **Aerial surveys** (Helicopter) – $\leq 80\%$ accurate, \$\$\$
- **Infrared Aerial Surveys** (Fixed-wing Aircraft) – $\leq 90\%$, \$\$\$
- **Infrared sUAS Surveys** (Drone) – 95-100% accurate, \$-\$\$

Sampling

- **Spotlight Surveys** – 31-88% accurate, highly variable, \$
- **Fecal Pellets** – high variability, temperature dependent, \$
- **Trail Cameras** – high variability, error/double-counting, \$\$

Comparison of Infrared Methods - Fixed Wing vs. Drone



https://youtu.be/2H_JUae06ho

Duke Farms 2020	Duke Boundaries			Overall Search Area		
	# Deer – Aircraft	# Deer – Drone	% Dif.	# Deer – Aircraft	# Deer – Drone	% Dif.
Outside Enclosure (<i>Low Density Veg.</i>)	157	167	-6%	184	191	-4%
Inside Enclosure (<i>High Density Veg.</i>)	20	27	-26%	20	27	-26%
Outside Enclosure (<i>High Density Veg.</i>)	14	17	-18%	44	58	-24%
TOTAL	191	211	-9%	248	276	-9%

2019-2021 RVCC Infrared Drone Deer Surveys

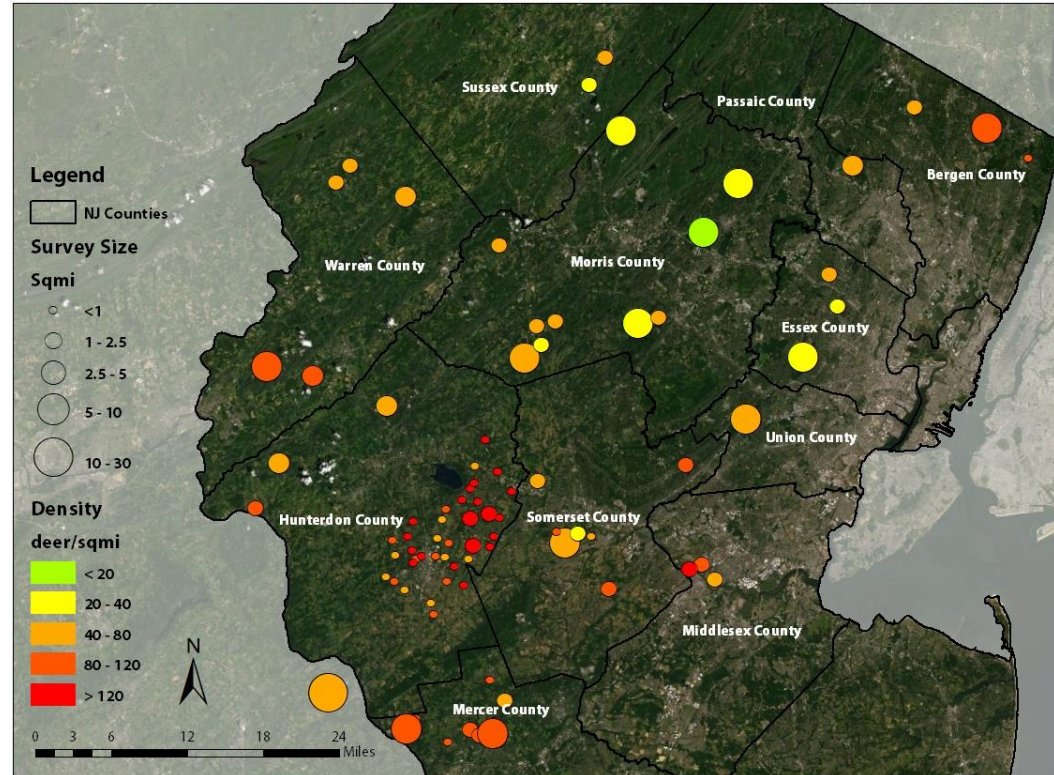
97 Towns/Preserves

106,677 acres

(165 mi²)

Avg. Density =

70 deer/mi²



Infrared Deer Surveys in Solebury in 2021

Methods:

Consecutive Nights

(March 2-3, 6-11, 2021)



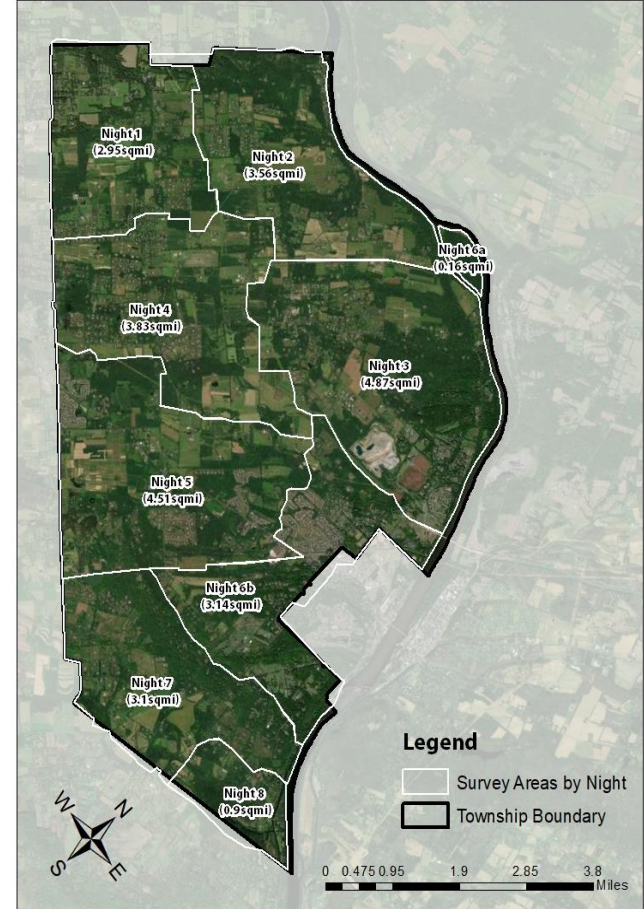
Weather Conditions

(No Precip, Winds <15 mph)

FAA Remote Pilot License (w/Waivers for Night-time Operations, Certified Visual Observers)

Autel Evo II Dual Drone, w/FLIR 640 Thermal Sensor

Class G Airspace, <400' Above Ground



Deer Surveys in Solebury in 2021

Methods:

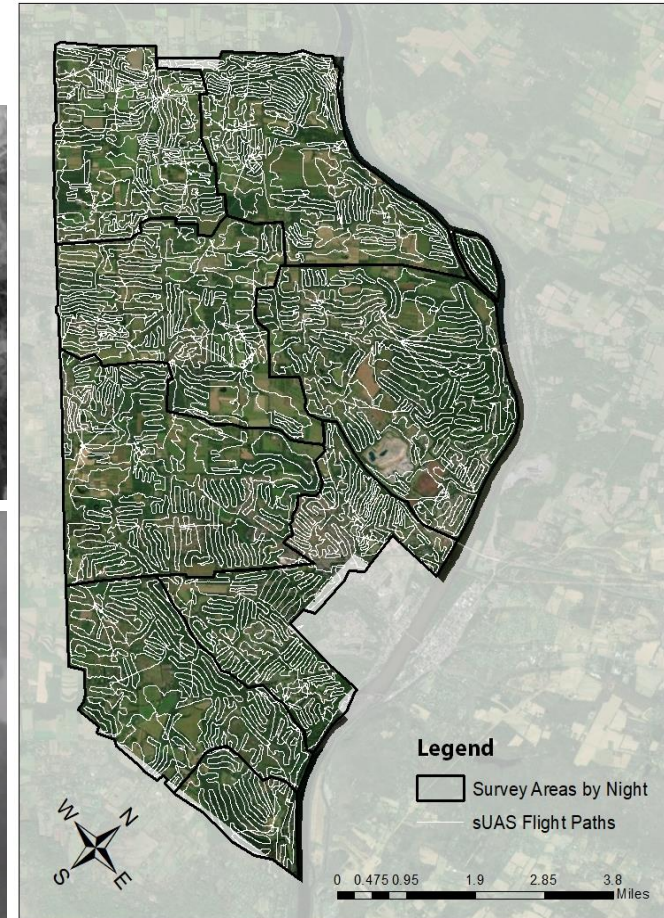
**Location/# Deer recorded
in real-time**

(ArcCollector App)

Survey width varies by
Visibility/cover

Methods optimized for
accuracy and to minimize
double-counting

**Data processed in
ArcMap (ArcGIS 10.0)**



Results of Deer Surveys in Solebury in 2021

Results:

2,054 deer

27.02 mi² area

= **76 deer/mi²**

(67-175 deer/mi²
per night)

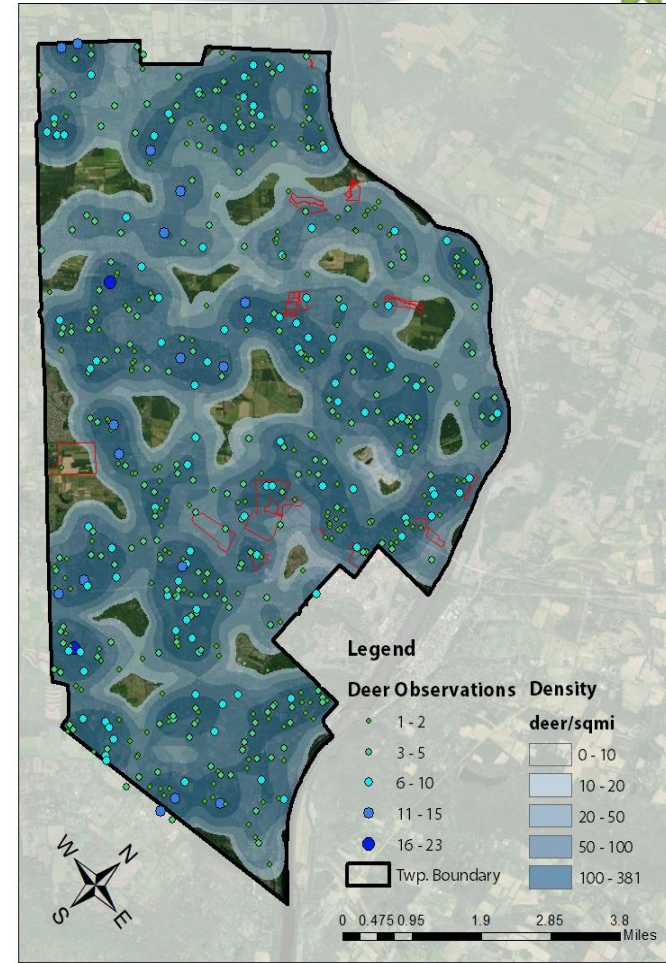
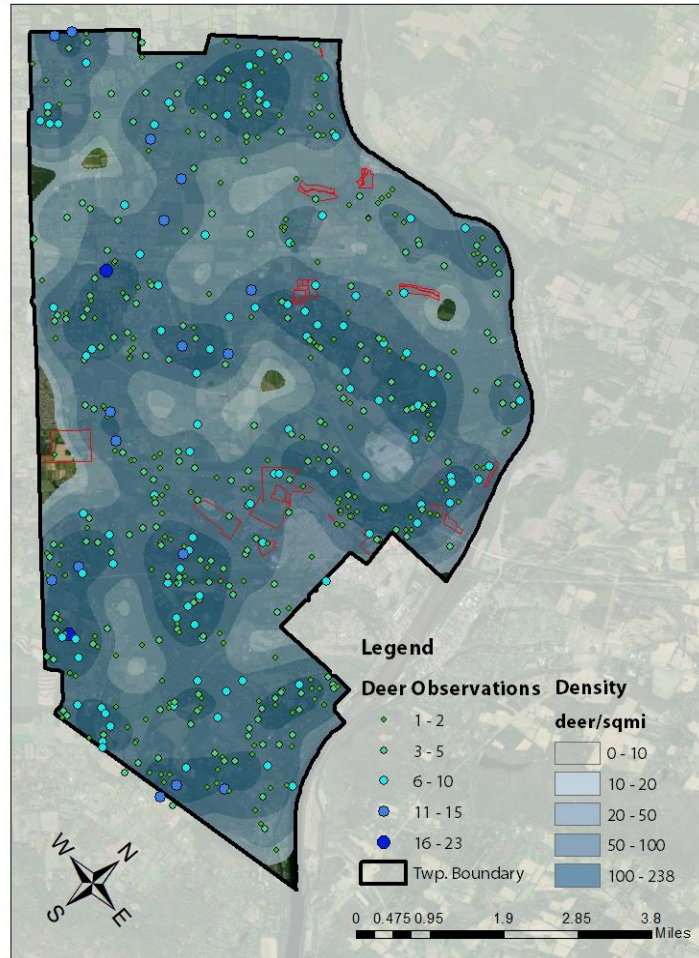
Local Densities

Up to 238-381

deer/mi²

89-98% of town

>10/mi²





Deer Population Benchmarks – *Thresholds for Ecological Impacts*

>10 deer/mi²

Impact preferred
browse species

>20 deer/mi²

Impacts to forest
understories, wildlife

>100 deer/mi²

Without deer
management

Historic: **8-11 deer/mi²**



Healthy forest with dense understory vegetation and native plant species.

Present: **70 deer/mi² (17-136)**

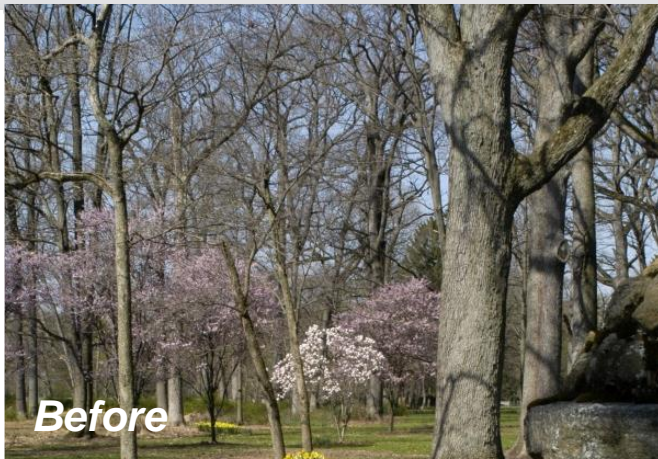
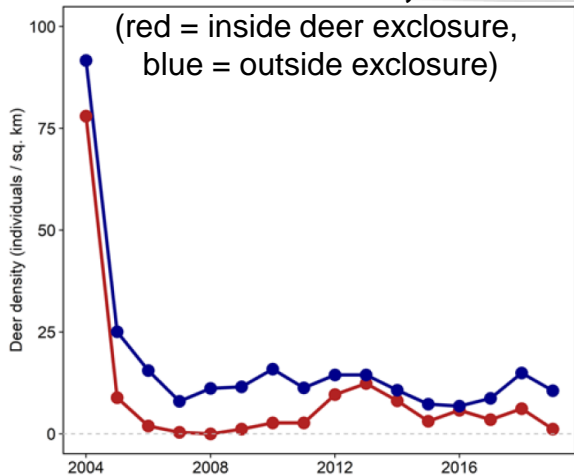


Overbrowsed forest at Hutcheson Memorial Forest in Franklin Township (2012)



Overbrowsed forest with invasive barberry shrubs at Peter's Tract in Bernardsville (2016)

Duke Farms, NJ



		Deer Population and Management Goals (T. Almendinger, Unpublished Data)							
Population after management	Avg. winter mortality rate (5%)	Breeding female = approx. 40% of total pop.	State reproductive rates 1997= (1.42 for yearling ♀ & 1.78 for adult ♀), average of 1.6 per doe	Average survivability (of fawns)	Population of adults and yearlings + the addition fawns	Reduction goal 40%	Reduction goal 50%	Reduction goal 60%	Reduction goal 70%
column D - harvest total	Pop.- (Pop.* 0.05)	Population * 0.4=	# of breeding age ♀ * 1.6=	# Fawns* 0.75	New population total =	j4 x .4=	j4 x .5=	j4 x .6=	j4 x .7=
2054	1951.3	780.52	1248.832	936.624	2887.924	1155.17	1443.962	1732.754	2021.547

Recommendations for Deer Management

- Setting Deer Management Goals
- Tools for Deer Management
 - Management Hunting on Township-Owned/Other Lands
 - Depredation Permits on Agricultural Lands
 - Enhanced Results via Deer Drives and/or Sharpshooting
- Data Collection
 - Deer Population - Harvest Results, Annual Surveys, Other Stats
 - Indicators – Forest Monitoring, Collisions, Ag. Damages, Lyme's



Costs and Effectiveness of Deer Management Methods

Recreational Hunting (Private Clubs/Permit) –

Revenue-positive/low cost but Less effective

Sharpshooters –

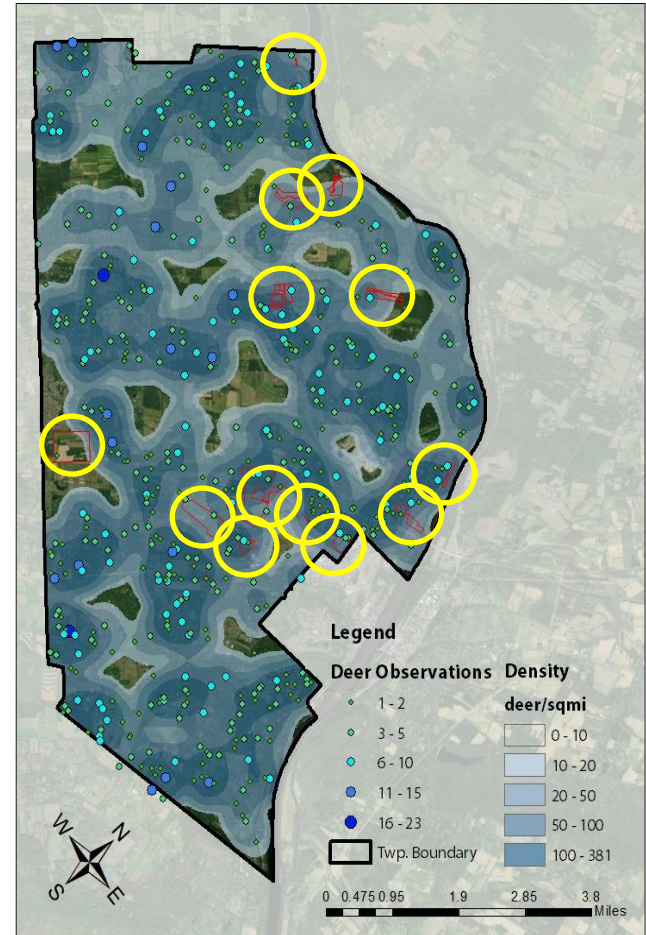
High-cost (\$208-292/deer) but Very effective

Management Hunting –

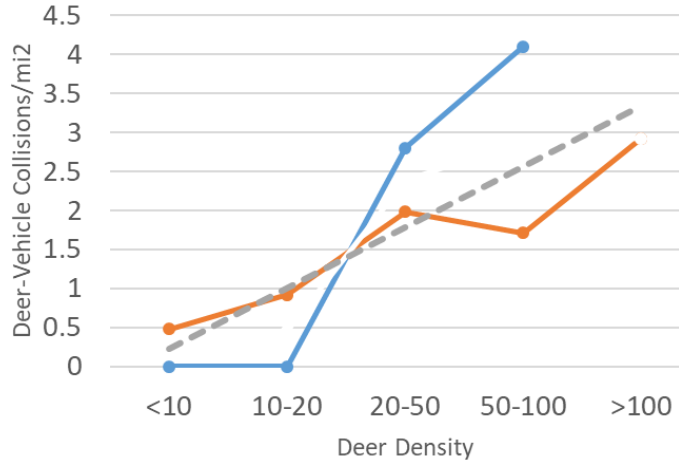
Low cost (\$30-50/deer) and Very effective

Non-lethal Methods (Contraceptives) –

High-cost (\$430-1,100/deer) and Ineffective/experimental



Data Collection: Deer-Vehicle Collisions



Average \$4,000 vehicle damage per reported collision
(State Farm Insurance 2018)

Princeton reduced population by 60%,
and collisions declined by
the same amount that year
(Williams et al. 2013)

River Vale sUAS Heat Map



Deer Collision and Road Based Spotlight Survey Density in Raritan Township

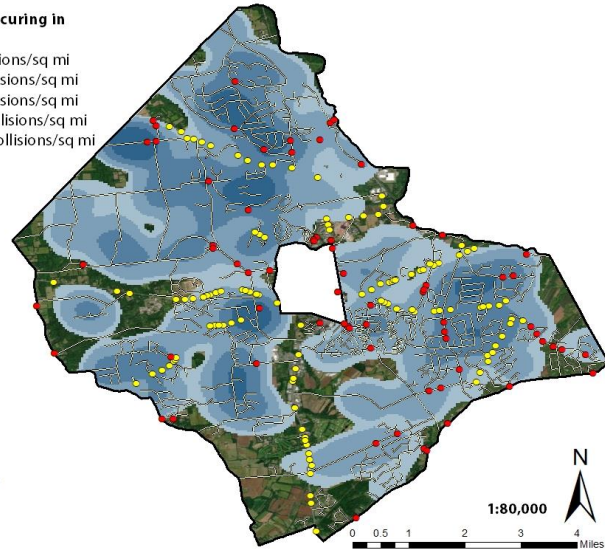
Deer Collision Density Occuring in Each Deer Density Range
 1-10 deer/sq mi: 1.14 collisions/sq mi
 10-20 deer/sq mi: 3.54 collisions/sq mi
 20-50 deer/sq mi: 5.24 collisions/sq mi
 50-100 deer/sq mi: 5.12 collisions/sq mi
 100-186 deer/sq mi: 3.39 collisions/sq mi

note that all deer collisions are included in this summary

Legend
 Density Calculated from Road Survey Observations

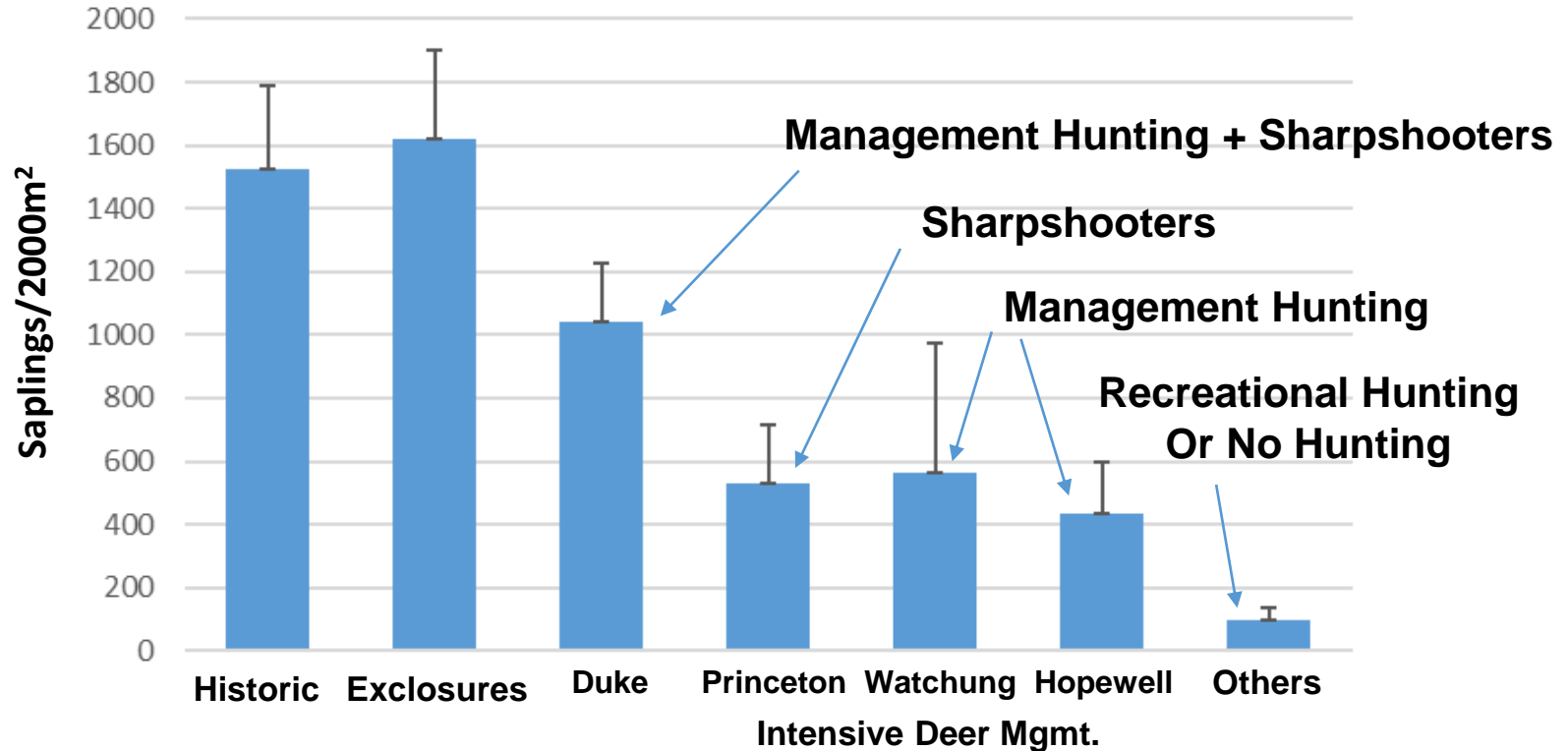
- 1 - 10
- 10-20
- 20-50
- 50-100
- 100-186

- Deer Collisions**
- occurring on survey roads
 - not occurring on survey roads
 - Roads Surveyed
 - ▭ Township Boundary





Data Collection: *Forest Monitoring/Ecosystem Health*





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Thanks!!!

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