



U.S. Fish & Wildlife Service

Northeast Region

Decision-support and the use of avian count data across northeast National Wildlife Refuges

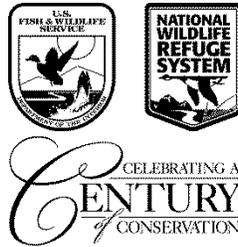
Charles Frost, Biometrician
U.S. Fish and Wildlife Service
National Wildlife Refuge System
Region 5, Hadley, MA

Outline

- I. Context / Problem
- II. Inventory and Monitoring
- III. Management Questions/Modules
 1. Refuge
 2. Regional
 3. Flyway
- IV. Practical Applications
 1. Effort Timing
 2. Disease Surveillance

Background

- History of waterfowl management
- Migratory stopover habitat
 - Impoundments



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Overarching Problem Statement

- How can we utilize past, present, and future inventory and monitoring information (specifically, waterbird surveys) to answer critical management questions?
- 3 distinct spatial scales: *Refuge*, *Regional*, *Flyway*

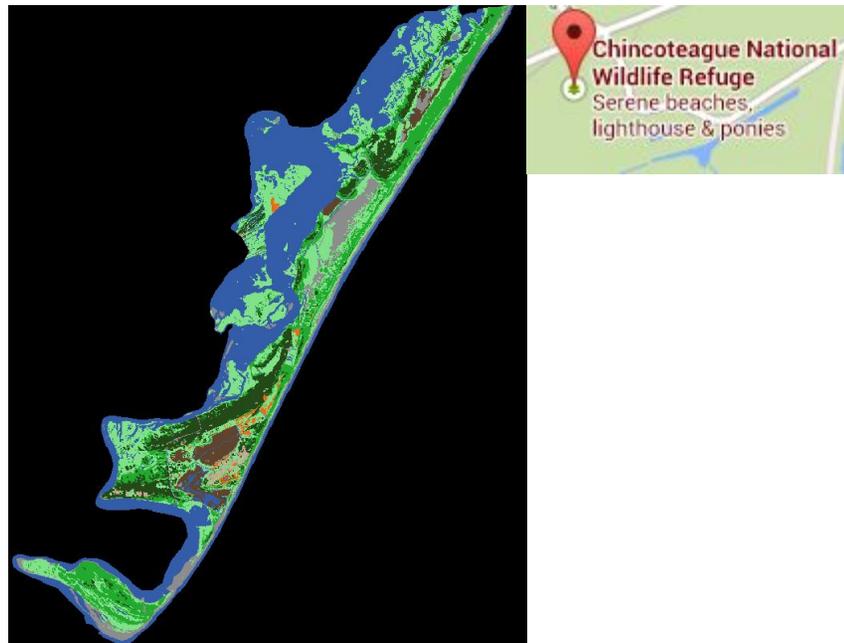
Key Considerations

1. Link models to *specific questions*
2. Link monitoring data to models
3. Link all models and monitoring to feasible management actions.
4. Link refuges throughout the region and the flyway
5. Close the loop and iterate!

Approach

- Create a real-time reporting system that can provide timely forecasts to refuge managers
- Create a distributed R package that will provide common analyses in a transparent and repeatable fashion
- Promote the use of complementary data sources (legacy data, citizen science) and outside software by creating simple input/output interfaces

Refuge Scale



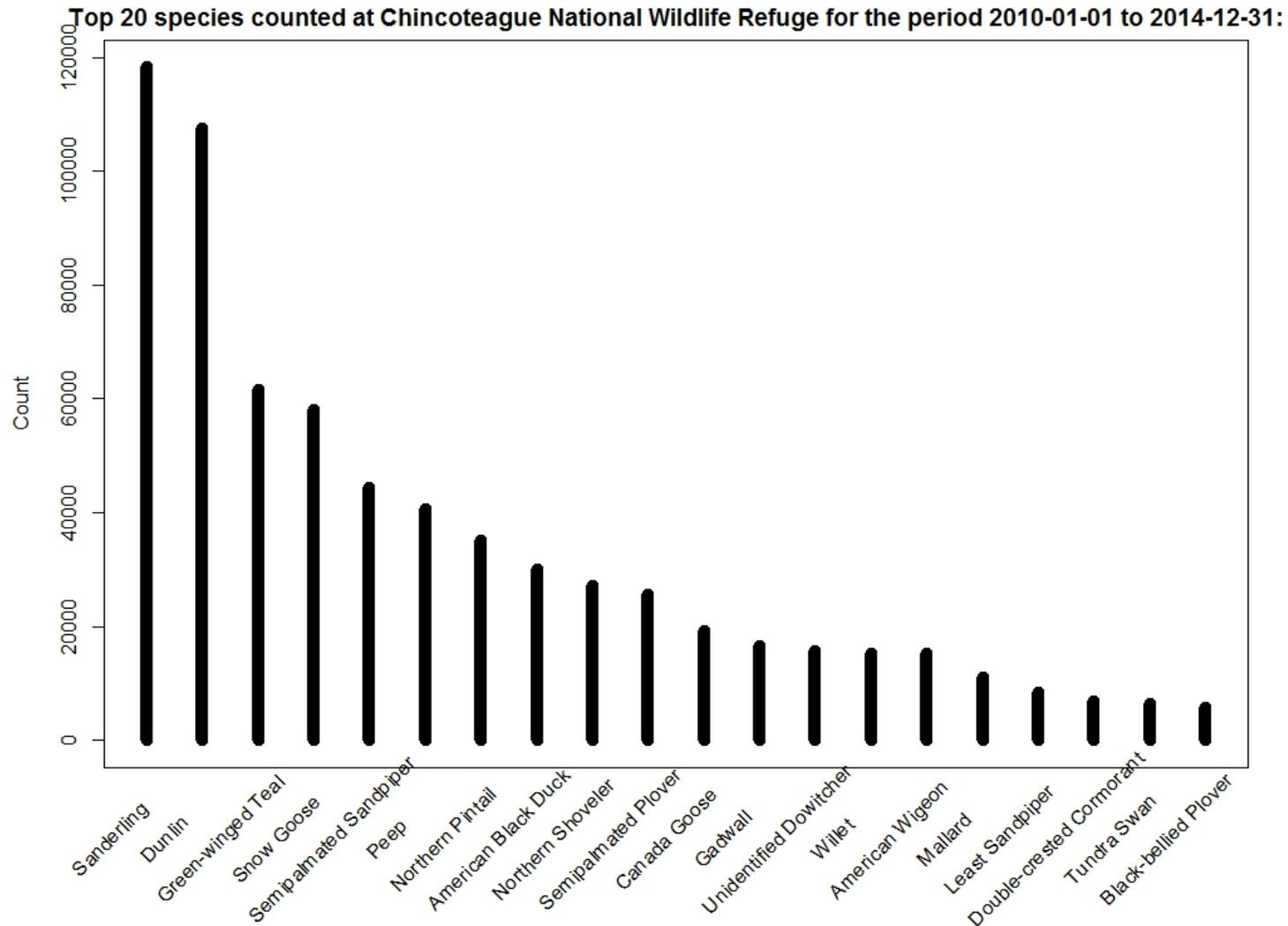
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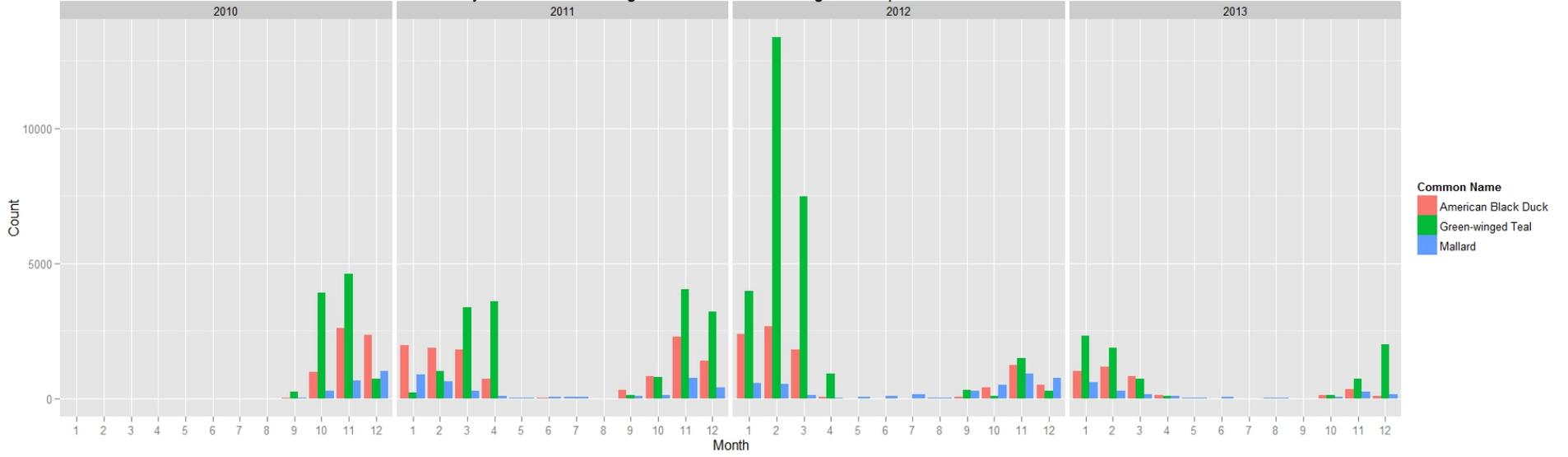
Refuge Scale Questions

- What is the recent status and trends in waterbird use on my refuge?
- How can I time my effort (survey timing, vegetation management, water control, etc.) to coincide with expected waterbird arrival?
- Do I have multiple impoundments being used by the same suite of species?

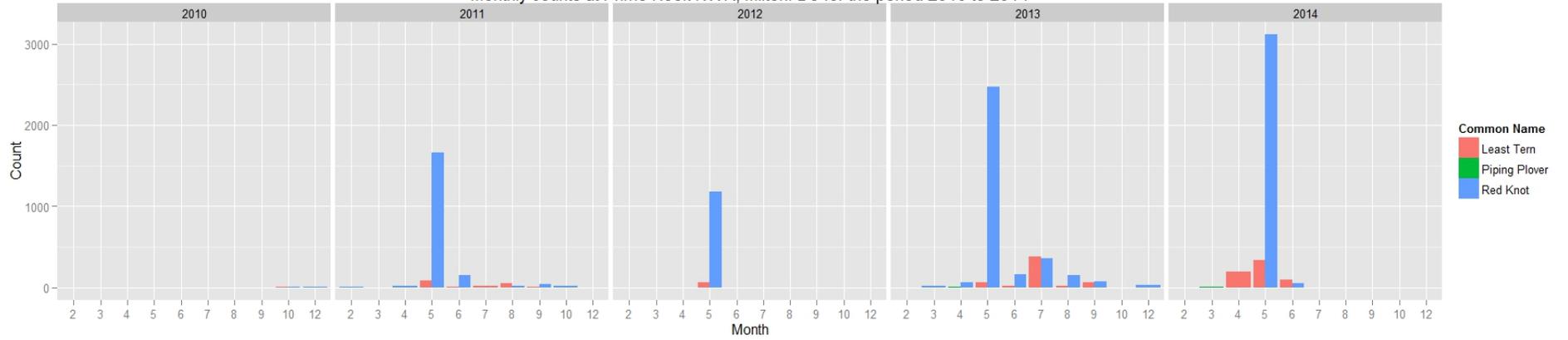
What is the recent status and trends in waterbird use on my refuge?



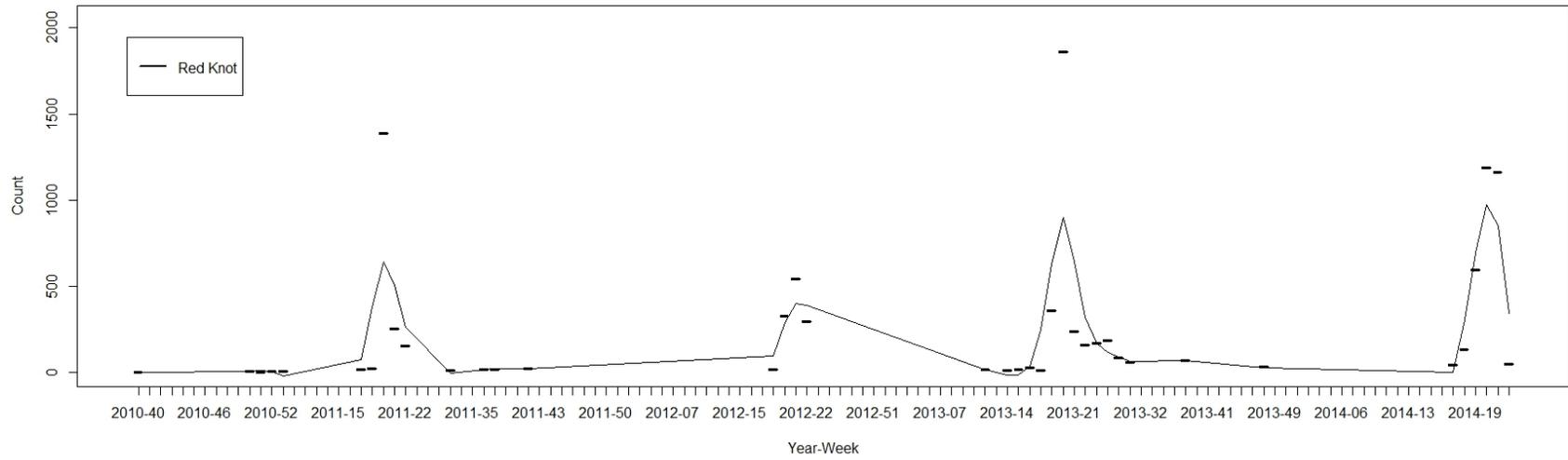
Monthly counts at Chincoteague National Wildlife Refuge for the period 2010 to 2013



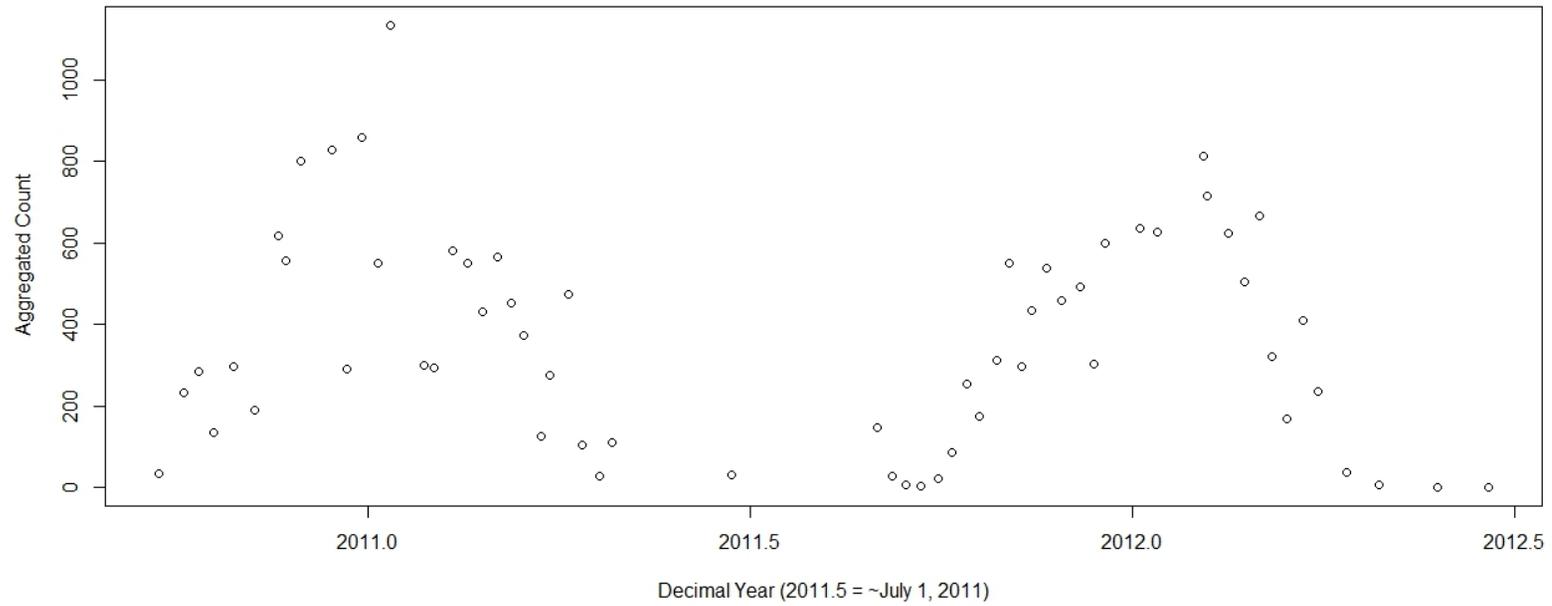
Monthly counts at Prime Hook NWR, Milton, De for the period 2010 to 2014



Comparison of weekly counts at Prime Hook NWR, Milton, De for the period 2010-01-01 to 2014-12-31



ABDU Counts, CNWR, 2010-2013



How can I time my effort at my refuge to coincide with expected waterbird arrival?

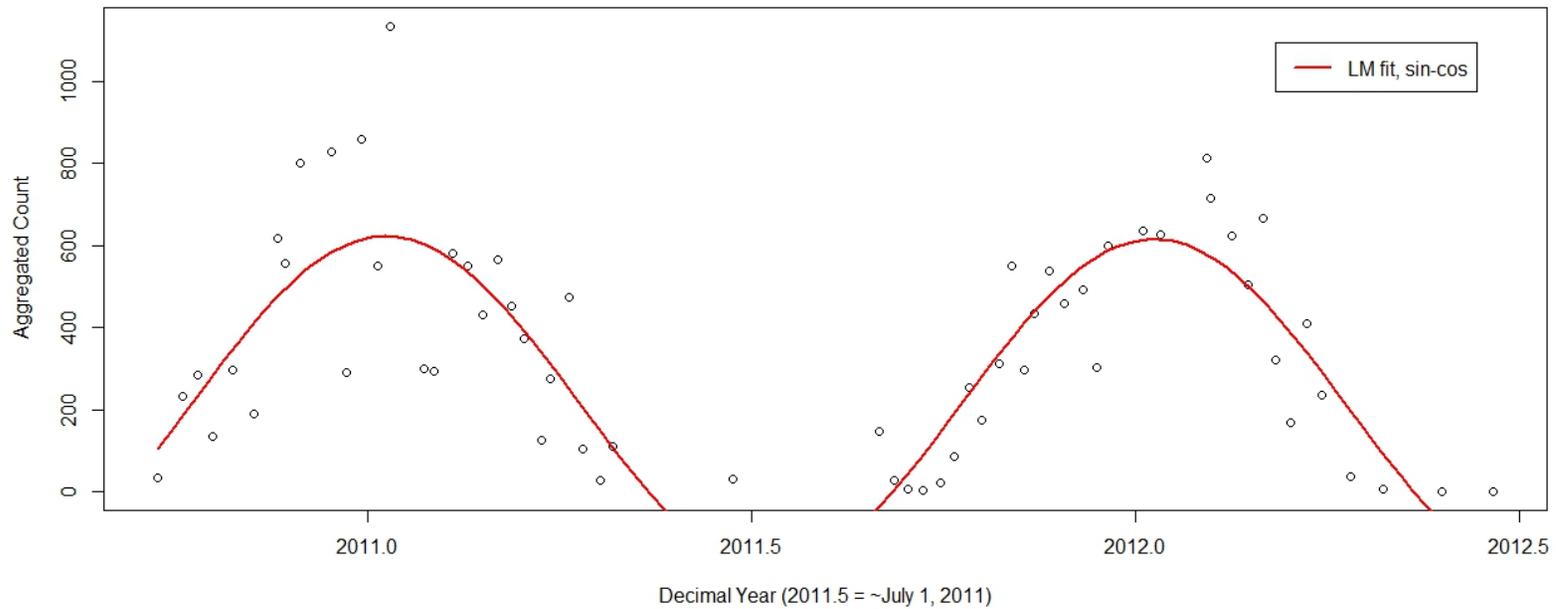
- Sinusoidal (linear) process model

$$\text{count} \downarrow t = \beta \downarrow 1 \sin 2\pi t + \beta \downarrow 2 \cos 2\pi t + \beta \downarrow 3 t + \varepsilon$$

- Decomposition of the nonlinear version for ease of parameter fitting (least squares fit of ω trivial in migration model)

$$\text{count} \downarrow t = \beta \downarrow 1 \sin(\omega t + \varphi) + \beta \downarrow 2 t + \varepsilon$$

ABDU Counts, CNWR, 2010-2013



- ...how is this helpful?
Stay tuned...



American Black Duck Duckling
N 45.109427° W 070.758372°

05/29/2011
Photo: Bill Thompson

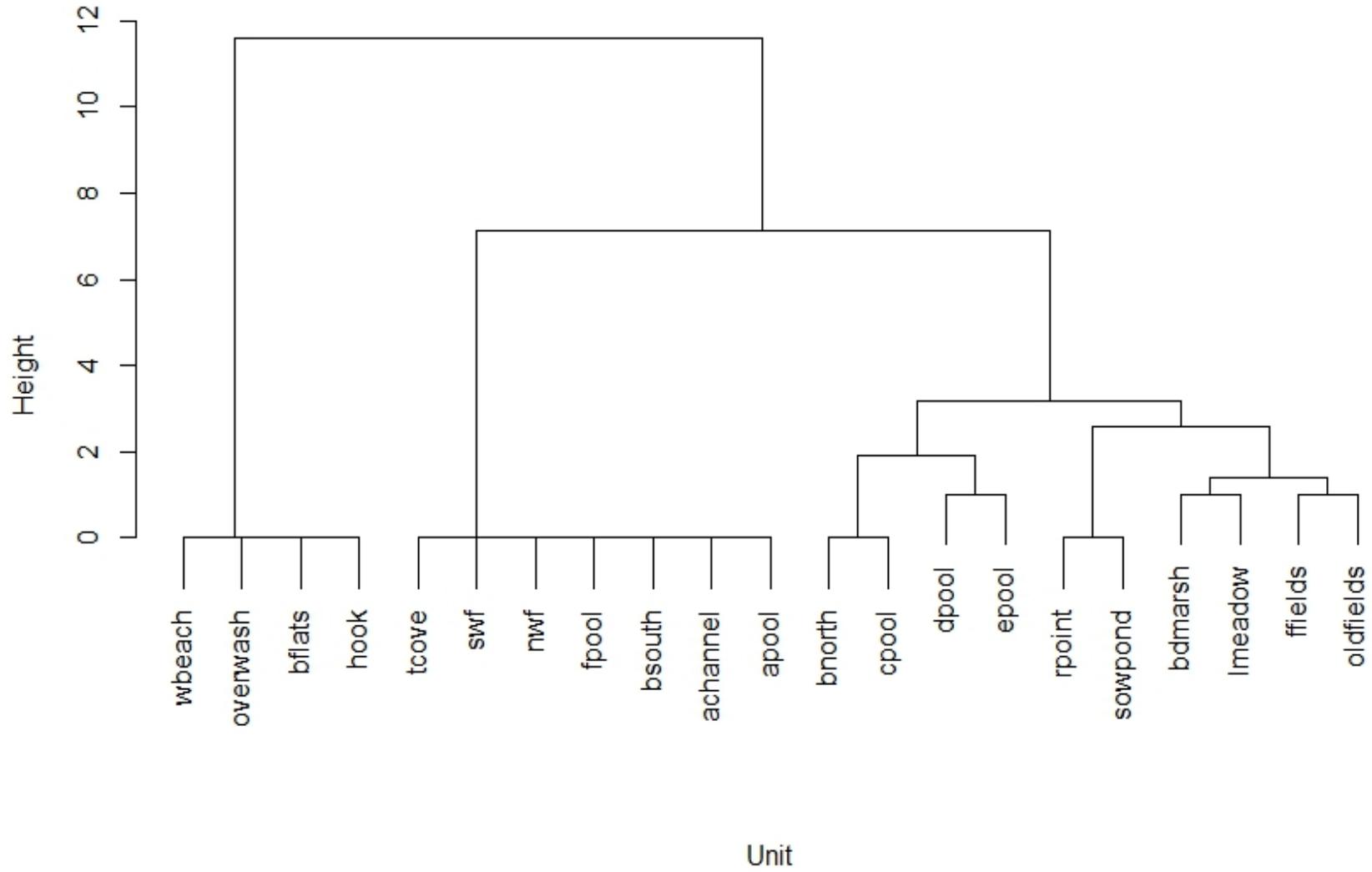
Do I have multiple impoundments on my refuge being used by the same suite of species?

- Mixed set of objectives and constraints (waterfowl, shorebirds, invasive vegetation, etc.)
- Are we coordinating our management actions within and between agencies?

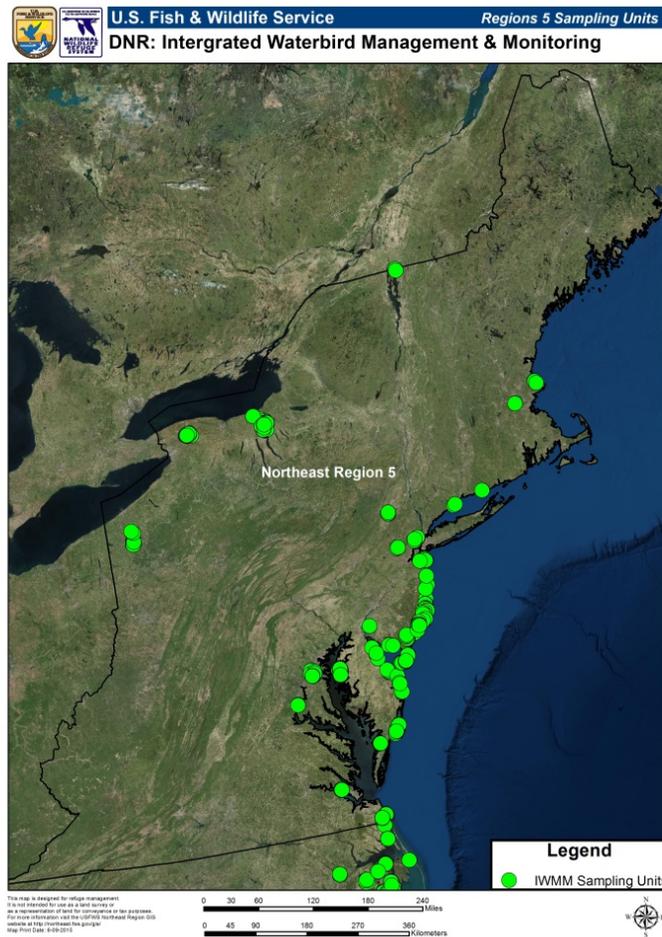
Do I have multiple impoundments on my refuge being used by the same suite of species?

- “Lose control” of an impoundment
 - Budget
 - Weather
 - Water control structures
 - Politics
- Do I have others meeting the needs of the same species?

Impoundment Similarity (Hierarchical Clustering Method, Occurrence)



Regional Scale



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Regional Scale Questions

- Are there any neighboring impoundments very similar to mine?
- How can we focus timely management decisions to target a given species at multiple refuges?
- Can we use data from multiple refuges to inform management on another refuge?

Are there any neighboring impoundments very similar to mine? (Regional)

- Regional impoundment catalog
 - Cooperative effort between USFWS, New Jersey Audubon, National Wildlife Federation, Princeton Hydro, Conservation Management Institute

Area_Ha	Elevation	M_perimeter	M_of_dike	M_from_ocean	M_from_house	WCS	Salinity	ISS_site	ISS_focal_site	R3_RS_study	IWMM_site	Ownership_type
21.5	0	3724	70	2410	1310	Yes	Saltwater	Yes	No	No	No	State
30.7	0	3607	387	1520	1570	Yes	Saltwater	Yes	Yes	No	Yes	State
22.5	0	3080	2223	1150	740	Yes	Saltwater	Yes	No	No	Yes	State
13.3	0	1759	715	680	1240	Unknown	Brackish	Yes	No	No	No	State
32.4	0	3894	394	2290	520	Yes	Saltwater	Yes	Yes	No	No	State
10.9	2	1693	302	3160	820	Yes	Saltwater	Yes	No	No	Yes	State
395.5	3	43325	685	30	60	Yes	Brackish	Yes	No	No	No	State
72.7	2	10848	2290	20	40	Yes	Brackish	Yes	Yes	No	No	State
91.4	2	7354	2460	3530	1650	Yes	Fresh	Yes	Yes	No	No	Federal
49.1	2	6843	273	5770	450	Yes	Fresh	Yes	Yes	No	No	Federal
38.4	4	4513	1017	4860	430	Yes	Fresh	Yes	Yes	Yes	Yes	Federal
165.4	3	12203	2215	3930	190	Yes	Fresh	Yes	Yes	Yes	Yes	Federal
55.0	4	5424	695	730	20	Yes	Saltwater	No	No	No	No	Private
144.1	5	18498	295	1400	20	Unknown	Brackish	No	No	No	No	Private
128.3	1	6738	1992	170	350	Yes	Brackish	Yes	No	No	Yes	State
59.2	0	5603	1708	1290	220	Yes	Saltwater	Yes	Yes	No	No	State
171.6	0	6030	6030	100	460	Yes	Saltwater	Yes	Yes	No	Yes	State
151.1	0	7401	7400	40	900	Yes	Saltwater	Yes	Yes	No	Yes	State
62.6	0	6370	645	950	230	Yes	Brackish	Yes	No	No	No	State
629.4	2	26168	3434	40	10	Yes	Brackish	Yes	Yes	No	Yes	Federal
1416.7	3	55531	4770	230	10	Yes	Fresh	Yes	Yes	Yes	Yes	Federal
55.8	3	4269	1615	350	200	Yes	Brackish	Yes	Yes	Yes	Yes	Federal
153.0	4	15758	508	20	140	Unknown	Saltwater	No	No	No	No	Private
53.1	5	8215	809	1750	280	Yes	Fresh	Yes	Yes	No	No	State
15.3	2	2511	364	710	840	Yes	Brackish	Yes	No	No	No	State
94.8	3	7885	3109	50	60	Yes	Saltwater	Yes	Yes	No	Yes	State
159.7	4	7344	2594	40	1360	Yes	Saltwater	Yes	Yes	No	Yes	State
482.8	4	30402	3881	860	110	Yes	Saltwater	Yes	Yes	No	No	Private
18.1	7	2232	1285	340	1990	Yes	Fresh	Yes	Yes	Yes	Yes	Federal
58.6	8	3955	3072	3080	230	Yes	Fresh	Yes	Yes	No	Yes	Federal
49.4	5	3180	3180	140	1160	Yes	Fresh	Yes	No	Yes	Yes	Federal
2.1	3	1389	1389	10	1360	Yes	Fresh	No	No	No	No	Federal
2.3	2	735	735	110	1170	Yes	Fresh	No	No	No	No	Federal
17.3	1	1859	1858	20	150	Yes	Brackish	No	No	Yes	No	Federal
3.5	1	1138	85	390	350	Yes	Fresh	No	No	No	No	Federal
14.4	1	2616	2615	110	1420	Yes	Fresh	No	No	No	No	Federal
17.0	1	2472	2471	70	1570	Yes	Fresh	No	No	No	No	Federal
12.5	3	2396	2395	20	1740	Yes	Fresh	No	No	No	No	Federal
2.4	2	726	725	120	1190	Yes	Fresh	No	No	No	No	Federal
28.3	2	2867	1673	790	1260	Yes	Fresh	No	No	Yes	No	Federal
8.251	2	1251	1251	750	1590	Yes	Fresh	No	No	Yes	No	Federal
6.5	2	1185	1185	920	1410	Yes	Fresh	No	No	Yes	No	Federal
10.1	2	1768	1768	80	180	Yes	Fresh	No	No	Yes	No	Federal

How can we focus timely management decisions to target a given species at multiple refuges?

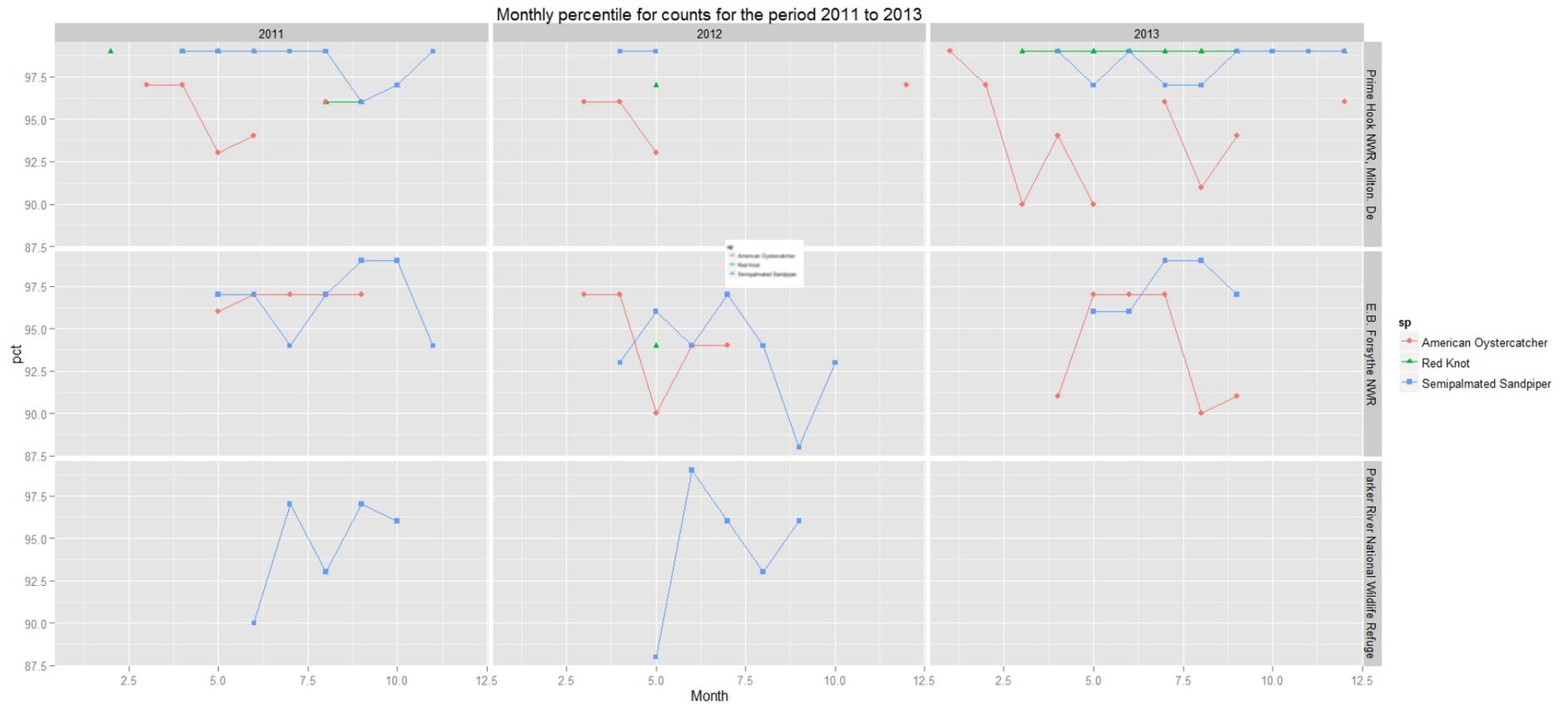
- Beach access
- Predator control
- Vegetation management



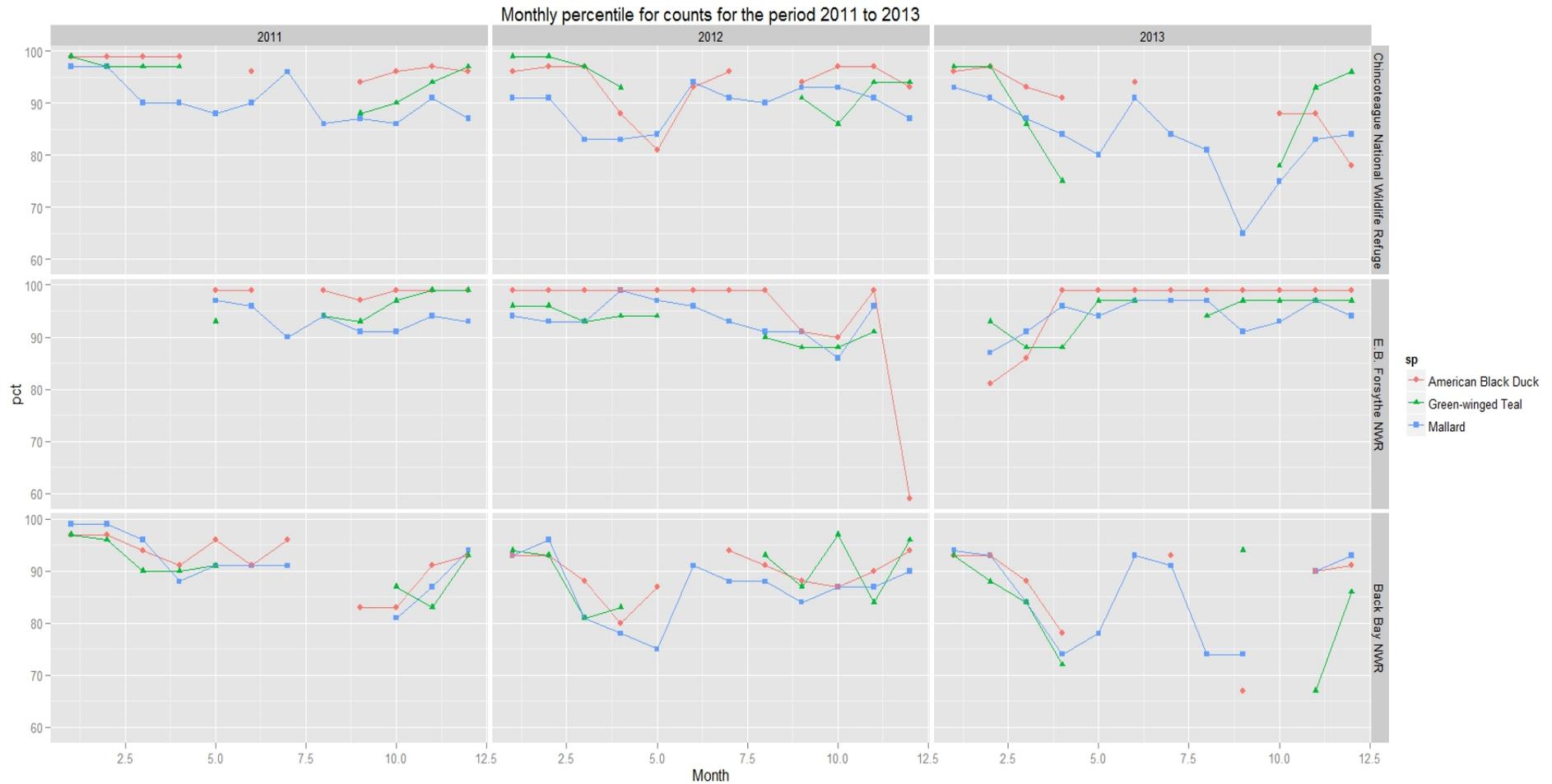
Piping Plover
N 42.079693° W 070.226317°

04/14/2012
Photo: Bill Thompson

How can we focus timely management decisions to target a given species at multiple refuges?



How can we focus timely management decisions to target a given species at multiple refuges?

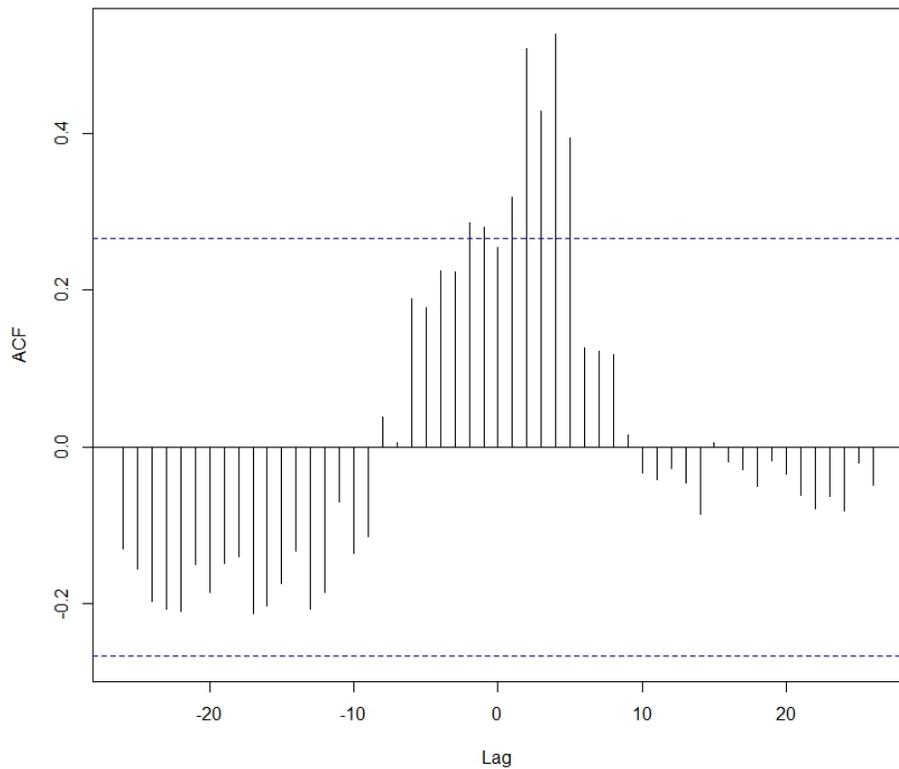


Can we use data from multiple refuges to inform management on another refuge?

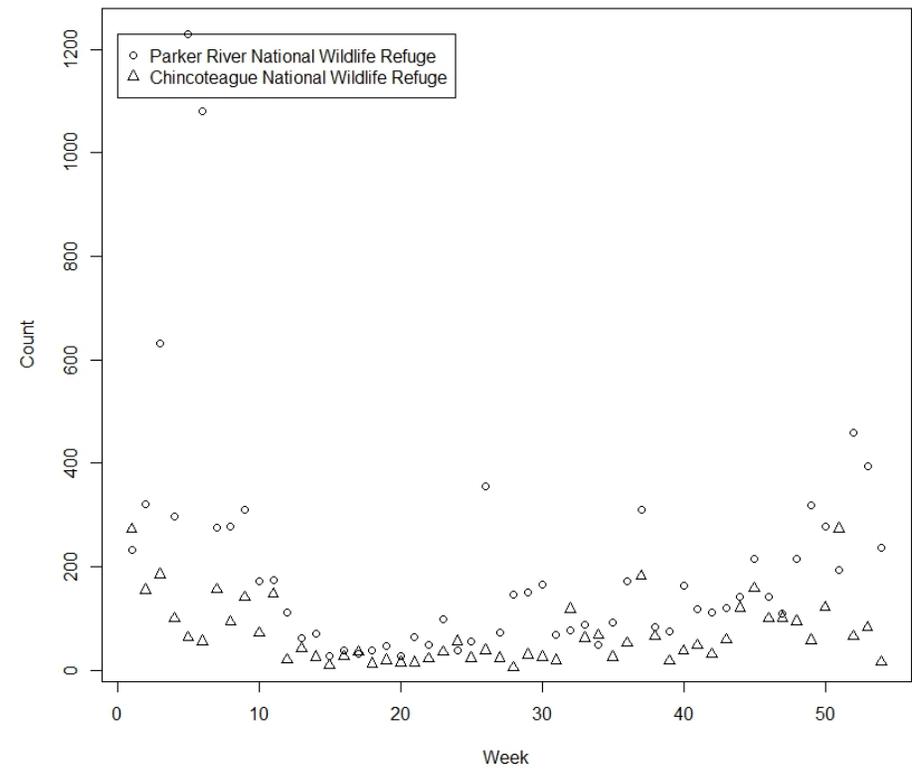
- Cross correlation
- Identifying the lag between 2 time series
- Counts at refuges up/downstream in the flyway
- Can we use counts at multiple sites to predict arrival at another?
 - Timing of drawdown, fill, vegetation management, count effort
 - Coordinating monitoring and management across regions

Can we use data from multiple refuges to inform management on another refuge?

CCF of Parker River National Wildlife Refuge vs. Chincoteague National Wildlife Refuge



Counts for mallard



Flyway Scale



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Flyway Scale Questions

- Can we use counts at multiple sites to predict arrival at another? (CCF)
- Are there complementary sources of data at the national level that can validate our current efforts?
 - eBird (www.eBird.org Cornell Lab of Ornithology)
 - Breeding Bird Survey (USGS)

Are there complementary sources of data at the flyway level that can validate our current efforts?

- Citizen science
- Frequency of observations tends to be higher near population centers
- Can we make sense of it?

```
> data=eBirdPull("American Black Duck")  
> head(data)
```

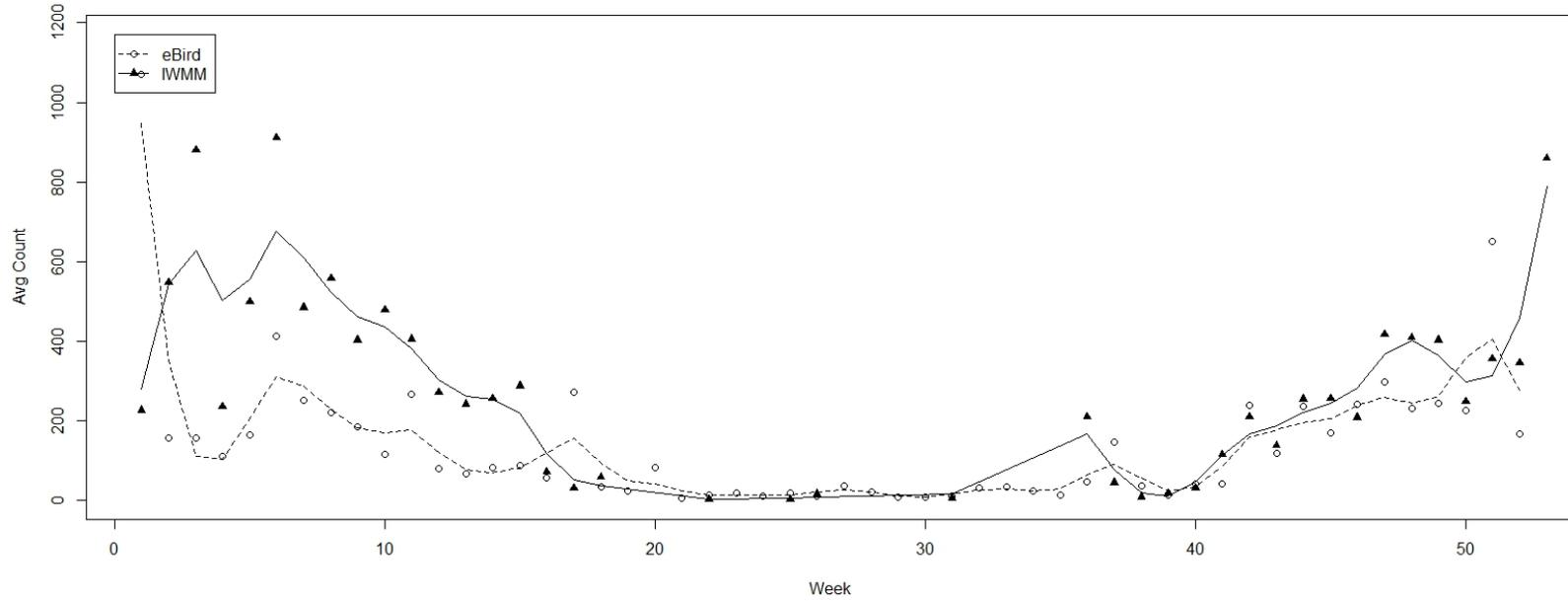
	SPECIES	OBSERVATION.COUNT	COUNTRY	LATITUDE	LONGITUDE	OBSERVATION.DATE	YEAR	MONTH	WEEK
19989	American Black Duck	10	United States	41.24858	-72.90293	2010-10-18	2010	10	42
19990	American Black Duck	1	United States	43.20960	-90.16449	2010-10-18	2010	10	42
19991	American Black Duck	5	United States	42.46229	-76.50185	2010-10-19	2010	10	42
19992	American Black Duck	200	United States	42.76390	-70.80230	2010-10-17	2010	10	41
19993	American Black Duck	4	United States	39.11004	-74.70884	2010-10-18	2010	10	42
19994	American Black Duck	20	United States	40.58488	-73.99458	2010-10-18	2010	10	42

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> |
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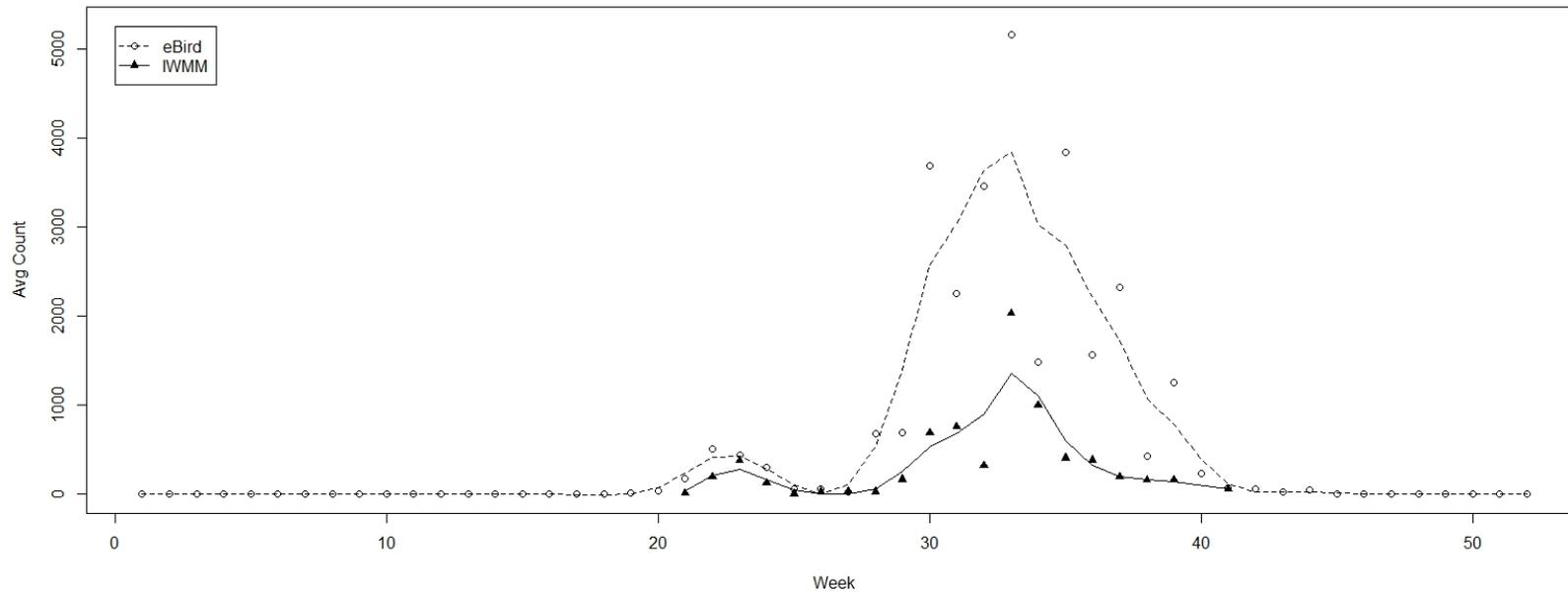
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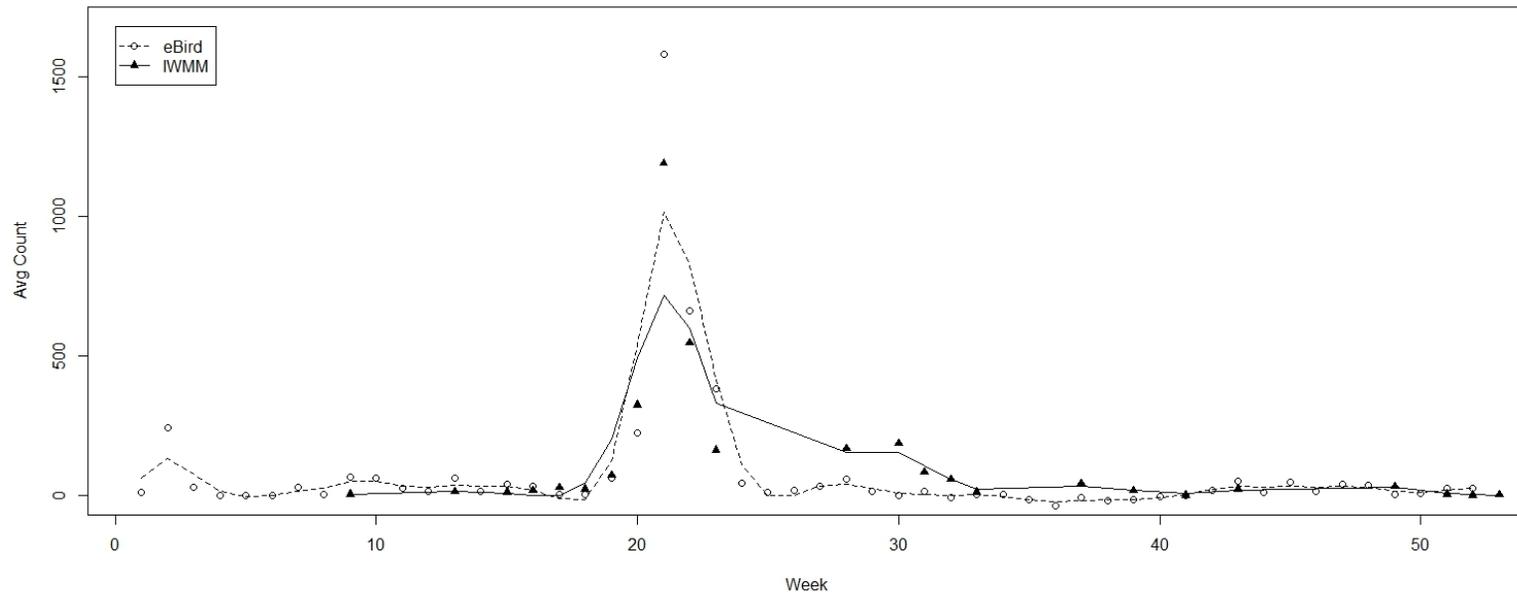
Summary of weekly American Black Duck eBird and IWMM counts at Chincoteague National Wildlife Refuge



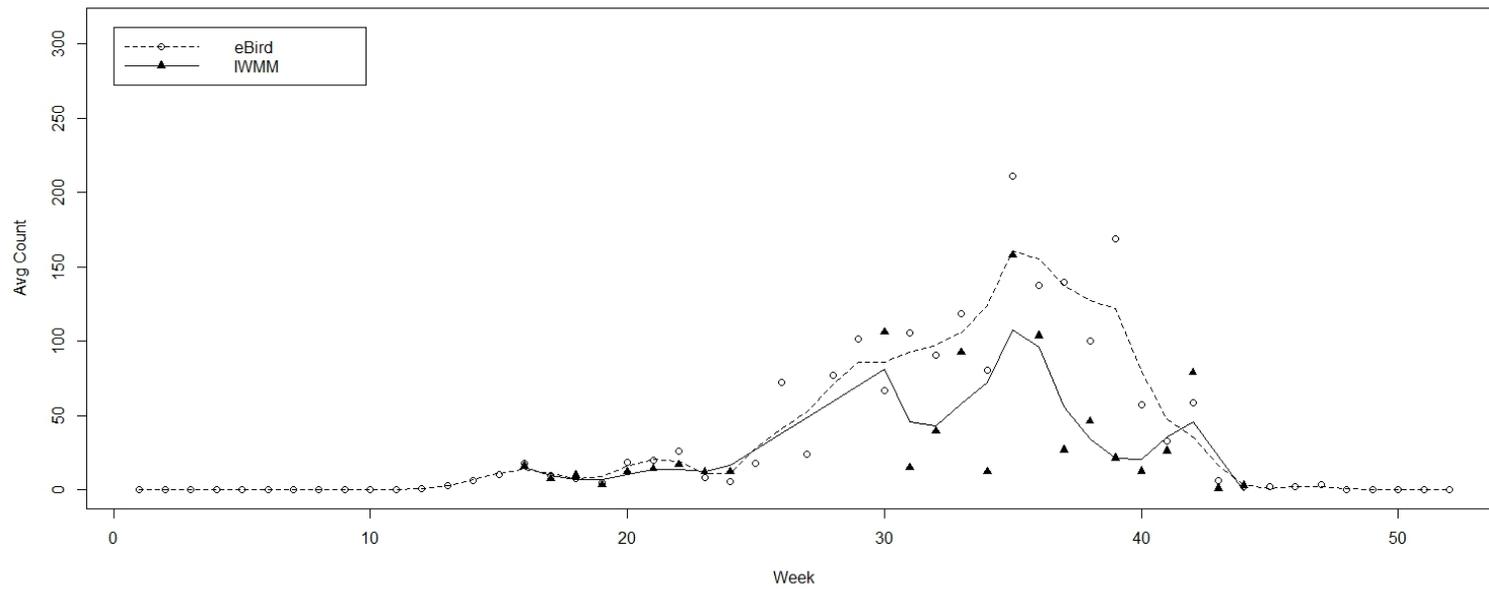
Summary of weekly Semipalmated Sandpiper eBird and IWMM counts at Parker River National Wildlife Refuge



Summary of weekly Red Knot eBird and IWMM counts at Prime Hook NWR, Milton. De



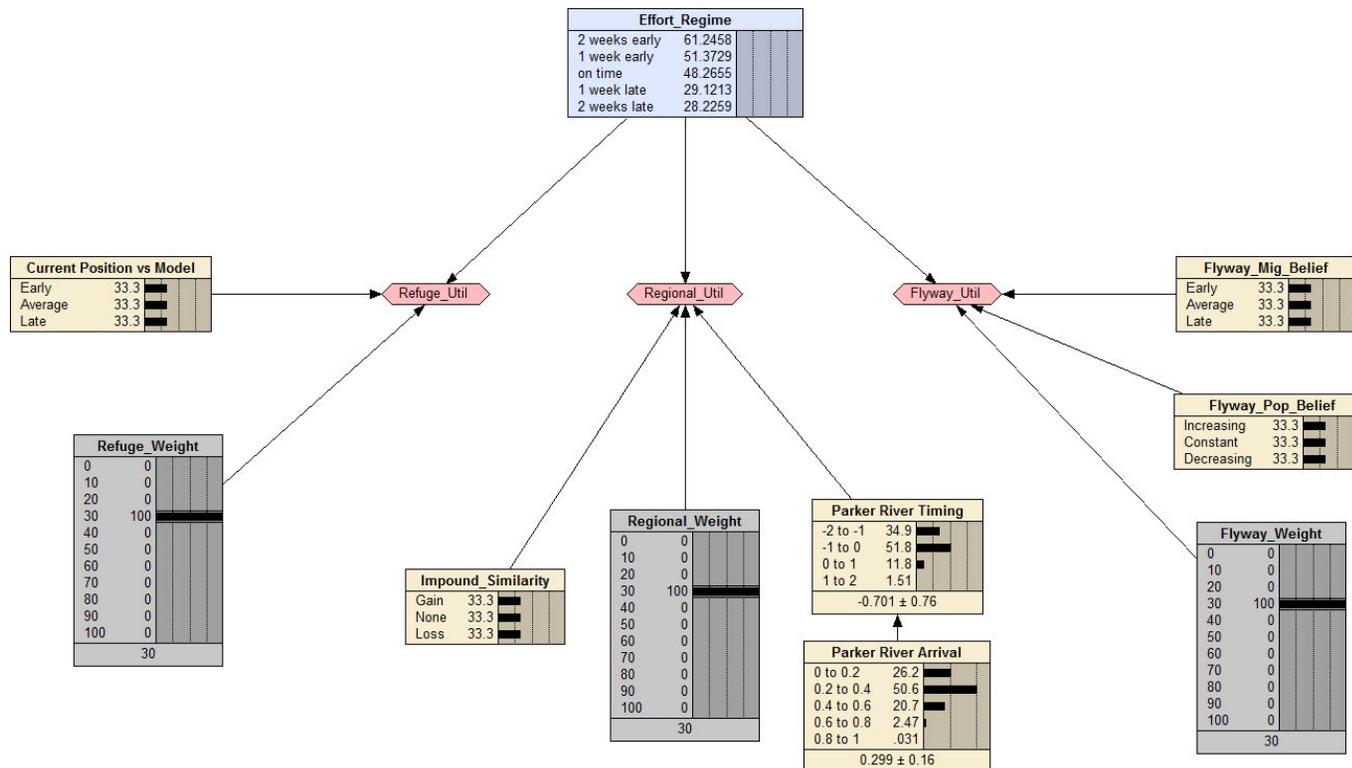
Summary of weekly Great Egret eBird and IWMM counts at Iroquois NWR

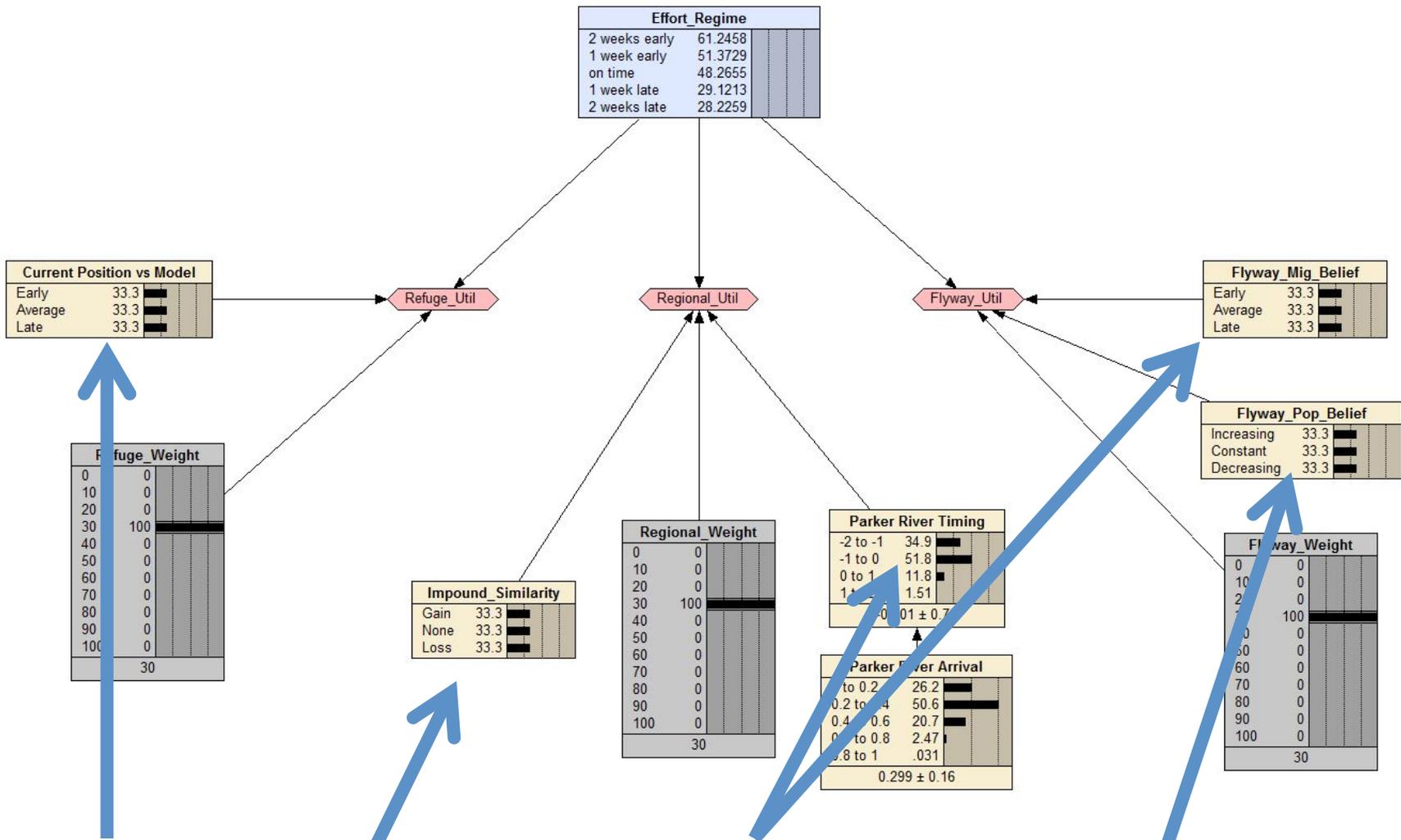


Practical Application (Close the Loop)

– Integrate 3 Spatial Scales

- Count effort (or management) timing





Sine Curve

Impoundment Catalog

CCF

Surface Generation

Effort_Regime	
2 weeks early	75.0000
1 week early	62.0000
on time	60.5000
1 week late	14.0000
2 weeks late	11.0000

Current Position vs Model	
Early	0
Average	100
Late	0

Refuge_Util

Regional_Util

Flyway_Util

Flyway_Mig_Belief	
Early	0
Average	100
Late	0

Flyway_Pop_Belief	
Increasing	33.3
Constant	33.3
Decreasing	33.3

Refuge_Weight	
0	0
10	0
20	0
30	100
40	0
50	0
60	0
70	0
80	0
90	0
100	0
30	

Impound_Similarity	
Gain	0
None	0
Loss	100

Regional_Weight	
0	0
10	0
20	0
30	100
40	0
50	0
60	0
70	0
80	0
90	0
100	0
30	

Parker River Timing	
-2 to -1	0
-1 to 0	100
0 to 1	0
1 to 2	0
-0.5 ± 0.29	

Parker River Arrival	
0 to 0.2	0
0.2 to 0.4	100
0.4 to 0.6	0
0.6 to 0.8	0
0.8 to 1	0
0.3 ± 0.058	

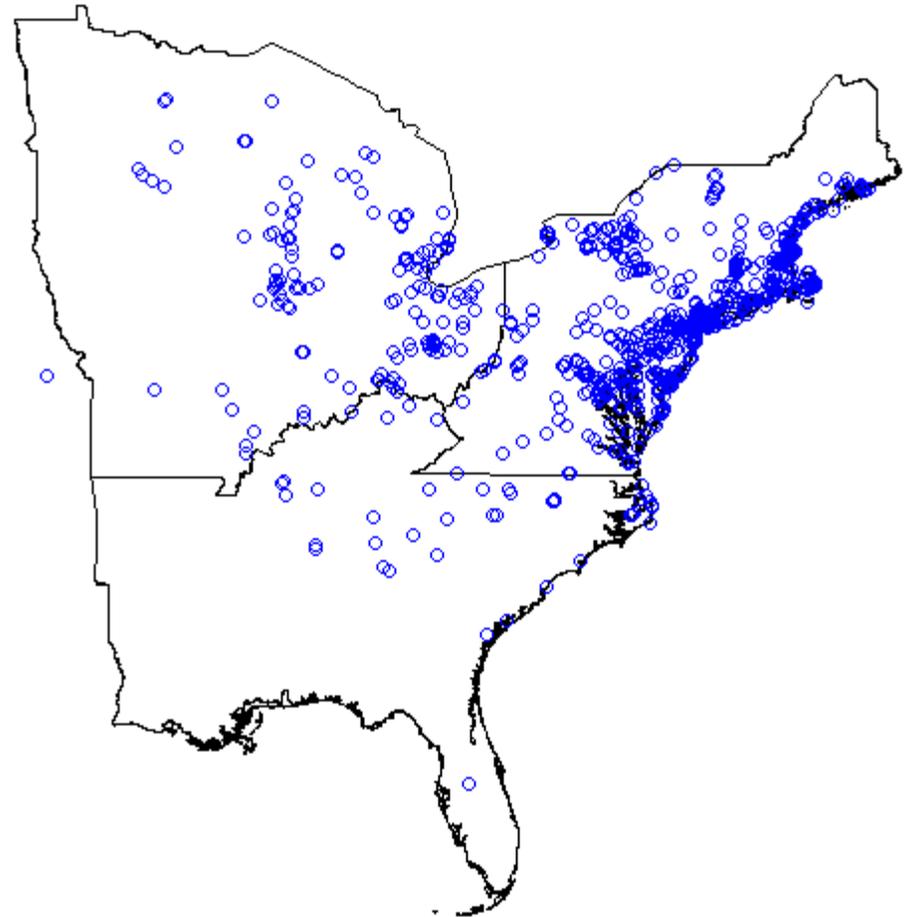
Flyway_Weight	
0	0
10	0
20	0
30	100
40	0
50	0
60	0
70	0
80	0
90	0
100	0
30	

Application 2 – Disease Surveillance

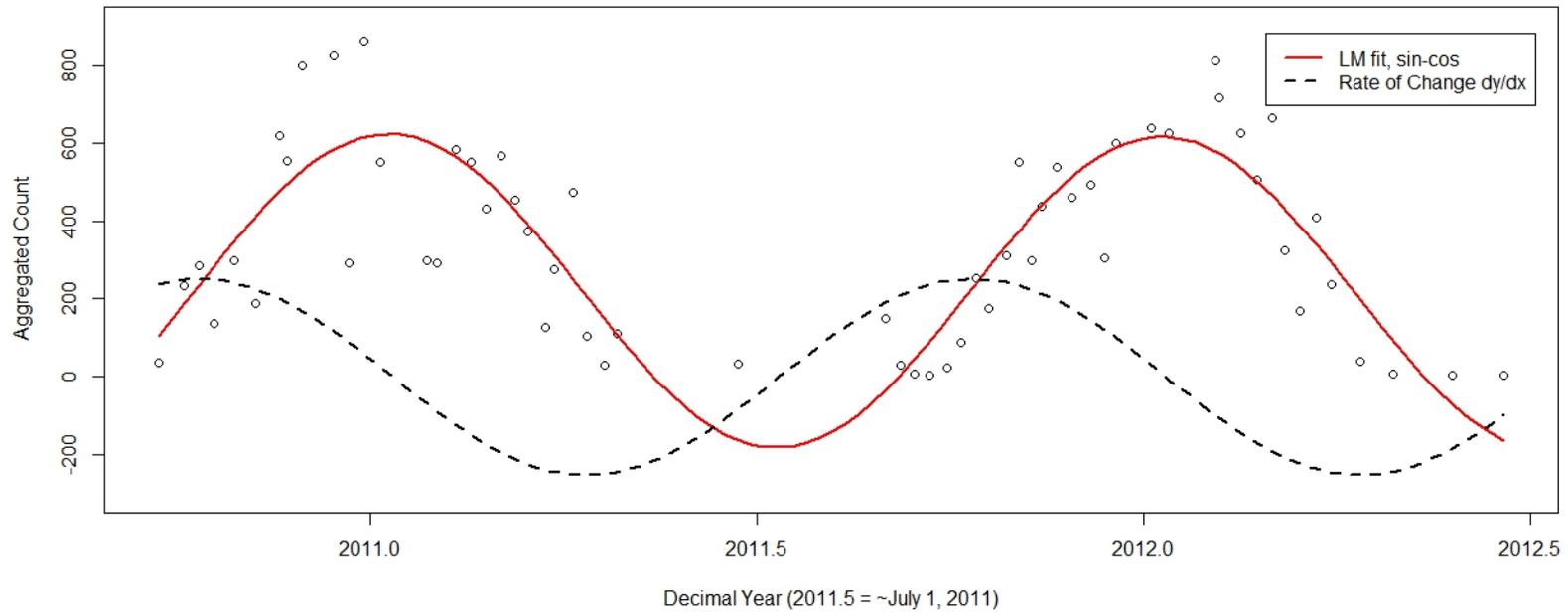
- Assisting efforts led by Chris Dwyer, Division of Migratory Birds, R5, USFWS
- Inherent lag between mortality event, sampling, confirmation, and surveillance response
- Can we use bird counts to recreate the distribution of birds at time t and time $t + lag$?

Can we use bird counts to recreate the distribution of birds at time t and time $t+lag$?

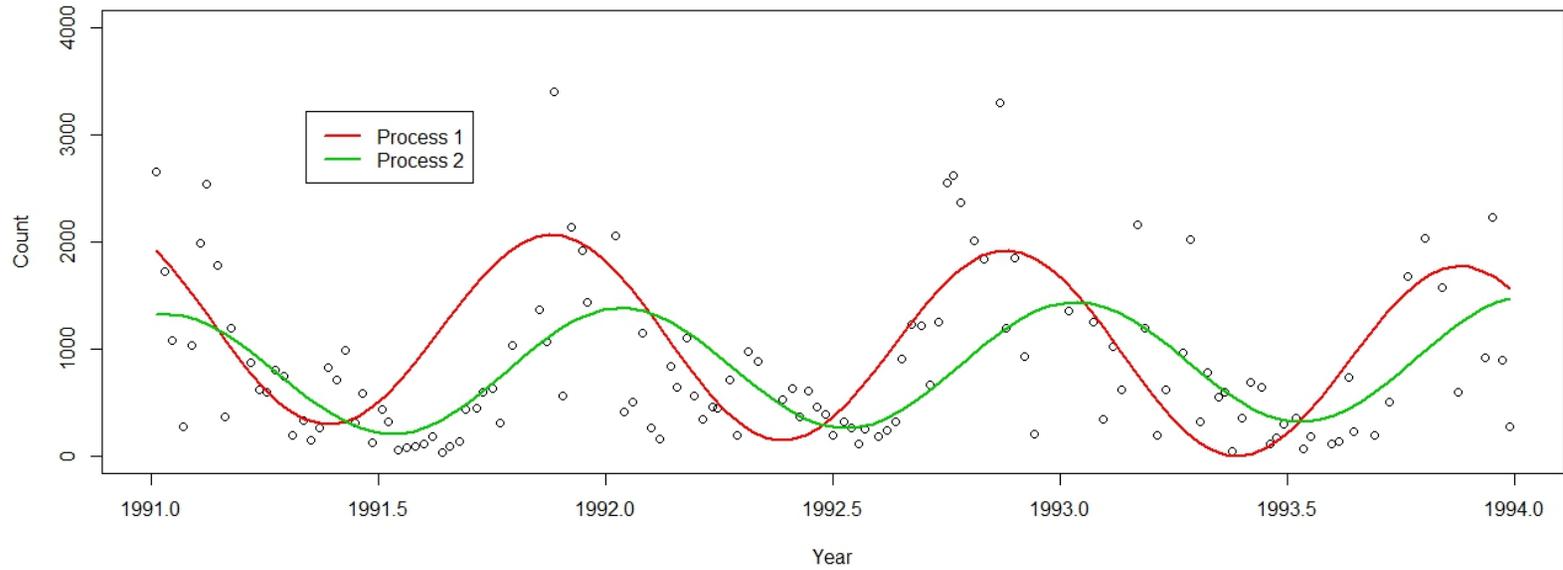
- Start with known range of species of interest
- Estimate basic movement parameters from NWR counts



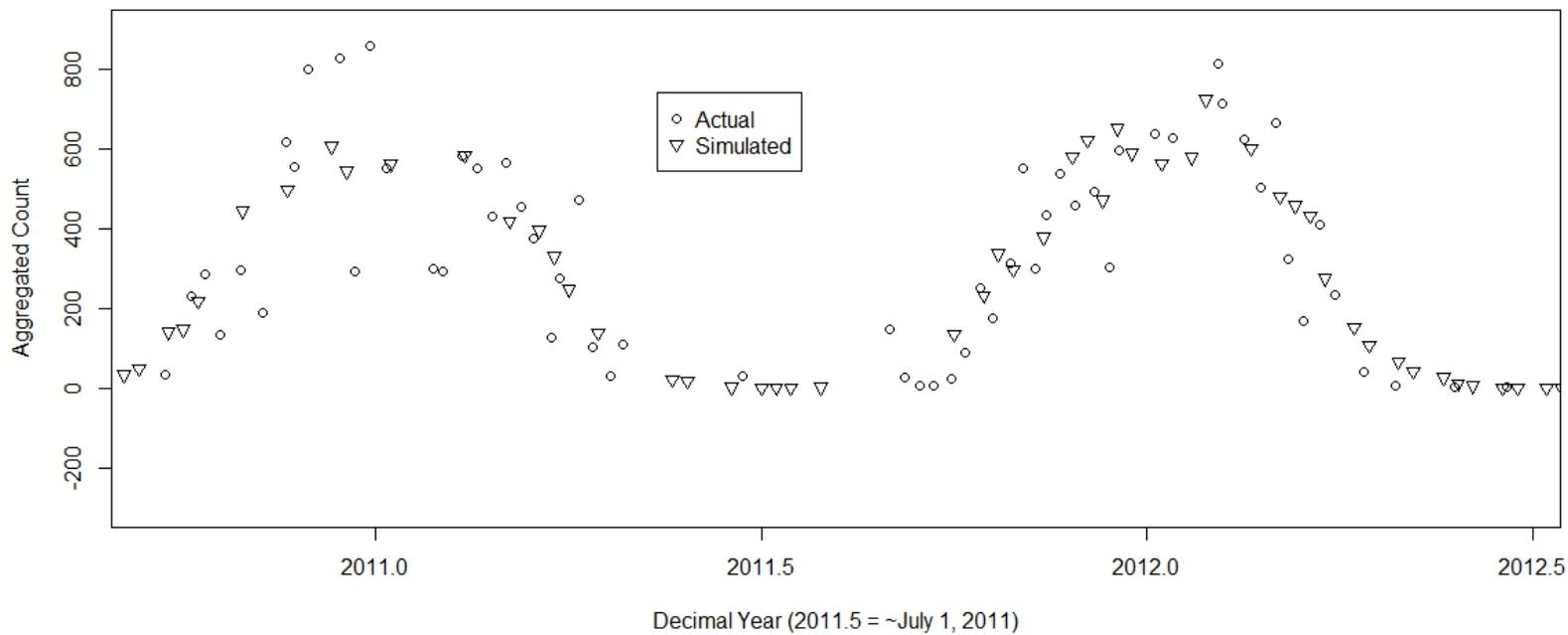
ABDU Counts, CNWR, 2010-2013



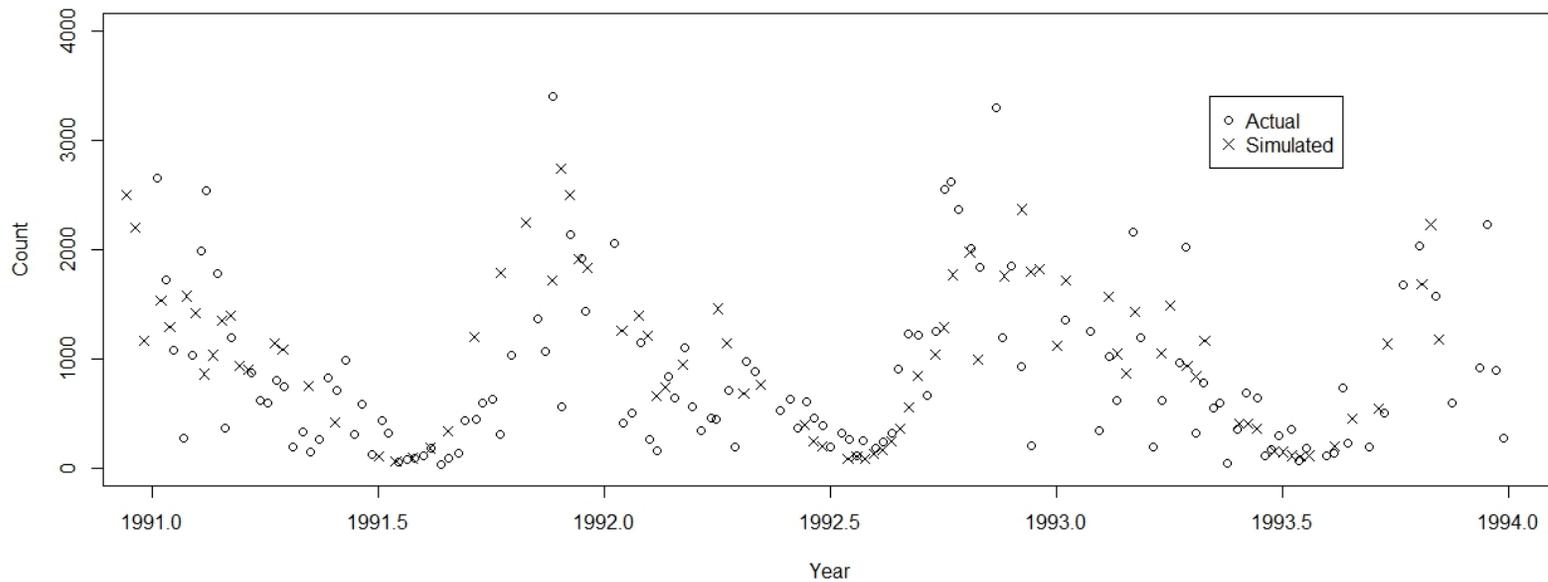
EBF NWR ABDU Counts



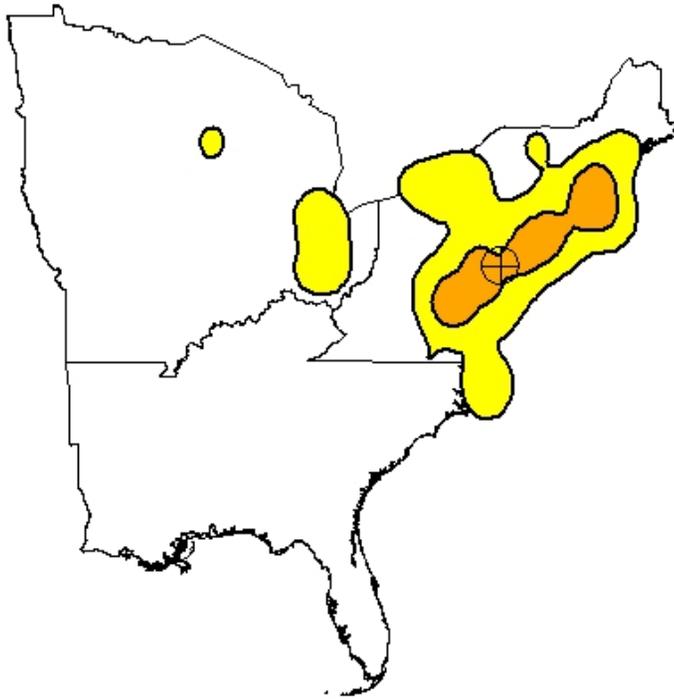
ABDU Counts, CNWR, 2010-2013



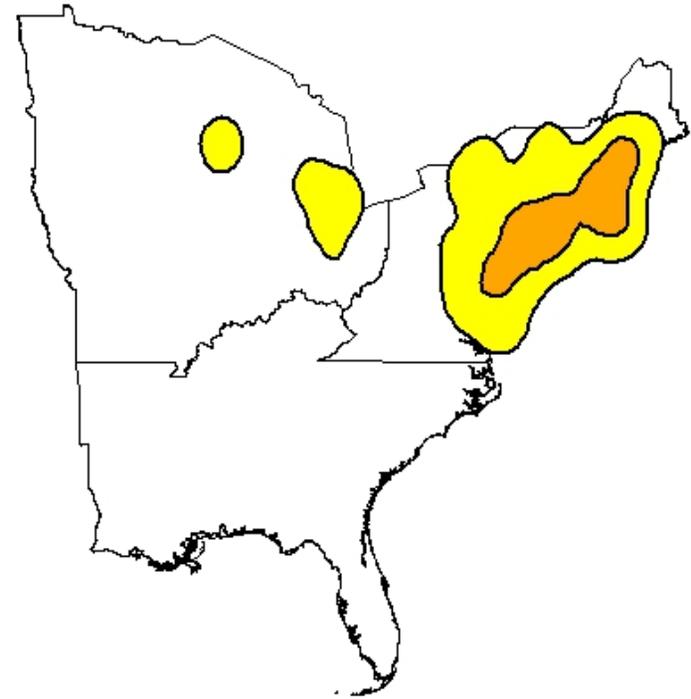
EBF NWR ABDU Counts



Atlantic and Mississippi Flyways, USFWS Regions 3, 4, 5



January 20th



March 1

Conclusions

- Closing the gap between data and decision
 - At multiple spatial scales: refuge, region, flyway
 - Using multiple data sources
 - With multiple agencies
- Informing management
 - Transparent
 - Defensible
 - Timely
 - Iterative

Questions?

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