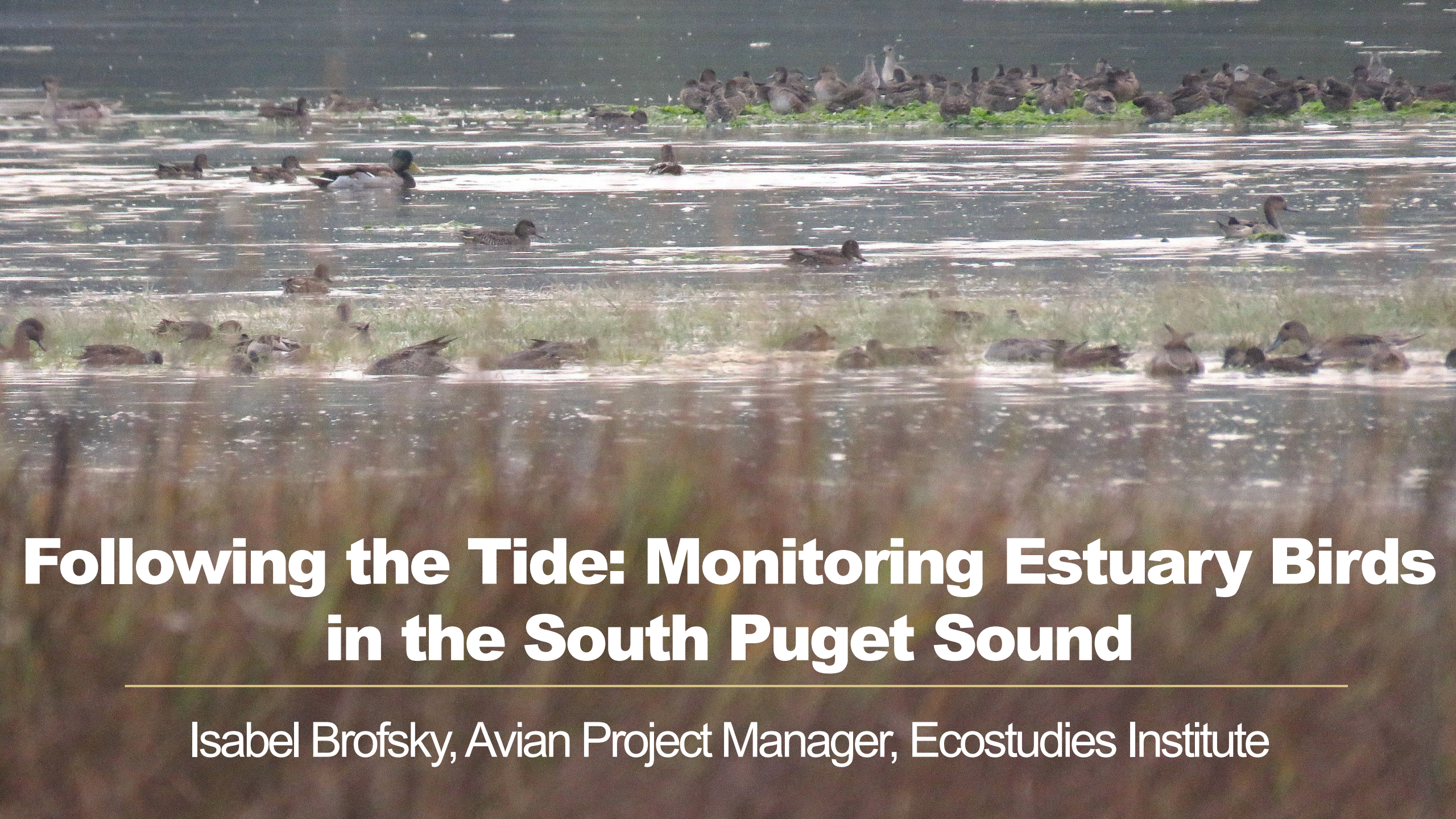
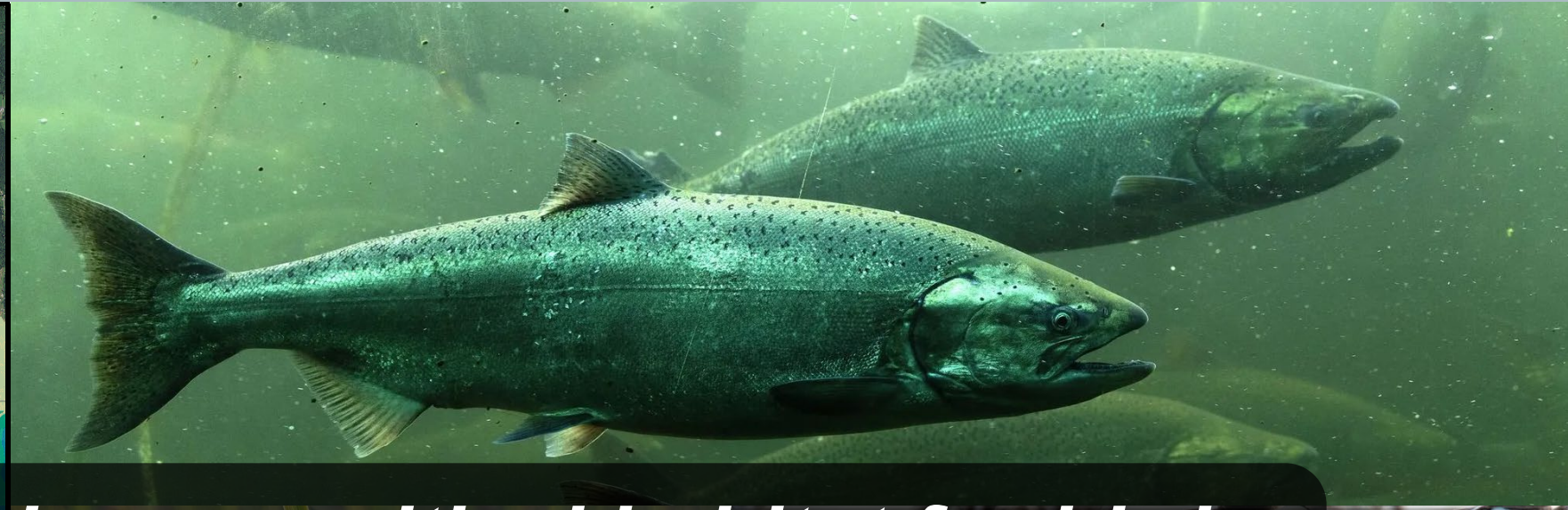


Following the Tide: Monitoring Estuary Birds in the South Puget Sound

Isabel Brofsky, Avian Project Manager, Ecostudies Institute



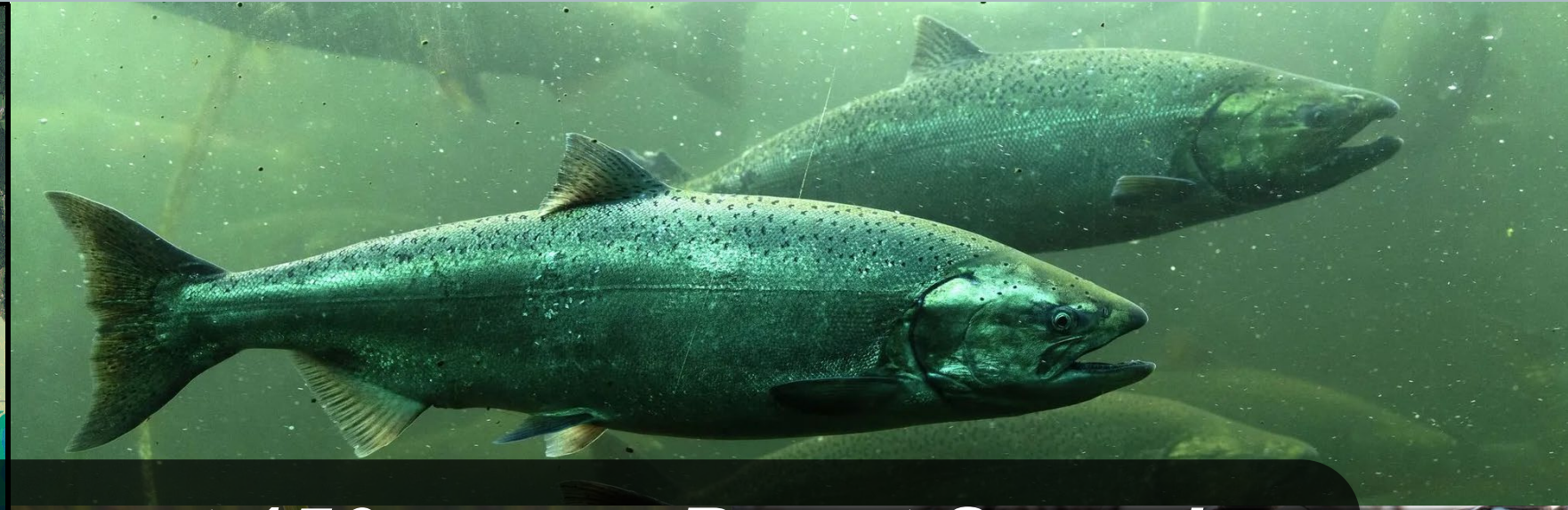


Estuaries are critical habitat for birds, fish, shellfish, and other wildlife

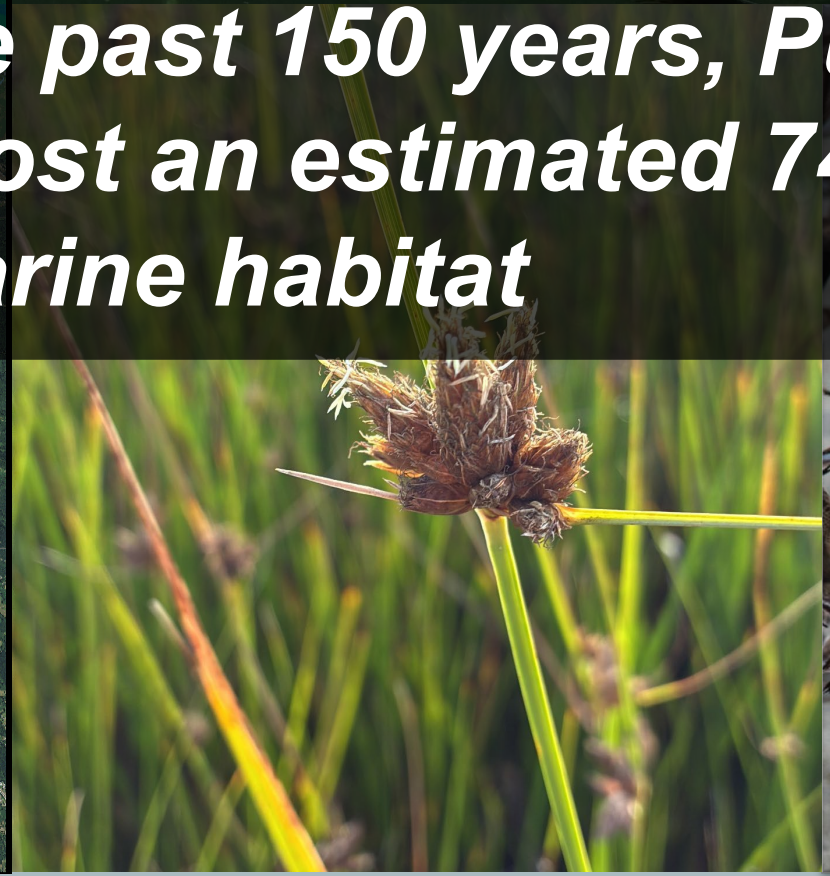






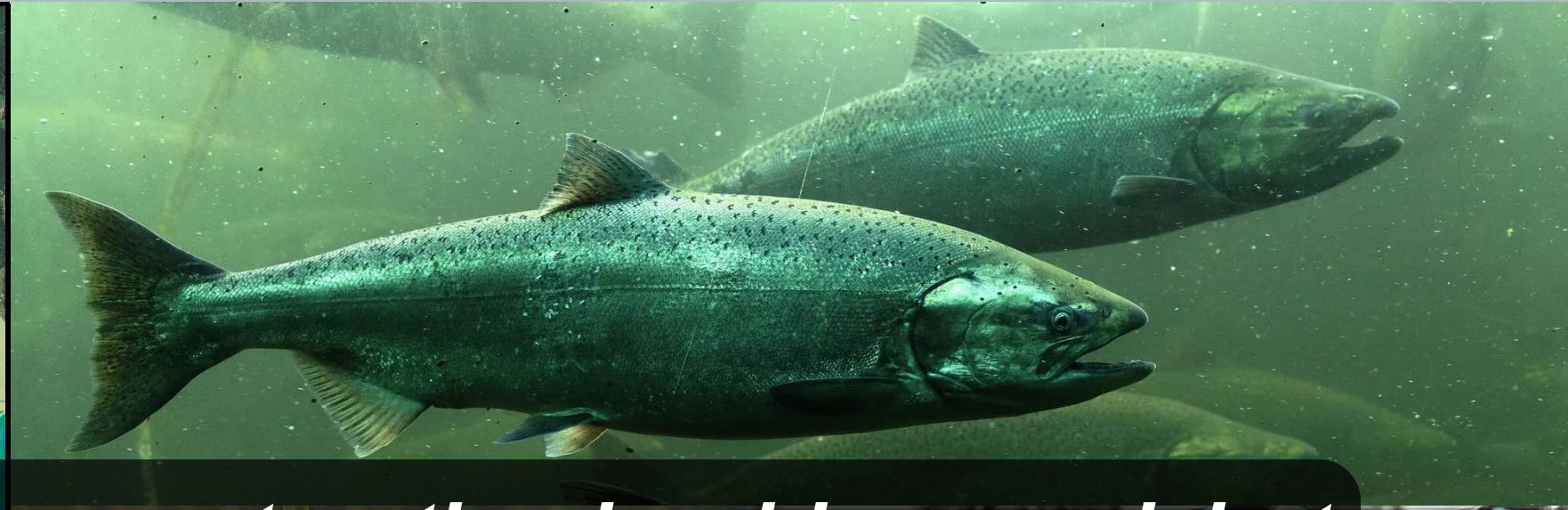


In the past 150 years, Puget Sound has lost an estimated 74% of historic estuarine habitat









Estuary restoration is widespread, but largely focused on salmonids







Inventoried past estuary bird monitoring efforts



2017

2018

2020-2021

2023

2024-present



2017

2018



2020-2021

2023

2024-present



Held regional working group meetings





Conducted pilot study in the north Puget Sound

2017

2018



2020-2021

2023

2024-present







2017

2018

2020-2021

2023

2024-present







Developed SSEAM monitoring framework







SSEAM program implementation

2017

2018



2020-2021

2023





2024-present

Salish Sea Estuaries Avian Monitoring Framework



- Support a regional network of partners
- Collect data using standardized monitoring protocols
- Maintain a central, shared database
- Evaluate fine-scale avian habitat associations



Why is avian monitoring important?

- Establish a baseline of fine-scale habitat associations
- Identify priorities for restoration actions
- Predict population trends at a regional scale



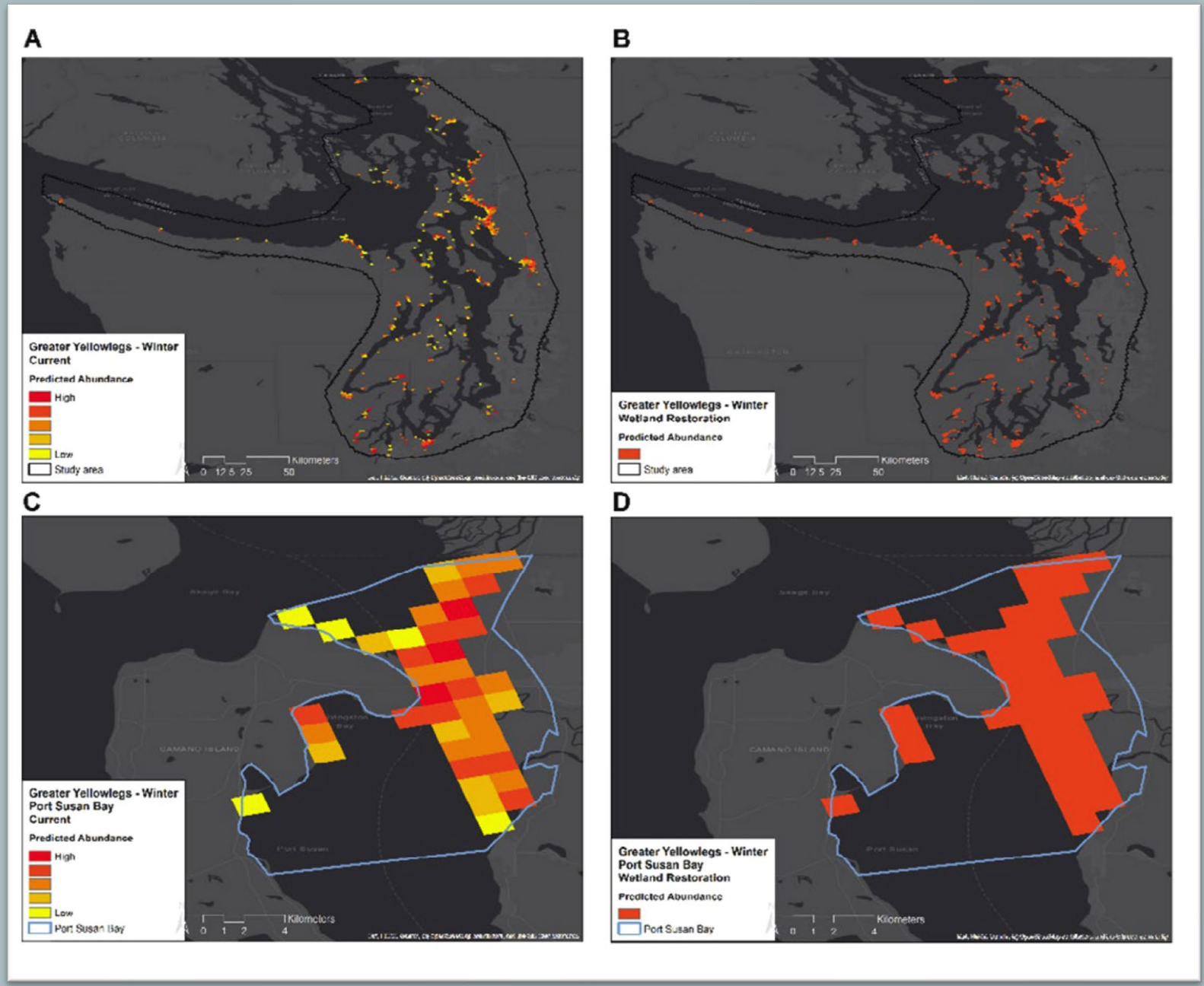
Why is avian monitoring important?

- Establish a baseline of fine-scale habitat associations
- Identify priorities for restoration actions
- Predict population trends at a regional scale



Why is avian monitoring important?

- Establish a baseline of fine-scale habitat associations
- Identify priorities for restoration actions
- Predict population trends at a regional scale





Waterfowl

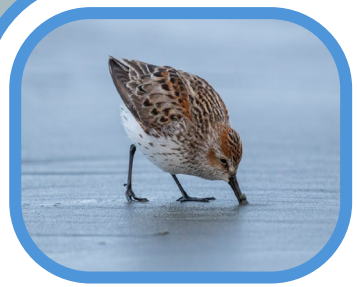
- Mallard
- Green-winged Teal
- Northern Pintail

Seasons:

Feb 1 – March 15

March 15 – April 15

Transect



Shorebirds

- Dunlin
- Black-bellied Plover
- Greater Yellowlegs
- Western Sandpiper
- Least Sandpiper

Seasons:

Feb 1 – March 15

April 15 – May 15

August 1 – Sept 30

Transect



Landbirds

- Marsh Wren
- Red-winged Blackbird
- Common Yellowthroat
- Savannah Sparrow
- Song Sparrow
- Swallow Spp.

Seasons:

May 1- June 30

Point Count



Secretive Marshbirds

- Wilson's Snipe
- American Bittern
- Sora
- Virginia Rail

Seasons:

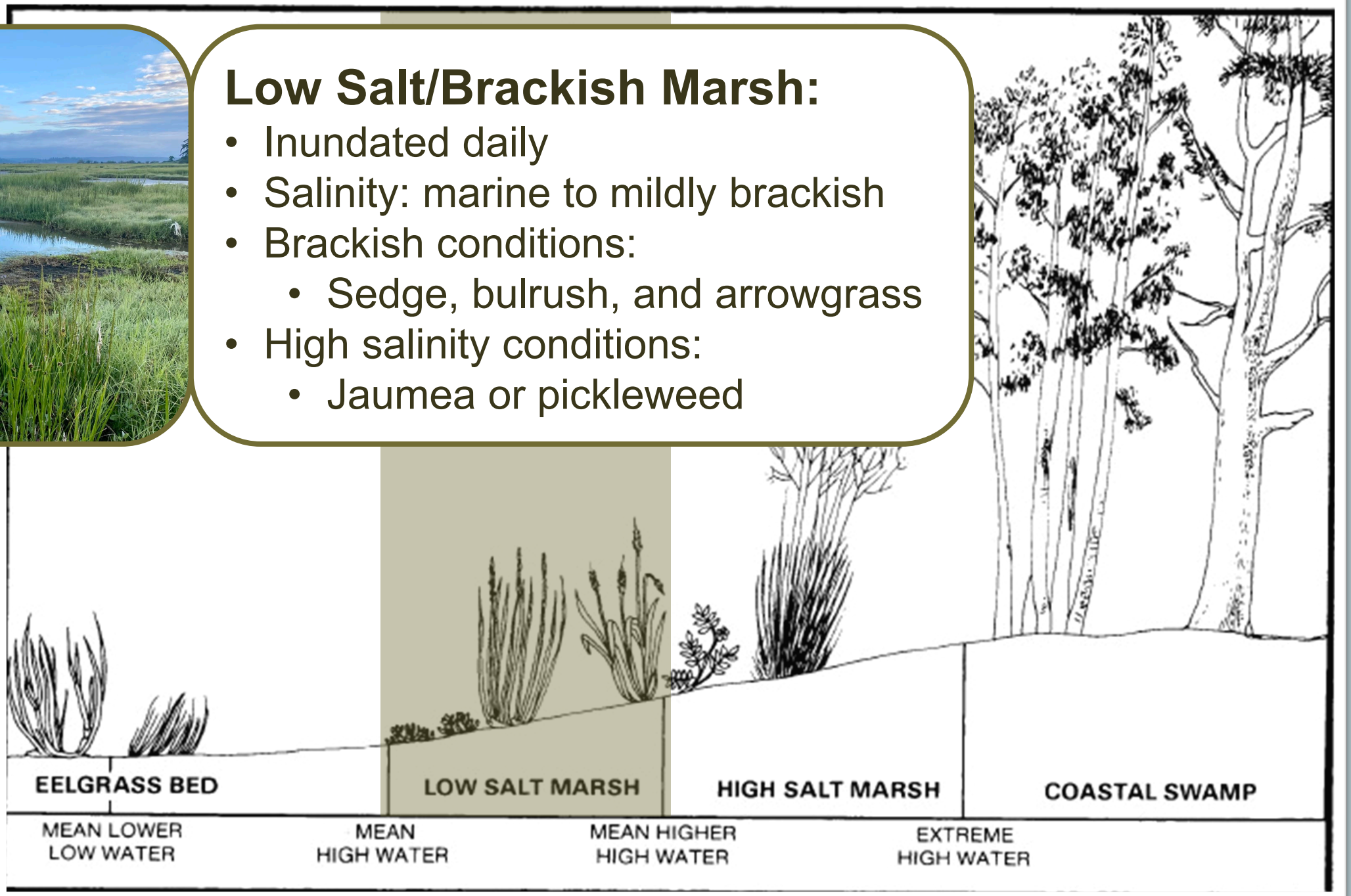
May 1- June 30

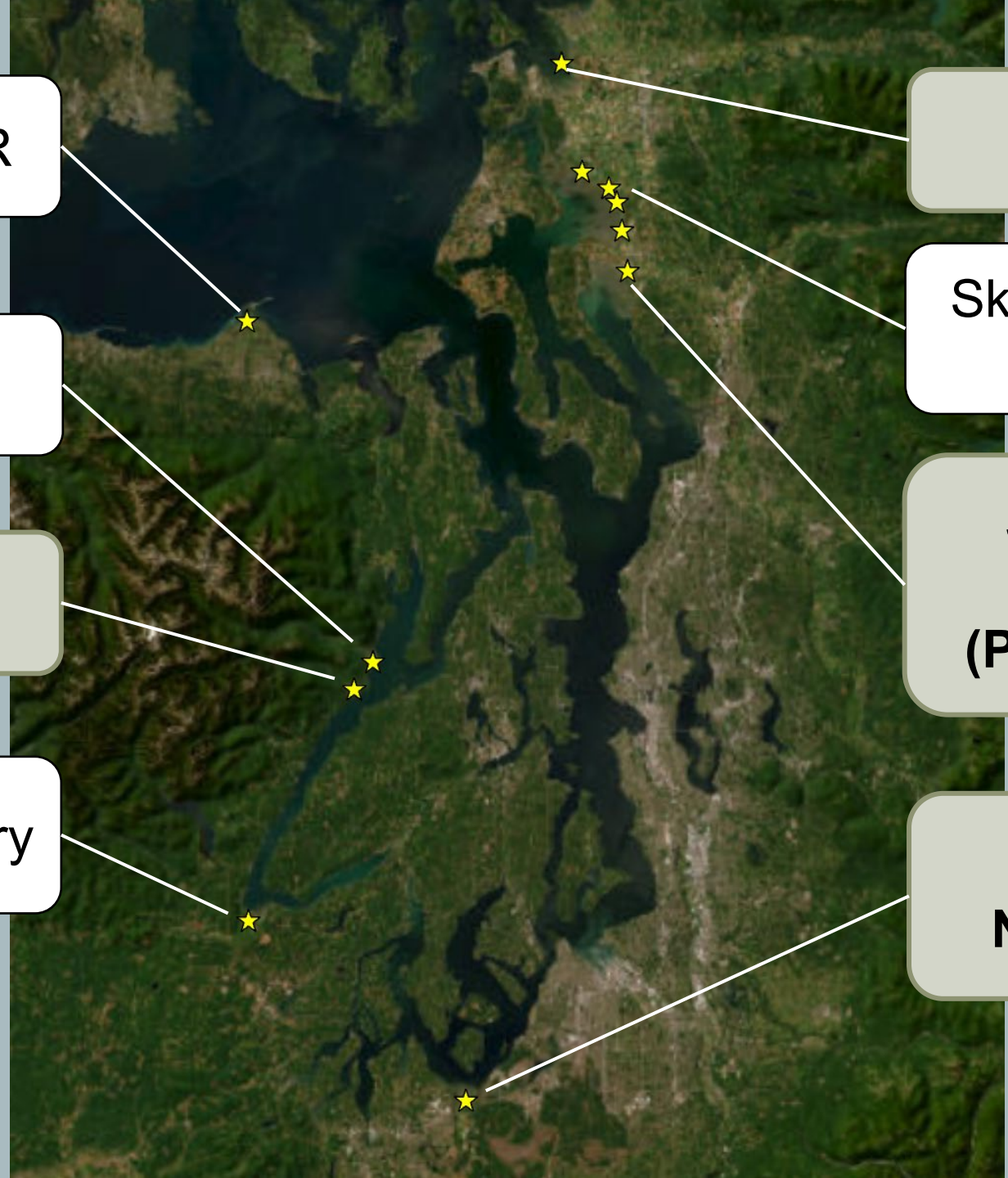
Point Count



Low Salt/Brackish Marsh:

- Inundated daily
- Salinity: marine to mildly brackish
- Brackish conditions:
  - Sedge, bulrush, and arrowgrass
- High salinity conditions:
  - Jaumea or pickleweed





Dungeness NWR

Dosewallips Estuary

Duckabush Estuary

Skokomish Estuary

Padilla Bay

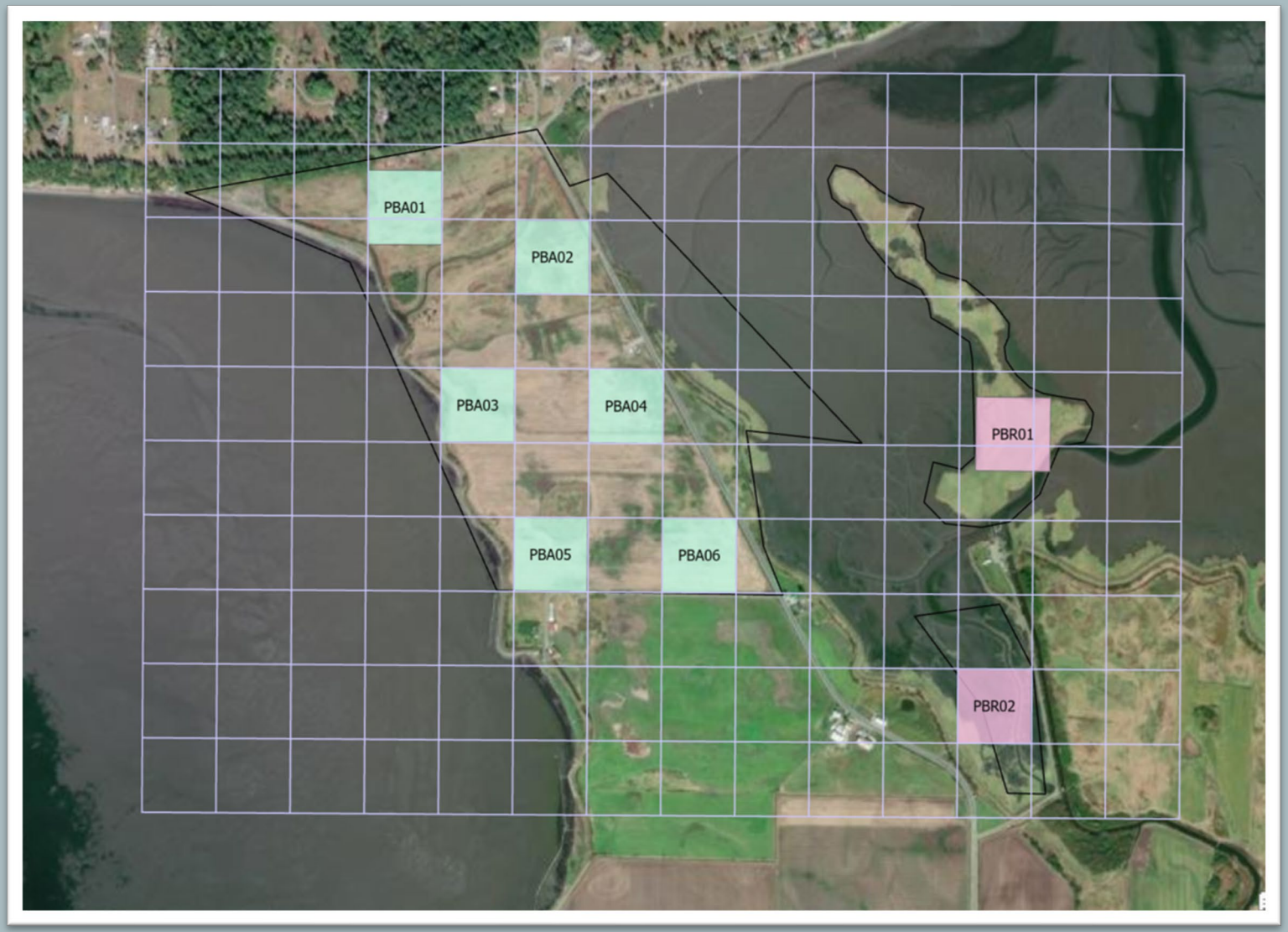
Skagit Wildlife Area (5 sites)

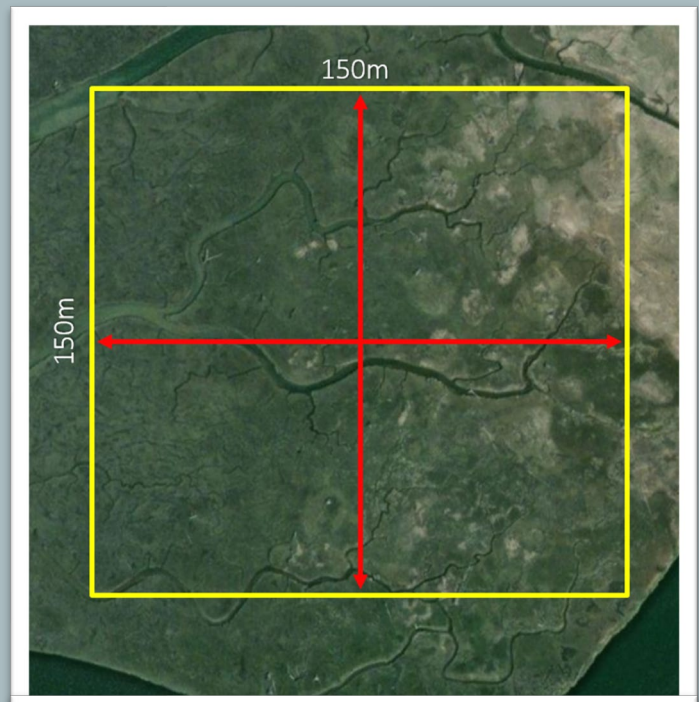
Stillaguamish Estuary (Port Susan Bay)

Billy Frank Jr. Nisqually NWR

ECOSTUDIES INSTITUTE

Site Selection & Sampling

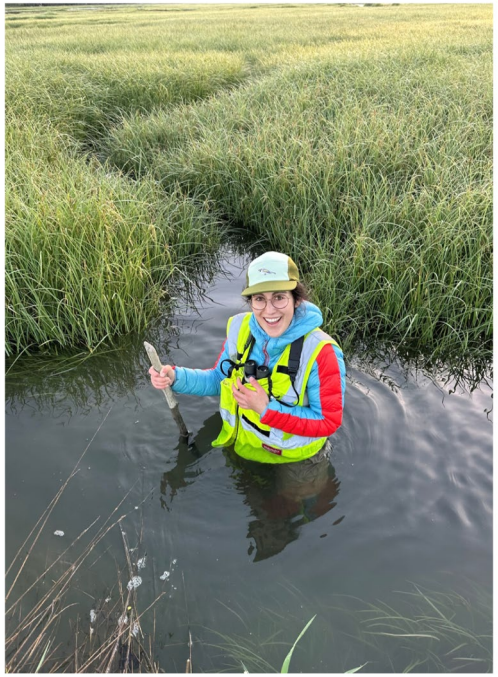


















403 surveys (2024) and 389 surveys (2025)

20,000 birds (2024) and 13,000 birds (2025)

77 species (2024) and 84 species (2025)



1,100 Barn Swallow



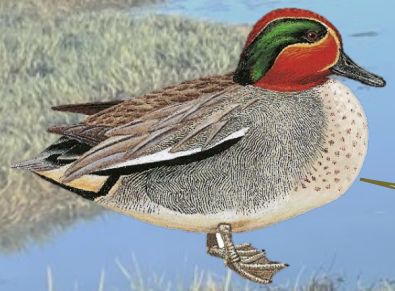
1,100 Marsh Wren

1,800 Dunlin



1,500 Least Sandpiper





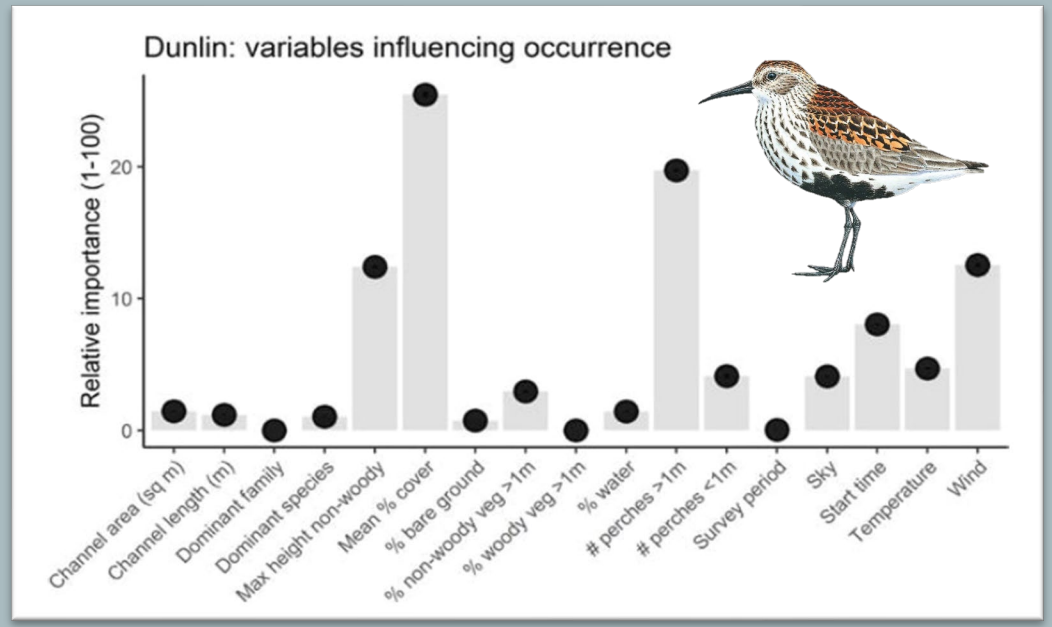
5,500 Green-winged Teal

Data Analysis

Bird occurrence/abundance ~ vegetation and environmental variables

Boosted regression trees (BRT)

- Machine learning approach
- Ideal for curvilinear, complex ecological relationships

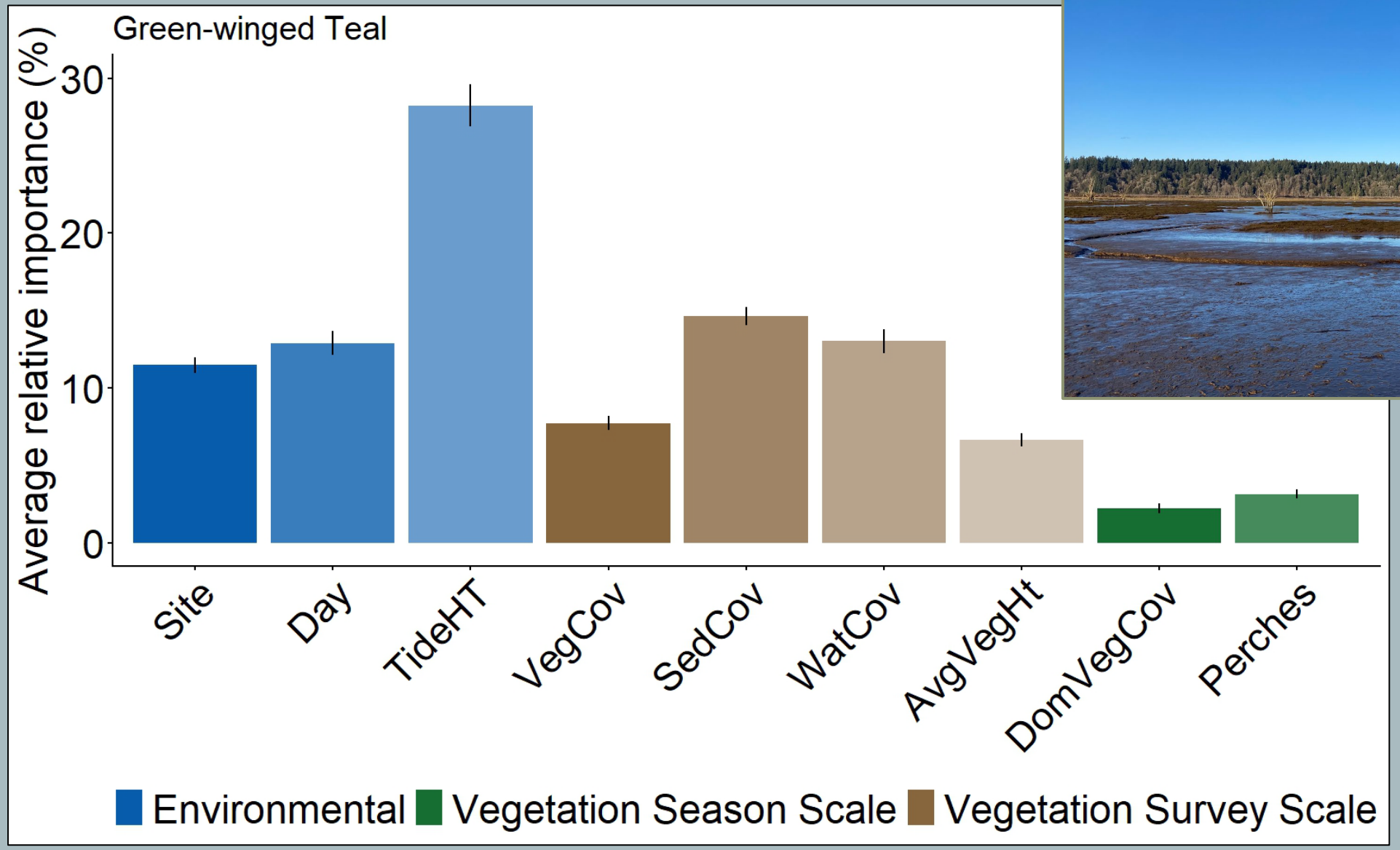


Covariates
Average vegetation height
% cover bare ground/vegetation/water
Tide height (ft)
Site
Salinity
Elevation
Channel structure (density, area, complexity)
Dominant vegetation type
% non-woody vegetation (>1m and <1m)
% woody vegetation (>1m and <1m)
# perches/roost structures (>1m and <1m)
Max height of non-woody vegetation
Date/Season



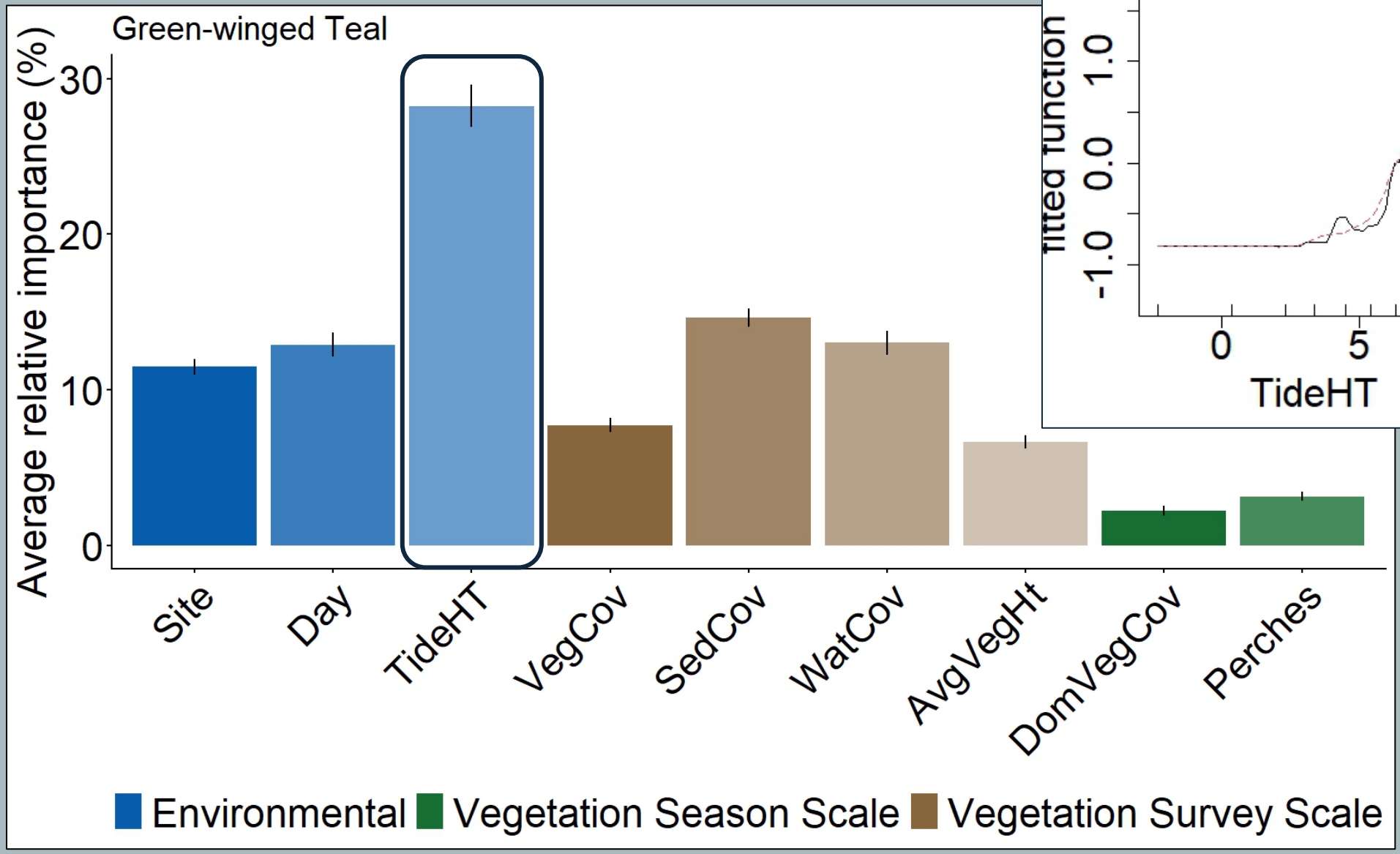
Green-winged teal abundance driven by tide height and % cover mudflat and water

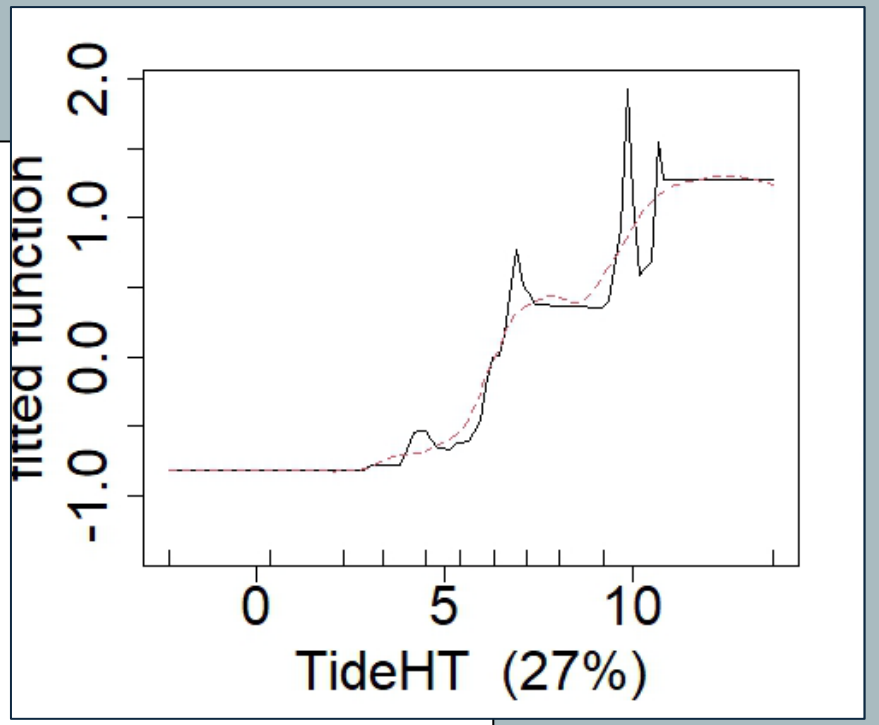






Green-winged teal abundance was associated with…
higher tides

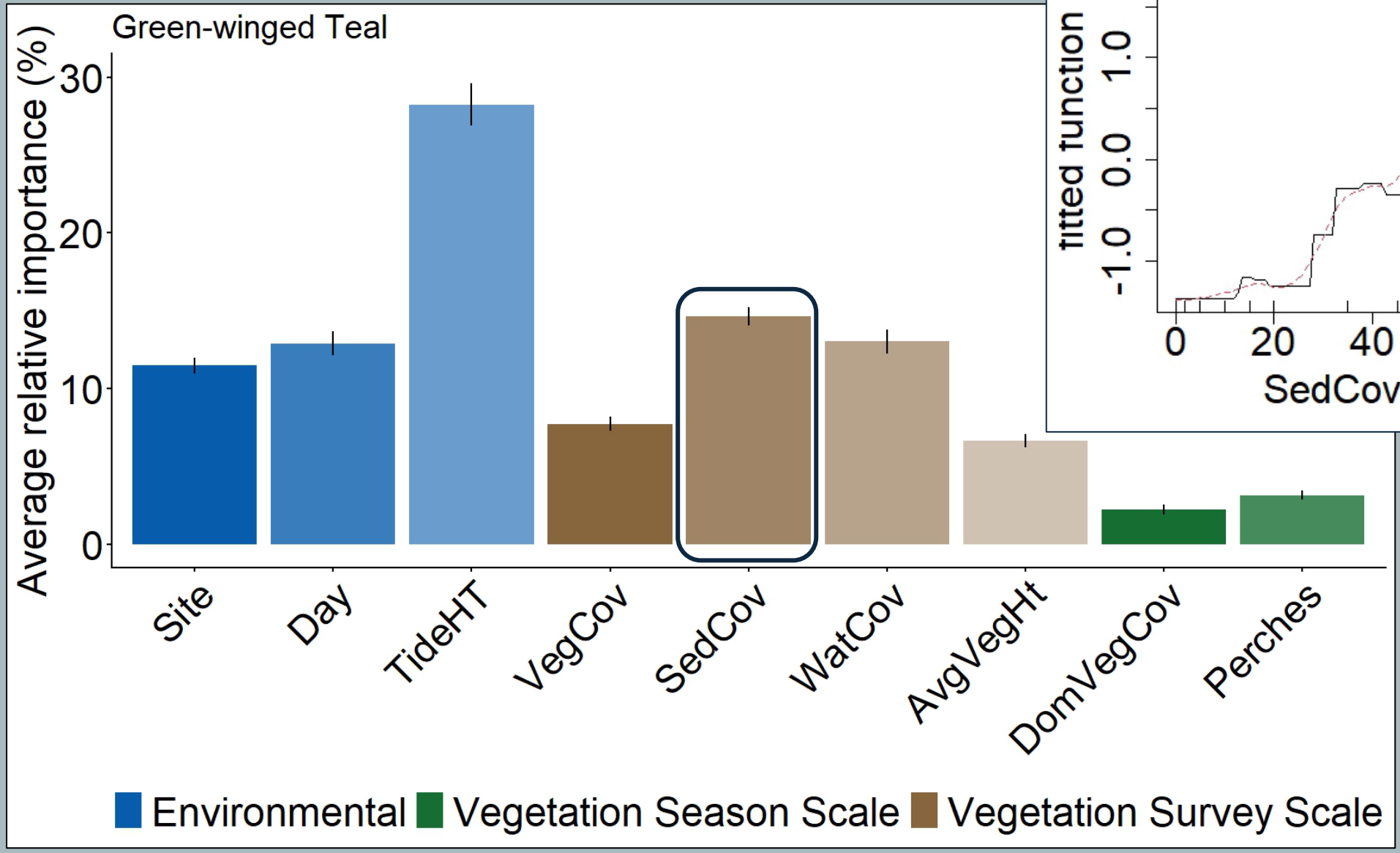


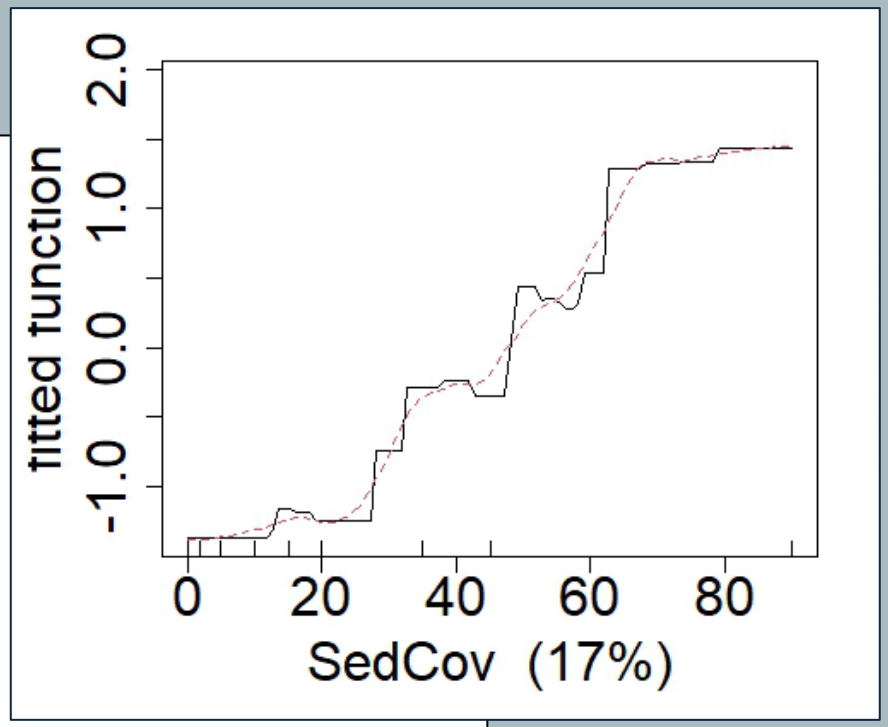






Green-winged teal abundance was associated with…
more exposed mudflat



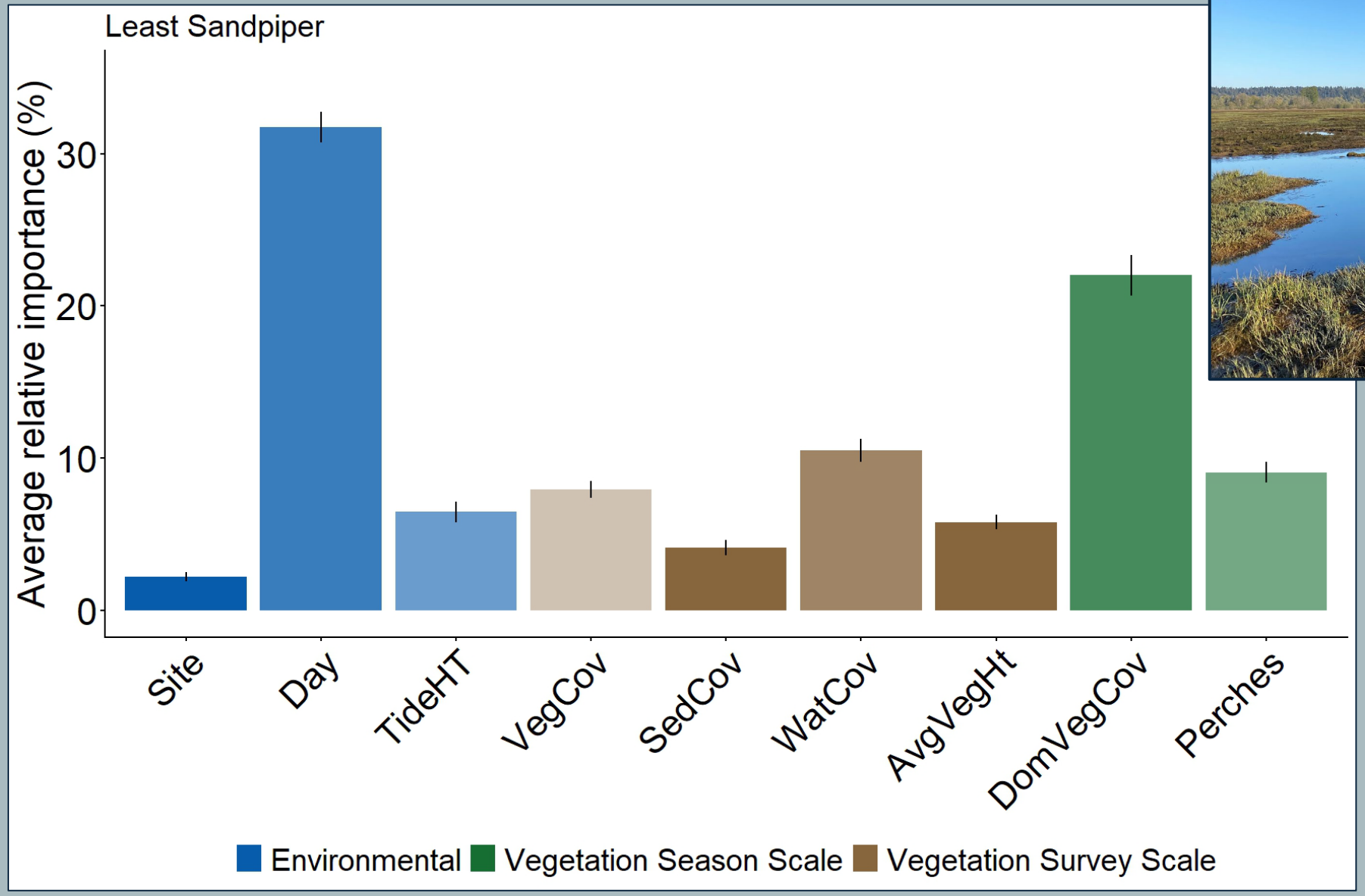






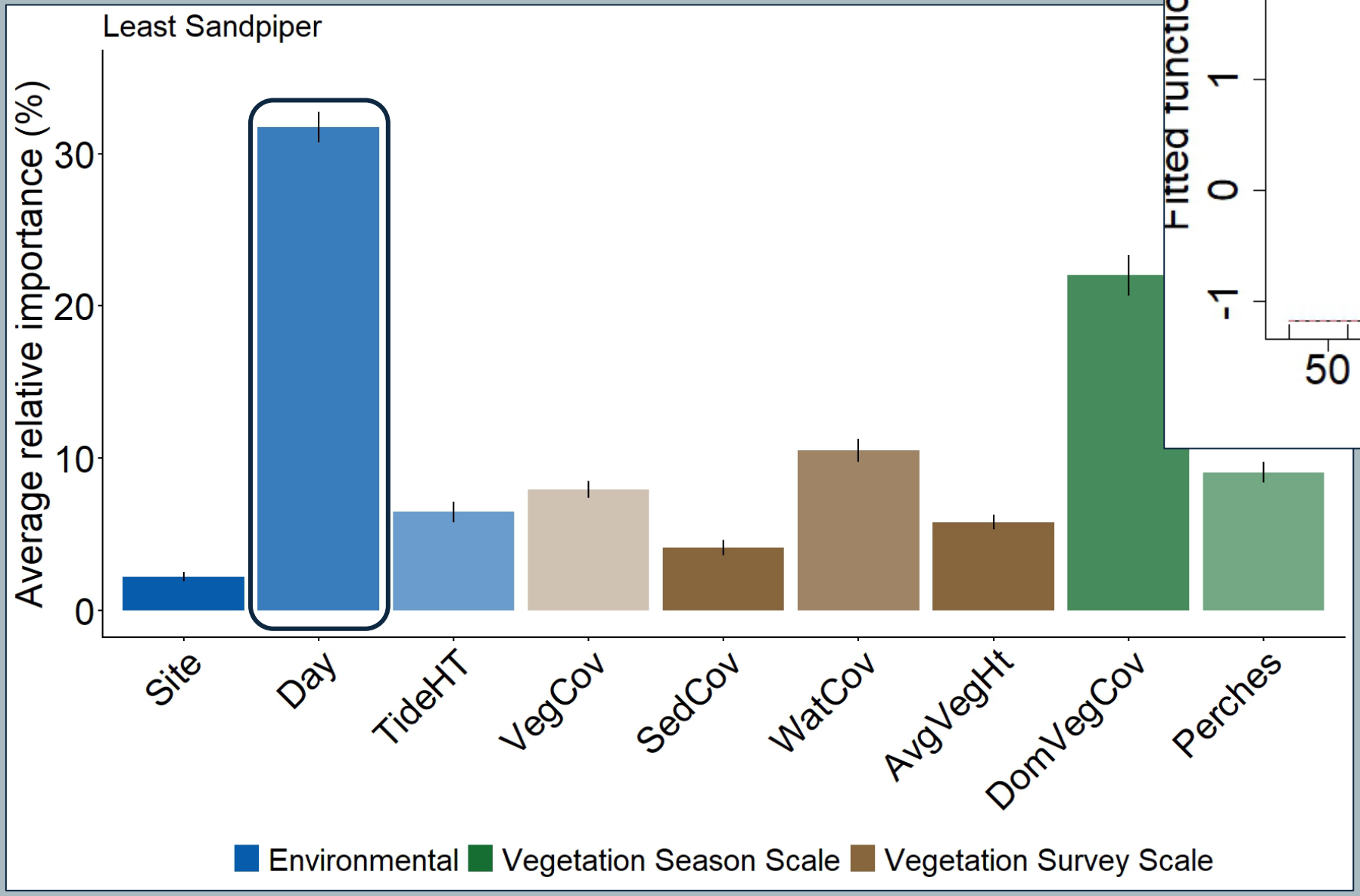
Least sandpiper abundance driven by day and % cover of the dominant vegetation type

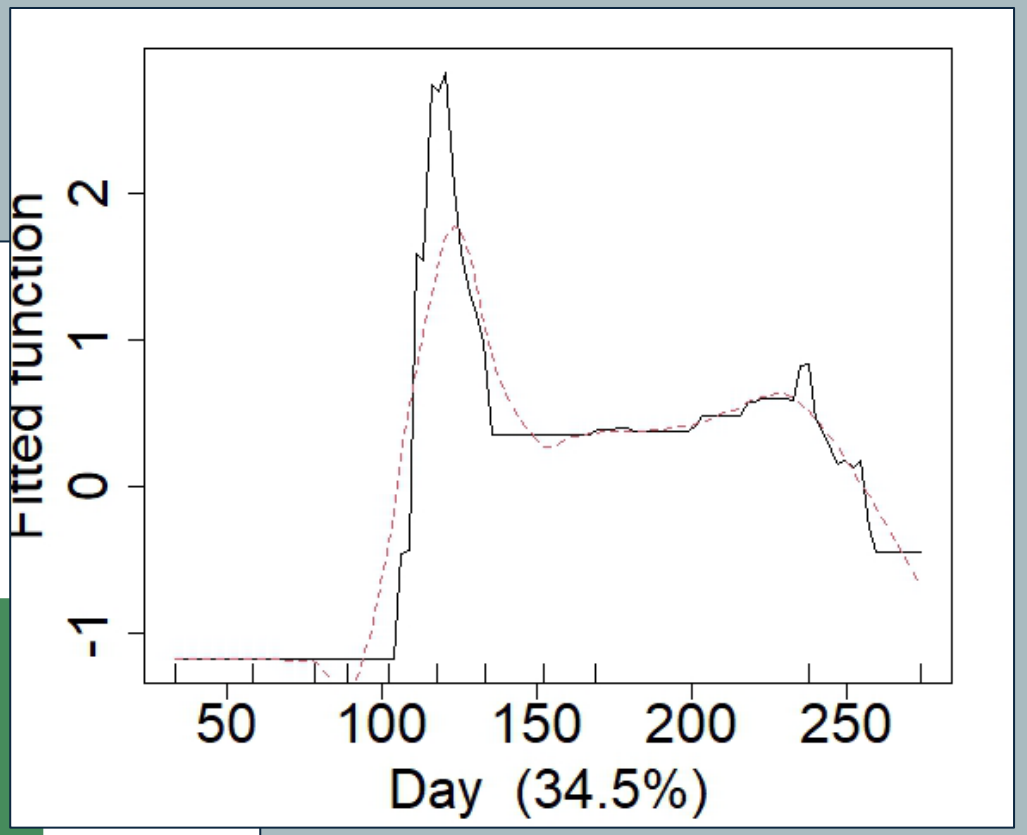






Least sandpiper abundance… **peaked in spring and fall**

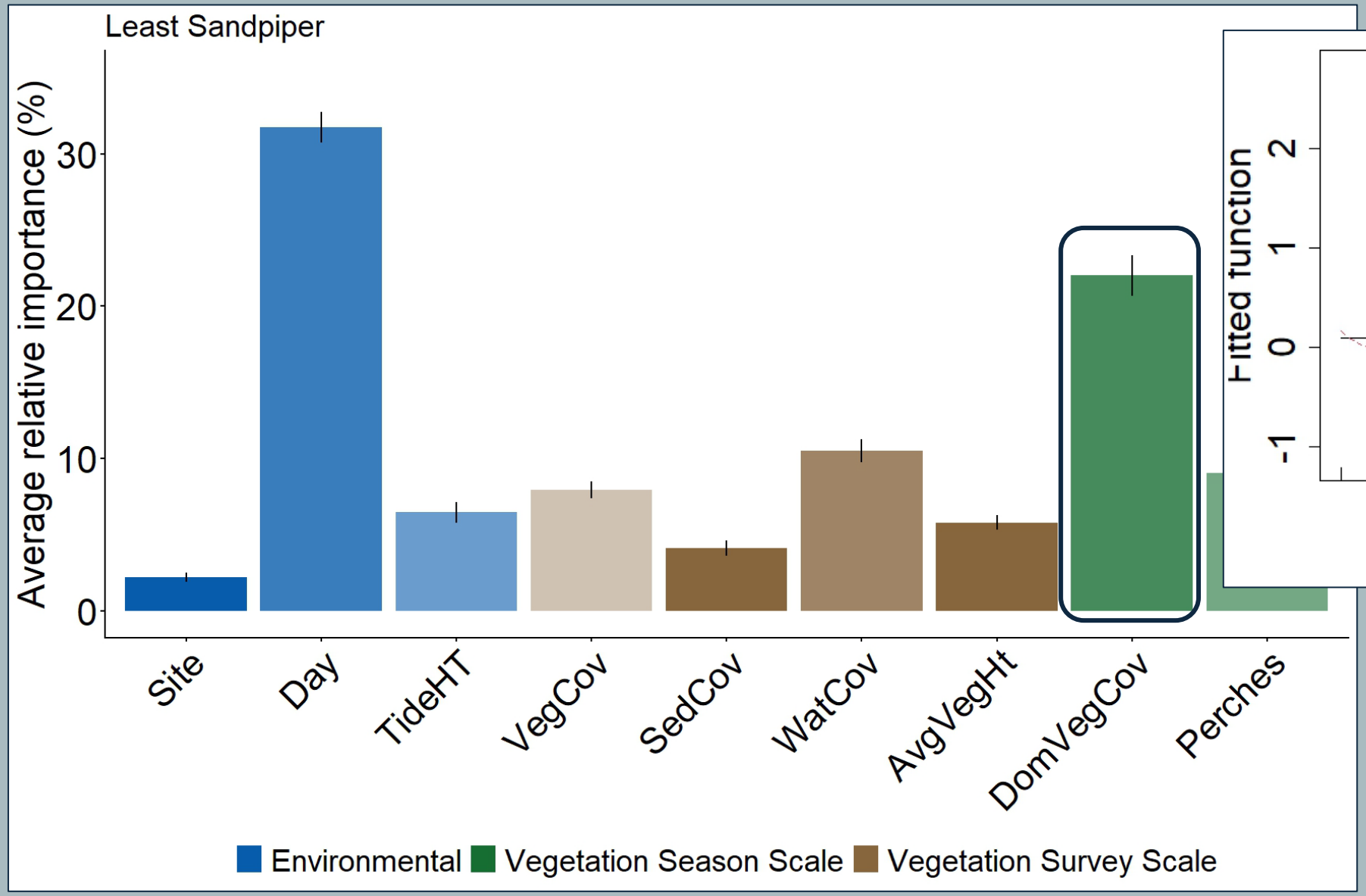


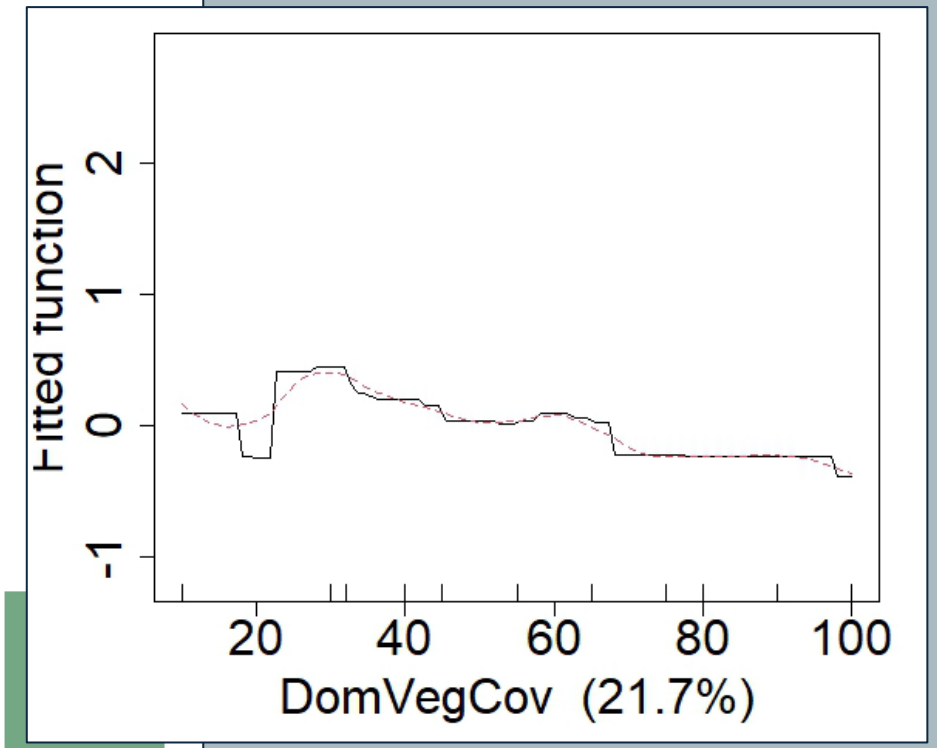






Least sandpiper abundance was associated with…
low % cover of the dominant vegetation type

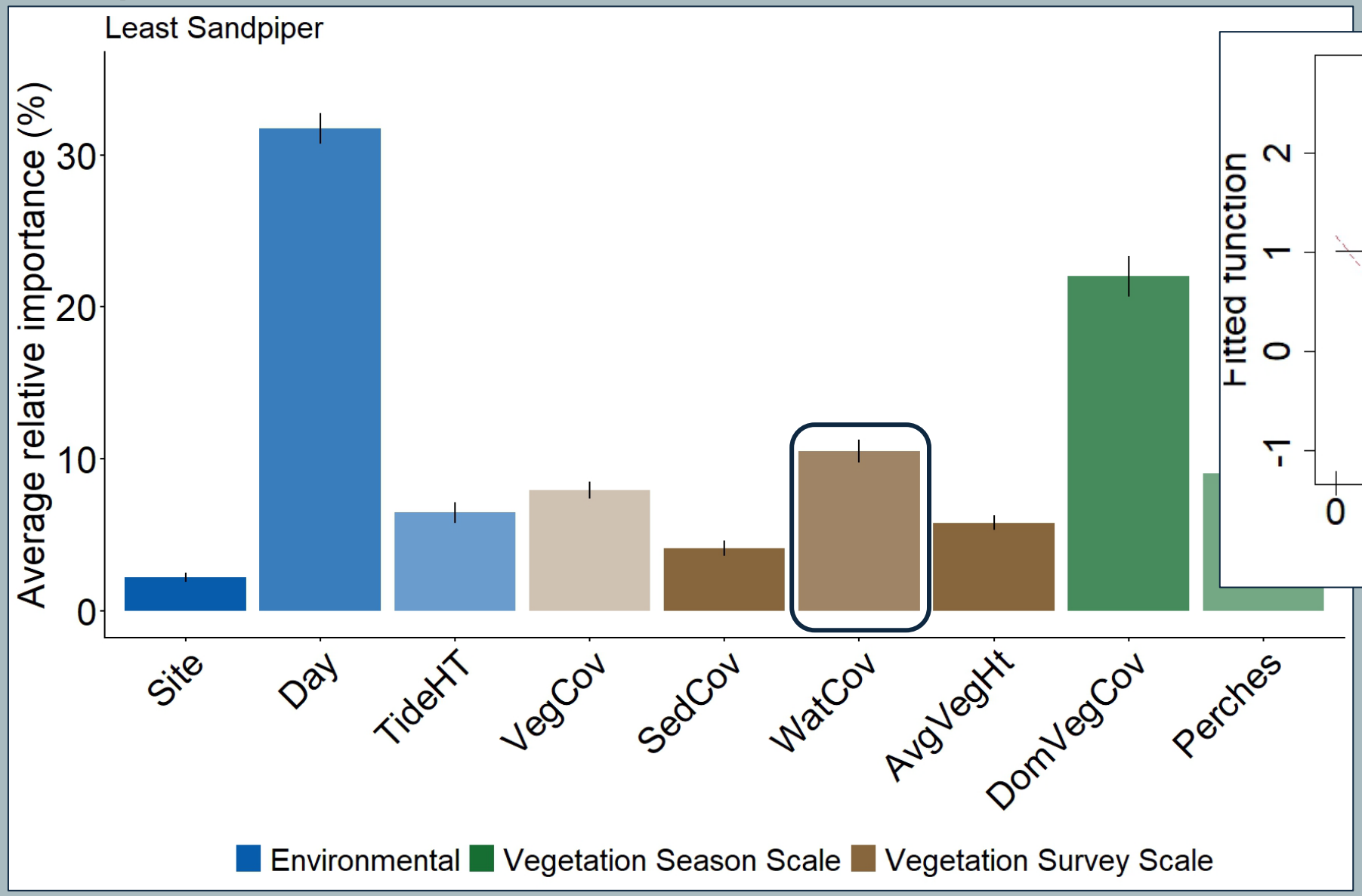


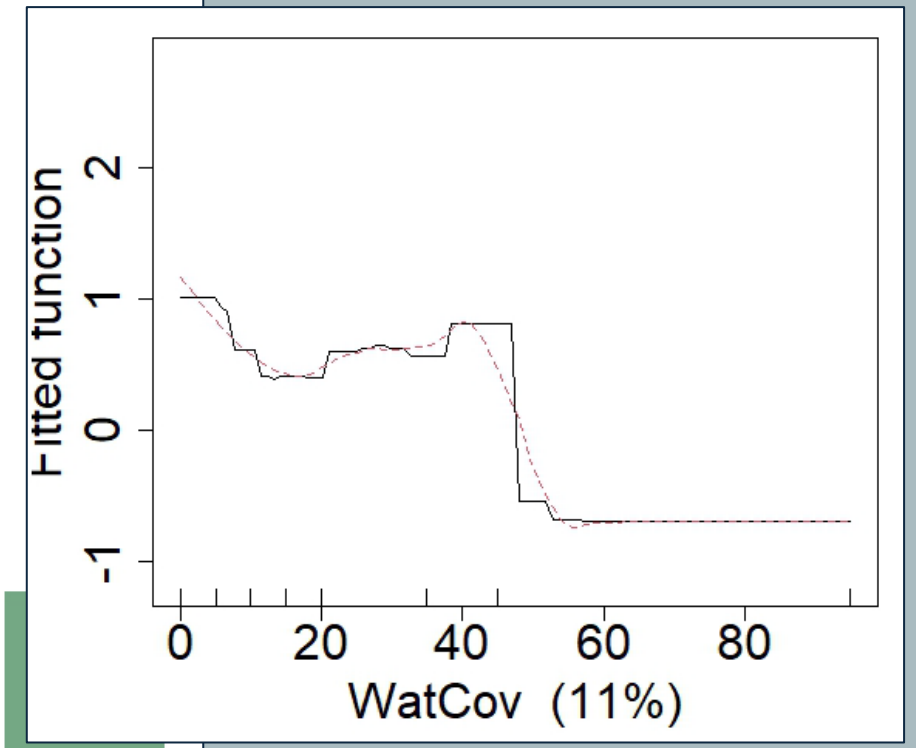






Least sandpiper abundance was associated with…
less than 50% water cover

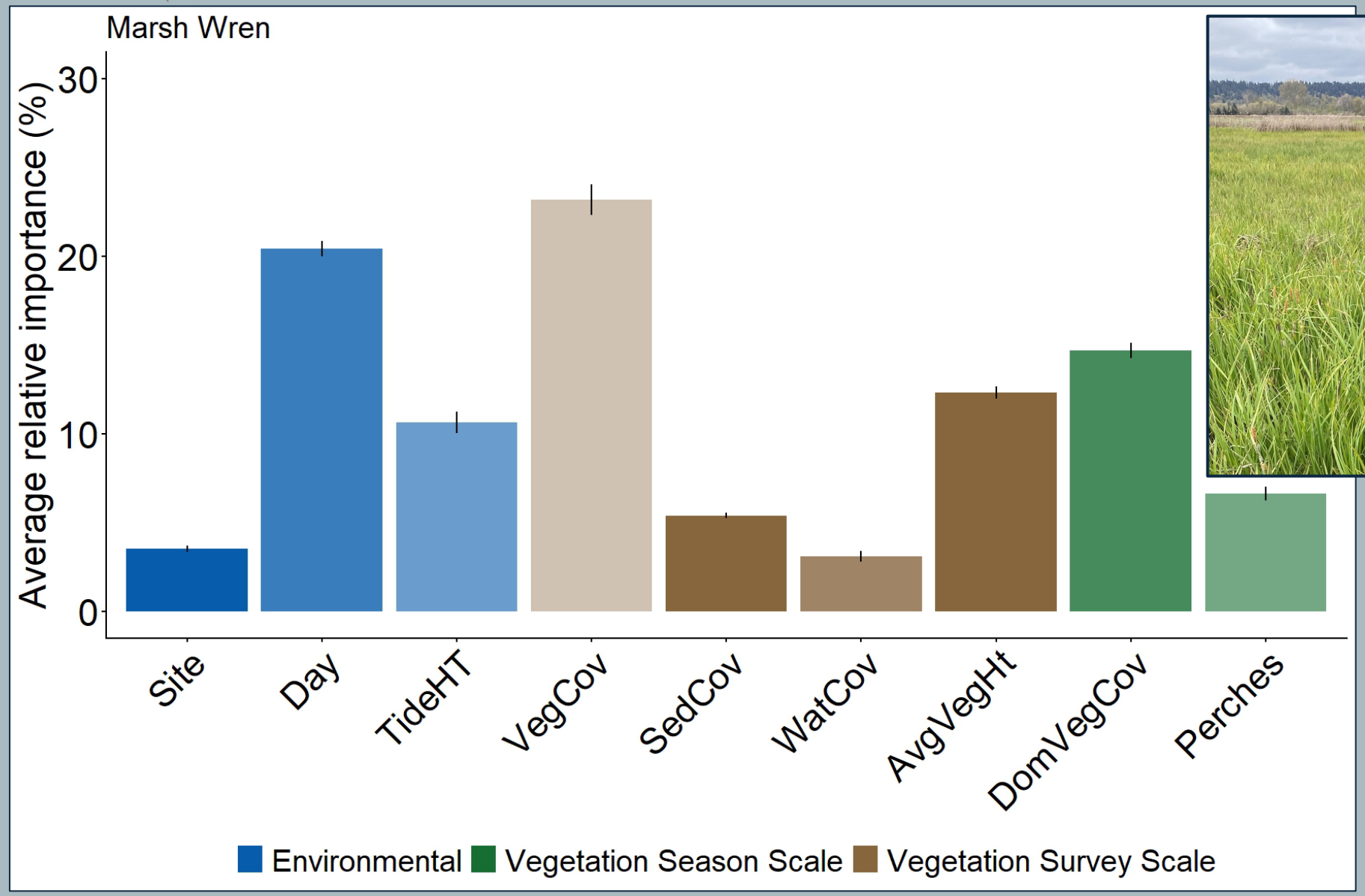








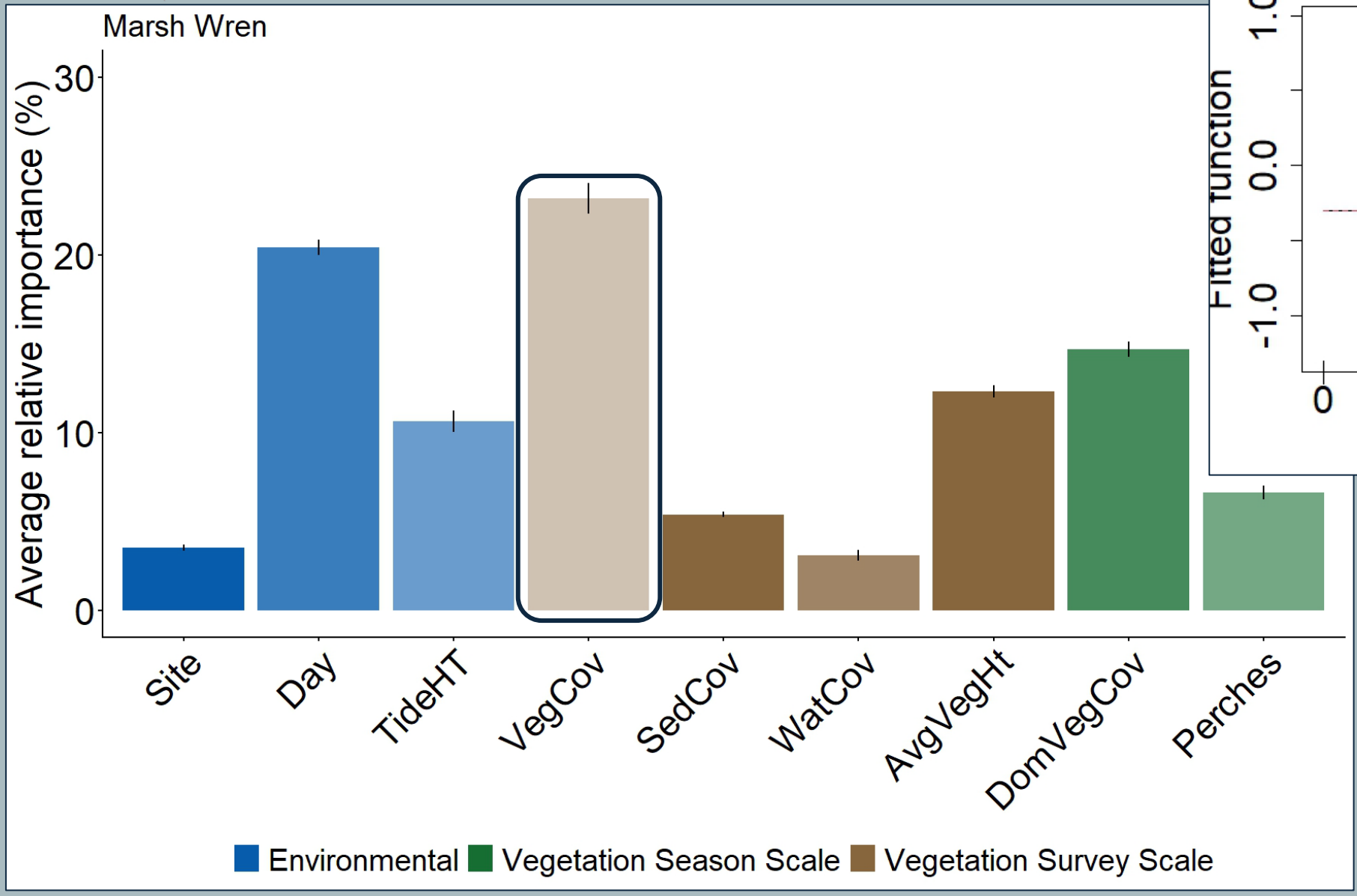
Marsh wren abundance driven by day, % cover of non-woody vegetation, dominant vegetation type, and vegetation height

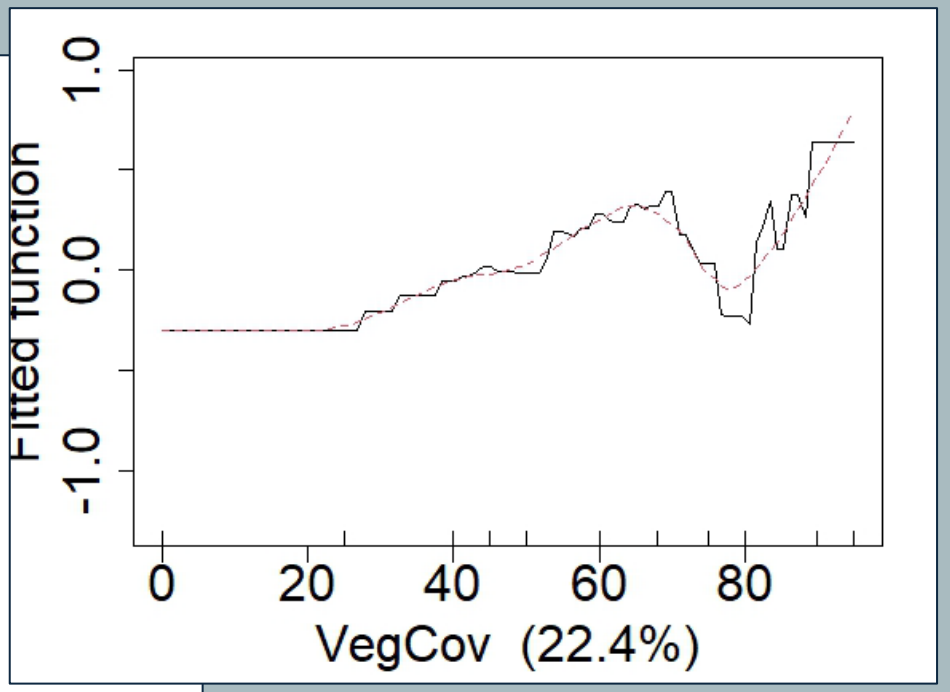






Marsh wren abundance was associated with…
high non-woody vegetation cover

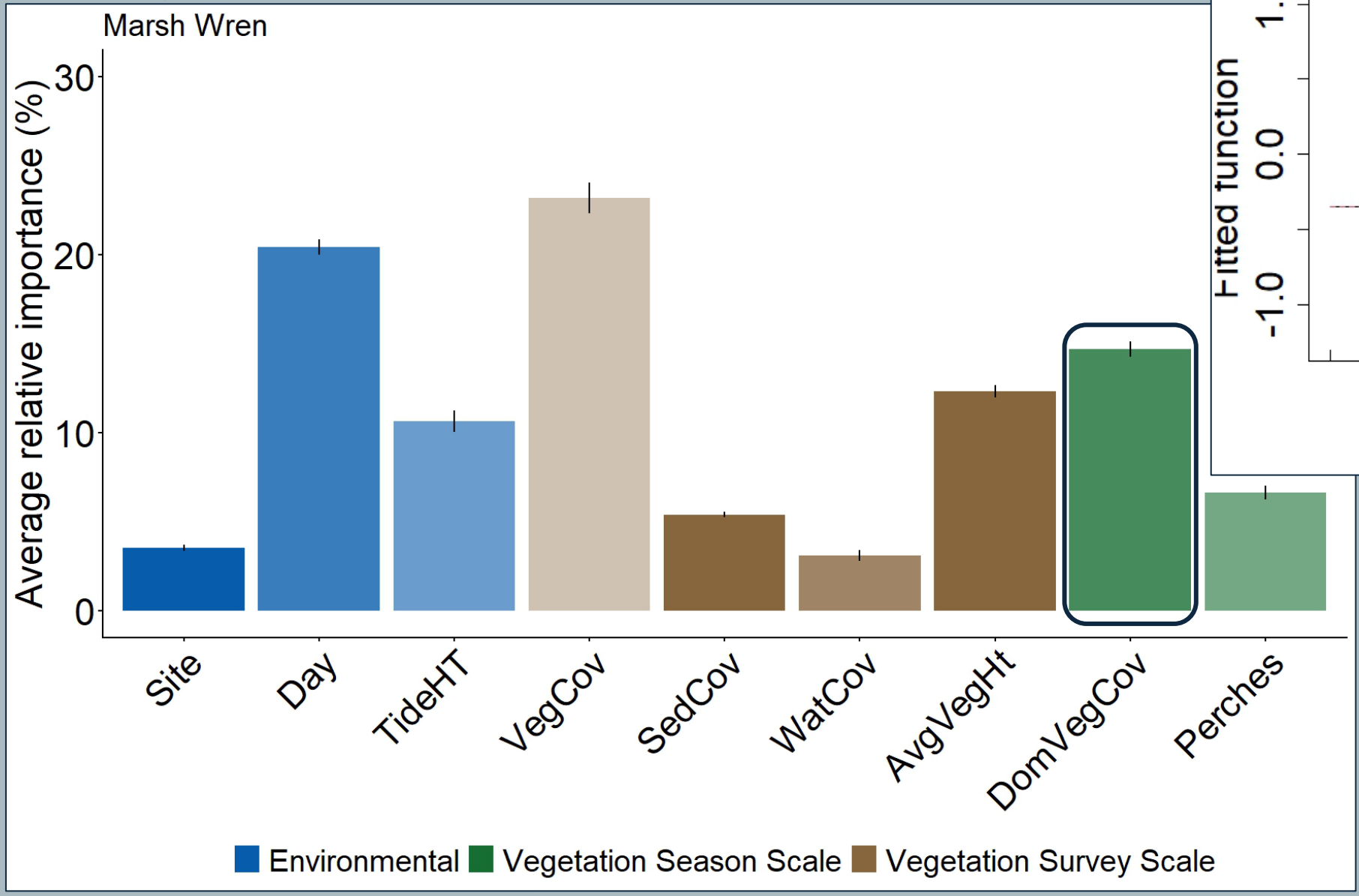


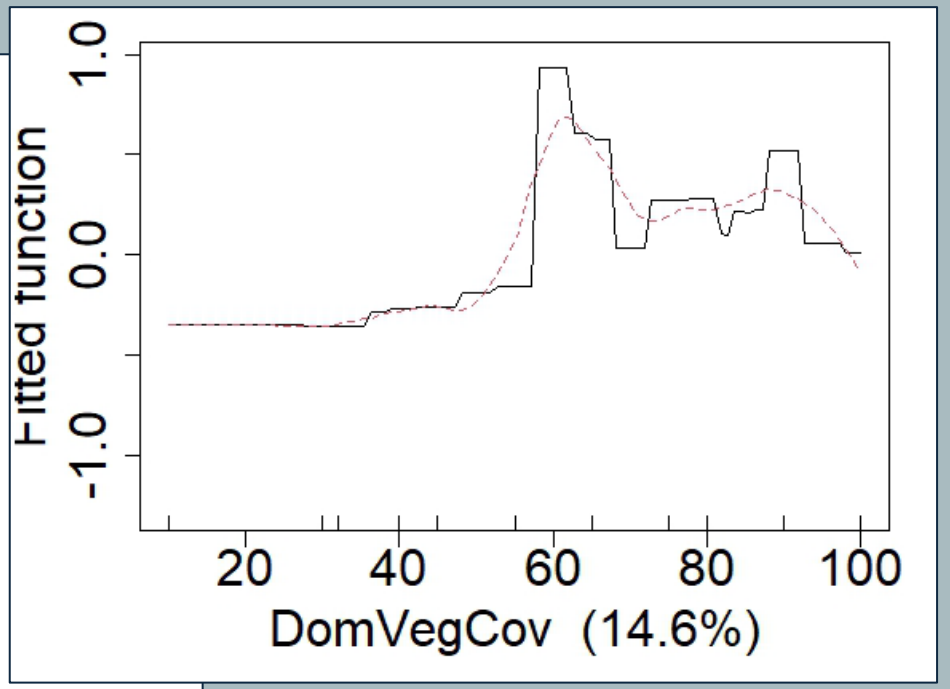






Marsh wren abundance was associated with…
high dominant vegetation cover

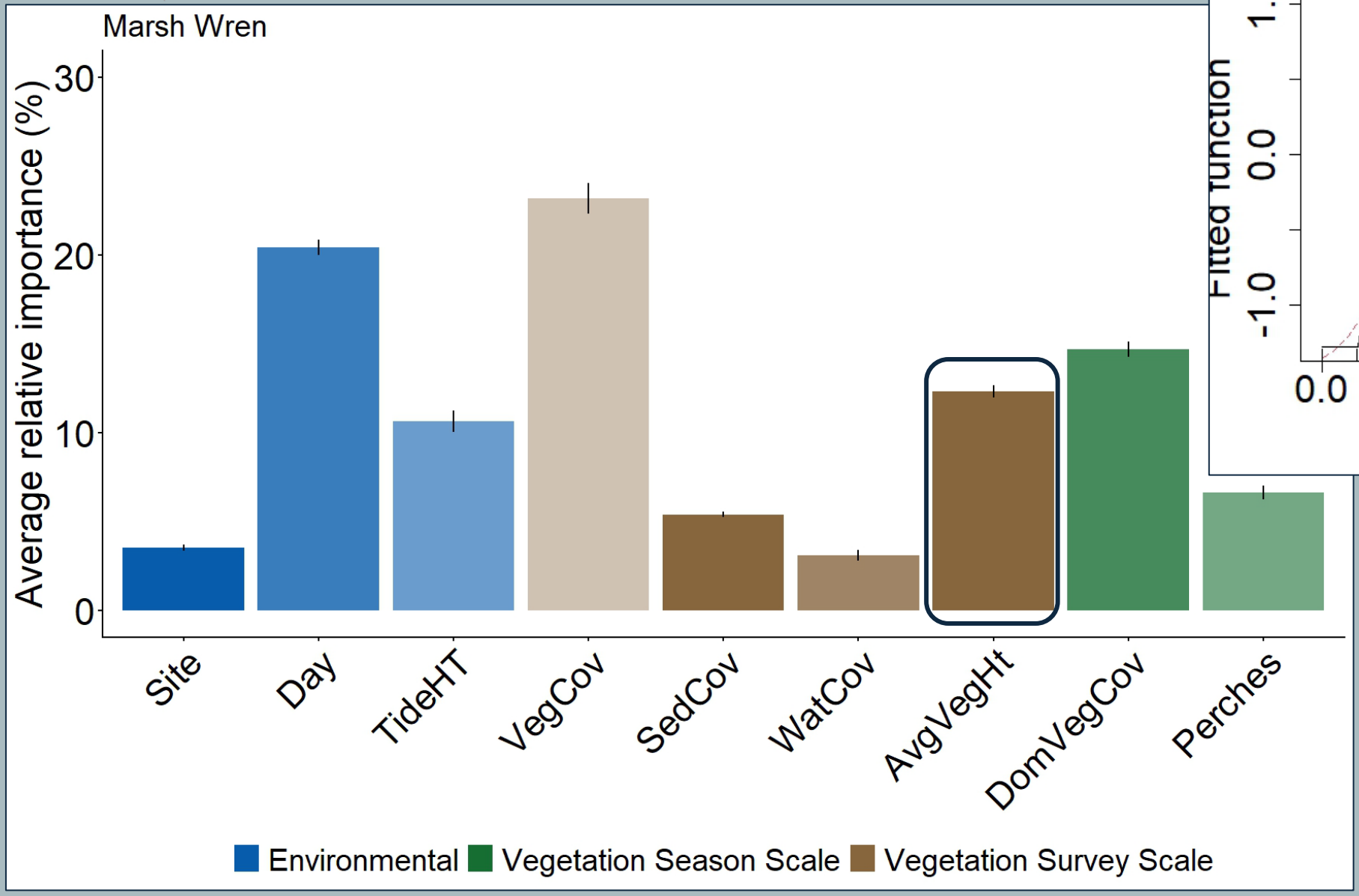


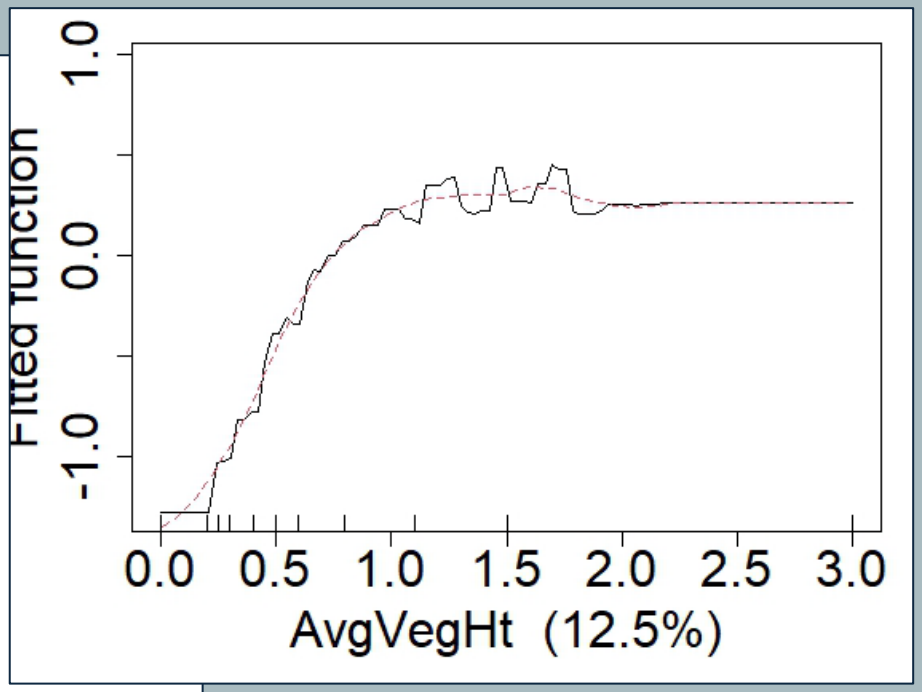






Marsh wren abundance was associated with… **average vegetation height of over 0.5 meters**







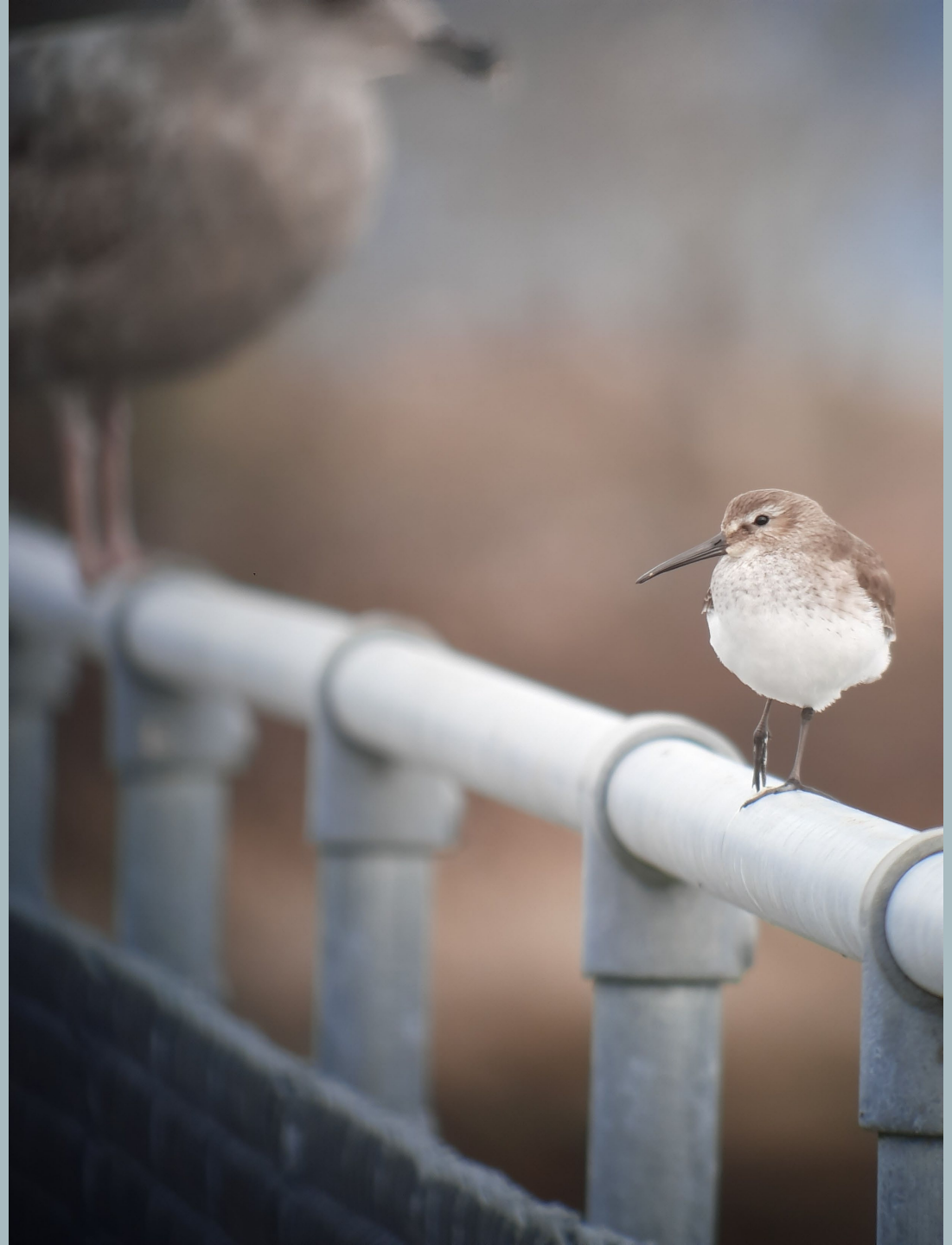


Conclusions

- Seasonal fluctuations and tides are strong predictors
- Within-guild species-specific habitat niches
- Diverse vegetation composition
- Channel characteristics may be key

Future Directions

- 2026 & 2027 – surveys across 11+ sites
- Collect 3-5 years of data across sites
- Incorporate channel data & other environmental covariates
- Analyze full suite of focal species and guilds





Questions?

Funding for this project was provided by the WDFW Estuary and Salmon Restoration Program (ESRP), Puget Sound Partnership Monitoring to Accelerate Recovery (MAR) Program, Pacific Birds Habitat Joint Venture Partnership Grants Program, and the Stillaguamish Tribe.

