Volunteer Geographic Information: How Crowdsourced Data is Helping to Map the Spread of Brown Marmorated Stink Bug

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Rutgers University

Background

- Brown marmorated stink bug (*Halyomorpha halys*)
  - Major agricultural pest
  - Nuisance pest
- **Citizen science/crowd-sourced data**
- Mapping

Boucher's Birding Blog: Apps for the Smart Birder — Which One Should You Use?

MAY 27, 2013 | by: Timothy Boucher | 65

Salmon Cam Returns

We're pleased to return Salmon Cam, a live view of spawning Chinook and coho salmon and steelhead trout.

What is Cool Green Science?

noun **1.** Blog where Nature Conservancy scientists, science writers and external experts discuss and debate how conservation can meet the challenges of a 9 billion + planet.

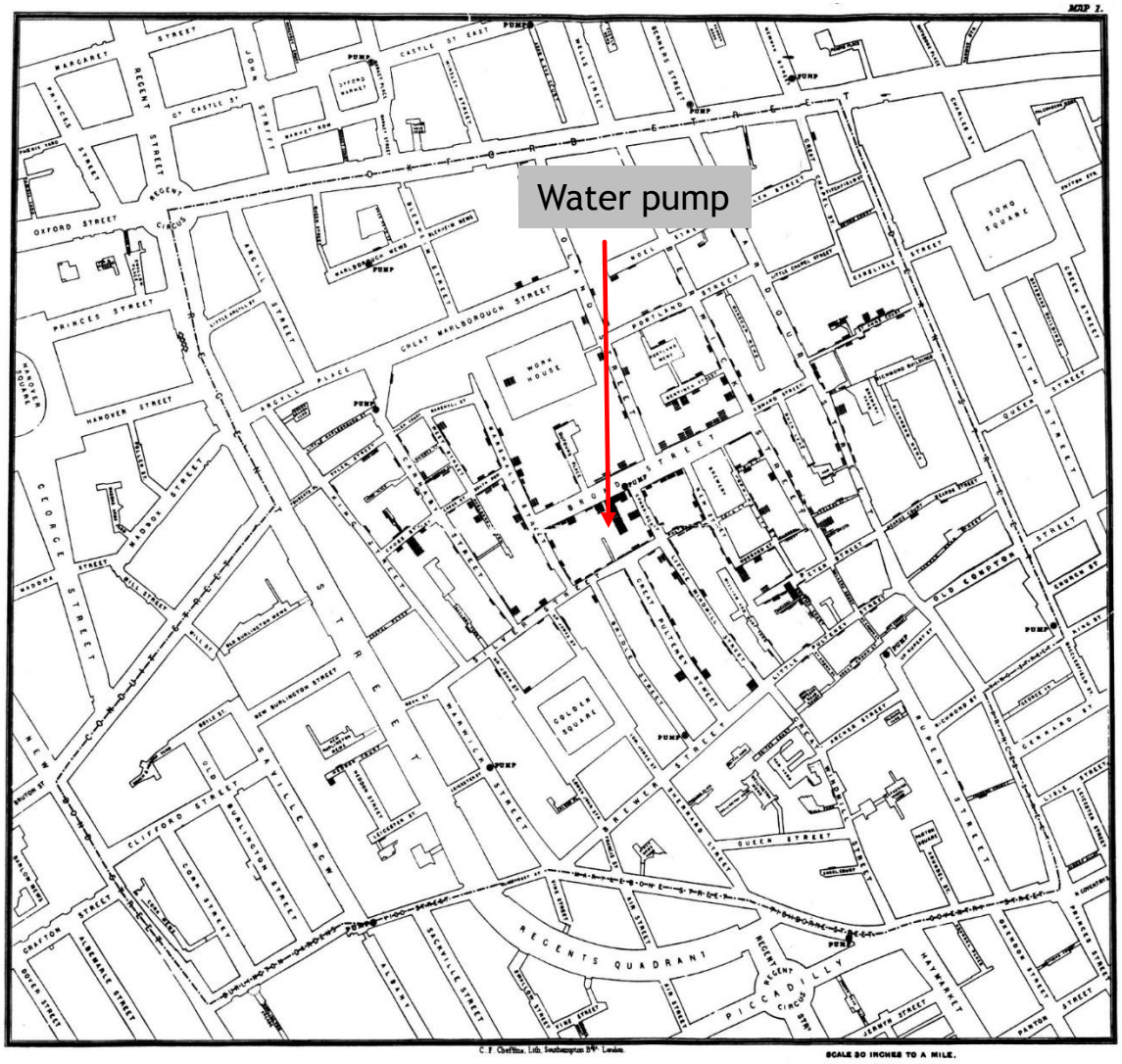
2. Blog with astonishing photos, videos and dispatches of Nature Conservancy science in the field.

3. Home of Weird Nature, The Cooler, Quick Study, Traveling Naturalist and other amazing features.

Cool Green Science is managed by **Matt Miller**, the Conservancy's deputy director for science communications, and edited by **Bob Lalasz**, its director of science communications. Email us your feedback.

Background

- Brown marmorated stink bug (*Halyomorpha halys*)
  - Major agricultural pest
  - Nuisance pest
- Citizen science/crowd-sourced data
- **Mapping**

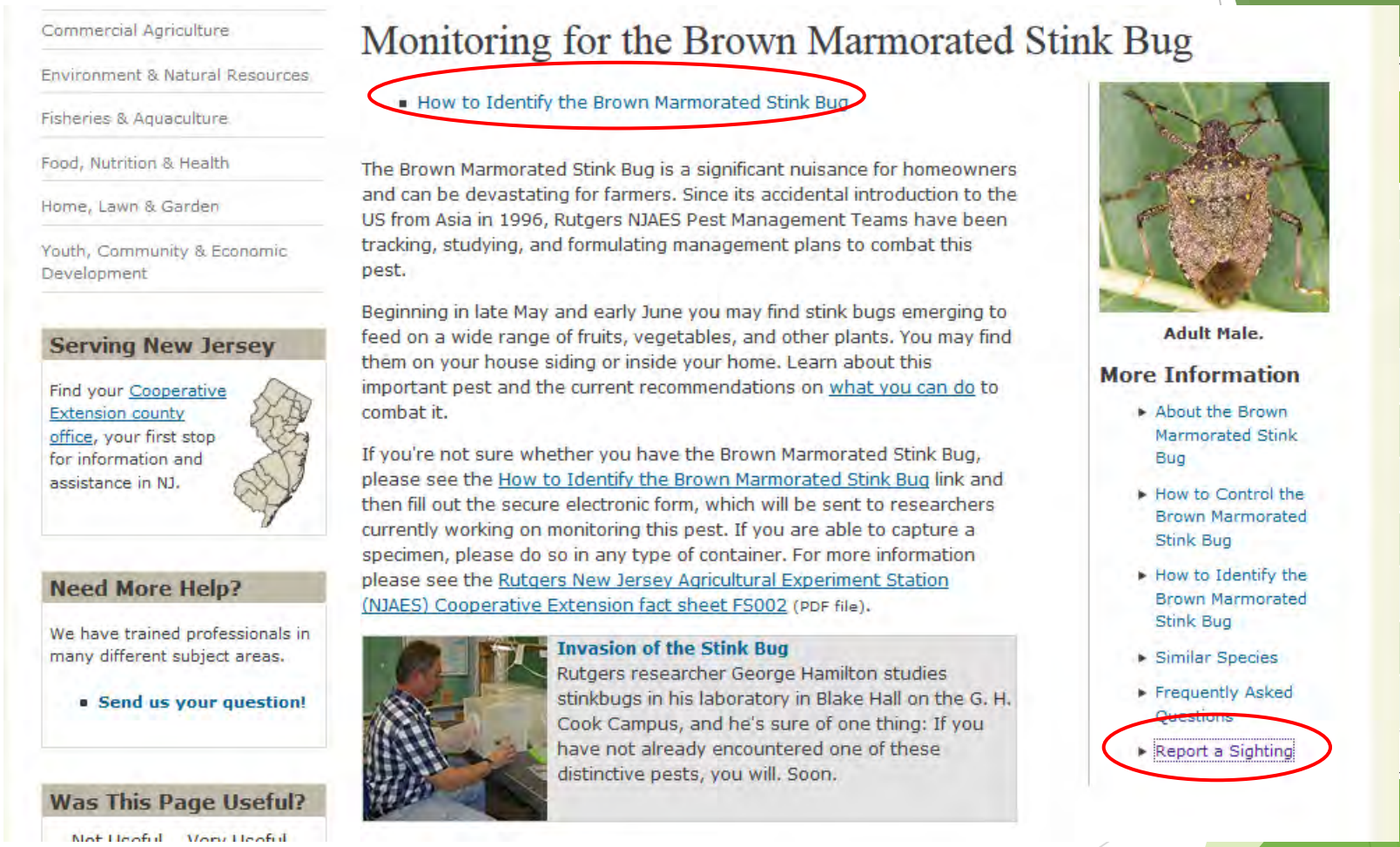


- 1854 Cholera outbreak in Soho district of London
- Physician John Snow

Objectives

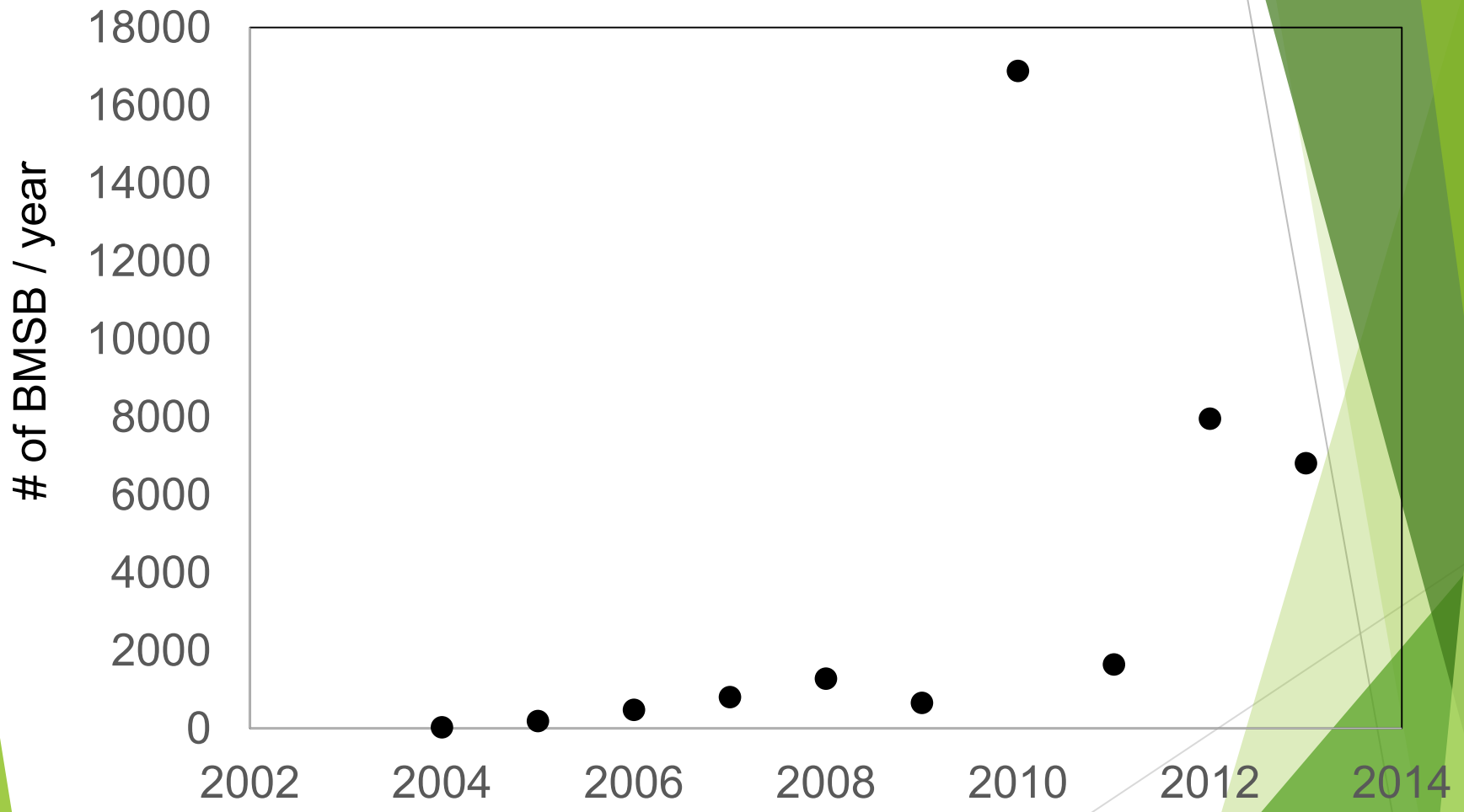
- Utilize mapping to visualize crowd-sourced reports of brown marmorated stink bug (BMSB)
- Map trap capture data of BMSB
- Compare trap capture data to the number of crowd-sourced reports per month

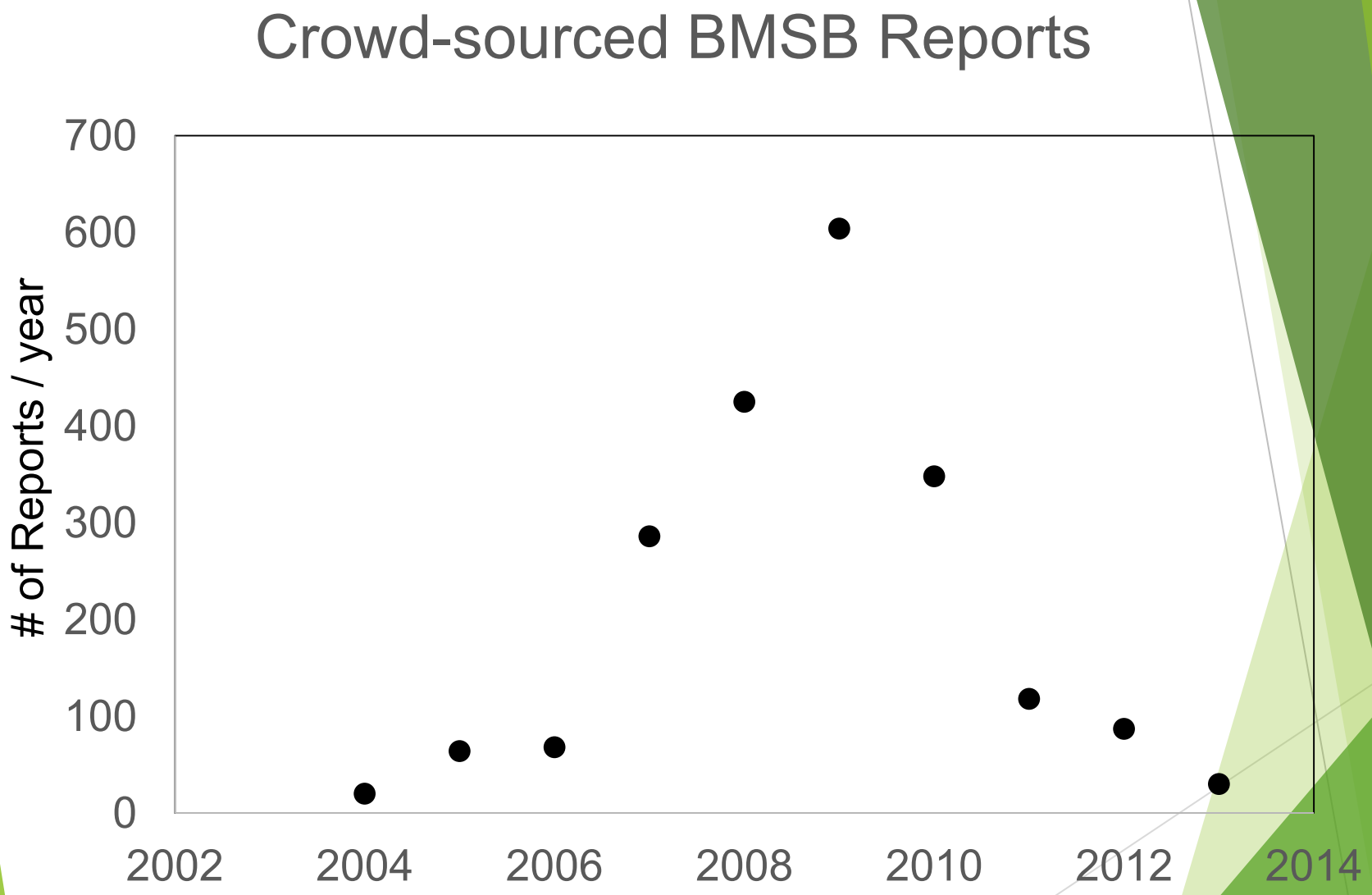
Materials and Methods



- May, August, October
- Point density

Blacklight Trap Captures - BMSB




Crowd-sourced BMSB Reports
# of Reports / year
700
600
500
400
300
200
100
0
2002
2004
2006
2008
2010
2012
2014

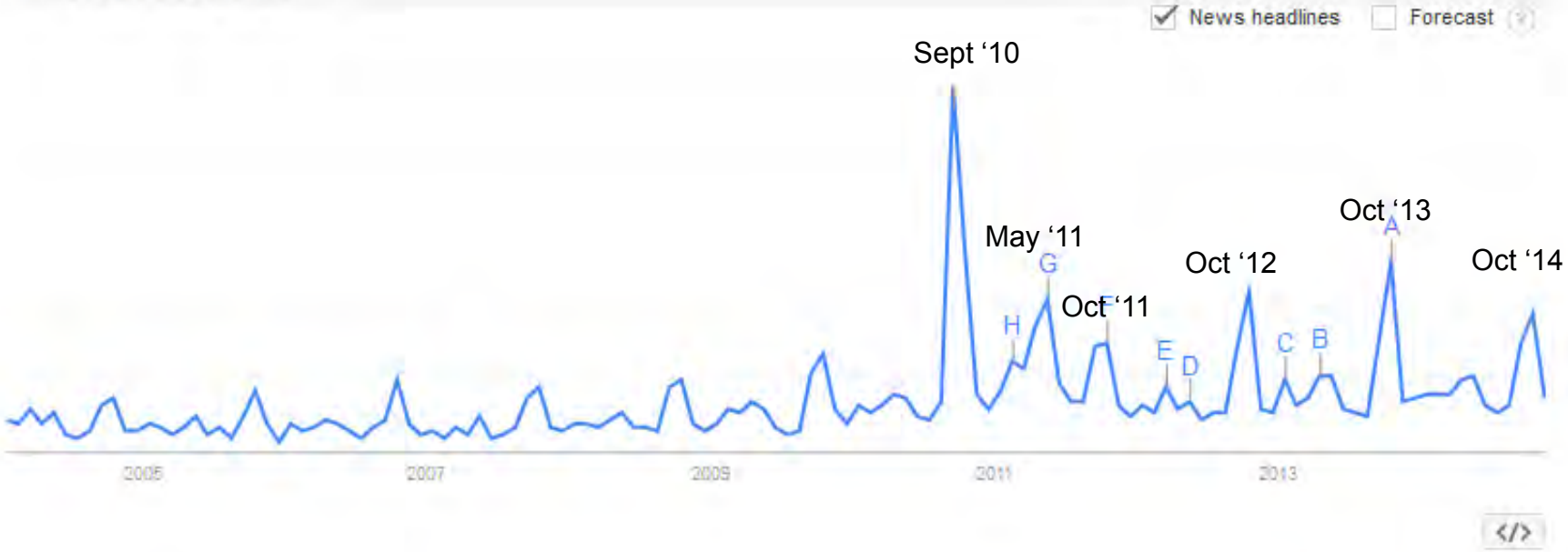
Topics

Subscribe

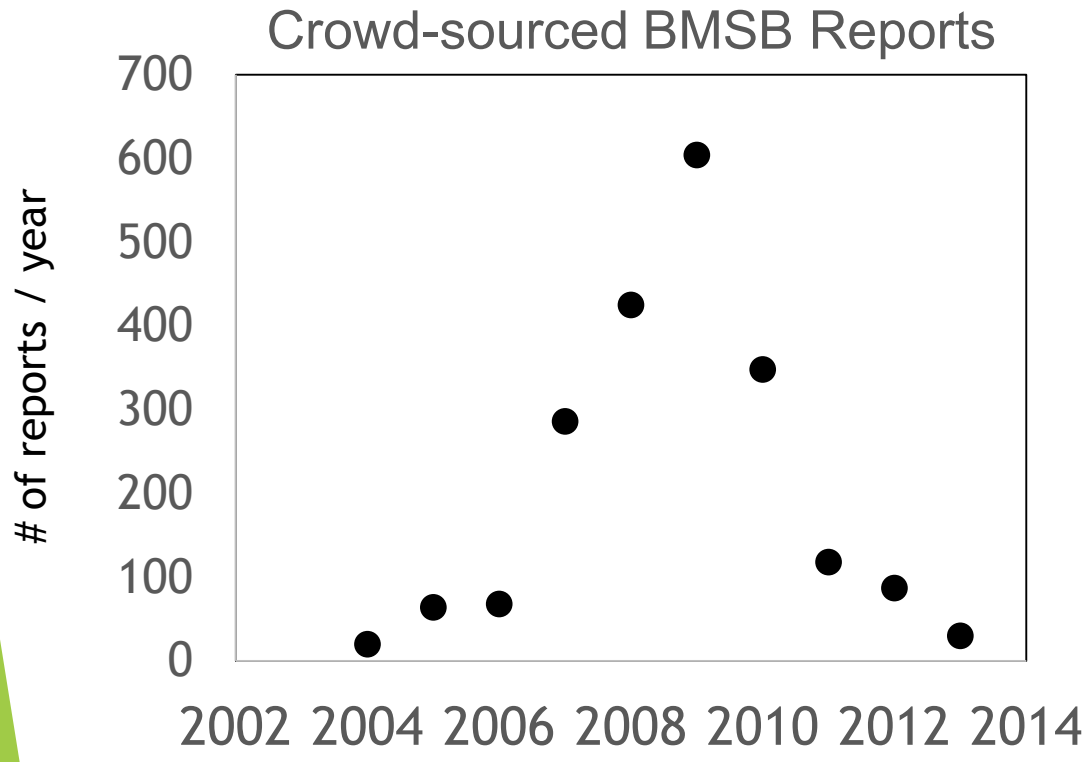
stink bug
Search term

+ Add term

Interest over time

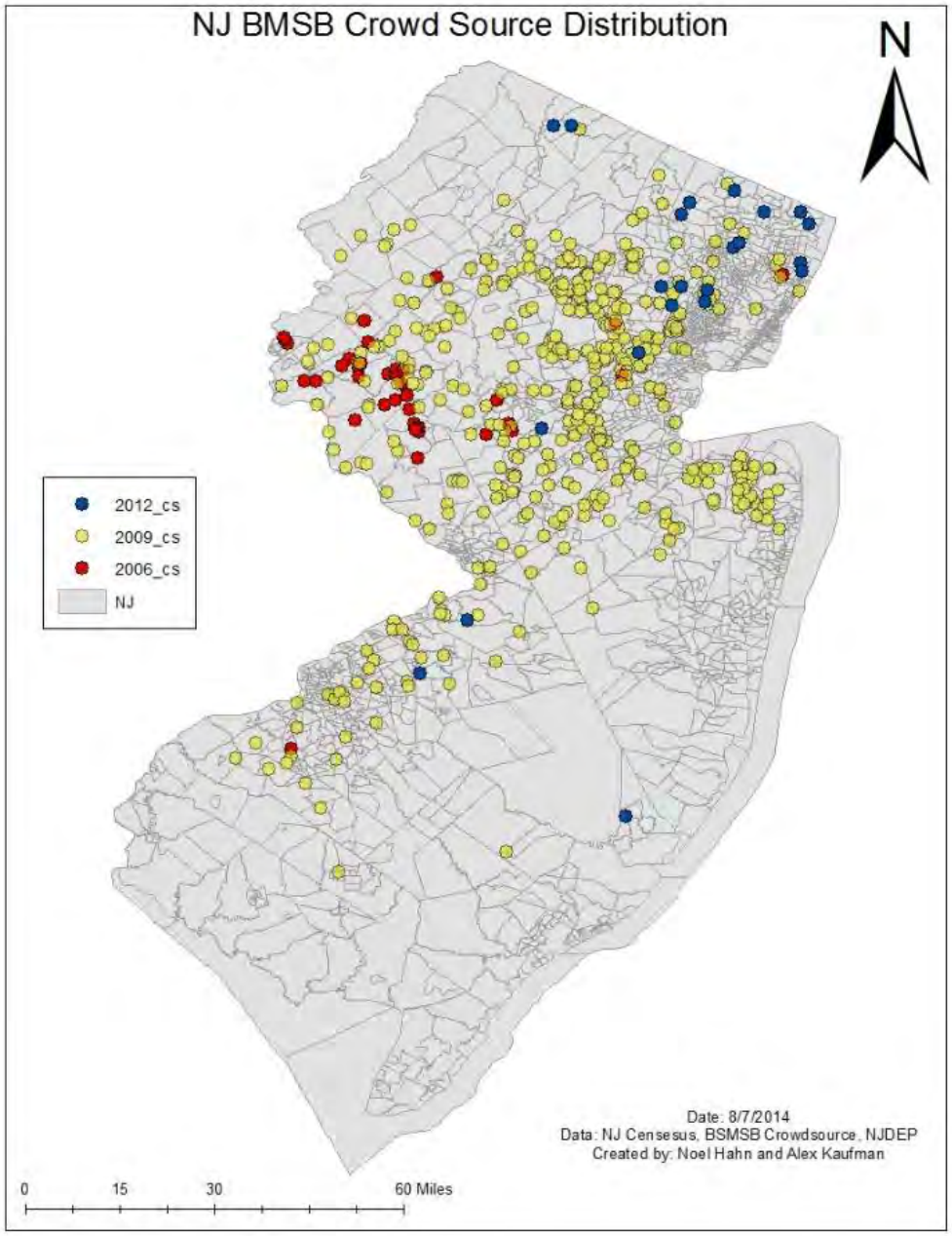


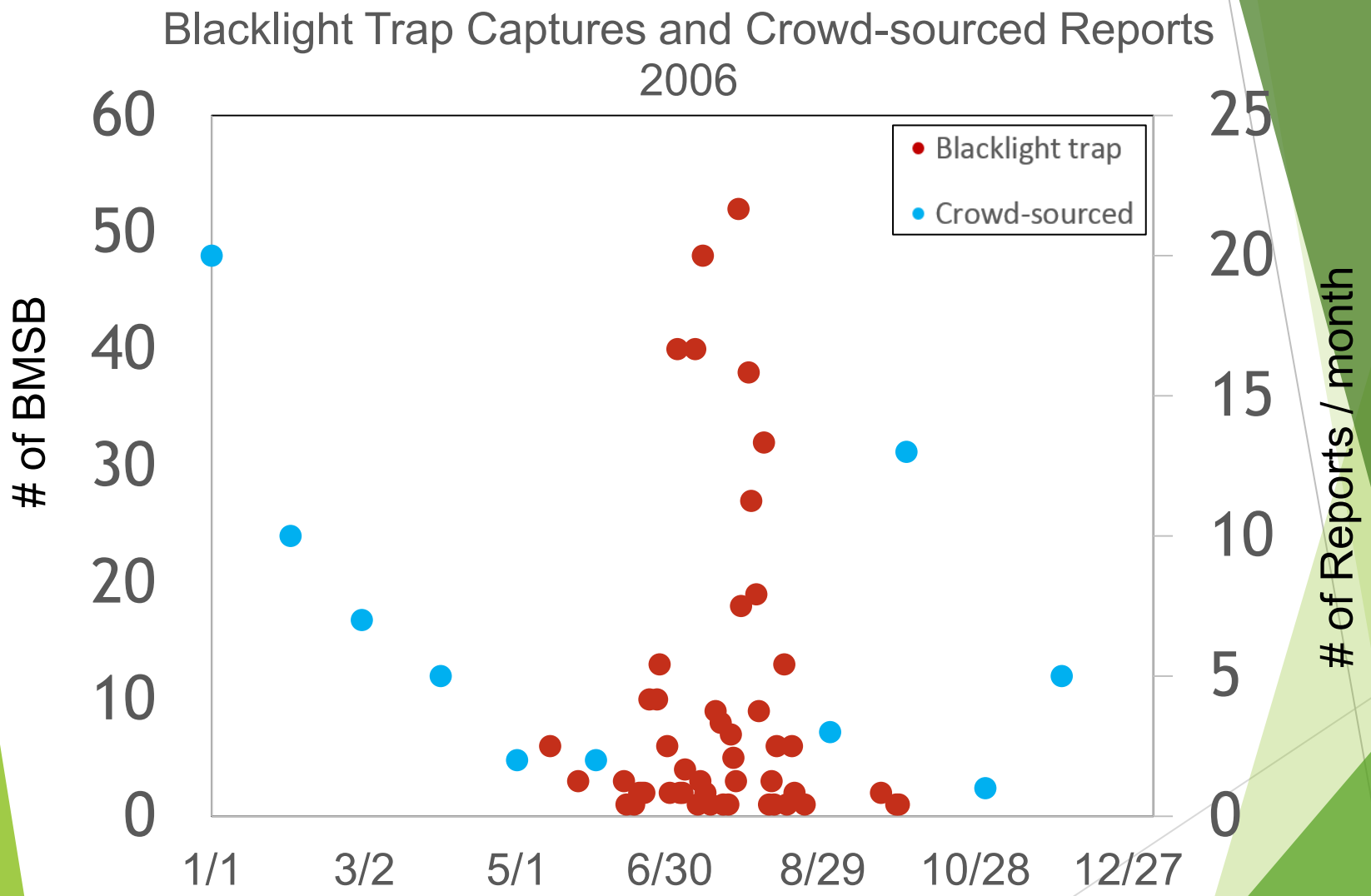
Regional interest

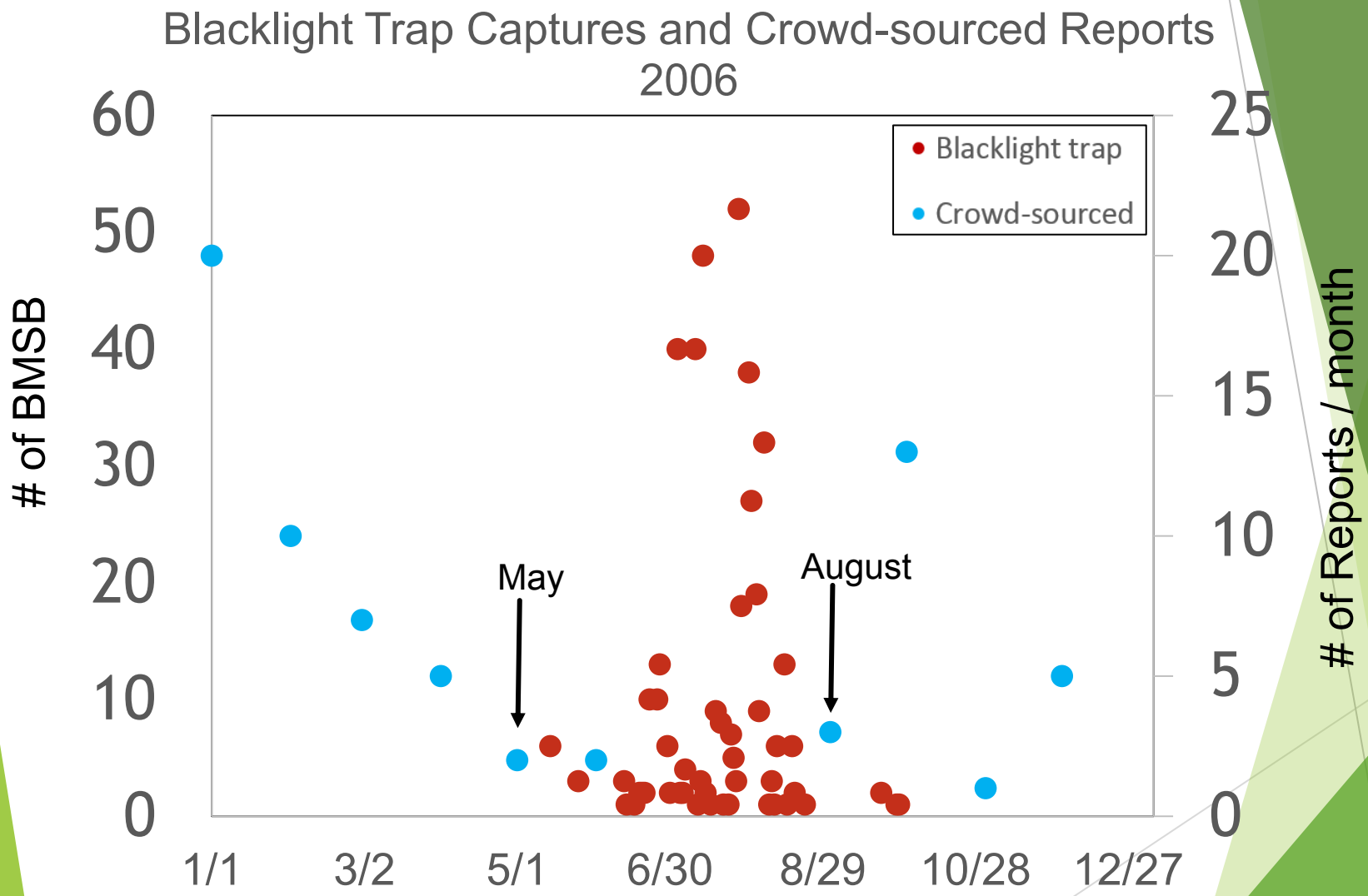

Crowd-sourced BMSB Reports
# of reports / year
700
600
500
400
300
200
100
0
2002 2004 2006 2008 2010 2012 2014

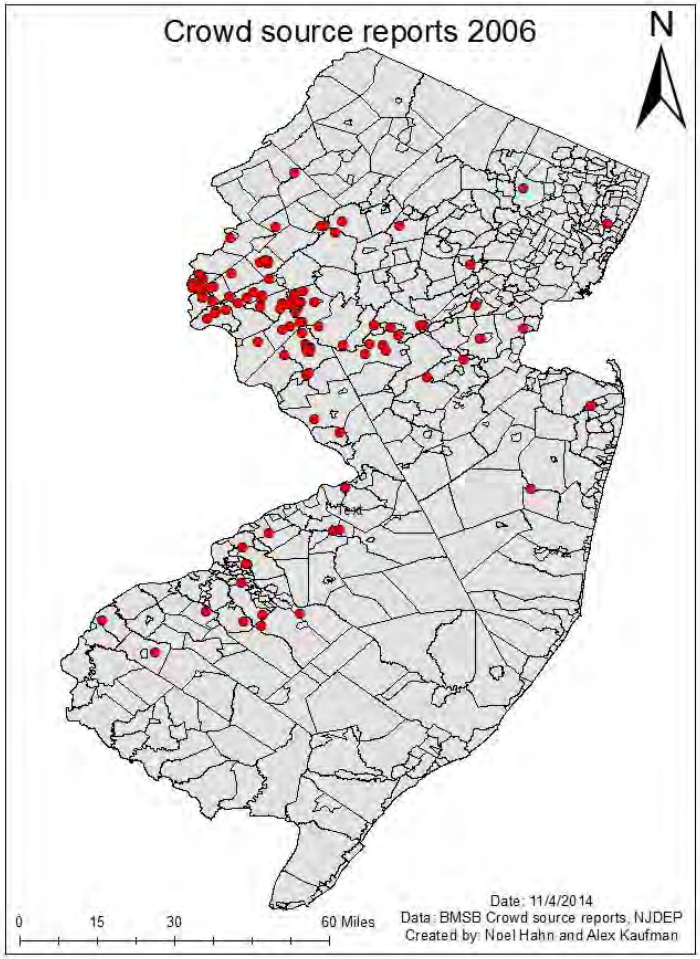
2004

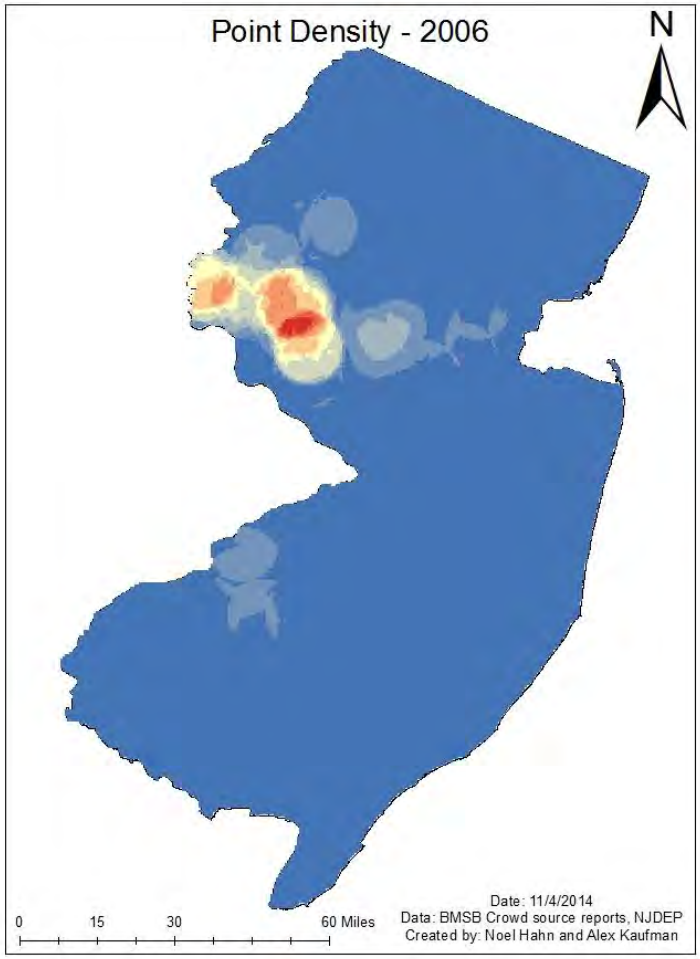
2004

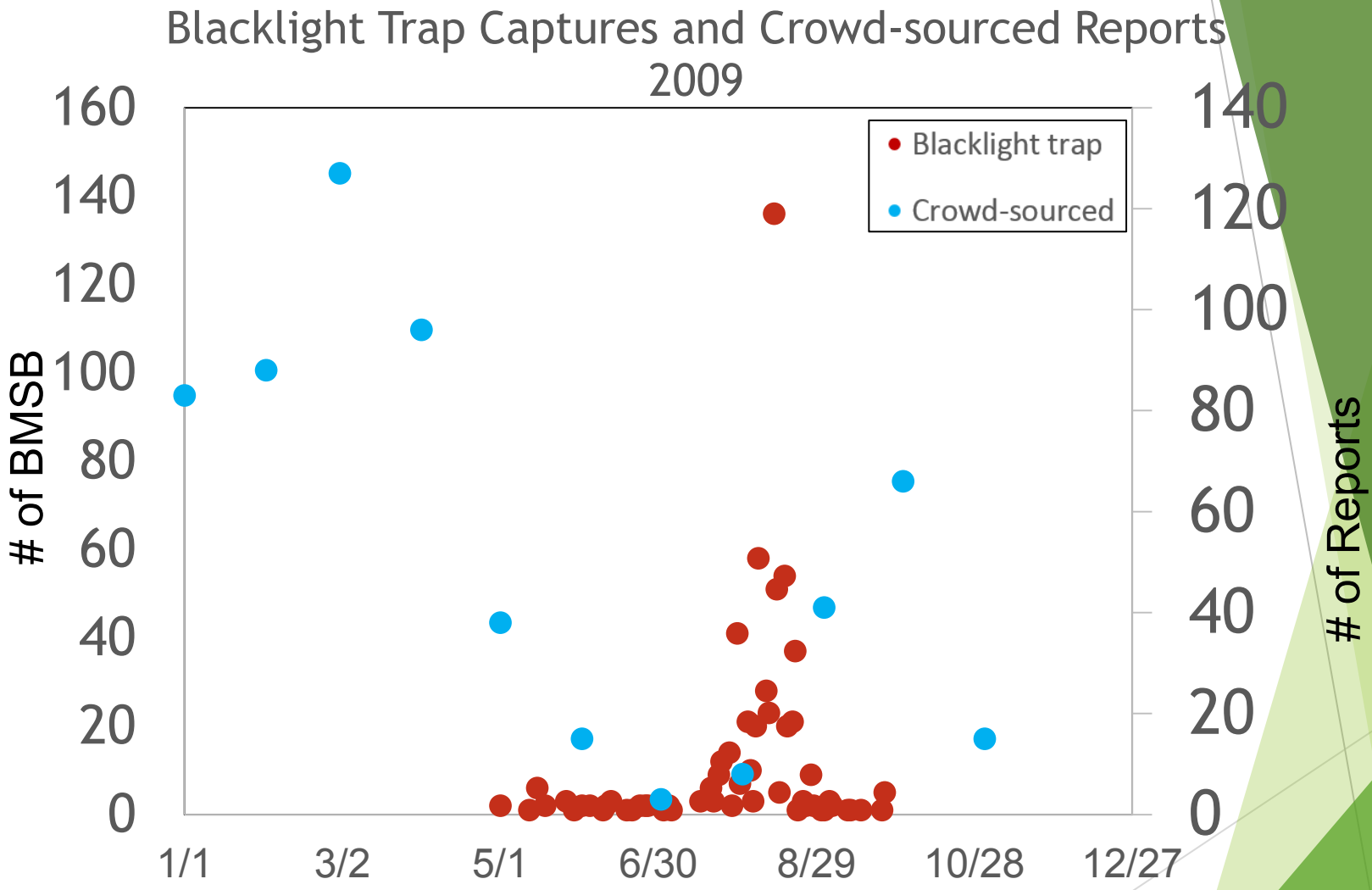

NJ BMSB Crowd Source Distribution
N
2012_cs
2009_cs
2006_cs
NJ
Date: 8/7/2014
Data: NJ Censesus, BSMSB Crowdsource, NJDEP
Created by: Noel Hahn and Alex Kaufman
0
15
30
60 Miles

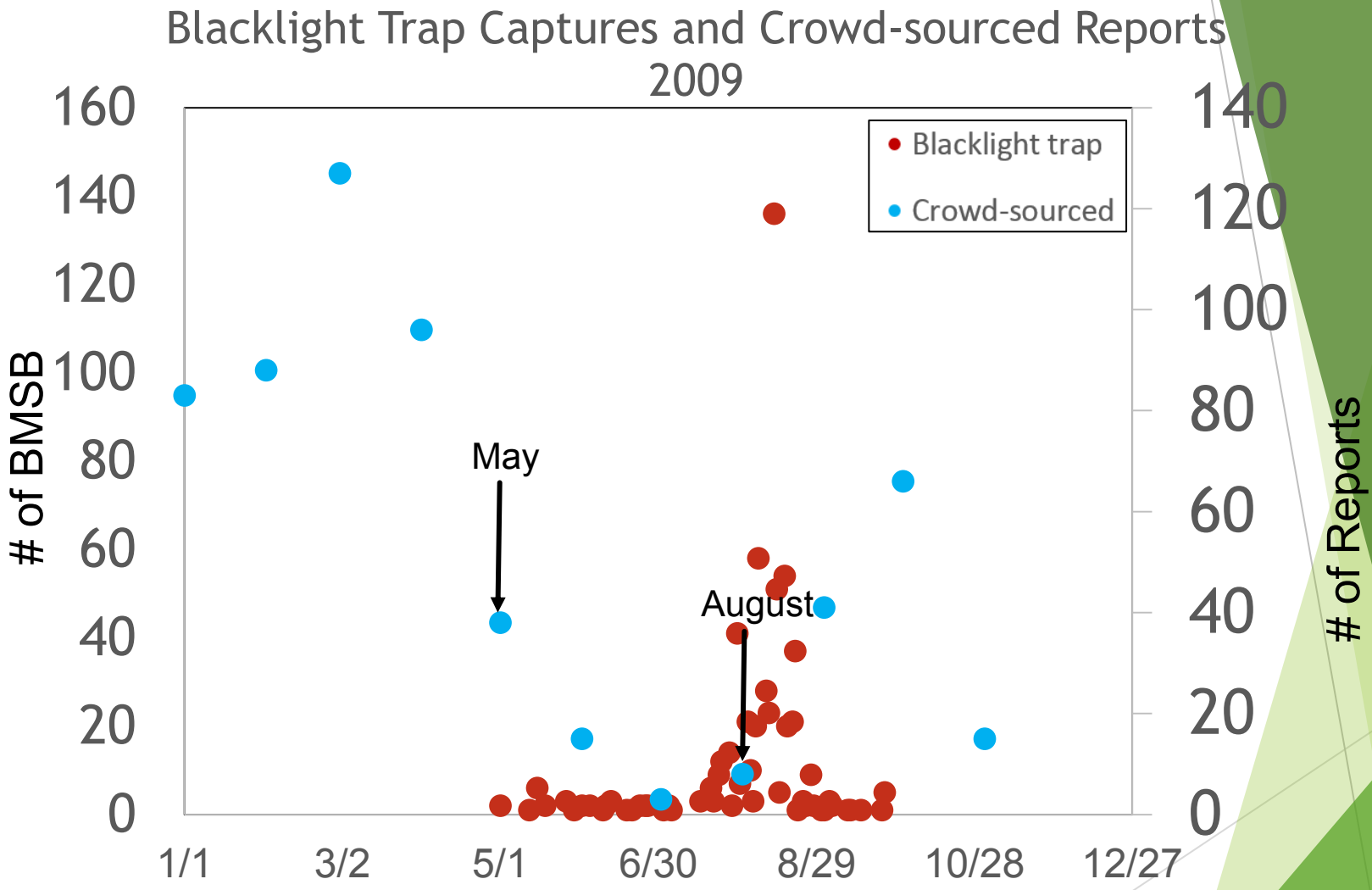

Blacklight Trap Captures and Crowd-sourced Reports
2006
# of BMSB
# of Reports / month
Blacklight trap
Crowd-sourced
60
50
40
30
20
10
0
25
20
15
10
5
0
1/1
3/2
5/1
6/30
8/29
10/28
12/27

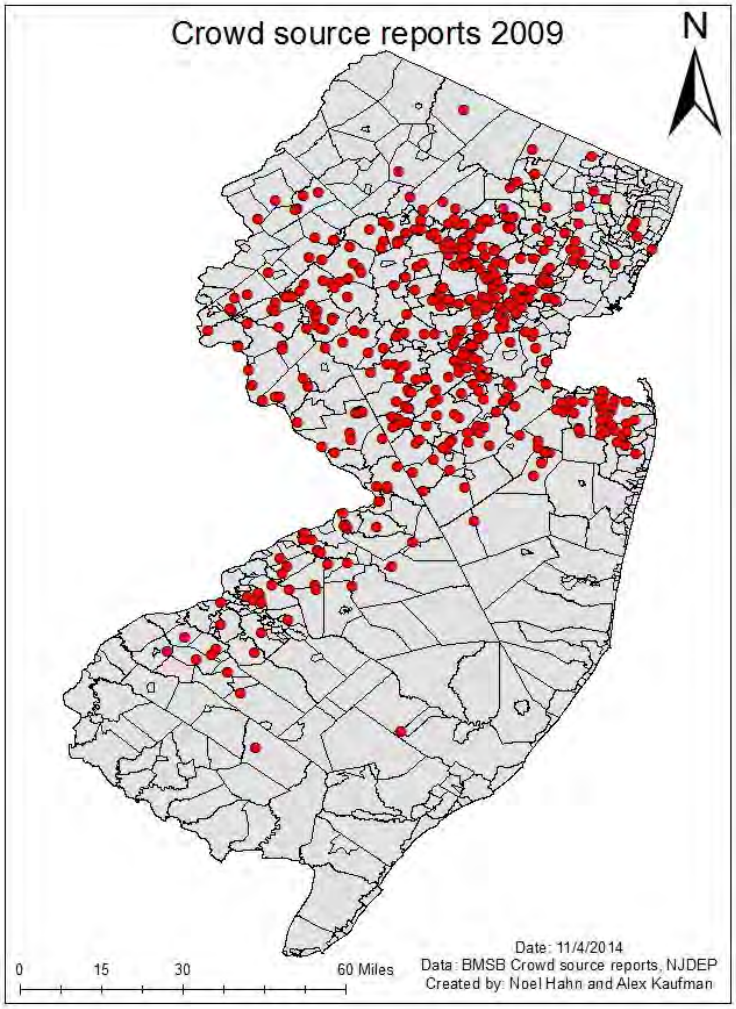

Blacklight Trap Captures and Crowd-sourced Reports
2006
# of BMSB
# of Reports / month
Blacklight trap
Crowd-sourced
May
August
60
50
40
30
20
10
0
25
20
15
10
5
0
1/1
3/2
5/1
6/30
8/29
10/28
12/27

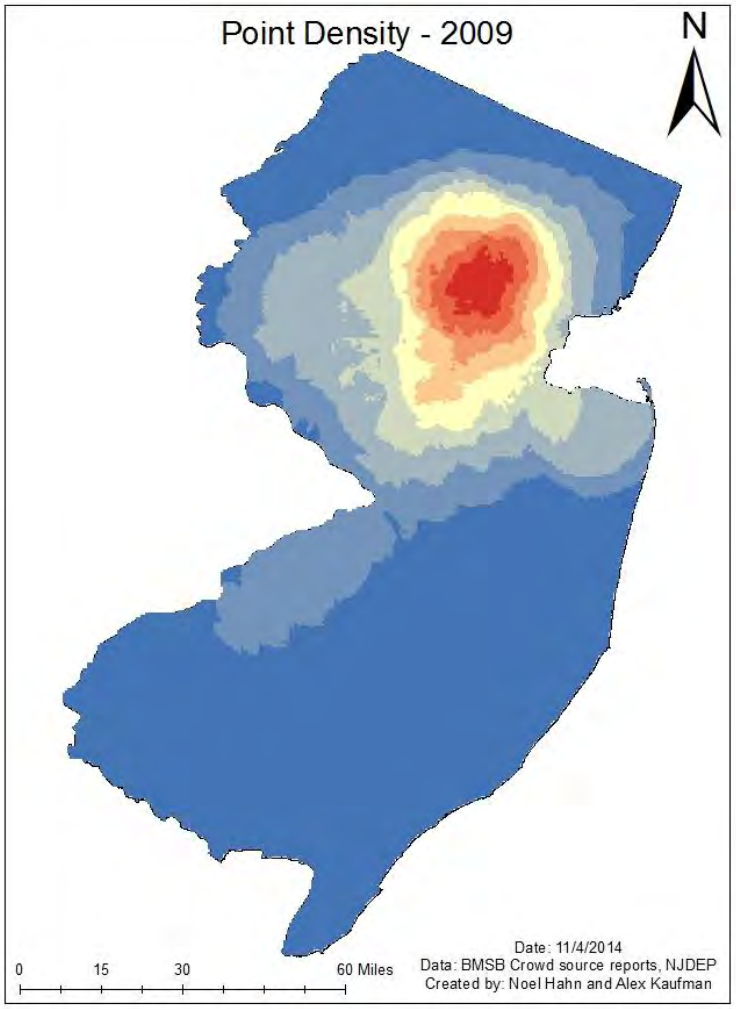

Crowd source reports 2006
N
0
15
30
60 Miles
Date: 11/4/2014
Data: BMSB Crowd source reports, NJDEP
Created by: Noel Hahn and Alex Kaufman

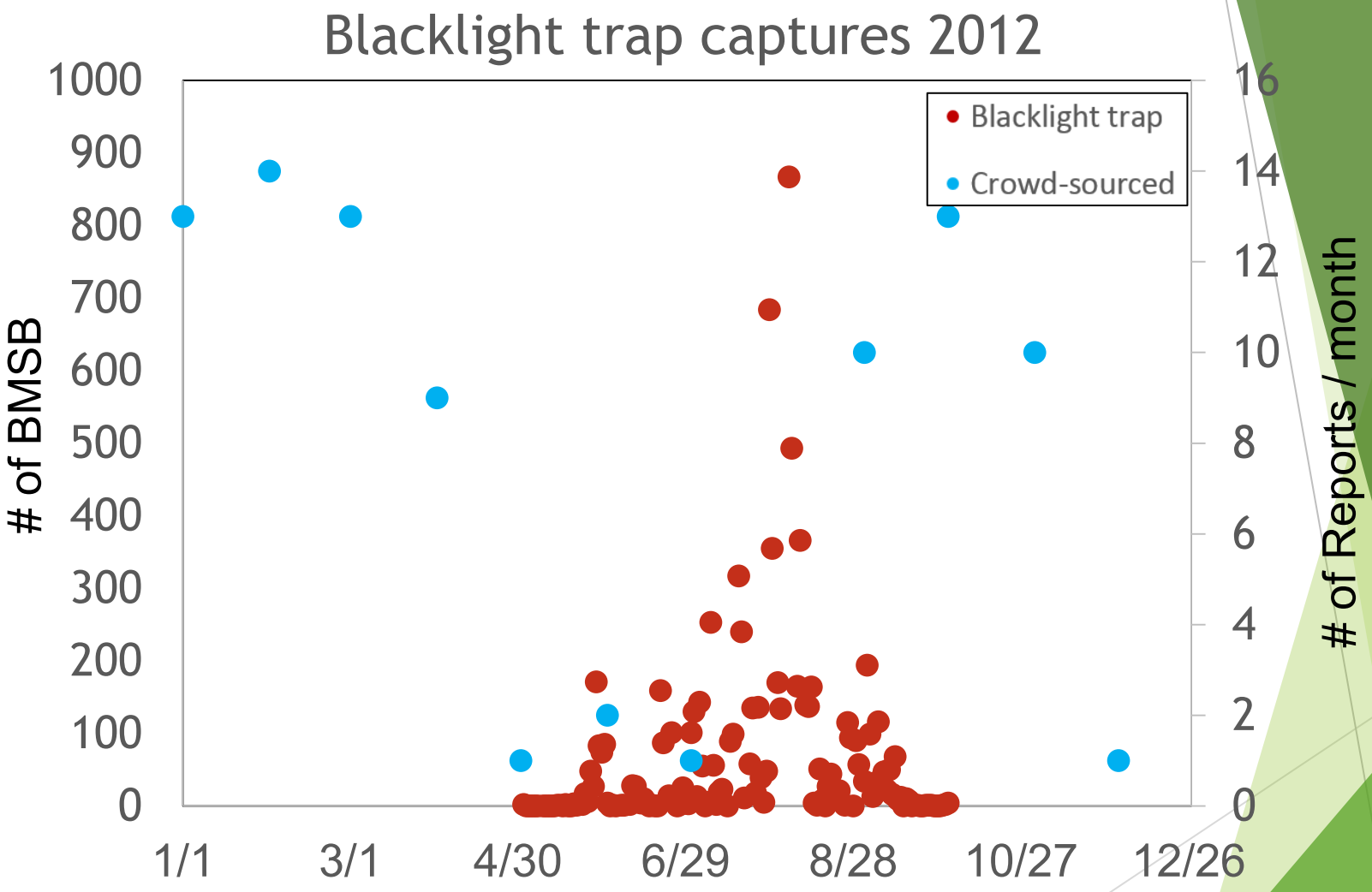

Point Density - 2006
N
0
15
30
60 Miles
Date: 11/4/2014
Data: BMSB Crowd source reports, NJDEP
Created by: Noel Hahn and Alex Kaufman

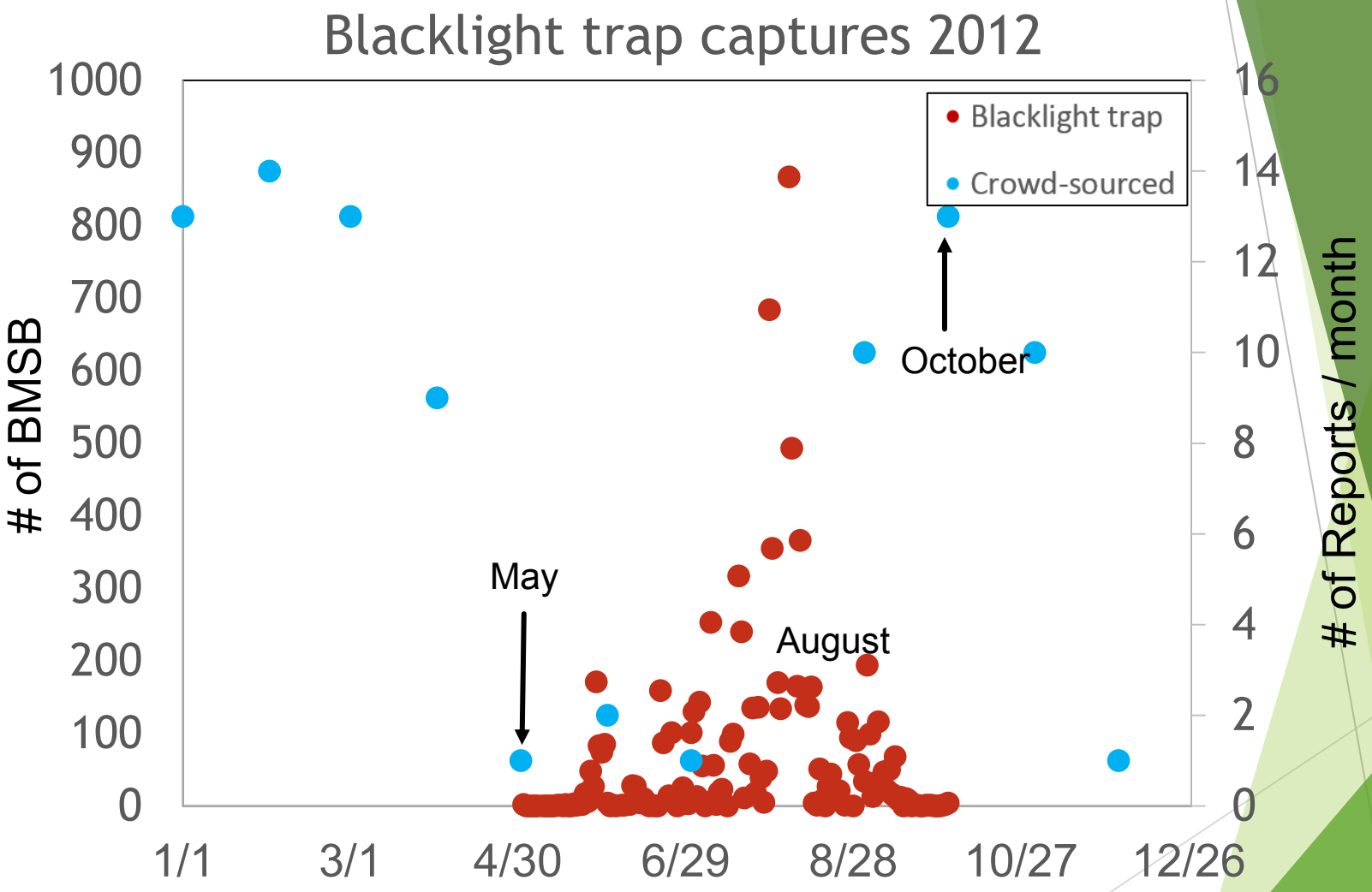

Blacklight Trap Captures and Crowd-sourced Reports
2009
# of BMSB
# of Reports
Blacklight trap
Crowd-sourced
160
140
120
100
80
60
40
20
0
140
120
100
80
60
40
20
0
1/1
3/2
5/1
6/30
8/29
10/28
12/27

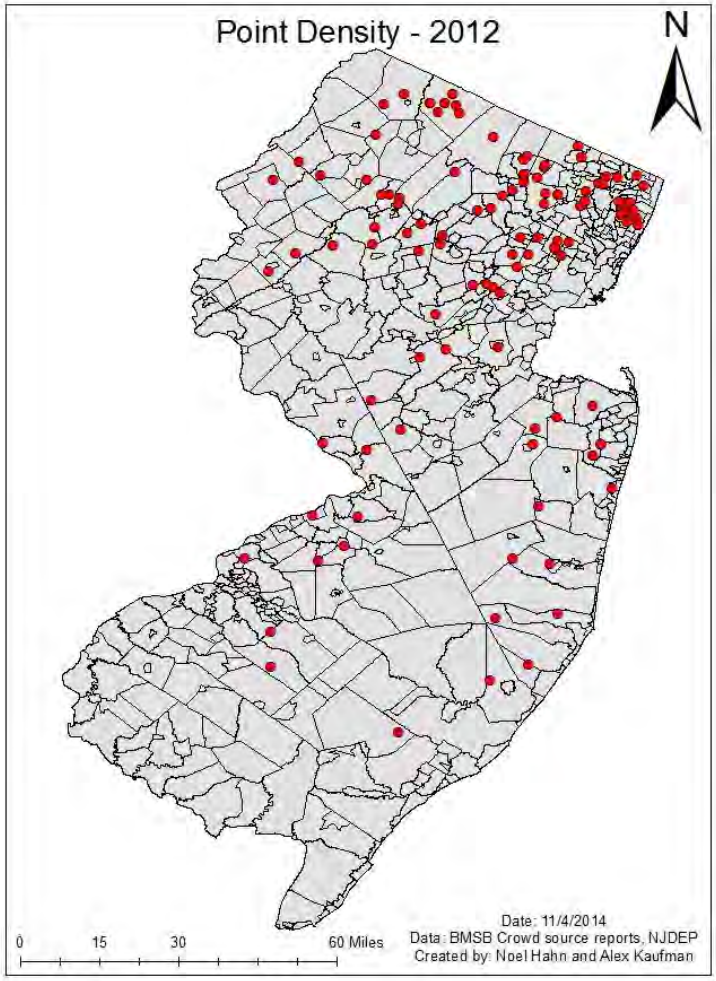

Blacklight Trap Captures and Crowd-sourced Reports
2009
# of BMSB
# of Reports
Blacklight trap
Crowd-sourced
May
August
160
140
120
100
80
60
40
20
0
140
120
100
80
60
40
20
0
1/1
3/2
5/1
6/30
8/29
10/28
12/27

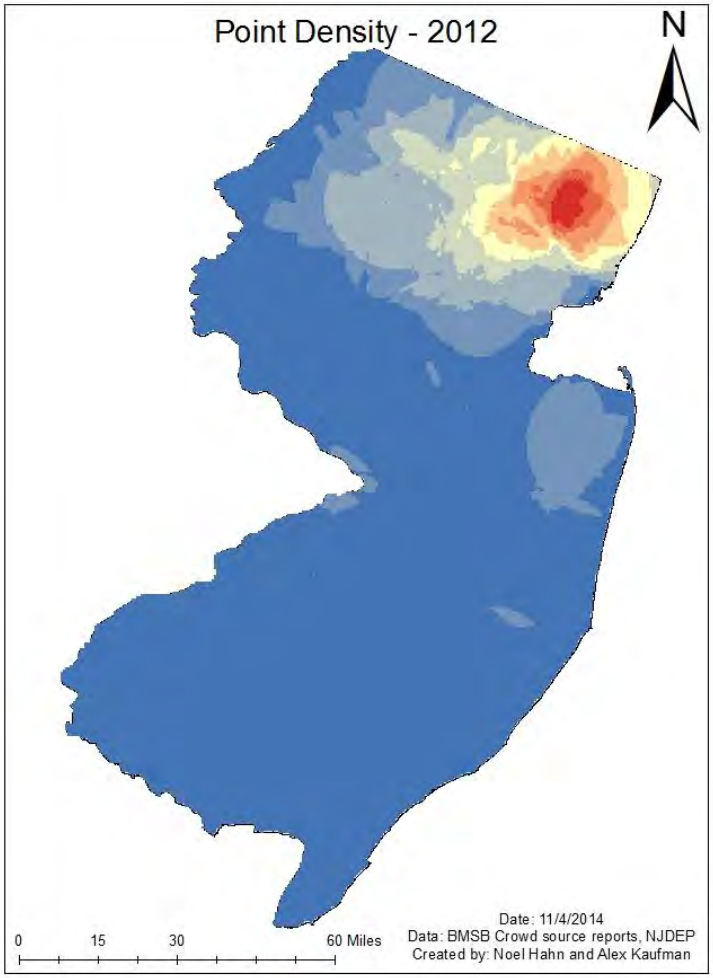

Crowd source reports 2009
N
0
15
30
60 Miles
Date: 11/4/2014
Data: BMSB Crowd source reports, NJDEP
Created by: Noel Hahn and Alex Kaufman


Point Density - 2009
N
0
15
30
60 Miles
Date: 11/4/2014
Data: BMSB Crowd source reports, NJDEP
Created by: Noel Hahn and Alex Kaufman


Blacklight trap captures 2012
# of BMSB
# of Reports / month
Blacklight trap
Crowd-sourced
1000
900
800
700
600
500
400
300
200
100
0
16
14
12
10
8
6
4
2
0
1/1
3/1
4/30
6/29
8/28
10/27
12/26


Blacklight trap captures 2012
# of BMSB
# of Reports / month
1000
900
800
700
600
500
400
300
200
100
0
16
14
12
10
8
6
4
2
0
1/1
3/1
4/30
6/29
8/28
10/27
12/26
Blacklight trap
Crowd-sourced
May
August
October


Point Density - 2012
N
0
15
30
60 Miles
Date: 11/4/2014
Data: BMSB Crowd source reports, NJDEP
Created by: Noel Hahn and Alex Kaufman


Point Density - 2012
N
0
15
30
60 Miles
Date: 11/4/2014
Data: BMSB Crowd source reports, NJDEP
Created by: Noel Hahn and Alex Kaufman

Conclusions

- High number of crowd-sourced reports in 2009.
- 2010 experienced a large increase in the number of BMSB found in blacklight traps.

- High number of reports in 2009 → high numbers of BMSB caught in blacklight traps in the summer. However, this was not the case in 2012.

- The density of reports from 2006 and 2009 were located in central/northern New Jersey, reflecting the higher density of BMSB caught in traps in those areas.

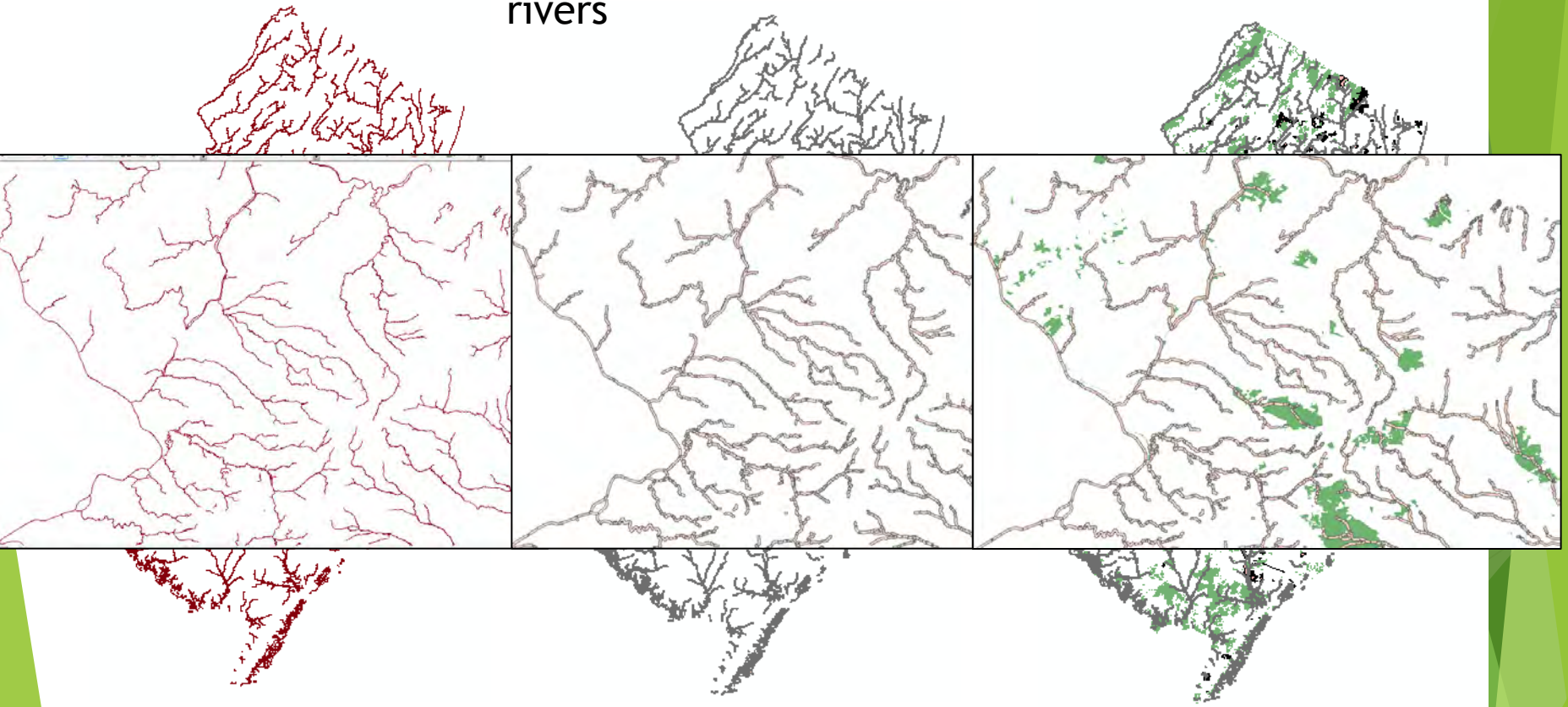
GIS is Useful!

Ramps (*Allium tricoccum*)

Base map of rivers

Buffer of 500 feet around rivers

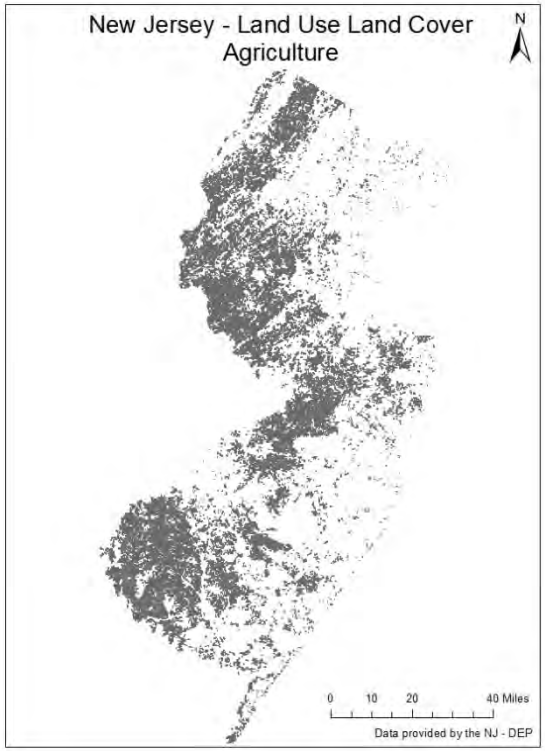
Buffer + Open Space

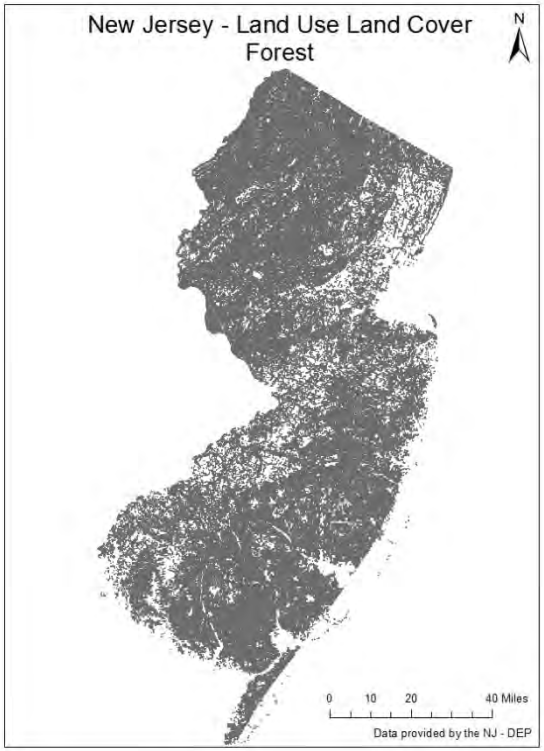


Land Use Types and Crowdsourced Reports

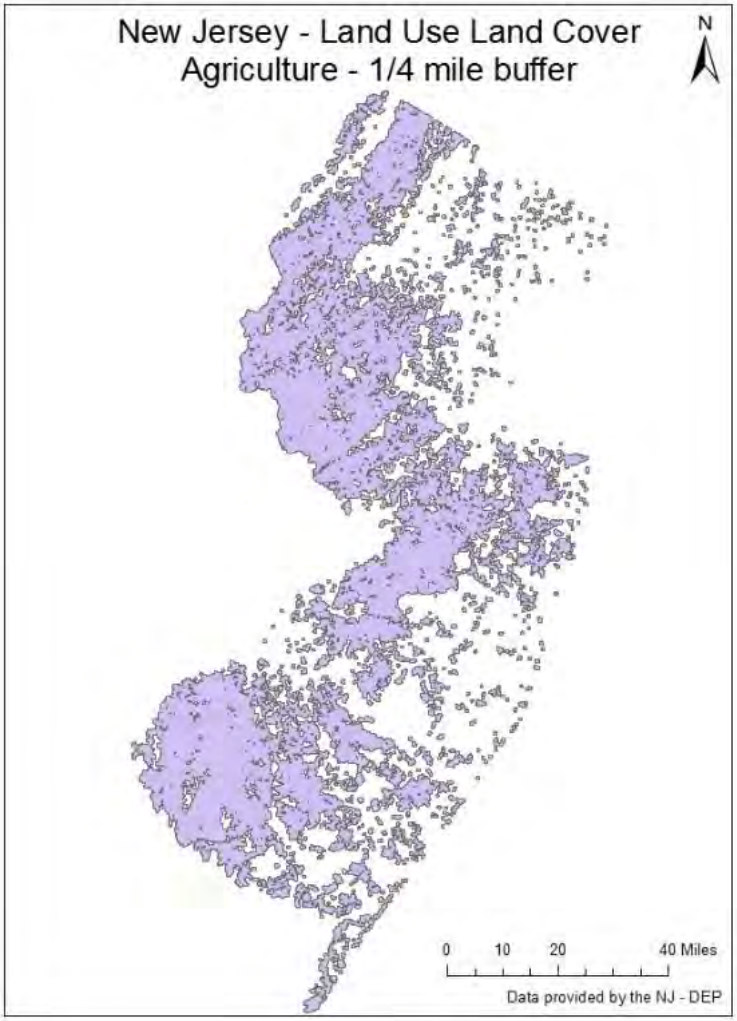
- Land use/Land cover data from NJ DEP - 2007
  - Urban
  - Barren Land
  - Forest
  - Wetlands
  - Agriculture
  - Water
- Isolated Agriculture, Forest

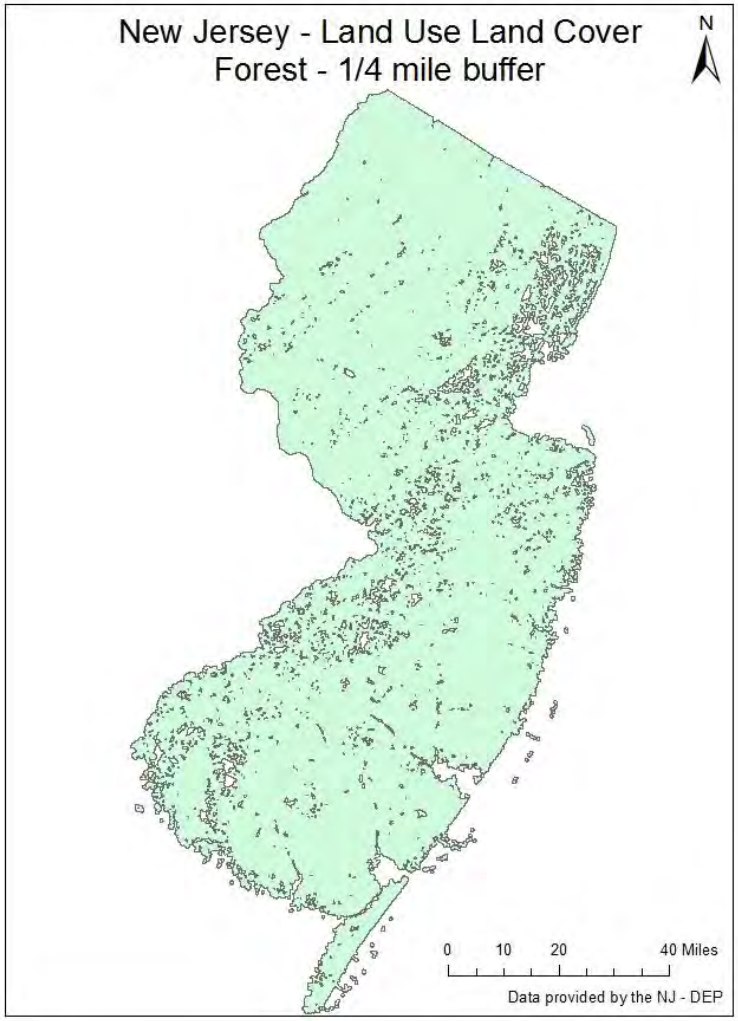
- Buffer region – ¼ mile around Agriculture and Forest shapefiles
- # of reports were counted
  - Agriculture
  - Forest
  - Agriculture + ¼ mile buffer
  - Forest + ¼ mile buffer
- Only 2002, 2007 LU/LC data is available

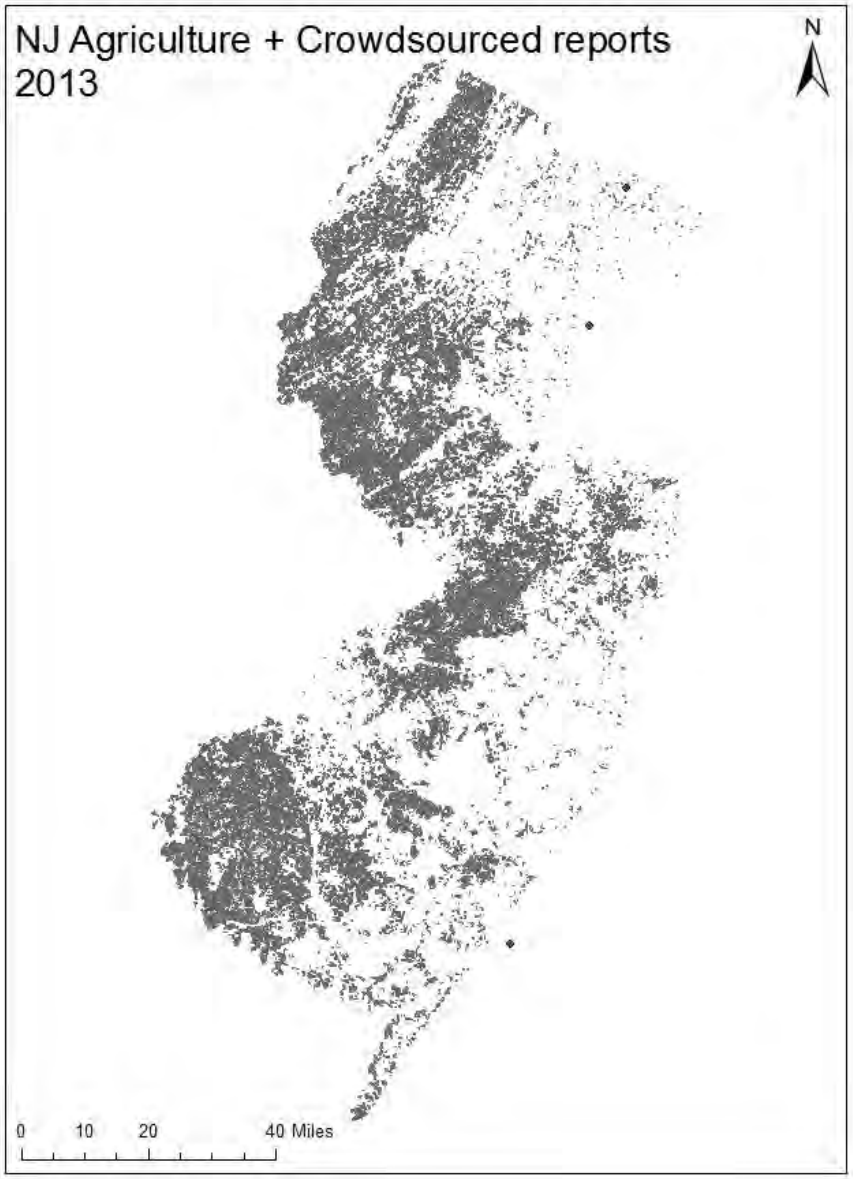

New Jersey - Land Use Land Cover
Agriculture
N
0 10 20 40 Miles
Data provided by the NJ - DEP


New Jersey - Land Use Land Cover
Forest
N
0 10 20 40 Miles
Data provided by the NJ - DEP

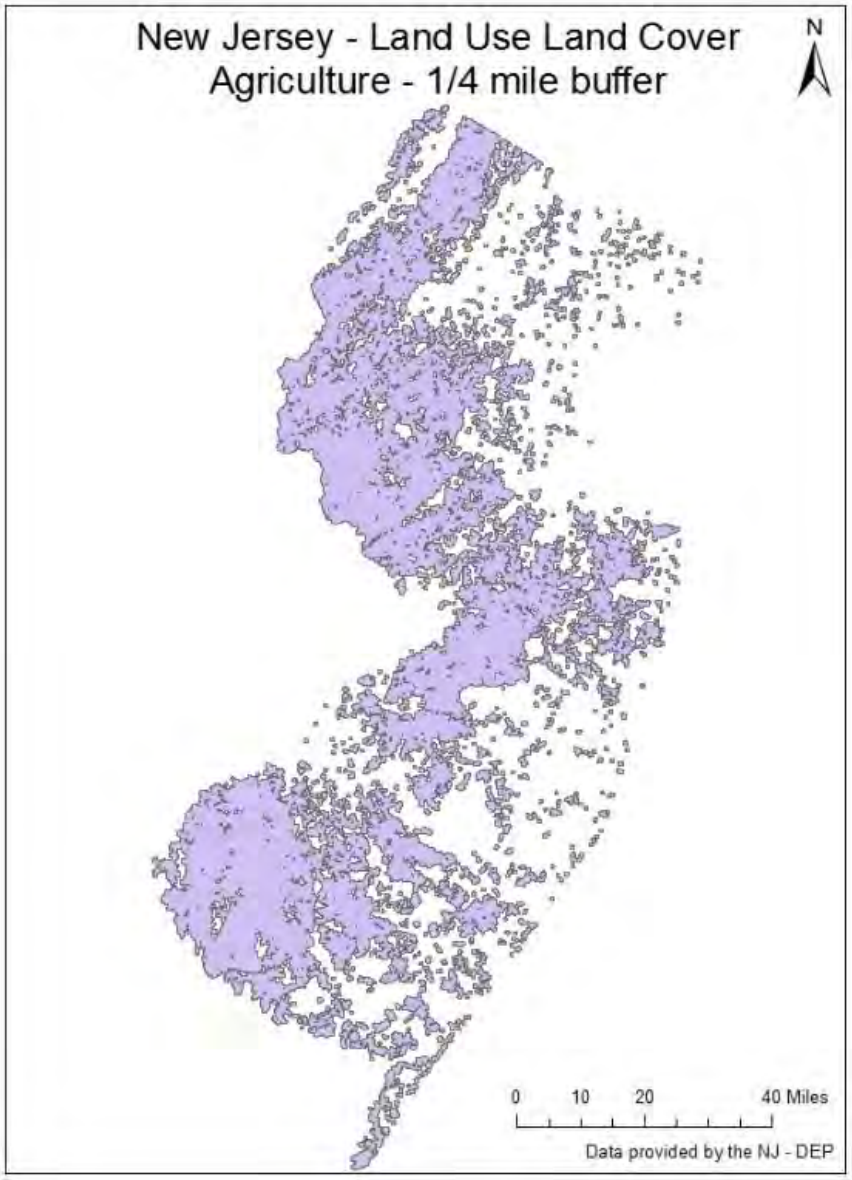
New Jersey - Land Use Land Cover
Urban
N
0 10 20 40 Miles
Data provided by the NJ - DEP


New Jersey - Land Use Land Cover
Agriculture - 1/4 mile buffer
N
0 10 20 40 Miles
Data provided by the NJ - DEP

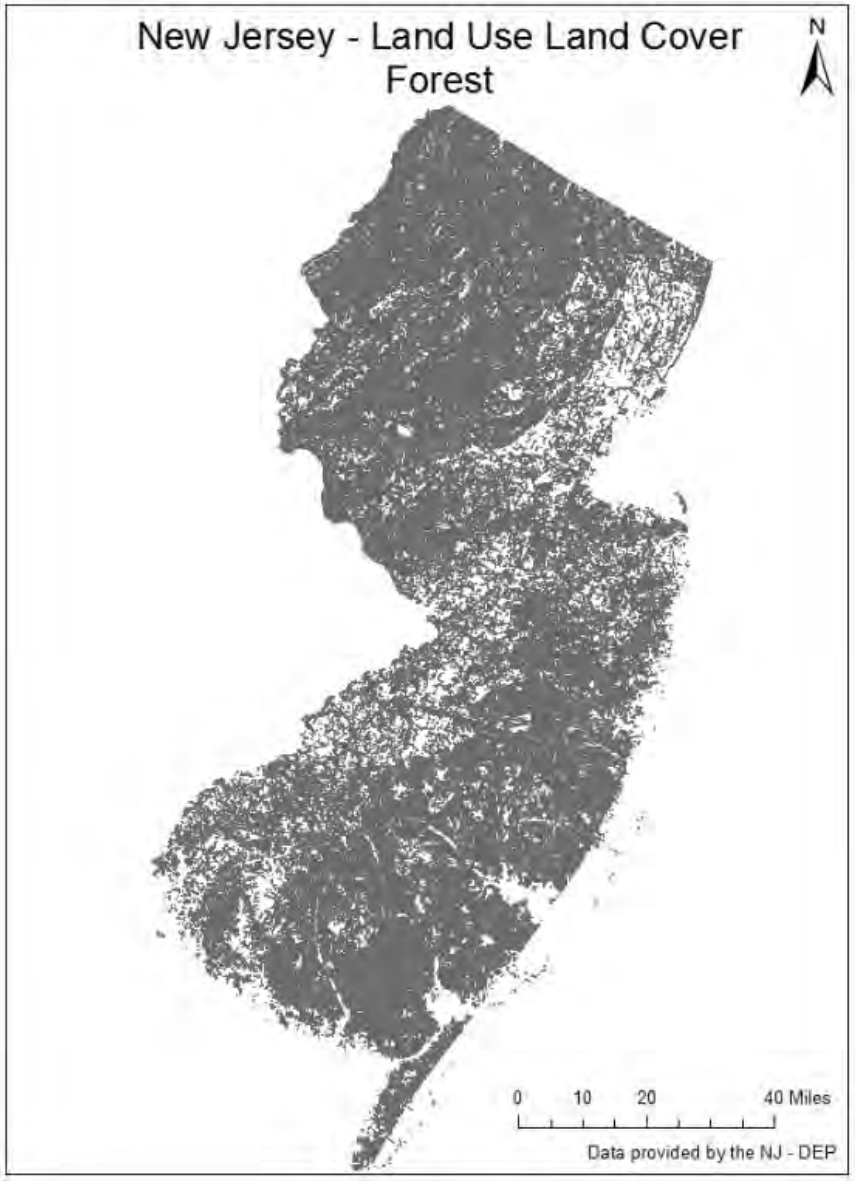

New Jersey - Land Use Land Cover
Forest - 1/4 mile buffer
N
0 10 20 40 Miles
Data provided by the NJ - DEP



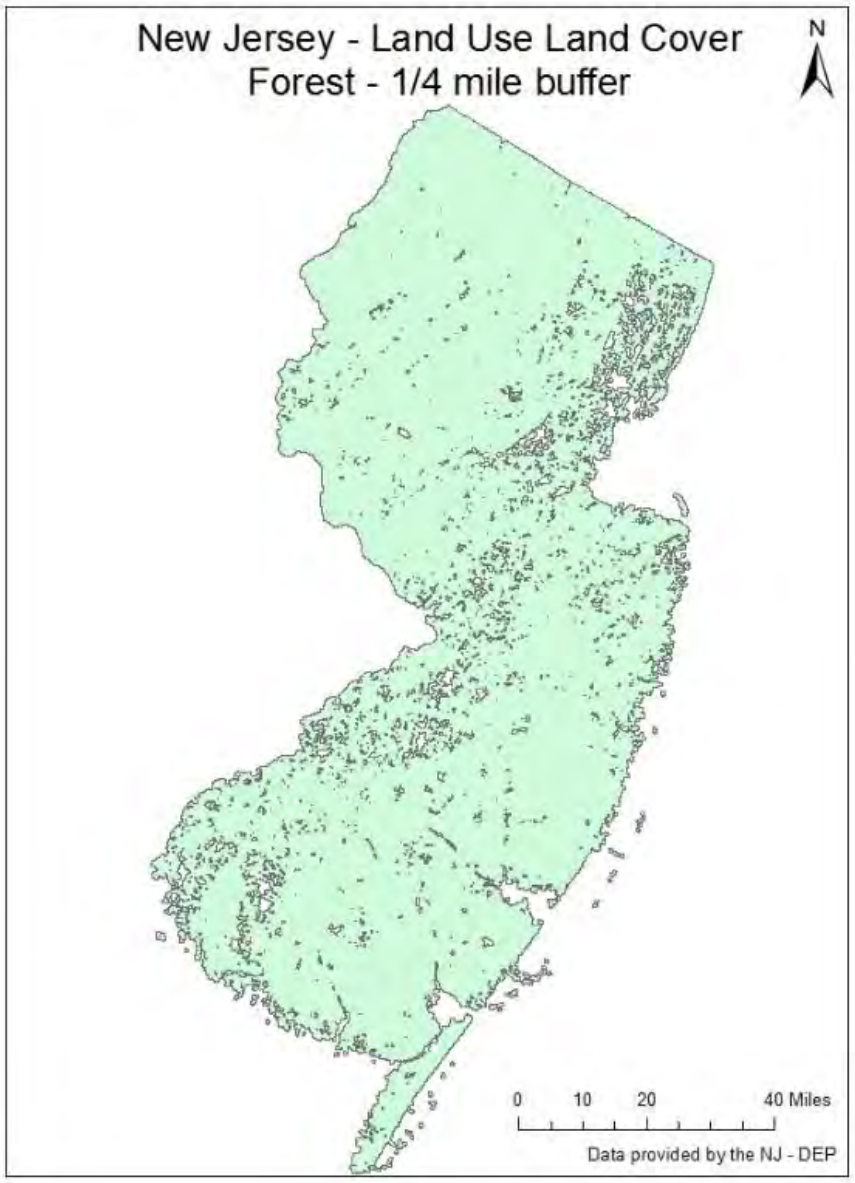
Year	# of reports	Total # of reports
2006	3	43
2007	3	188
2008	6	322
2009	9	470
2010	3	248
2011	0	58
2012	1	24
2013	0	3



Year	# of reports	Total # of reports
2006	27	43
2007	95	188
2008	134	322
2009	175	470
2010	66	248
2011	17	58
2012	6	24
2013	0	3



Year	# of reports	Total # of reports
2006	6	43
2007	17	188
2008	16	322
2009	21	470
2010	7	248
2011	8	58
2012	2	24
2013	0	3



Year	# of reports	Total # of reports
2006	42	43
2007	179	188
2008	305	322
2009	451	470
2010	217	248
2011	52	58
2012	23	24
2013	0	3

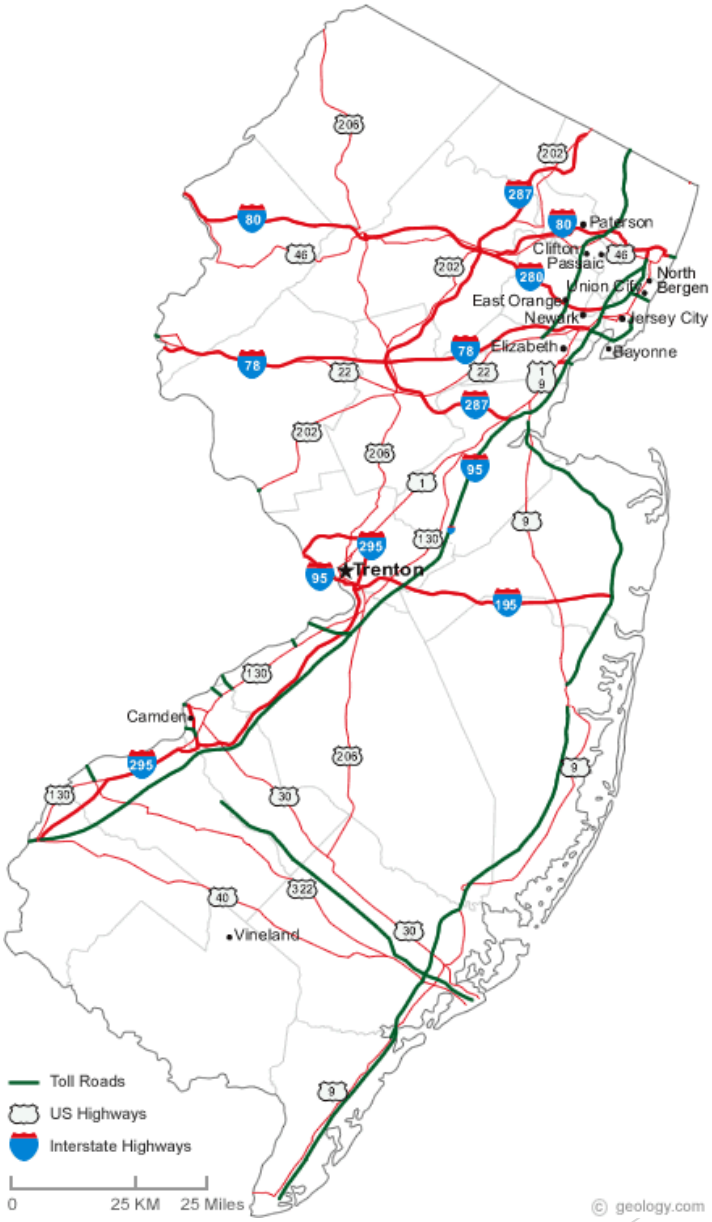
Conclusions

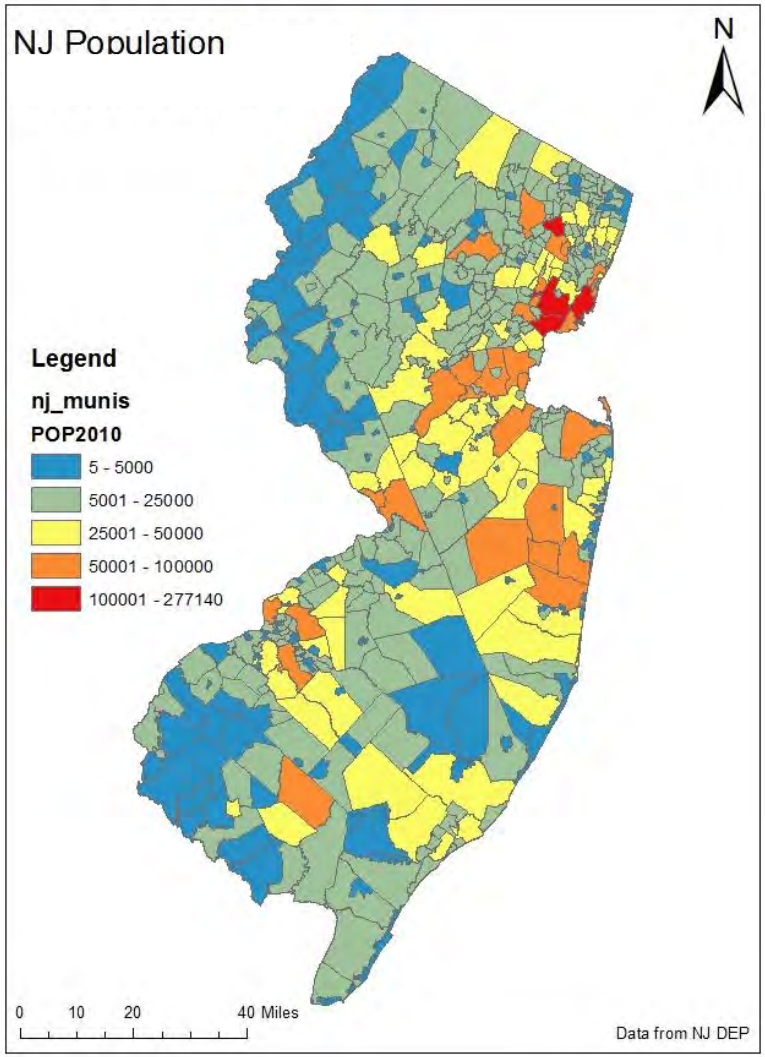
Year	Total # of reports	Ag	Forest	Ag + ¼ mile buffer	Forest + ¼ mile buffer
2006	43	3	6	27	42
2007	188	3	17	95	179
2008	322	6	16	134	305
2009	470	9	21	175	451
2010	248	3	7	66	217
2011	58	0	8	17	52
2012	24	1	2	6	23
2013	3	0	0	0	0

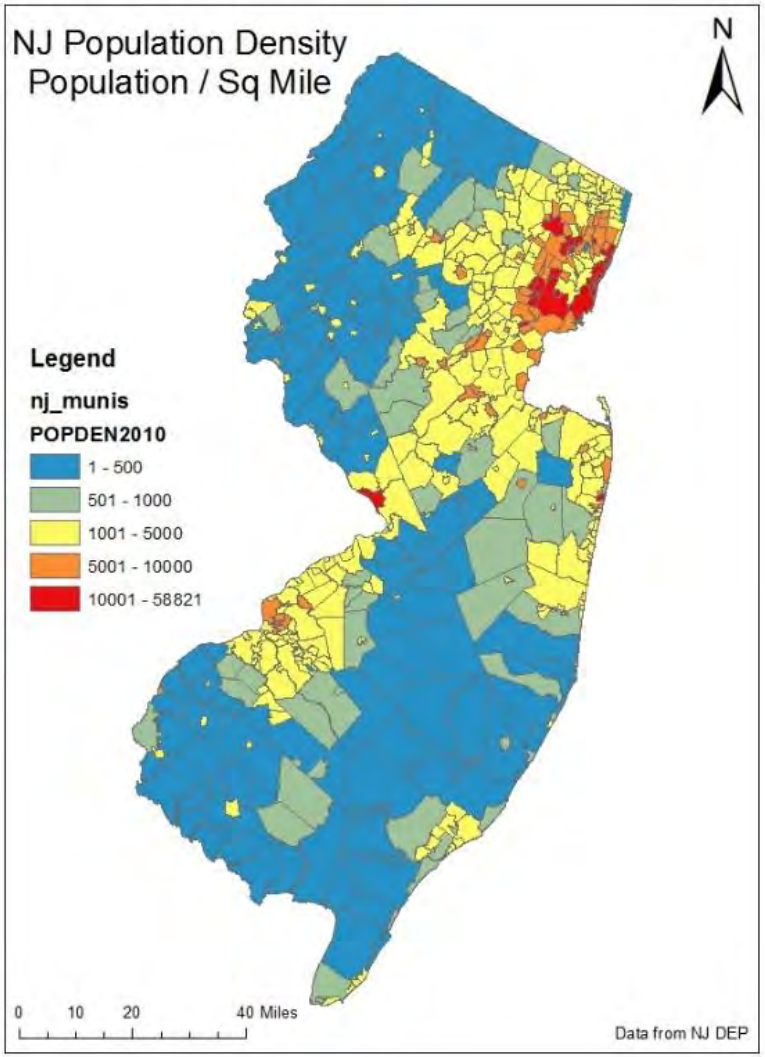
- There are more reports around forested areas than around agricultural areas

Population Density

Rank	Incorporated place	Metropolitan area	State	Population (2010 census)	Land area (mi^2)	Population density (people per mi^2)
1	Guttenberg	New York City	New Jersey	11,176	0.19	58,821
2	Union City	New York City	New Jersey	66,455	1.27	52,326.7
3	West New York	New York City	New Jersey	49,708	1.02	48,733.3
4	Hoboken	New York City	New Jersey	50,005	1.28	39,066.4
5	Kaser	New York City	New York	4,724	0.17	27,788.2
6	**New York City**	New York City	New York	8,175,133	302.6	27,016.3
7	Cliffside Park	New York City	New Jersey	23,594	0.96	24,577.1
8	East Newark	New York City	New Jersey	2,406	0.10	24,060
9	Maywood	Los Angeles	California	27,395	1.18	23,216.1
10	Passaic	New York City	New Jersey	69,781	3.11	22,437.6
11	Great Neck Plaza	New York City	New York	6,707	0.31	21,635.4
12	North Bay Village	Miami	Florida	7,137	0.33	21,627.2
13	Cudahy	Los Angeles	California	23,805	1.12	21,254.4
14	Huntington Park	Los Angeles	California	58,114	3.03	19,179.5
15	Somerville	Boston	Massachusetts	75,754	4.11	18,431.6
16	West Hollywood	Los Angeles	California	34,399	1.88	18,297.3
17	Irvington[b]	New York City	New Jersey	53,926	2.96	18,218.2
18	Poplar Hills	Louisville	Kentucky	362	0.02	18,100.0


206
202
287
80
Paterson
Clifton
Passaic
46
202
280
North
Bergen
Union City
East Orange
Newark
Jersey City
78
Elizabeth
Bayonne
22
1
9
287
202
206
95
1
9
130
295
95
Trenton
195
130
Camden
295
206
9
130
30
40
322
Vineland
30
9
Toll Roads
US Highways
Interstate Highways
0
25 KM
25 Miles
© geology.com


NJ Population
N
Legend
nj_munis
POP2010
5 - 5000
5001 - 25000
25001 - 50000
50001 - 100000
100001 - 277140
0 10 20 40 Miles
Data from NJ DEP


NJ Population Density
Population / Sq Mile
N
Legend
nj_munis
POPDEN2010
1 - 500
501 - 1000
1001 - 5000
5001 - 10000
10001 - 58821
0 10 20 40 Miles
Data from NJ DEP

Crowdsourced reports and Population Density

- NJ is the most densely populated state
- Varied population density throughout state

- 2010 Census data
- Calculated reports per 1000 people in each municipality
  - Count(of reports) / population * 1000

2013
Count / 1000 people
N
0
10
20
40 Miles
Data provided by NJ - OIT OGIS and
US Citizens who kindly submitted reports
Map made by Noel Hahn

Future directions

- Crowdsourced data will continue to be explored alongside trap capture data
- Occupancy models
  - Presence-only data
- Further investigation of other contributions to rise and dip in reports

Inherent Problems With The Data

- Issues with participants
  - Familiar with BMSB
  - Loss of interest
- Natural population fluctuations
- Population densities

Acknowledgements

Committee members

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