

# Factors Influencing Breeding Waterbird Use of Islands in San Francisco Bay



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# Breeding Waterbirds of San Francisco Bay

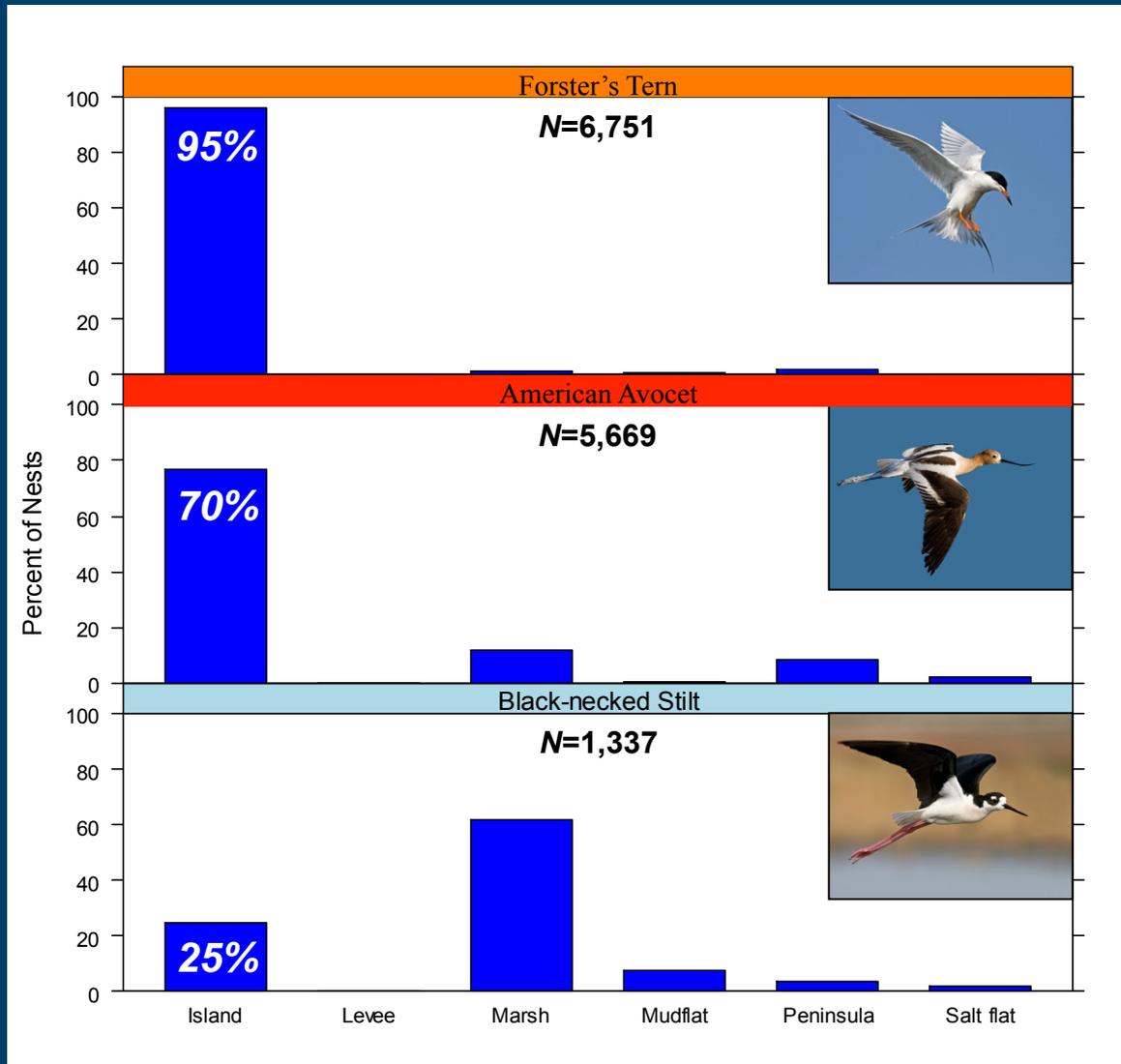
- 4,000 American Avocets
- 1,000 Black-necked Stilts
- 3,000 Forster's Terns
- 50,000 California Gulls

## Other species:

- Caspian Terns
- Double-crested Cormorants
- Black Skimmers
- Snowy Plovers
- California Least Terns
- Waterfowl
- Songbirds
- Rails



# Most Nests Are On Islands



# What Makes Good Island Nesting Habitat?

## 3 Spatial Scales

- **Pond-level**
  - Number of Islands per Pond
  - Location of Islands within Ponds
- **Island-level**
  - Island size
  - Island shape (linear vs. round)
- **Nest site-level**
  - Topography
  - Elevation
  - Vegetation

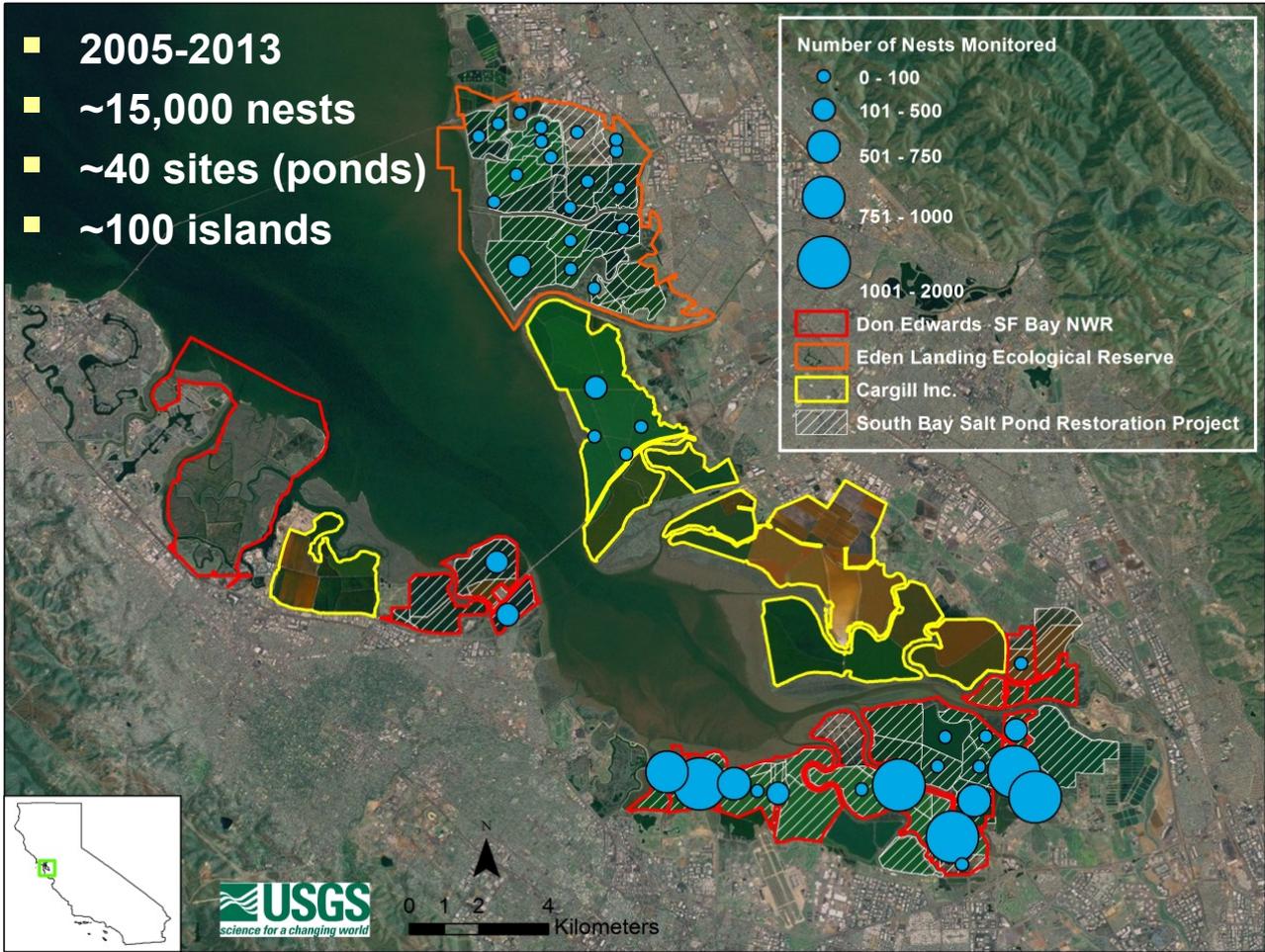
## 2 Waterbird Metrics

- Nest abundance
- Nest success



# Historic Nest Monitoring Dataset

- 2005-2013
- ~15,000 nests
- ~40 sites (ponds)
- ~100 islands



# Nest Abundance in a Pond Unrelated to the Number of Islands in a Pond

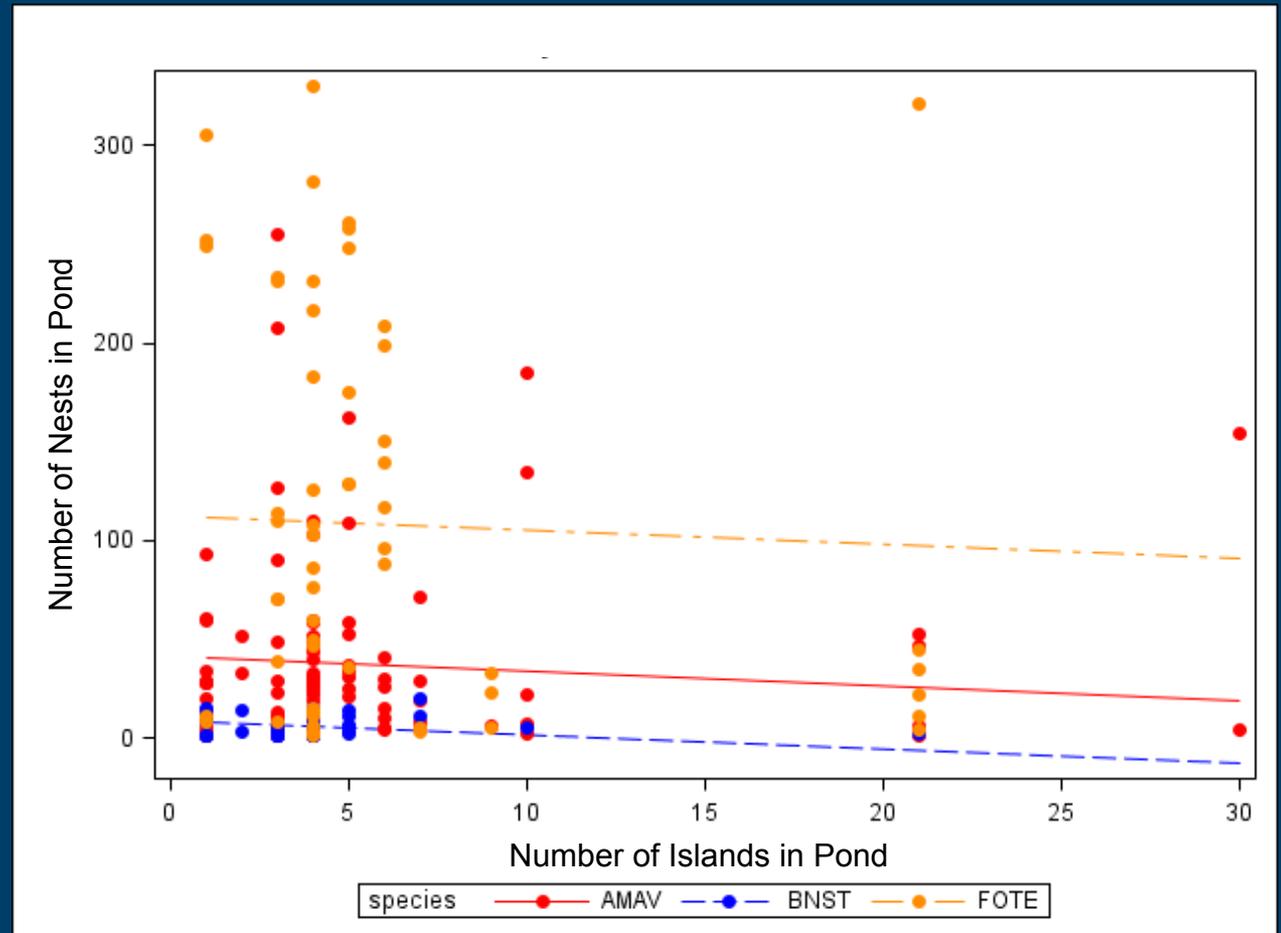


## Pond-level

- Islands per Pond
- Island Location

## Island-level

- Island size
- Island shape



# Nest Success is Unrelated to the Number of Islands in a Pond

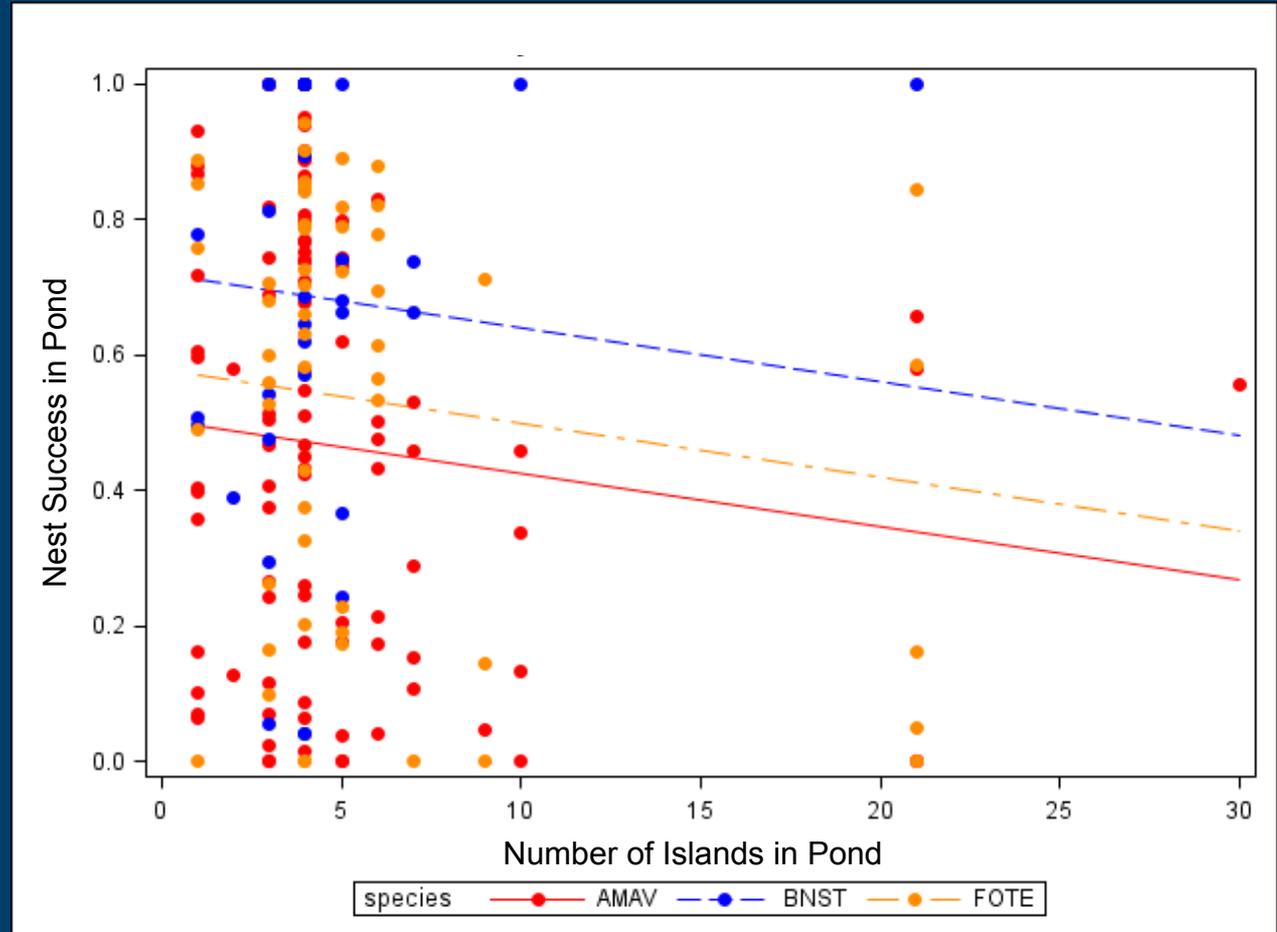


## Pond-level

- Islands per Pond
- Island Location

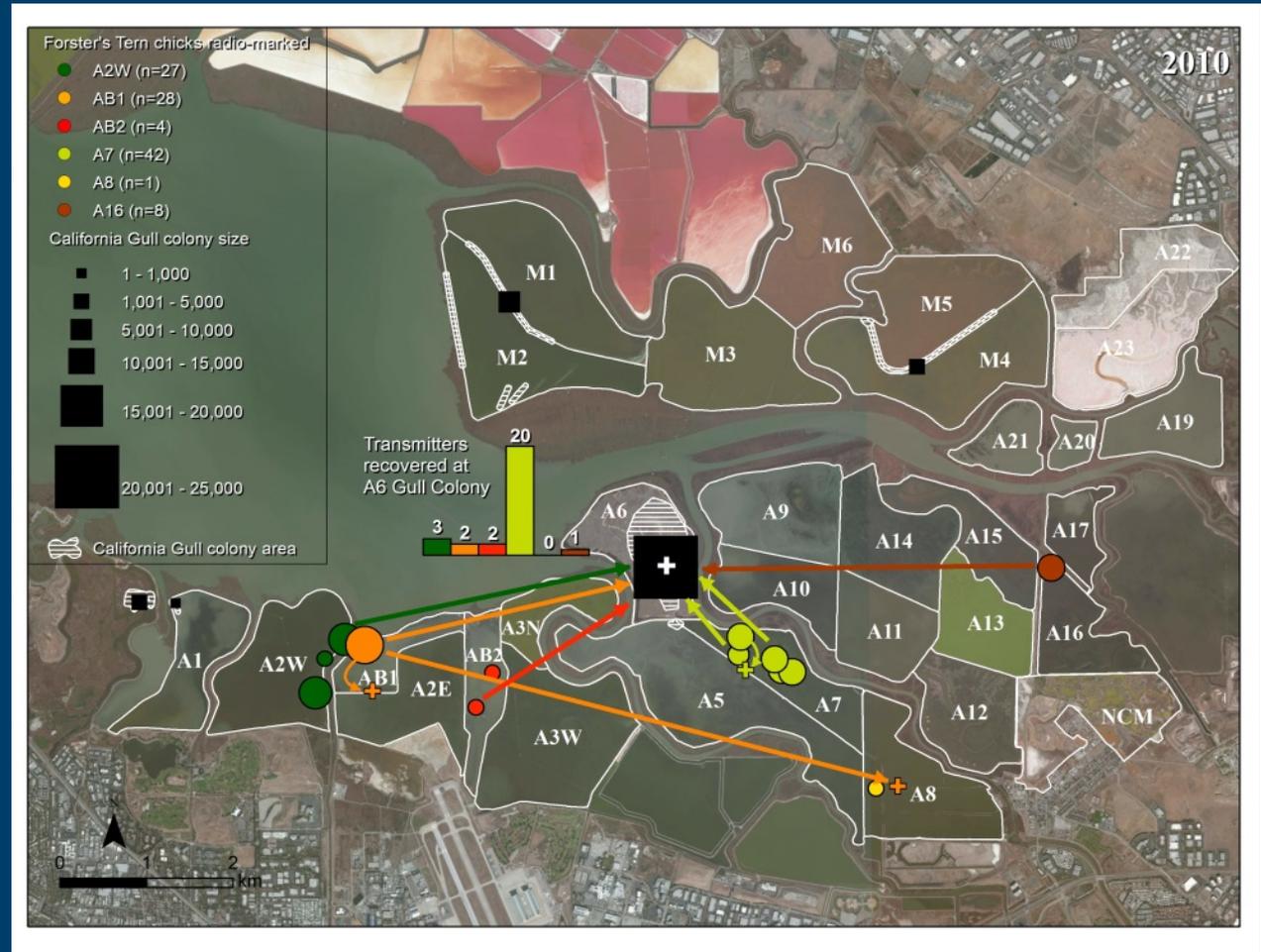
## Island-level

- Island size
- Island shape



# All your eggs (islands) in one basket (pond)

- Islands in multiple ponds may provide waterbirds with alternative nesting sites



# Nest Abundance Greater on Islands Near Levees

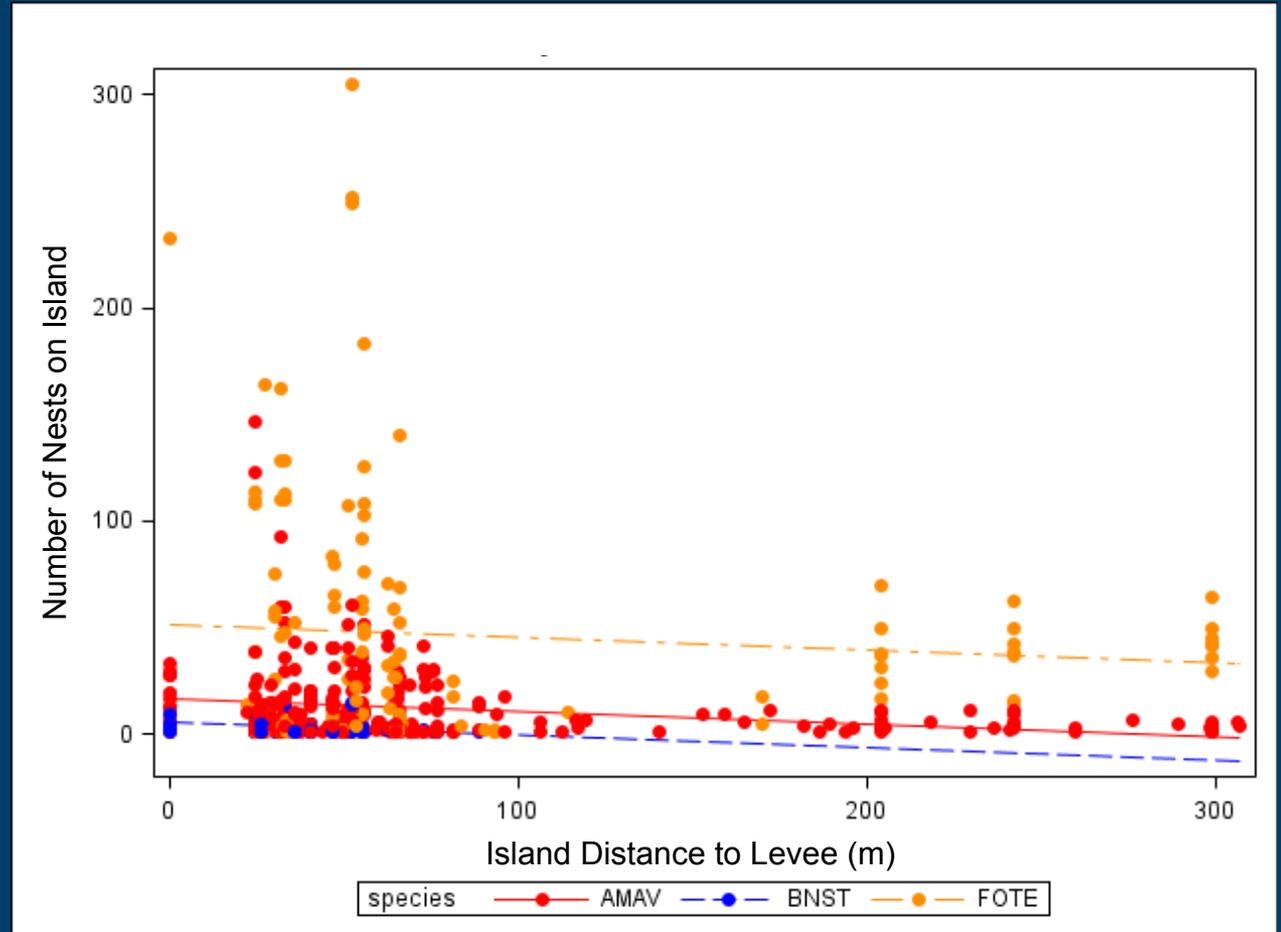


## Pond-level

- Islands per Pond
- Island Location

## Island-level

- Island size
- Island shape



# Nest Success is Greater On Islands Further from Levee

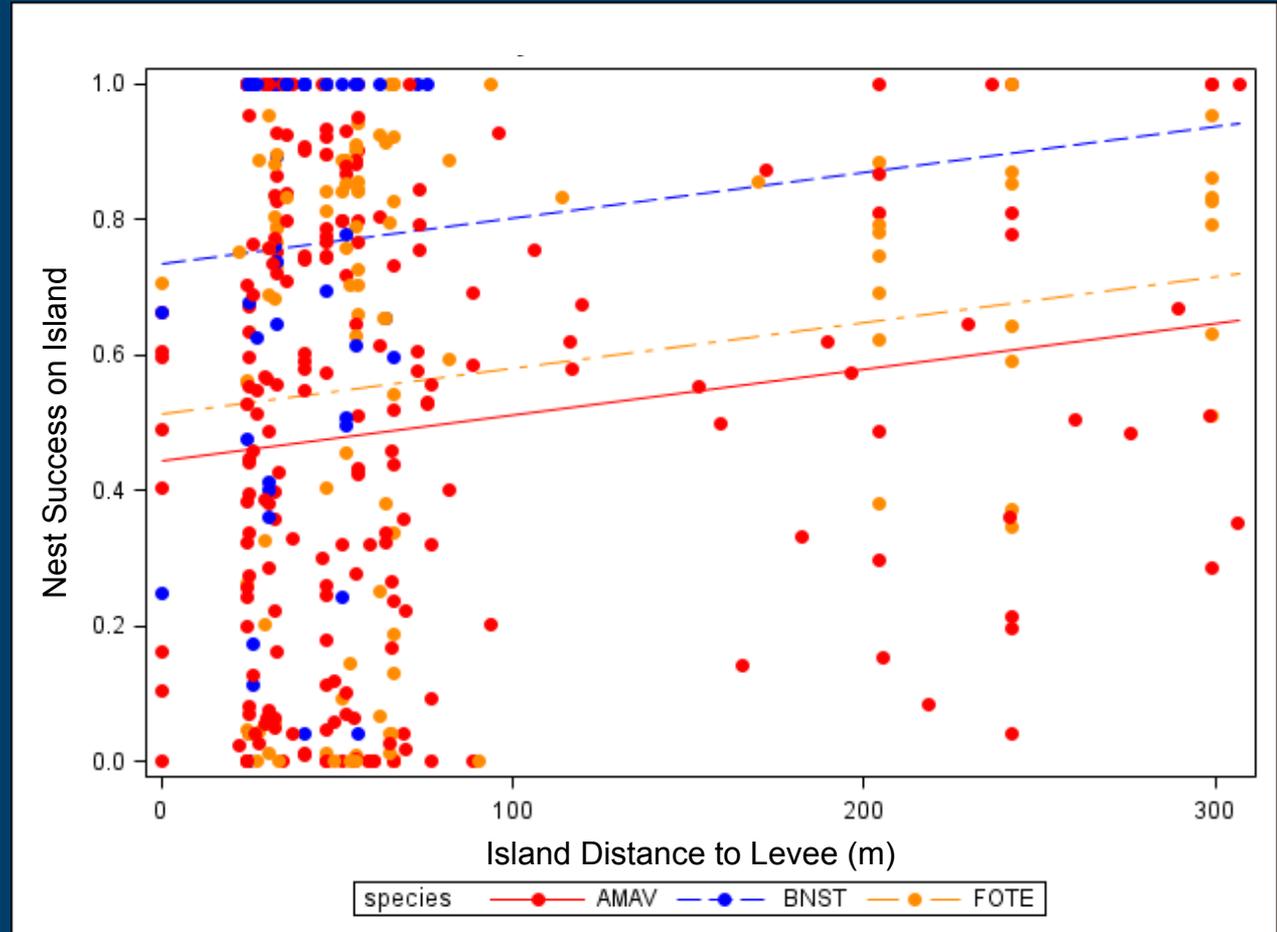


## Pond-level

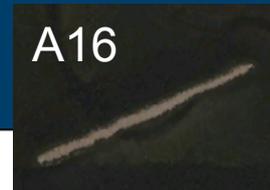
- Islands per Pond
- Island Location

## Island-level

- Island size
- Island shape



# Nest Abundance Greatest on Small- to Medium-sized Islands

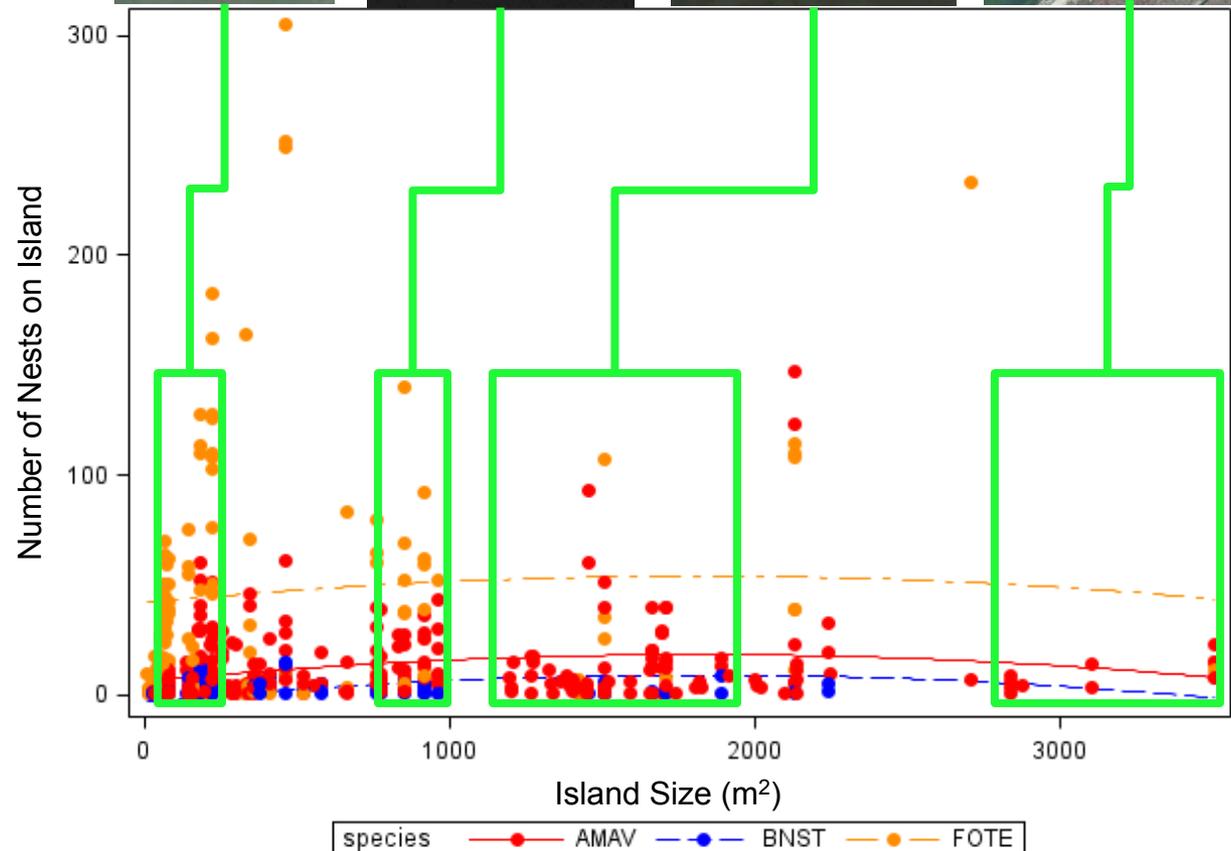


## Pond-level

- Islands per Pond
- Island Location

## Island-level

- Island size
- Island shape



# Nest Abundance is Greater on Linear Islands

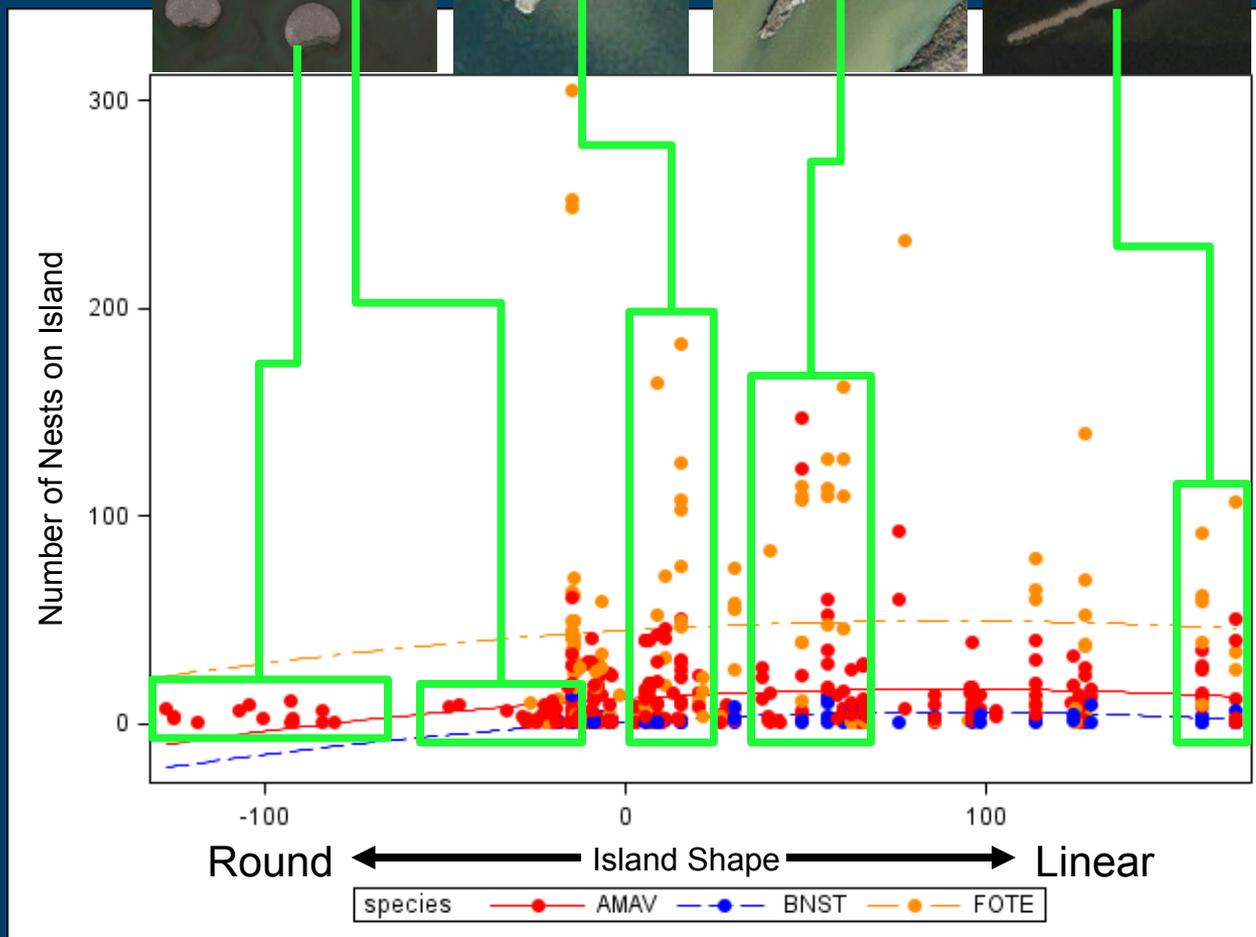


## Pond-level

- Islands per Pond
- Island Location

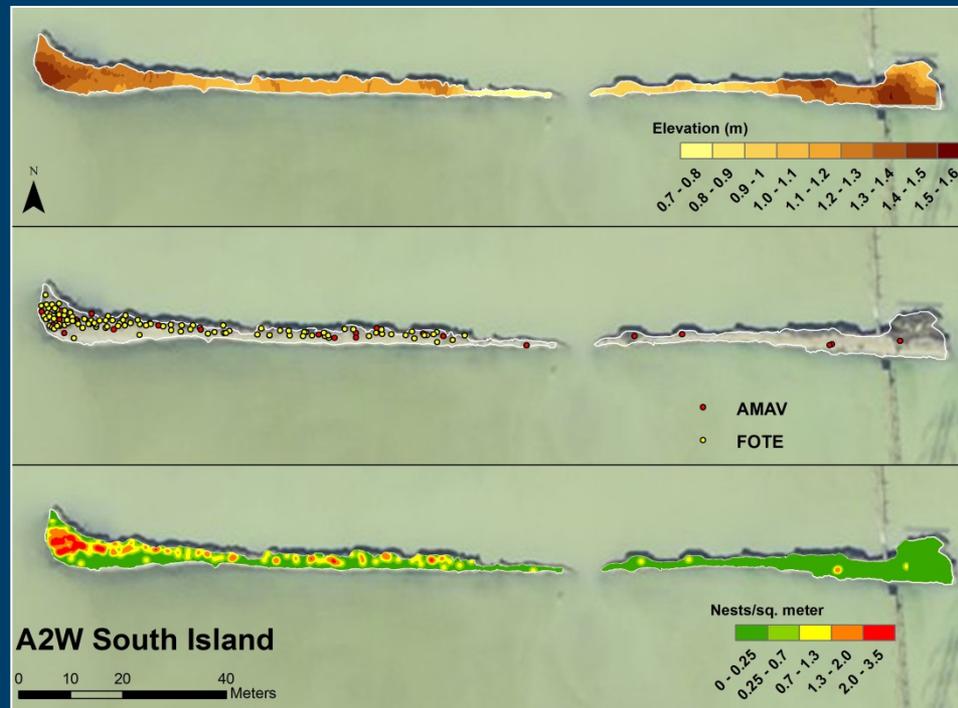
## Island-level

- Island size
- Island shape



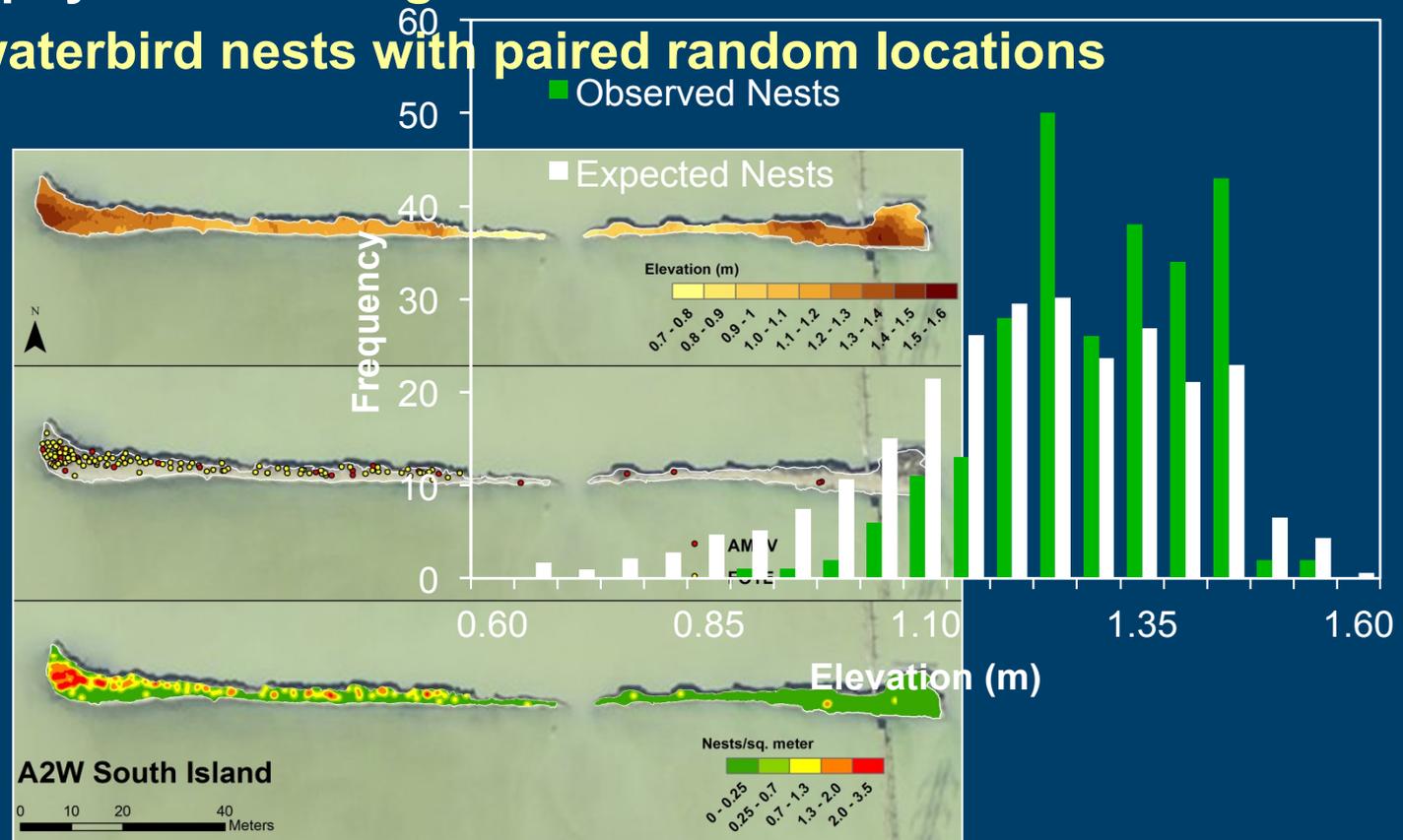
# Nest site-level

- 2011- 2012
- Real-time kinetics (RTK) GPS (1cm accuracy)
  - Topography of 30 nesting islands
  - 1,600+ waterbird nests with paired random locations

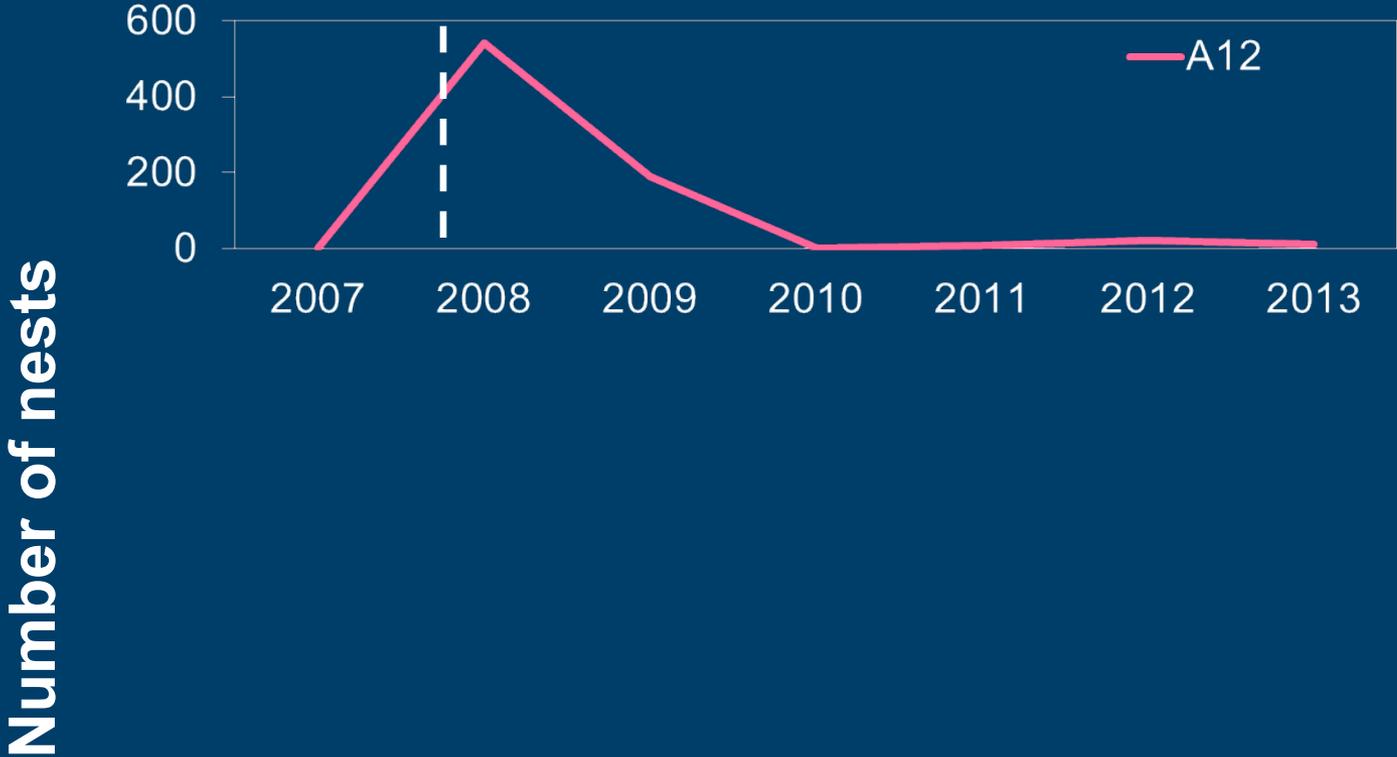


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# Long-term Monitoring of Waterbird Nesting



## Recipe for Island Nesting Habitat

- Spread out islands among more ponds: 3-5 islands per pond, 30 built in SF2
- Place islands away from levee boundaries
- Small- to medium-sized islands (<2 ha), SF2 or smaller
- Linear islands better than round islands, SF2 too round
- Long-term nest monitoring is critical, SF2 nests tapered off

# Acknowledgments

## Funding

- Resources Legacy Fund
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- US Geological Survey



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- Don Edwards San Francisco Bay National Wildlife Refuge
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- Eden Landing Ecological Reserve
- Napa-Sonoma Marshes Wildlife Area
- San Francisco Bay Bird Observatory



# Nest-level Scale

