Investigating the population dynamics of the American Oystercatcher on the islands of Massachusetts

Sean Murphy, City University of New York

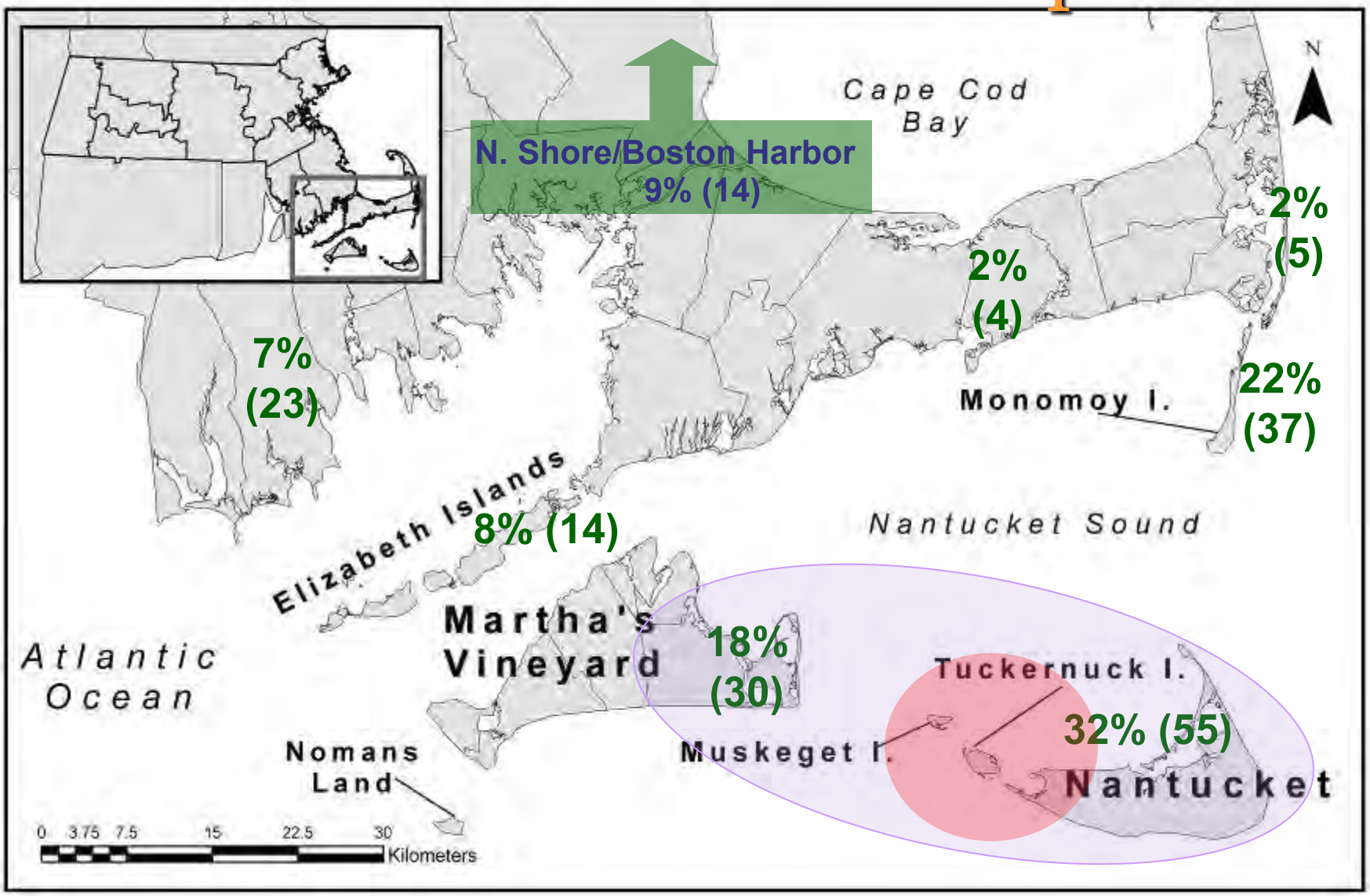
Objectives

1. **Color banding:** Current status in Nantucket County, Massachusetts

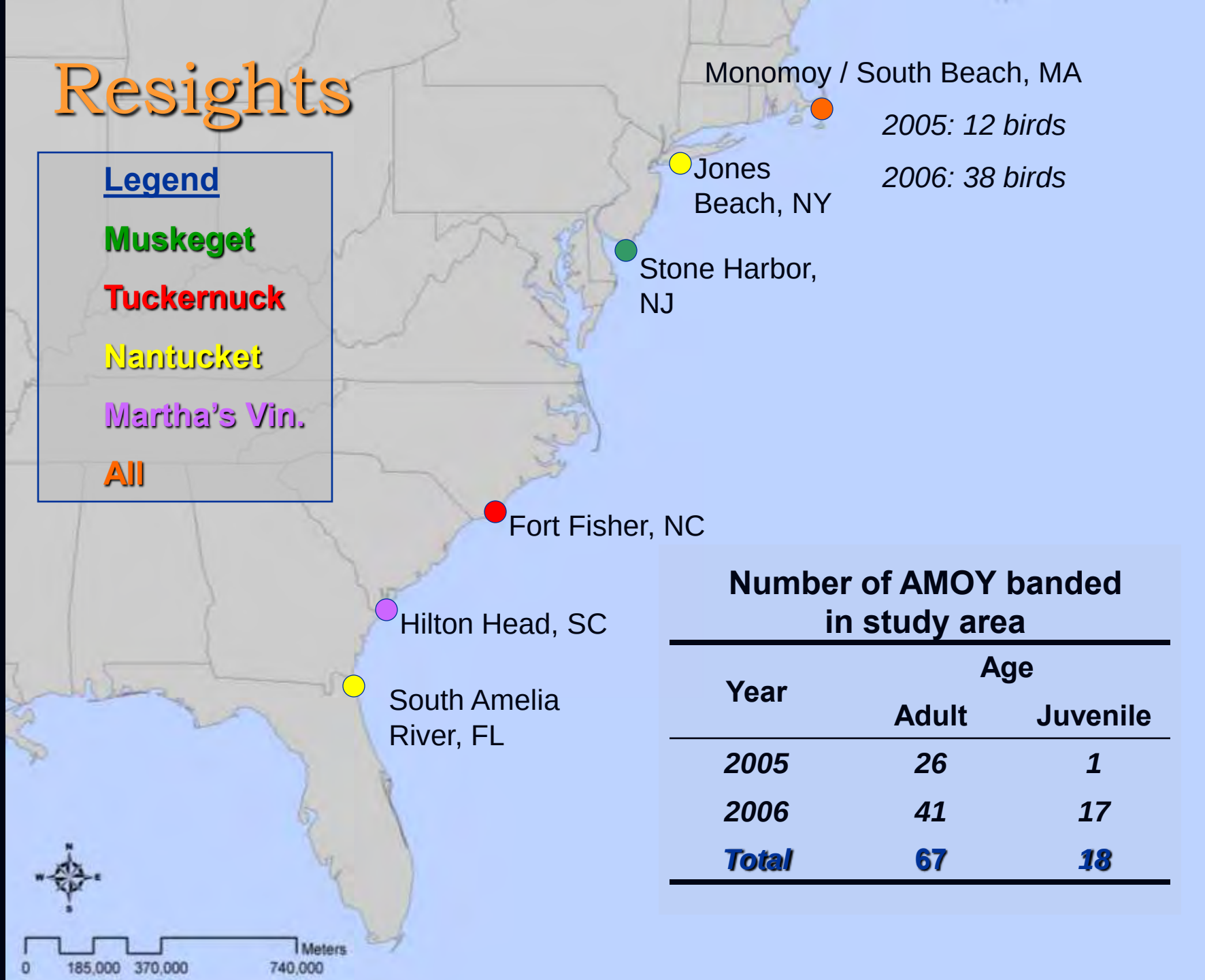
2. **Population model:** Investigate and predict local population dynamics

3. **Molecular techniques:** Introduce the utility of microsatellites to investigate population dynamics

2006 state total = 180 pairs



Resights



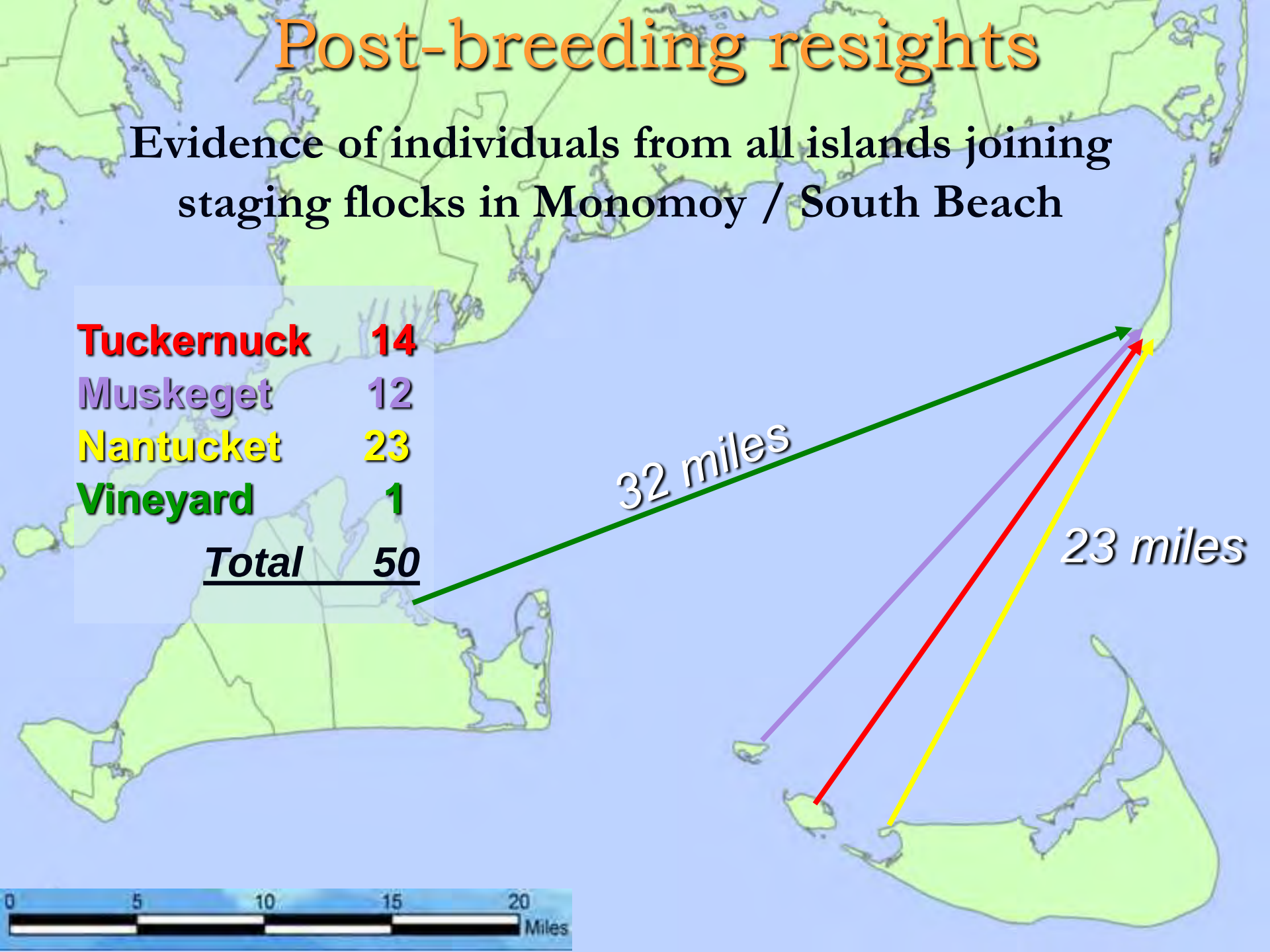
Number of AMOY banded in study area

Year	Age	
	Adult	Juvenile
2005	*26*	*1*
2006	*41*	*17*
Total	***67***	***18***

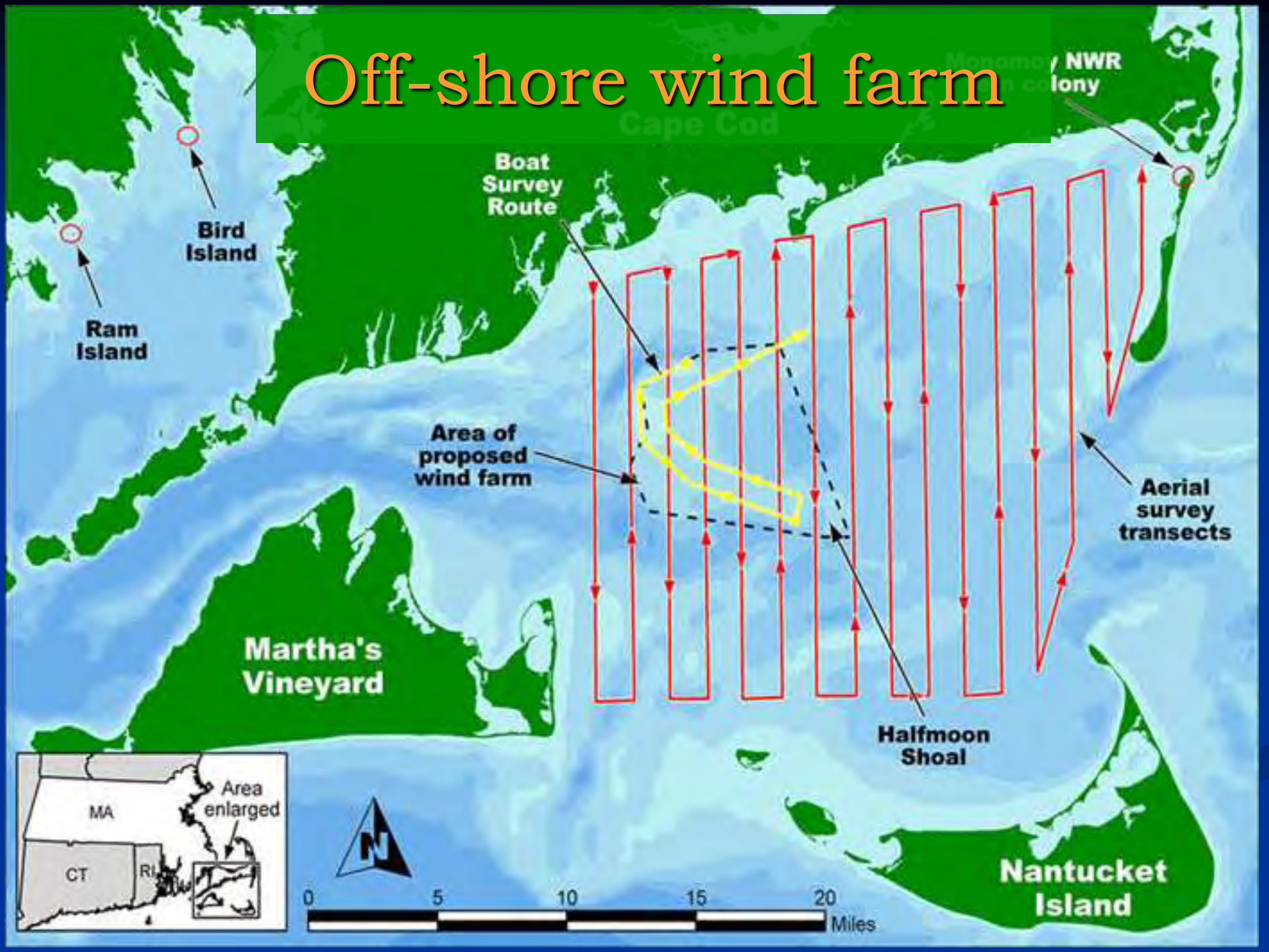
Post-breeding resights

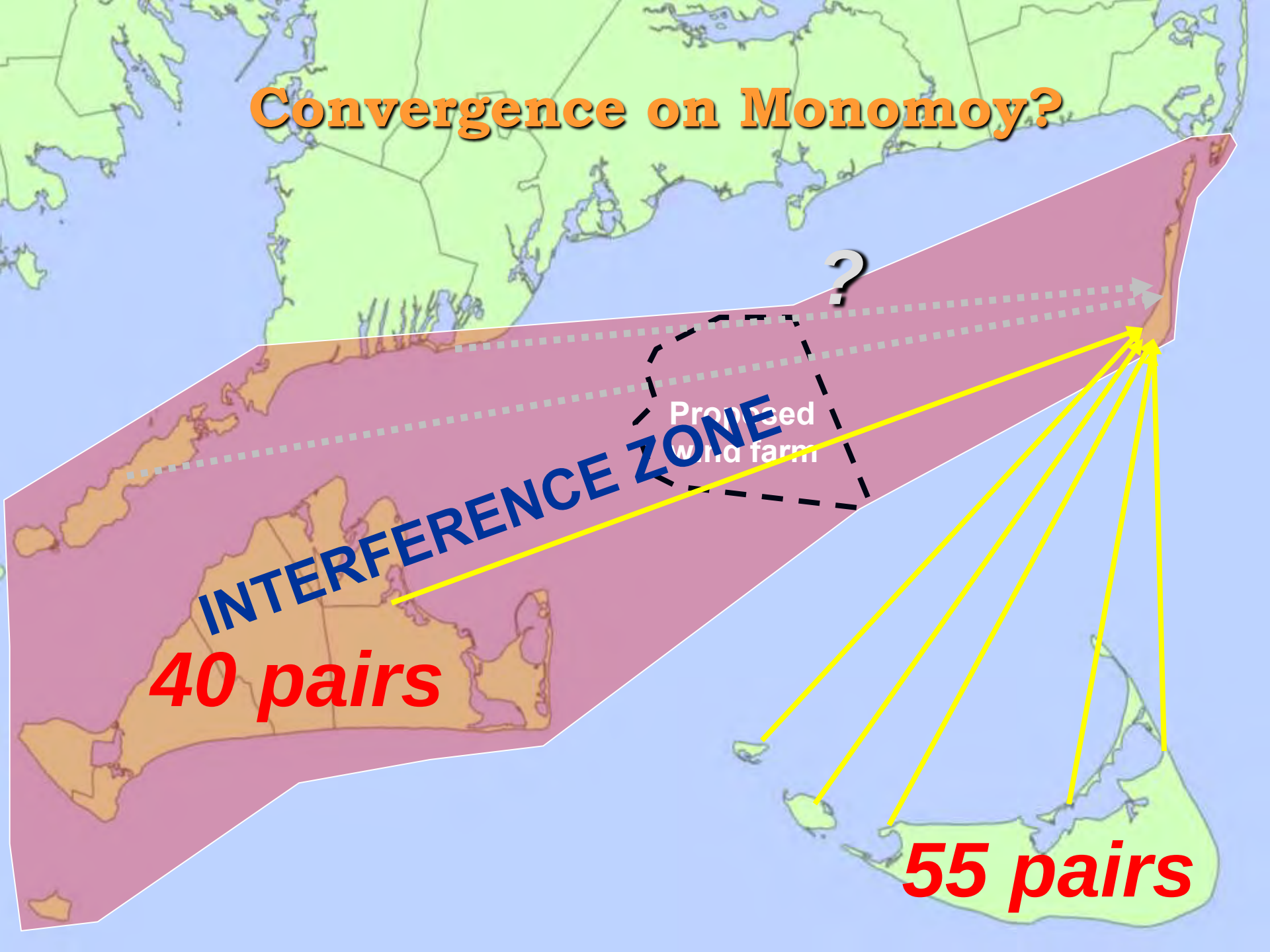
Evidence of individuals from all islands joining staging flocks in Monomoy / South Beach

Tuckernuck	**14**
Muskeget	**12**
Nantucket	**23**
Vineyard	**1**
Total	***50***



Off-shore wind farm




Convergence on Monomoy?
?
Proposed
wind farm
INTERFERENCE ZONE
40 pairs
55 pairs

Color-banding conclusions

- Oystercatchers breeding in Nantucket Co. are dispersing north to Monomoy Island

- Preliminary results hint at a large wintering distribution

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Leslie matrix population model

$$\mathbf{N}_{t+1} = \mathbf{A} * \mathbf{N}_t + \mathbf{I}_t$$

Projected population

Population at time *t*

Immigration matrix

Population projection matrix

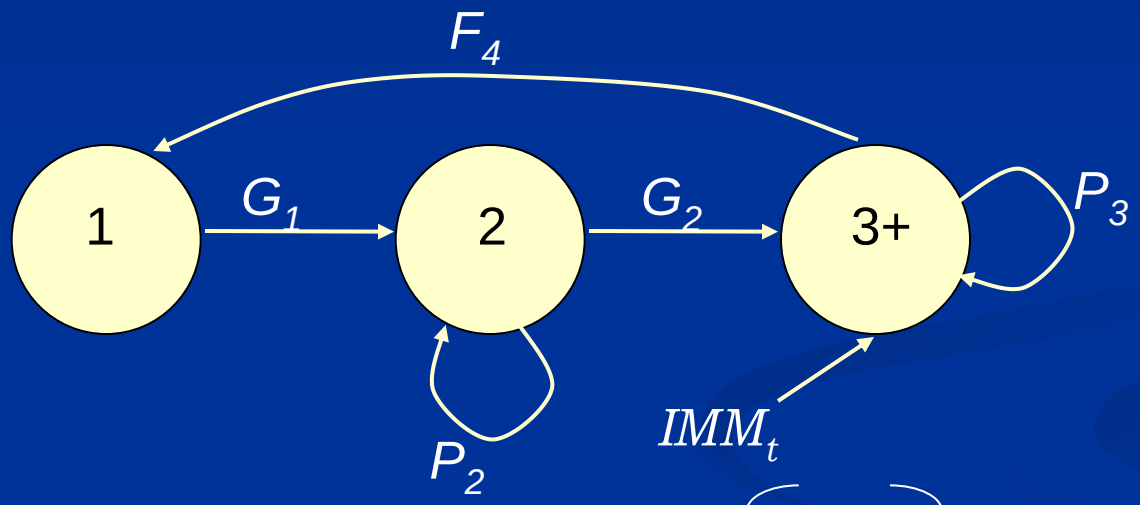
$$A = \begin{pmatrix} 0 & 0 & F_3 \\ G_1 & P_2 & 0 \\ 0 & G_2 & P_3 \end{pmatrix}$$

$$I = \begin{pmatrix} 0 \\ 0 \\ IMM_t \end{pmatrix}$$

Life-cycle and matrices

Lifespan:

Juvenile.....Subadult.....Adult

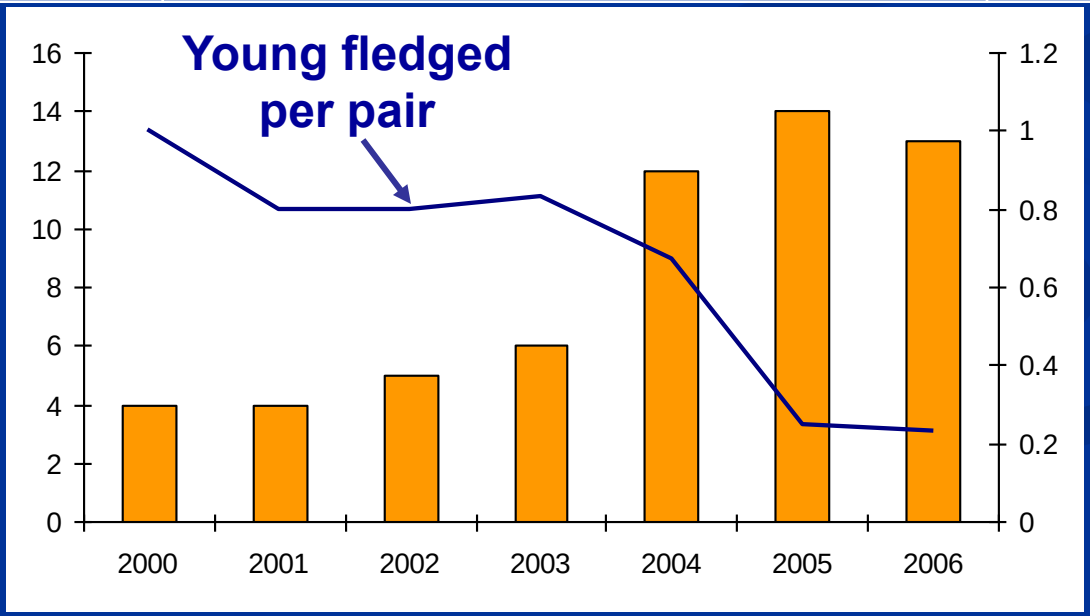


$$A = \begin{bmatrix} 0 & 0 & F_3 \\ G_1 & P_2 & 0 \\ 0 & G_2 & P_3 \end{bmatrix} \qquad I = \begin{bmatrix} 0 \\ 0 \\ IMM_t \end{bmatrix}$$

$$N_{t+1} = A * N_t + I_t$$

Parameter values

Stage	Class	Demographic parameters	Surv $_i$	Fecundity $_i$
1	Juvenile	s_1	0.950	0
2	Subadult	p_2	0.751	0
2	Subadult	s_2	0.199	0
3+	Adult	p_3	0.950	0.3272 *SD ±0.149*
rr	Return rates	rr_{EUOY} = 0.89 (Durrell et al. 2000)	-	-
IMM_t	Immigration	Adult females per breeding season	-	-

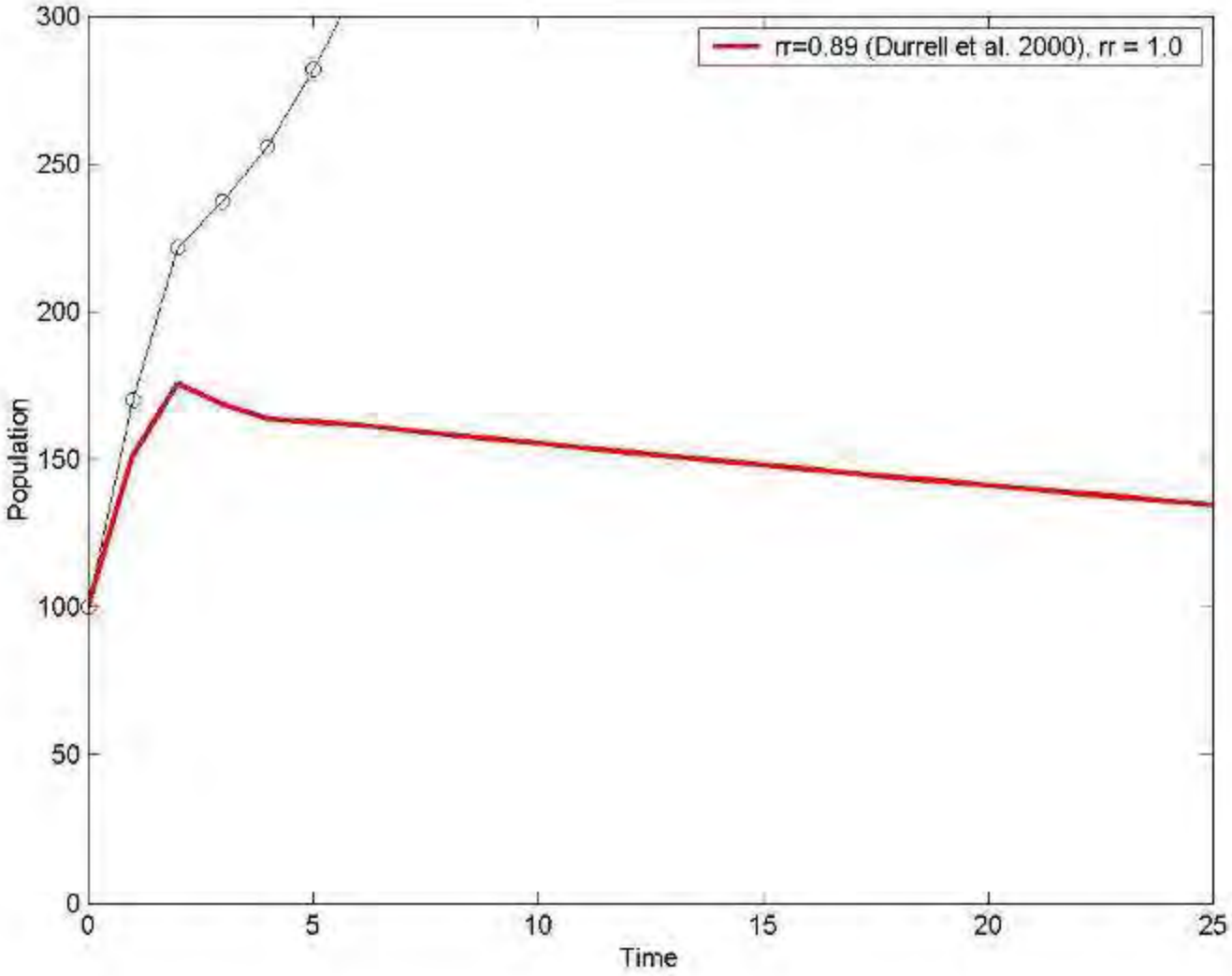


Elasticity analysis

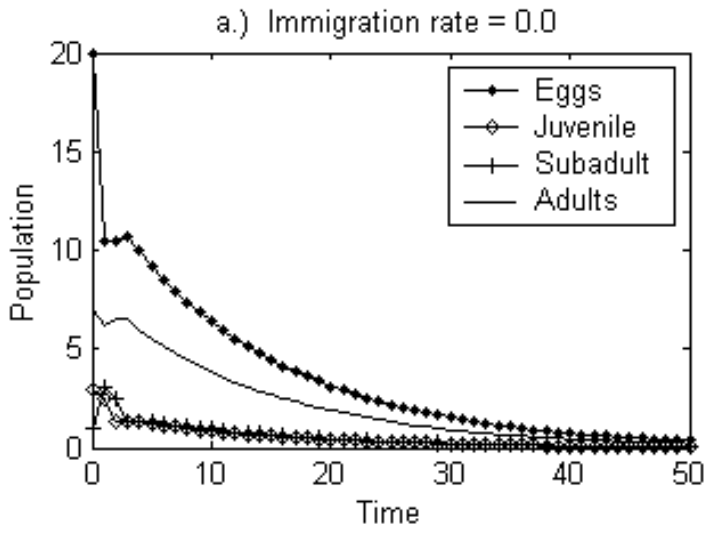
Elasticity of adult survival, $E_{33} = 0.603$

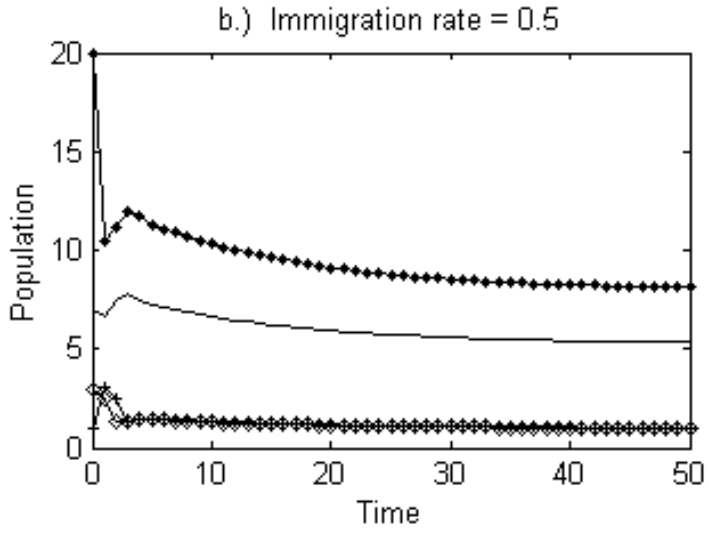
Class name	Class in year t+1	Class in year t			
		1	2	3	
Juvenile	1	0.1015	0	0.092	
Subadult	2	0	0.1015	0	
Adult	3	0	0	0.6034	

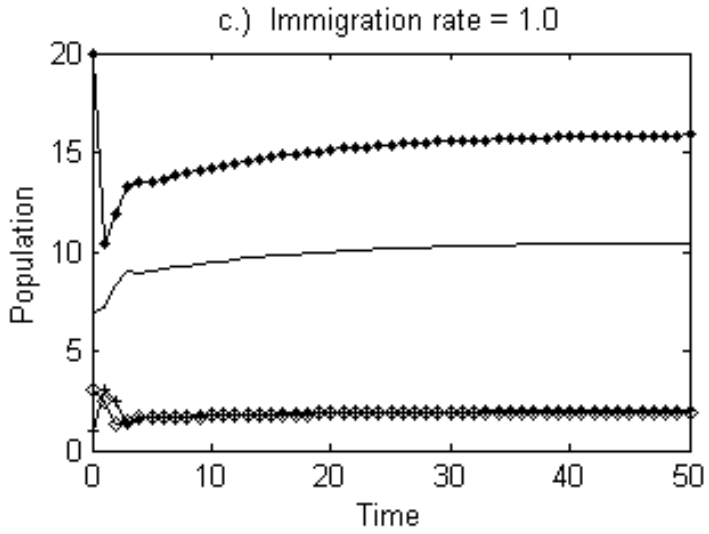
Population trajectory

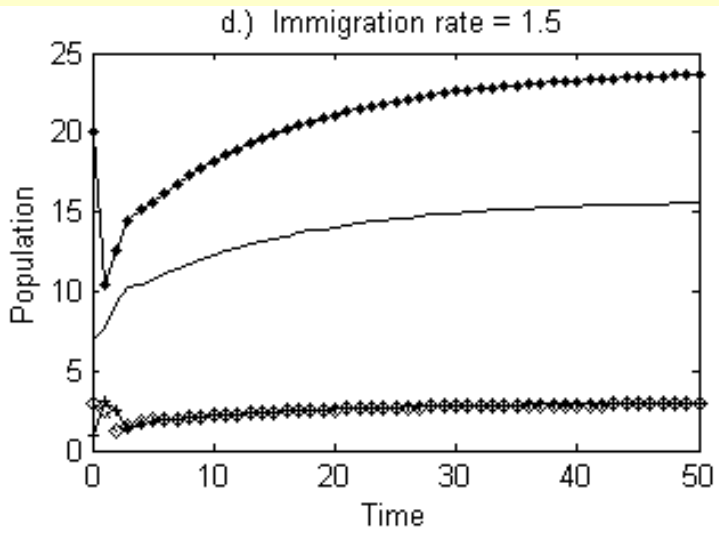


Immigration









Summary

According to this model …

- Changes to adult survival (P_3) has the largest impact on the trajectory of the local population.

- The inclusion of immigration predicts a growing *local* population

Photo by Giff

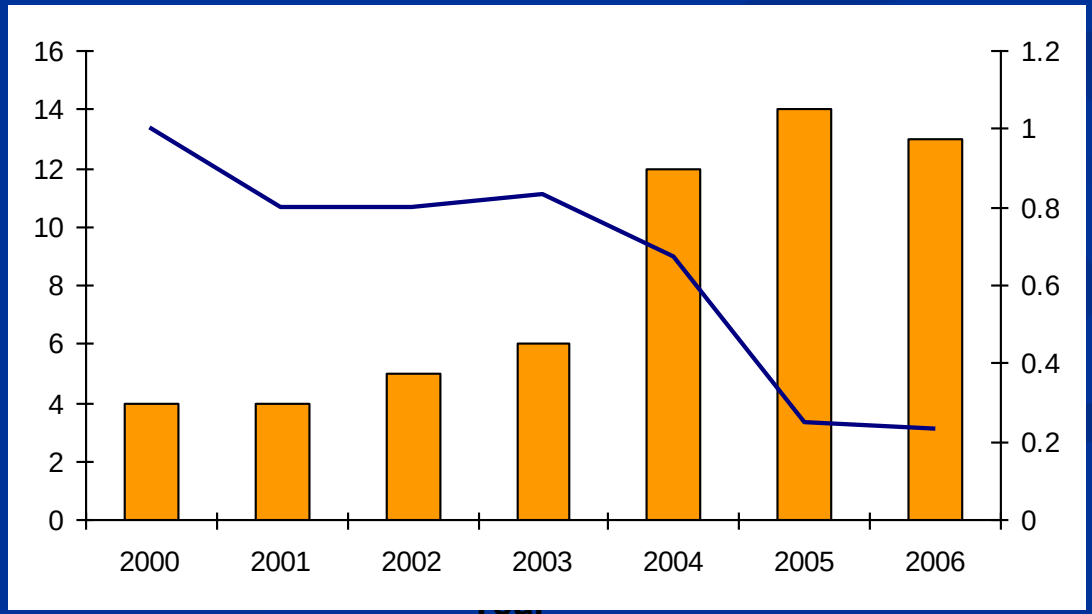
Conclusions: source vs. sink

Sink population – mortality exceeds local recruitment

- Annual productivity

Source population – productivity exceeds mortality

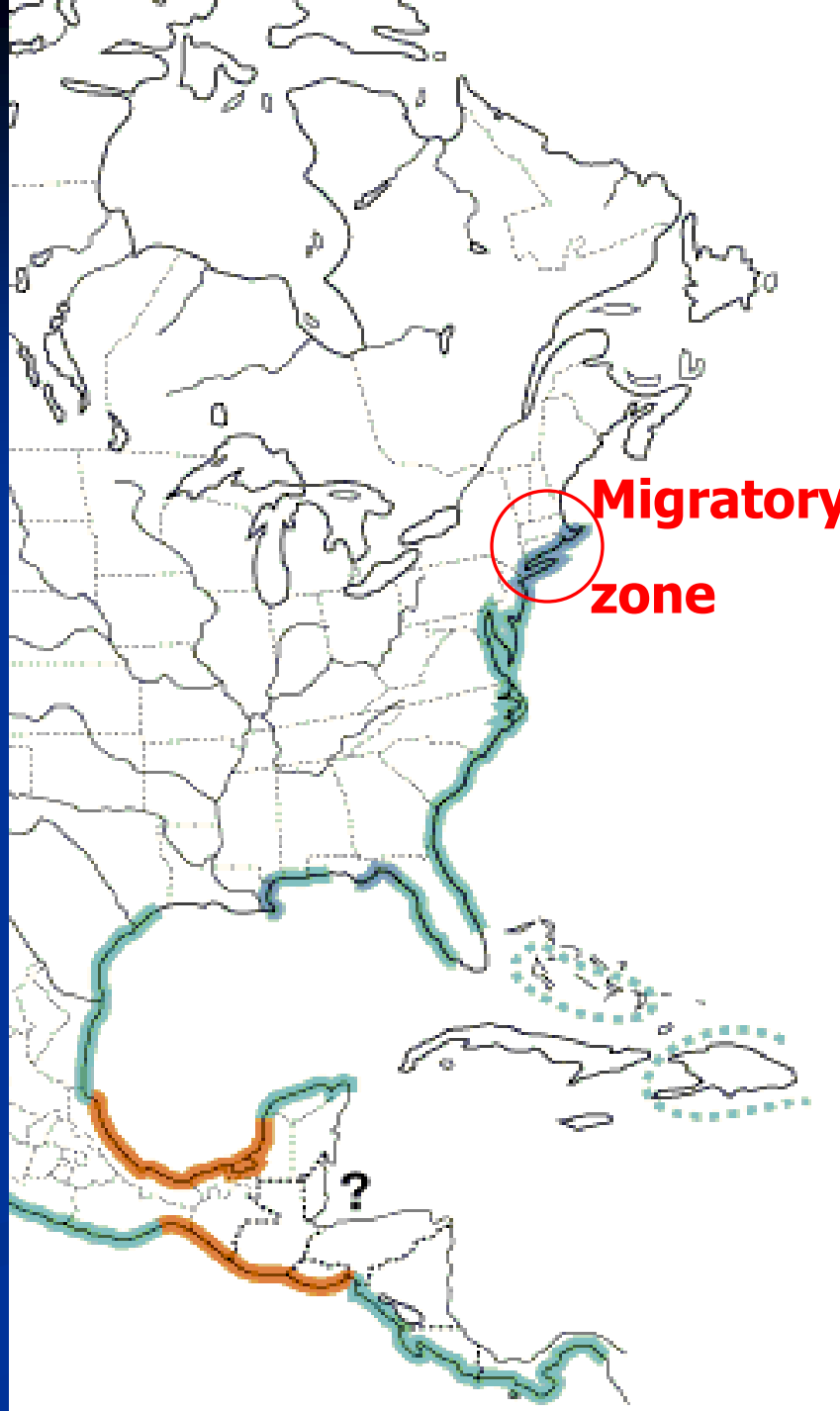
- Nantucket – 38 breeding pairs in 2006
- *???*



Conclusions: management tool

As more demographic data continues to be collected,

Inclusion of an immigration matrix may be vital in understanding populations dynamics located in the migratory region



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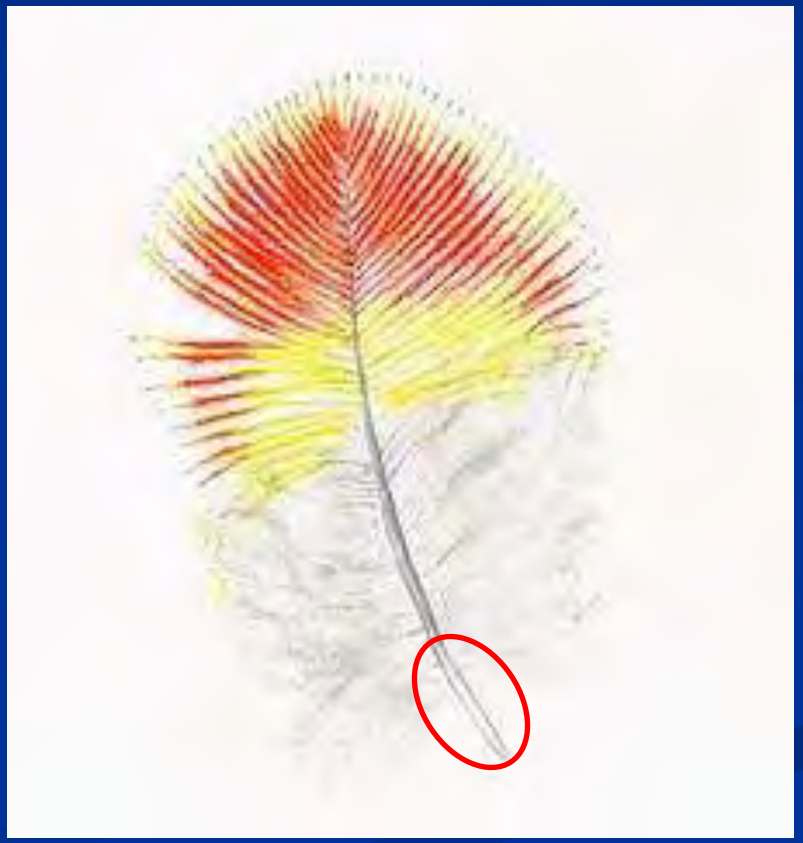
Taberlet and Bouvet (1991): population sampling

Collection:

- 4-5 breast feathers
- Placed in paper envelope, stored in dry place
- Long-term storage: -80° C

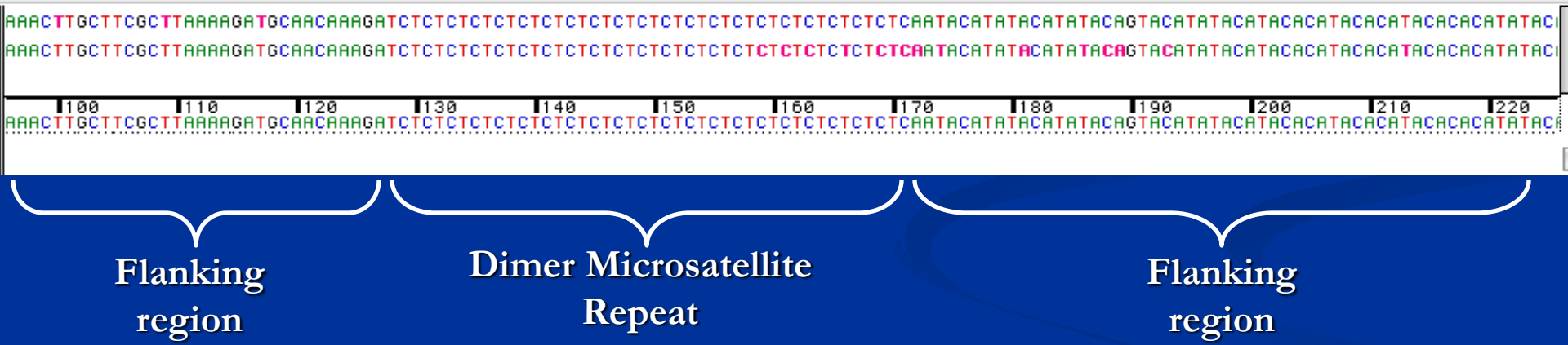
Preparation:

- Cut at base of rachis
- *Extraction*: standard chloroform techniques (Sambrook et al. (1989)



Microsatellites

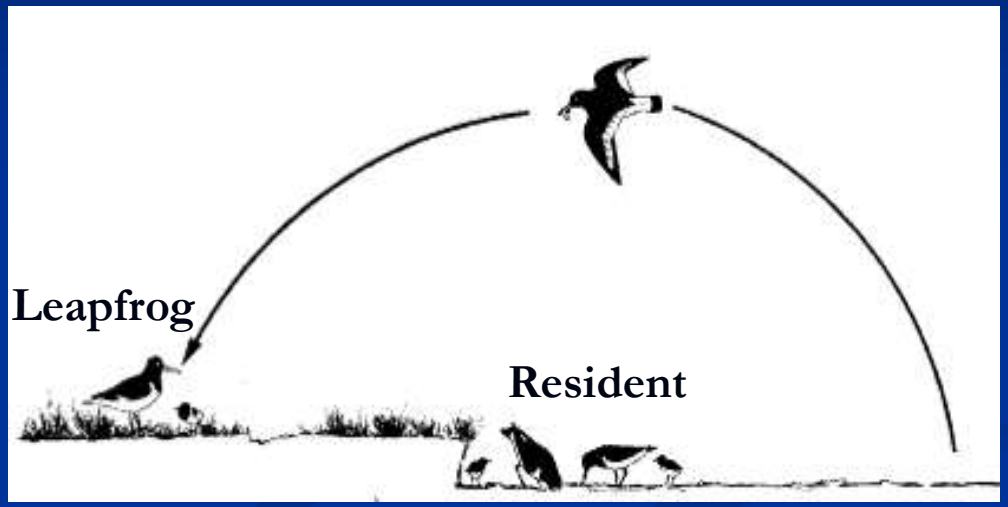
- Polymorphic loci of repeating nuclear DNA
- Flanked by a 30-50 base pair stretch allowing for the development of primers



- Polymorphic and hypervariable → fine scale studies:
  - population history / bottleneck detection / gene flow

Haematopus ostralegus

- 'Residents' and 'leapfrogs' of Schiermonnikoog (Ens et al. 1992)



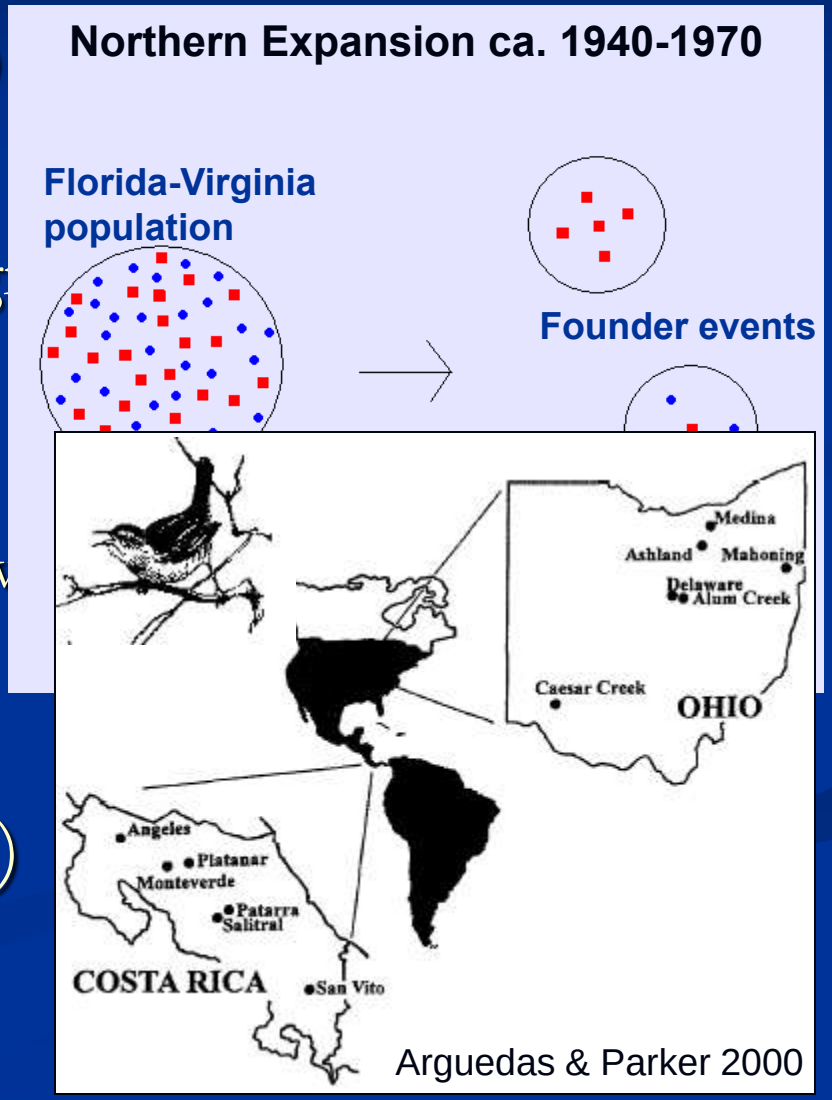
From Ens et al. 1992

- Genetic difference between two social groups?
- Developed 8 variable microsatellite loci for *H. ostralegus* were developed for ostralegus by Van Treuren et al. (1999)
- High levels of gene flow → juvenile dispersal

American Oystercatcher

Molecular analysis of AMOY could facilitate the following:

- Founder events (COLONISE)
- Bottleneck effect
- Genetic difference across geog
  large- and fine-scale
- Variation in gene flow
  - Migration enhances gene flow
  - Gene flow drops with an increase in distance
- N_e, historic λ (BATWING)



Volunteers wanted

More feathers, from more areas throughout the range

Acknowledgements

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Questions…