What do we know about the effects of stage on wading bird nesting at Lake Okeechobee?

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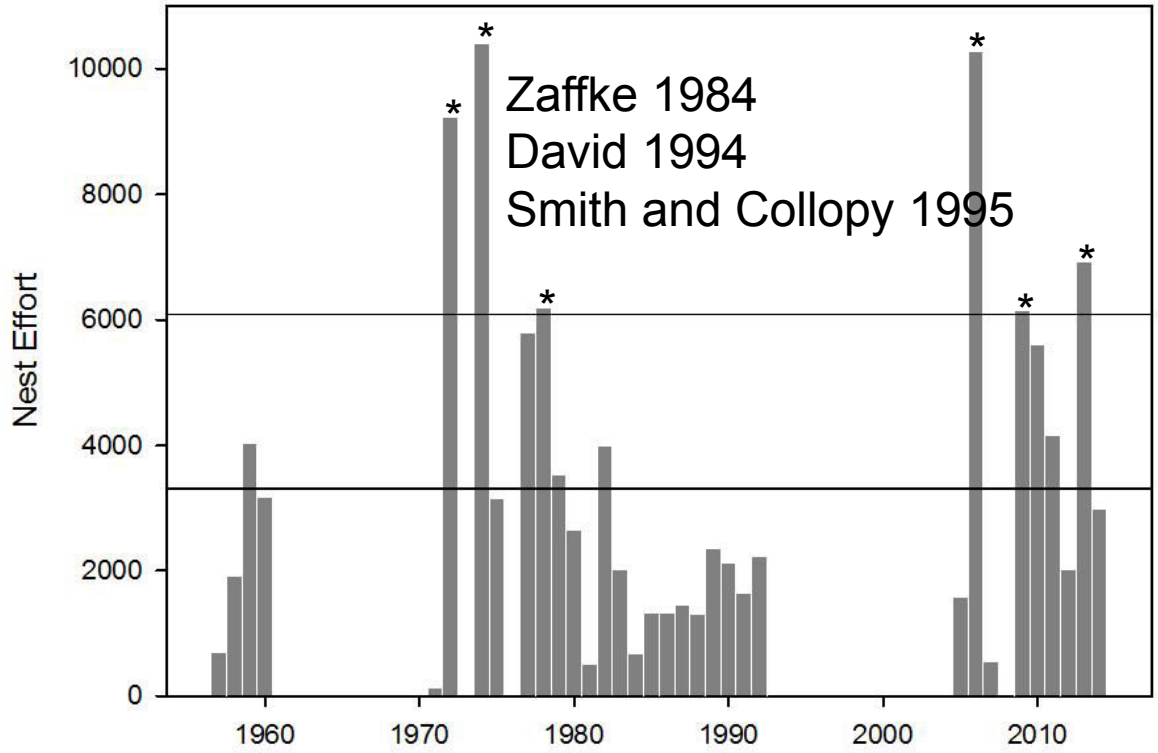
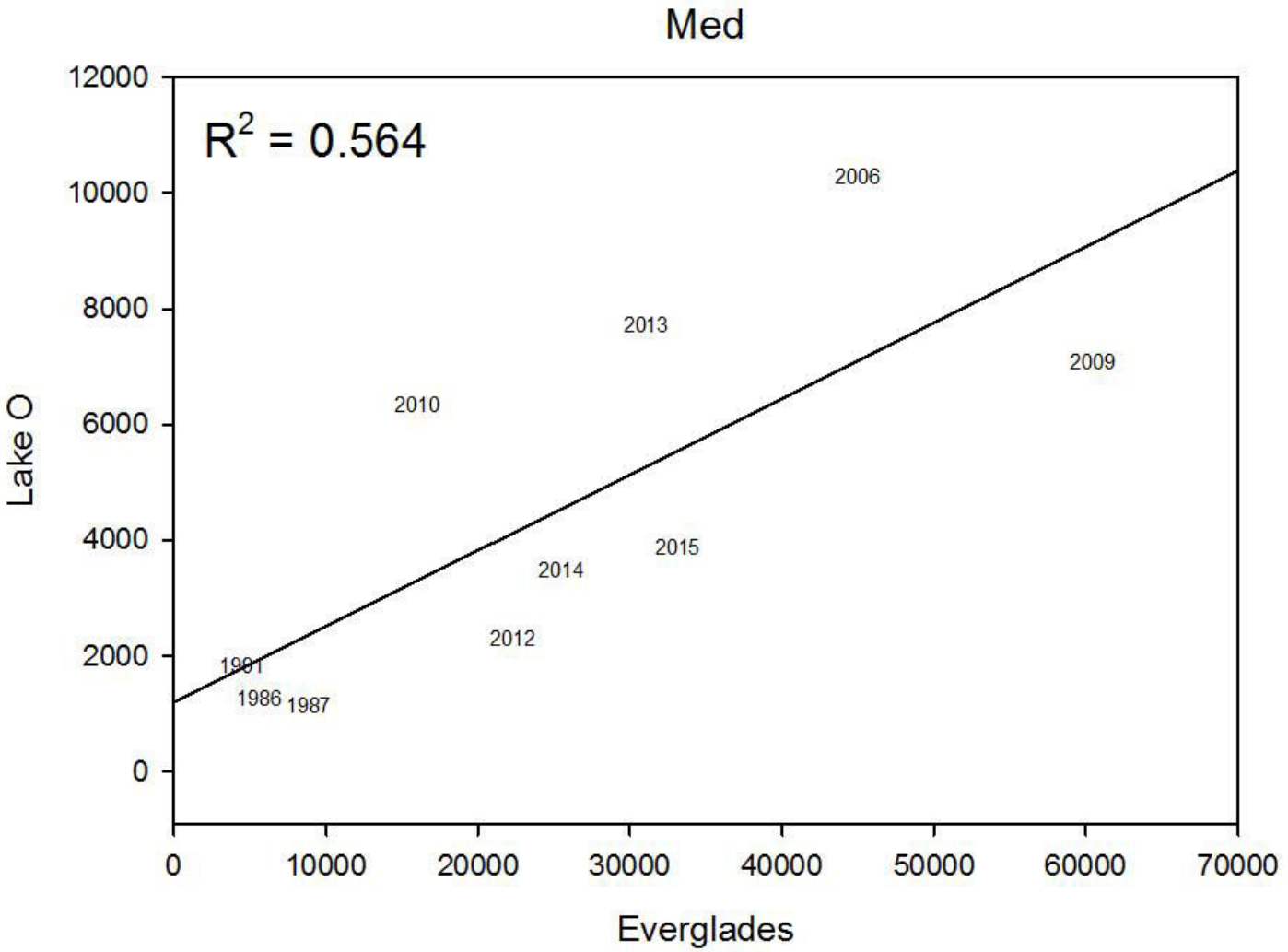
ENVIRONMENTAL SCIENCE PROGRAM

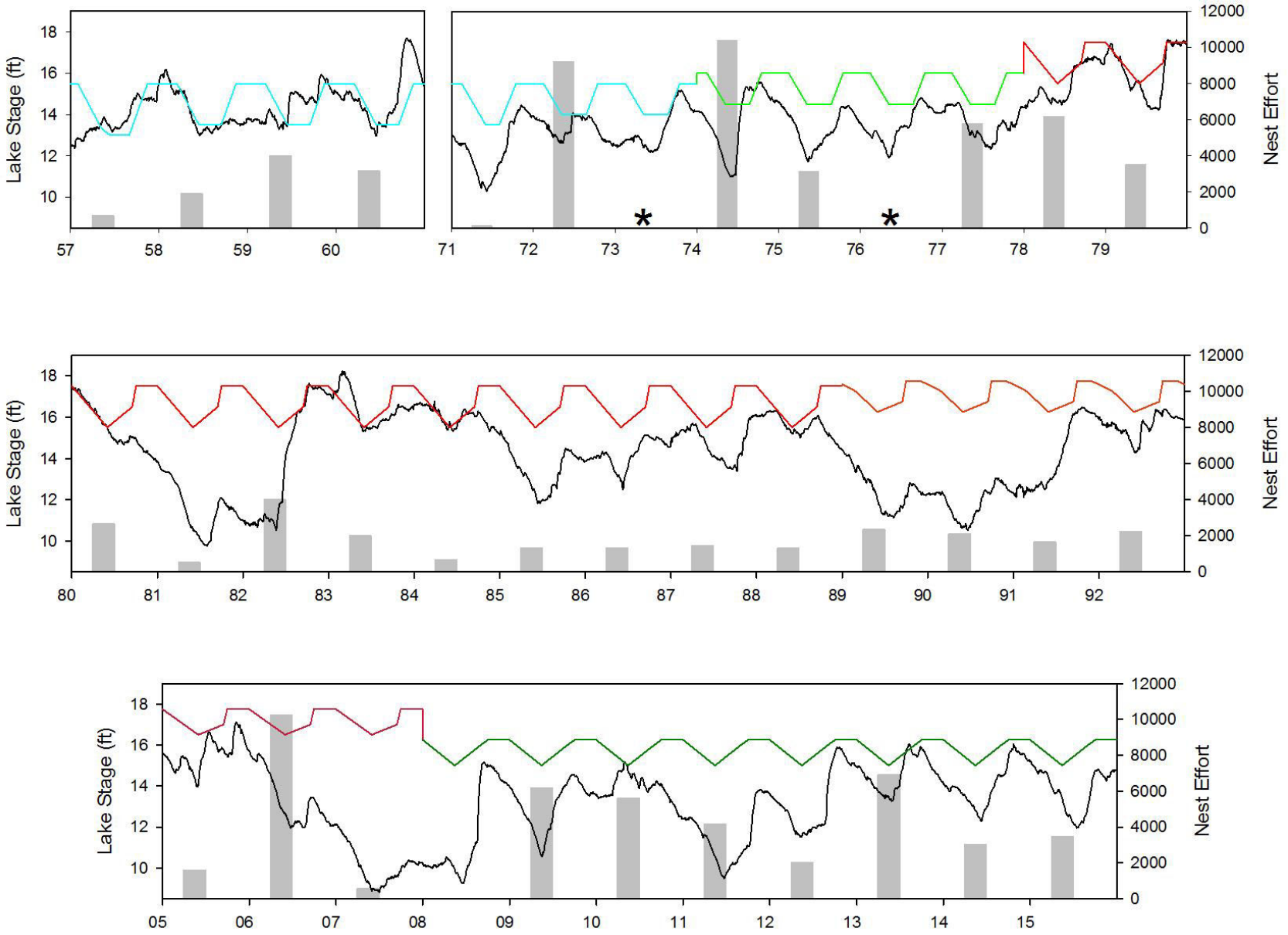
Combined MAP Data With Historic Nest Records [develop assessment and evaluation models to support operations]



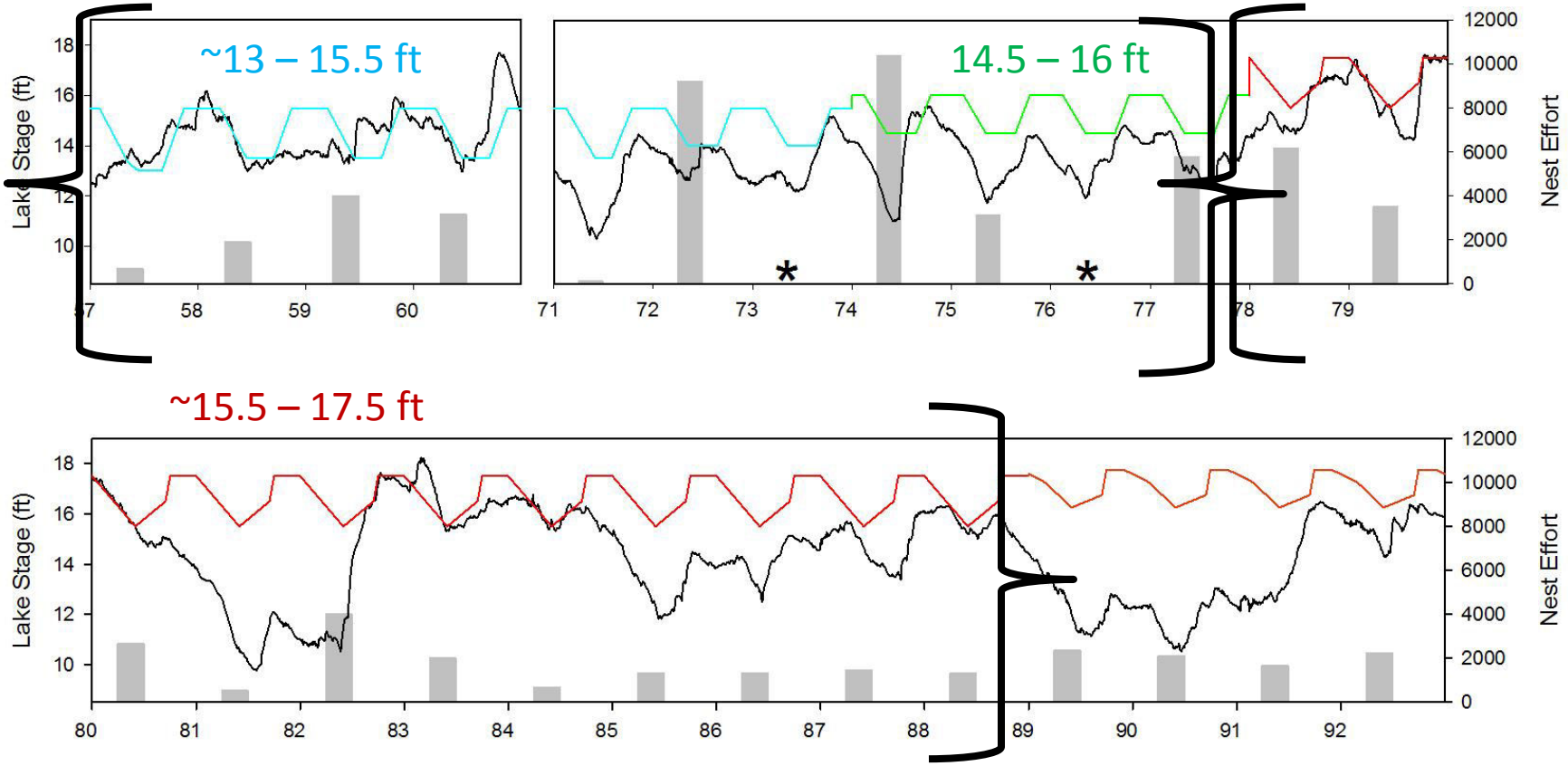
Lake O second most important wading bird nesting area in S FL (~20% of Everglades)



Lake Okeechobee regulation schedules, stage, and numbers of nests

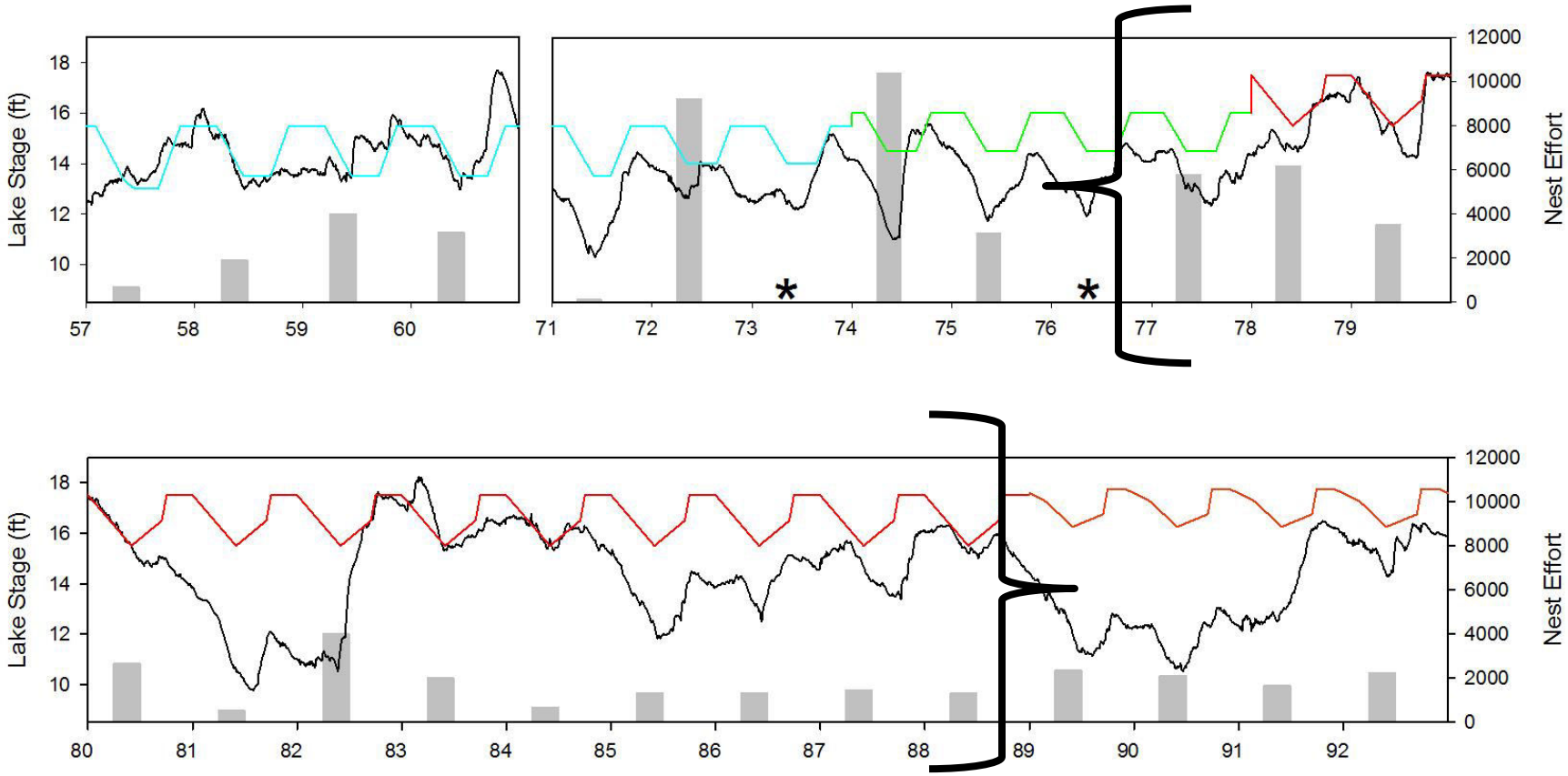


David 1994a

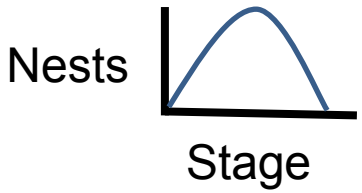


When upper end of schedule increased from 15.5 to 17.5 nest numbers declined, likely due to loss of willows

David 1994b



Nest numbers were highest when stage 12.8’-14.4’ and water levels receding



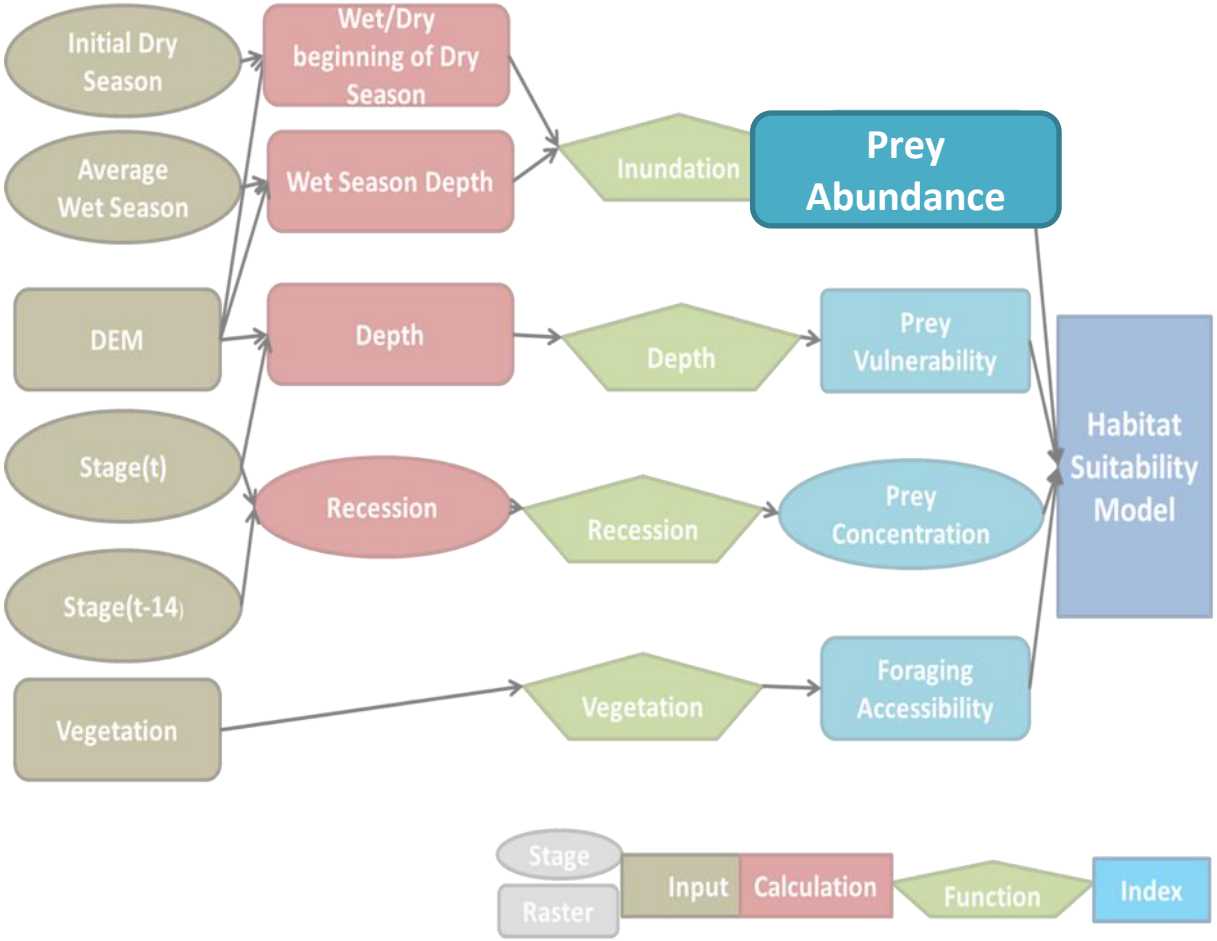
Smith and Collopy (1995)

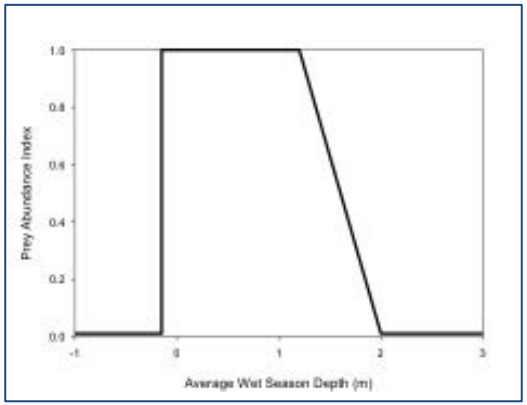
- Nest numbers highest when
  - Water depth moderate-high at start of dry season and prolonged recession
  - Good dry season conditions preceded by 2 years of high water (prey production)
- Differences among species
  - Great Egrets preferred deeper water
- Recommended periodic droughts to support growth of willow for nesting substrate (importance of extreme events in wetlands)

In 2014 FAU began developing predictive tools linking nest effort to Lake Stage

- Habitat suitability model (HSM) for wading birds at Lake Okeechobee (*R. Botta*)

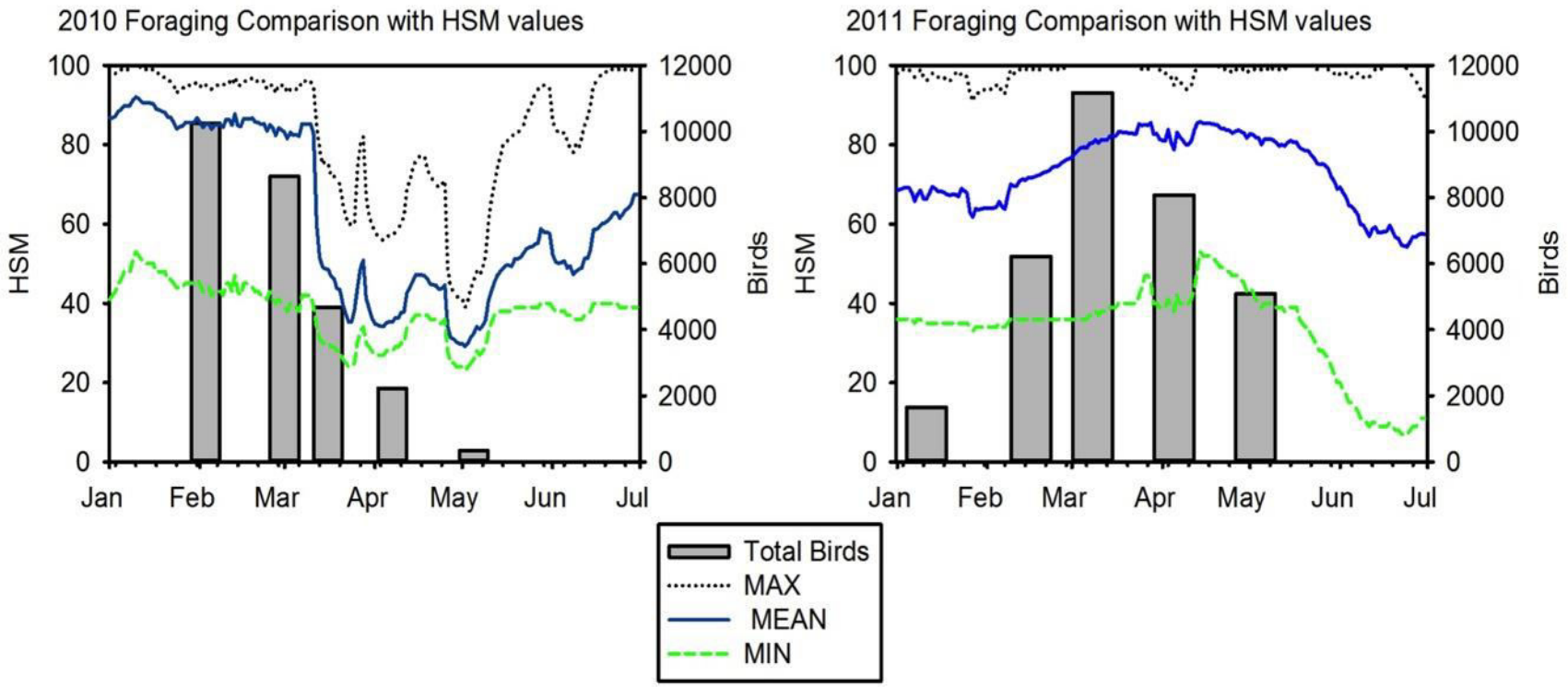
Model and Functions (Stage)



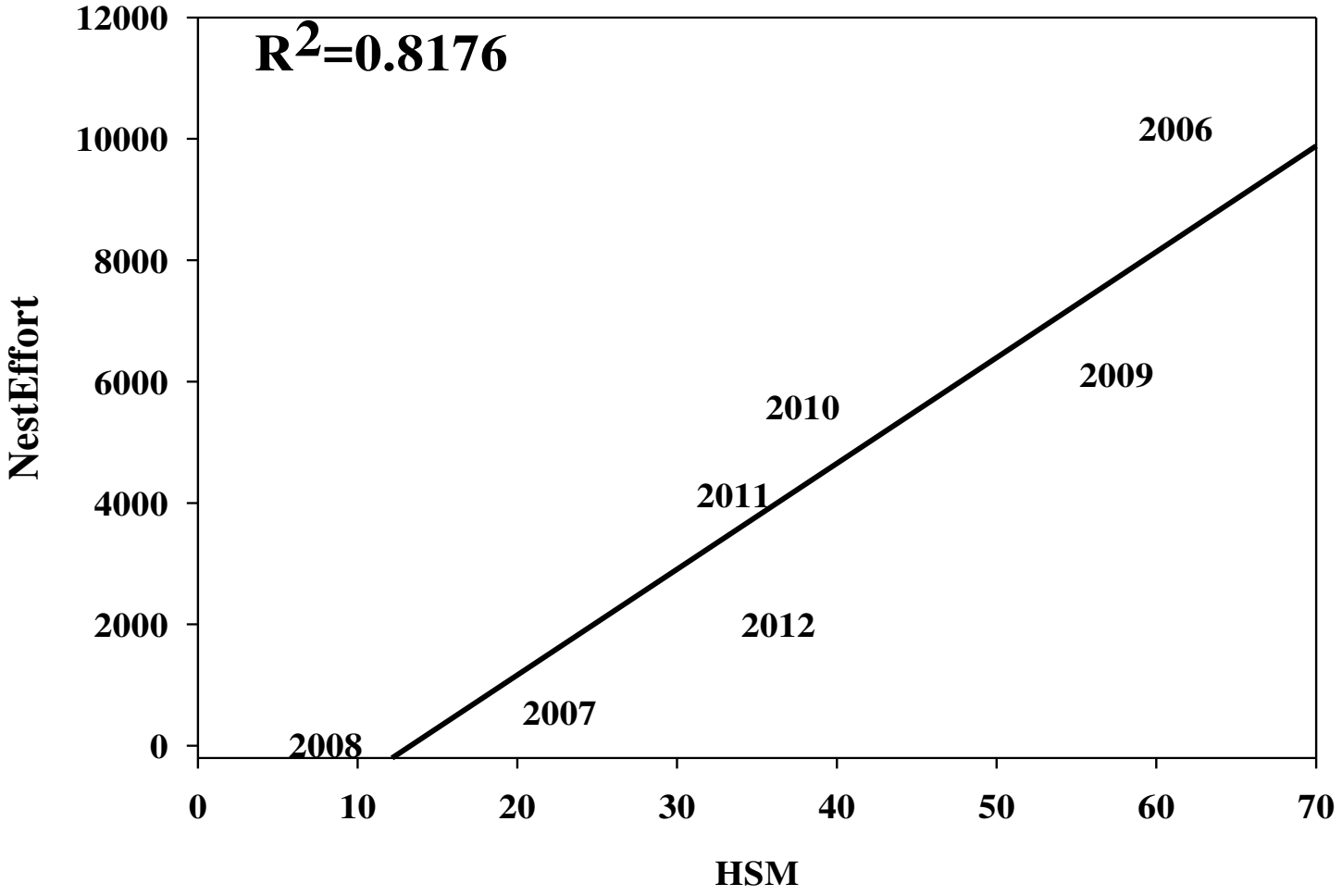


- Max area of marsh < 2’ depth in wet season
- Max area marsh < 9” during dry season

Comparisons of Daily HSM values to Daily Foraging Survey Totals from SFWMD

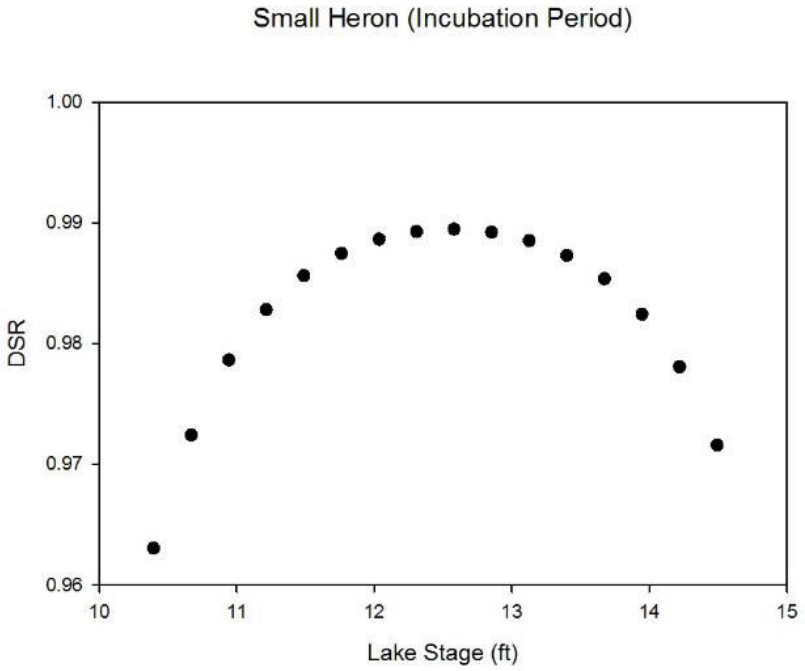


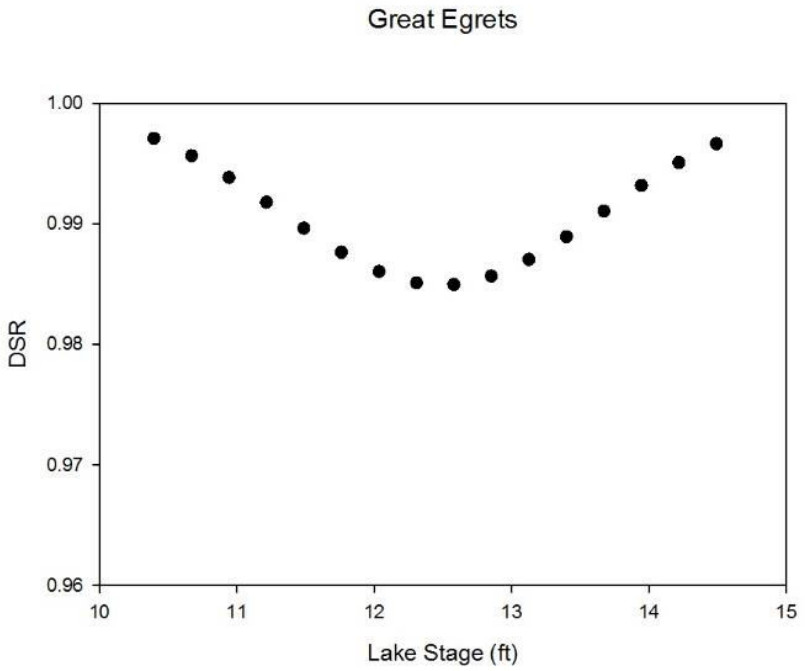
Annual aggregated HSM and numbers of nests 2006-2012



Aggregated HSM: highest quartile value Jan-May

Preliminary analysis: daily nest survival linked to recession rate and stage (D. Essian) (complex interaction)

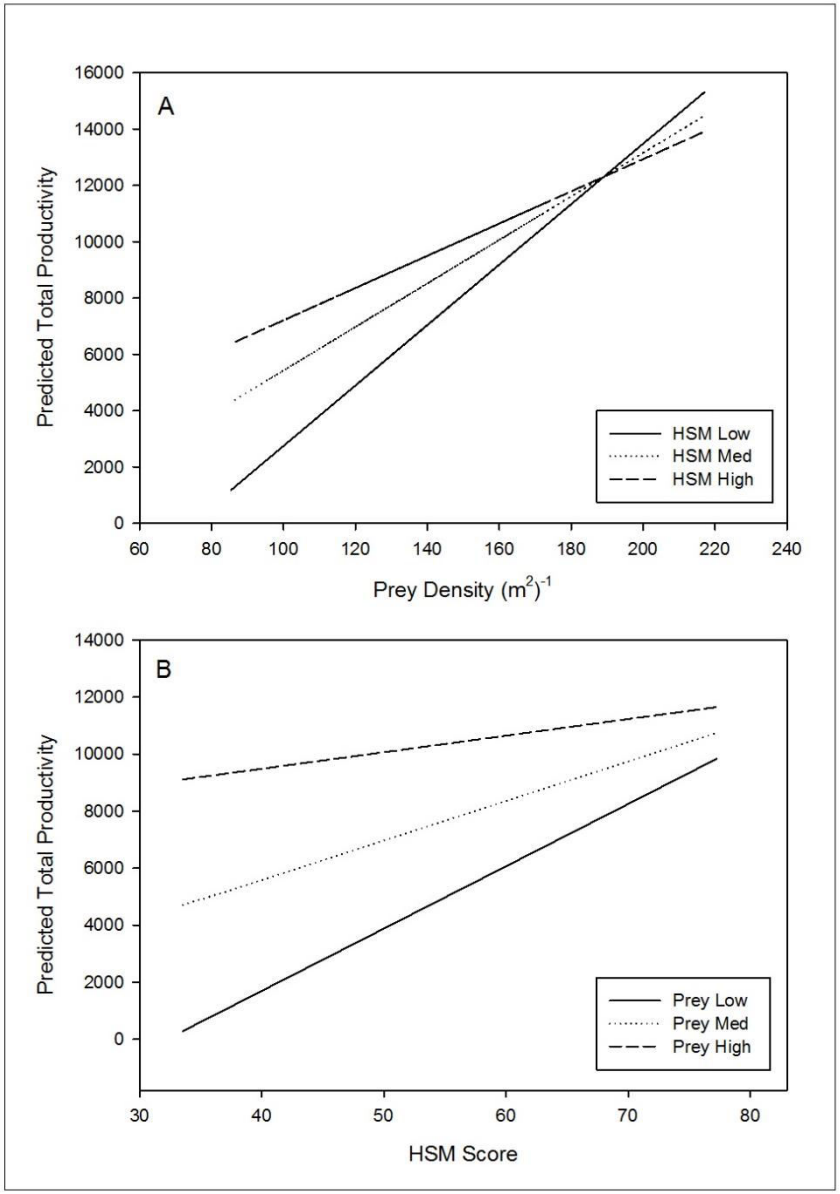




Statistical models incorporating multi-year stage through willow index (J. Chastant)

Wading bird productivity highest when:

- High area of willow (moderate stage)
- High prey density



Summary

- Historic number of nests was highest when:
  - Stage 12.8’ – 14.4’ and receding
  - Upper end of schedule 15.5 rather than 17.5
- HSI related to nests and was highest when:
  - Max area of marsh < 2’ depth in wet season
  - Max area marsh < 9” during dry season
- Wading bird productivity related to:
  - Area of Willow (moderate stage levels and extreme events)
  - Fish density
- Small heron nest survival highest at moderate stages
  - But interaction with recession and Great Egret nest survival was marginally higher at low or high stages

Acknowledgements

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RECOVER
assessment
science
integration
evaluation

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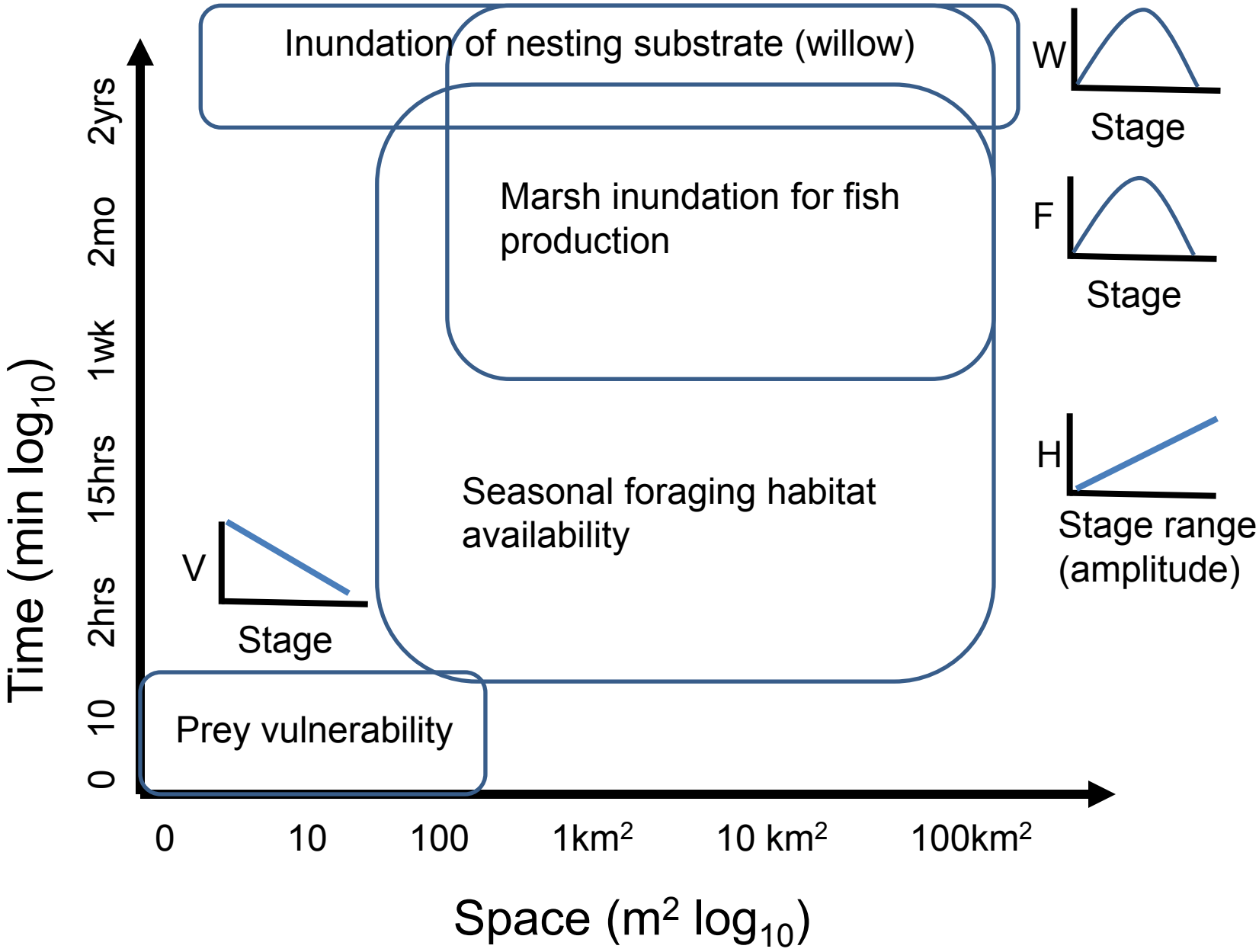
Conclusions

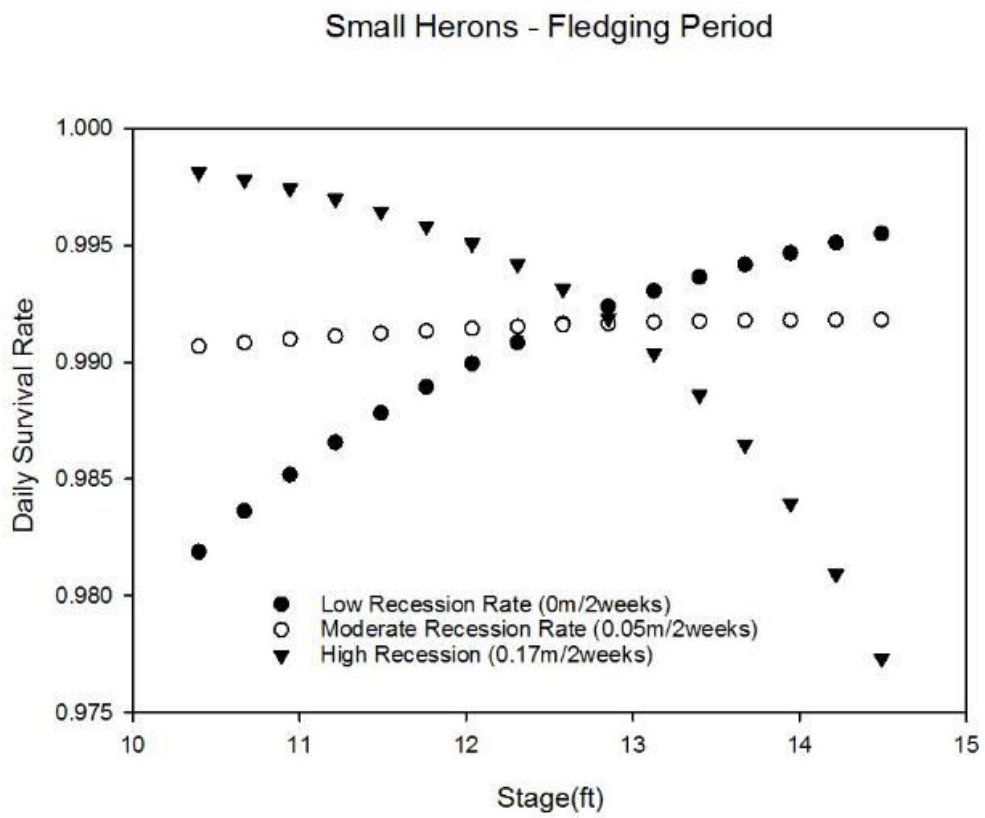
- Poor understanding of effects of operation schedules, versus effects of actual water levels
- Moderate to high peak wet season stage to promote fish production (14’-16’)
  - (David, Smith, FAU Botta, FAU Chastant)
- Prolonged dry season recession to max area of shallow (< 9“) foraging habitat (~12’)
  - (David, Smith, FAU Botta, FAU Essian)
- Periodic low water years to support willow (extreme events)
  - (Smith, David, FAU Chastant)

How do hydrologic fluctuations control wading bird nesting?



Extra slides

Interaction between stage and recession for fledging rate

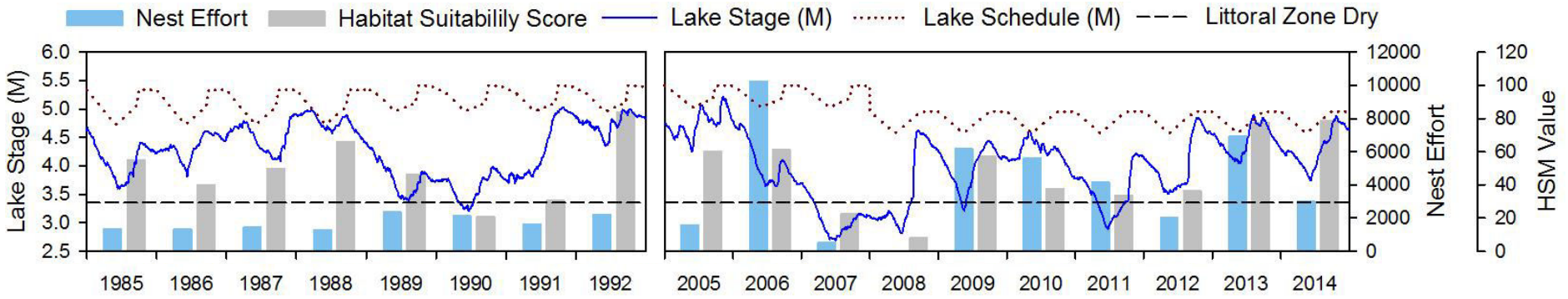


Willow Area Index

- We classified each water year (June to May) based on the water levels of the previous two water years.
  - If water levels were above 4.7 m for ≥ 580 days of the 730 days prior to that water year = **LOW**
  - If water levels were below 3.9 m for ≥ 170 days during the last 365 days of the 730 days prior to that water year = **MED**
  - If water levels were below 3.9 m for ≥ 170 days during the first 200 days of the 730 days prior to that water year, and stayed below 4.7m during the entire 730 days = **HIGH**

HSM as Index of Habitat Suitability 2006-2012 but Needed Proxy for HSM Prior to 2006

- y= Jan 1 Stage*Area Willow: $R^2 = 0.84$
- Hind casted HSM proxy for the nesting years of 1977-1992



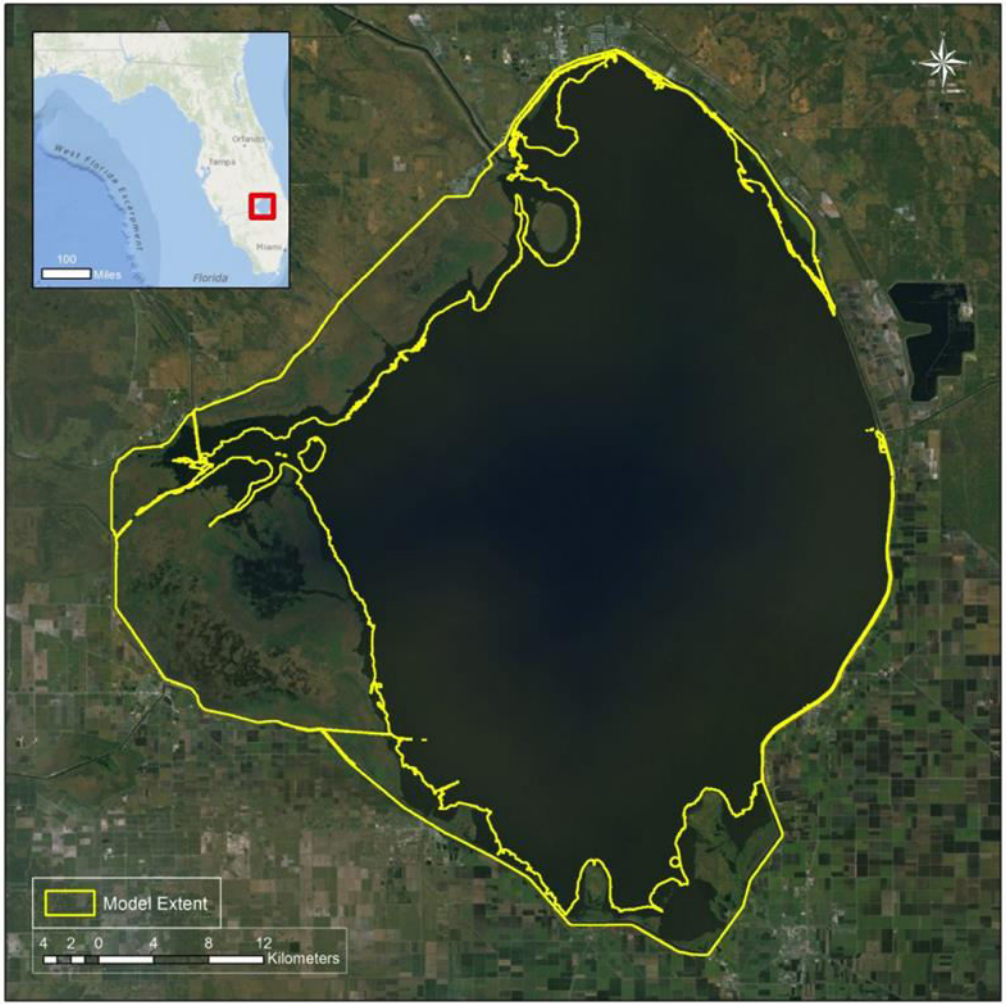
HSM for Wading Birds

Grid Extent and Resolution

- Extent- Littoral Zone
- Resolution- 30.48m (100ft)
- 551,986 Grid Cells

Analysis and Automation

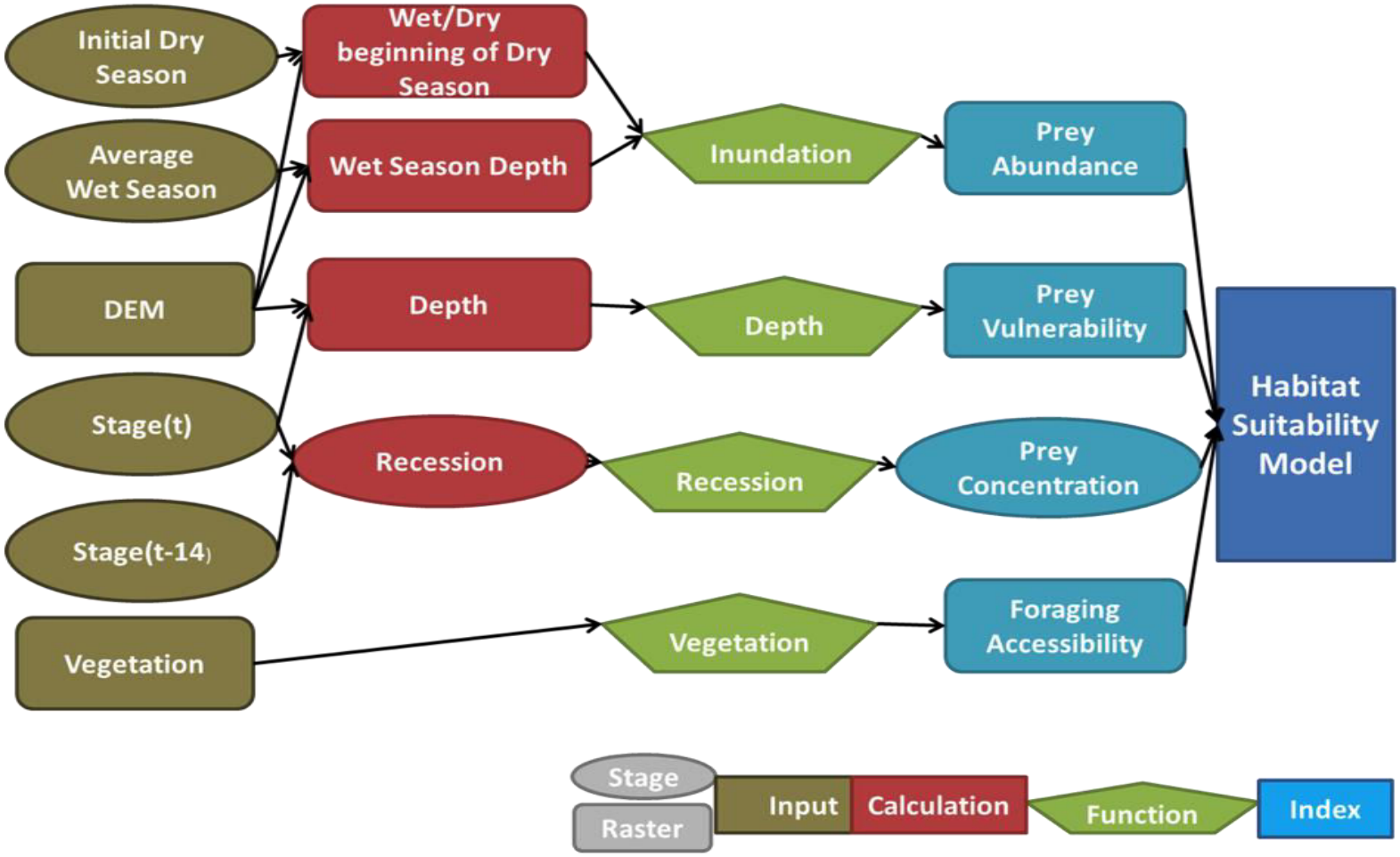
- ESRI ArcGIS 10.1
- SAS 9.2
- Python 2.7.1



HSM Data Sources

- **Vegetation Data**
  - From 2007 SFWMD veg map
  - Suitable/Unsuitable- based on woody vegetation, levee
  - Static
- **Elevation Data**
  - LiDAR based Digital Elevation Model (DEM)
  - From data collected for FDEM in 2007
- **Hydrologic Data**
  - SFWMD's DBHydro
  - Gauges: L001, L005, L006, LZ40, S4, S352, S308, S133

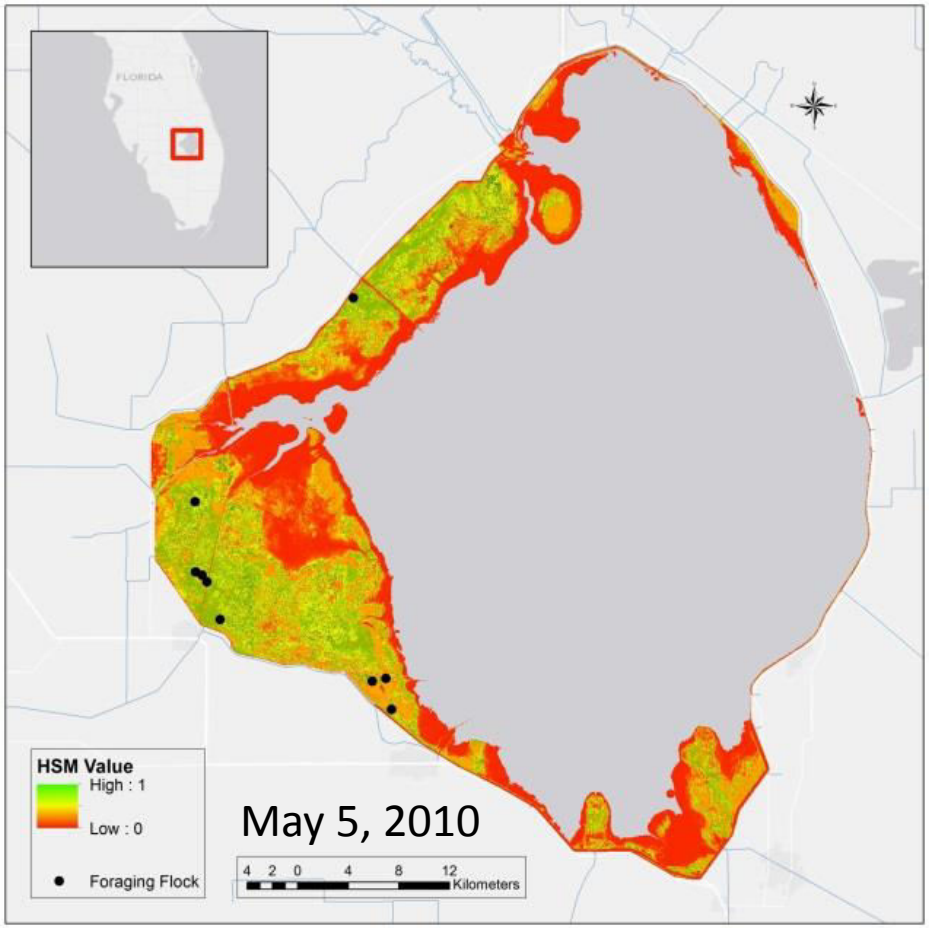
HSM Model and Functions

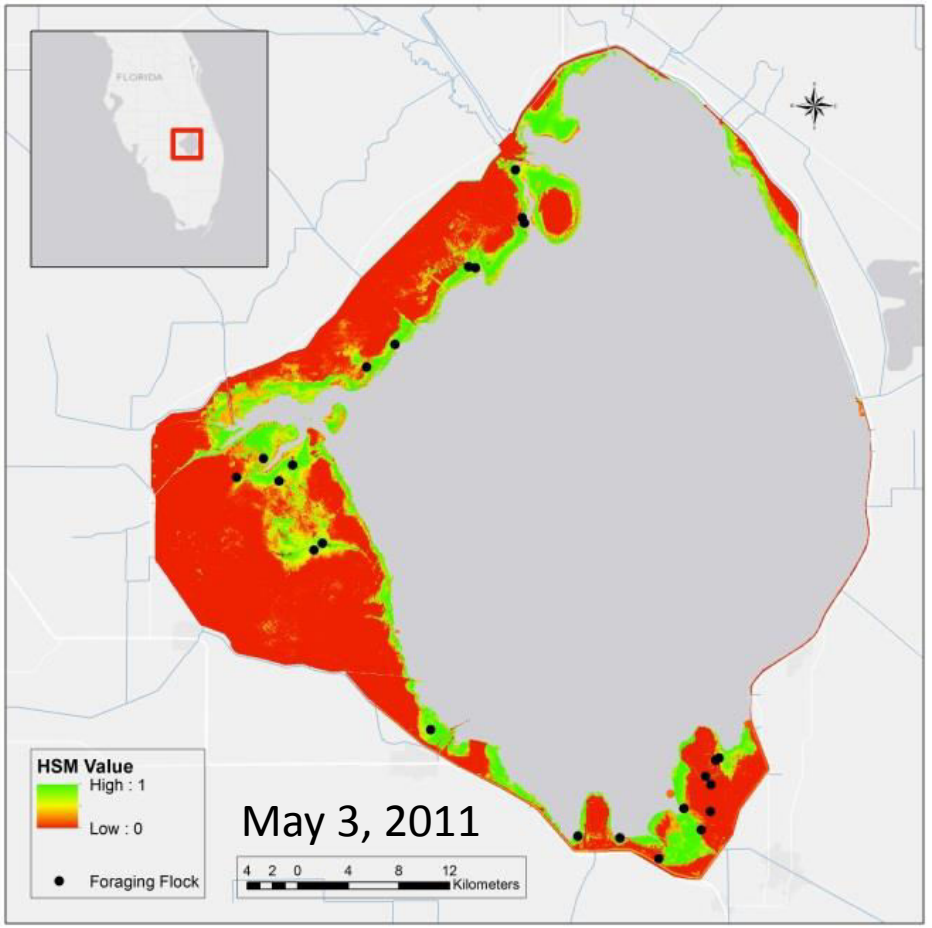


$$HSM(cell) = VUL^{.4} * CONC^{.2} * VEG^{.2} * ABUND^{.2}$$

HSM Evaluation with Flocks

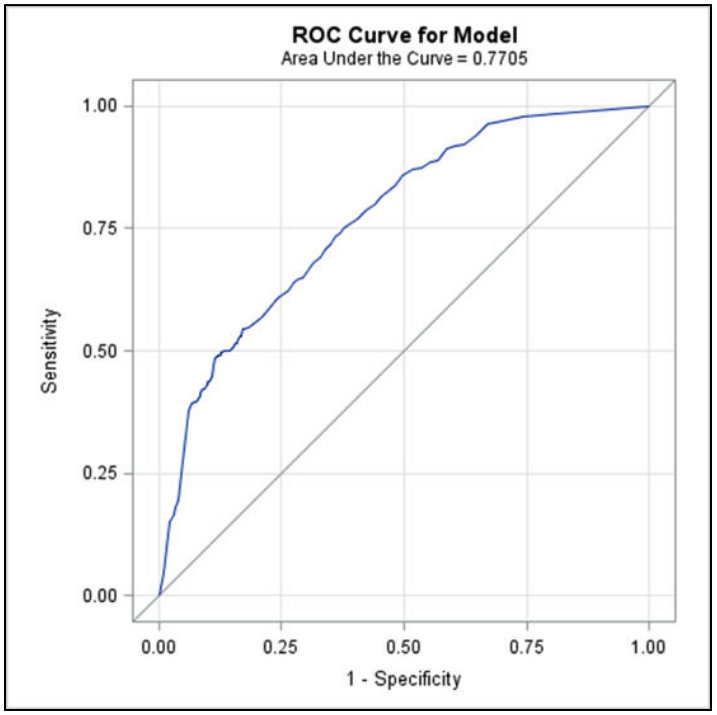
Wading bird foraging flocks overlaid on HSM





HSM Evaluated at 2 levels: Flock and Nest

- **Wading Bird Foraging Flock Presence**
  - Conducted by SFWMD
  - Complete Littoral Coverage
  - Flocks ≥50 white waders
  - 2010 - 2012
  - 16 Monthly Surveys
  - 192 Flocks Observed



- **Daily HSM Values**
  - Assessed model fit using Receiver Operator Characteristics (ROC) Area Under Curve (AUC) Method
  - Useful: AUC = 0.77