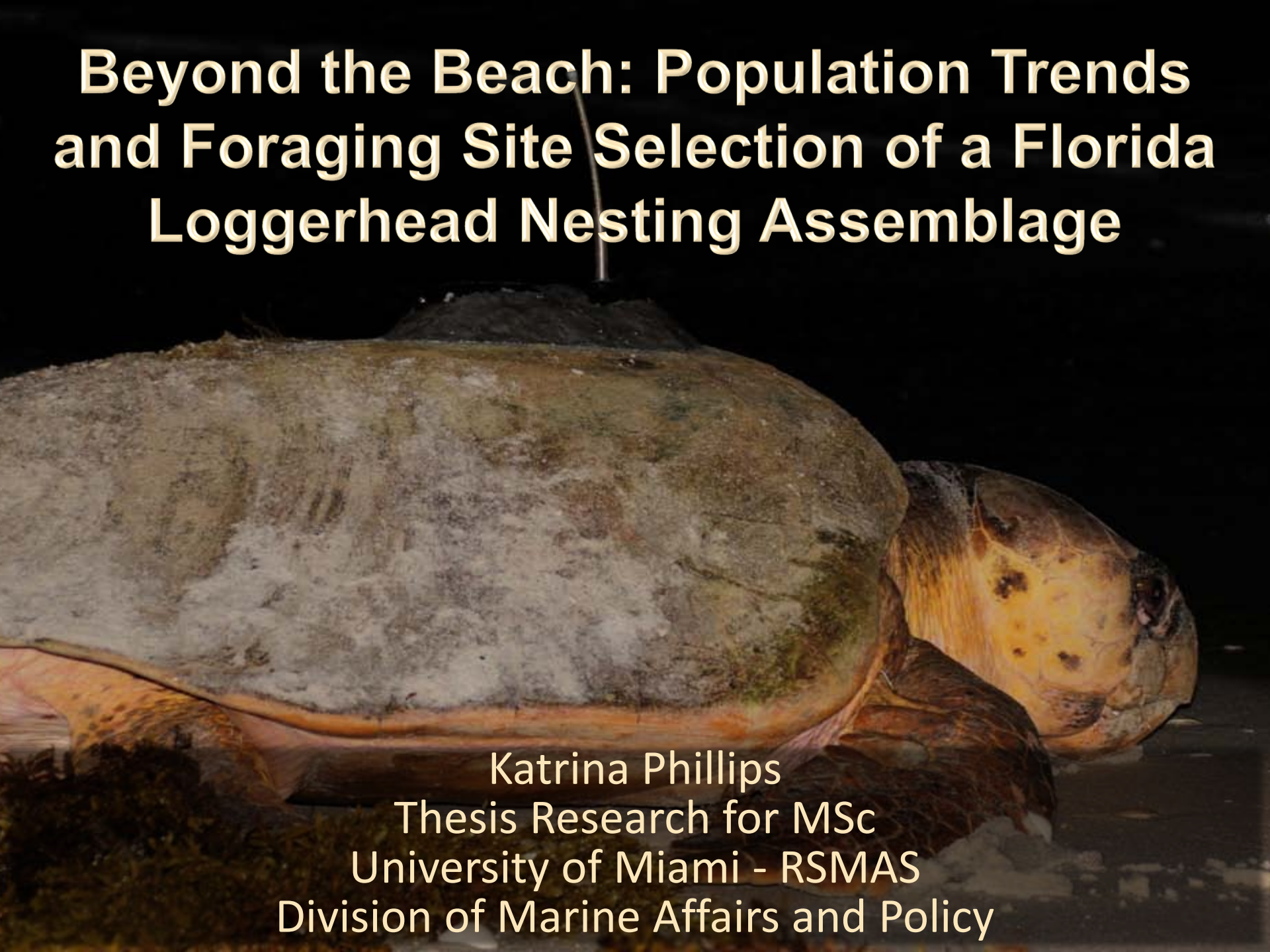
Beyond the Beach: Population Trends and Foraging Site Selection of a Florida Loggerhead Nesting Assemblage



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Outline

→Sea Turtle Introduction

→ Mark-Recapture Analysis

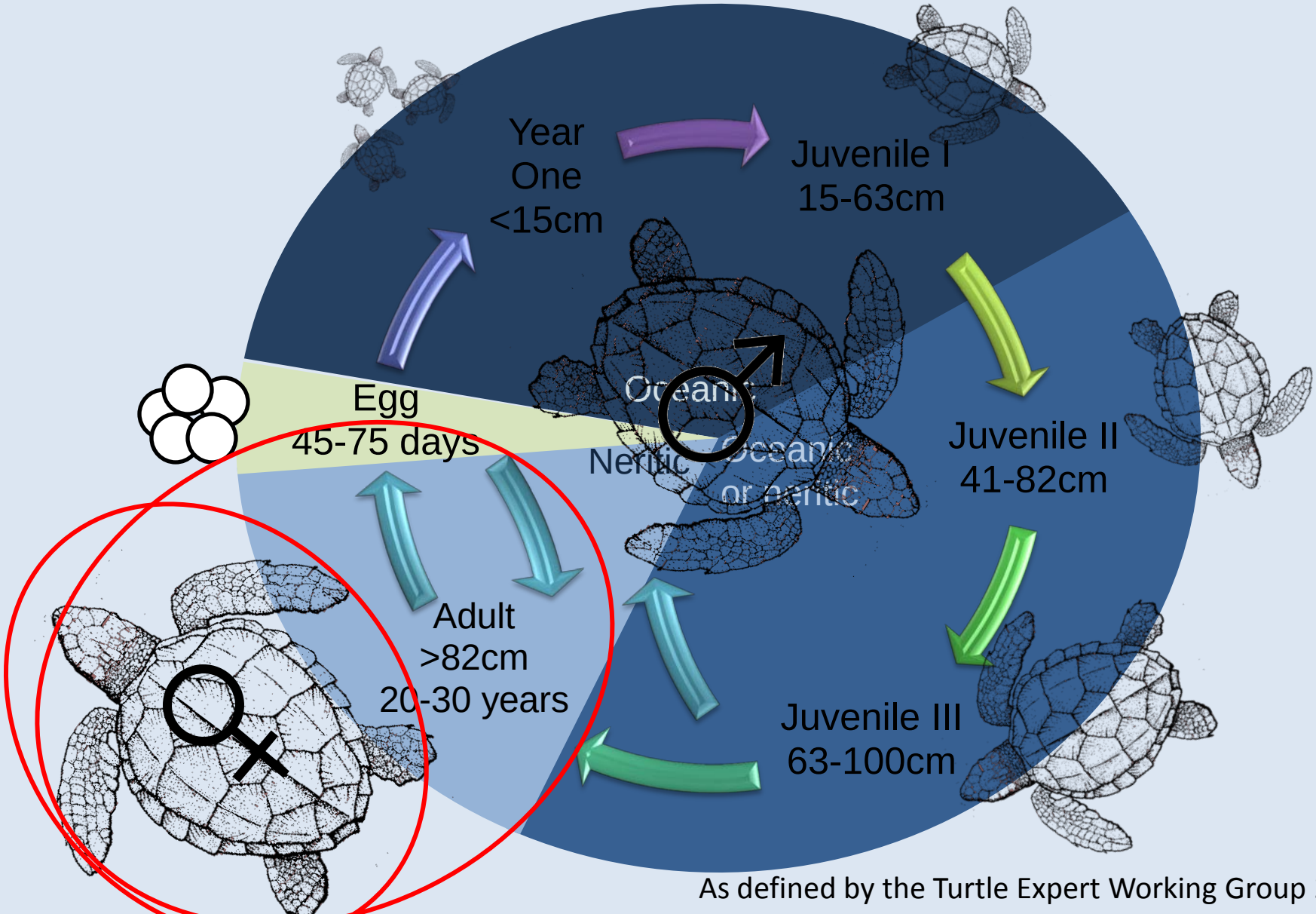
→ Satellite Telemetry Study

→ Application to Management

Sea Turtle Species

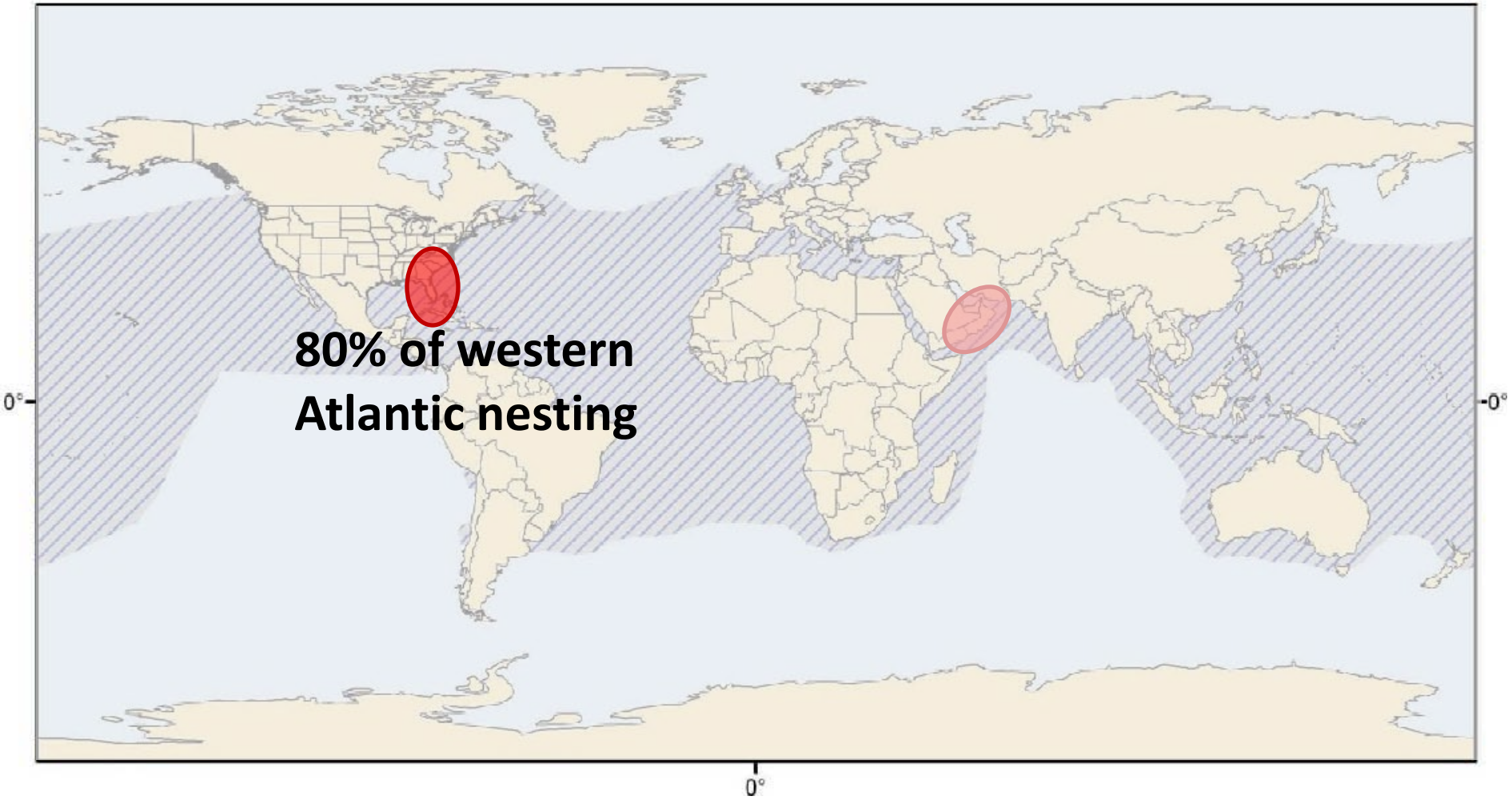
- Loggerhead (*Caretta caretta*) — T
- Green (*Chelonia mydas*) — E/T
- Olive Ridley (*Lepidochelys olivacea*) — E/T
- Kemp's Ridley (*Lepidochelys kempii*) — Endangered
- Leatherback (*Dermochelys coriacea*) — Endangered
- Hawksbill (*Eretmochelys imbricata*) — Endangered
- Flatback (*Natator depressus*)

Life Cycle



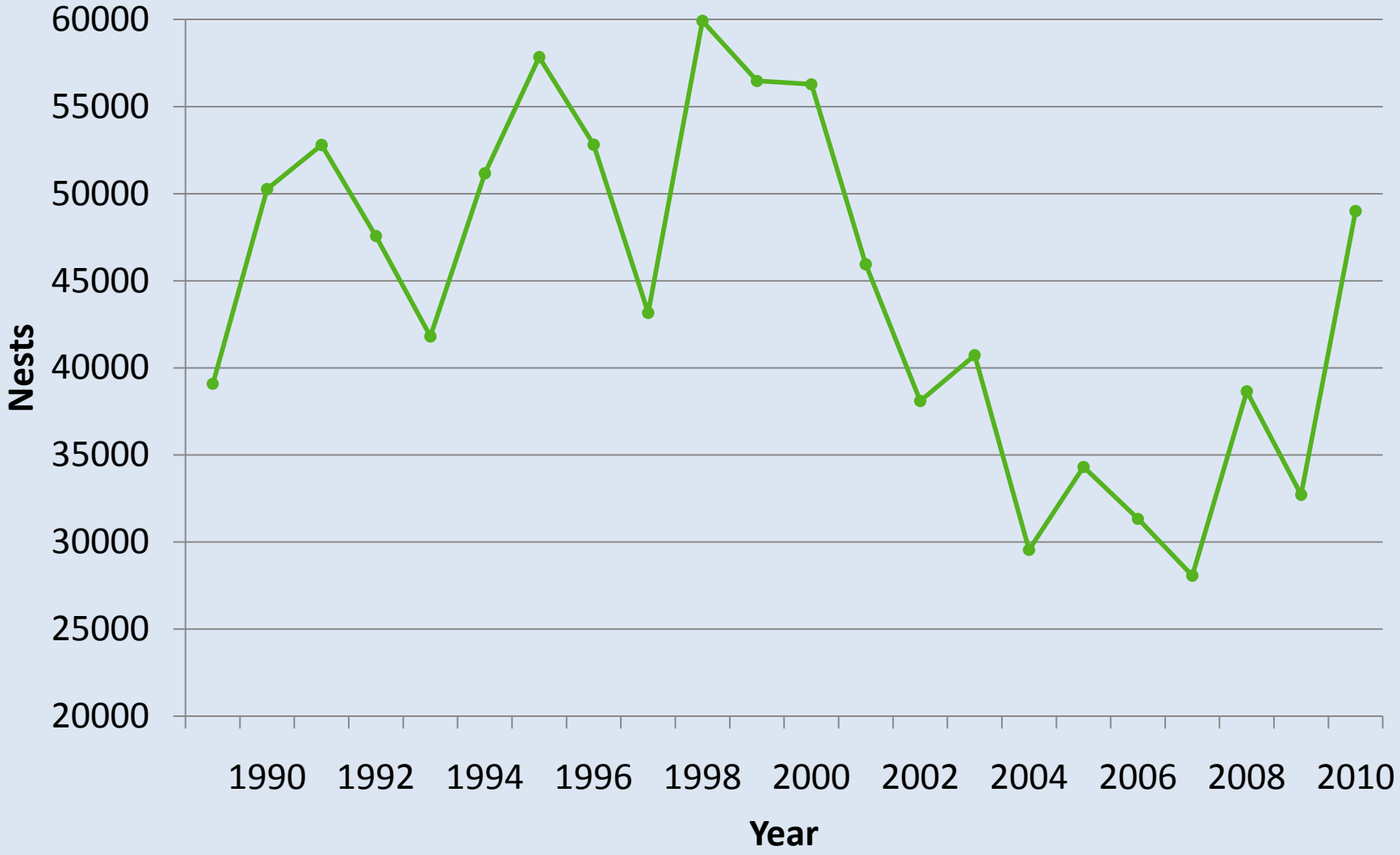
As defined by the Turtle Expert Working Group 2009

Loggerhead Range



NOAA Fisheries Office of Protected Resources 2009

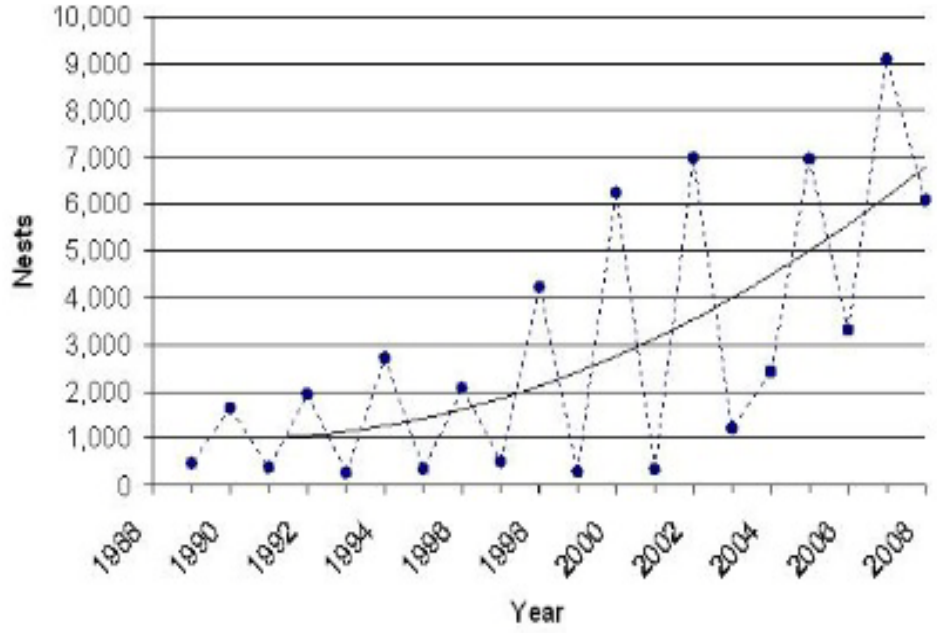
Loggerhead Nest Counts on Florida Index Beaches 1989-2010



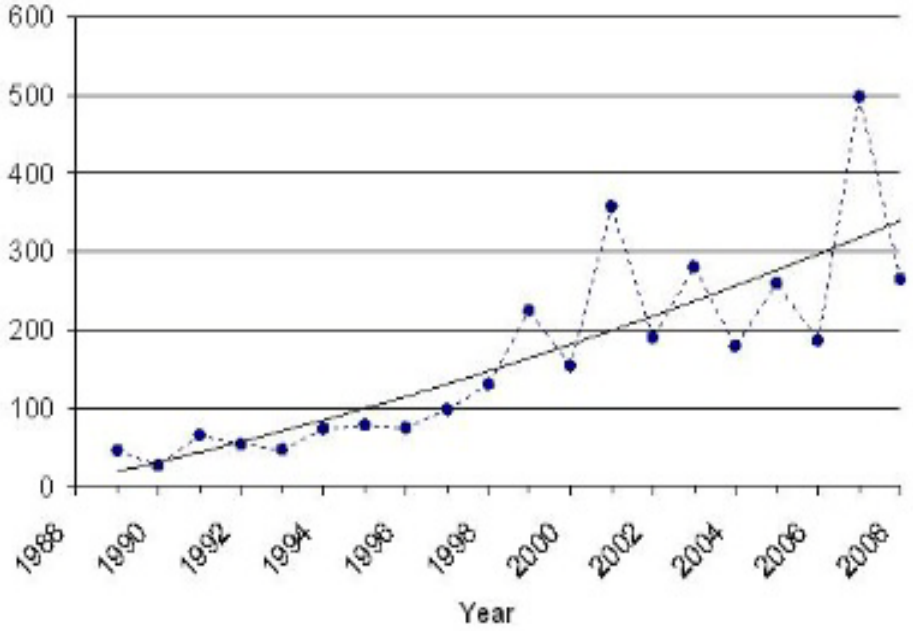
Florida Fish and Wildlife Conservation Commission

Nesting Habitat?

Green Turtle Nests



Leatherback Nests



Florida Fish and Wildlife Conservation Commission 2009

Offshore

- Females do not nest every year → remigration interval

- Interval length influenced by age of turtle (Lund 1986, TEWG 2009, Hatase 2004) and/or quality of the foraging habitat (Saba et al. 2008, Miller et al. 2003)

- Evidence of foraging site fidelity (Girard et al. 2009, Mansfield et al. 2009, Mansfield 2006, Lazar et al. 2004)

Research Questions

Mark-Recapture Analysis

- Could variable remigration frequency be contributing to changes in annual nest counts?

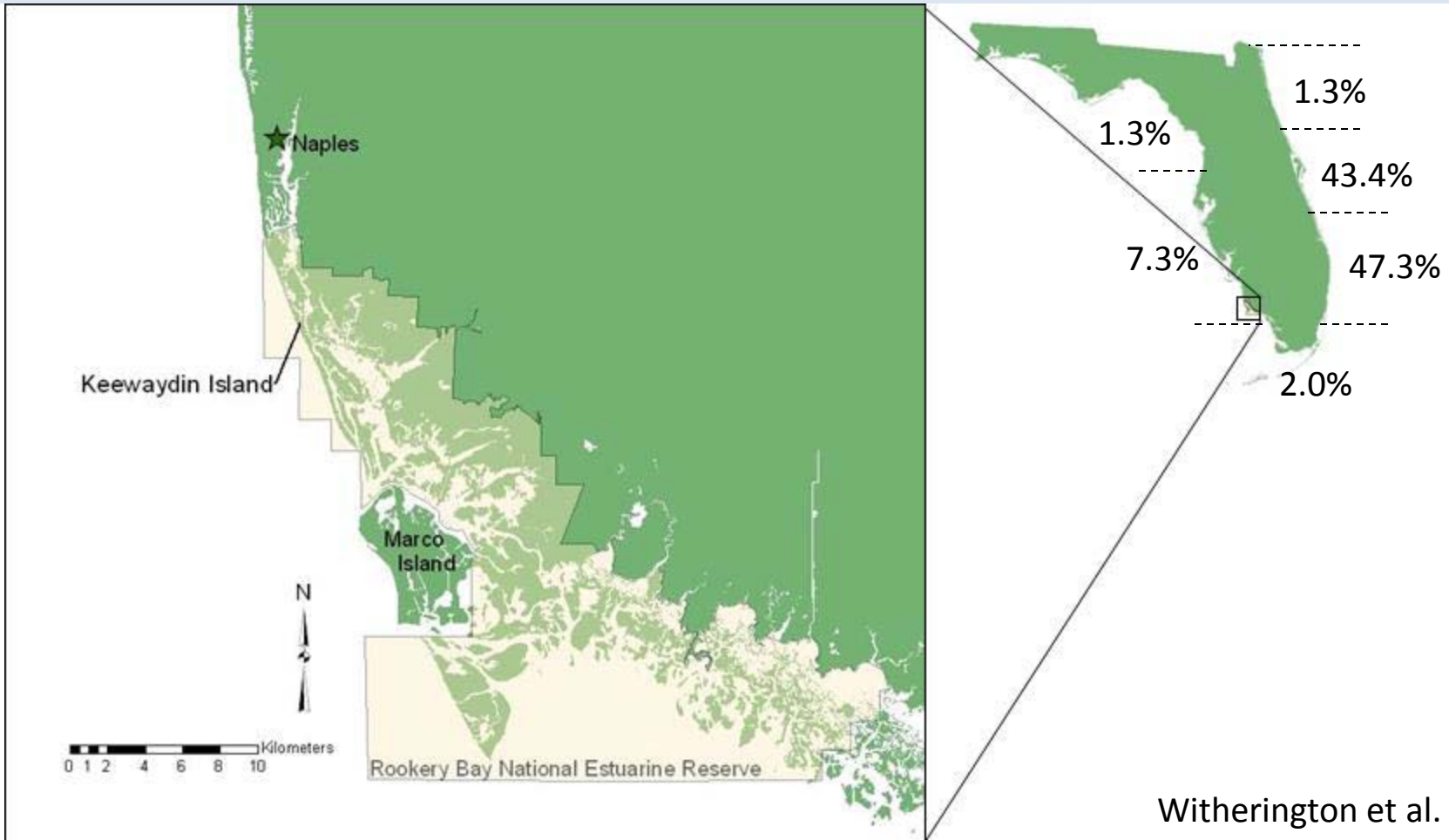
Satellite Telemetry

- Does the nesting assemblage share a common, discrete foraging area?

- Could targeted management in the foraging area(s) be implemented to assist population recovery?

The Conservancy of Southwest Florida

Loggerhead tagging project on Keewaydin Island, FL since 1983



Witherington et al. 2009

Part I: Mark-Recapture Study

- Saturation nighttime flipper tagging during nesting season from May - August
- Double tagging strategy since 1990
  - 2,292 encounters; 841 individual IDs

Mark-Recapture: Data Collected

- Time and date of nest/false crawl, carapace measurements, tag numbers, location on beach, clutch size
- Average carapace length 90.0cm (SD 5.42; SCL)
- Average clutch size 101 eggs (SD 26.00)

Program MARK

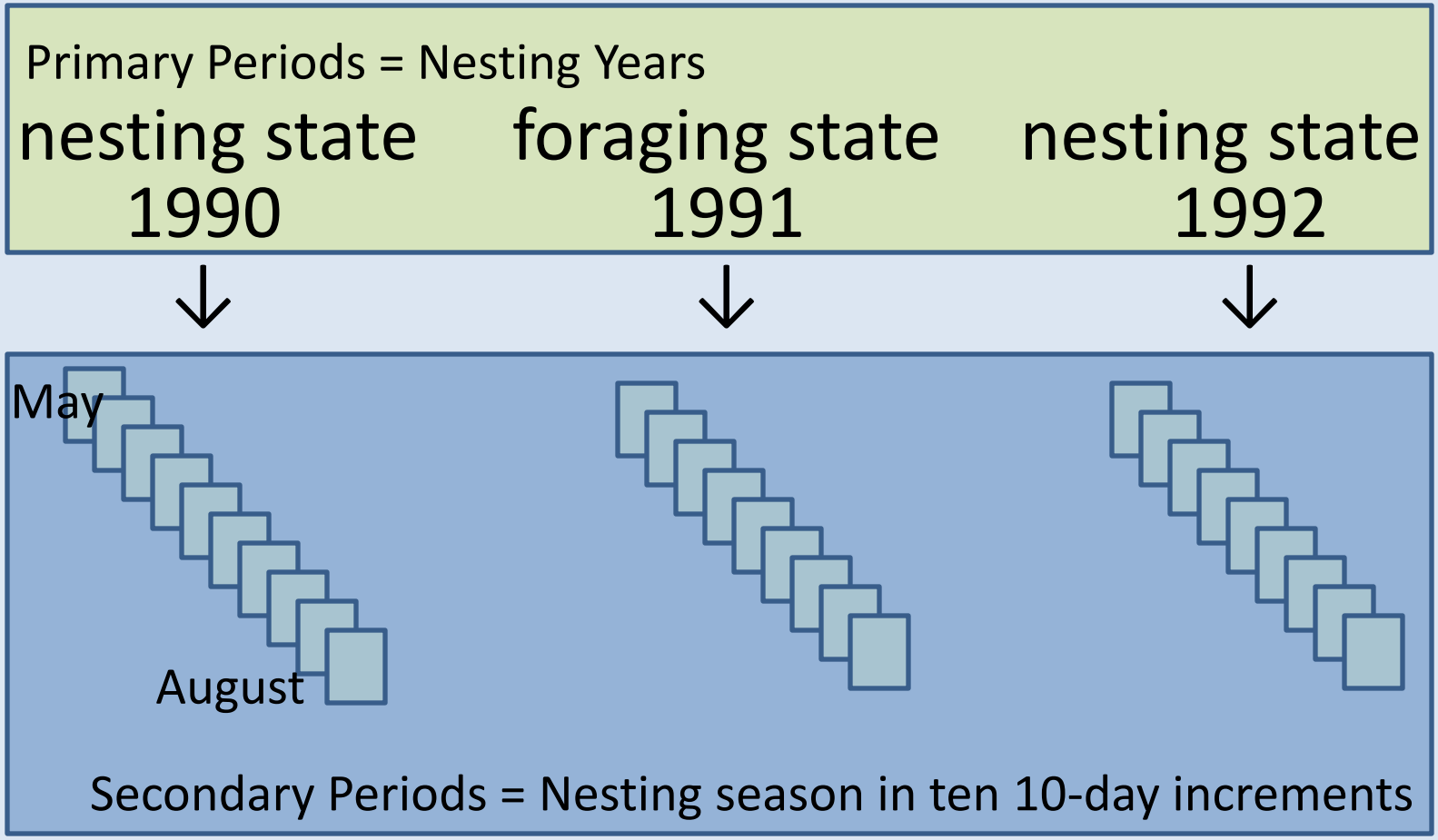
- Statistical modeling software to estimate population parameters

- Based on encounter histories (i.e. 001011100)

- Two-state open robust design (Kendall 2010)

Program MARK developed by Gary White (Colorado State University)

Model Set-up



0110110100 0000000000 0101110000…

Kendall 2010

Parameters Estimated

- Real parameters: survival (*Φ),* detection probability (p), state transition probabilities (psi), probability of entry (pent) and probability of remaining (phi)
- Derived parameters: residence time, N

Parameters may vary across primary or secondary periods - ϕ(t) vs. ϕ(.)

Subset of possible models and used AIC for model selection

Ex. ϕ(t)p(t)psi1to2(t)psi2to1(t)pent(t)phi(t)

Results: Model Selection

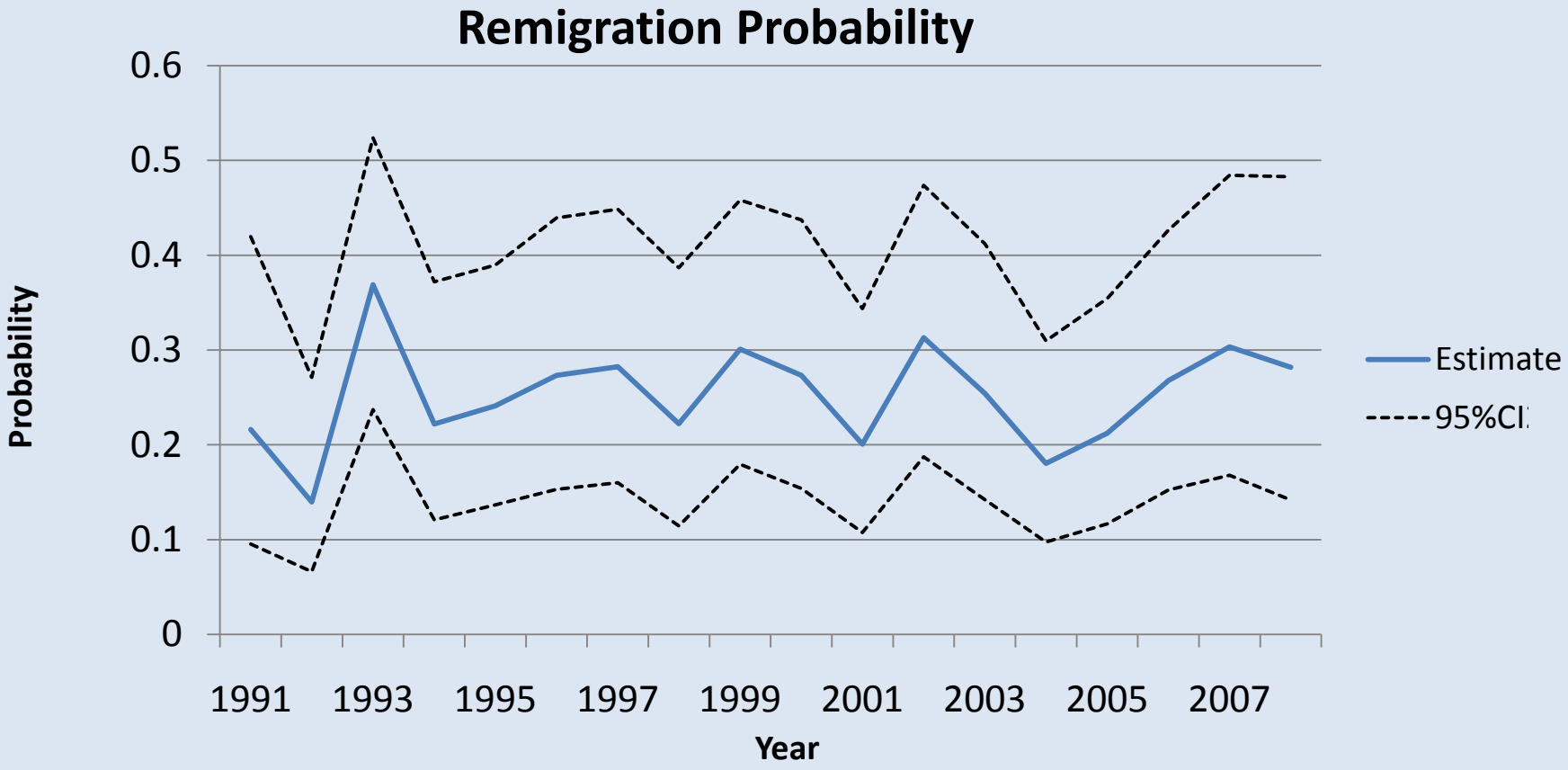
Model	S	p	Psi $^{N\ to\ F}$	Psi $^{F\ to\ N}$	pent	phi	Par	AIC	ΔAIC
1	Const.	Const.	Const.	1˚	2˚	2˚	38	11202.52	0
2	Const.	1˚	Time	Time	2˚	2˚	60	11220.83	18
3	Const.	Const.	Time	Time	2˚	2˚	41	11261.43	59
4	Const.	Const.	Time	Time	Time	Time	257	11309.09	107
5	Const.	Const.	Const.	Time	Time	Time	252	11359.02	157
6	Const.	Time	Time	Time	Time	Time	351	11386.55	184
7	Time	Time	Time	Time	Time	Time	367	11400.02	198
8	Const.	Const.	Time	Time	Const.	Time	81	11531.58	329
9	Const.	Time	Time	Time	Const.	Time	248	11630.43	428
10	Const.	Set	Time	Time	Time	Time	301	12123.19	921

Results: Real Parameters

Survival 0.73(95%CI 0.69-0.76)

Detection probability 0.45 (95%CI 0.42-0.48)

Transition from nest to forage 0.99 (95%CI 0.98-0.996)

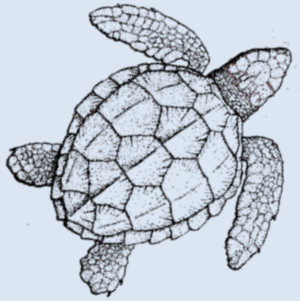


Analysis of Estimates

Estimated survival 0.73 (0.69-0.76)

Turtle Expert Working Group: Western Atlantic Population Assessment in 2009

- **Peninsular Florida 0.73 (0.71-0.76)**
  - Melbourne Beach, FL
- Greater Caribbean 0.85 (0.81-0.88)
  - Quintana Roo, Mexico
- Northern United States 0.81 (0.77-0.84)
  - Wassaw Island, GA



Fidelity a factor?

TEWG 2009

Mark-Recapture Summary

- Survival 0.73
- Detection probability 0.46
- No significant trends in transition probability
- Probability of entry/remaining decreases over nesting season
- Nesting state abundance decreasing

Part II: Satellite Telemetry Study

To identify foraging areas, site fidelity & home ranges

- Eleven tags deployed (4 in 2009 and 7 in 2010)
- Targeted mostly long-term remigrants for tagging

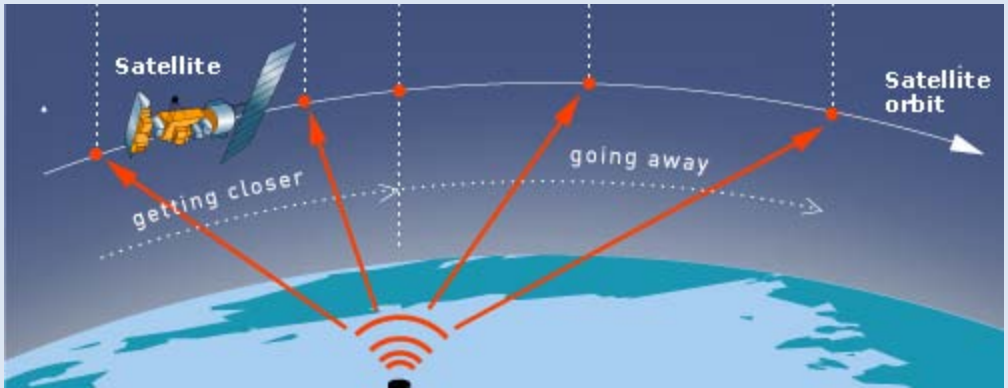
Satellite Attachment 1

Satellite Attachment 2

Satellite Attachment 3

Satellite Transmissions

- Saltwater switch
- Duty cycle 24-on/24-off
- Site of transmission estimated via Doppler Shift
- Location classes (3,2,1,0,A,B,Z)
- Data filtered using the Satellite Tracking and Analysis Tool (STAT)



Coyne and Godley 2005, CLS 2010

Movement Analyses

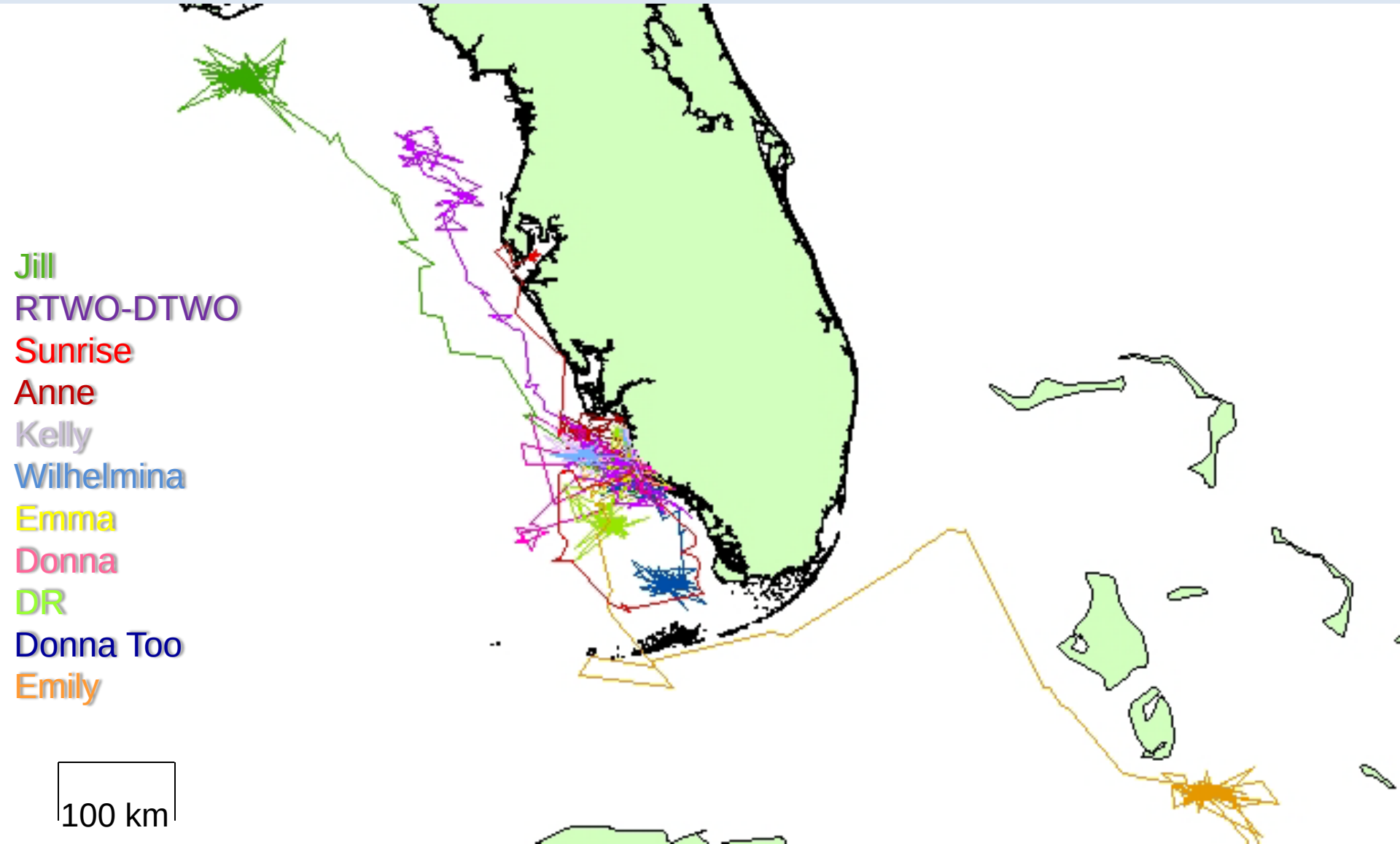
- Tracks divided into inter-nesting, migration and foraging periods

- ArcView GIS 3.2a Animal Movement Extension
  - Site fidelity tests (1000 ‘random walks’)
  - Kernel density home range analysis: 95% and 50% core use areas, multiple smoothing parameters

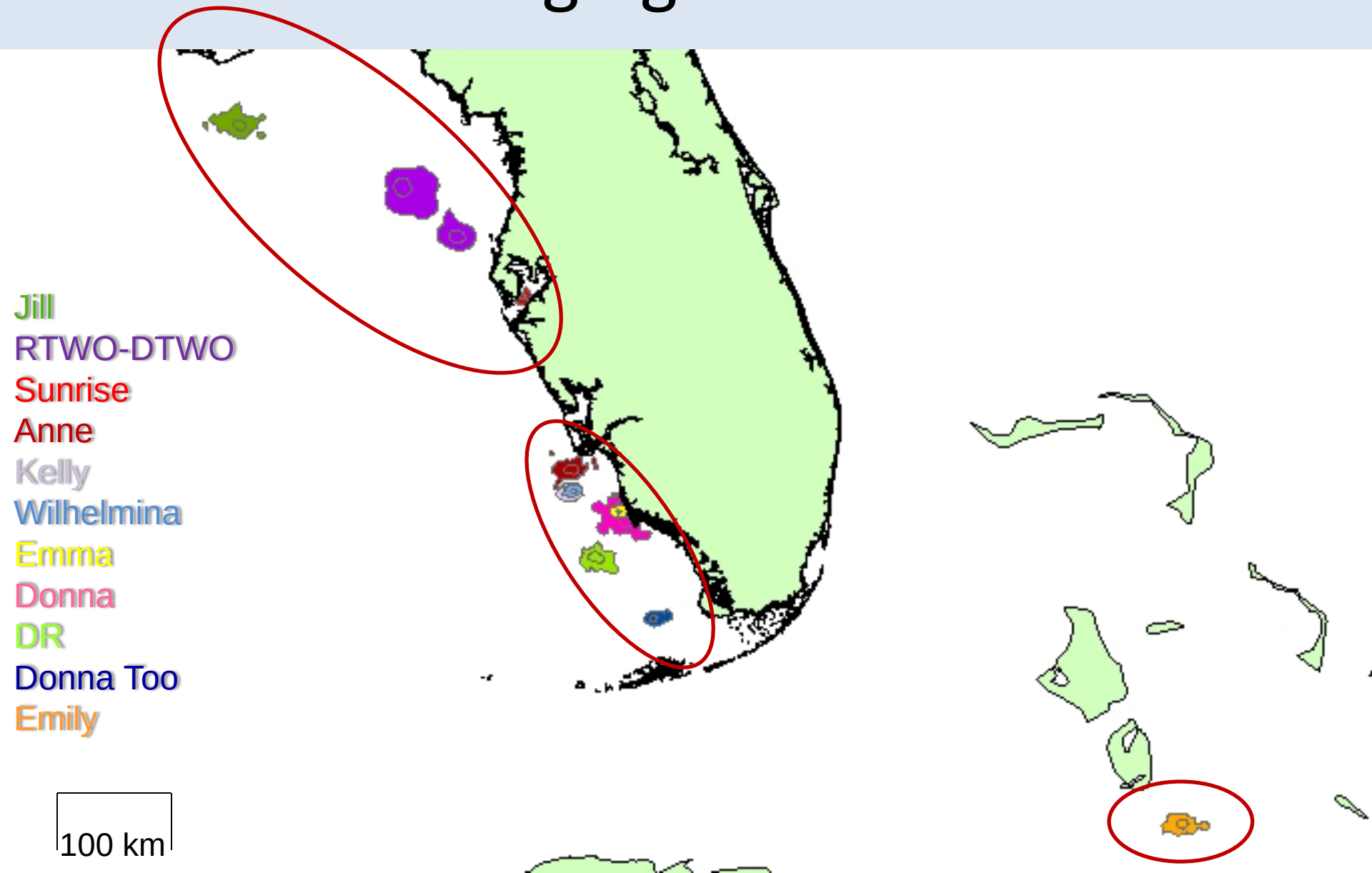
Satellite Transmissions

Turtle ID	Release Date	Transmission Time (days)	Total Displacement (km)	SCL (cm)	First Observed	No. of Seasons
Sunrise	01 July 2010	42	205	96.4	2004	2
Anne	19 June 2010	47	34	79.6	2010	1
Emma	19 June 2010	64	2	94.4	2007	2
DR	12 June 2009	97	51	88.2	1993	7
RTWO-DTWO	30 June 2010	114	281	89.2	2003	2
Wilhelmina	12 June 2009	125	40	89.8	2009	1
Kelly	21 June 2010	155	50	92.3	2001	4
Jill	01 July 2010	297	438	95.7	1997	3
Emily	16 June 2009	305	547	94.6	1988	9
Donna	07 July 2009	339	45	94.3	2009	1
Donna Too	22 June 2010	(355)	109	86.6	2004	2

Satellite Tracking



Foraging Grounds



Satellite Telemetry Summary

- Females display fidelity to discrete foraging grounds within 18 days of final nest

- Foraging areas are not shared for the nesting assemblage but do all occur over the shelf

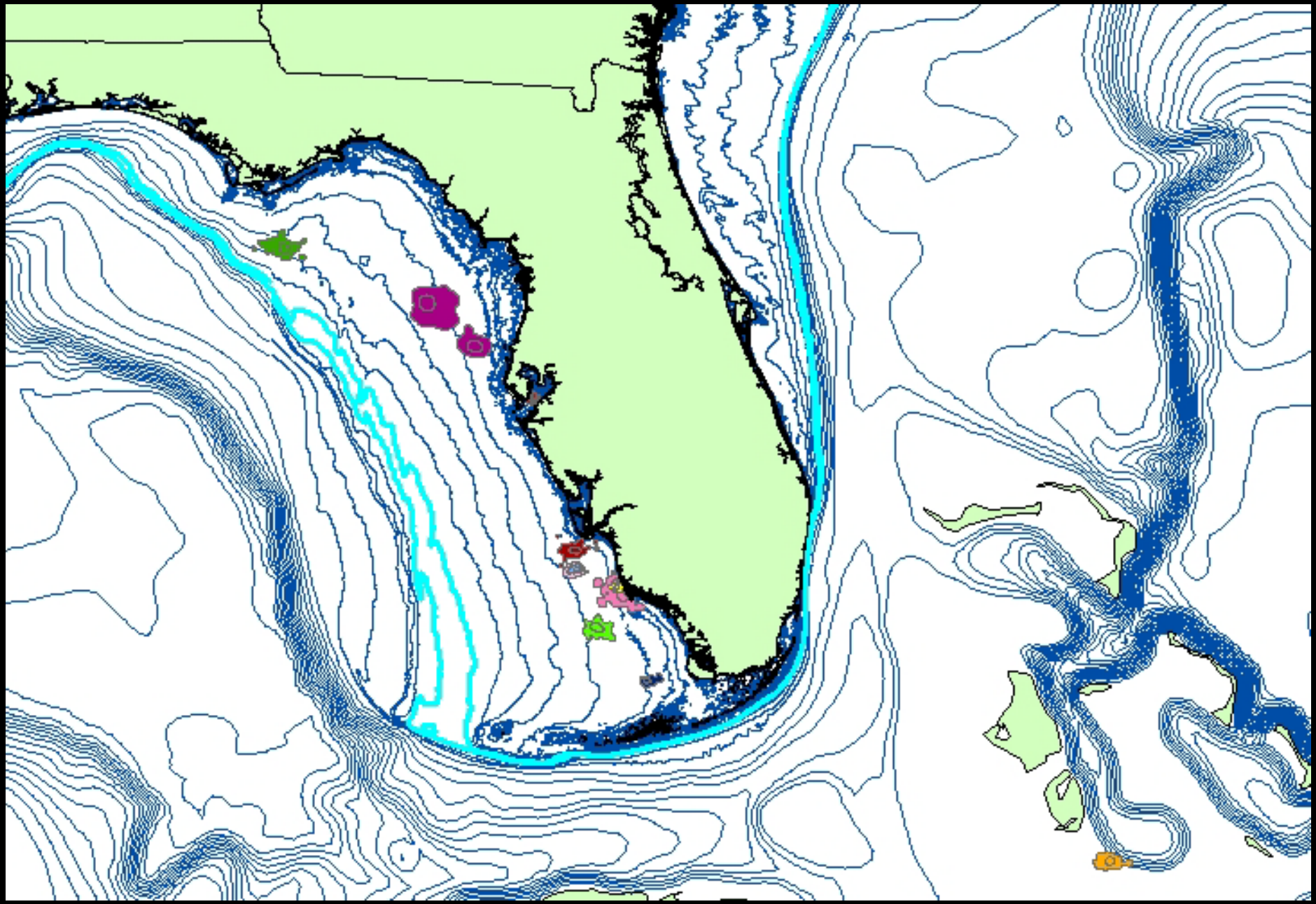
Part III: Management

United States

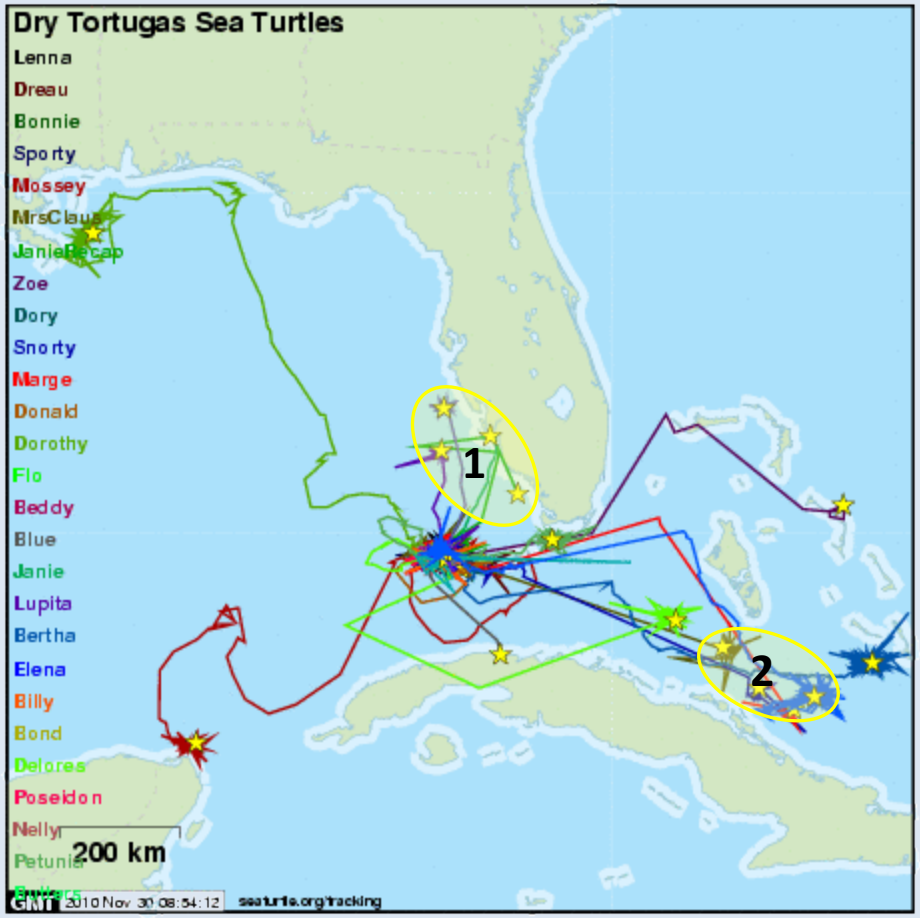
- **Endangered Species Act** limits 'takes'
  - 'harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to do these things' (16USC§1531-1544)
- **Magnuson Stevens Fishery Conservation and Management Act** urges bycatch reduction
  - Turtle excluder devices (TEDs) on trawling vessels, circle hooks in longline fishery

Implications for Management

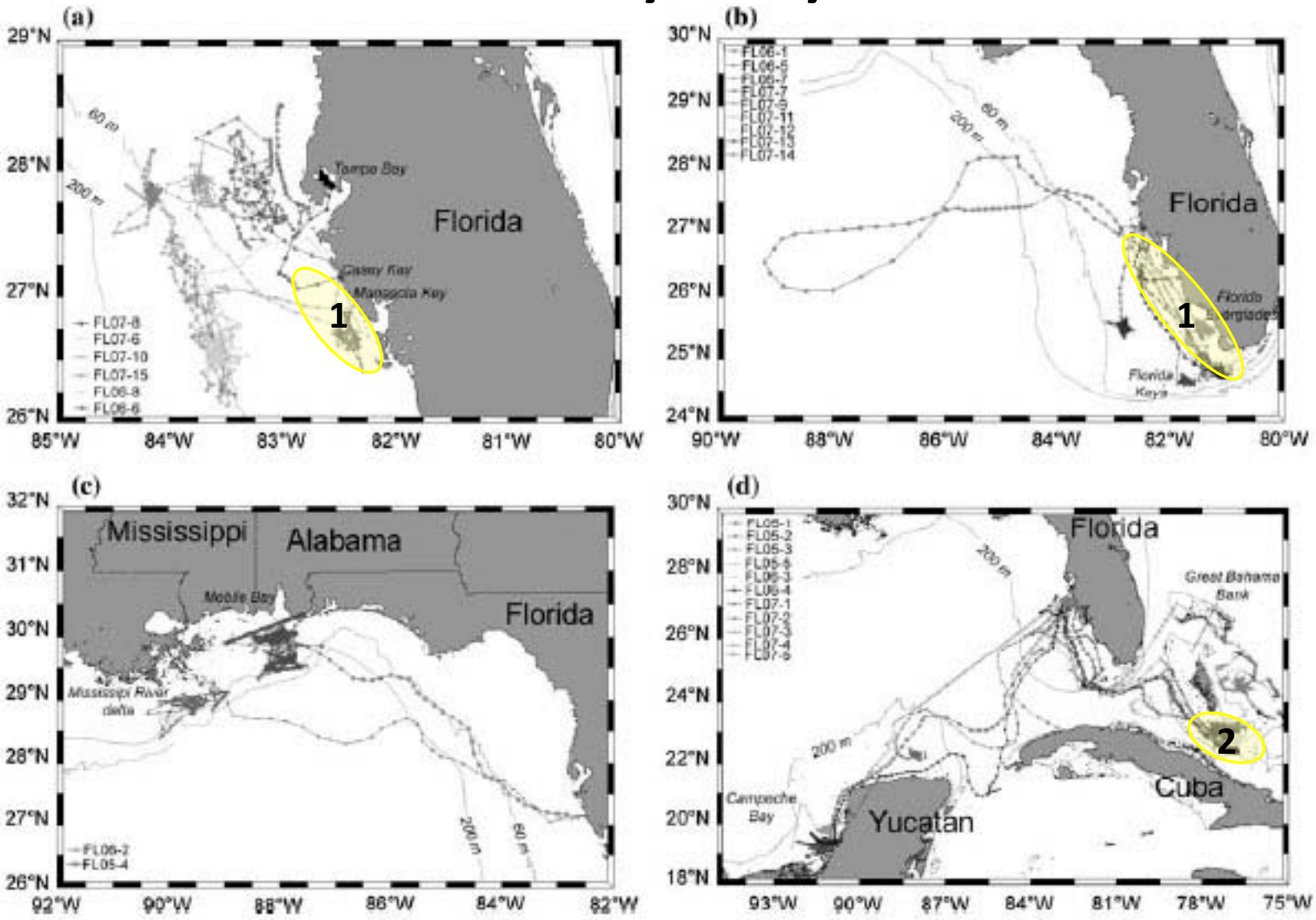
- Low survival rates in the region
- Fishery bycatch potential at all life stages
- Gulf of Mexico bottom longline fishery
- Is more targeted habitat management possible?



Dry Tortugas



Casey Key



Girard et al. 2009

Research Questions

- Could variable remigration frequency be contributing to changes in annual nest counts?

  - No evidence of a remigration trend

- Does the nesting assemblage share a common, discrete foraging area?

  - Discrete but not always shared foraging sites

- Could targeted management in the foraging area(s) be implemented to assist population recovery?

  - yes

In the Future

- Urge collaboration among projects to inform fishery managers on loggerhead high use areas
- More targeted (spatial and temporal) strategies may decrease loggerhead takes while minimizing impact on fishers

Acknowledgements

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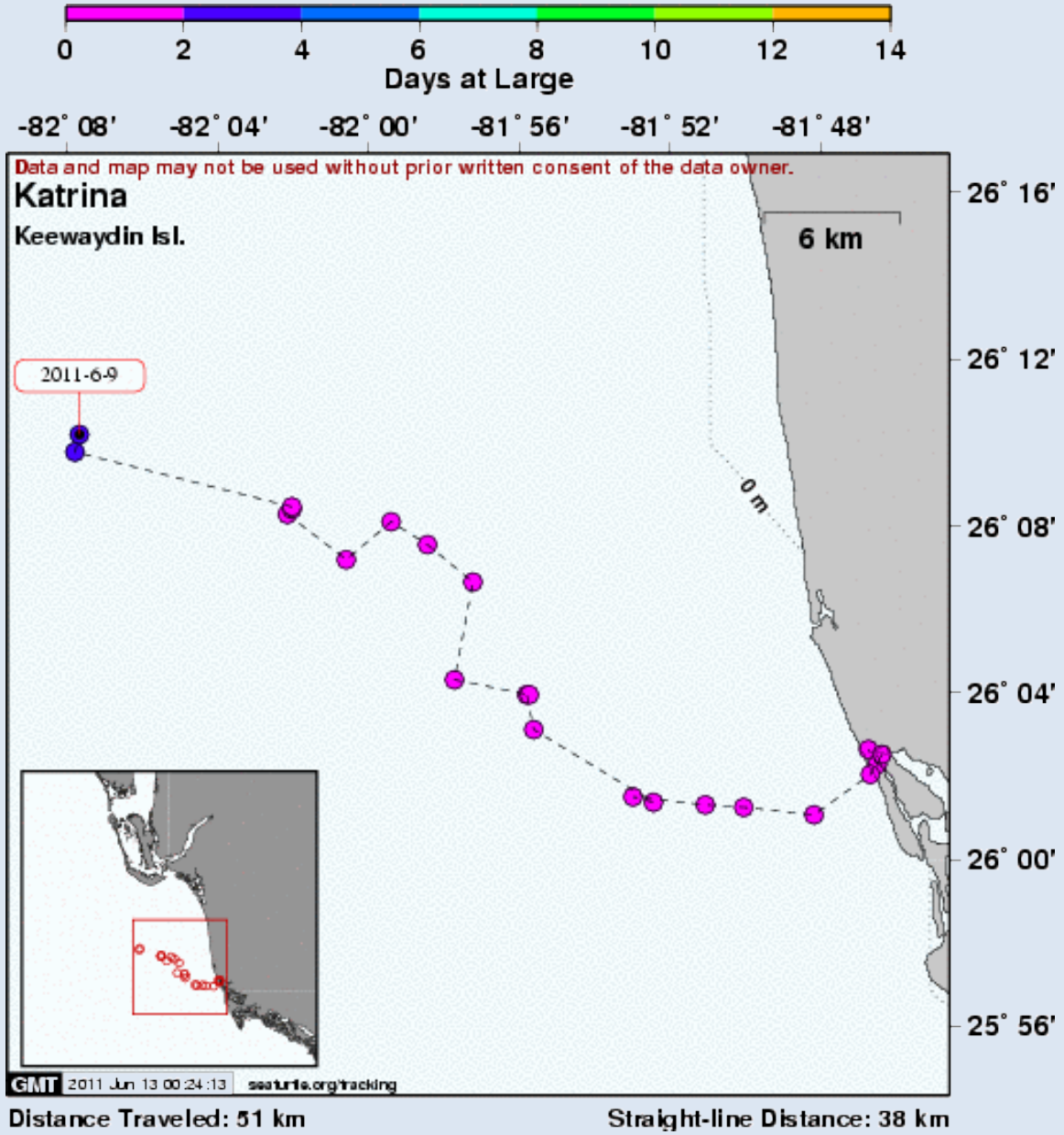
www.seaturtle.org