

Assessing Coastal Dune Lake Health

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Overview



- Background
- Project Goals
- Methods
- Results



The Lakes



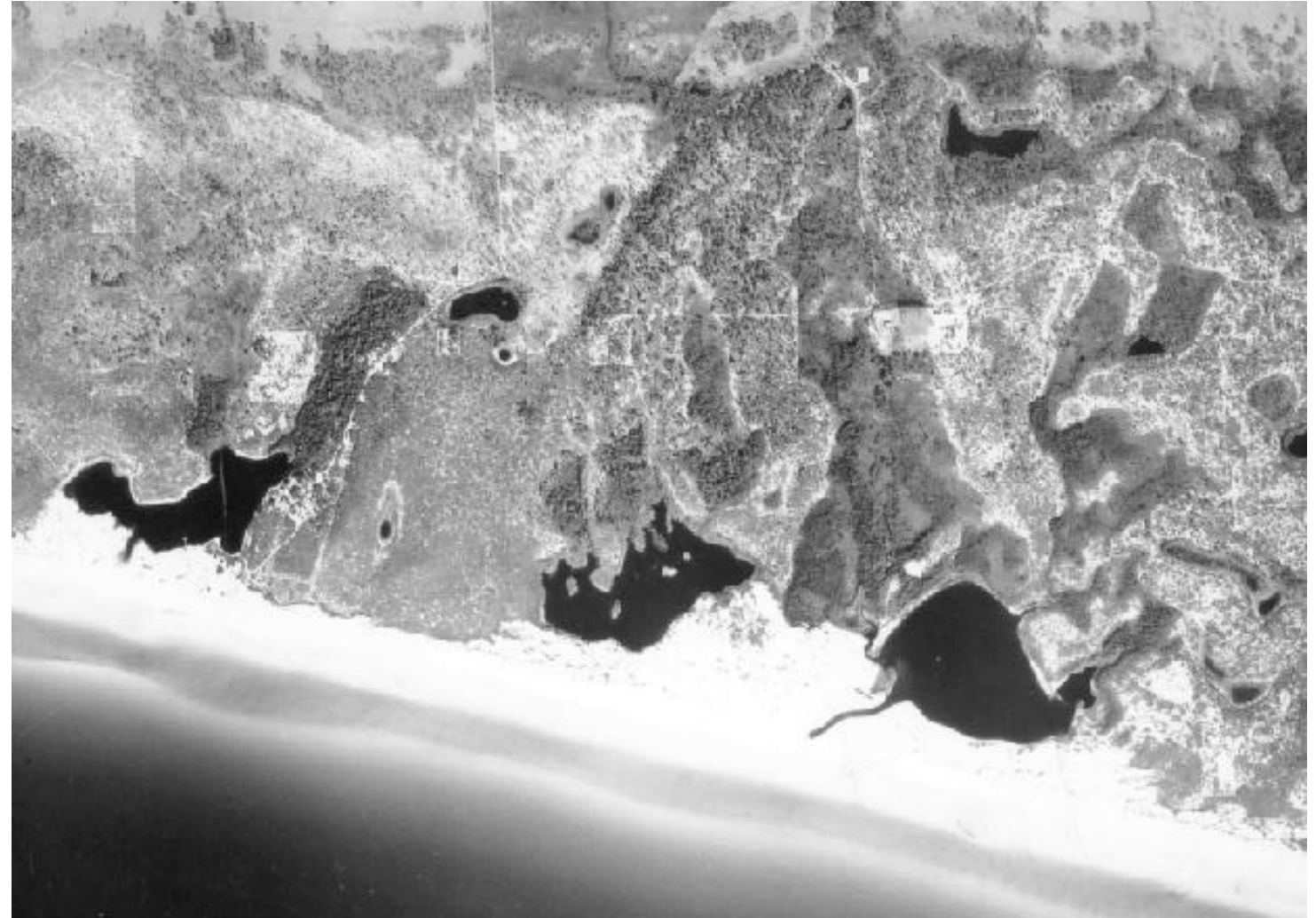
- Rare
- Dynamic
 - Rainfall
 - Connections to Gulf
- Beautiful Landscape
 - Attracts visitors
 - Residences
- Constant Change



The Lakes - 1941



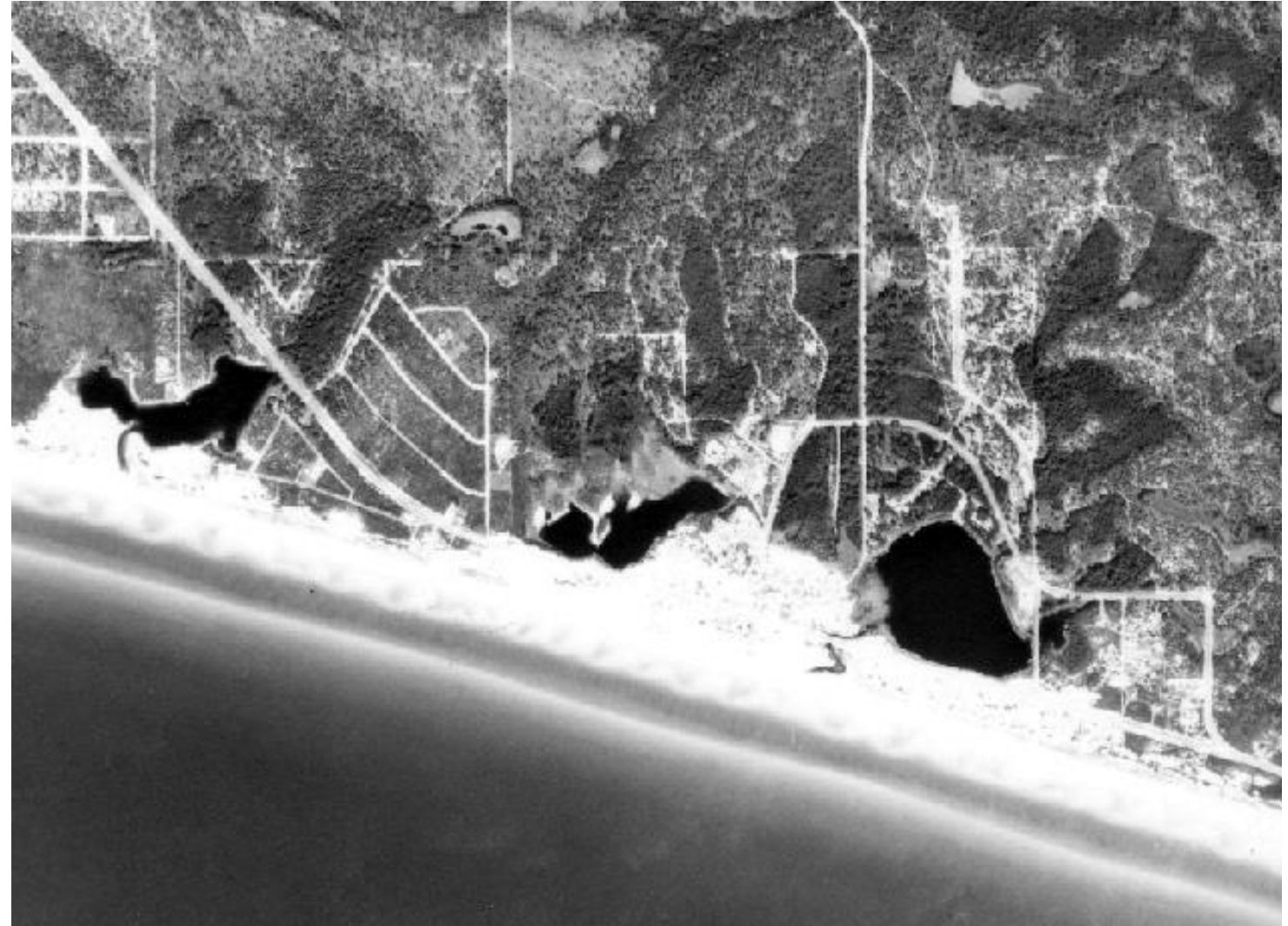
- Concerns about change
- Preservation
- Water Quality



The Lakes - 1969



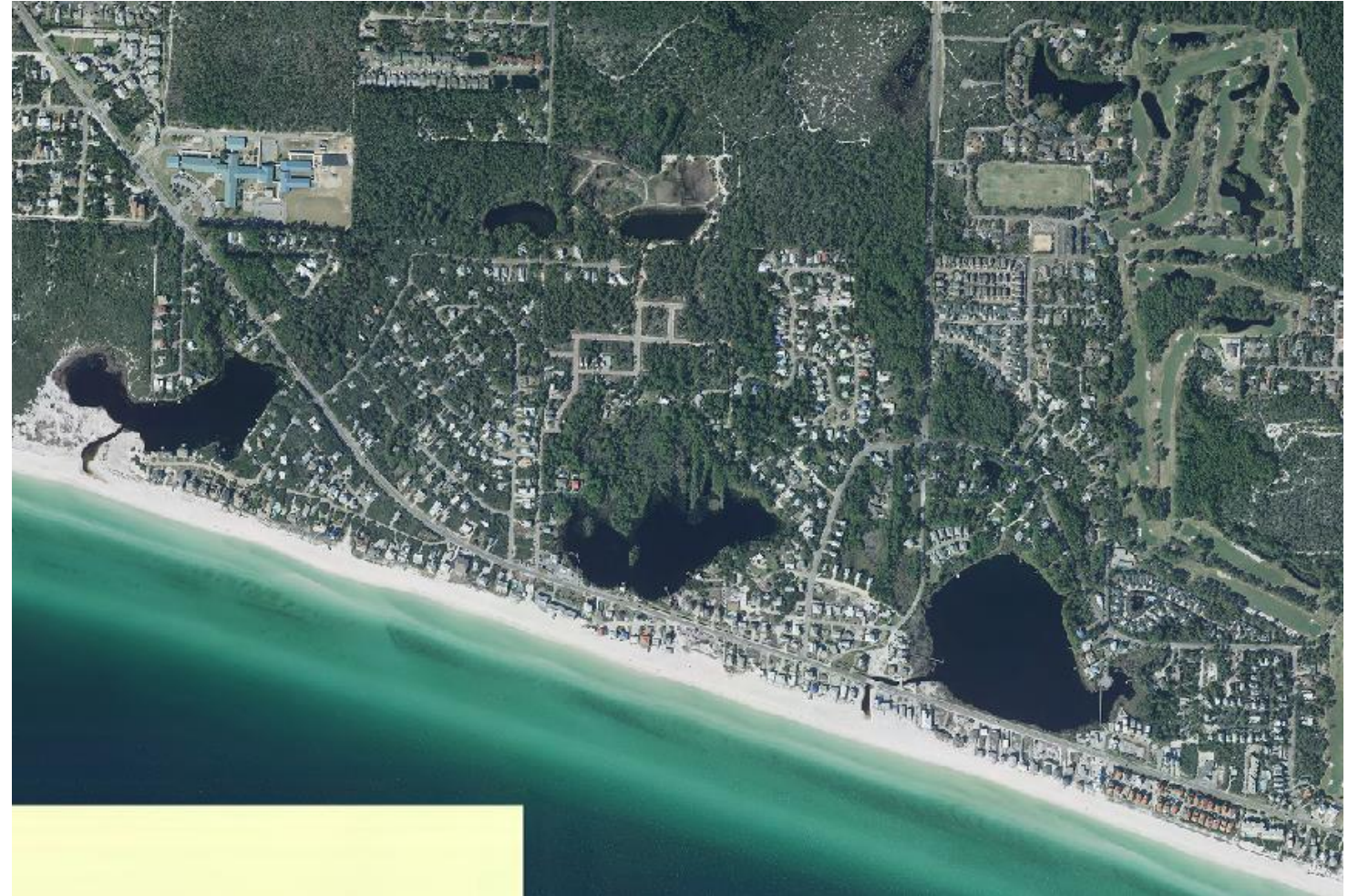
- Development over the last 50 – 60 years



The Lakes - 2016



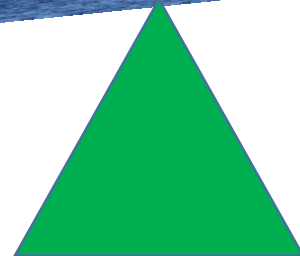
- Changes continue...



The Lakes



Finding balance between humans and nature



Project Goals



- Evaluate changes to Comp. Plan.
- Evaluate Current CDL conditions and relate them to watershed pollutant loading characteristics.
- Provide framework for assessing changes in CDLs.

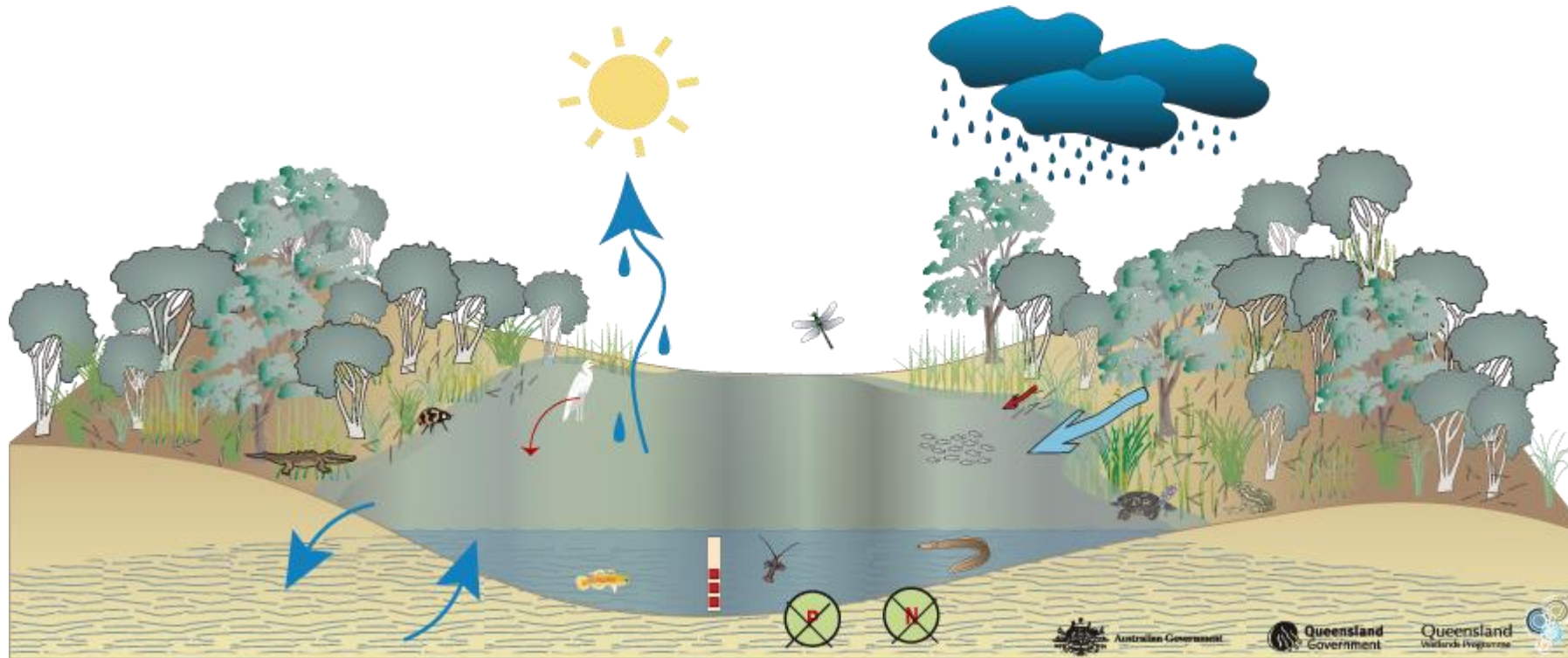


Methods



- Preliminary Data Analysis
- Additional Data Collection
- Data Analysis

- Future Scenario Modeling
- Stakeholder Meetings

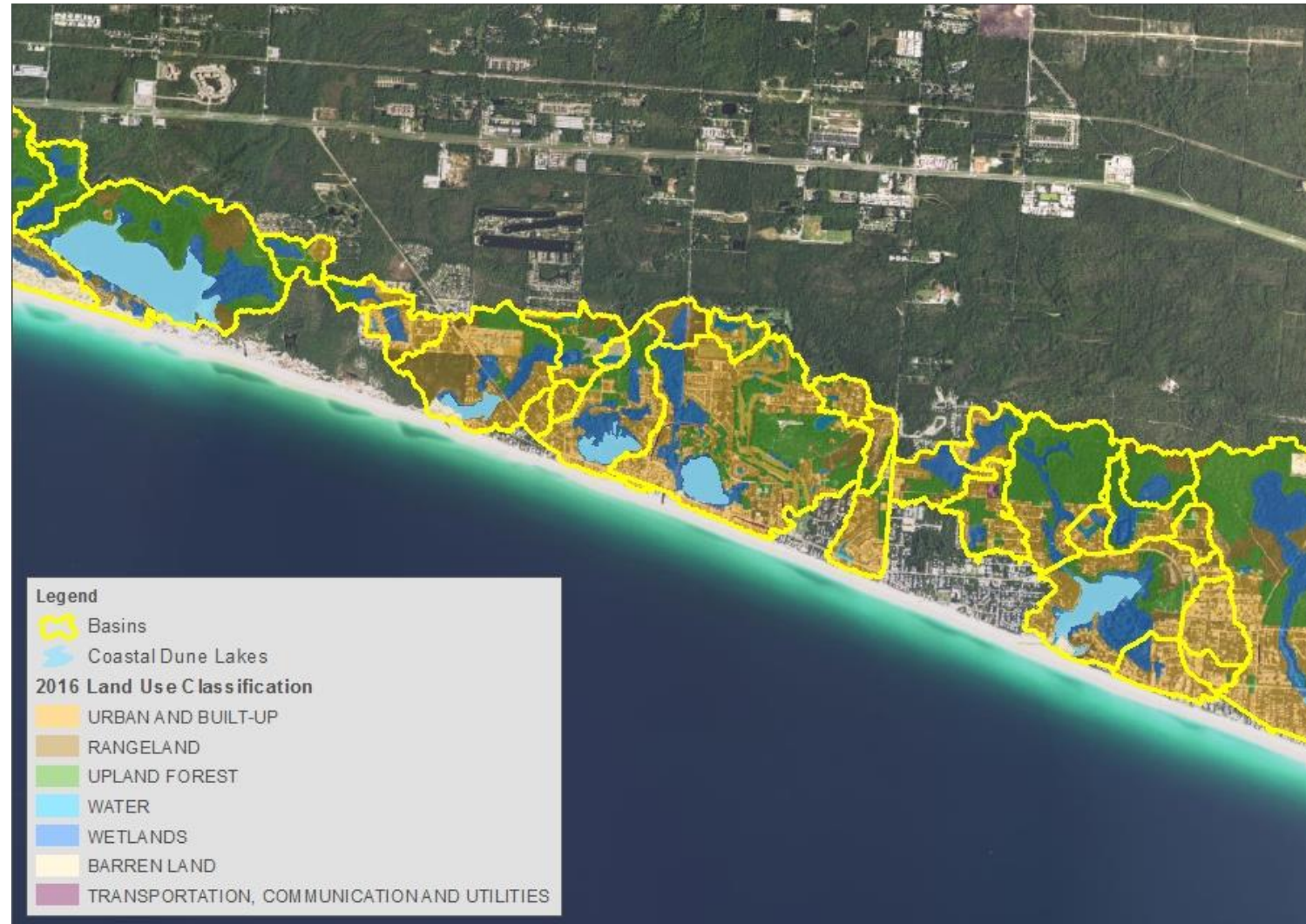


Pollutant Loading Model

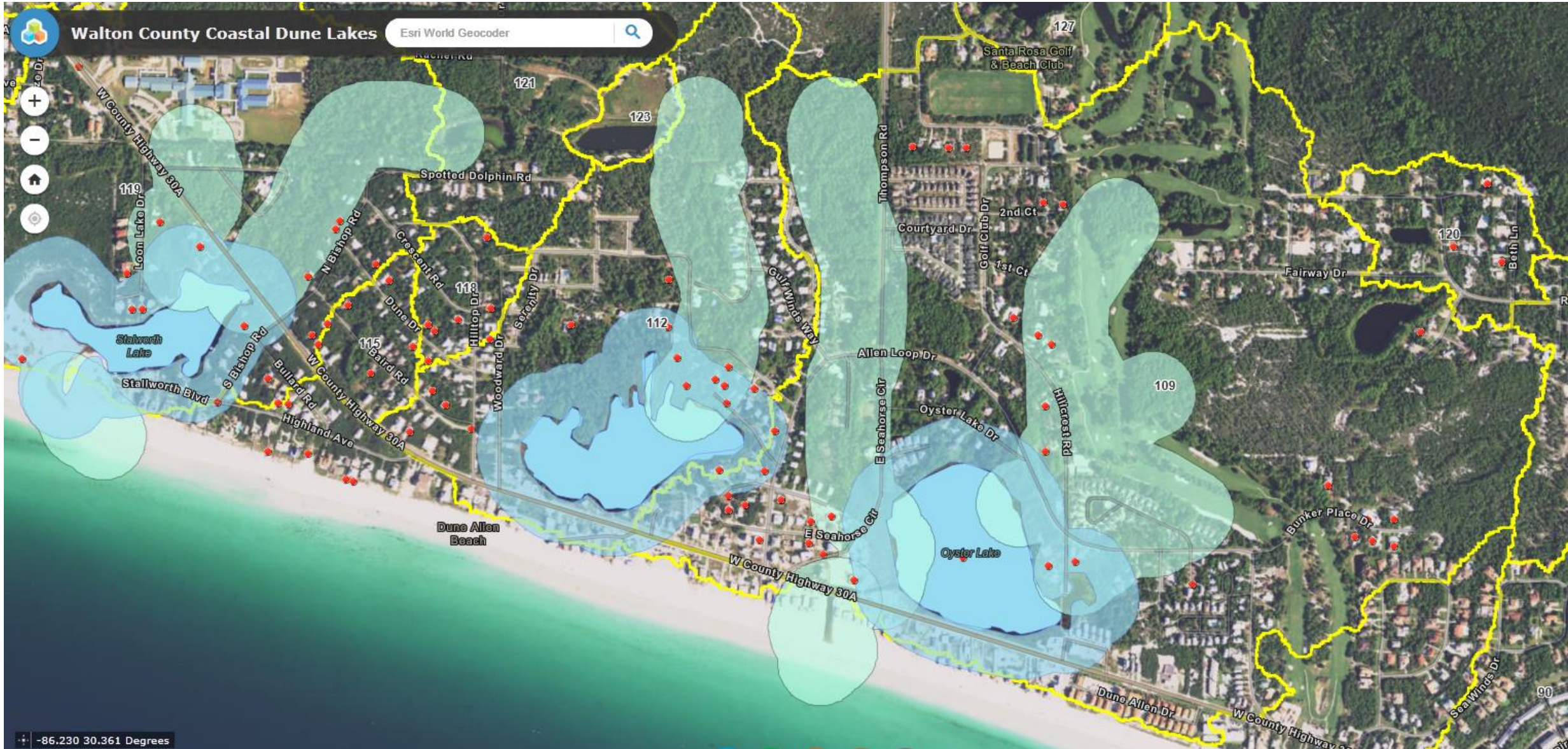


Inputs (and source):

- Drainage basins (LiDAR)
- Soils (NRCS)
- Land Use (NFWFMD with updates)
- BMPs (LiDAR)
- Septic tanks (DoH with updates)
- Point sources (none?)
- EMCs (literature values)
- Runoff Coefficients (literature values)
- BMP efficiencies (literature values)
- Rainfall (NOAA)



Pollutant Loading Model





- Evaluate effectiveness of BMPs
- Range of human disturbance across the lakes?
- Measure a biological endpoint that is sensitive to the type of disturbance the BMPs are designed to mitigate
 - Physical disruption
 - Nutrients/water quality issues

EPA Biological Condition Gradient



Natural structural, functional, and taxonomic integrity is preserved.

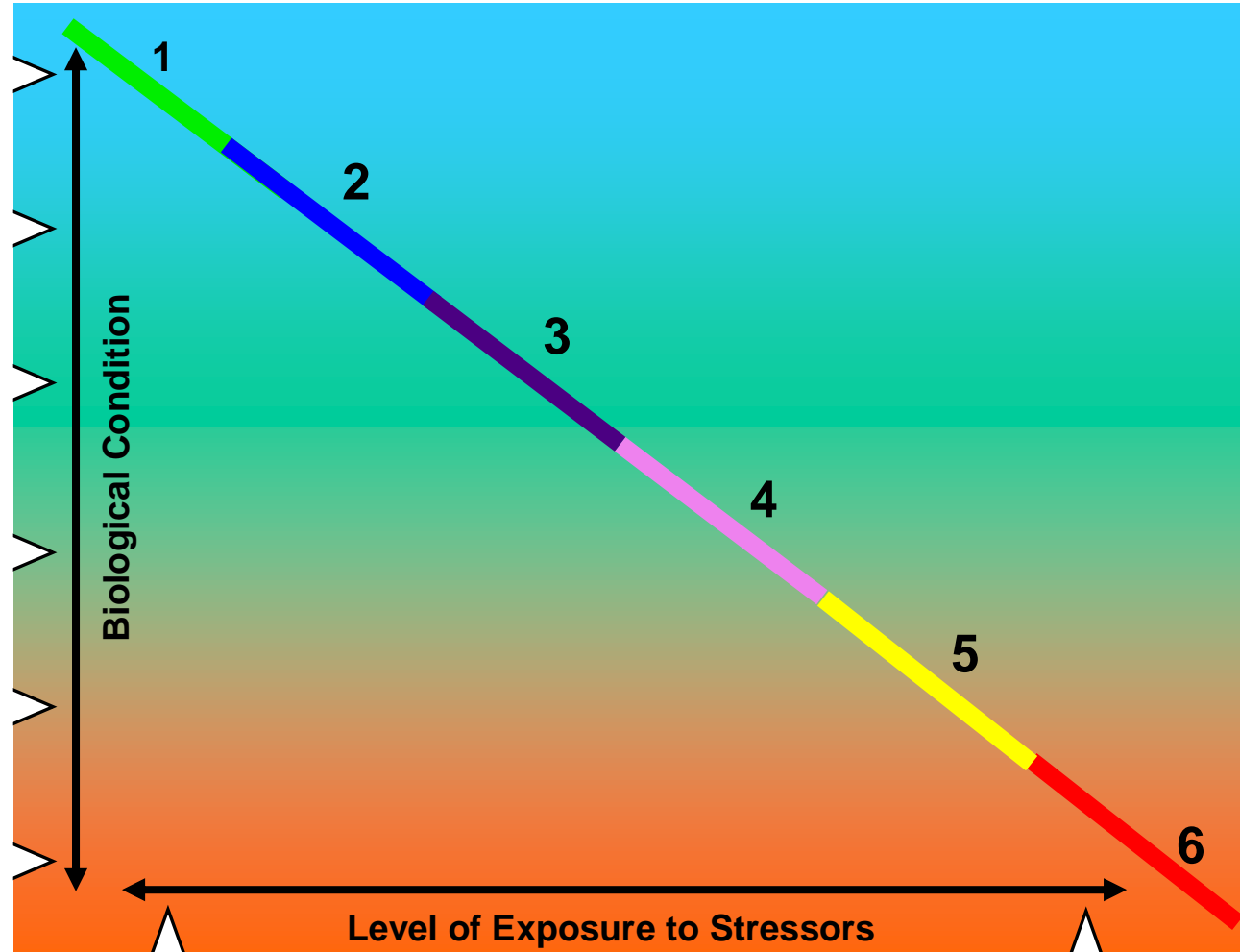
Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained.

Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained.

Moderate changes in structure due to replacement of sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained.

Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy.

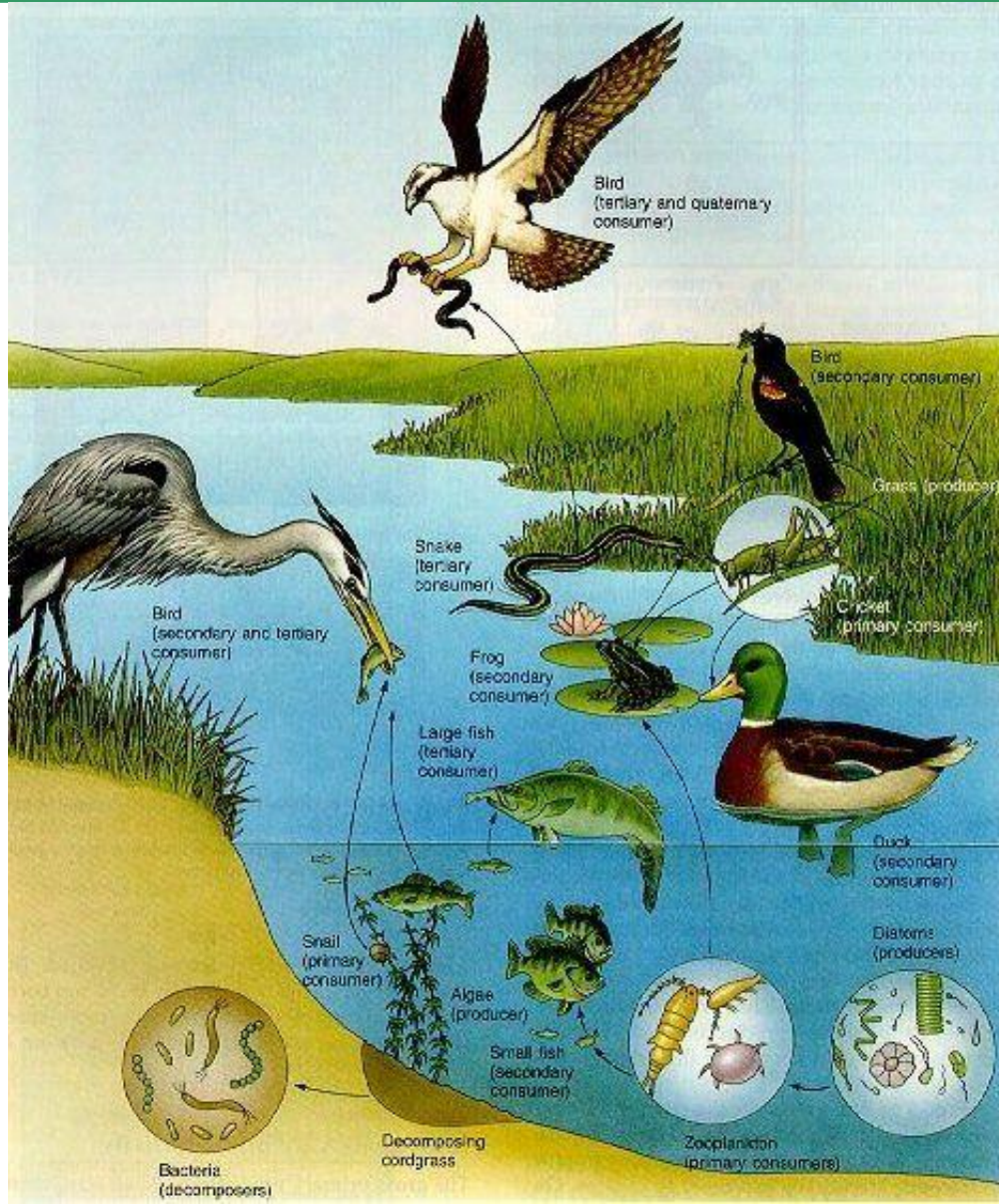
Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities.



Watershed, habitat, flow regime and water chemistry as naturally

Chemistry, habitat, and/or flow regime severely altered from natural conditions.

Parameter Selection



- Biological Communities
 - Phytoplankton: covered in modeling exercises
 - Invertebrates: confounded by water color
 - Fish/vertebrates: not sensitive enough
 - **Lake plants: early responders to landscape disturbance and nutrients**

Additional Data Collection



- CDLs sampled for:
 - Lake Habitat Assessment
 - Vascular plant communities
 - Physical/chemical parameters
- May 8 – 11, 2017

Access thanks to Susan Pallidini, Mebane Cory-Ogden, Jim Bob Sellars, Bill Crane, Matthew Allen, Patrick Hartsfield

FDEP Lake Habitat Assessment



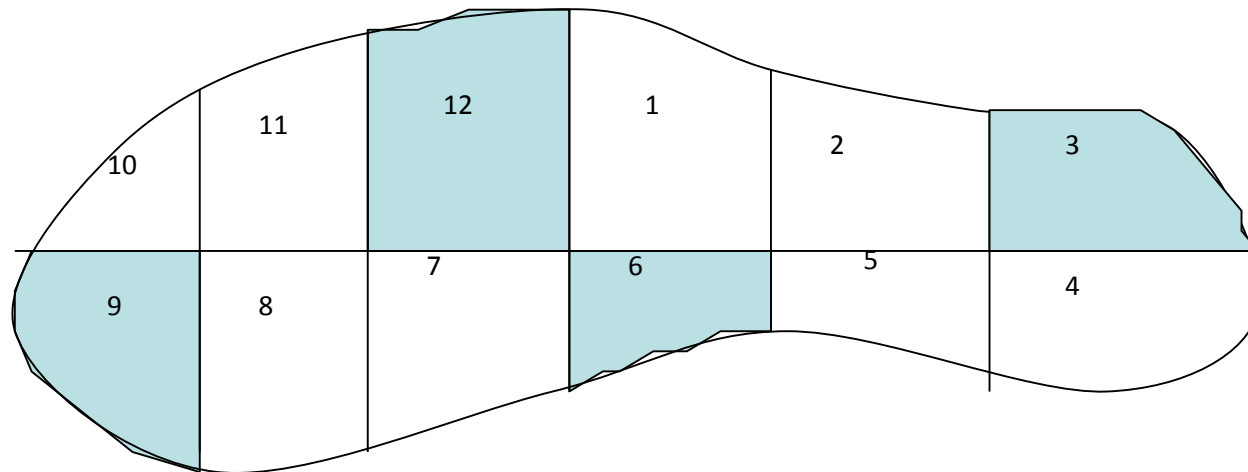
- FDEP SOP FT 3200
- Lake-wide score based on assessing:
 - Stormwater inputs
 - Bottom substrate quality
 - Adverse lakeside alterations
 - Upland buffer zone
 - Adverse human watershed land use



Vascular Plant Sampling



- FDEP SOP LVI 1000
- Lake divided into 12 total sections. Four sampled for plants in a pattern, with random start
 - 4 species lists generated per lake, identified to lowest practical taxonomic level
 - Community attributes calculated from taxa lists



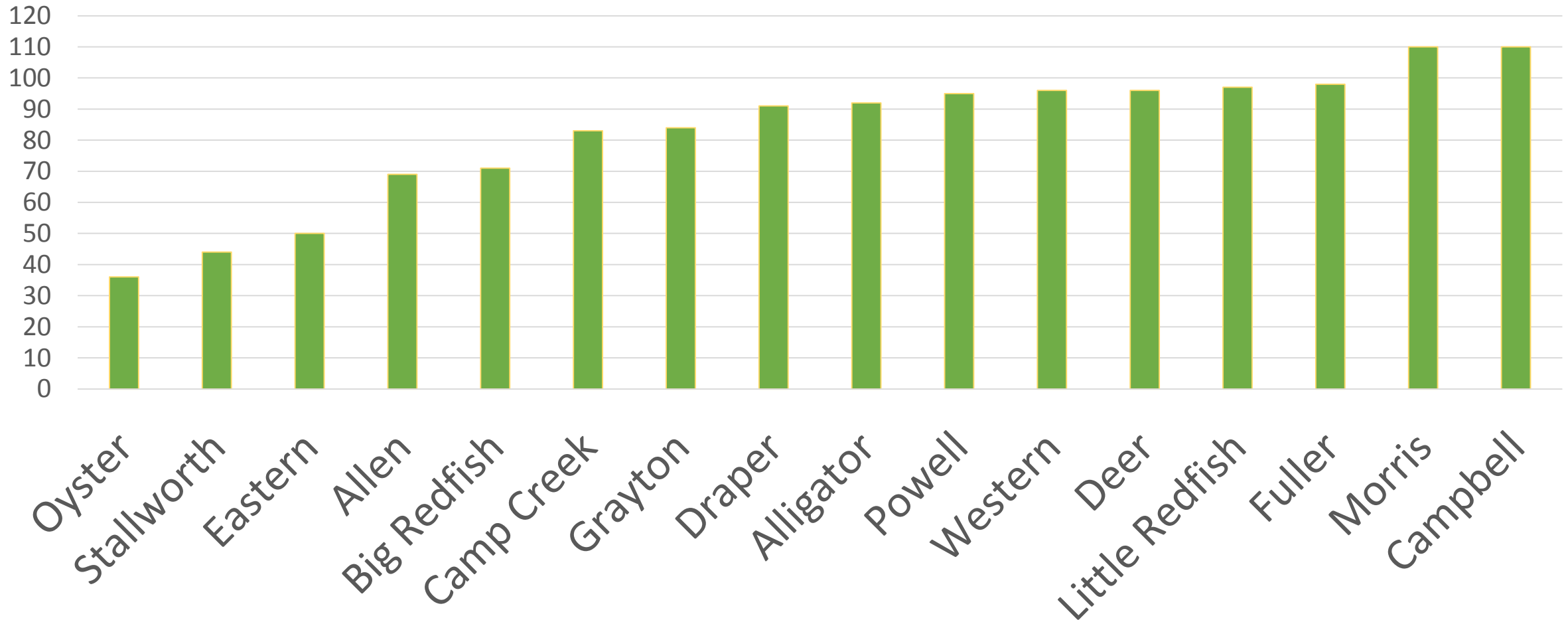


Results of Human Disturbance Measurements

Habitat Assessment Results



Habitat Assessment Total Scores: Sorted



Walton County Lake Protection BMP

Related Lake Habitat Assessment Measure

**Septic tanks drain fields 100 feet
away**

Upland Buffer Zone. A buffer zone of >18 m (59 ft) is considered optimal.

**Untreated stormwater runoff should
not enter the lake.**

Stormwater Inputs. Sheet flow over an uncultivated vegetated buffer zone is considered optimal

Erosion control

Stormwater Inputs. Good BMPs (buffers, swales, retention areas, etc.) score high

No hazardous wastes

Stormwater Inputs. Adverse Watershed Land Use

**Seawalls, bulkheads, stc. not
permitted**

Lakeside Adverse Human Alterations. Perimeter of the lake assessed for human structure

Endangered species habitat

Upland Buffer Zone. Width of vegetated zone

No new point or NPS

Adverse Watershed Land Use

Setback required = 100 feet

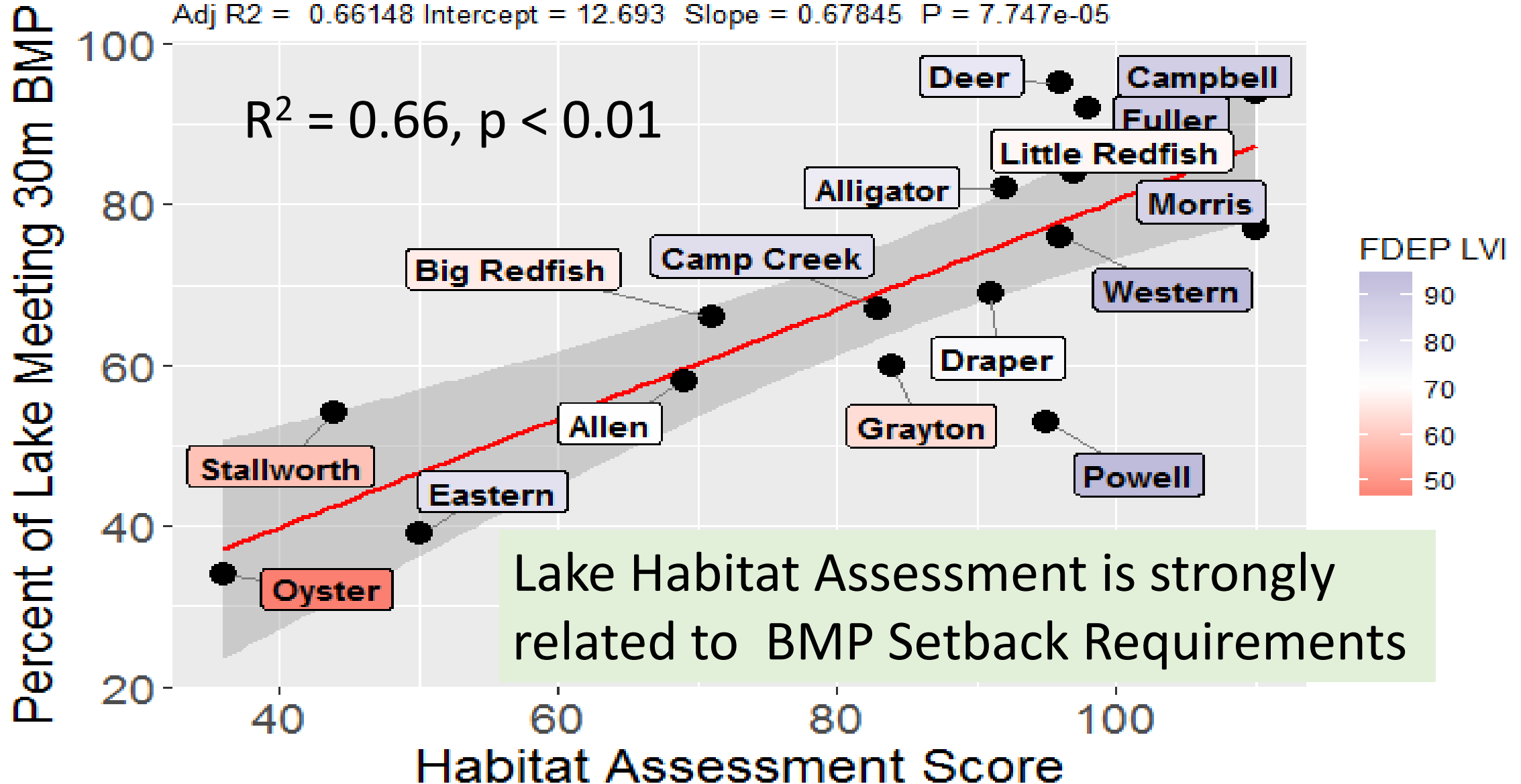
Upland Buffer Zone. Lakeside vegetated zone, >18 m

Preserve 60 % within 300 feet

Upland Buffer Zone. Lakeside vegetated zone, >18 m

Habitat Assessment Score Regressed Against 30 m BMP Attainment

Adj R2 = 0.66148 Intercept = 12.693 Slope = 0.67845 P = 7.747e-05





Vascular Plant Community Results

Metrics

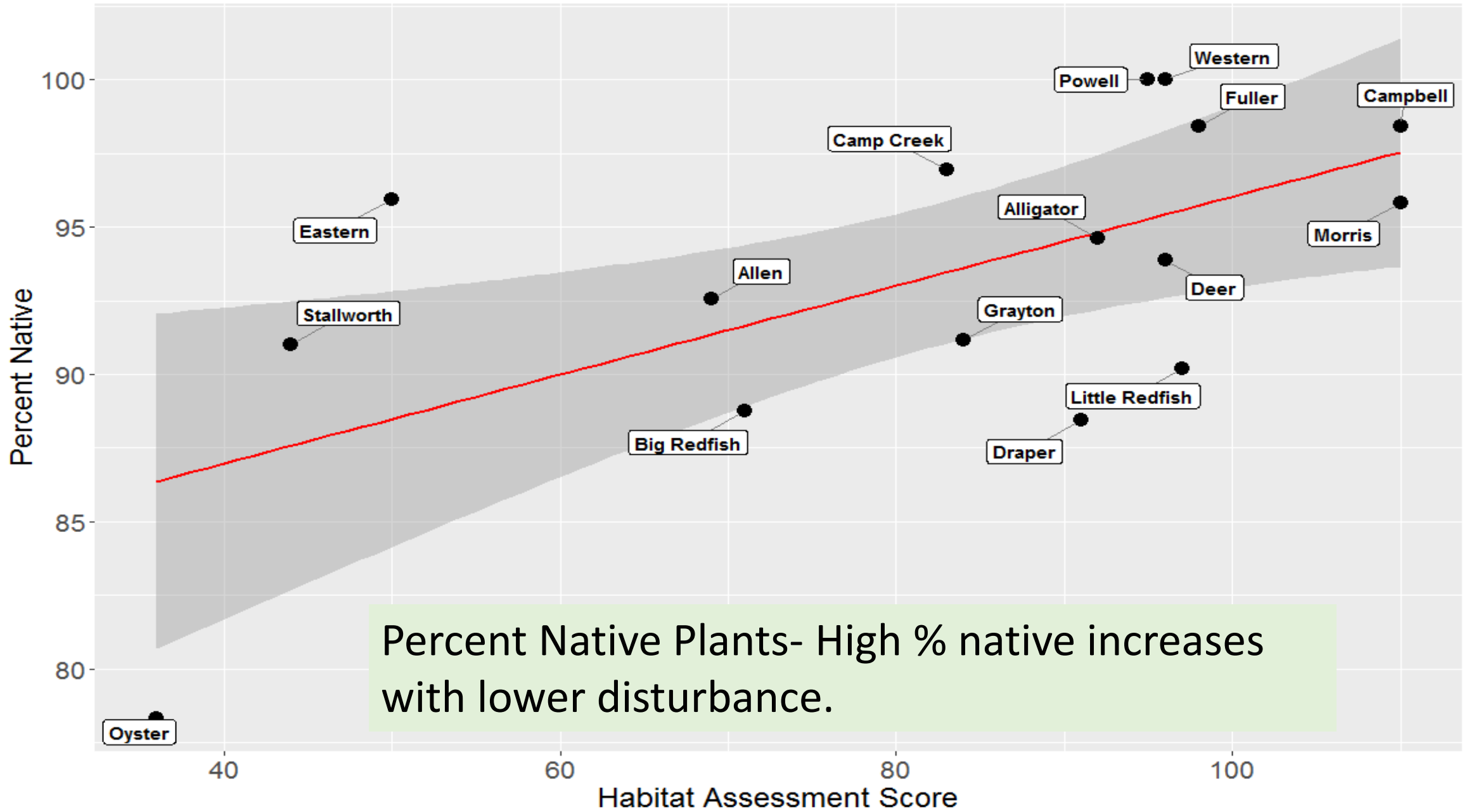


Measures of biological community health that respond to human disturbance in a predictable manner

Explored use of metrics previously found to be effective

Percent Native Plants and Habitat Assessment

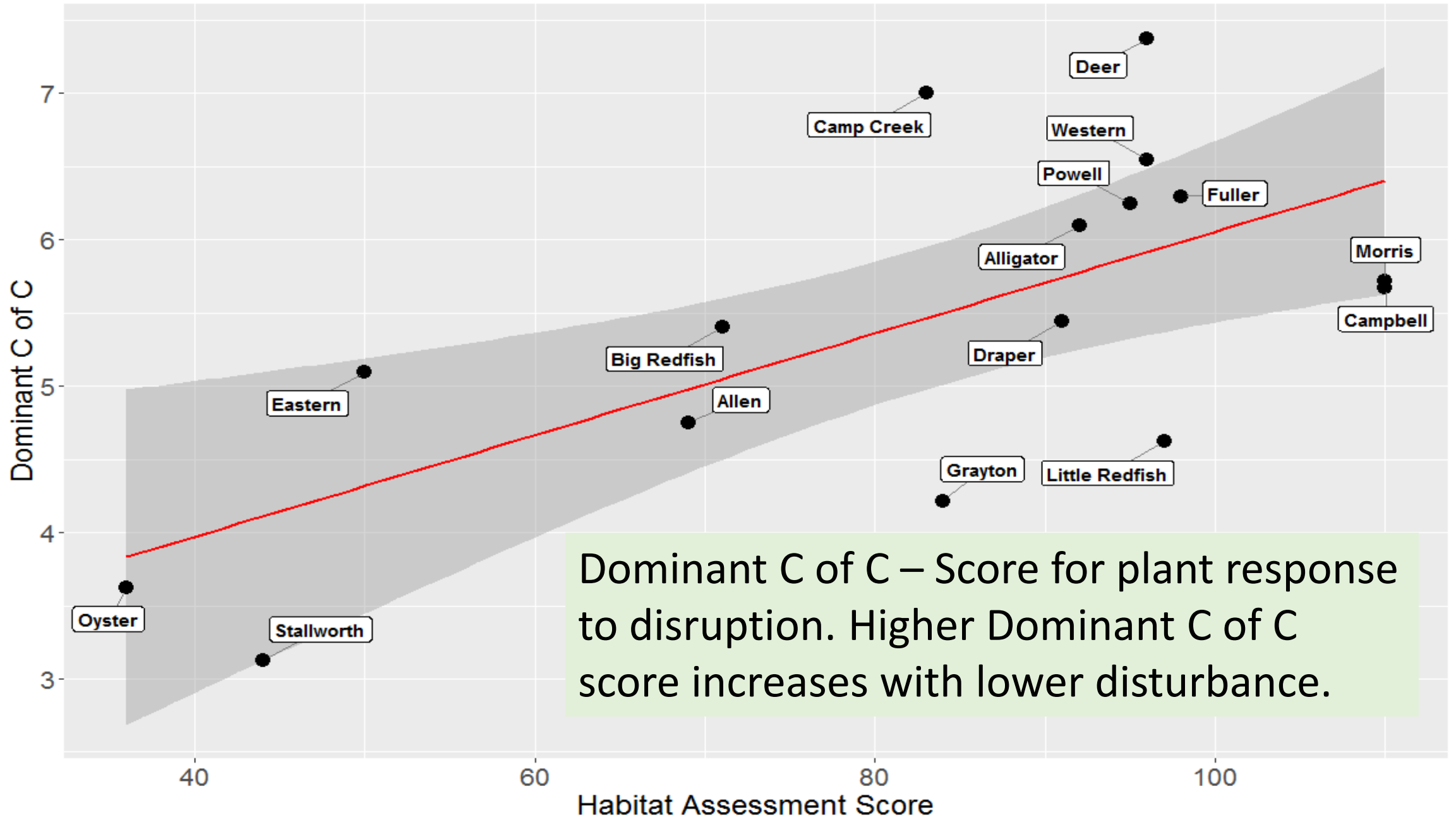
Adj R2 = 0.33572 Intercept = 80.939 Slope = 0.15092 P = 0.010986



Percent Native Plants- High % native increases with lower disturbance.

Dominant C of C and Habitat Assessment

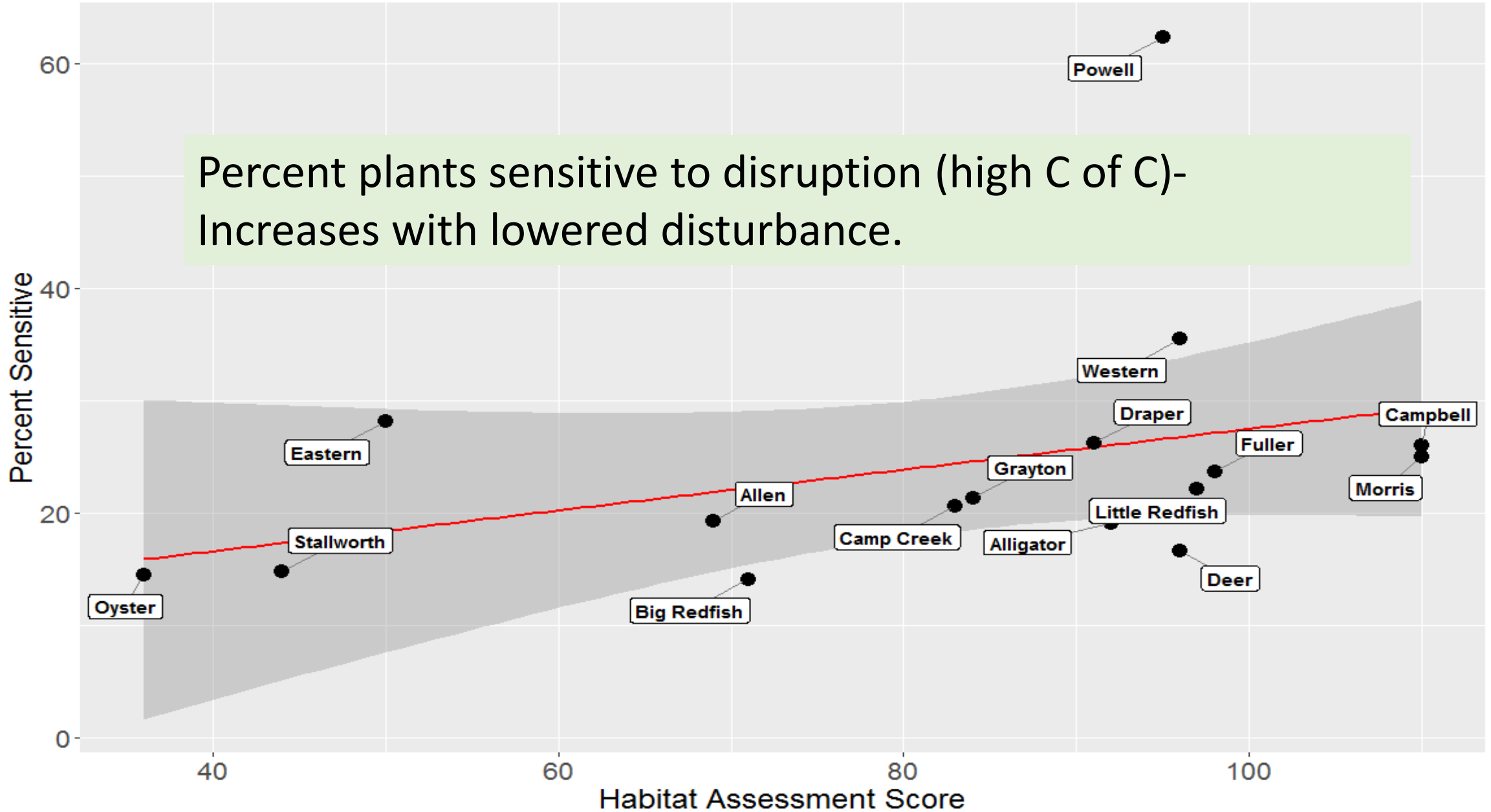
Adj R2 = 0.40585 Intercept = 2.582 Slope = 0.03474 P = 0.0047309



Dominant C of C – Score for plant response to disruption. Higher Dominant C of C score increases with lower disturbance.

Percent Sensitive Plants and Habitat Assessment

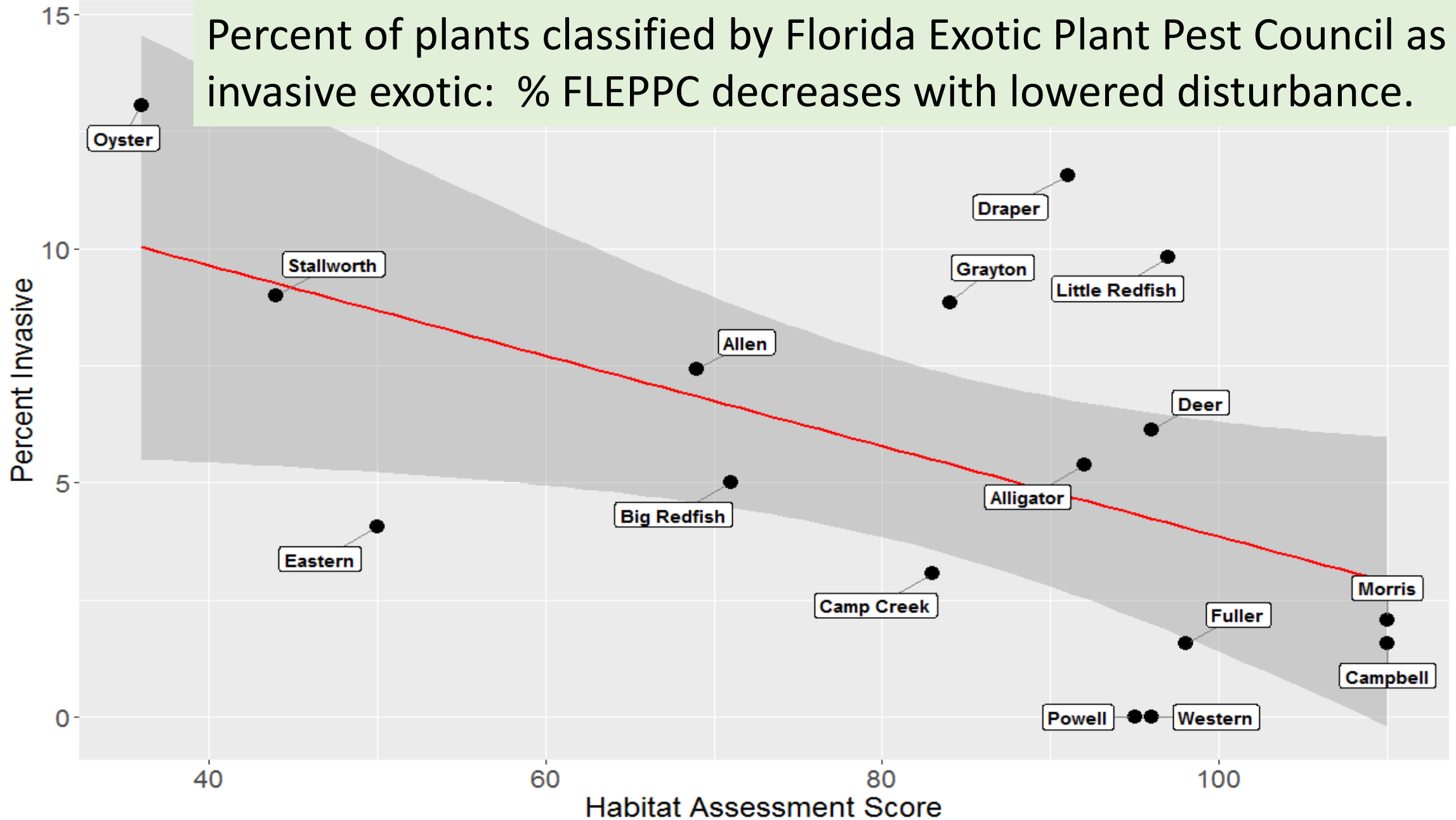
Adj R2 = 0.062181 Intercept = 9.3842 Slope = 0.18149 P = 0.17971



Percent Invasive species and Habitat Assessment

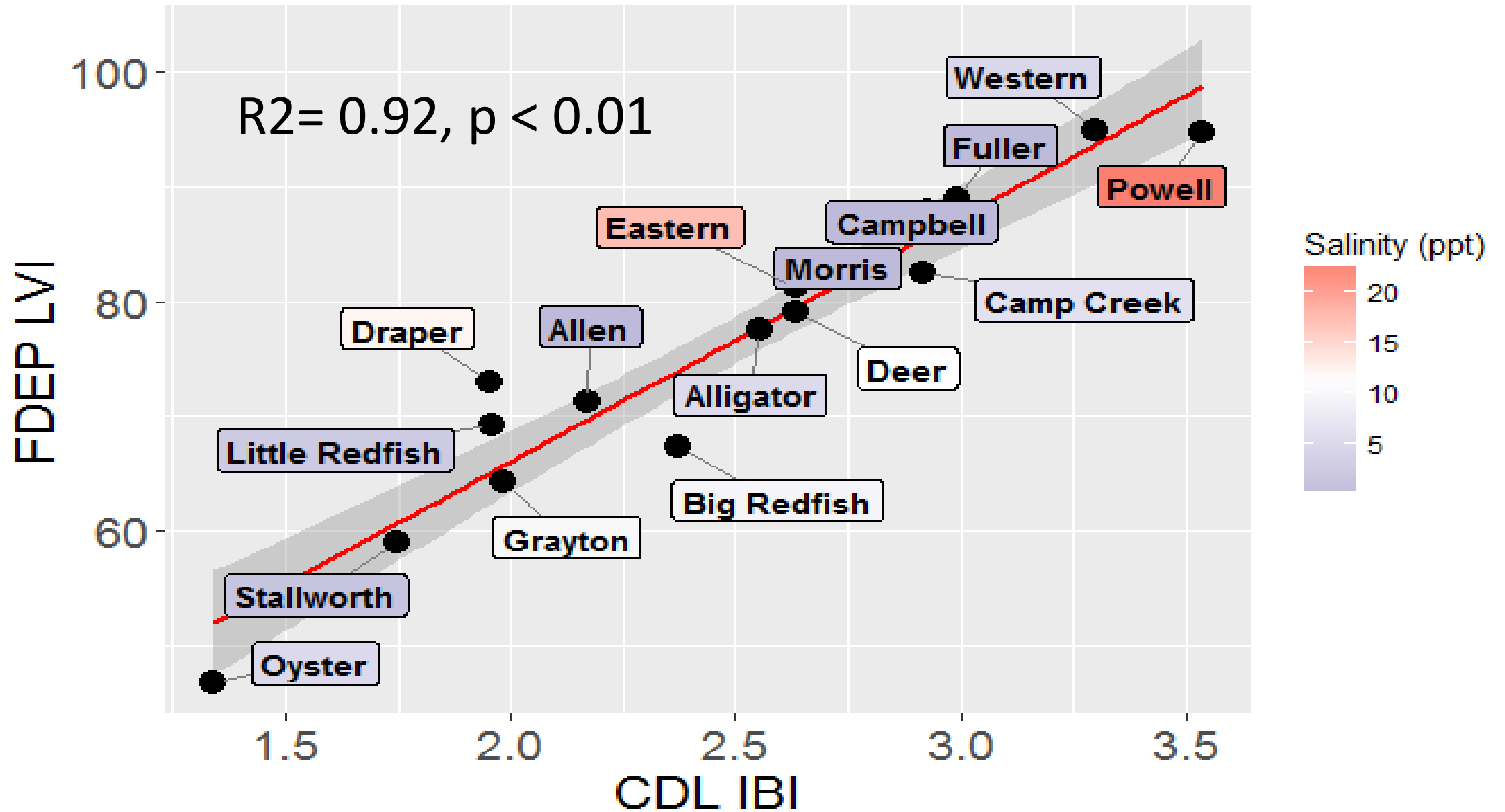
Adj R2 = 0.23263 Intercept = 13.5 Slope = -0.096442 P = 0.033625

Percent of plants classified by Florida Exotic Plant Pest Council as invasive exotic: % FLEPPC decreases with lowered disturbance.



Comparison of FDEP LVI to CDL IBI

Adj R2 = 0.91733 Intercept = 23.368 Slope = 21.322 P = 3.5305e-09

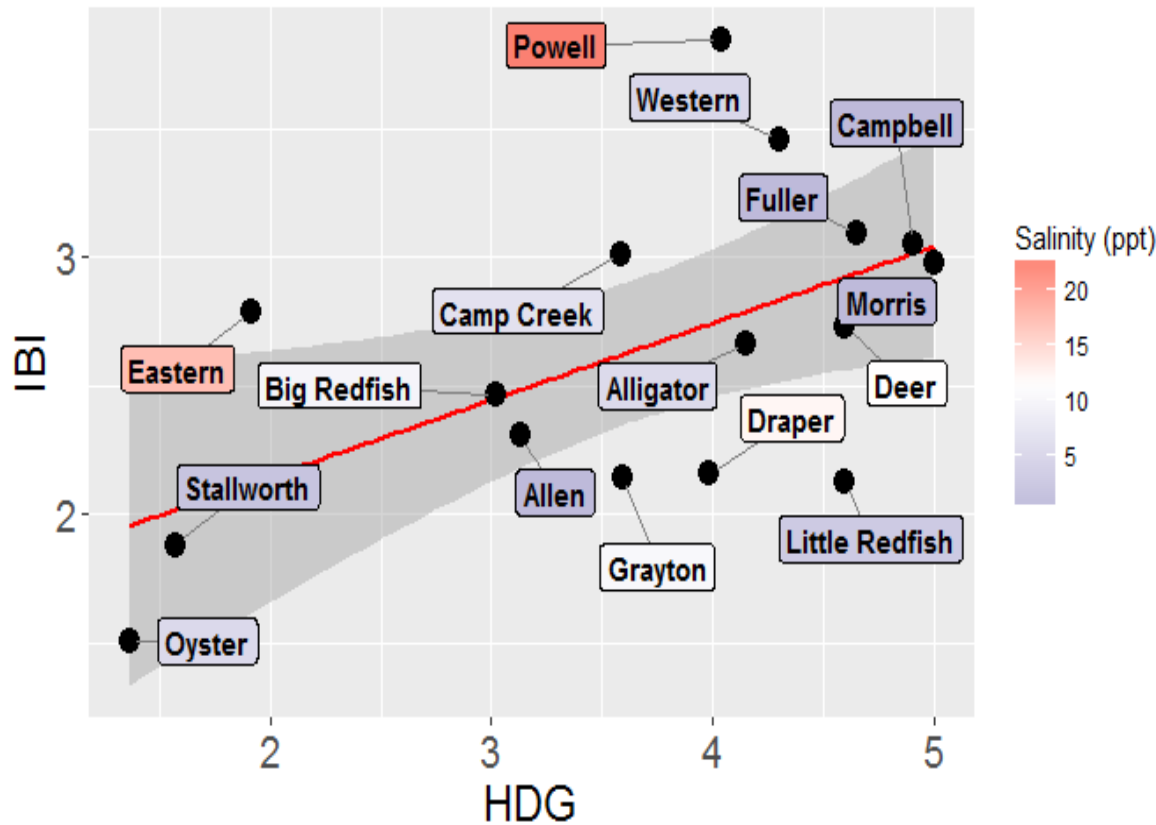


CDL Plant Index and Lake Vegetation Index



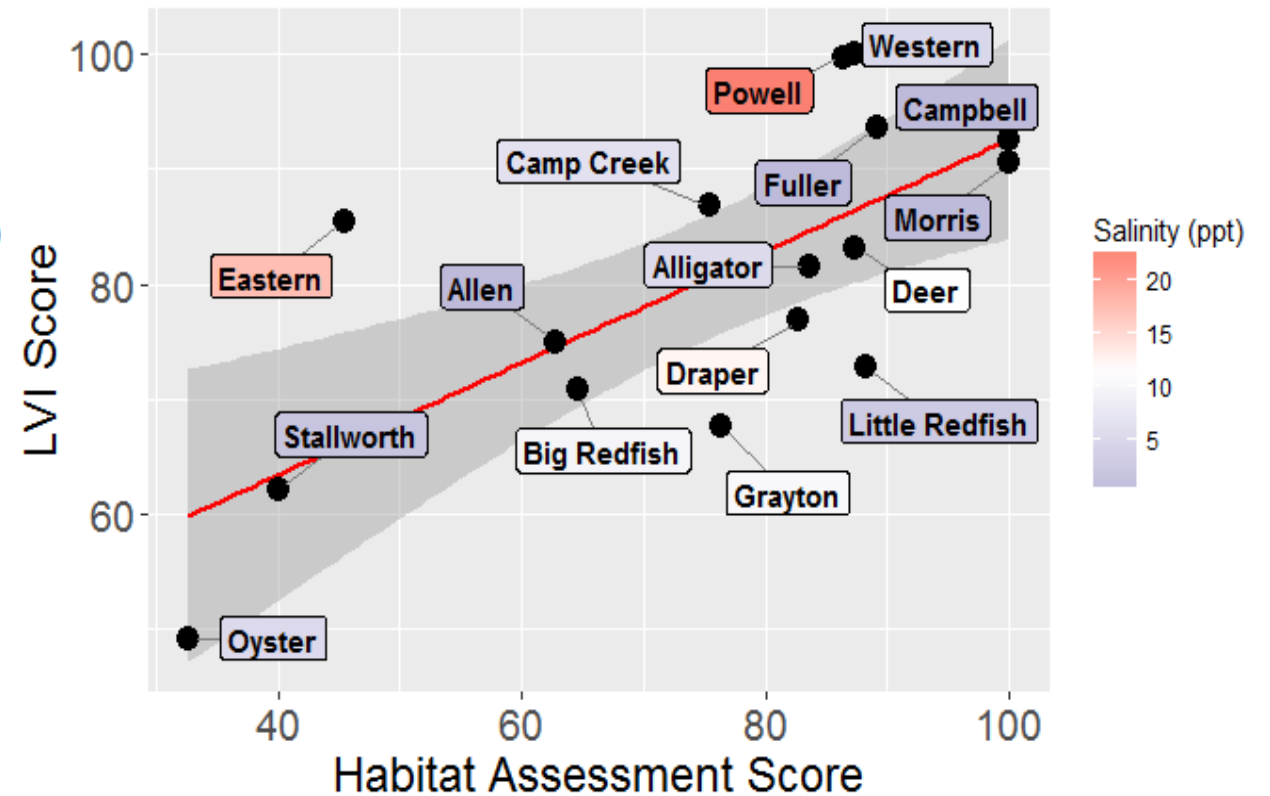
Human Disturbance Gradient and Plant IBI for CDLs

Adj R2 = 0.28 Intercept = 1.5498 Slope = 0.29875 P = 0.020411



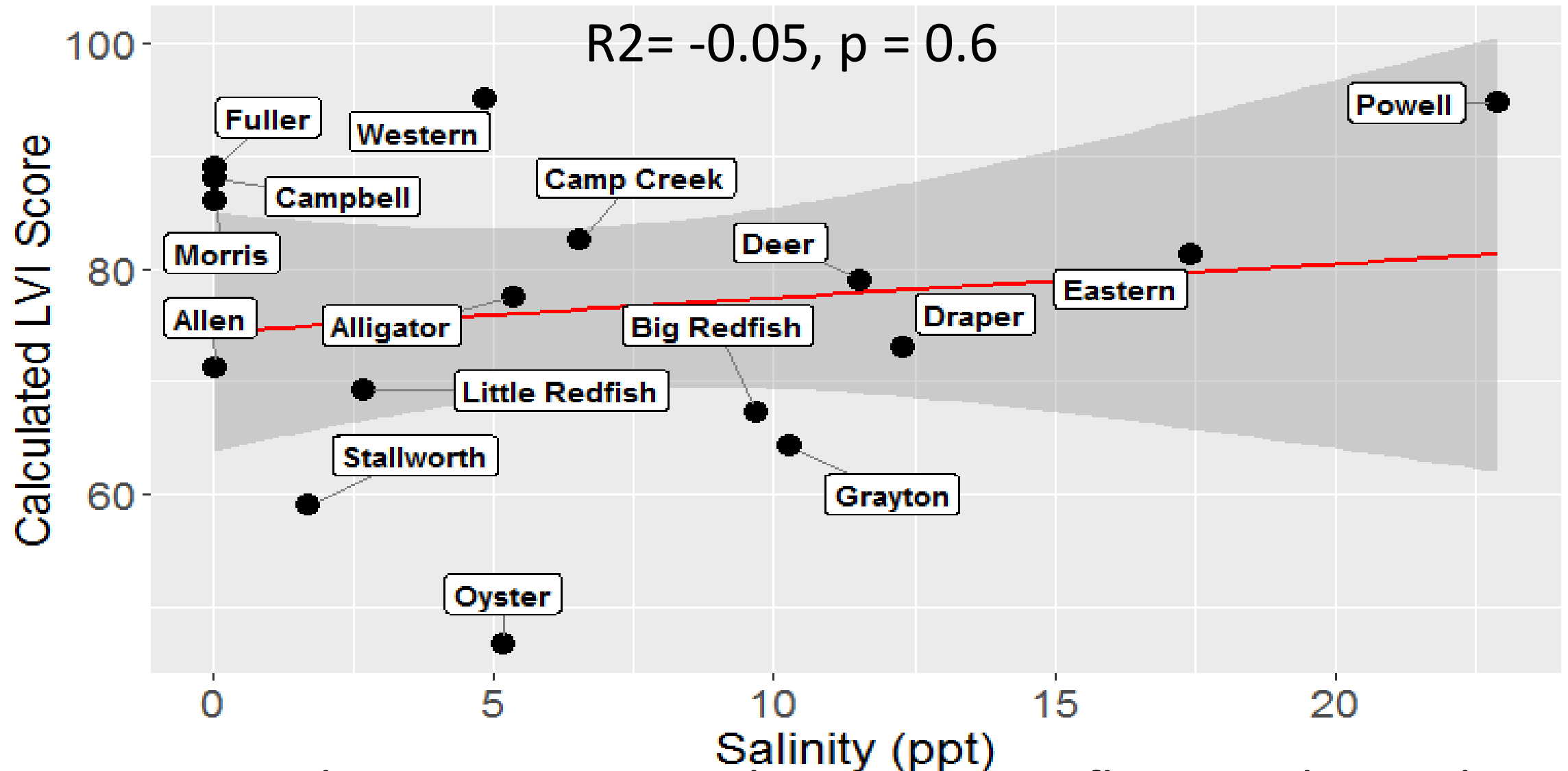
FDEP LVI relation to FDEP Habitat Scores for CDLs

Adj R2 = 0.47855 Intercept = 43.943 Slope = 0.48683 P = 0.0017934



LVI Score and Salinity for Walton County CDLs

Adj R2 = -0.046413 Intercept = 74.401 Slope = 0.30111 P = 0.5721



Human Disturbance Appears to be Stronger Influence Than Salinity



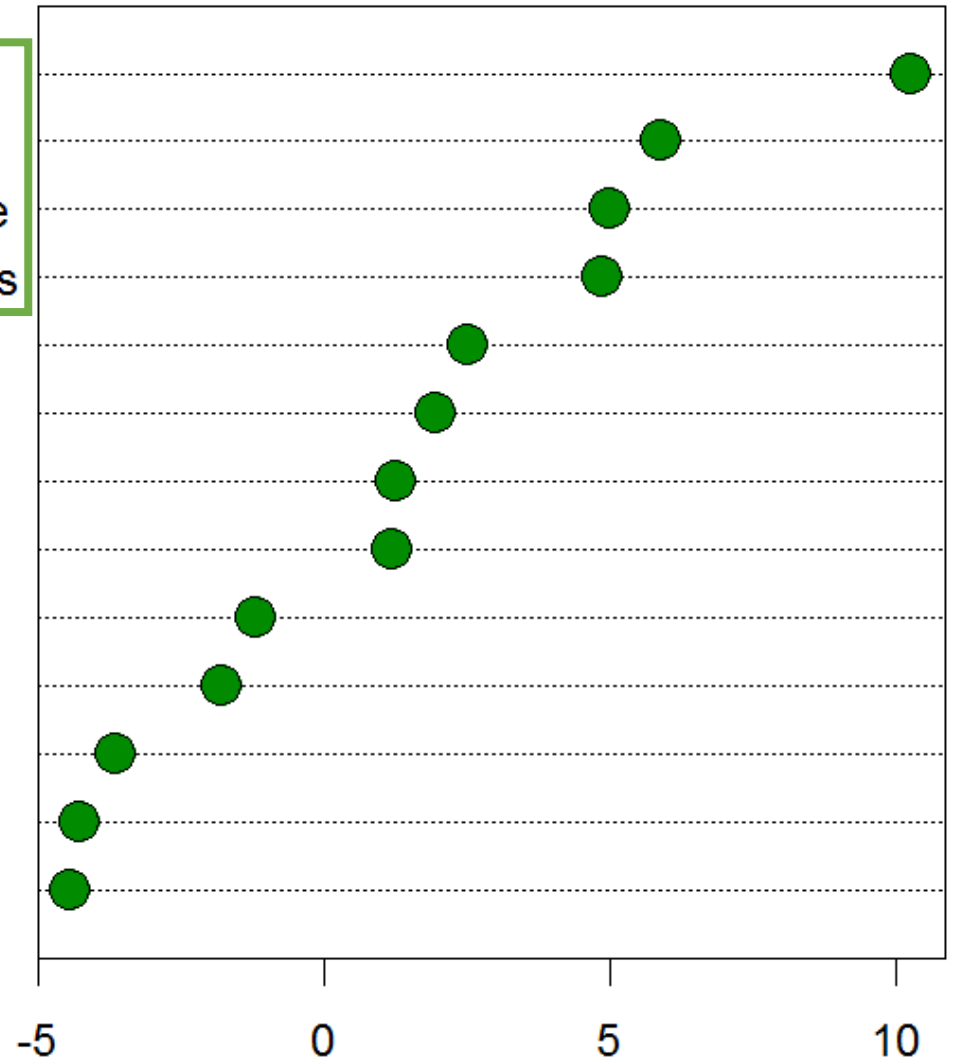
Links Between Biological Response and Water Quality/BMPs

- Quantifies the relative importance of physical and water quality variables influencing plant community response

Random Forest variable importance

HA.Stormwater
HA..Bottom.Substrate
HA.Watershed.landuse
HA.Lakeside.Alterations

TP
HA.Upland.Buffer
LDI_watershed
LDI_100m
SALIN
PH
DOSAT
SD
TN



Preliminary Results



- Lake Habitat Assessment is relevant for gauging conditions consistent with the BMPs:
 - “Crosswalk” between the Walton County Lake Protection BMPs and the FDEP Lake Habitat Assessment (HA), and
 - CDL-specific 30 m setback GIS exercise

Preliminary Results



- Four plant metrics were used to derive a CDL-specific, multi-metric vascular plant Index of Biological Integrity (IBI)
- Very strong relationship between CDL-IBI and FDEP Lake Vegetation Index (LVI)

Preliminary Results



- Random Forest Model indicated that five best predictors of plant biological index were:
 - Stormwater inputs,
 - Bottom substrate quality,
 - Lakeside alterations,
 - Watershed landuse, and
 - TP

Preliminary Results



- The analyses thus far provide evidence that the elements of the Walton County lake protection BMPs are expected to be effective in the future for maintaining and/or restoring biological health in the CDLs

Pending Work



- Watershed pollutant loading model
- Empirical analysis
- Future modeling scenarios
- Final analysis & report
- Stakeholder meetings

Questions?

