

Water level variability control of
invasive plant cover and water
bird populations in Palo Verde,
Costa Rica: Implications for
wetland restoration

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Concurrent Session on *Inducing Resilience
for Water-Subsidized Systems*

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Water birds in wetlands

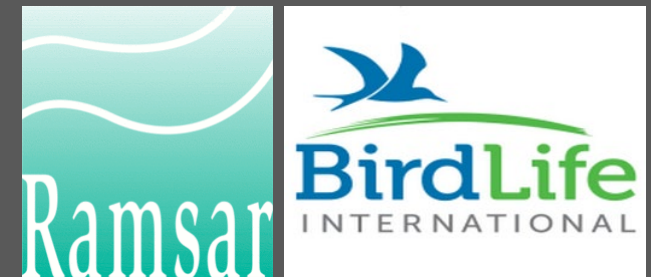
- A conservation target
- An ecological indicator
- Varying abundances
- Sensitive to water depth



Palo Verde priority species:

Black-bellied Whistling-duck
(*Dendrocygna autumnalis*)

- **Preferred water depth:**
5-25 cm
- **Seasonality:**
all year (non-breeding)
- **Ramsar + IBA criteria:**
≥1% of global population





Palo Verde priority species:

Blue-winged Teal
(*Spatula discors*)

- **Preferred water depth:**
5-25 cm
- **Seasonality:**
migratory (Sep – Apr)
- **Ramsar criteria:**
vulnerable species

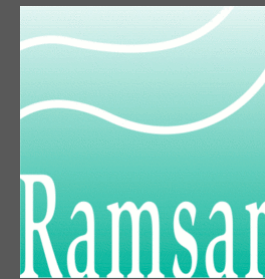




Palo Verde priority species:

Jabiru
(*Jabiru mycteria*)

- **Preferred water depth:**
0-30 cm
- **Seasonality:**
all year (breeding)
- **Ramsar criteria:**
locally threatened +
critical life stage





Palo Verde priority species:

Wood stork
(*Mycteria americana*)

- **Preferred water depth:**
≥25 cm
- **Seasonality:**
all year
- **Ramsar + IBA criteria:**
≥1% of global population

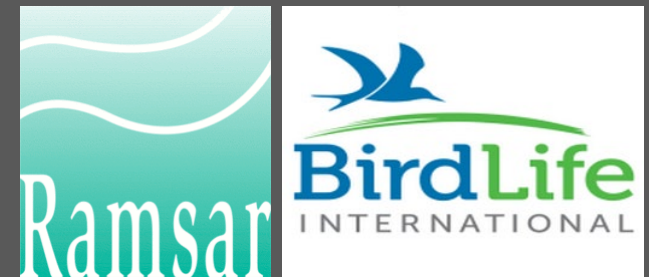




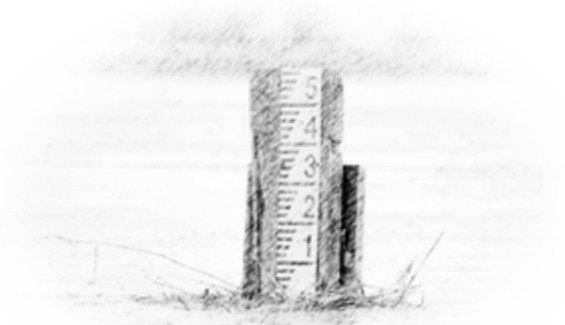
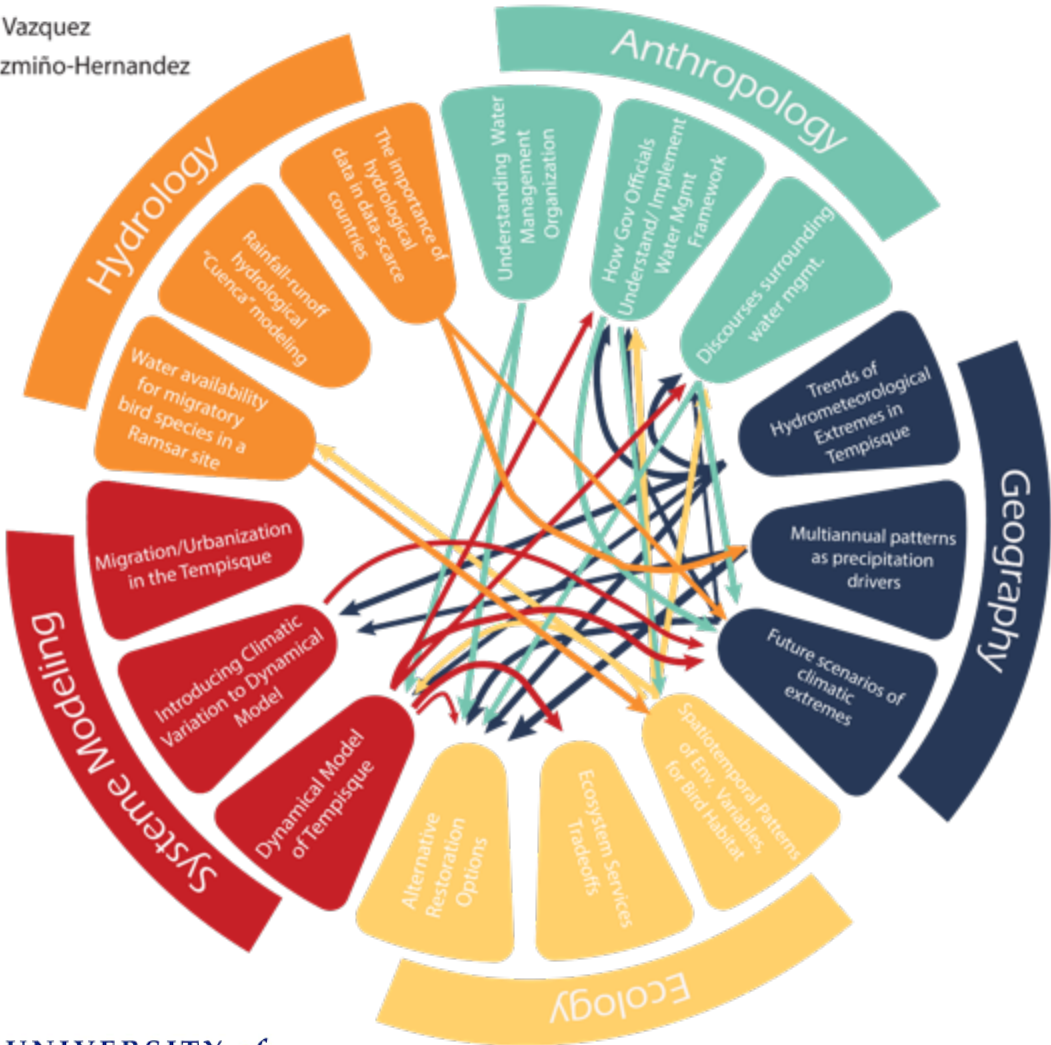
Palo Verde priority species:

White ibis
(*Eudocimus albus*)

- **Preferred water depth:**
≥25 cm
- **Seasonality:**
all year
- **Ramsar + IBA criteria:**
≥1% of global population

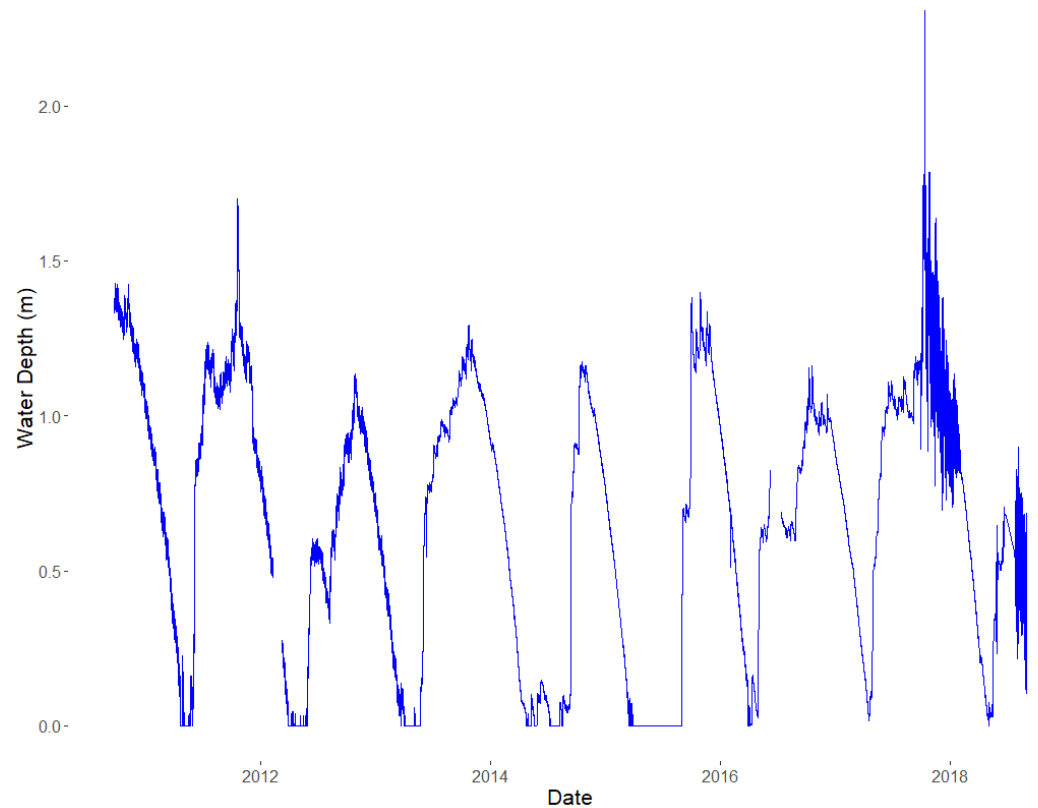


- Oswaldo Medina-Ramirez
- Caroline Huguenin
- Stefano Barchiesi
- Kathleen Vazquez
- Marco Pazmiño-Hernandez



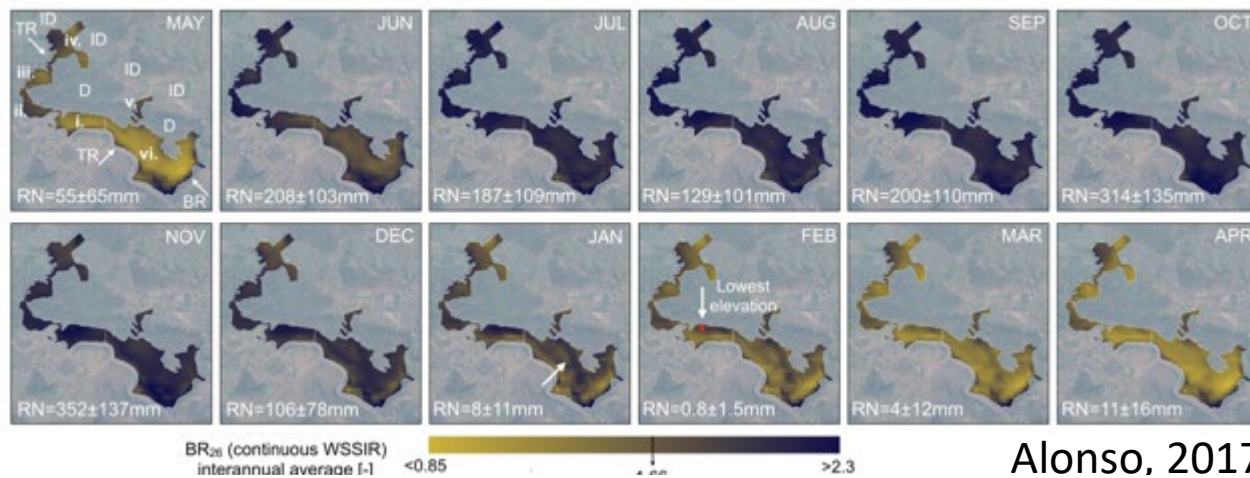
Water depth

Time Series of Hourly Water Levels (Depth) at Palo Verde - OTS

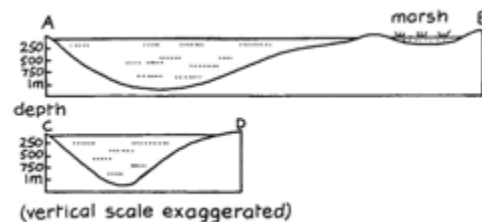
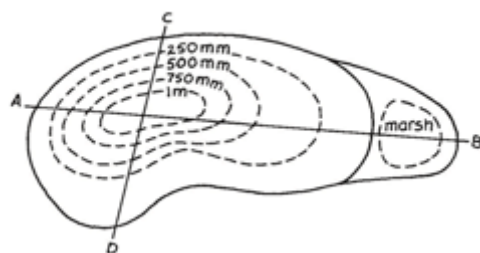




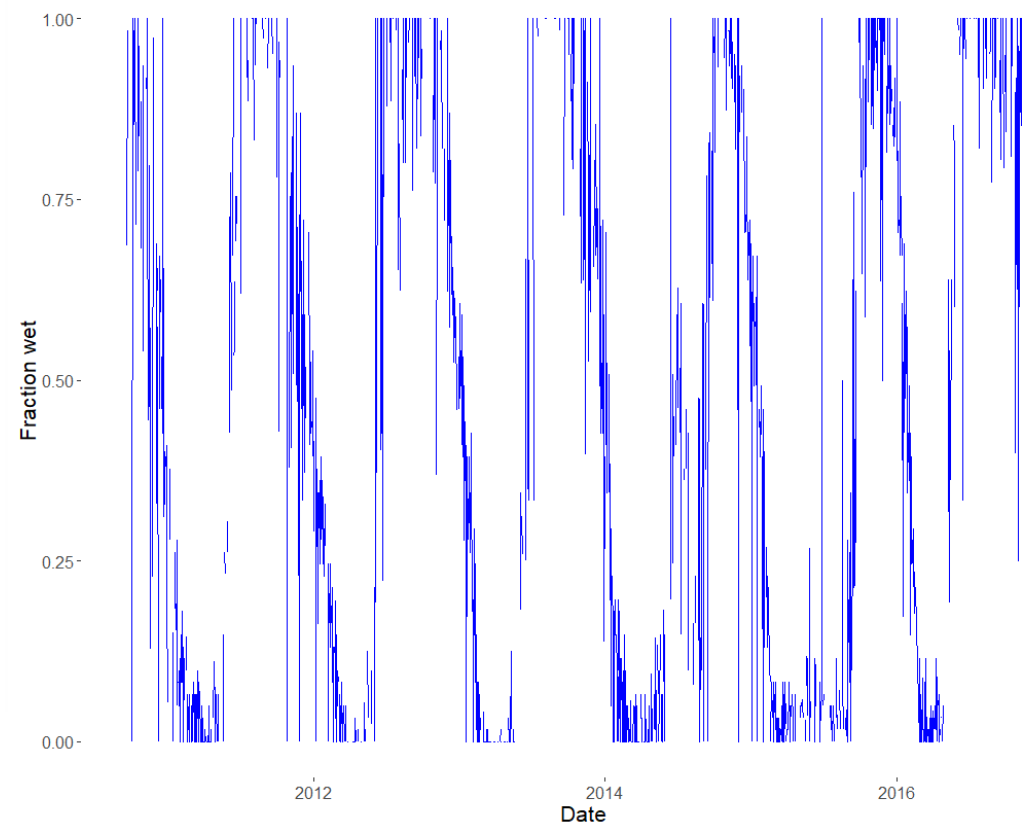
Wetland extent



Alonso, 2017

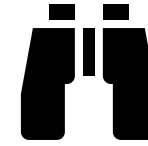


Time Series of Daily Wetland Extent for the Palo Verde lagoon





- Time of the observation
- Duration of the observation
- Space covered by the observation
- Number of participants in the observation



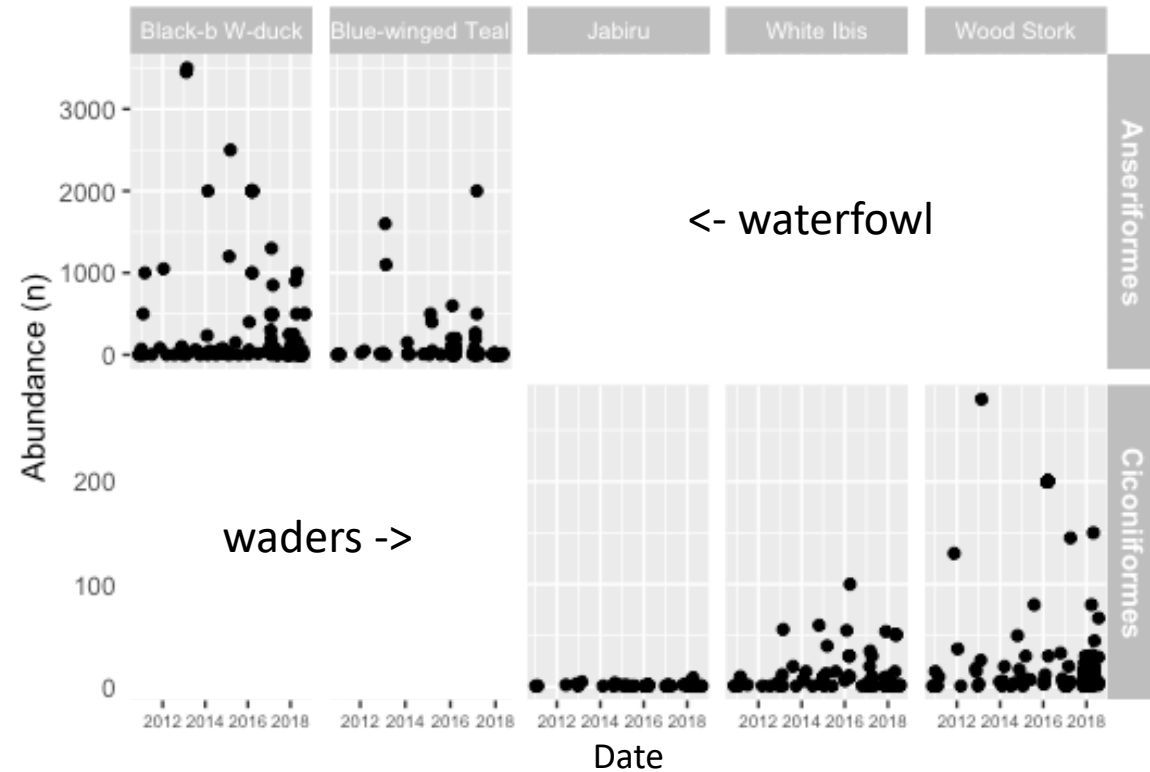
Bird abundances



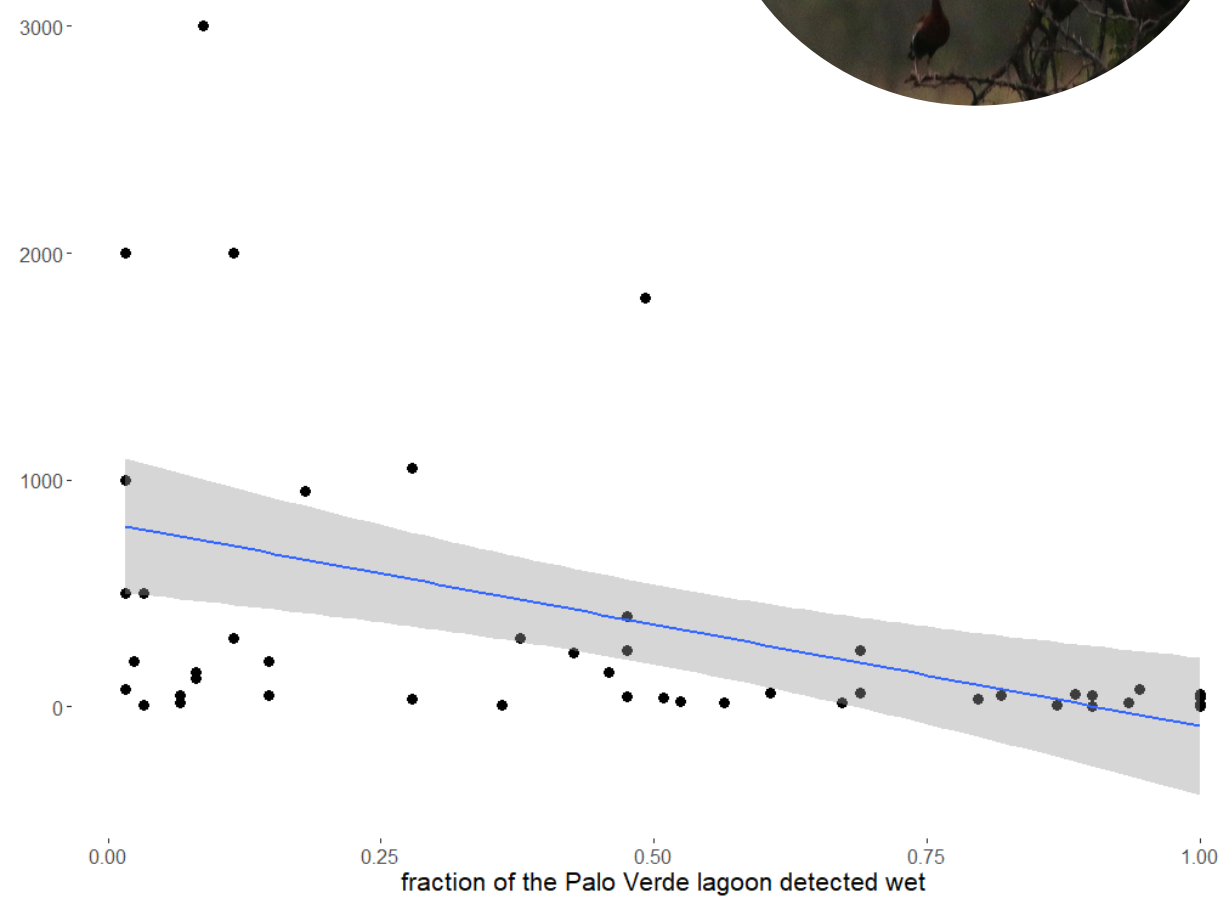
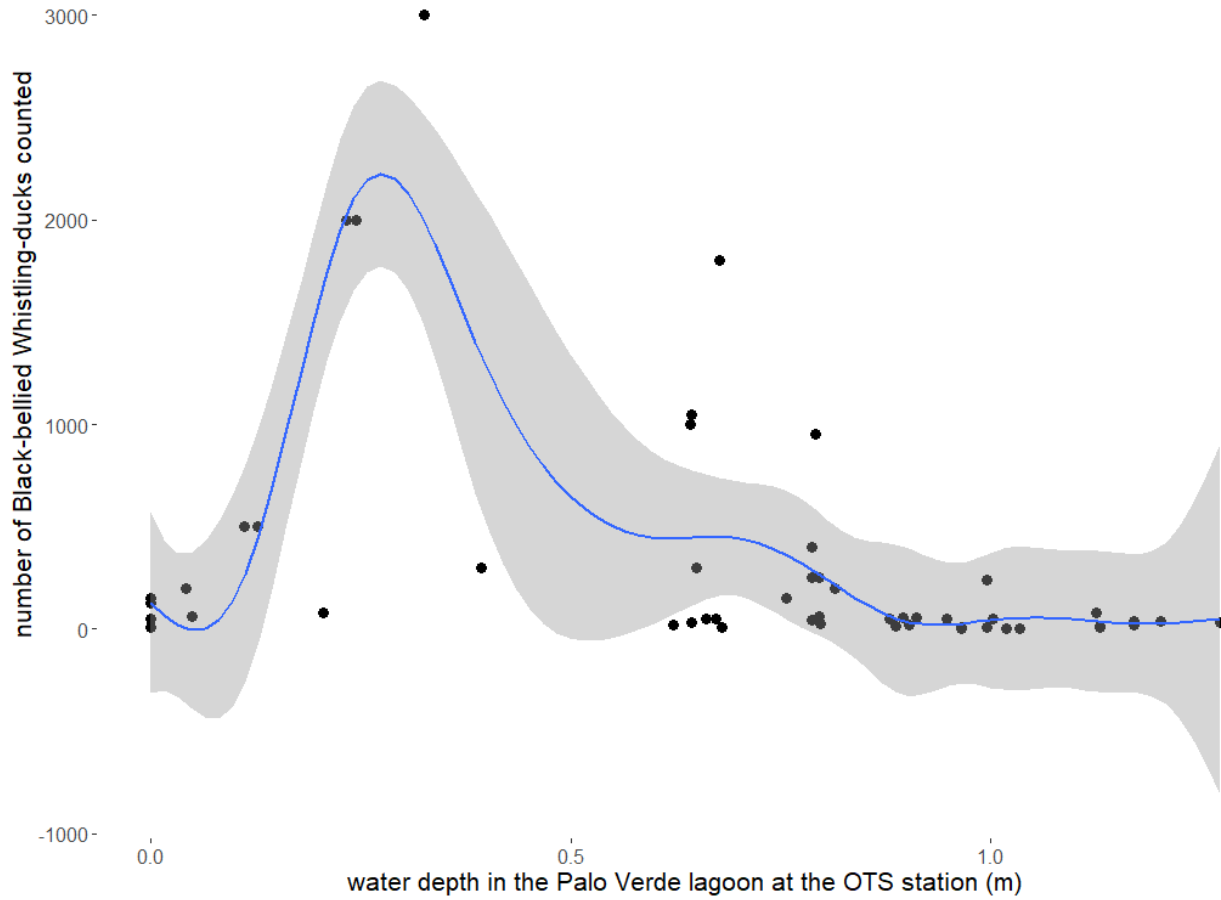
- Spatial autocorrelation
- Temporal autocorrelation



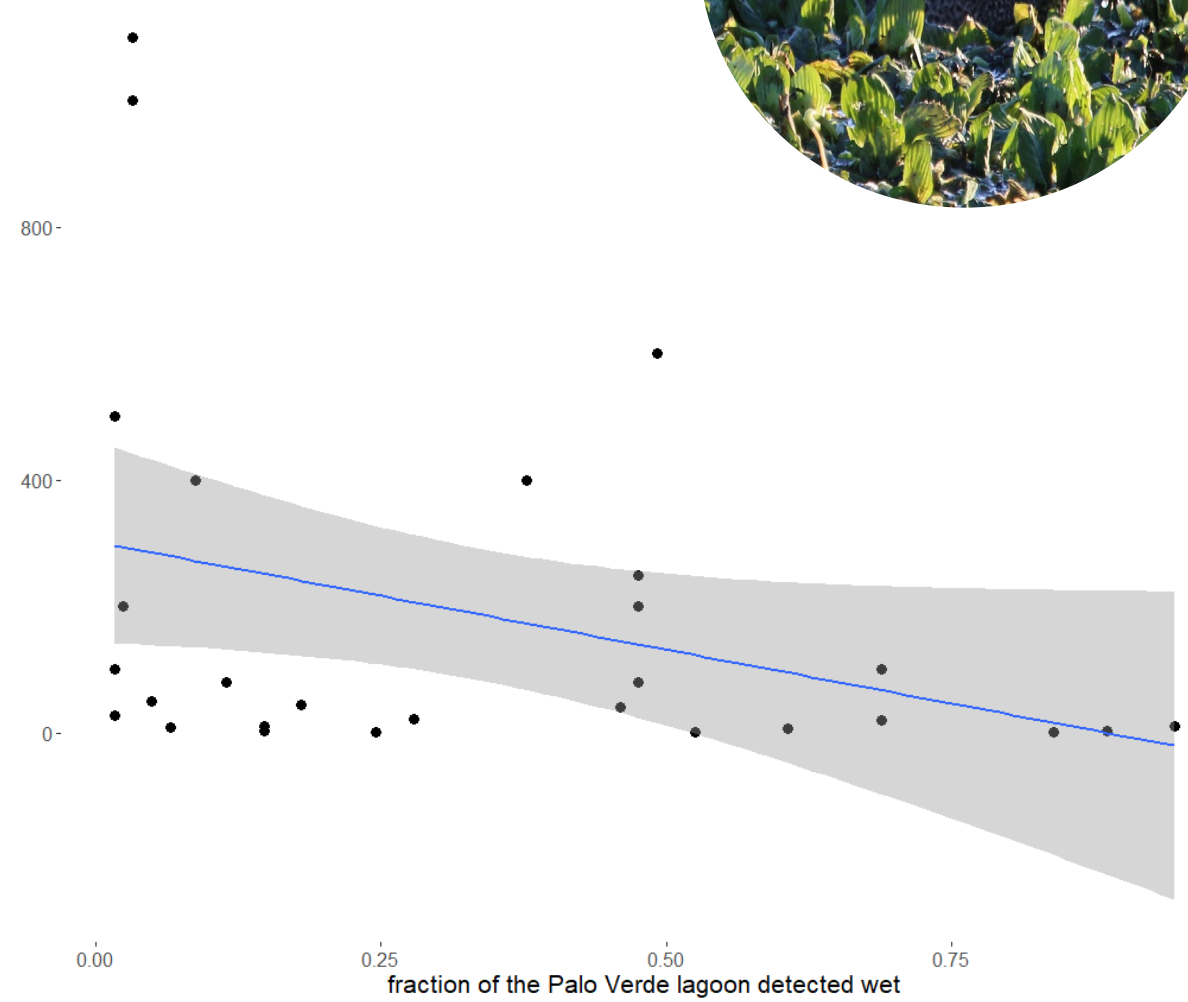
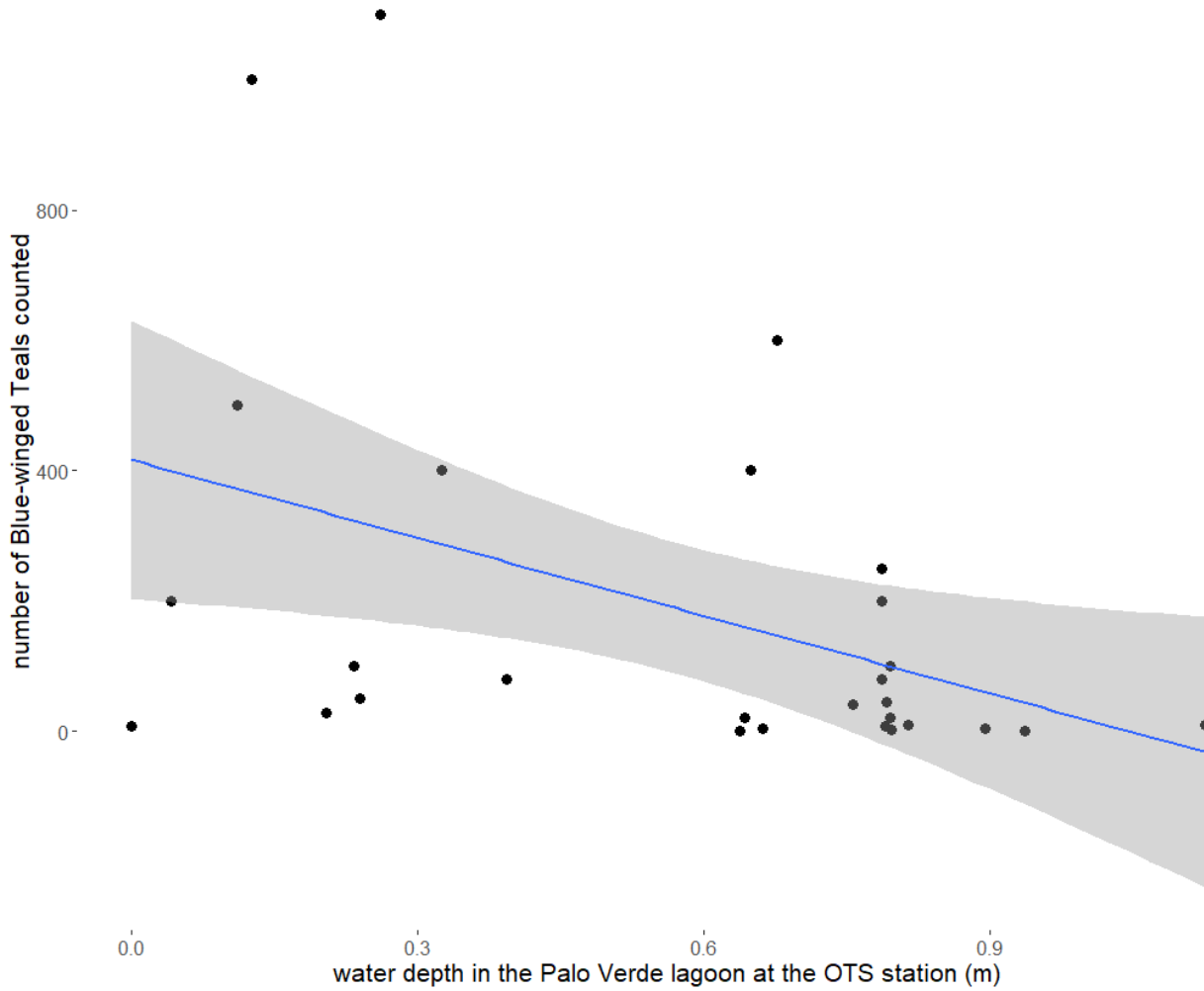
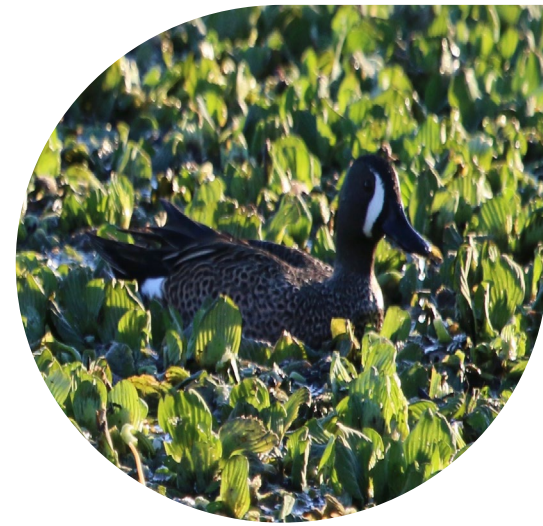
- Habitat use and availability



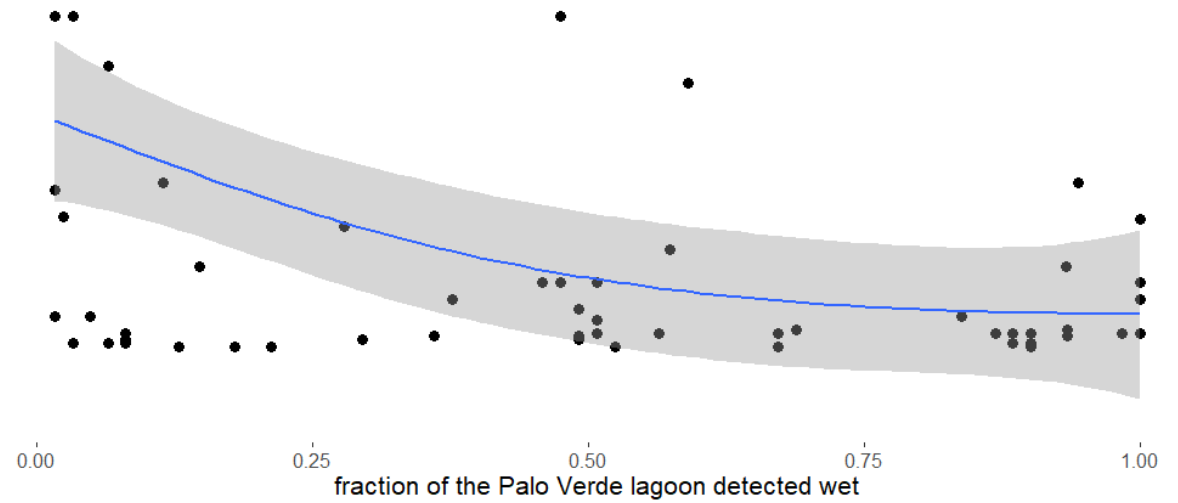
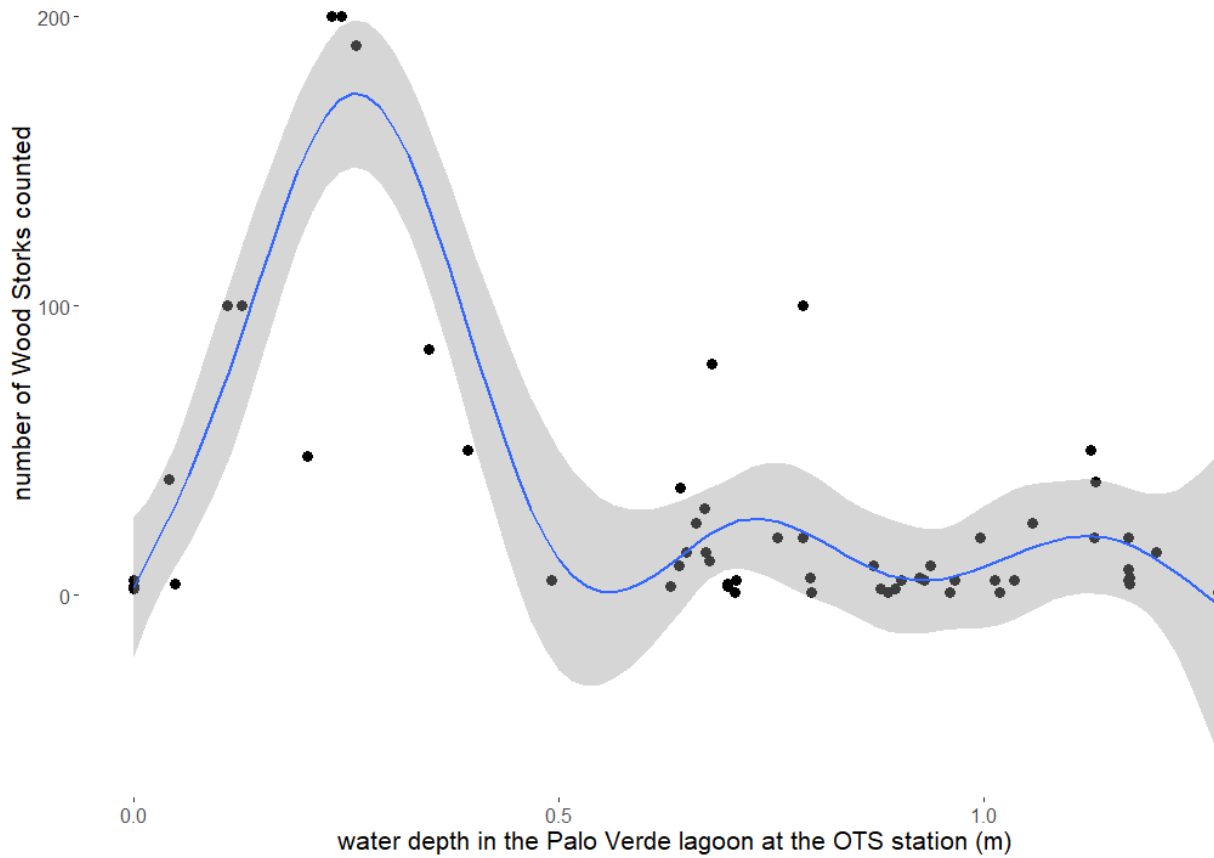
Species-specific relationships:



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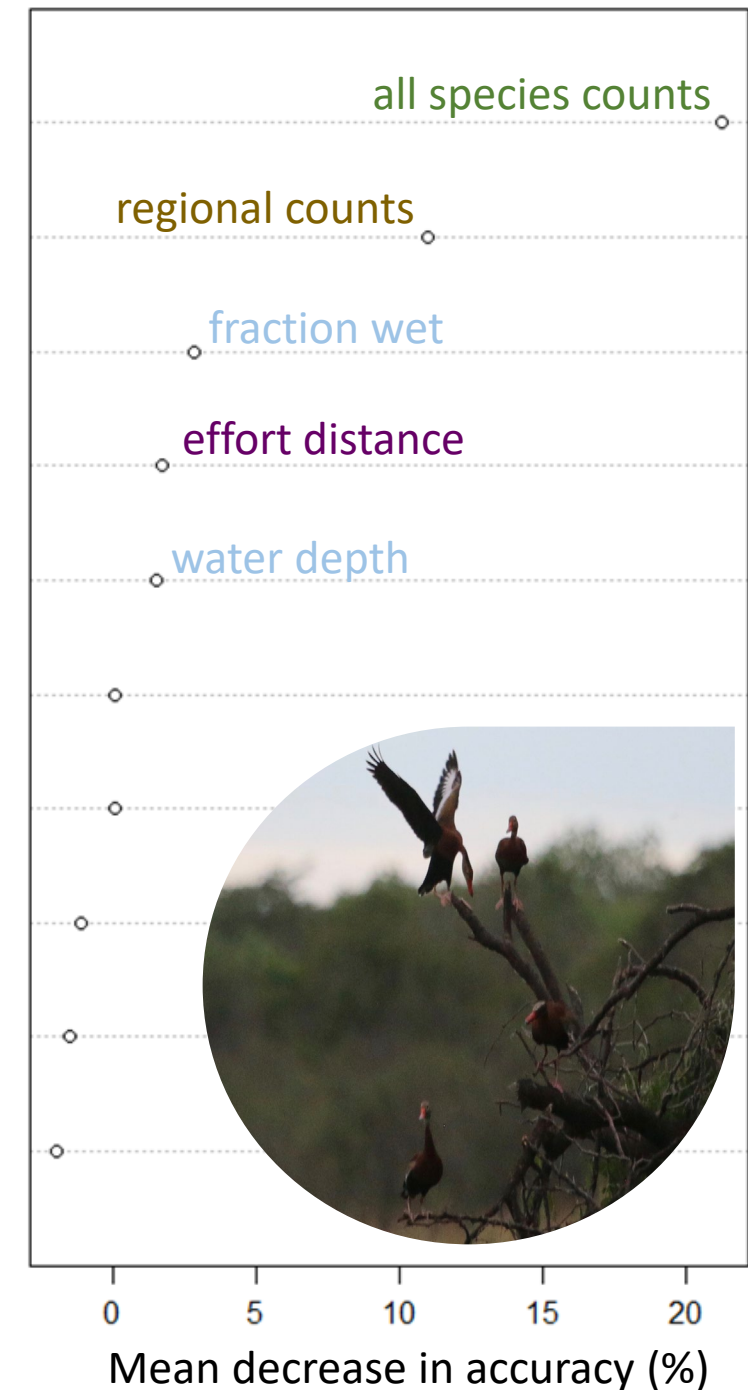


Species-specific relationships:



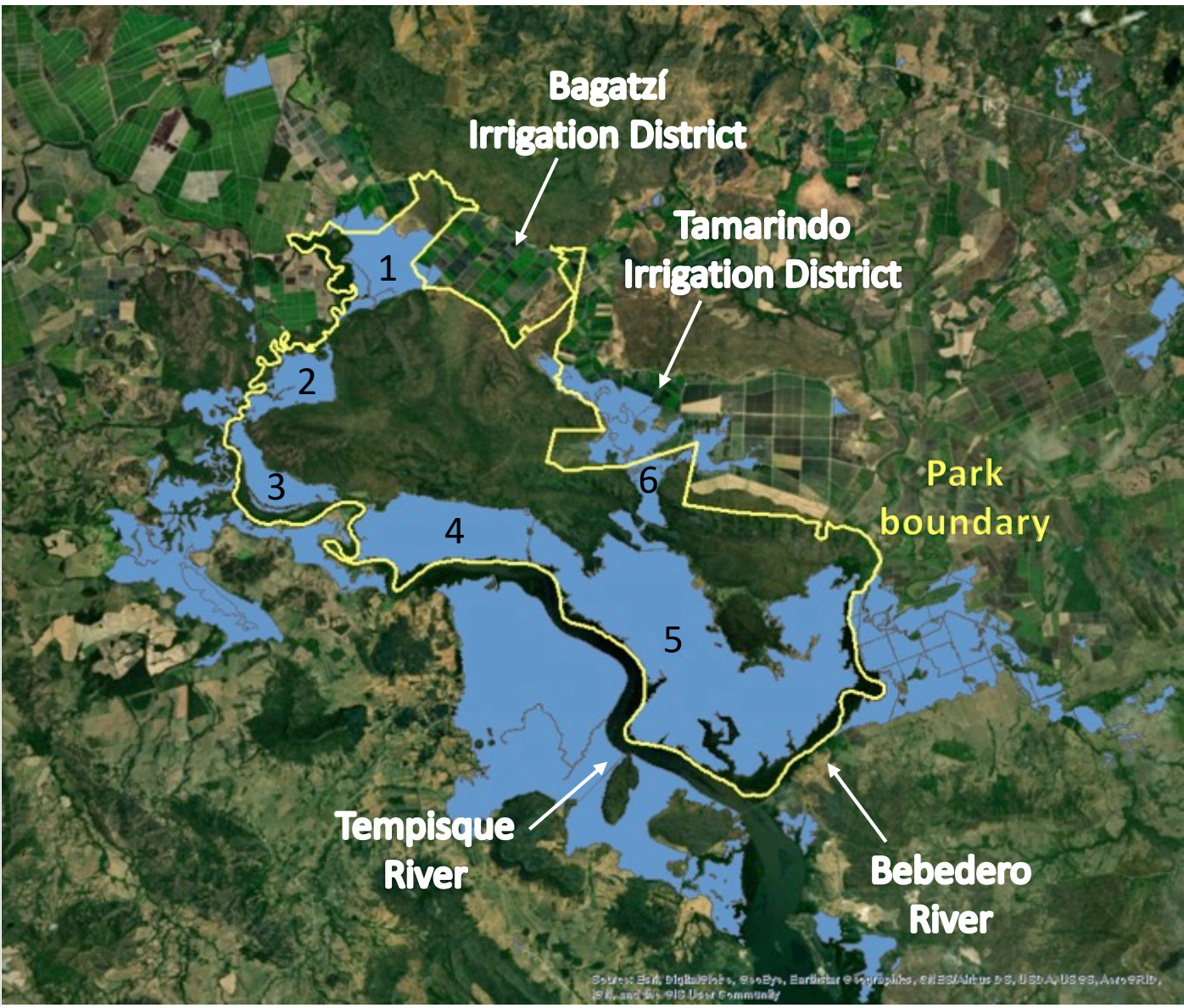
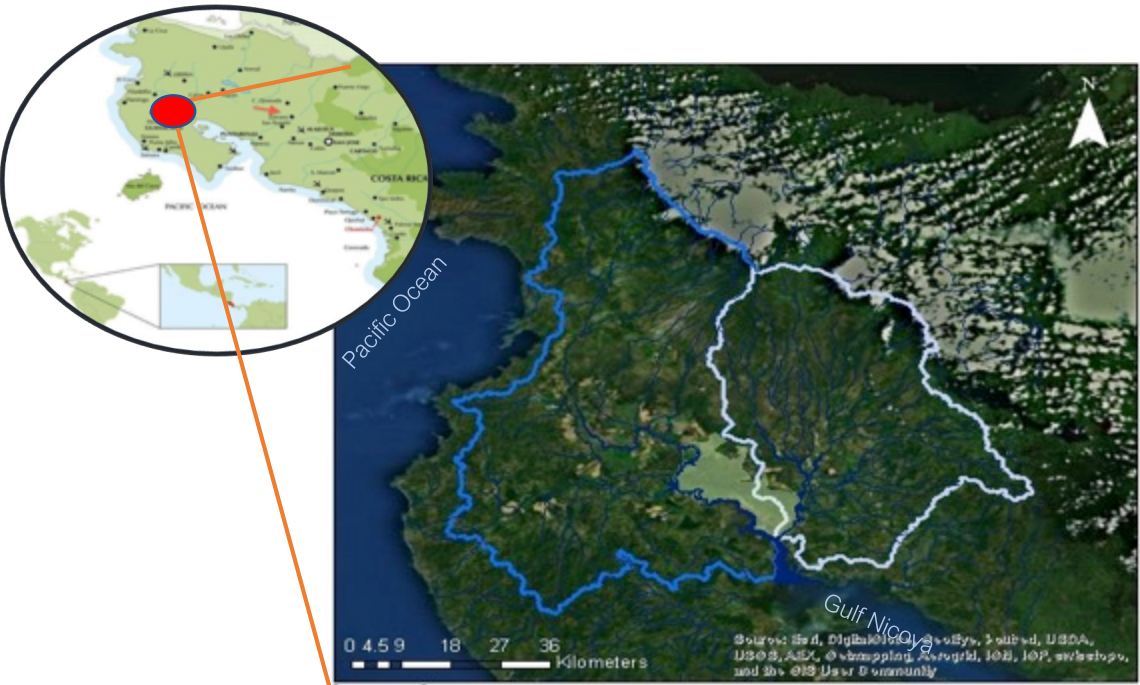
Species Abundance Model

Variable	Description
Species counts	Response variable
All water bird species counts	Habitat use covariate
Species counts in the region	Spatial autocorrelation covariate
Cumulative day since 1 st observation	Temporal autocorrelation covariate
Day of the year (seasonality)	Temporal autocorrelation covariate
Time of birding (start)	Observation effort covariates
Time of birding (duration)	Observation effort covariates
Distance travelled by birders	Observation effort covariate
Number of birders	Observation effort covariate
Water depth	Environmental covariate
Fraction wet	Environmental covariate



Scaling prediction

- | | | |
|-------------------------|---|-----------------------------|
| 1. <i>Poza Verde</i> | ← | 4. <u><i>Palo Verde</i></u> |
| 2. <i>Varillal</i> | ← | 5. <i>Nicaragua</i> |
| 3. <i>Piedra Blanca</i> | ← | 6. <i>La Bocana</i> |



Legend

- Foliar samples
- Plots marked
- Planned stations

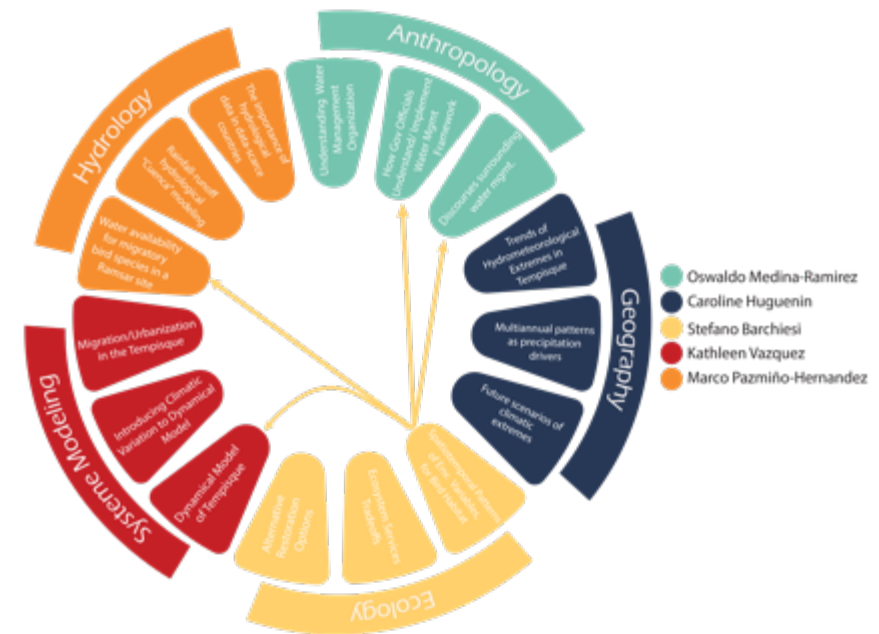


Invasive vegetation cover



Preliminary conclusions & Implications for wetland restoration

- Role of hydrology in controlling water bird populations
- Greater quantitative understanding of avifaunal trends can inform current practice of *fanguero*
- First step for subsequent and parallel analyses on:
 - spatial configuration of ecosystem services and values in the wetland system
 - sensitivity of alternate restoration decisions to uncertainty
 - climate extremes, system resilience, and water governance narratives



Thank you

