Responses of Brown Pelicans (*Pelecanus occidentalis*) Ecology & Habitat to a Major Hurricane

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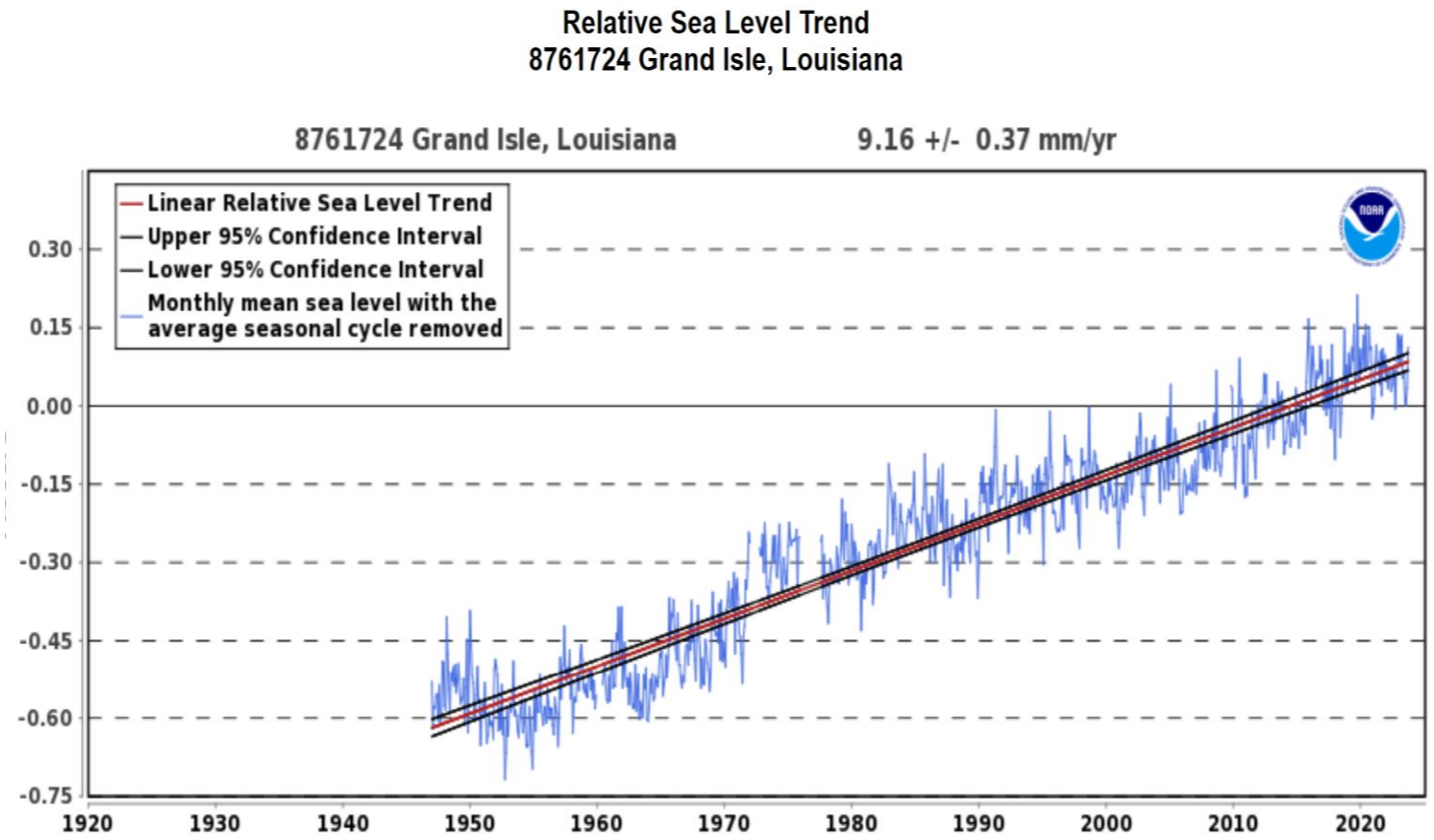
Department of Biology

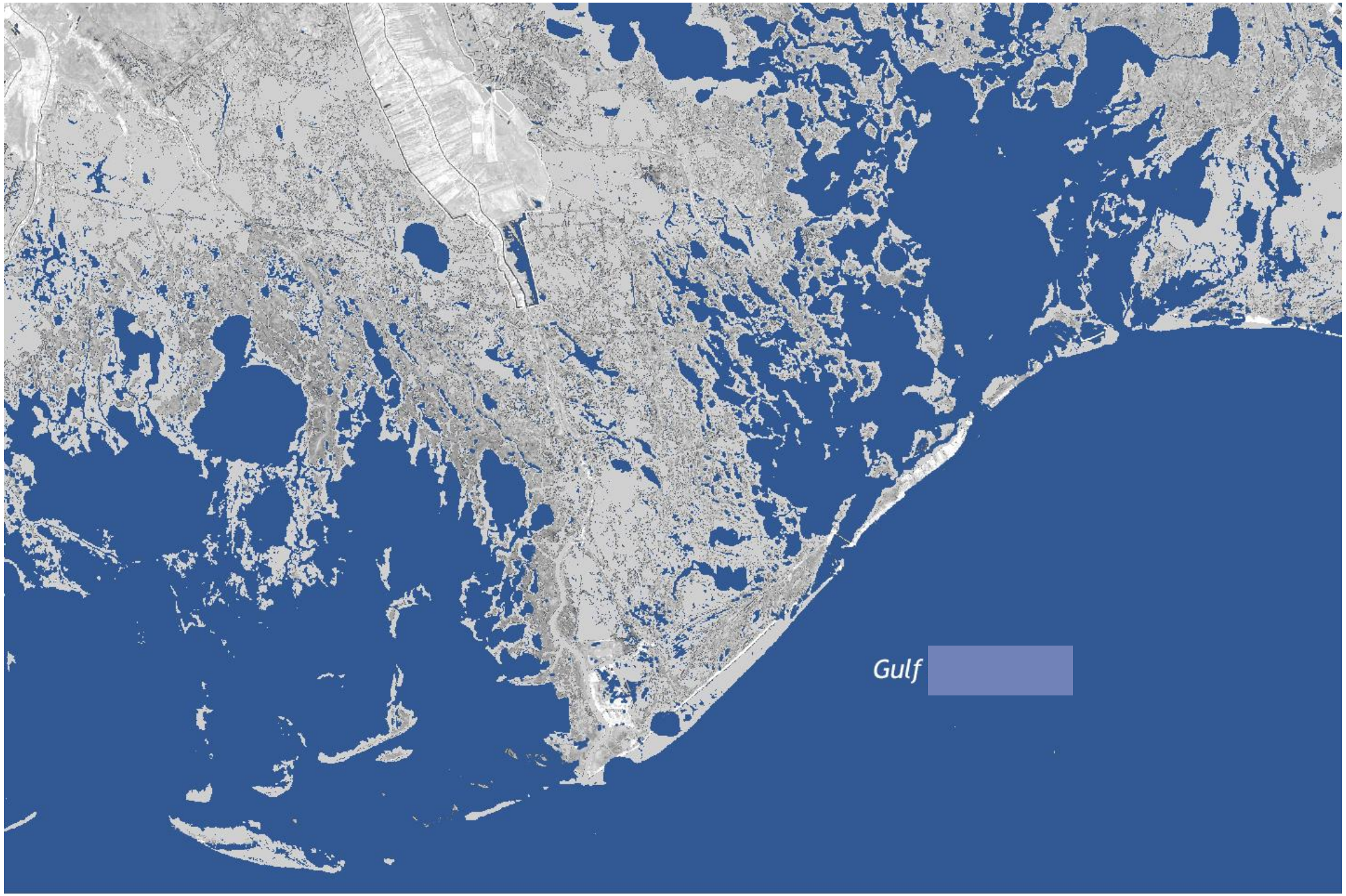
Thesis Defense

Photo: Bonnie Slaton

Introduction

- Louisiana is experiencing high rates of relative sea level rise
- Land loss 4,800 km^2 since 1930's (Couvilion et al. 2017)
  - Erosion
  - Subsidence
  - Storm Surge

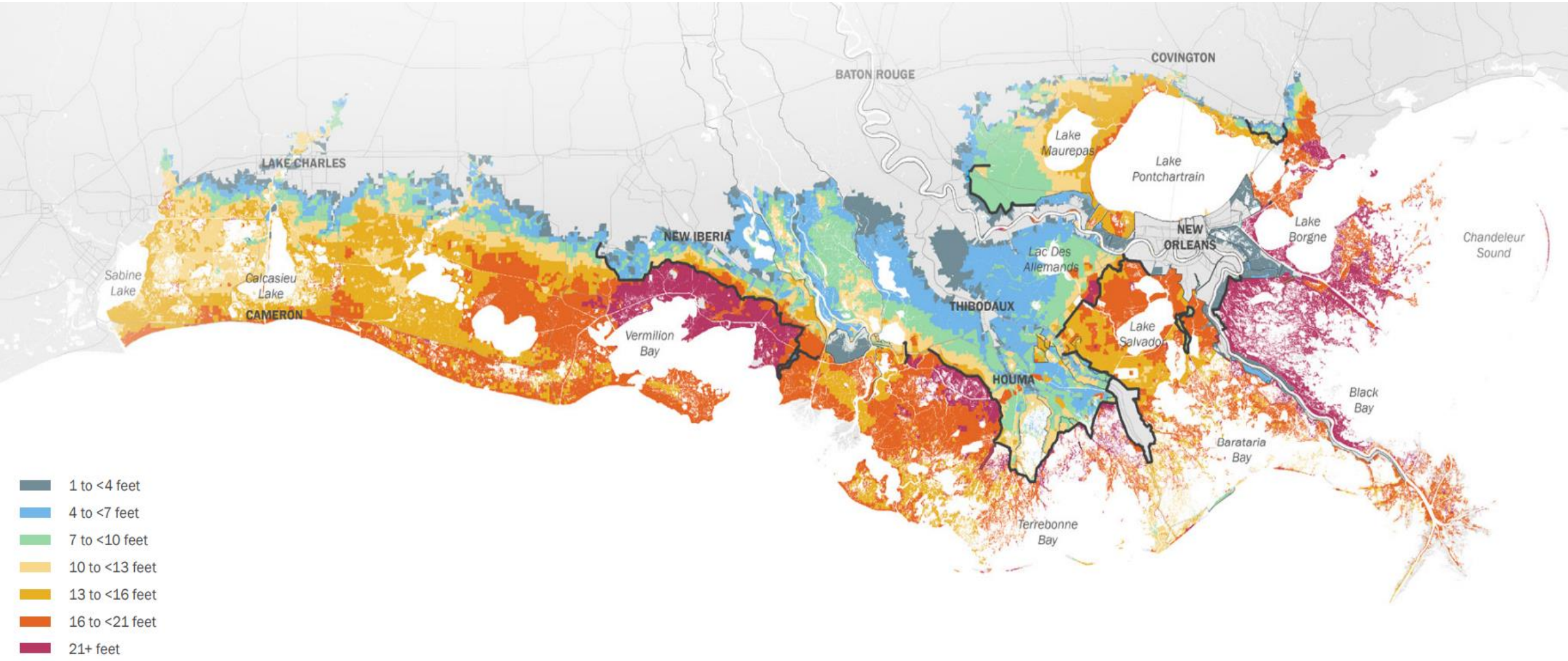




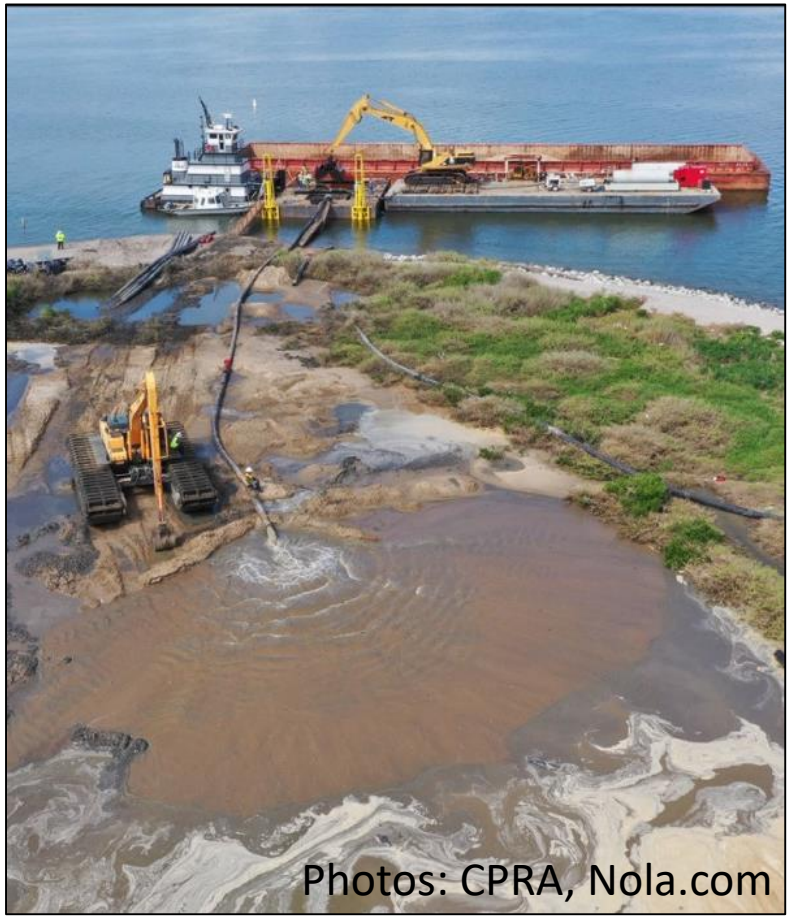
NOAA

1932

CPRA Master Plan 2023: Future Without Action

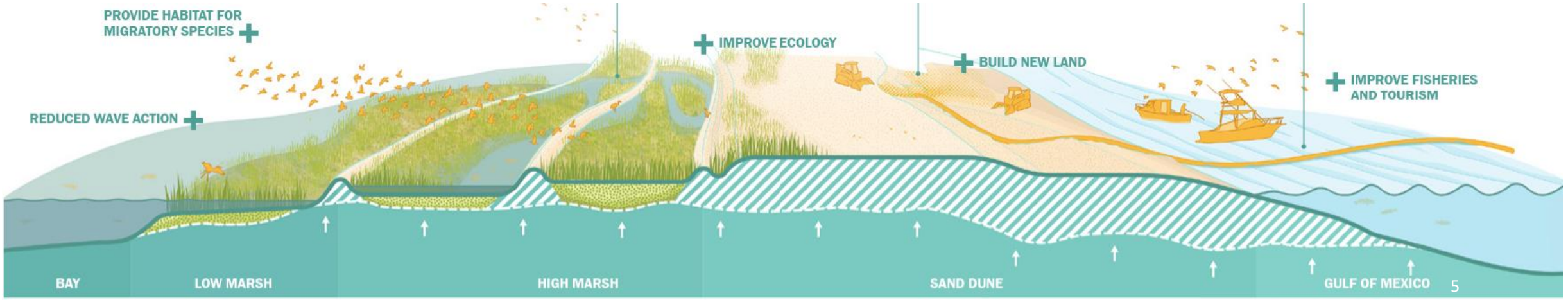


Barrier Island Restoration



Photos: CPRA, Nola.com

- Shoreline protection
- Dredging to increase island area and elevation
- Restore ecology for target flora & fauna



Google Earth Pro


B. Slaton


B. Slaton

Barrier Island Landscape

Islands for the Birds

Photos: G. Herbert (AP, left), B. Slaton (right)

Hurricanes & Islands

Strong winds (>119 km/h)

Erosion	Wave action	Overwash

Structural changes in woody vegetation, defoliation

Flora and fauna dispersal

Invasive species establishment


MOULTRIE
88°F 29.83inHg
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05 JUN 2022 09:37 am

Brown Pelican (*Pelecanus occidentalis*)

CornellLab

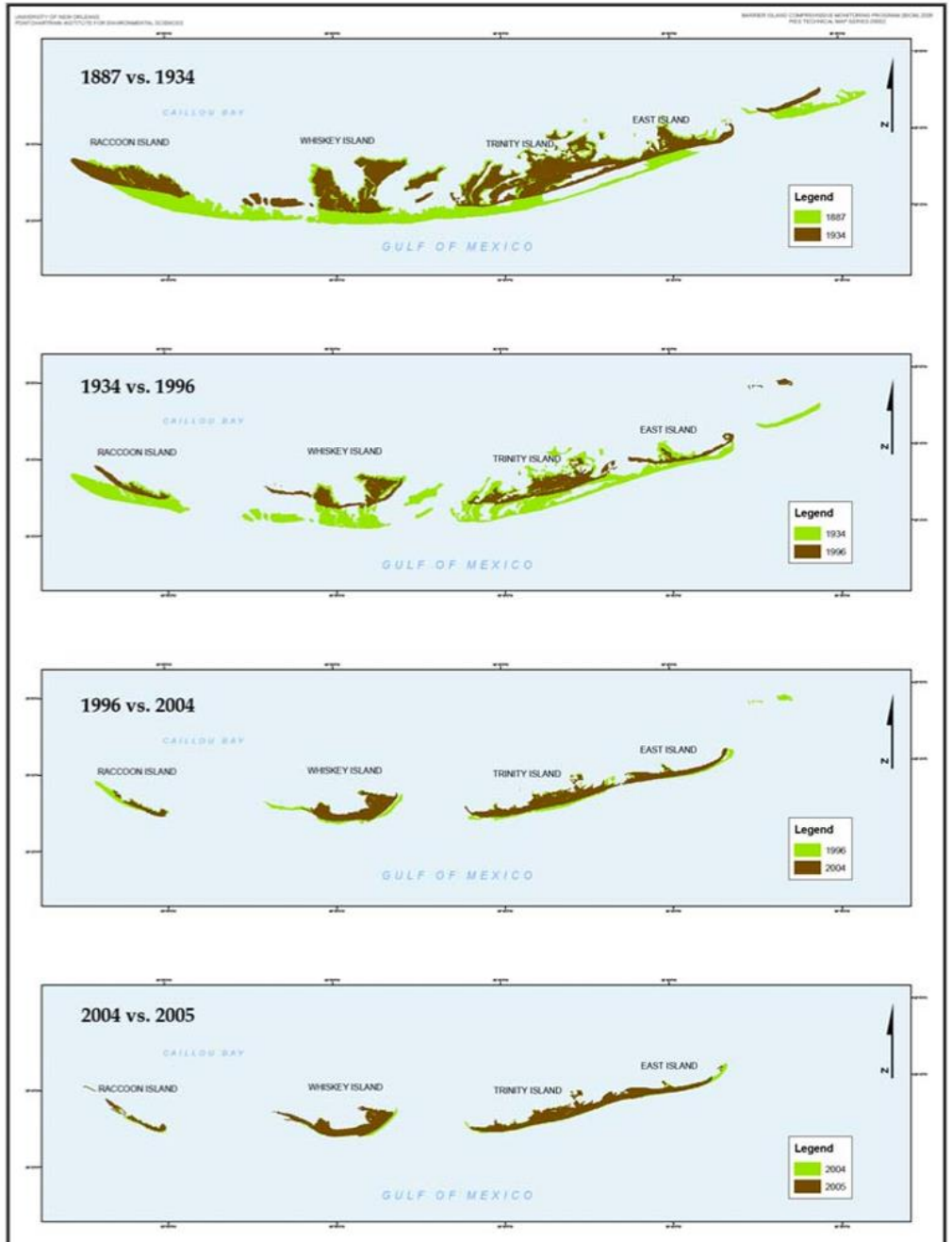
- Mixed-species colonies
- Cooperative pairs
- Nesting substrate
  - Ground & Shrub

Photos: B. Slaton

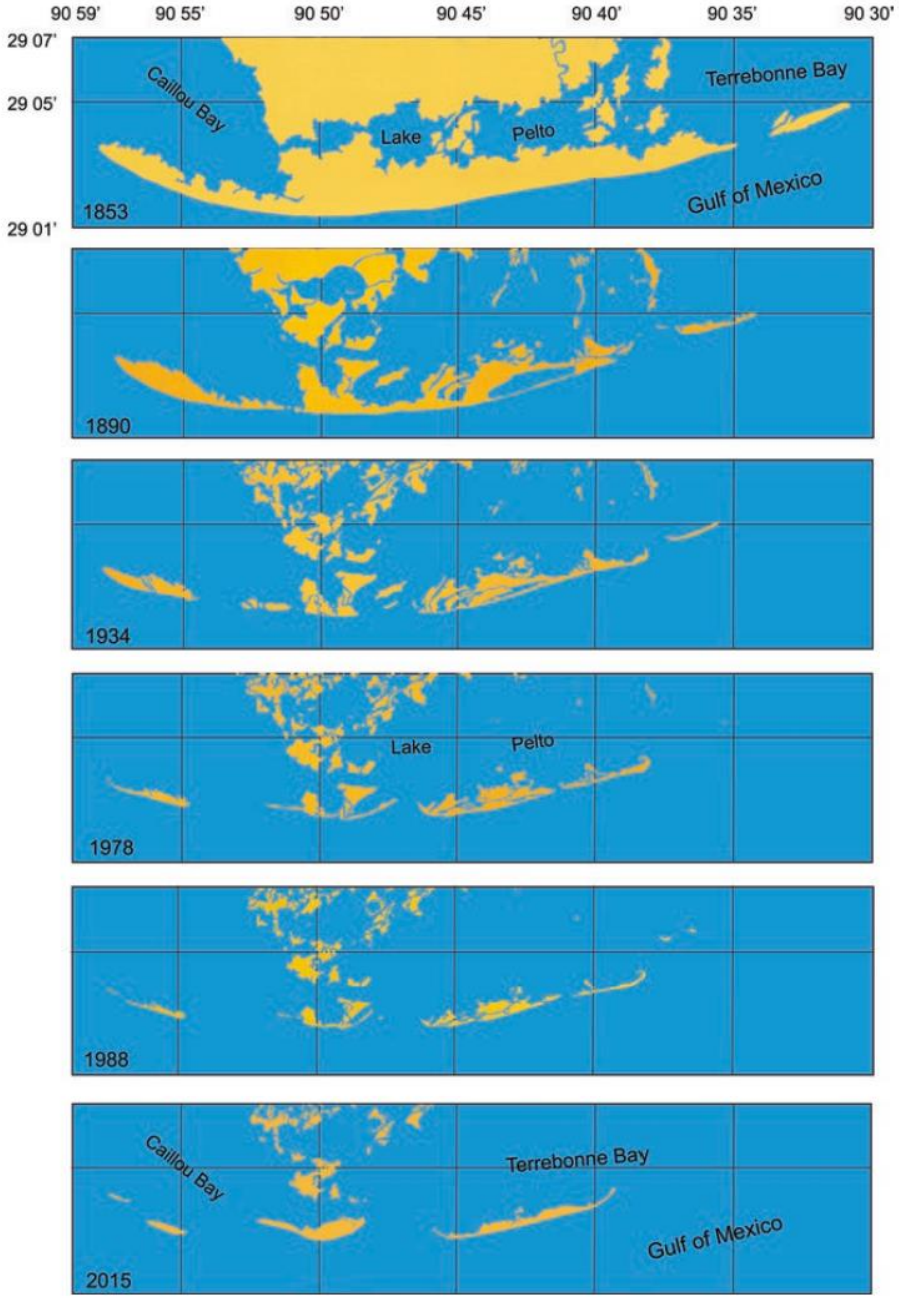
Threats to the Brown Pelican

- Use of pesticide DDT
  - extirpation in LA in 1960's
  - Listed on Endangered Species Act in 1970
  - Delisted in 2009
- Pollution
  - Deepwater Horizon BP Oil Spill
- Rapid loss of habitat

Martinez et al. 2009



Fitzgerald et al. 2018



Nesting Island Loss

- Selman et al. (2016)
- Decreased 70% after 2005 Hurricanes
- At least 10 islands lost

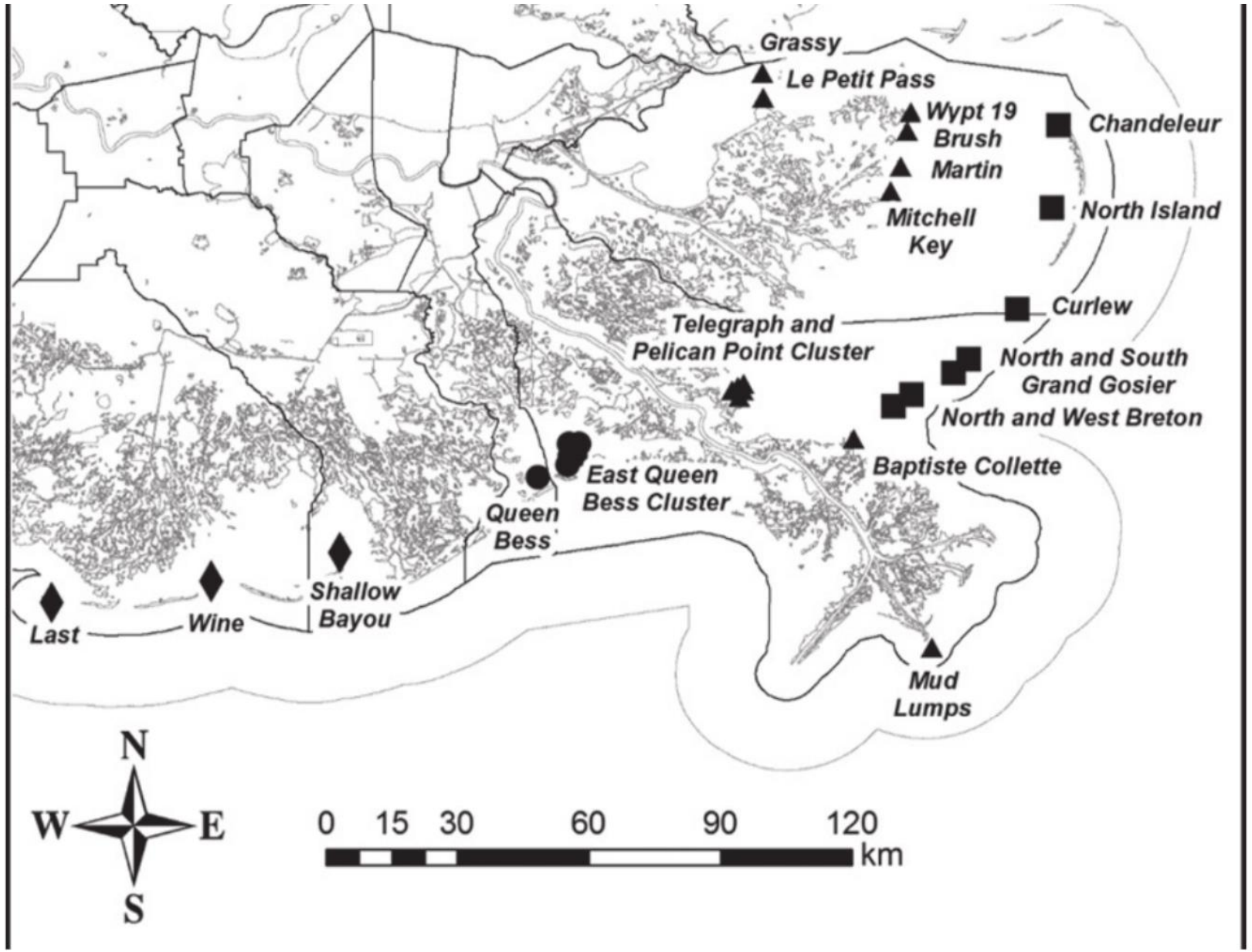
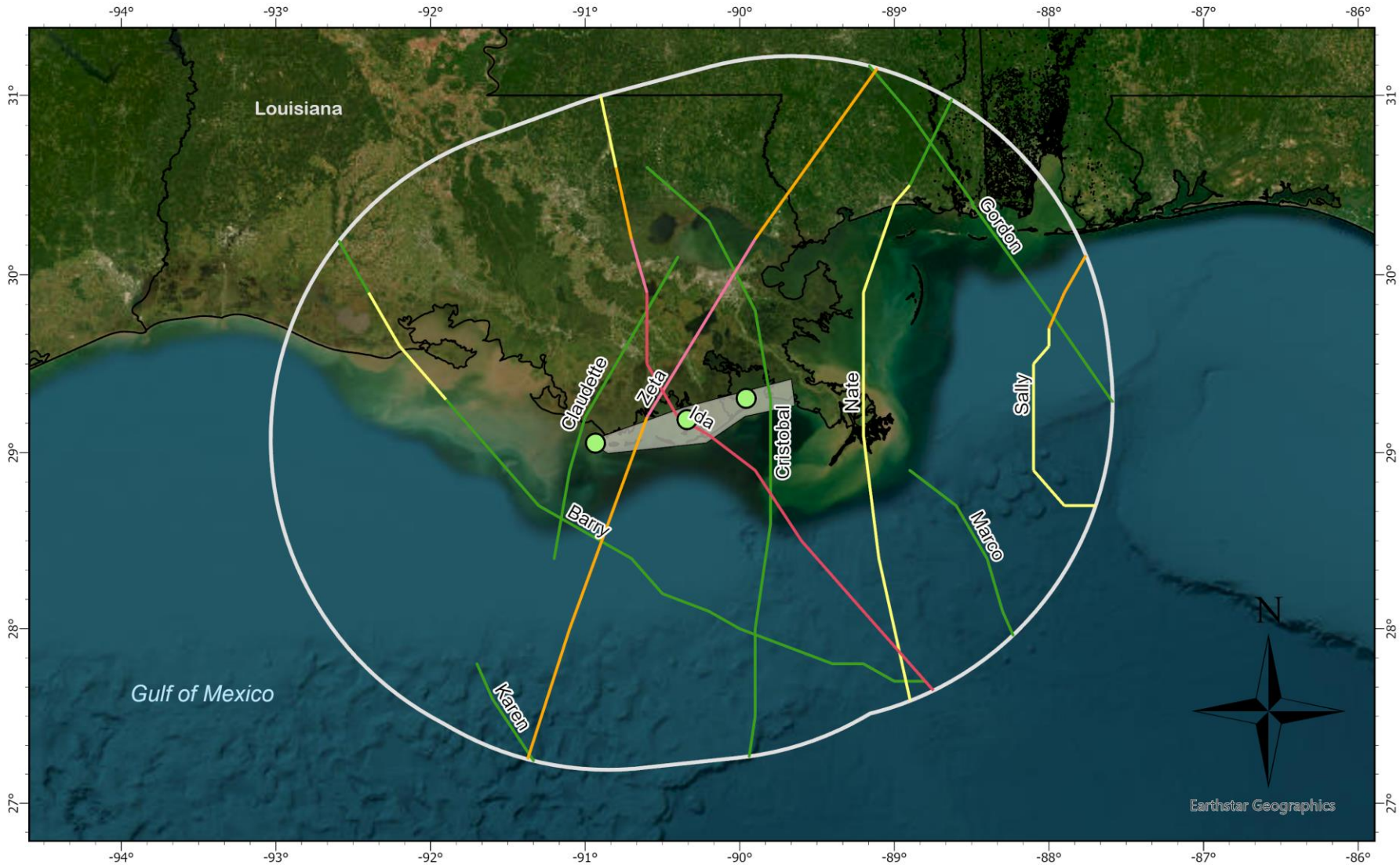


Figure 1. Location of Brown Pelican nesting colonies in coastal Louisiana, with the inset showing the location of the recently established colony at Rabbit Island. Different symbols represent different regional groupings as defined in text (diamond: Terrebonne; circle: Barataria; triangle: Nearshore East; square: Chandeleur).



Spatial Reference: GCS WGS 1984
Units: Decimal Degree

Data Sources:
Gulf State Map.....ESRI
Hurricane Paths....NOAA

0 100 200 Kilometers

200 km Buffer
Study Area
Breeding Colony

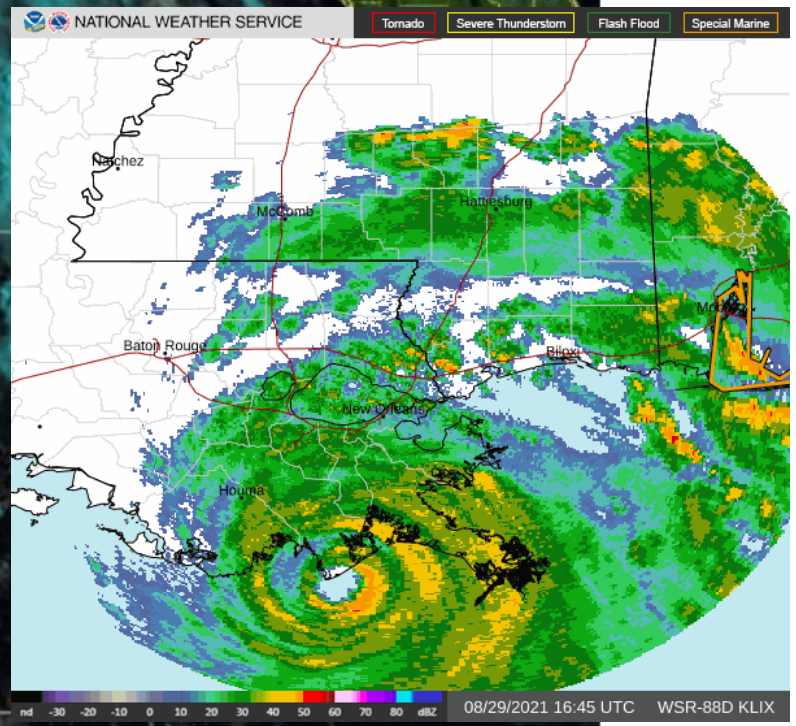
Tropical Storm
Category 1
Category 2
Category 3
Category 4
Category 5

Hurricane Ida

Aug 29, 2021

Category 4

Max sustained winds ~241km/h



29 Aug 2021 14:00Z NOAA/NESDIS/STAR GOES-East ABI DayLandCloud

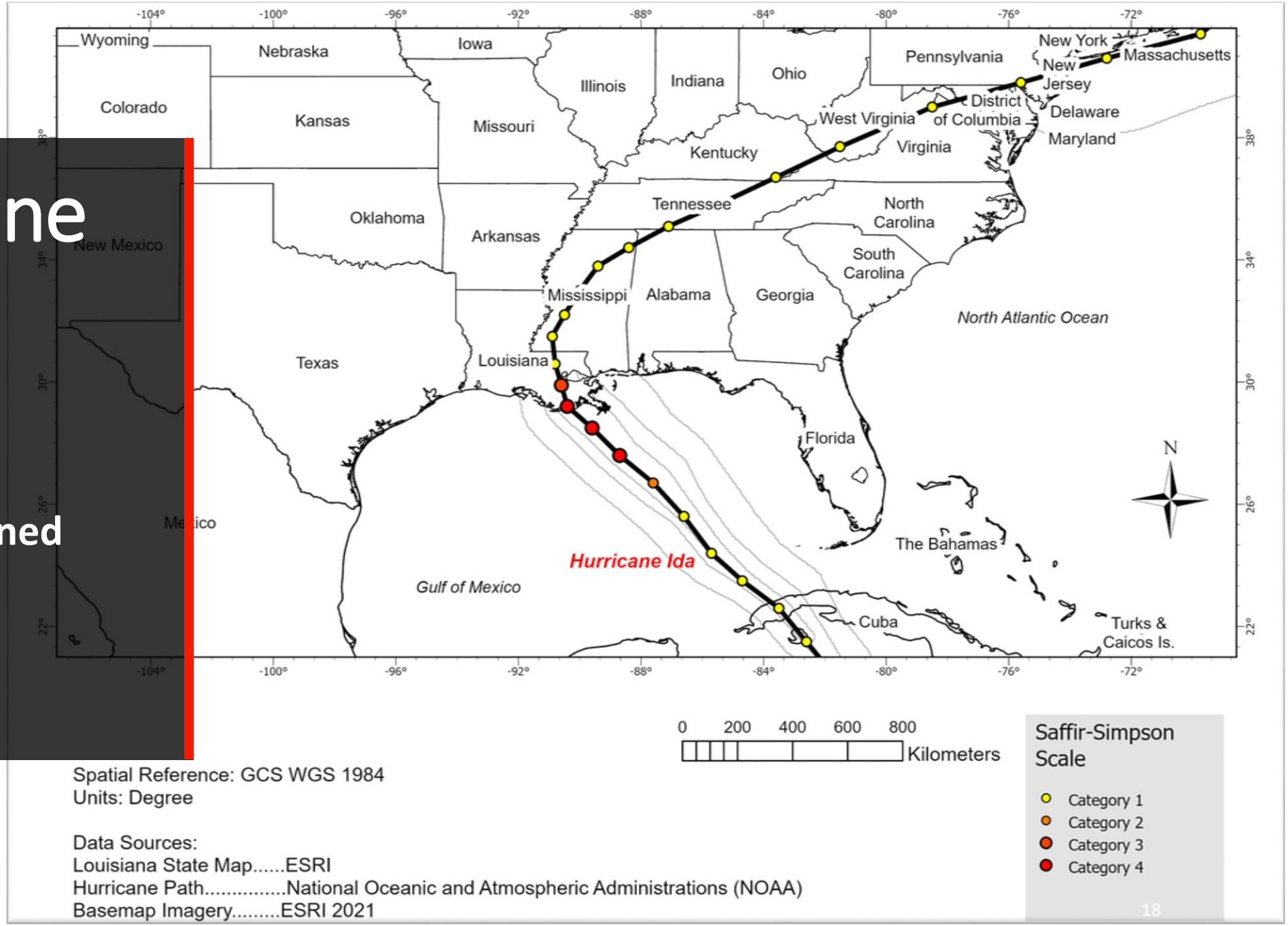
GOES-16 DAY CLOUD CONVECTION IMAGE OF IDA A FEW HOURS BEFORE LANDFALL AT PORT FOURCHON., LOUISIANA, AT 1400 UTC 29 AUGUST 2021. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Hurricane Ida

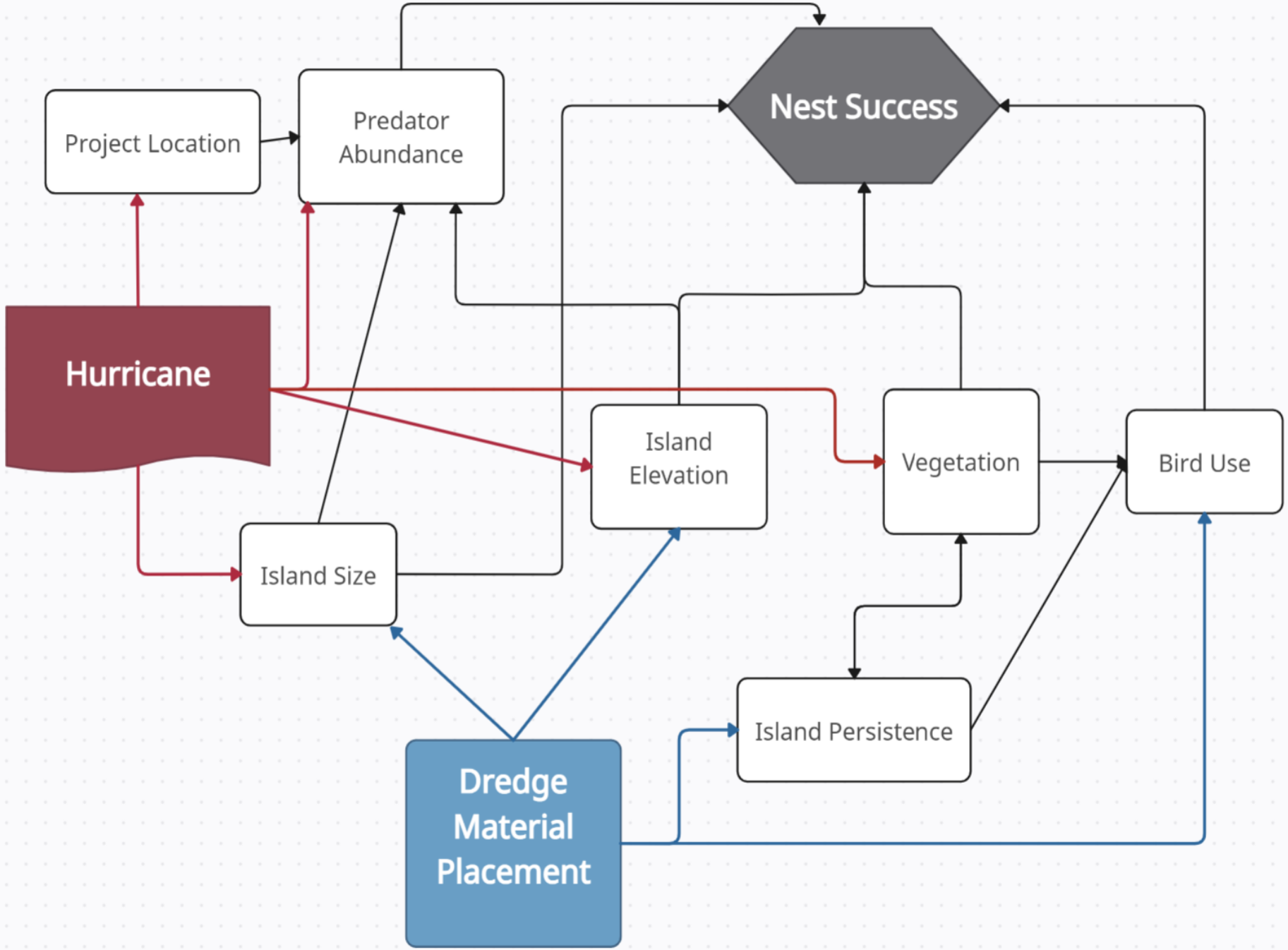
August 29, 2021

Category 4

Maximum sustained winds ~241km/h



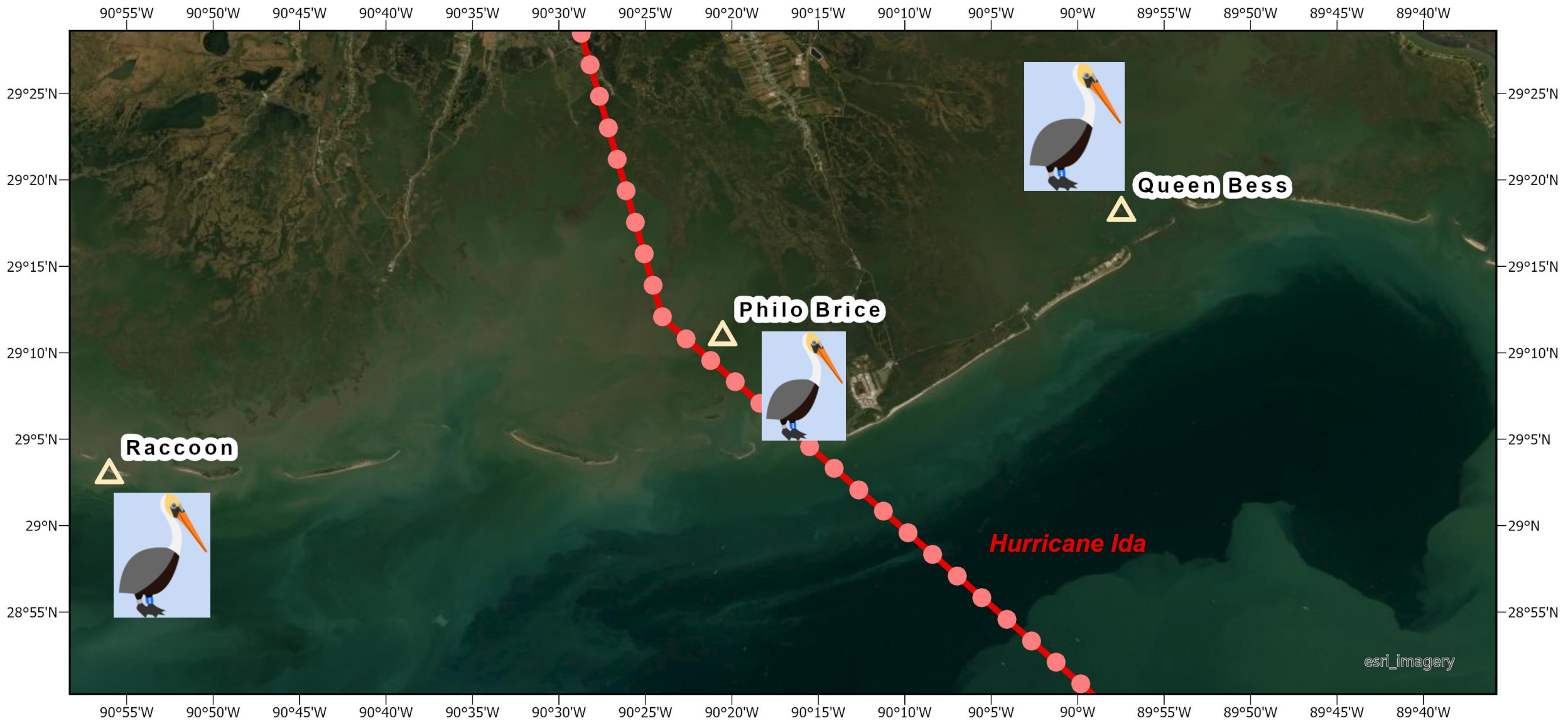
Photos: B. Depp (NatGeo)


Nest Success
Project Location
Predator Abundance
Hurricane
Island Elevation
Vegetation
Bird Use
Island Size
Island Persistence
Dredge Material Placement

Objectives

Compare Brown Pelican reproductive success on 3 breeding colonies before (Spring 2021) and after Hurricane Ida (Spring 2022 & 2023)

Compare island vegetation composition and island area before and after Hurricane Ida + restoration


90°55'W
90°50'W
90°45'W
90°40'W
90°35'W
90°30'W
90°25'W
90°20'W
90°15'W
90°10'W
90°5'W
90°W
89°55'W
89°50'W
89°45'W
89°40'W
29°25'N
29°20'N
29°15'N
29°10'N
29°5'N
29°N
28°55'N
Queen Bess
Philo Brice
Raccoon
Hurricane Ida
esri_imagery

Raccoon Island Restoration

2012

2022

Imagery Google Earth Pro

Philo Brice Island-unrestored

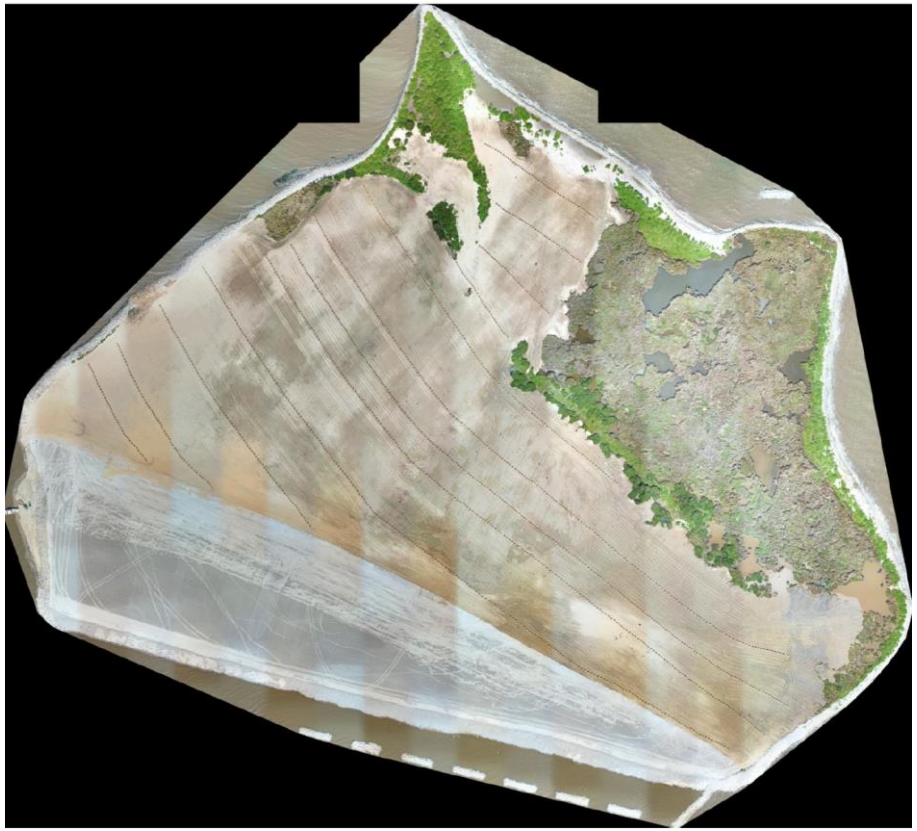
Imagery Google Earth Pro

Photos: B. Slaton

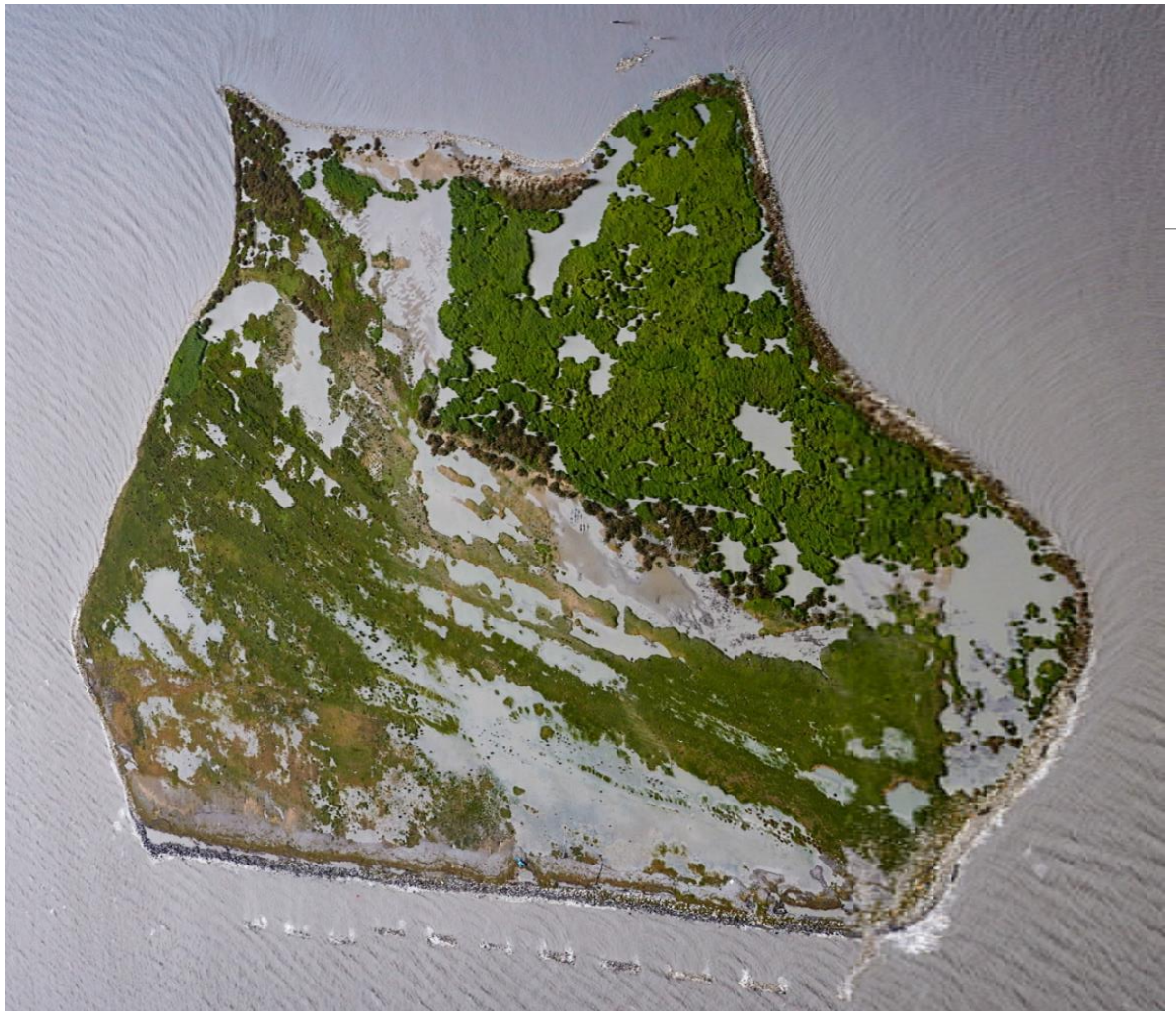
Queen Bess Restoration

2019
~2 ha

2021
~ 12 ha



Photos: CPRA

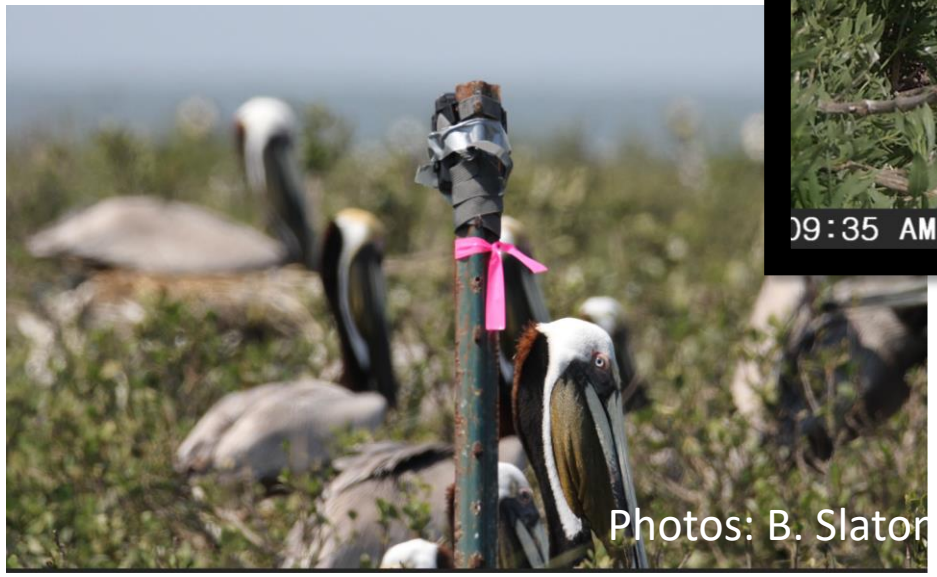


1 day post-Hurricane Ida
August 30, 2021

March 2025

Photo: Ben Depp NatGeo (left), Google Earth Pro (right)

Pelican “Krewe” Field Methods



Photos: B. Slator

Breed March-August

2021, 2022, and 2023

2021, cameras=26 (J. Martinez)

2022, cameras=32

2023, cameras=51

2021-2023 monitored **387** total nests

Field Methods

- Visit islands every 2-4 weeks
- Collected > 4.8 million photos to analyze
- “fledged” at 21 days post-hatch
- Daily Survival success/fail

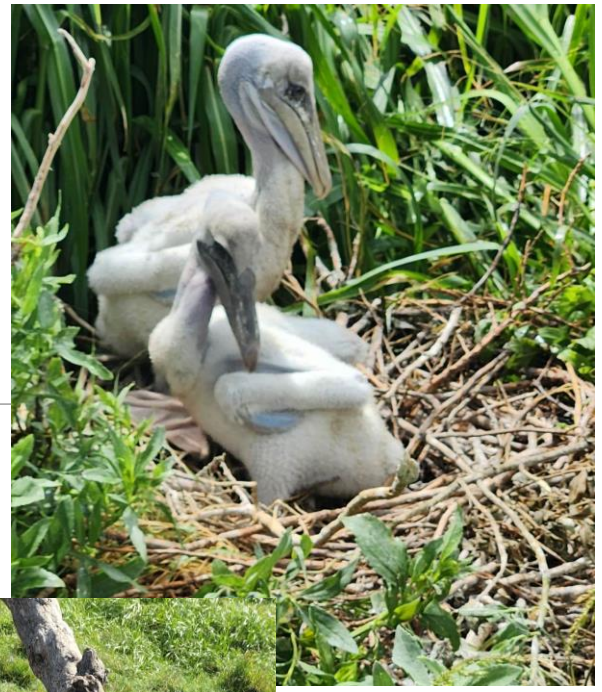
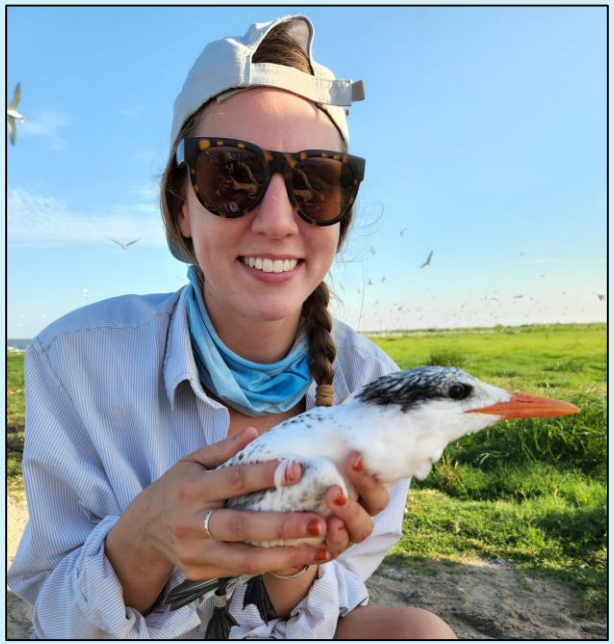
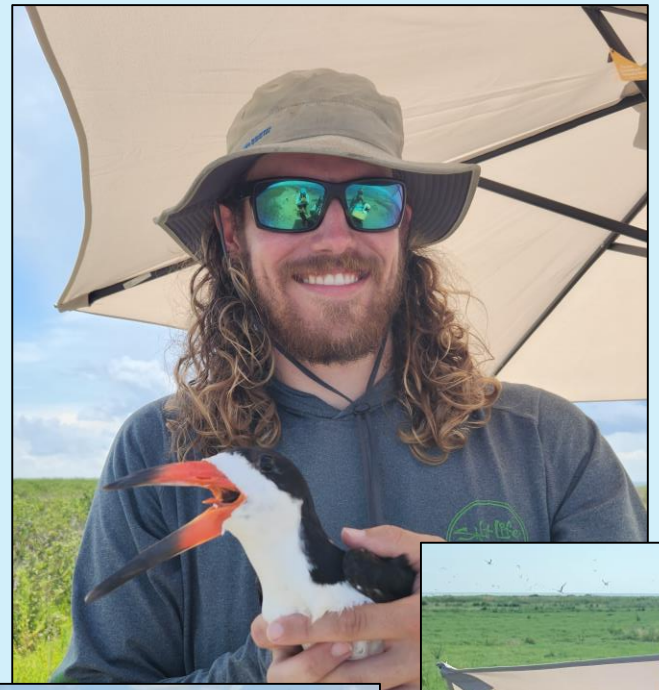
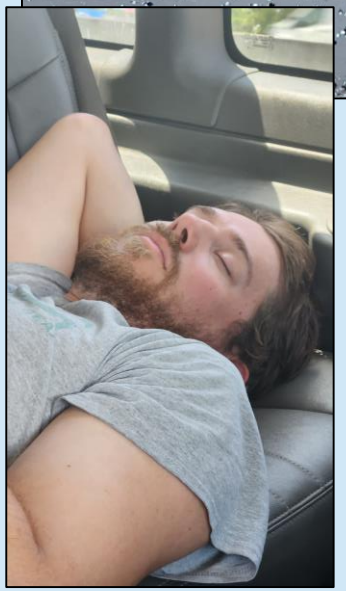
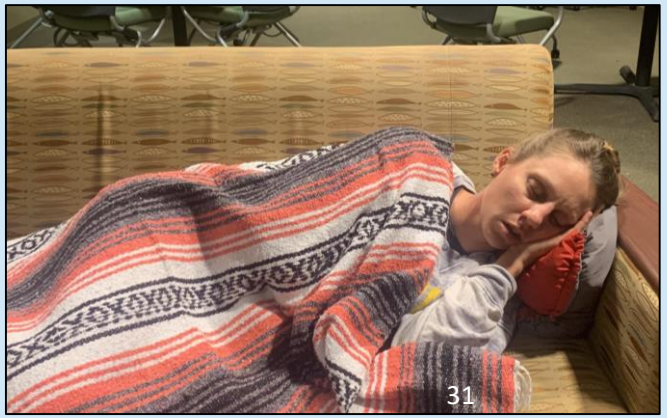


Photo: B. Slaton, AP (right)



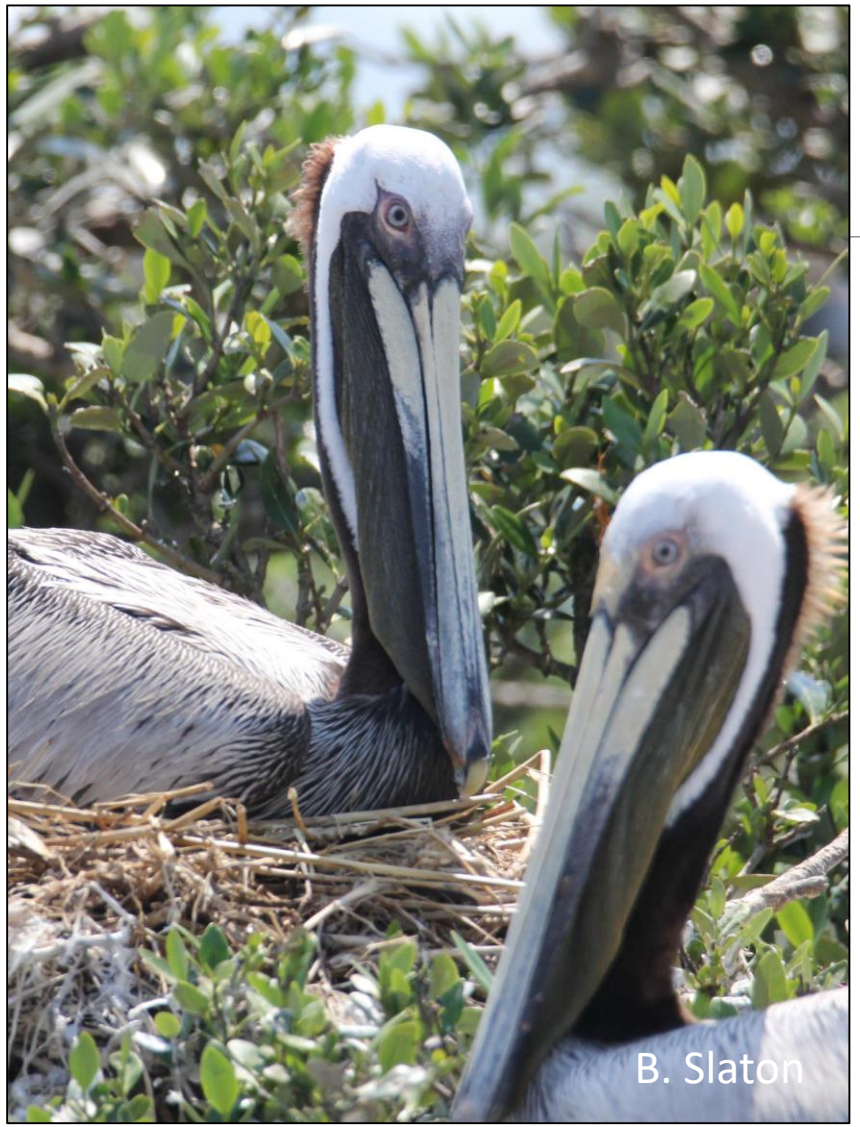






How to Measure Avian Reproductive Success?

- **Apparent Nest Success**
- **Daily Success Rate (DSR)**
- **Fledging Success**



Reproductive Success

- Generalized Linear Models
  - Covariates:
  - year
  - island
  - nest vegetation substrate
  - distance to hurricane
  - orientation to hurricane
  - island area
  - restoration status

Shrub & Ground Nests

Raccoon

Queen Bess

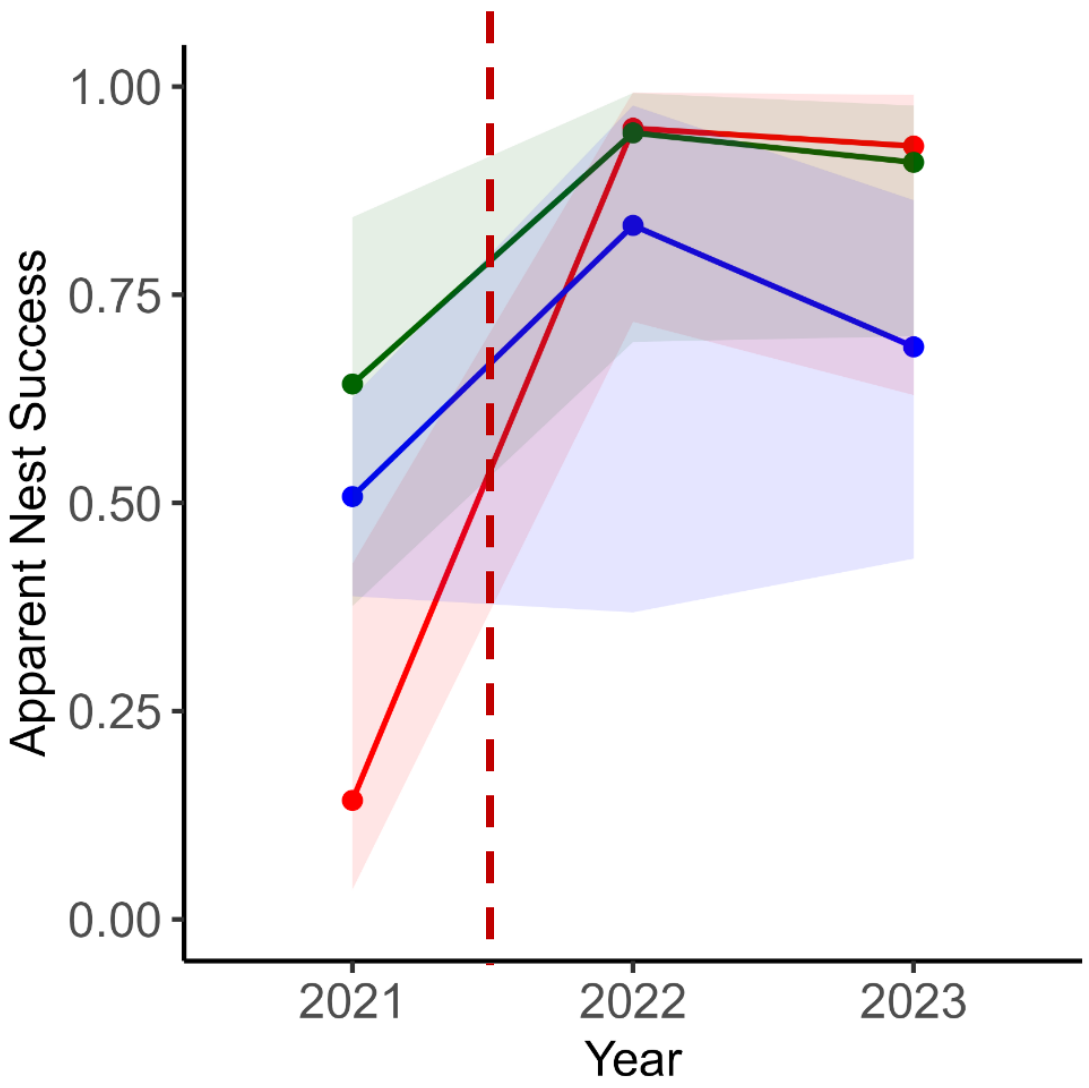
Shrub Nests Only

Raccoon

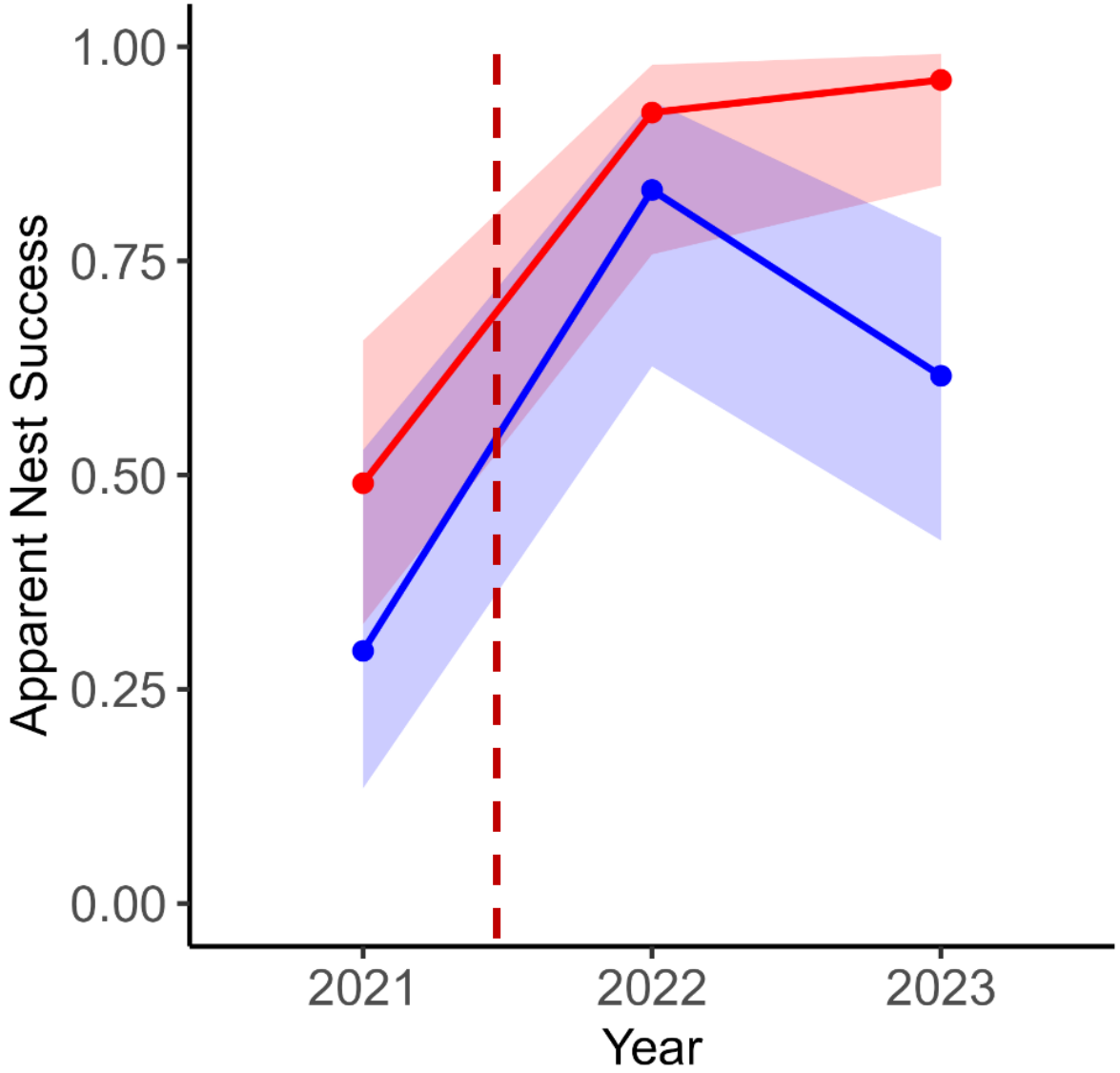
Queen Bess

Philo Brice

Apparent Nest Success-Shrub

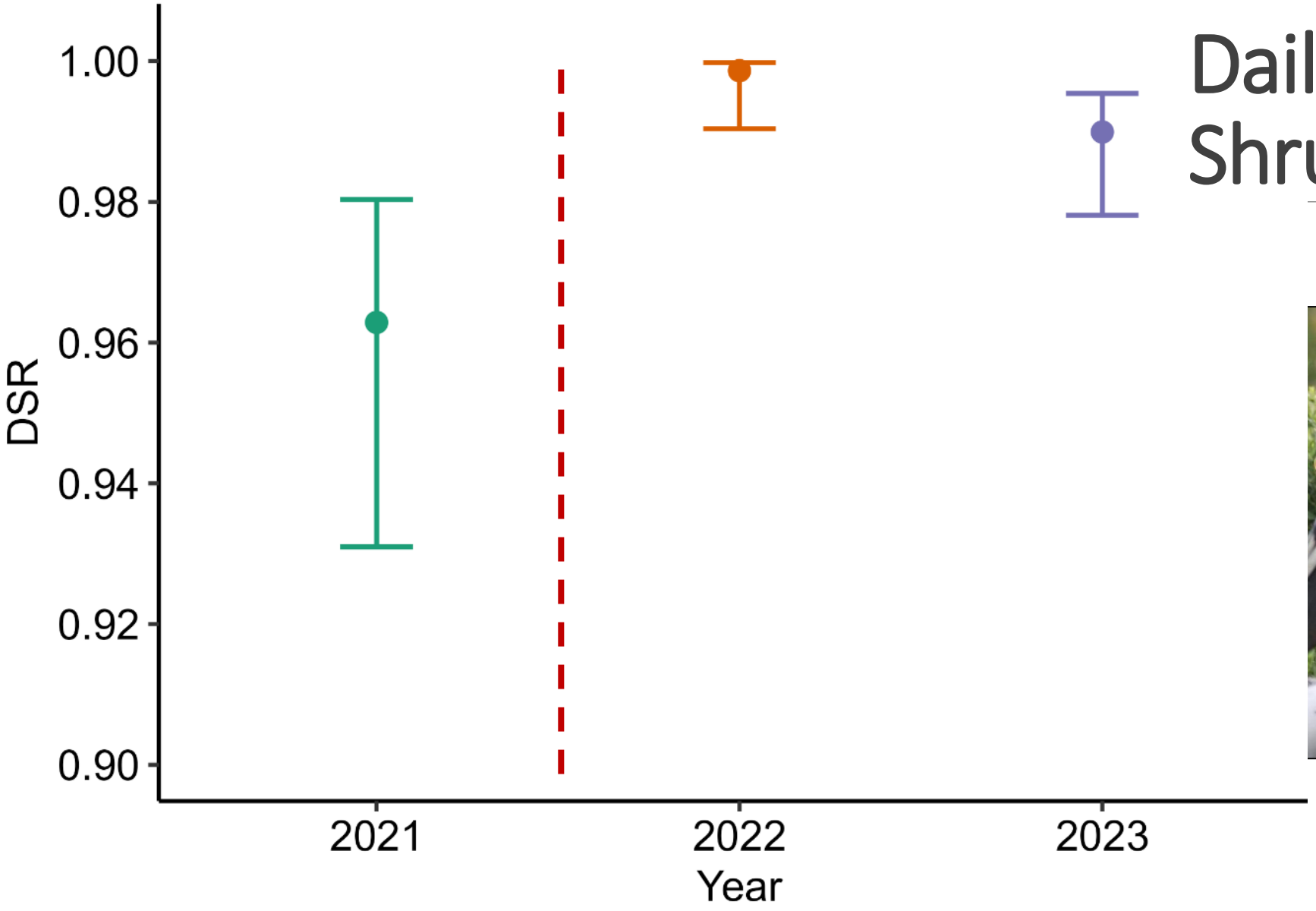


Apparent Nest Success- Shrub & Ground

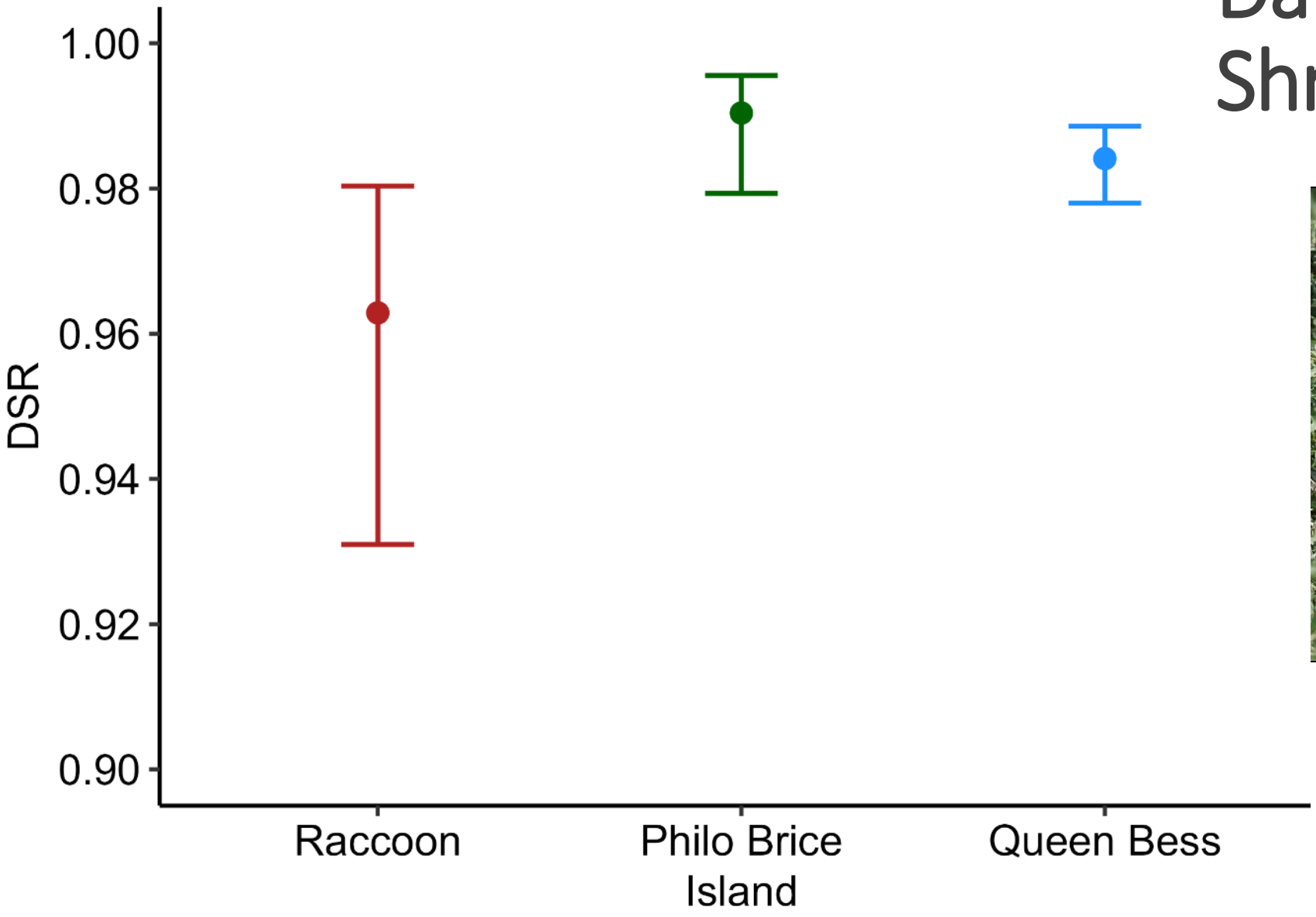


Island
Raccoon
Queen Bess

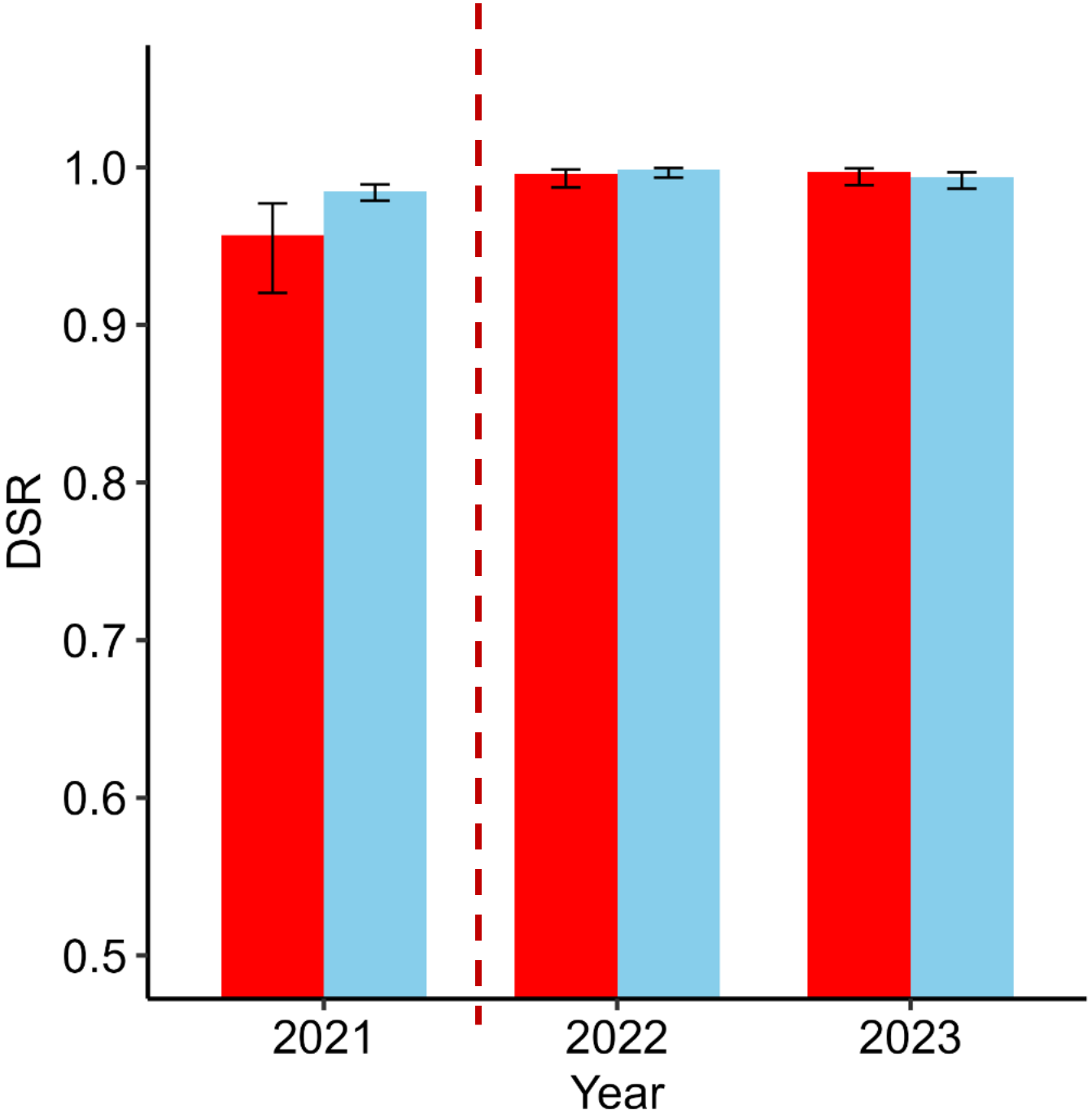
Daily Success Rate- Shrub



Daily Success Rate- Shrub

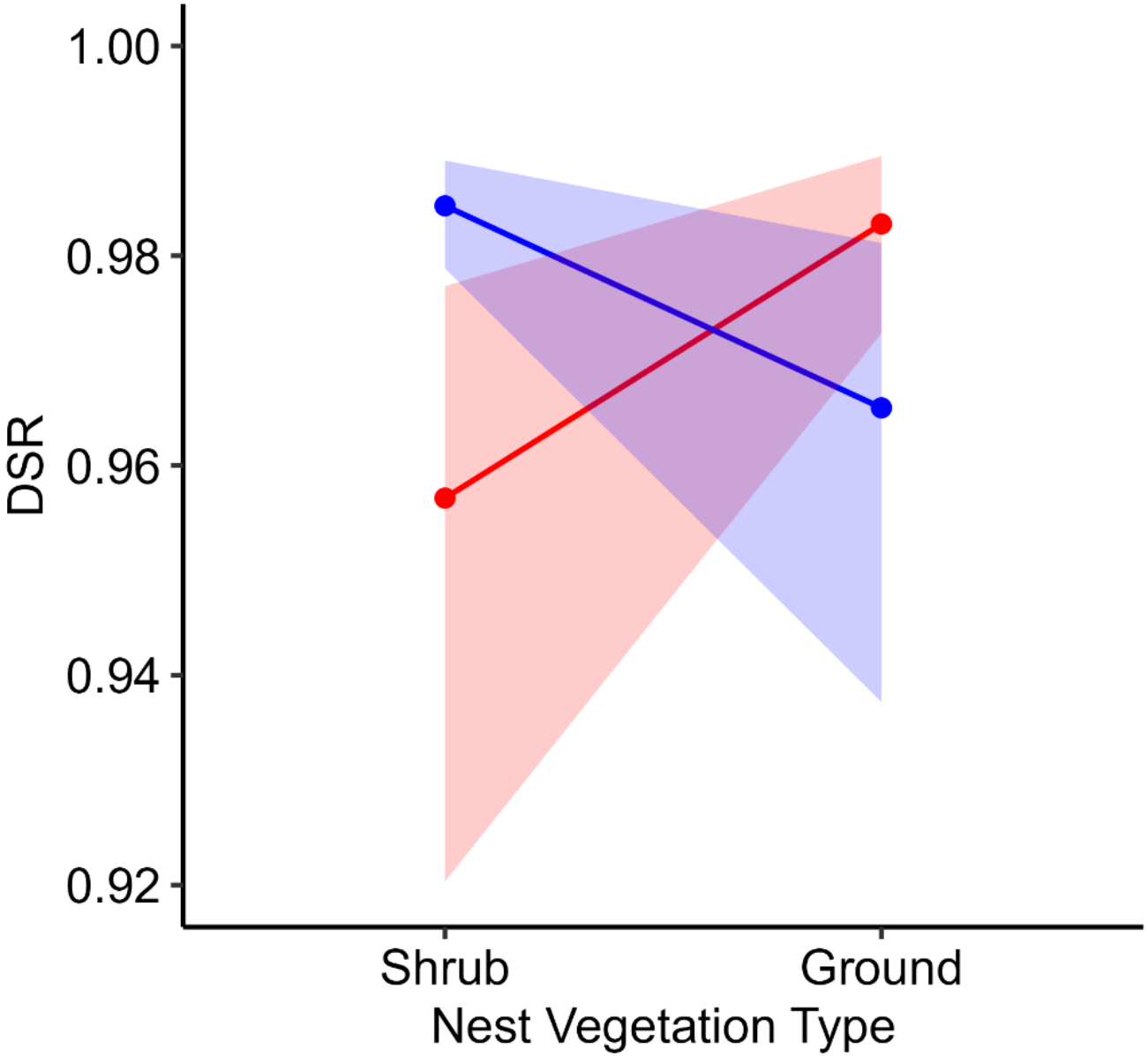


Daily Success Rate- Shrub & Ground



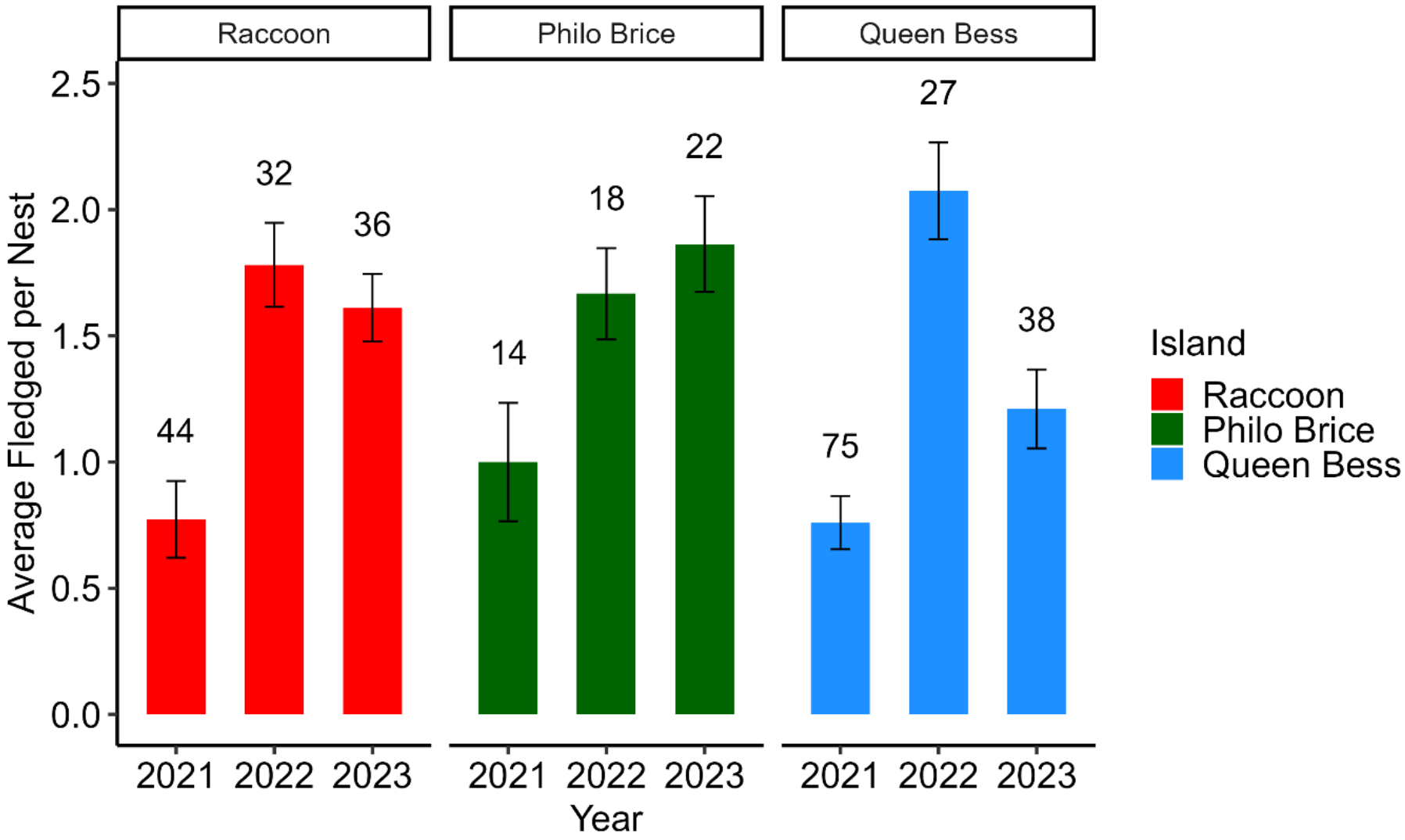
Island
Raccoon
Queen Bess

Daily Success Rate- Shrub vs. Ground

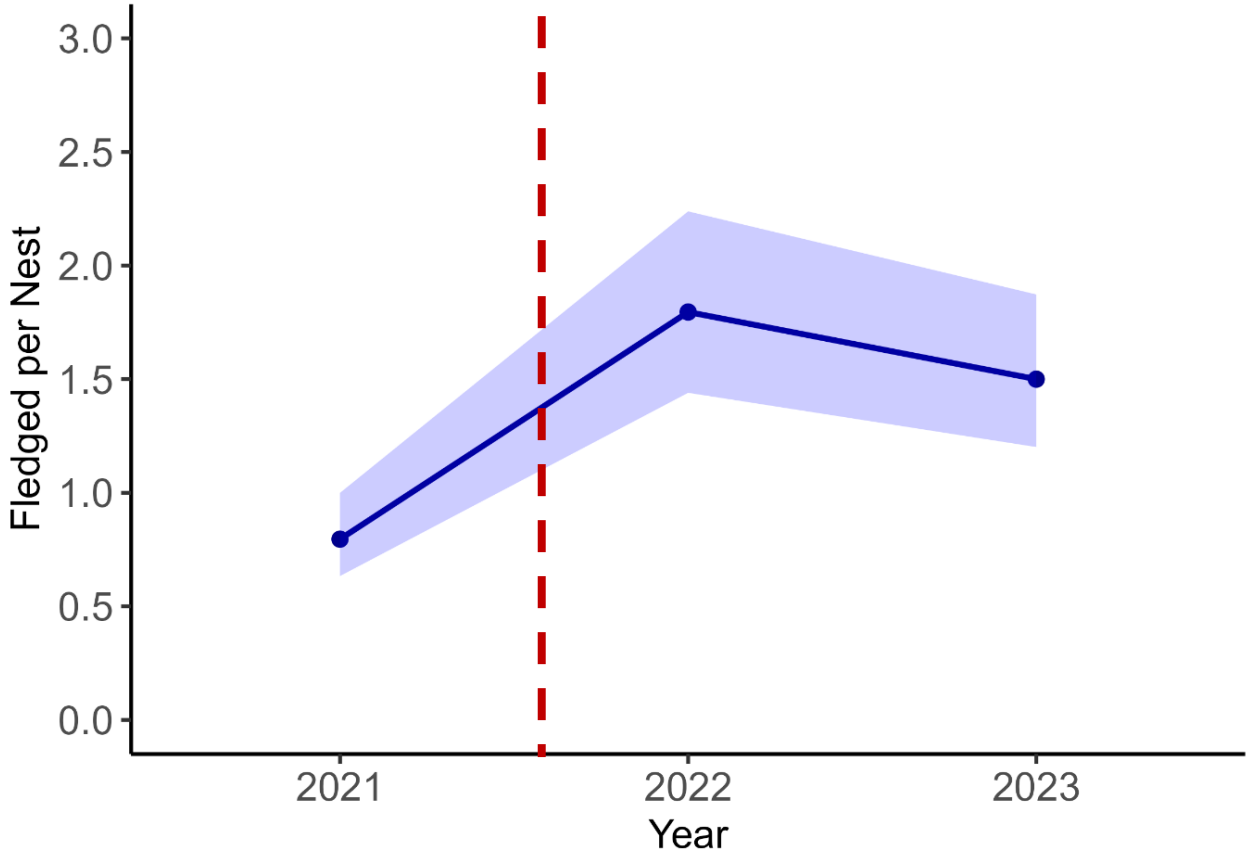


Island
Raccoon
Queen Bess

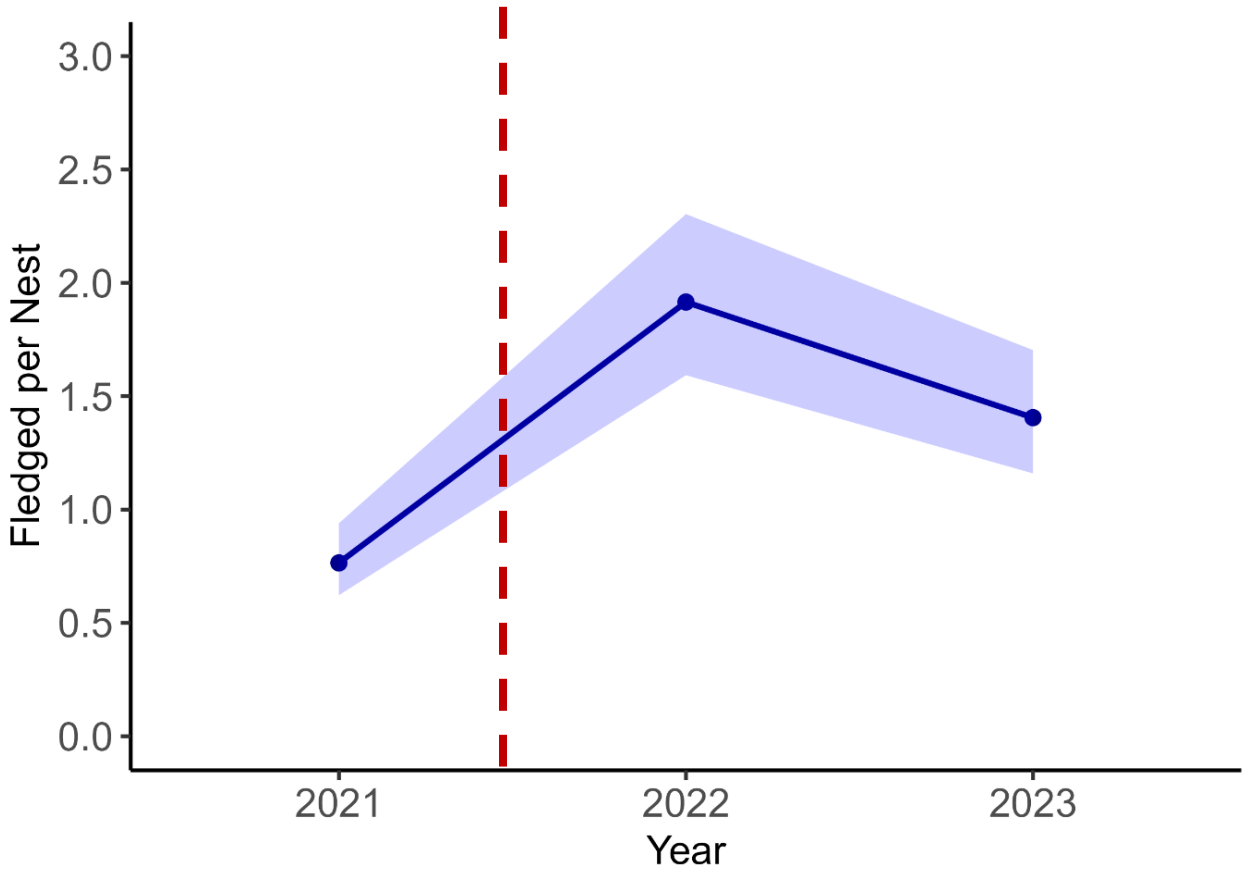
Fledging Success



Fledging Success- Shrub Nests



Fledging Success- Shrub & Ground



Discussion

Overall, the three measures of nest success were higher after the hurricane than before!

Measures of success tended to be higher in areas that experienced more direct storm impacts.

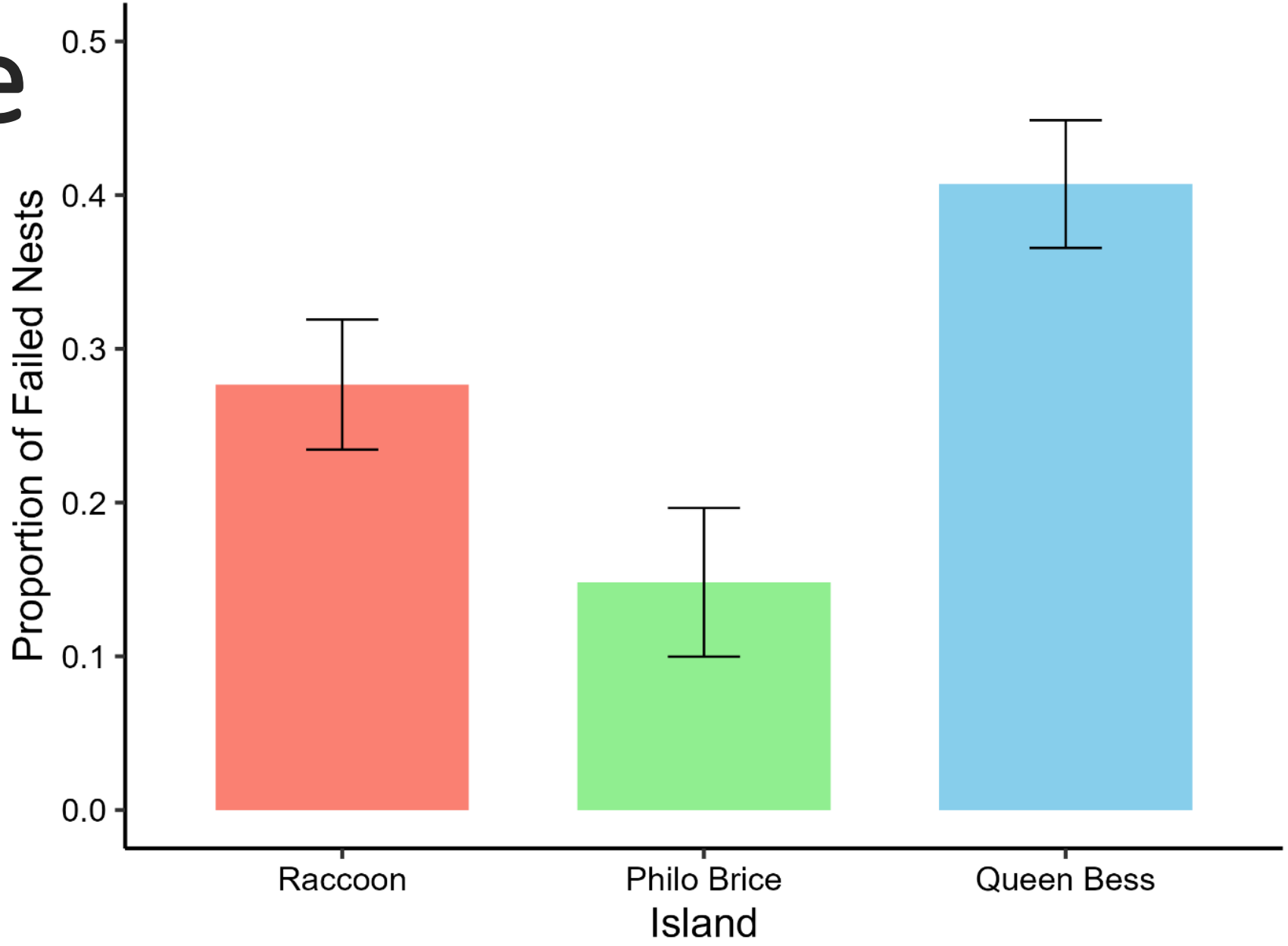
We are unsure why these results are in contrast to other studies (Walter et al. 2013).

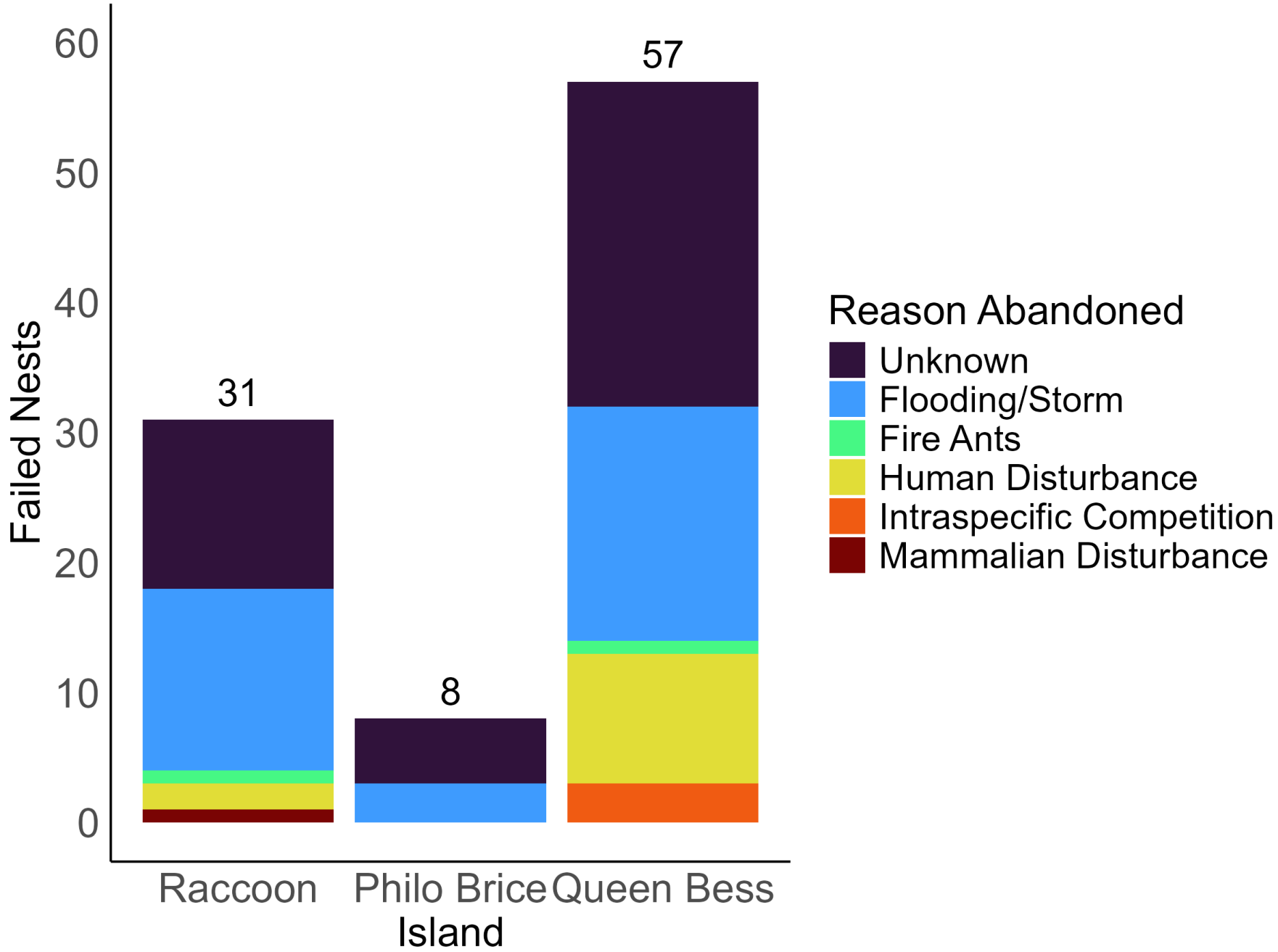
Elevation + Frequency of flooding

Reasons for Nest Failure/Abandonment

- Flooding, wave action
- Weather events
- Fire ant predation
- Human-induced stress
- Intraspecific competition
- Mammalian disturbance

Nest Failure




60
50
40
30
20
10
0
Failed Nests
31
8
57
Raccoon
Philo Brice
Queen Bess
Island
Reason Abandoned
Unknown
Flooding/Storm
Fire Ants
Human Disturbance
Intraspecific Competition
Mammalian Disturbance


MOULTRIE
73°F 29.93inHg
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MOULTRIE
72°F 29.91inHg
MOULTRIECAM
13 APR 2021 03:01 pm


MOULTRIE
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MOULTRIE
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13 APR 2021 03:05 5pm


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13 APR 2021 03:06 5pm


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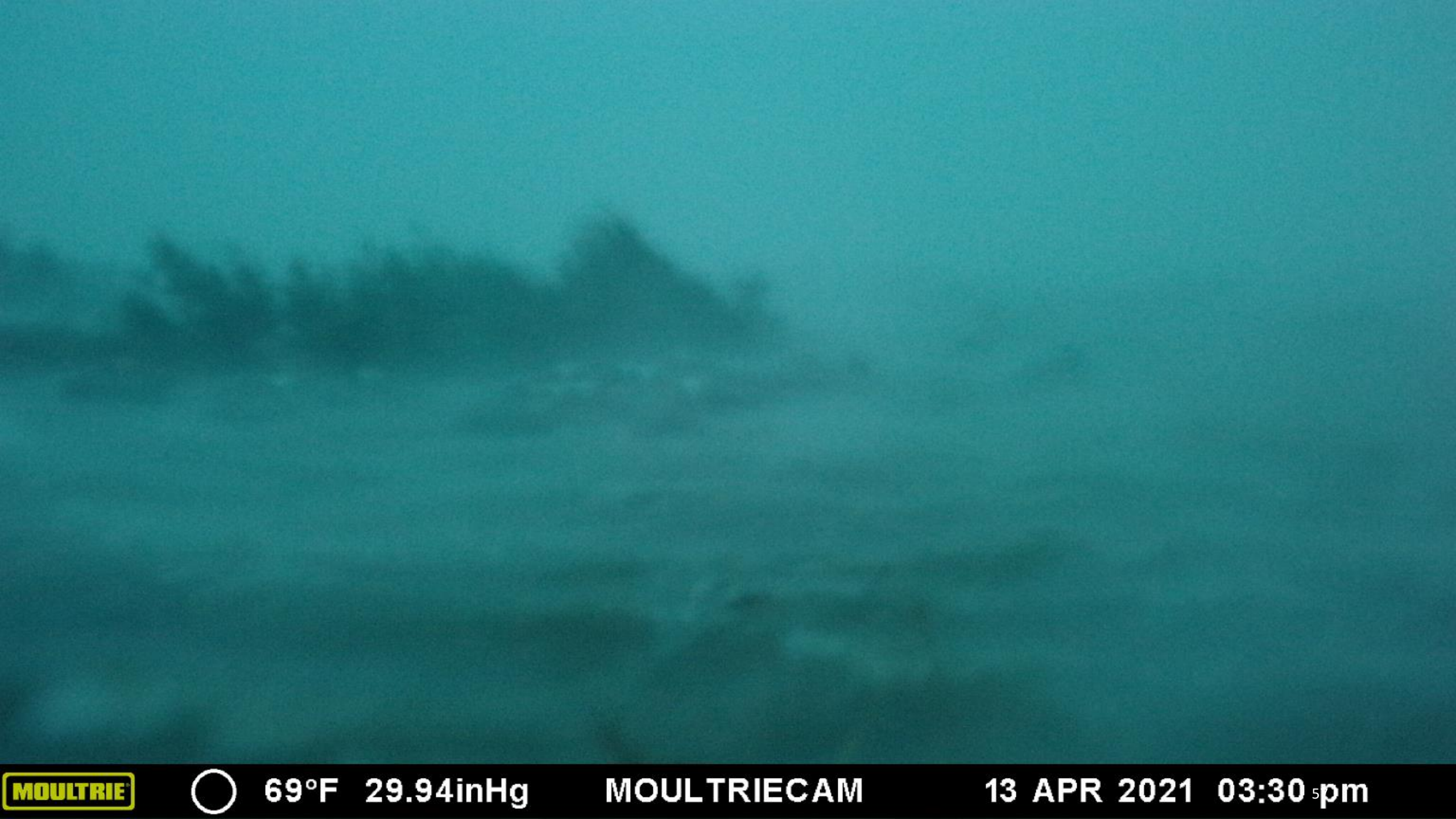
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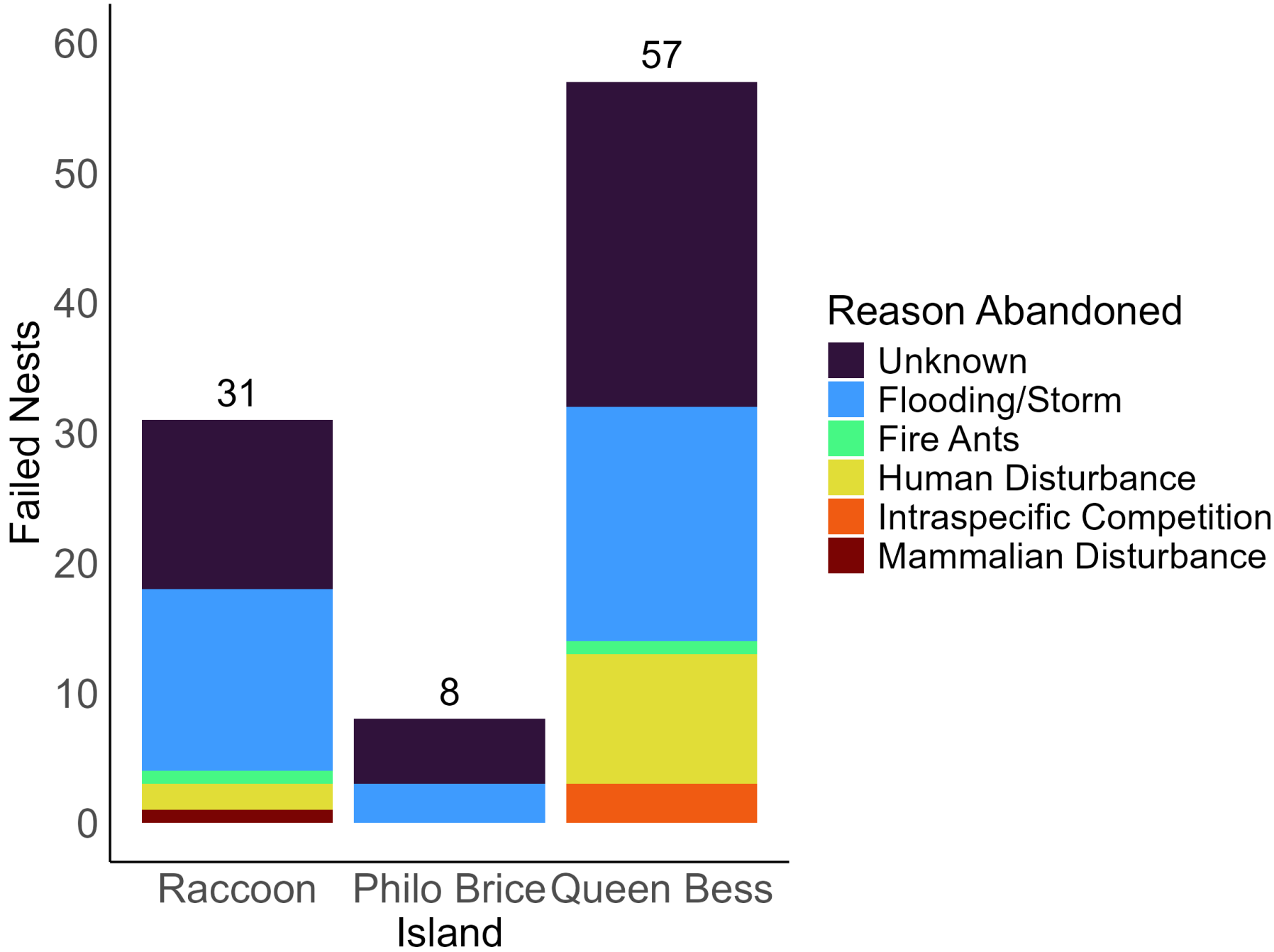
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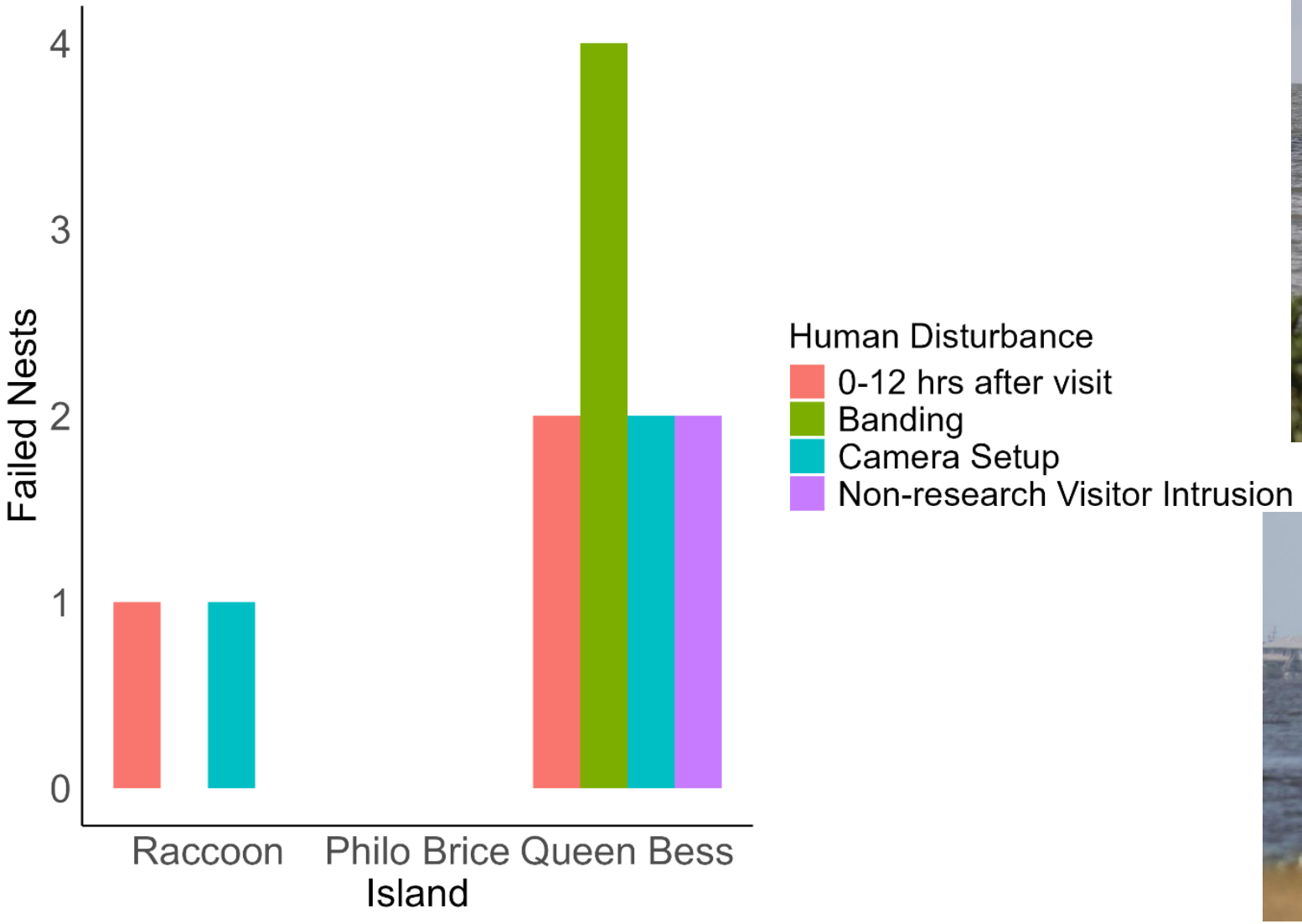
Queen Bess
Island
Reason Abandoned
Unknown
Flooding/Storm
Fire Ants
Human Disturbance
Intraspecific Competition
Mammalian Disturbance

Disturbance

Human Disturbance



Nest Failure Findings

- We found a large portion of nest loss was due to **unknown** causes or **flooding.**
- Flooding losses – increase island elevation
- Investigator activity
  - memory storage or remote retrieval

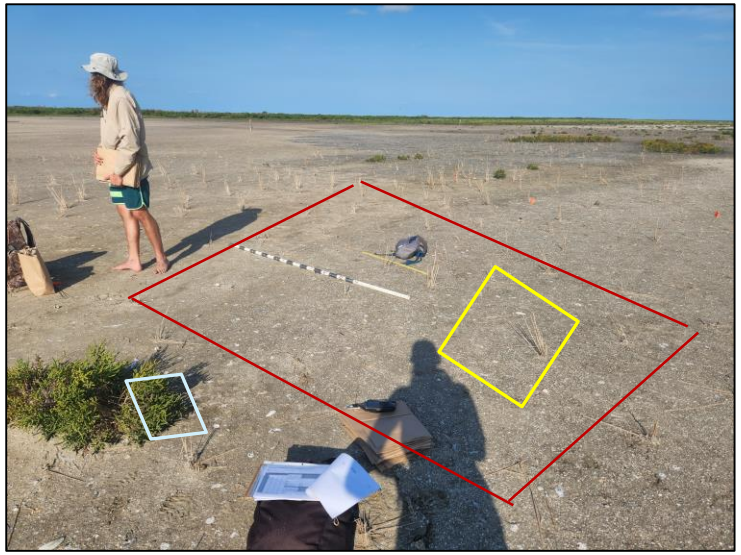
Objectives

- Compare Brown Pelican reproductive success on 3 breeding colonies before (Spring 2021) and after Hurricane Ida (Spring 2022 & 2023)

- Compare island vegetation composition and island area before and after Hurricane Ida + restoration

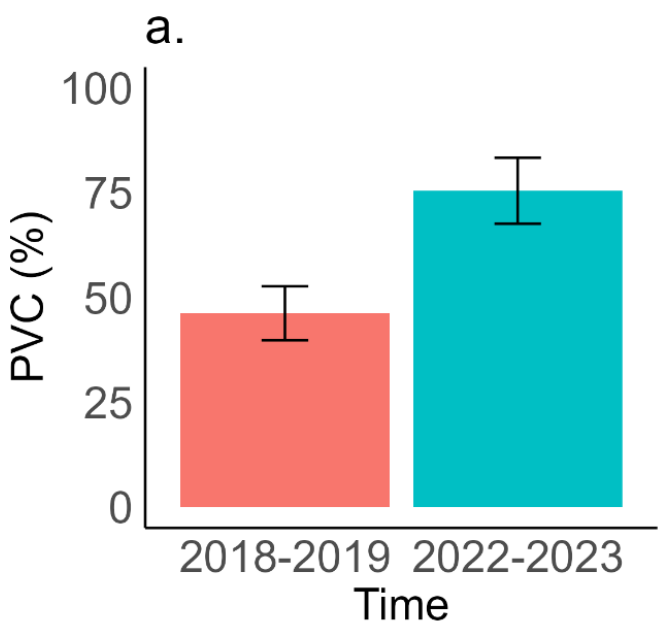
Methods: Vegetation

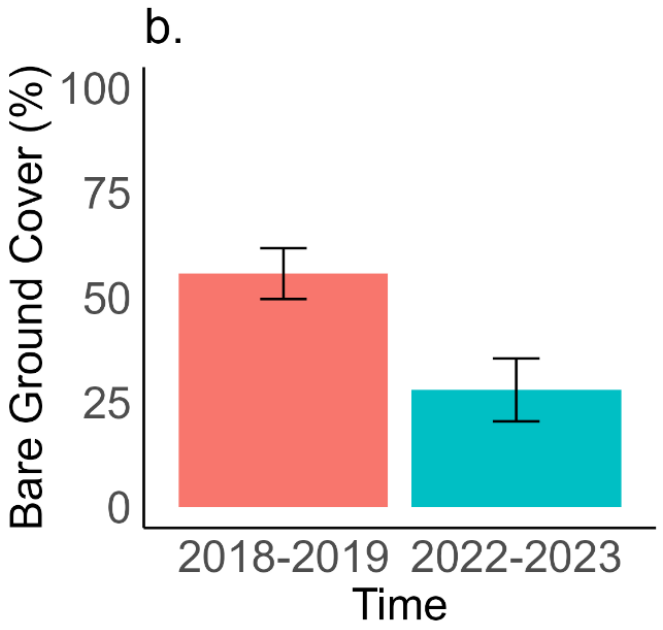
- 10x10 m^2
  - Raccoon in 2022 and 2023
  - 6 survey plots
    - Restored marsh
    - Unrestored marsh
    - Restored dune



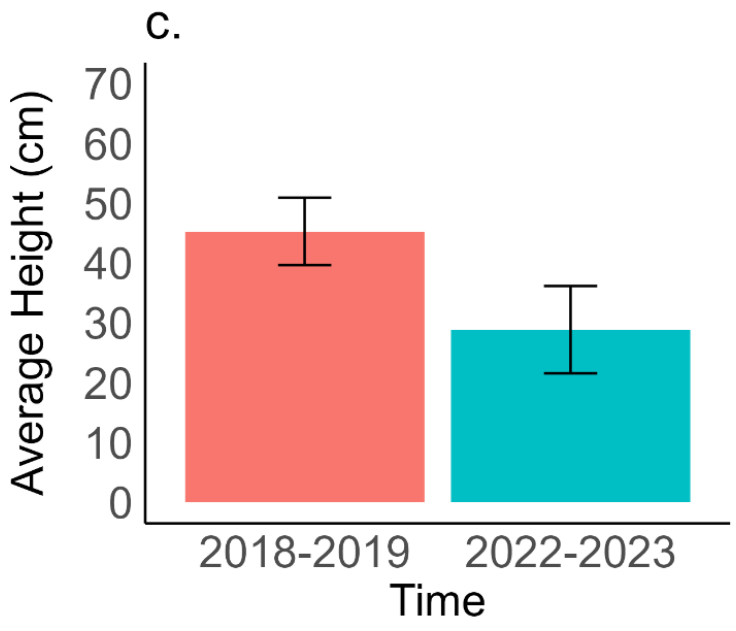
Vegetation Analysis 2018-2019 vs. 2022-2023

- Variables:
  - Percent Vegetation cover (PVC) of herbaceous, woody, bare
  - Average and Maximum Height
  - Species/Taxa
- Compared **island cover over time**
- Compared cover **within + between habitat types**

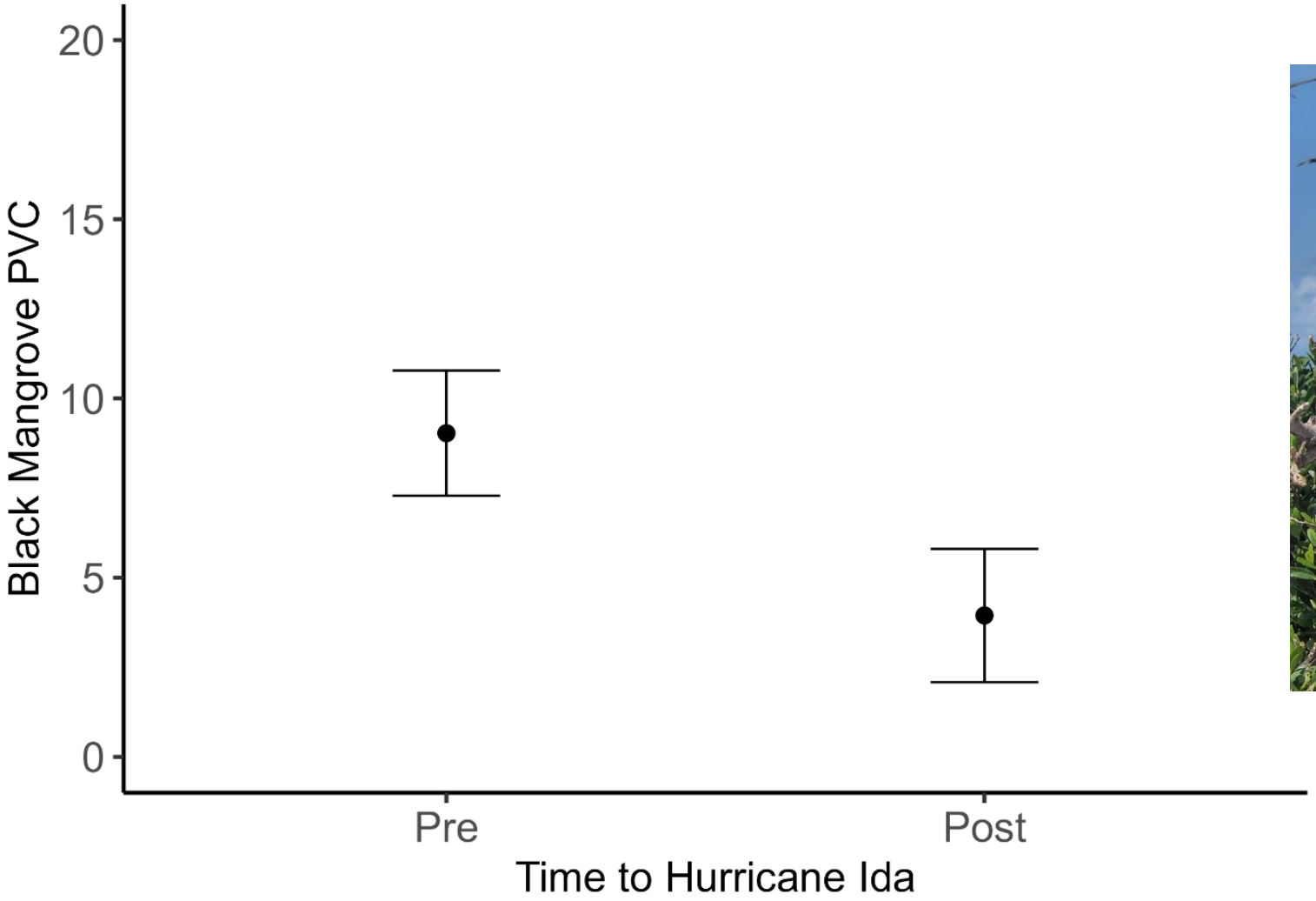




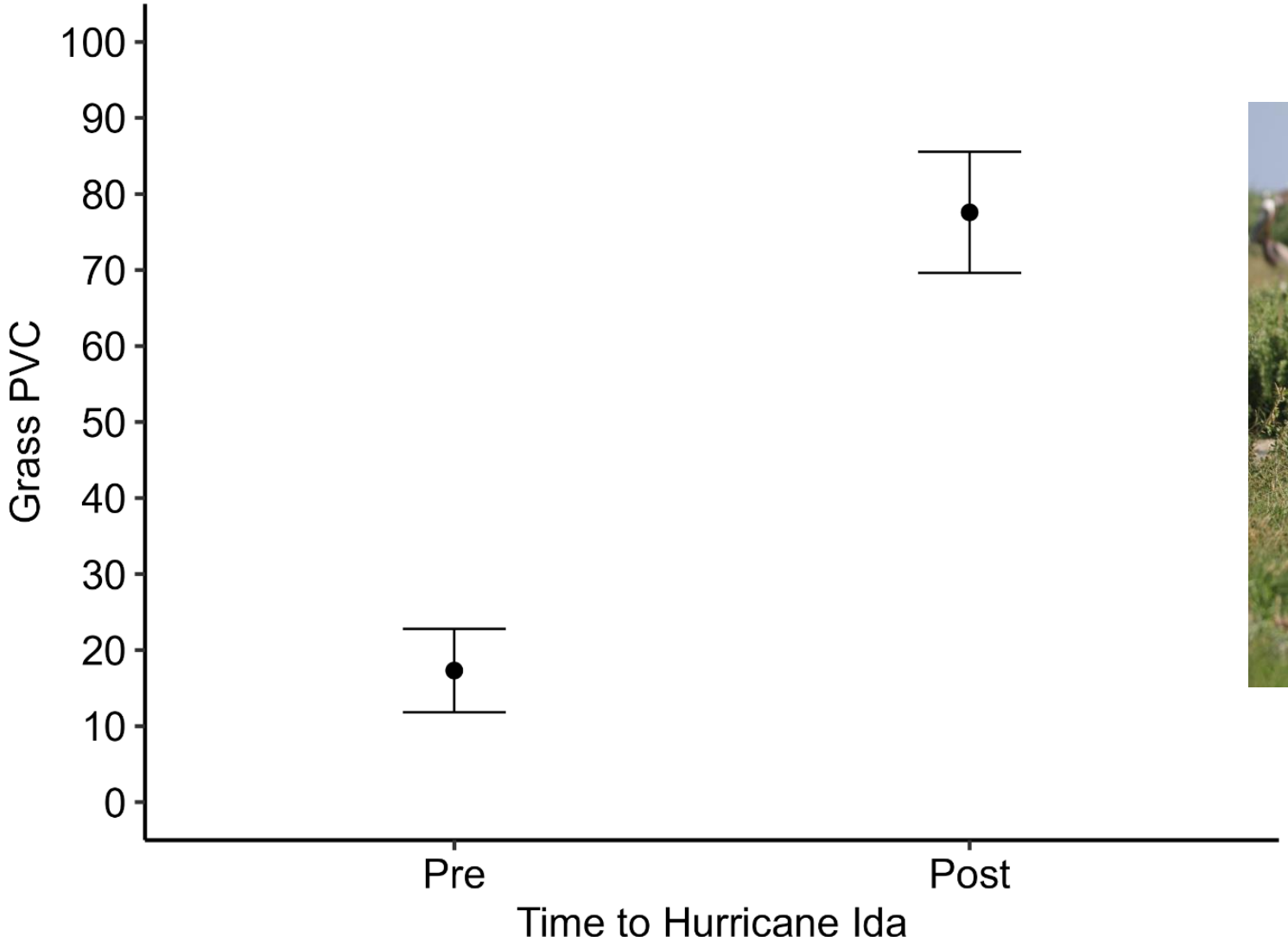
Vegetation Change on Raccoon



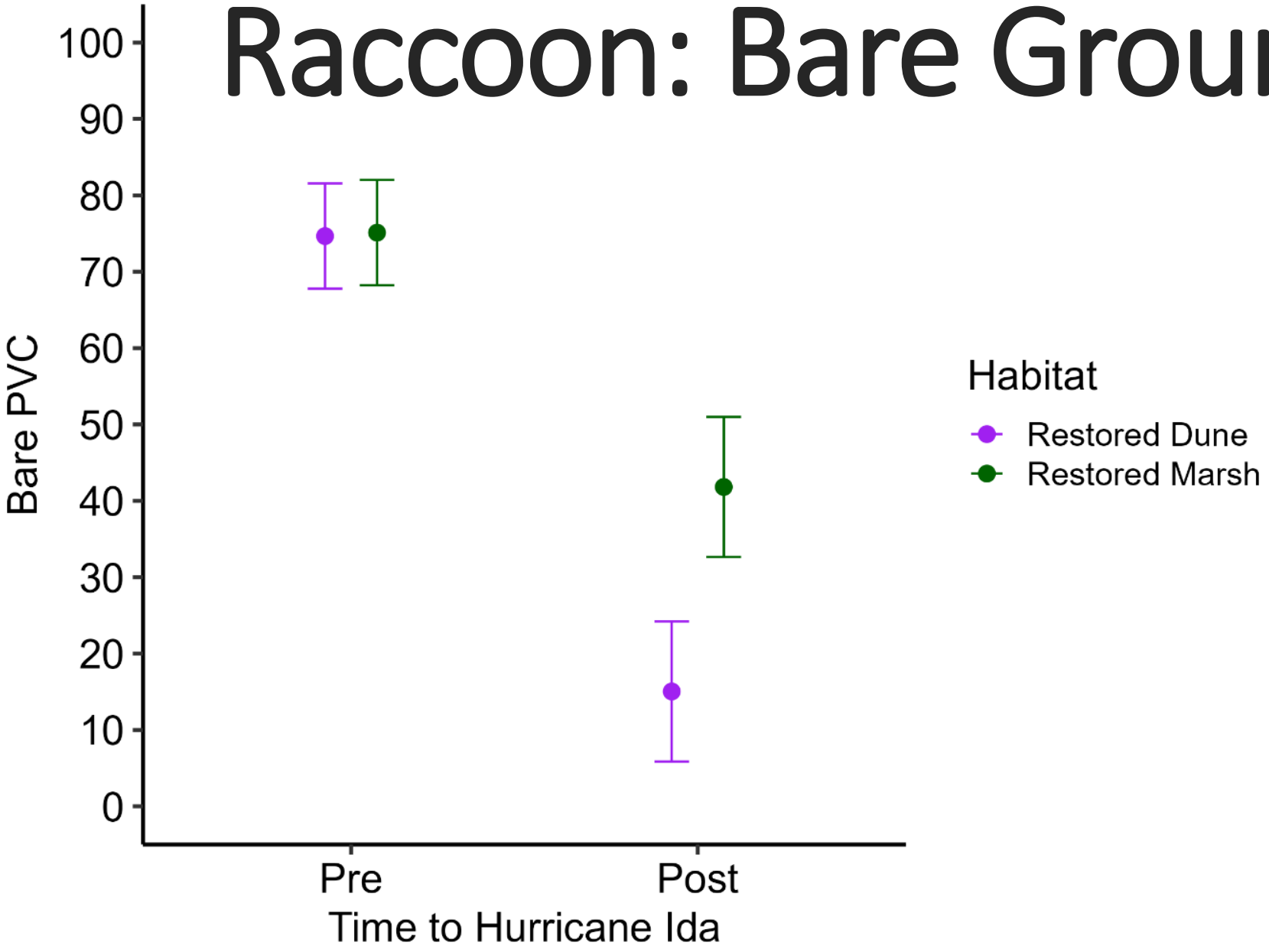
Raccoon: Black Mangrove

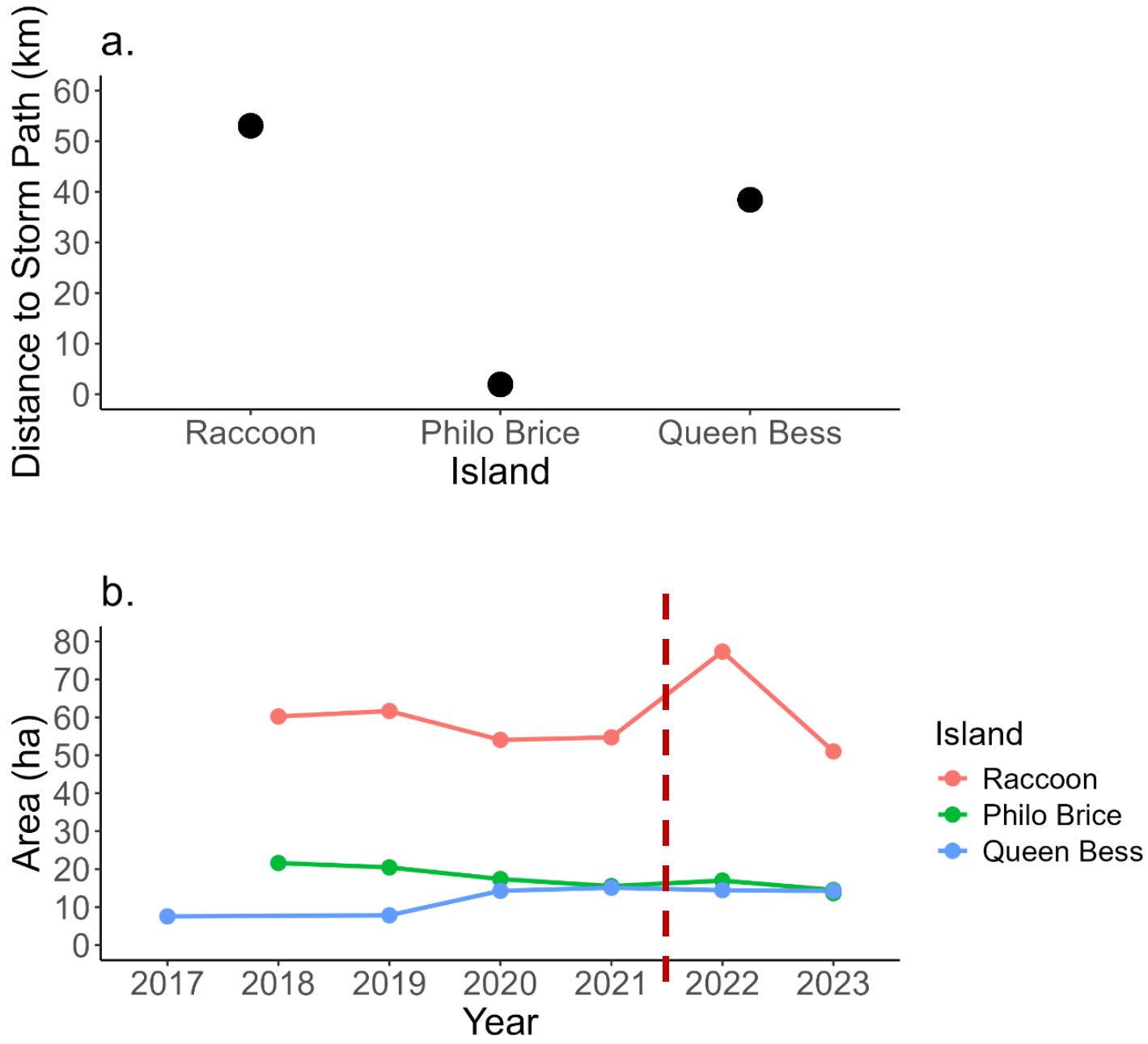


Raccoon: Grass



Raccoon: Bare Ground

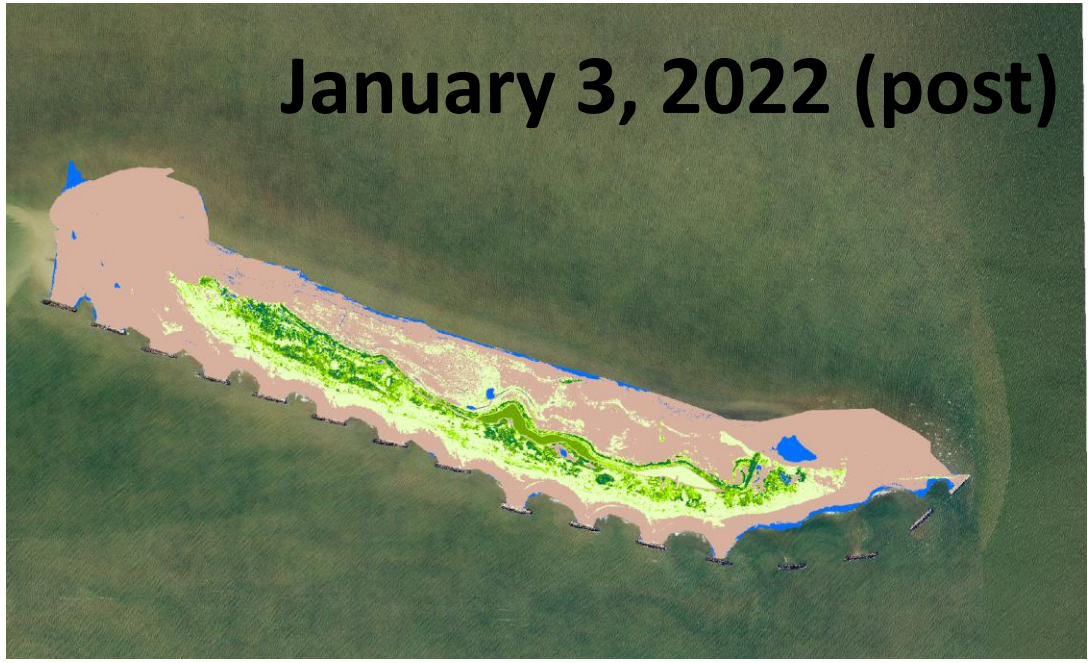


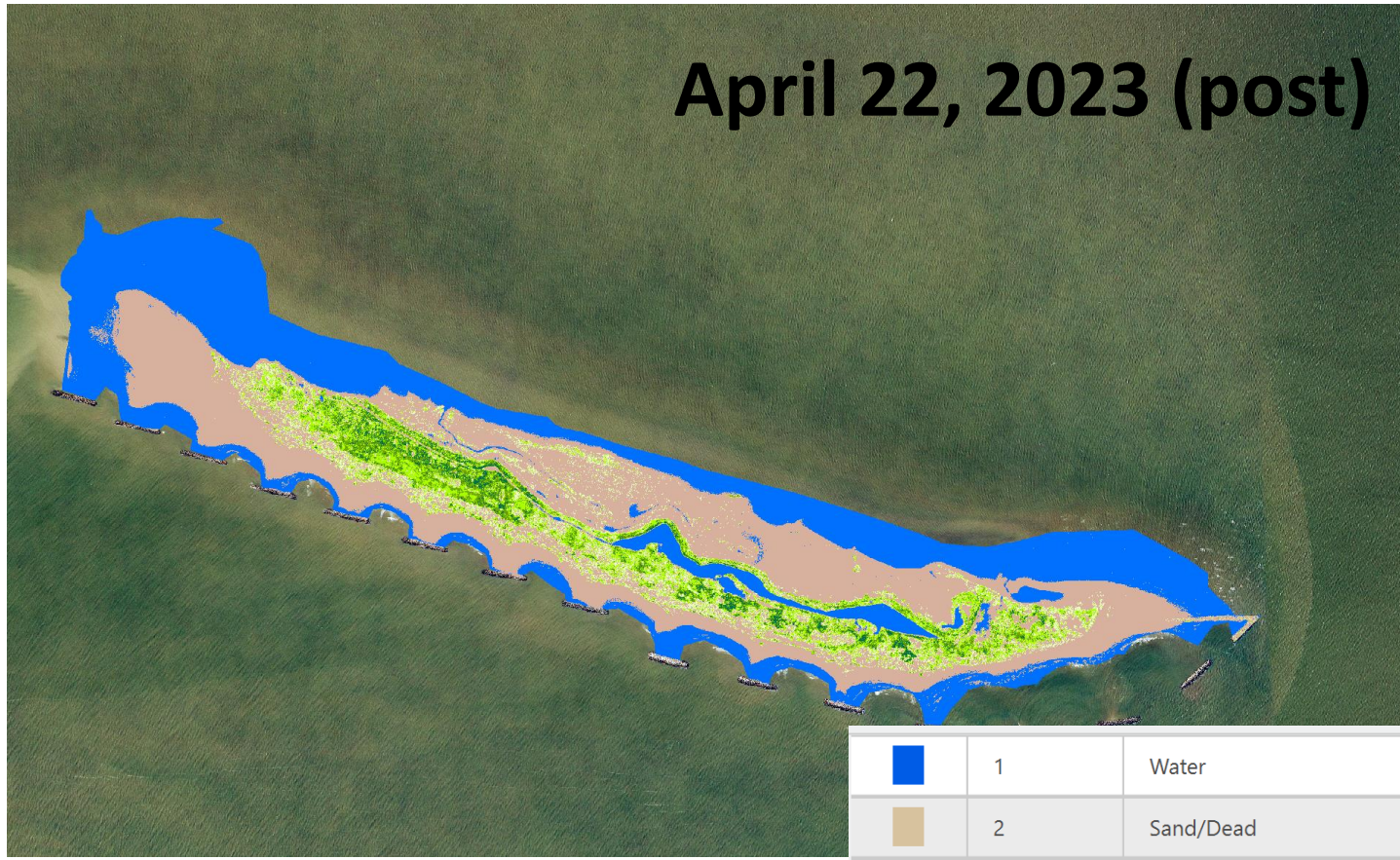

a.
Distance to Storm Path (km)
60
50
40
30
20
10
0
Raccoon
Philo Brice
Queen Bess
Island
b.
Area (ha)
80
70
60
50
40
30
20
10
0
2017
2018
2019
2020
2021
2022
2023
Year
Island
Raccoon
Philo Brice
Queen Bess

Raccoon Island

Imagery Source:Sentinel-2

Raccoon Vegetation Classification

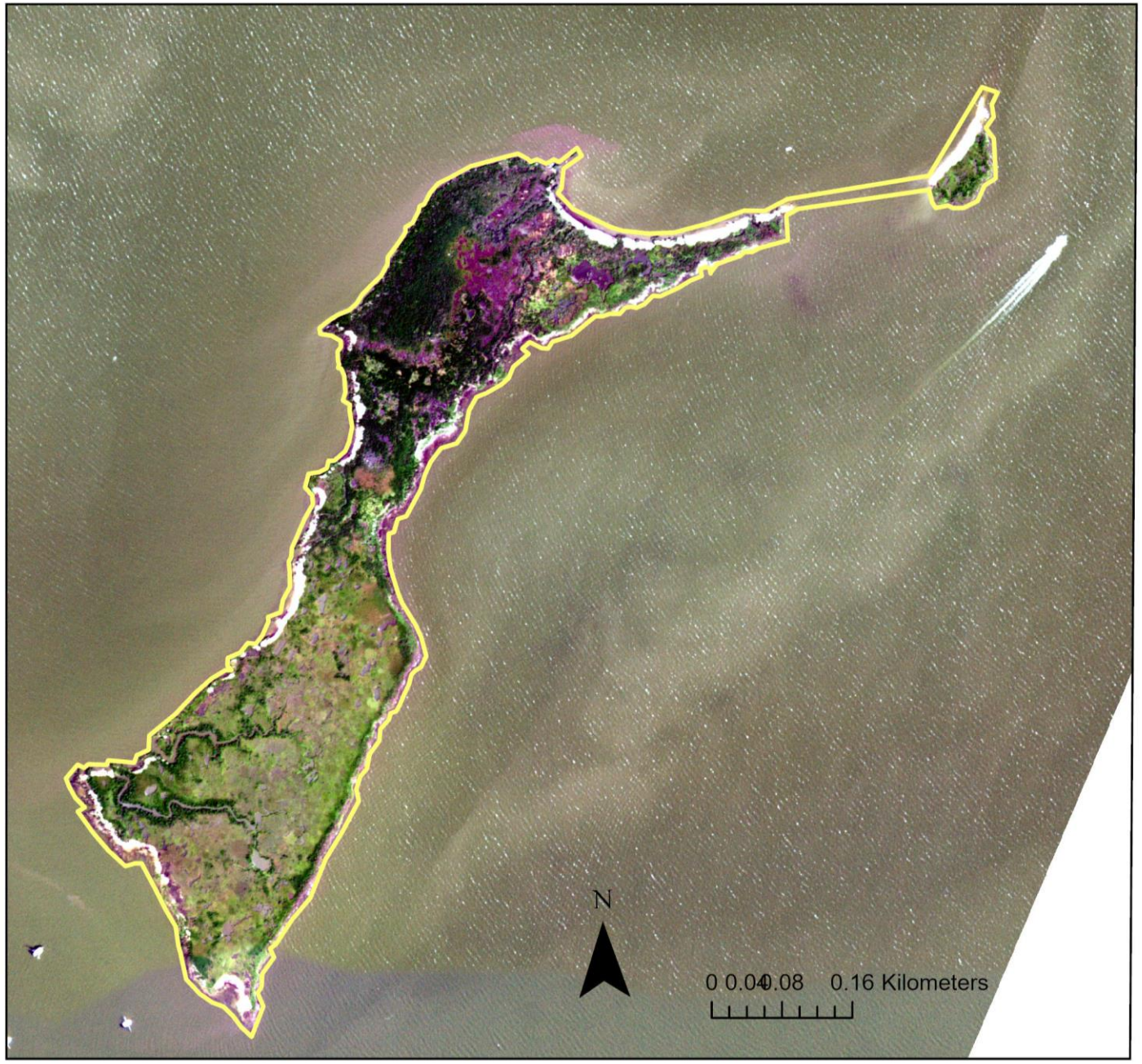




	1	Water
	2	Sand/Dead
	3	Sparse/Grass
	4	Low
	5	Medium
	6	High

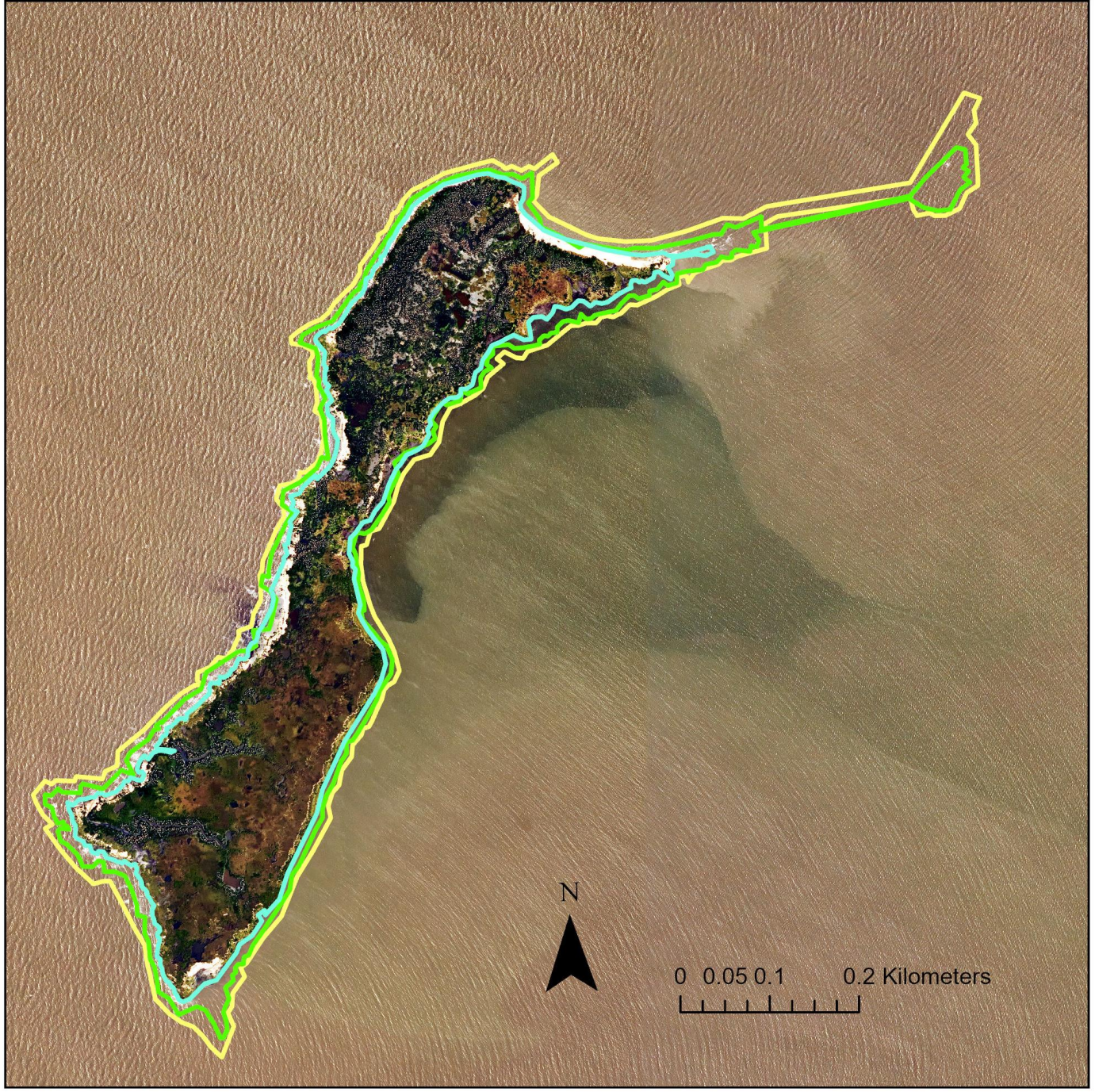
Imagery Source:Sentinel-2

Philo Brice 2019
20.5 ha



Imagery Source:Sentinel-2

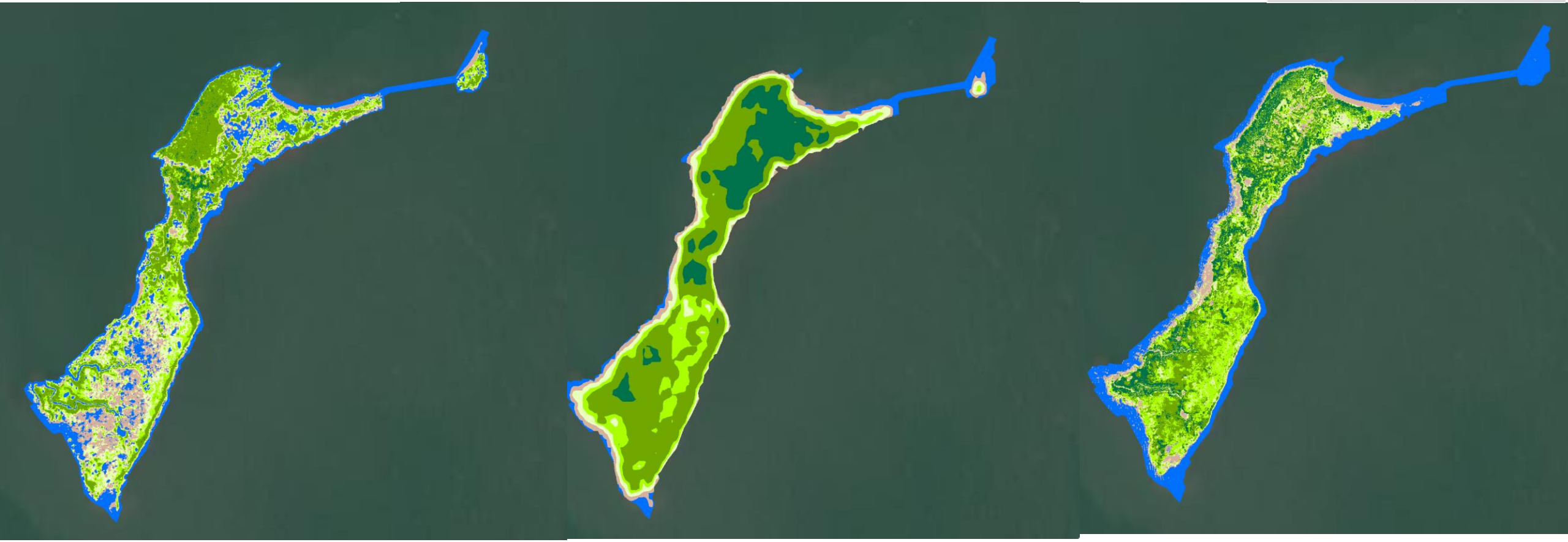
Philo Brice 2023
13.6 ha



Imagery Source:Google Earth Pro

Philo Brice Vegetation Classification

	1	Water
	2	Sand/Dead
	3	Sparse/Grass
	4	Low
	5	Medium
	6	High



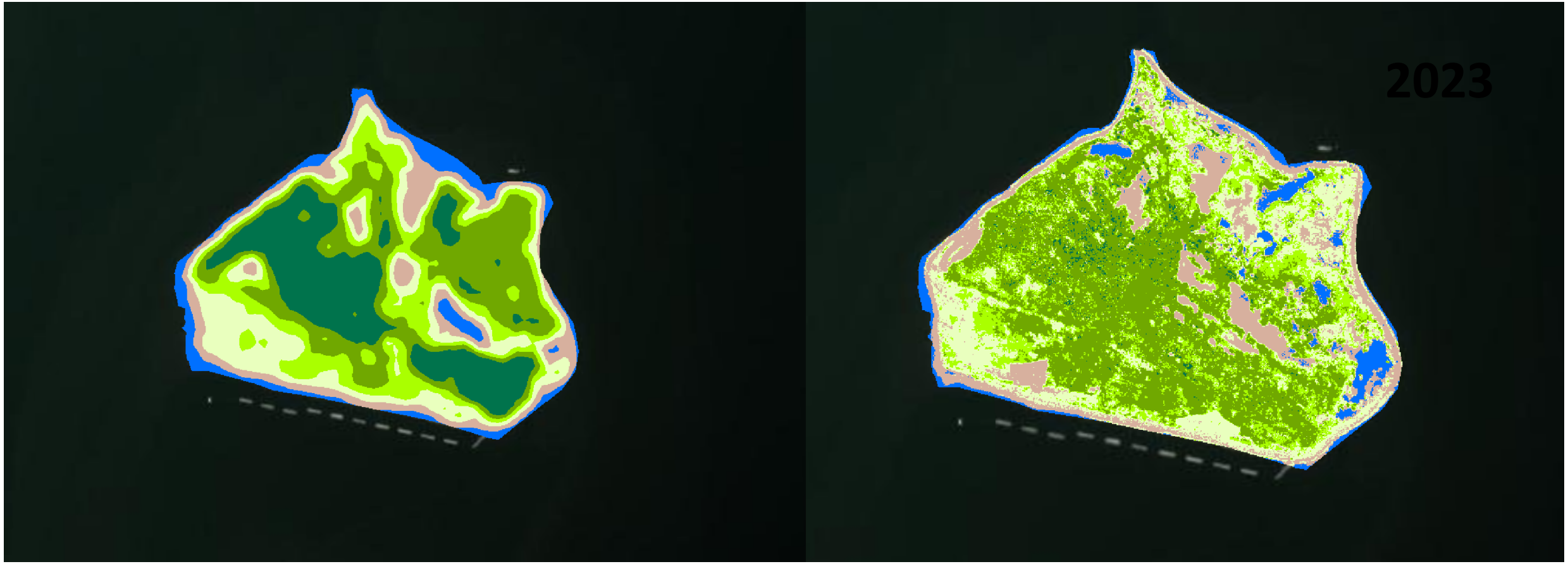
August 30, 2019 (pre)

August 20, 2021 (pre)

April 30, 2023 (post)

Queen Bess Vegetation Classification

	1	Water
	2	Sand/Dead
	3	Sparse/Grass
	4	Low
	5	Medium
	6	High



August 20, 2021 (pre) **April 30, 2023 (post)**

Island Findings

- Vegetation characteristics on Raccoon
  - shrubs decreased but not eliminated
  - Grass vegetation became more common
- Island area was variable
  - but no clear indication of land loss, except for gradual declines on Philo Brice

Conclusions

- Reproductive Success was higher post-Hurricane Ida
- Dynamic island vegetation and structure

Aerial Photo: Tyler Bowen

Management Implications

- Restoration and Monitoring
- Considerable uncertainty regarding storm effects
- Protect the Coast!

Photo: B. Slaton

Acknowledgements

Leberg Lab, Juita Martinez, LDWF, and CPRA through the Coastal Science Assistantship Program (CSAP)

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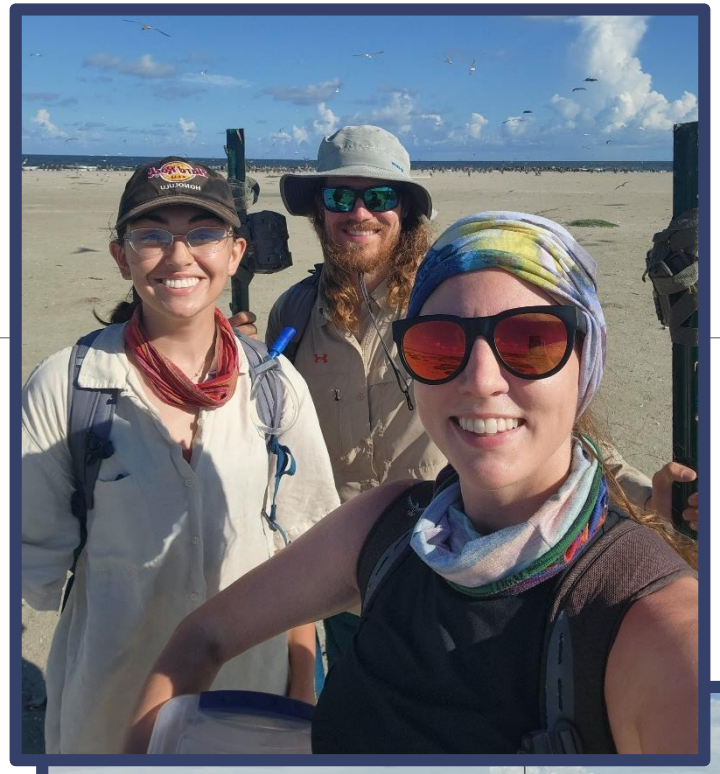

Thank you! Any Questions?

Aerial Photo: Tyler Bowen