The Demographic Causes of Population Growth and Decline in Snail Kites

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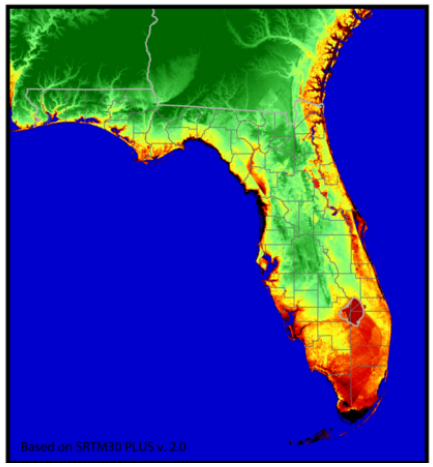
Population biology and conservation

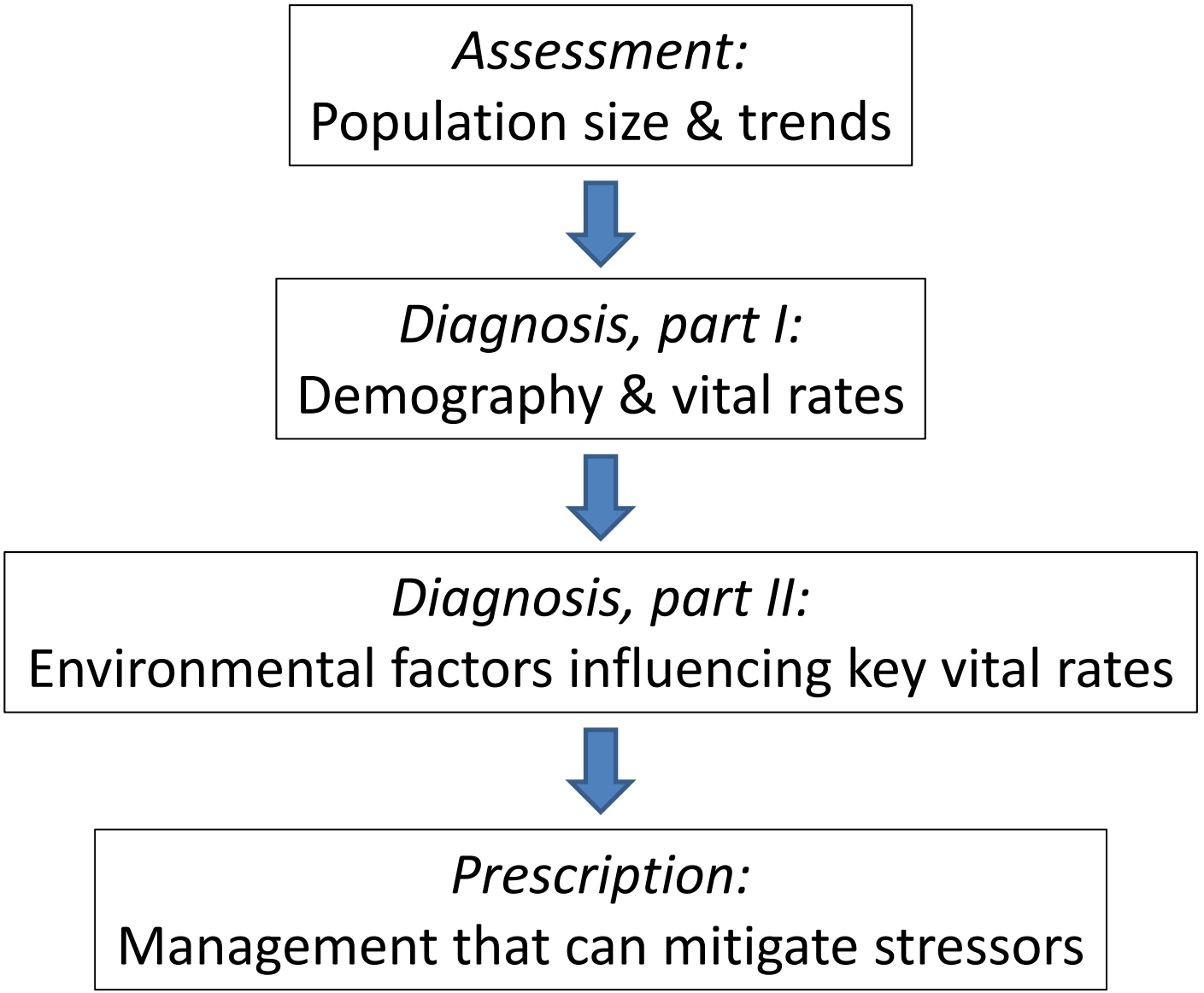
Sea Level Risks - Florida



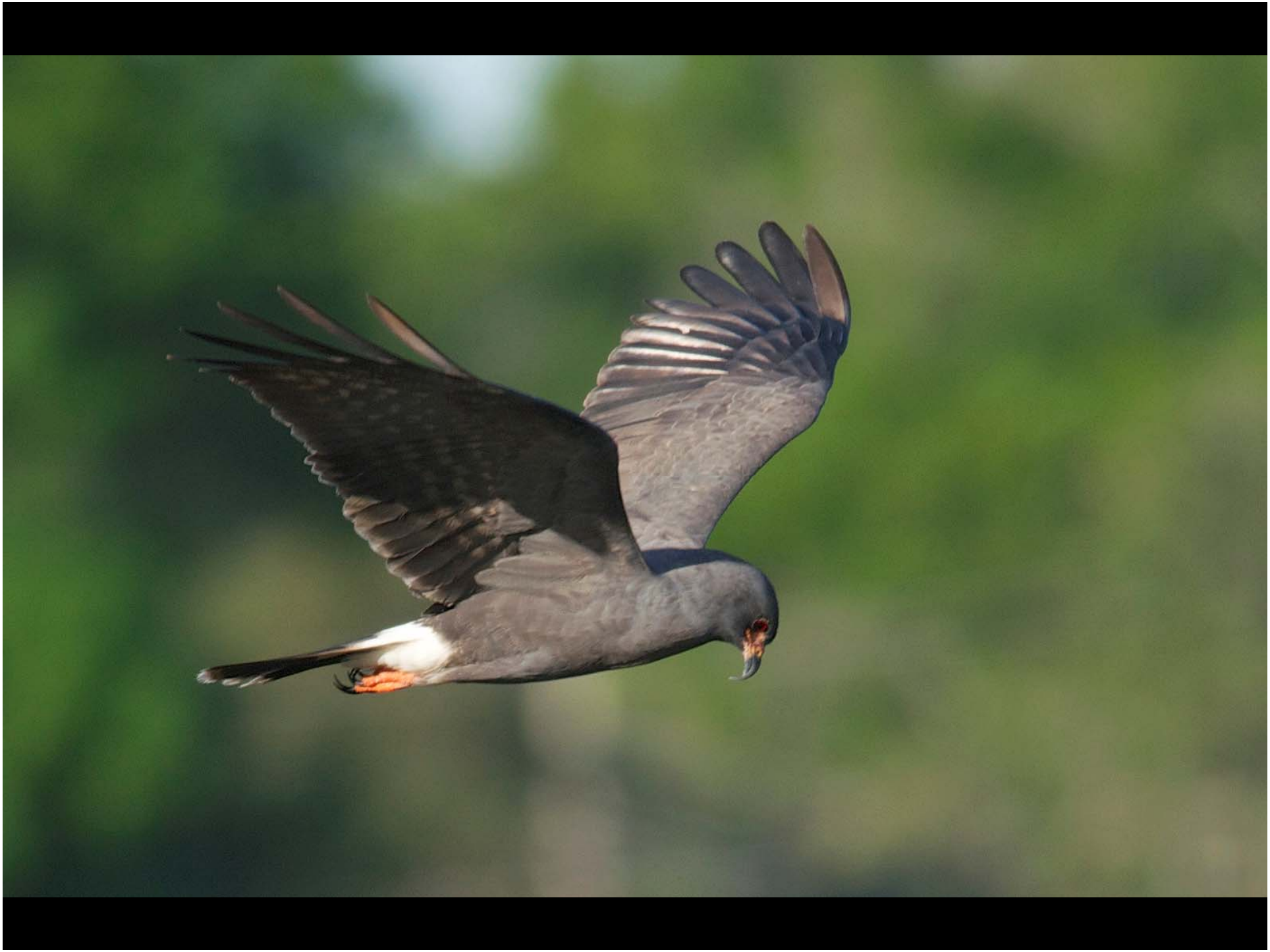
McCleery et al. (2015)

Crowder et al. (1994)

A population framework for conservation



Caswell (2001)



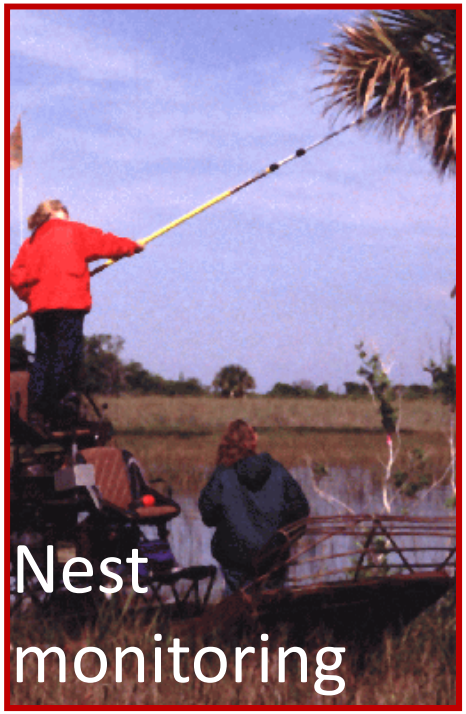
Why snail kites?

- ❑ Critically endangered
- ❑ Wetland dependent
- ❑ Extreme dietary specialist
- ❑ Requires a large spatial extent
- ❑ Confined to central and south Florida
- ❑ But integrates entire system
- ❑ Closely tied to hydrology and water management

The monitoring program:

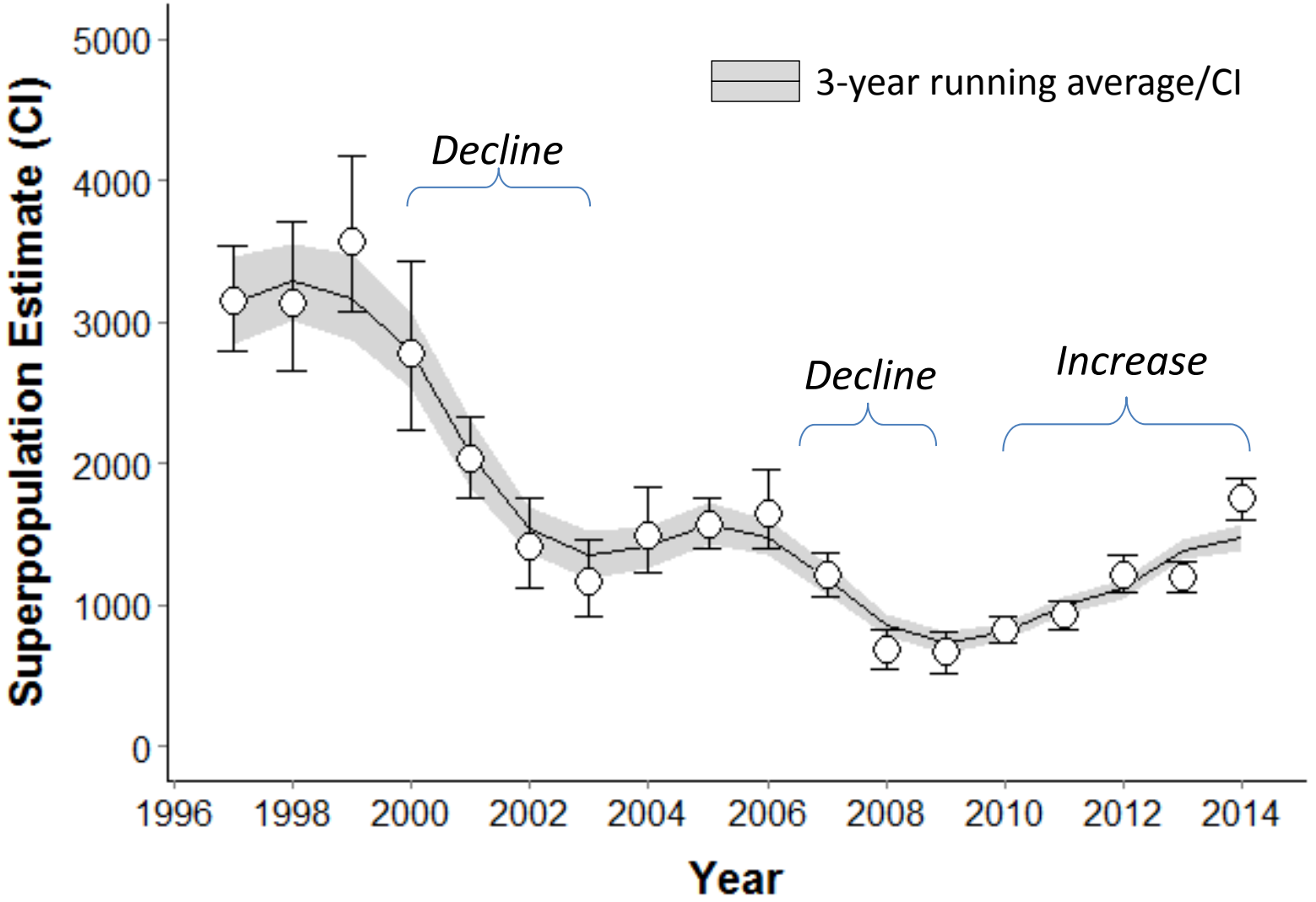
- 6 intra-annual, airboat surveys (~ 3 weeks apart; 1992 to present) to estimate population trends
- Nest monitoring during breeding season and banding of young
- Over 3400 birds banded; over 3300 nests monitored


Surveys

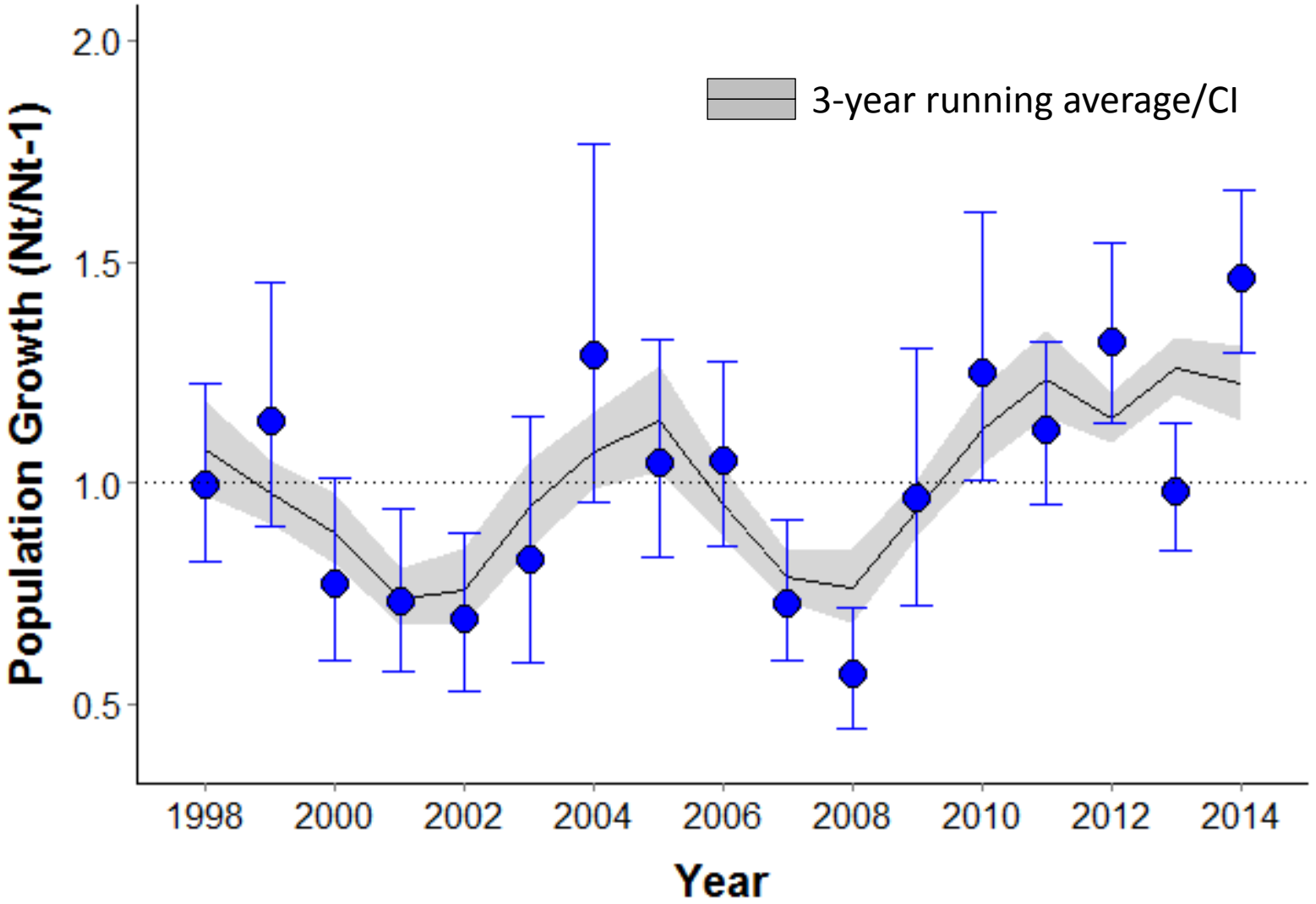

Nest monitoring

Marking

Assessment:
Population size and trends



Population growth rates and kite trends



Diagnosis:
Demography and vital rates

For entire population in Florida

$$\textbf{N}umbers_t = (\textbf{B}irths - \textbf{D}eaths)\, N_{t-1}$$

$$\lambda = \textbf{N}_t/\textbf{N}_{t-1} = \textbf{B}irths - \textbf{D}eaths$$

Reproduction and survival

For specific wetlands in Florida

$$\textbf{N}umbers_t = (\textbf{B}irths - \textbf{D}eaths + \textbf{I}mmigration - \textbf{E}migration)\, N_{t-1}$$

$$\lambda = \textbf{N}_t/\textbf{N}_{t-1} = \textbf{B}irths - \textbf{D}eaths + \textbf{I}mmigration - \textbf{E}migration$$

Movement among wetlands in Florida

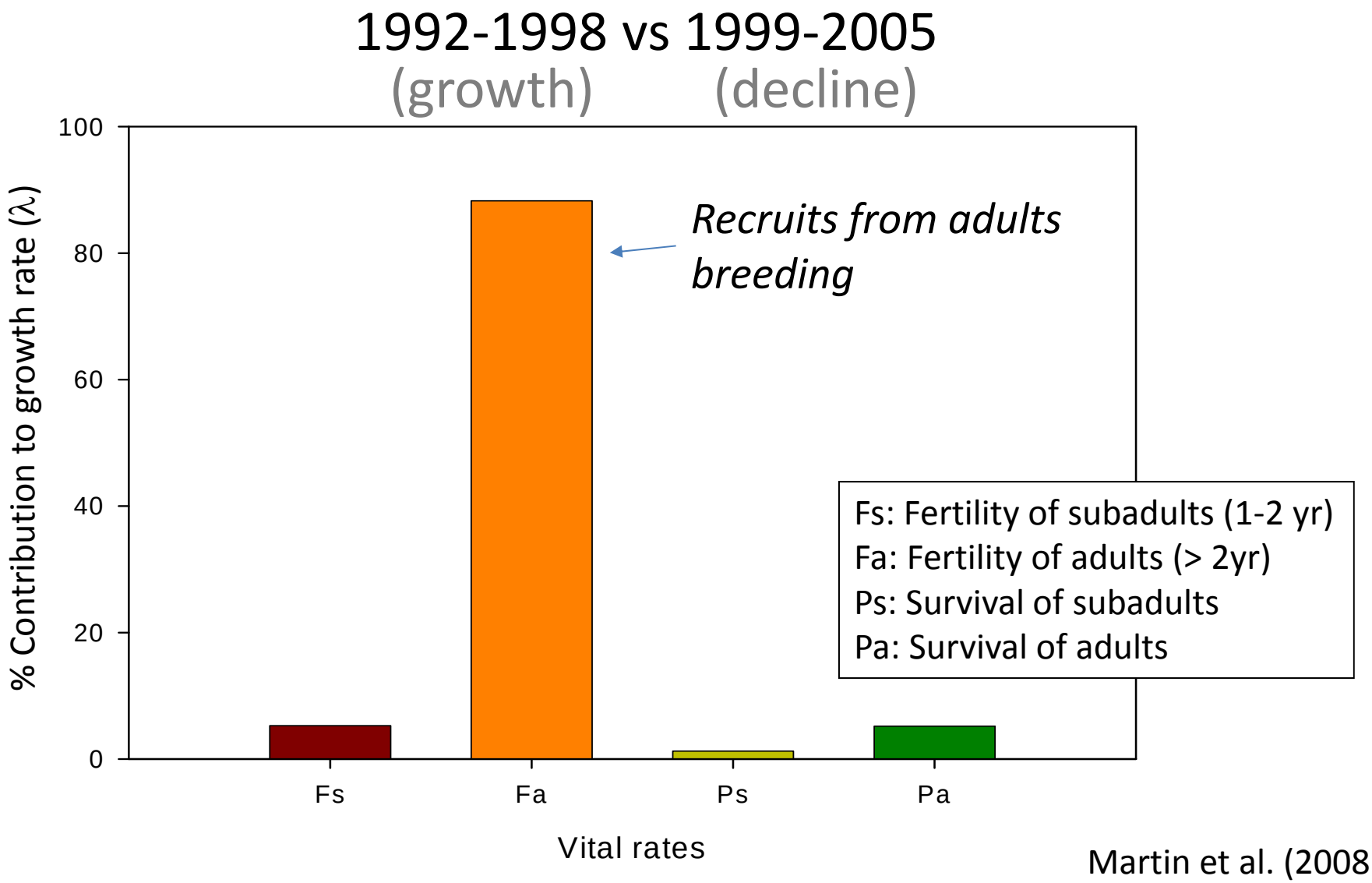
The contribution of vital rates to population growth: interpreting limiting factors

- Population projection models and perturbation analysis
- *Prospective* versus *retrospective* understanding of limiting factors
  - *Prospective:* if one could change a demographic parameter, which would be most important?
  - *Retrospective:* Which demographic parameters best explained observed *changes* in population growth?

$$\mathrm{A} = \begin{bmatrix} F_s & F_a \\ P_s & P_a \end{bmatrix}$$

F= fertility (breeding/recruitment)
P = survival
S = subadult
a = adult

Retrospective analysis regarding change in population growth rates:

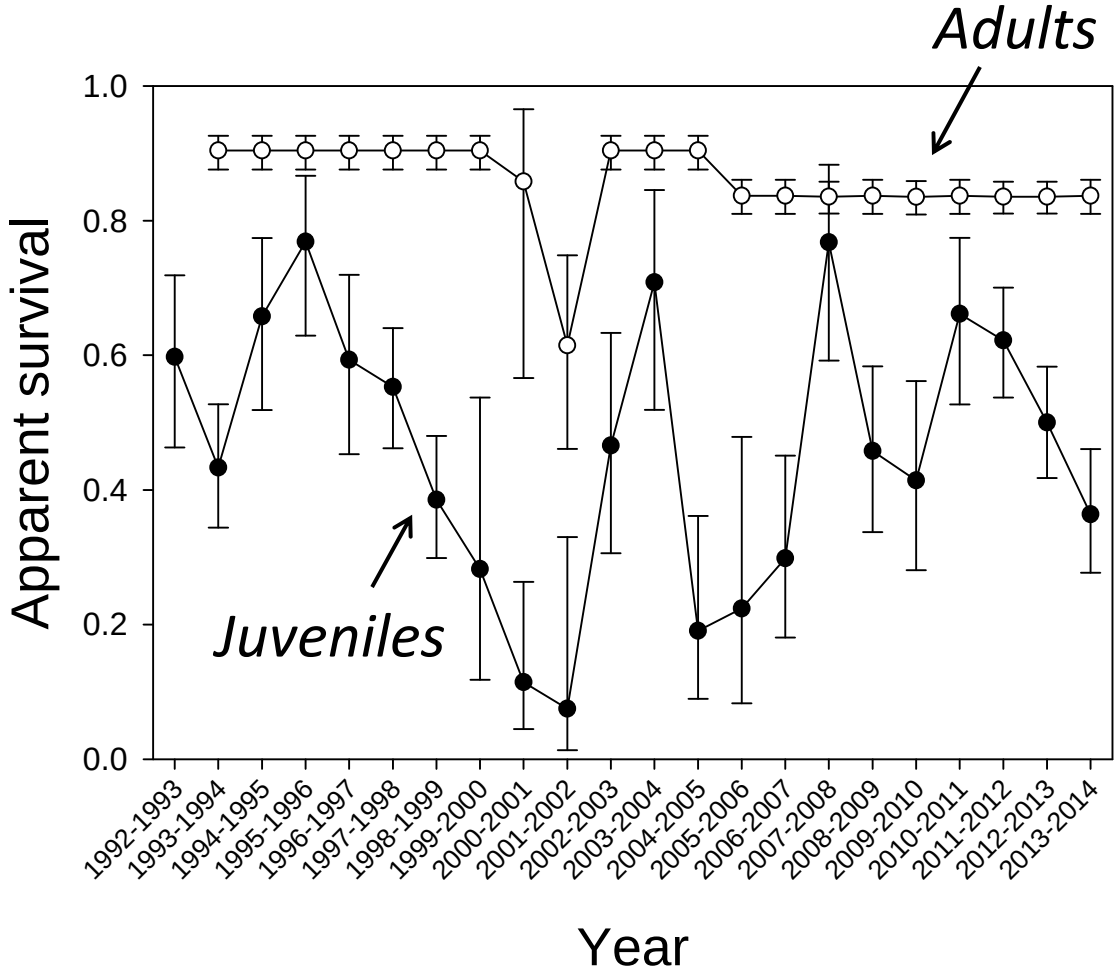


Martin et al. (2008)

Vital rates that explain variation in population growth 1996-2014

Rates considered:

- Juvenile apparent survival
- Adult apparent survival
- Annual fecundity: number of offspring / female
  (Ricklefs & Bloom 1977)



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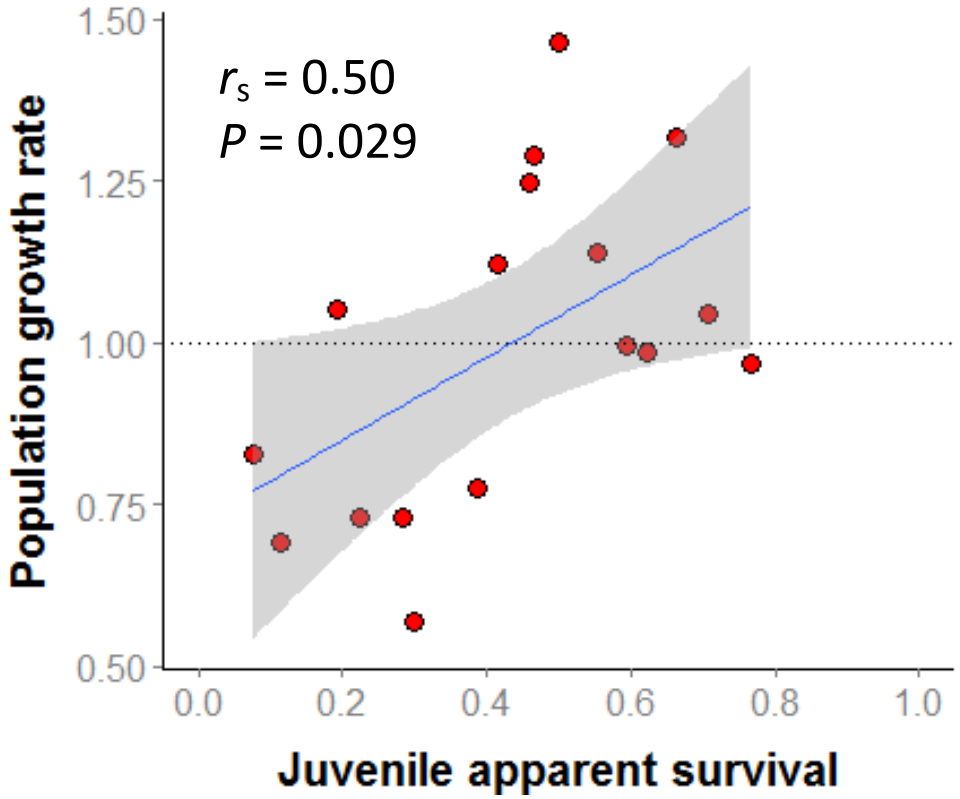
Rates explaining variation:

- Juvenile survival



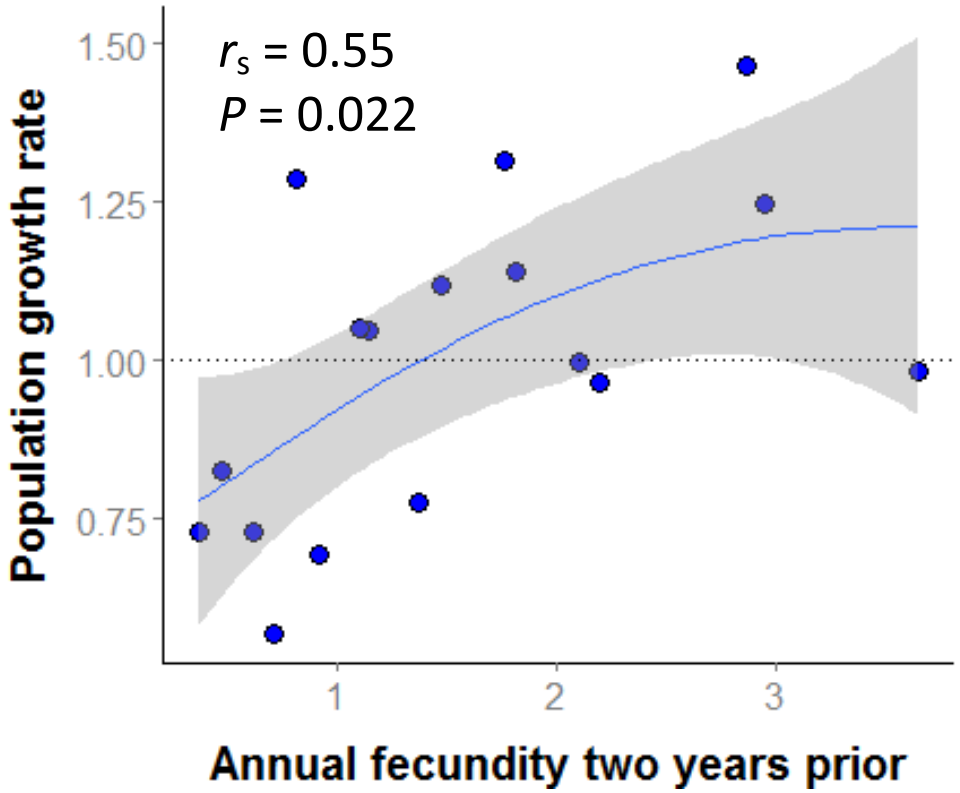
Vital rates that explain variation in population growth 1996-2014

Rates considered:

- Juvenile apparent survival
- Adult apparent survival
- Annual fecundity: number of offspring / female (Ricklefs & Bloom 1977)

Rates explaining variation:

- Juvenile survival
- Annual Fecundity
- Annual Fecundity two years prior



Reproductive rates that drive fecundity

- Breeding probability
- Nest survival
- Number of young fledged/successful nest
- Renesting
- Breeding season length

Ricklefs & Bloom (1977), Etterson et al. (2011)

Reproductive rates that drive fecundity

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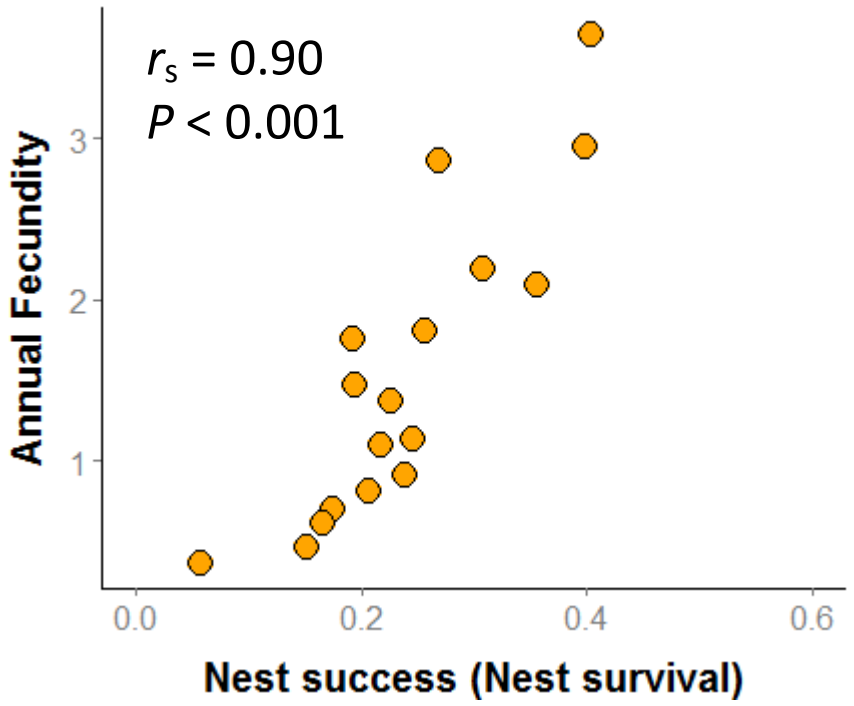
*Sensitivity analysis suggests fecundity most sensitive to **nest survival***

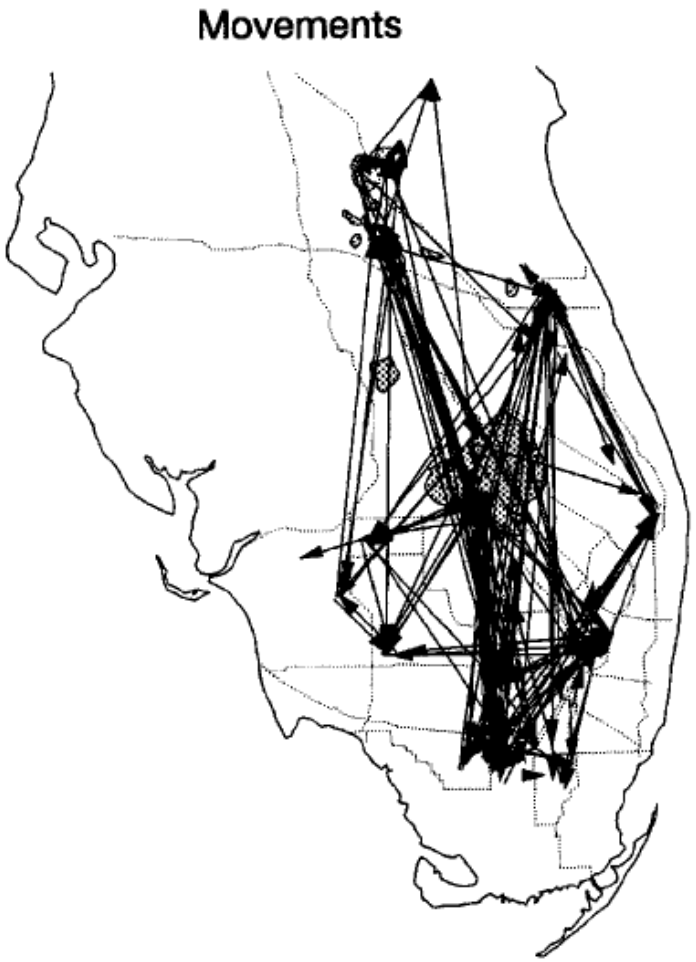
*Fecundity most correlated with **nest survival***



Ricklefs & Bloom (1977), Etterson et al. (2011)

From total population to regional trends

- Kites move widely across central and south Florida
- Thought to be a panmictic population



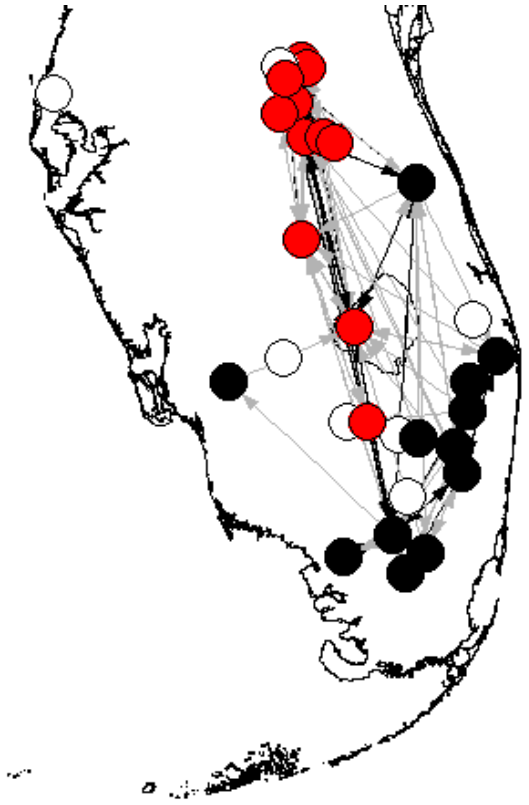
Bennetts & Kitchens (1997)
Meyer et al. 2011; this session

From total population to regional trends

- Kites move widely across central and south Florida
- Thought to be a panmictic population
- But, demographic rates (e.g. survival) vary across the region
- And, recently discovered strong breeding fidelity:

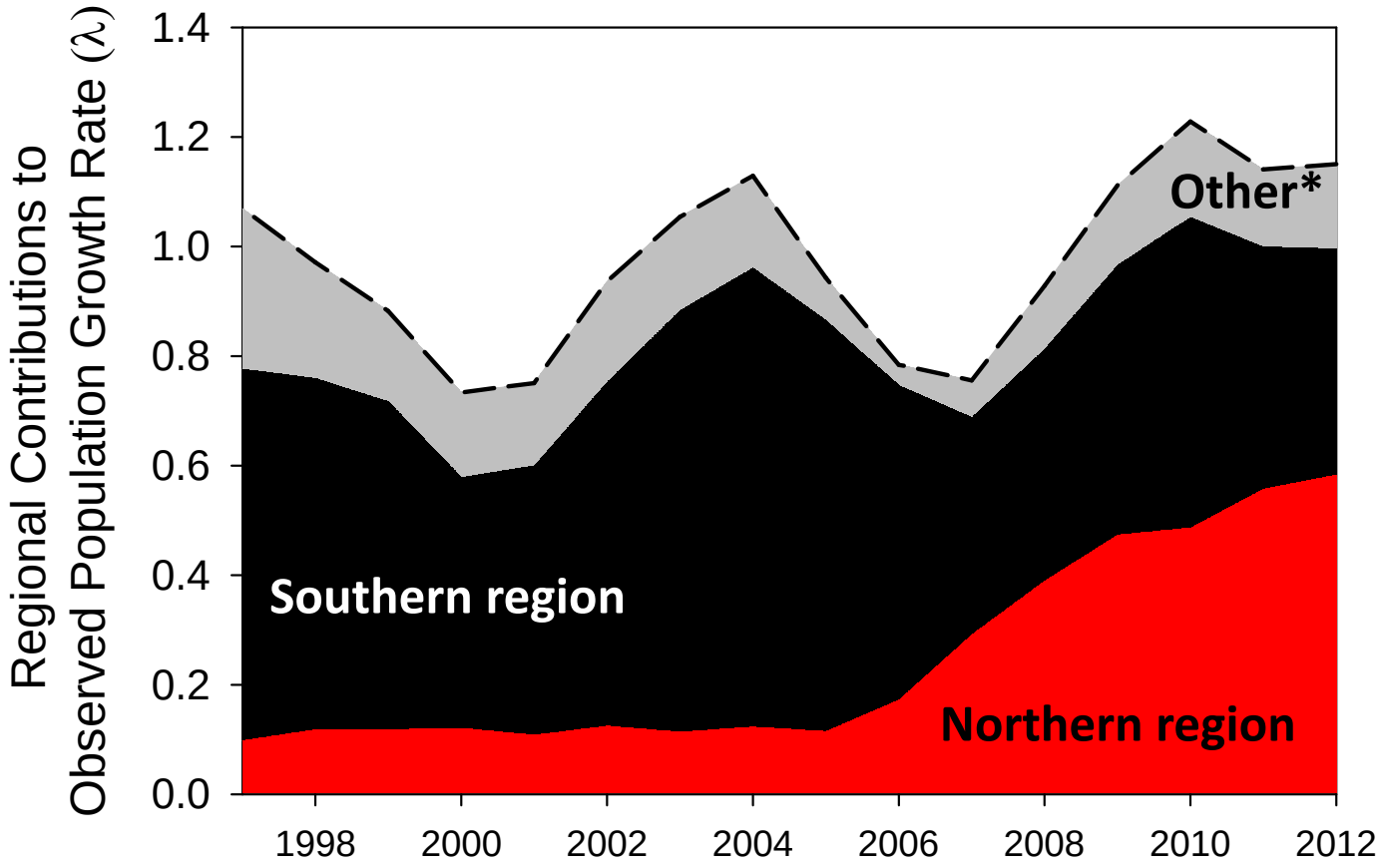
Site-level:
~40% natal philopatry,
67% breeding philopatry
Region-level:
~90% philopatry in Everglades,
Kissimmee River Valley

Geographic structure in breeding dispersal



How regions have contributed to population growth:

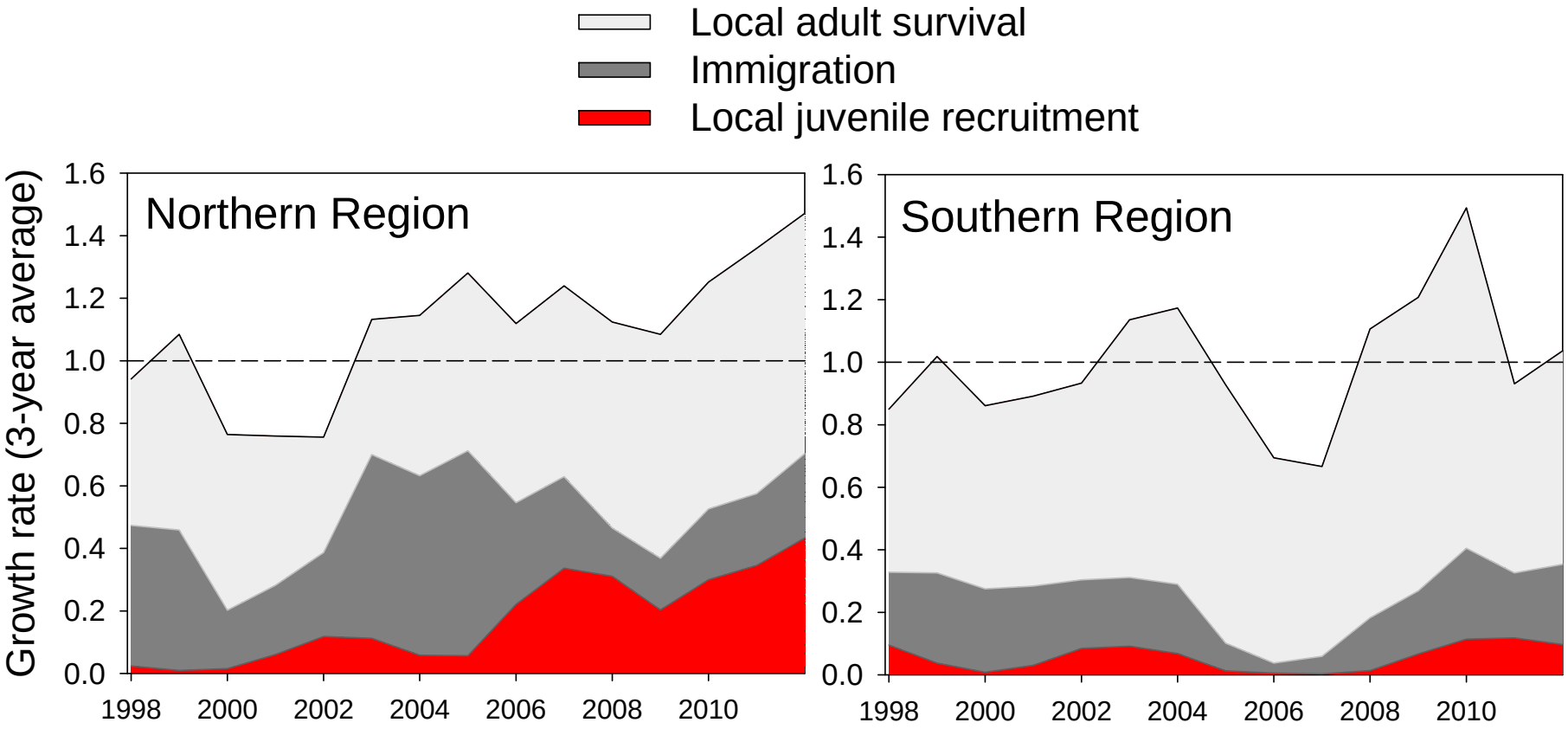
Contribution from northern region has increased since 2007



Other = includes sites not classified into regions and unsampled, peripheral sites

How regions have contributed to population growth:

Contribution from northern region driven by increase in recruitment



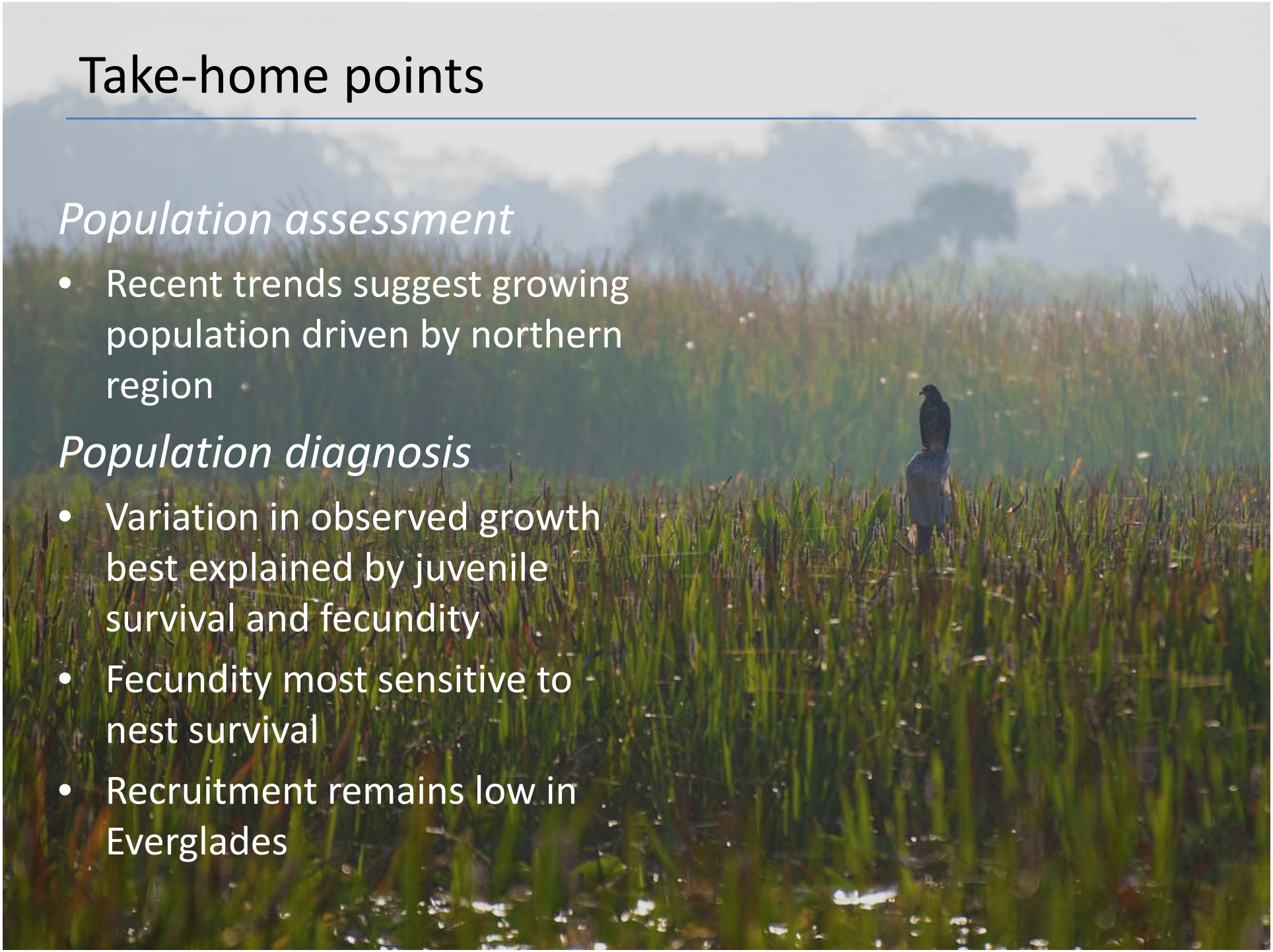
Take-home points

Population assessment

- Recent trends suggest growing population driven by northern region

Population diagnosis

- Variation in observed growth best explained by juvenile survival and fecundity
- Fecundity most sensitive to nest survival
- Recruitment remains low in Everglades



Moving forward

Priorities

- Management aimed at increasing reproduction likely most successful
- Identify key environmental stressors and management actions influencing reproduction, particularly nest survival a priority

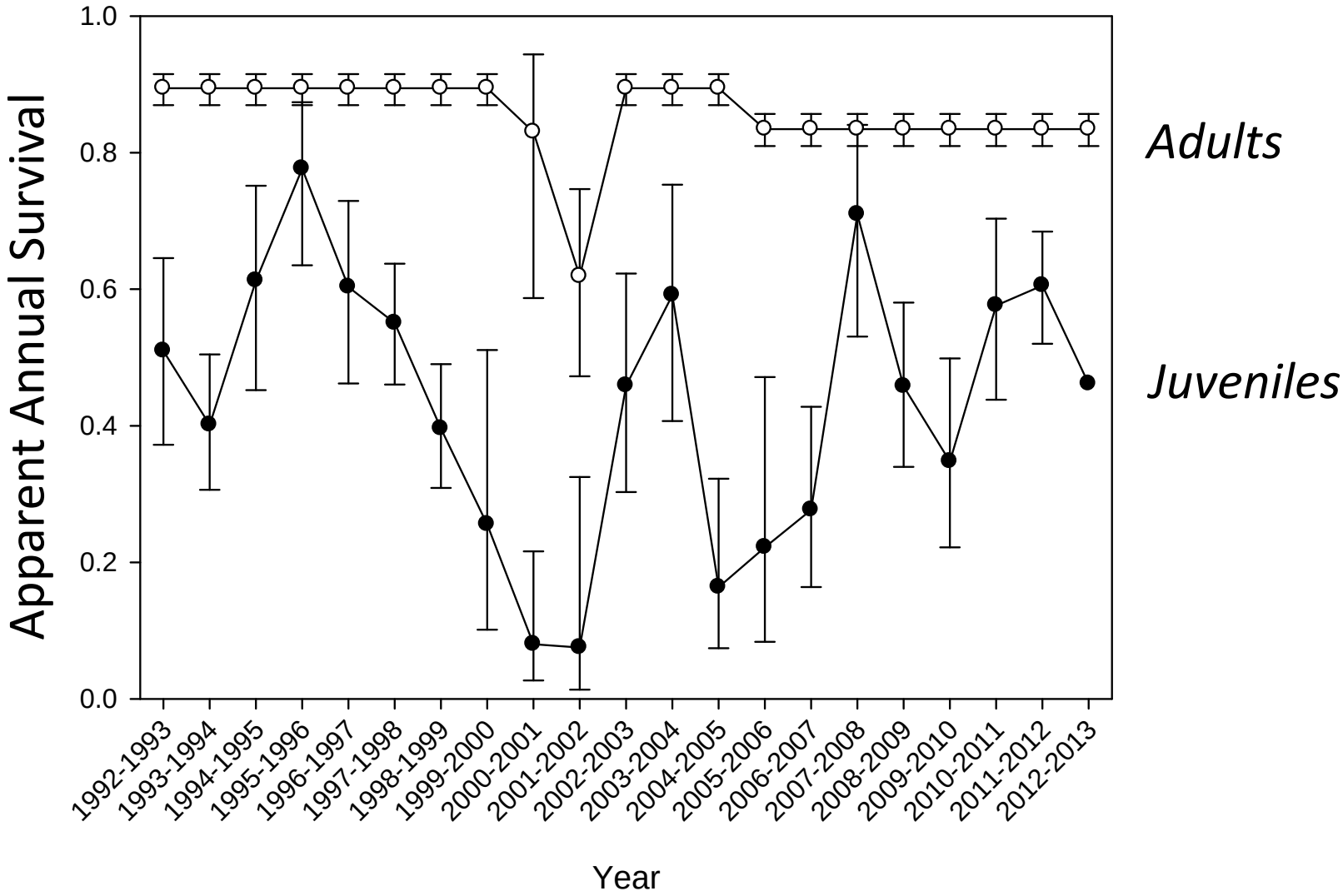
Acknowledgments

Monitoring design and implementation:
Rob Bennetts, Vicky Dreitz, Don DeAngelis, James Nichols, Bill Kendall, Jim Hines, FL Coop Unit

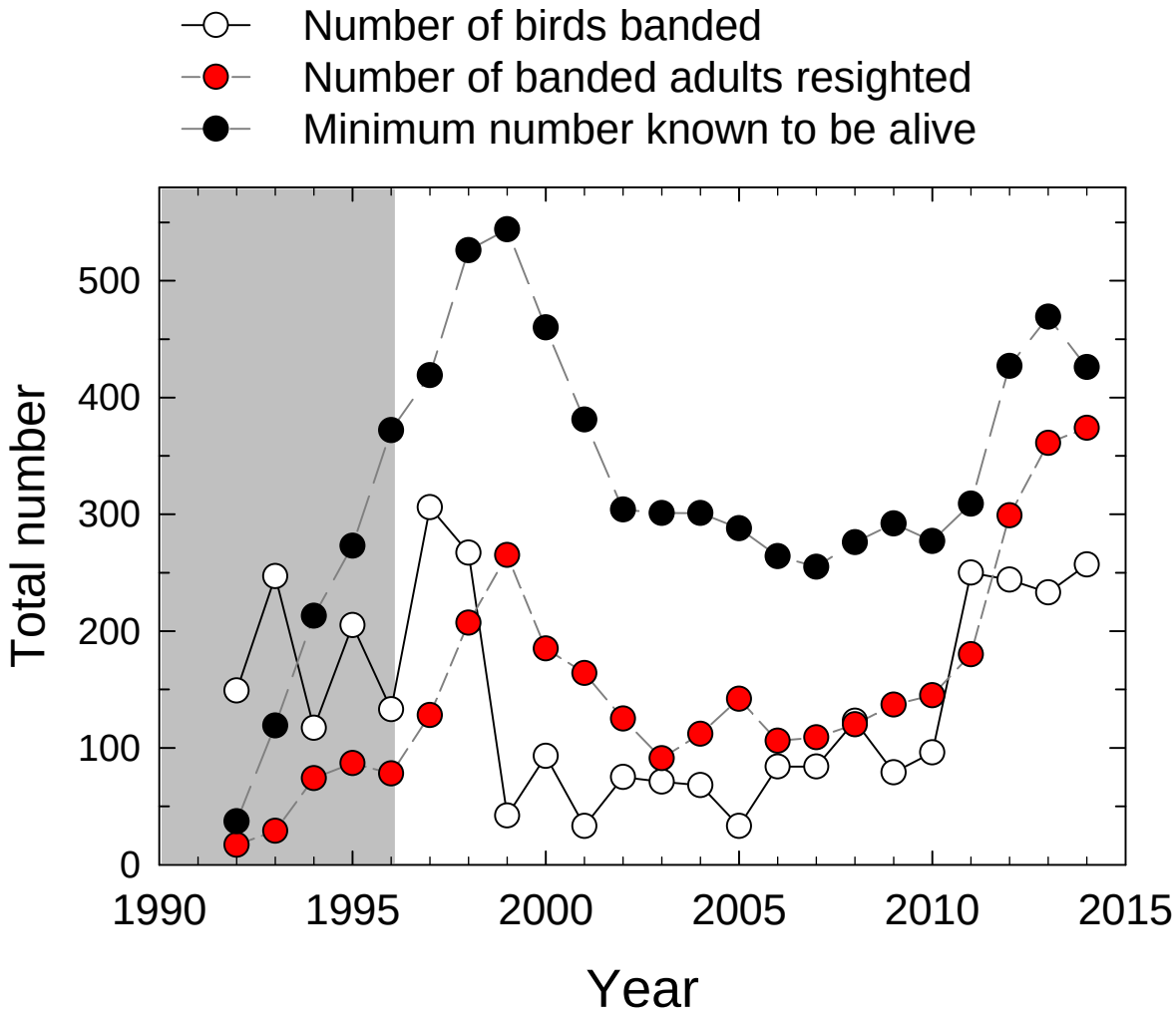
Funding:
U.S. Army Corps, U.S.G.S., USFWS, St. John's Water Management District, Florida Fish & Wildlife Conservation Commission

Extra slides

Survival estimates and kite trends



Mark-recapture and minimum number known alive

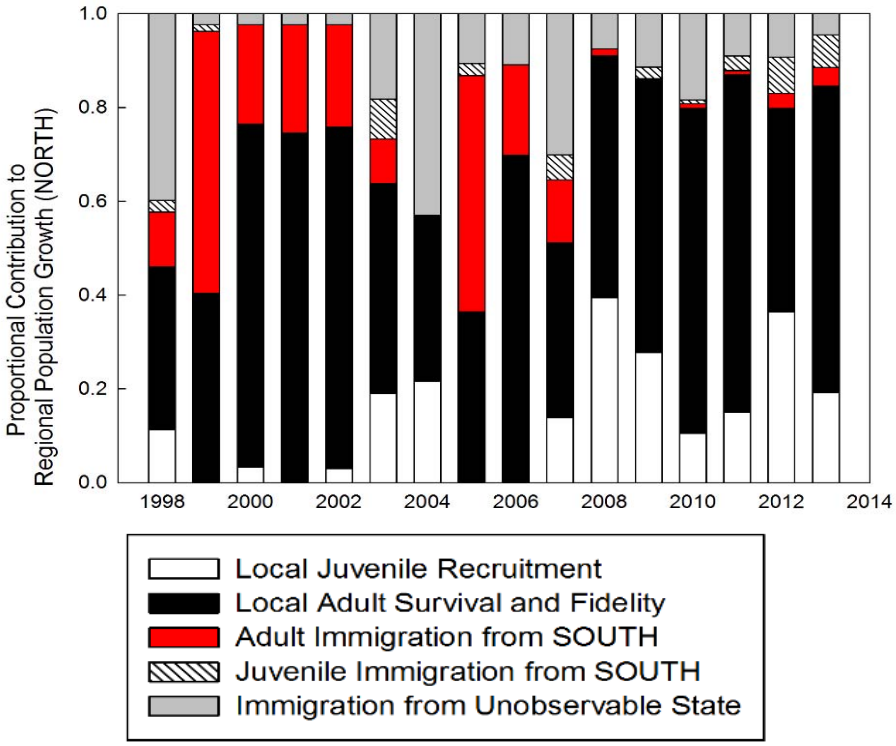


3472 total banded kites from 1992 through 2014

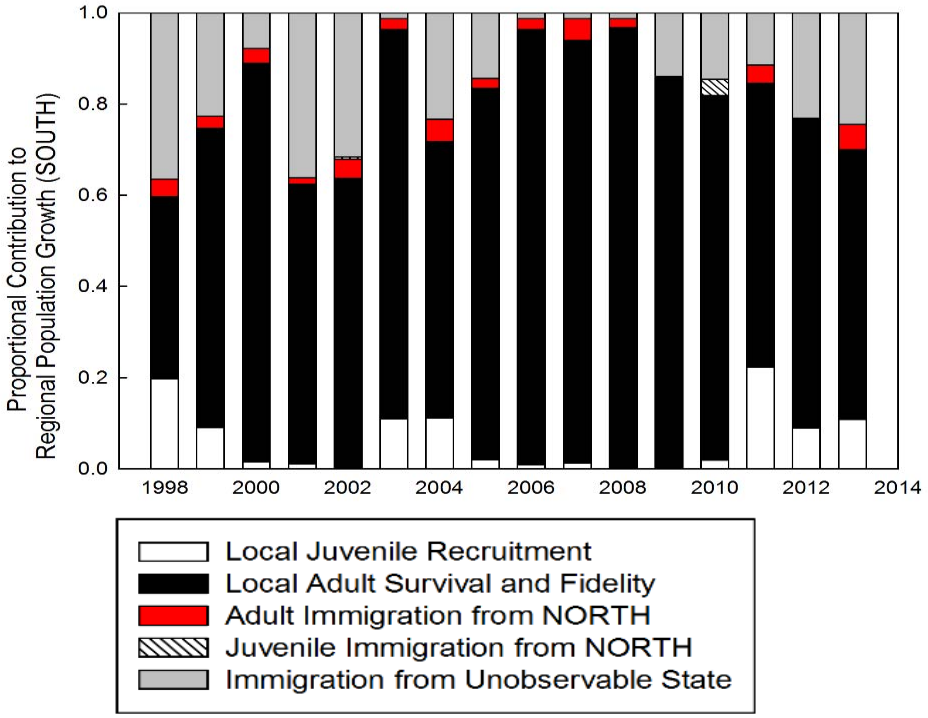
7805 total resights 1992 through 2014 (during survey season)

Reverse Multistate CMR models to estimate demographic contributions

Northern region



Southern region



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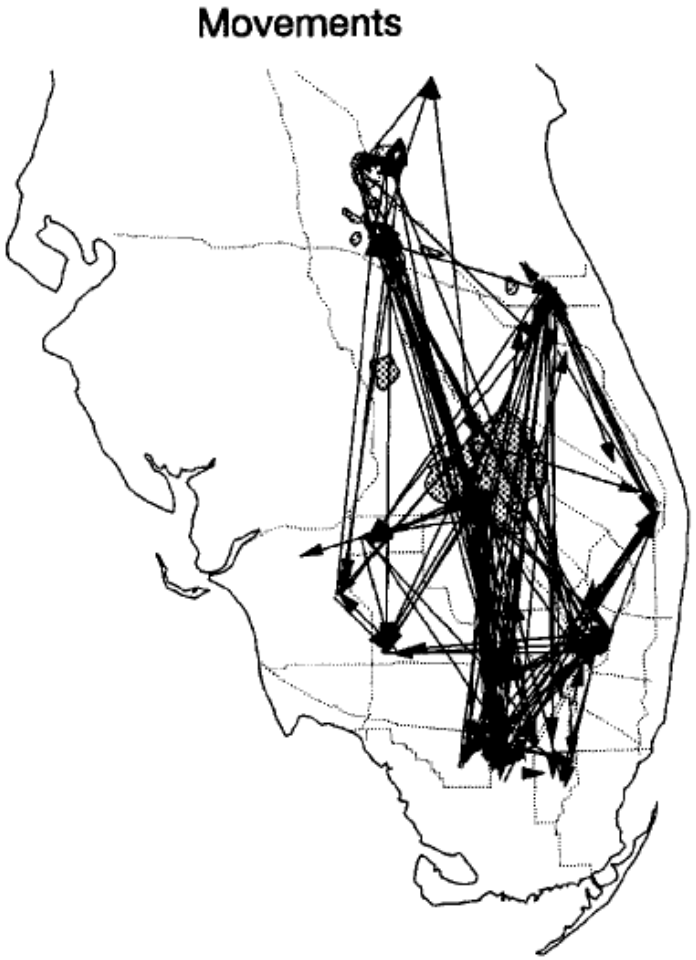


	Natal region			
Current nesting region	**Ever**	**KRV**	**Okee**	**Other**
Everglades	0.90	0.03	0.06	0.01
Kissimmee River Valley	0.06	0.89	0.04	0.01
Okeechobee	0.17	0.44	0.28	0.10
Other	0.39	0.09	0.07	0.45

Bennetts & Kitchens (1997)
Meyer et al. 2011; this session

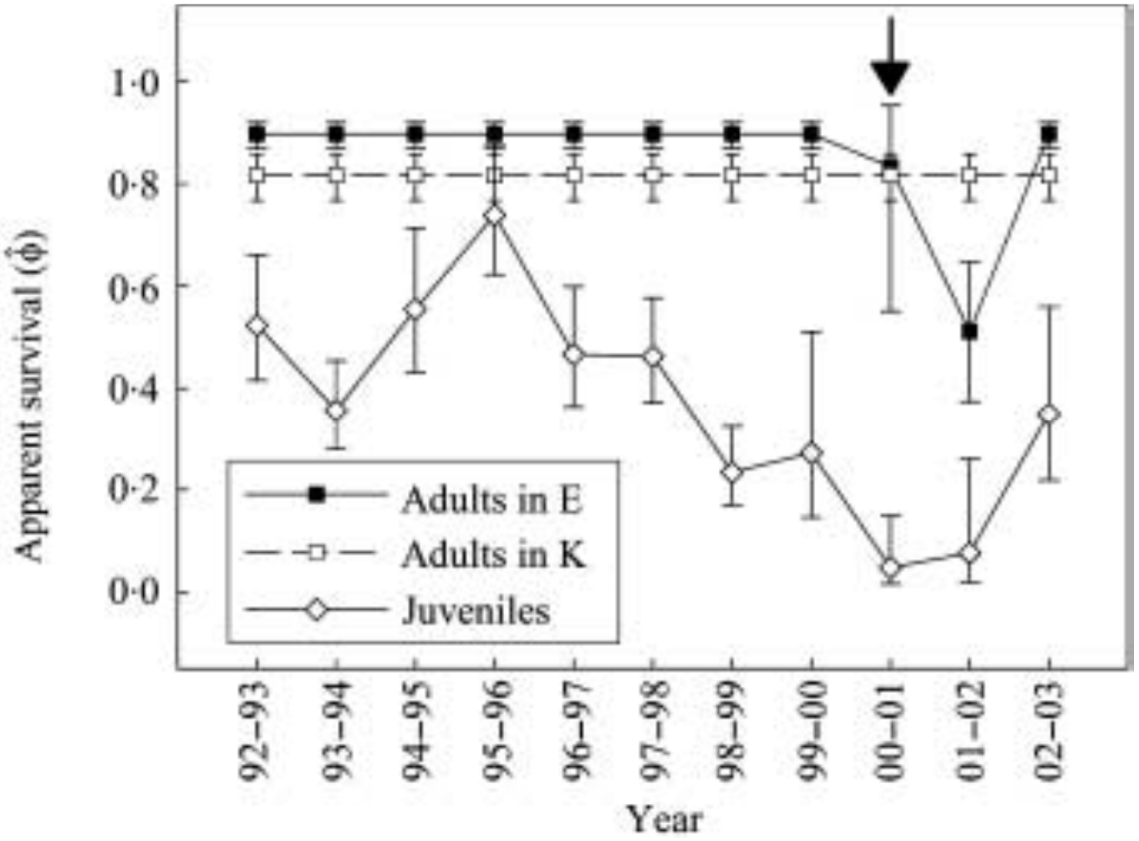
Regional structure in demographic rates

Northern Region

- Lower adult apparent survival
- No weather effects observed

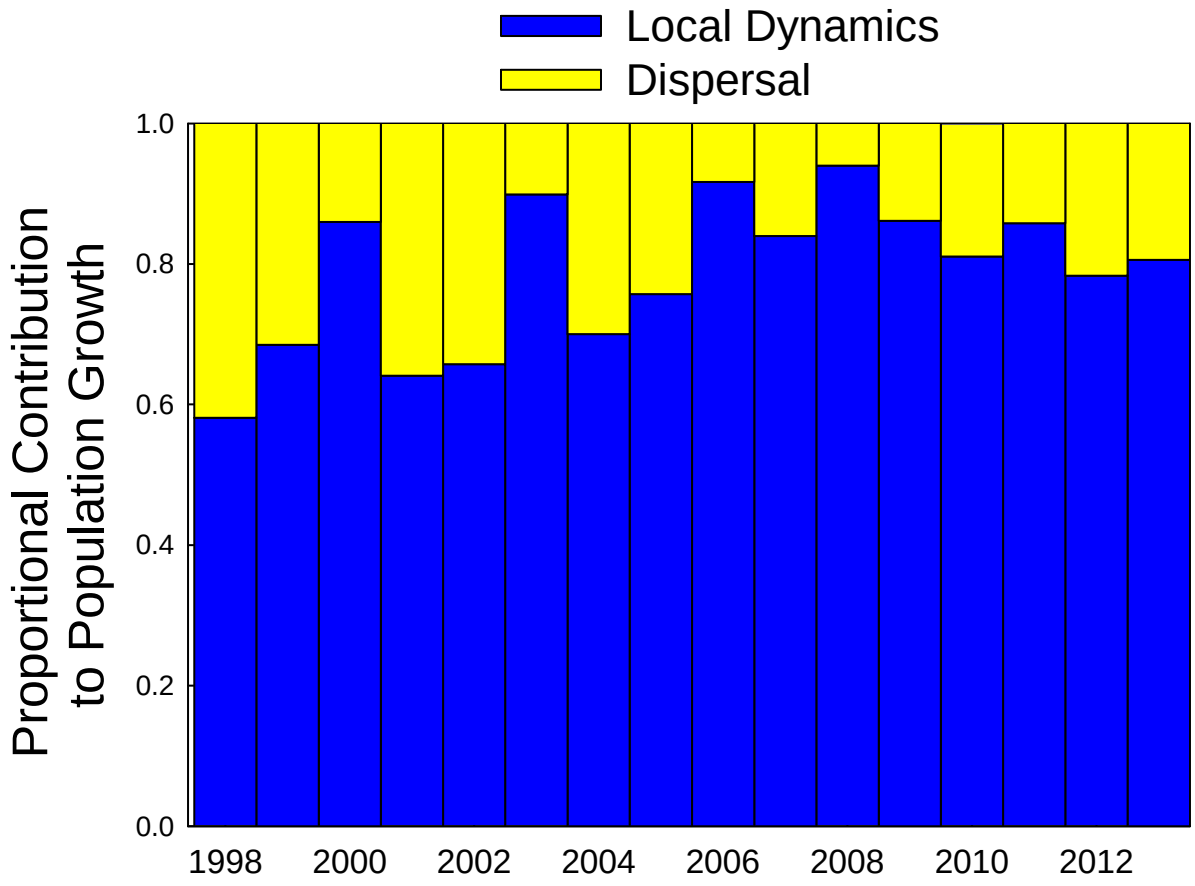
Southern Region

- Higher adult apparent survival
- Weather effects observed (dry conditions)



Martin et al. (2006)

How regions have contributed to population growth:
Local dynamics increasing in importance over time



Local dynamics: juvenile recruitment and adult survival / fidelity