Using Anurans to Measure Wetland Health on a Central Florida Wellfield
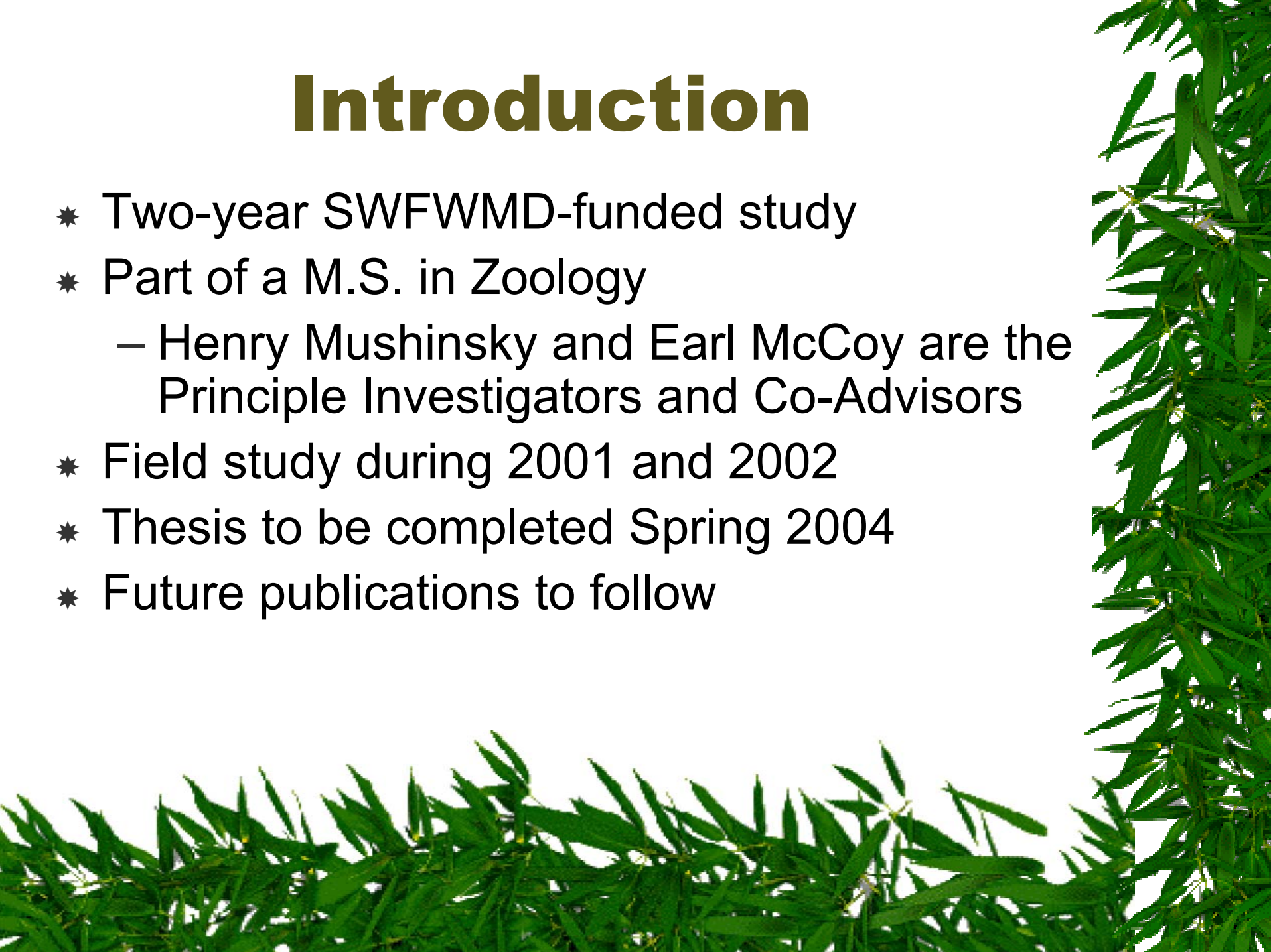
Introduction

 * Two-year SWFWMD-funded study
 * Part of a M.S. in Zoology
   – Henry Mushinsky and Earl McCoy are the Principle Investigators and Co-Advisors
 * Field study during 2001 and 2002
 * Thesis to be completed Spring 2004
 * Future publications to follow

Background

* Groundwater pumping affects hydroperiod of wetlands (Brown 1984)

* The State of Florida is charged with considering effects on flora and fauna in permitting decisions (Chapter 40D-2.301 FAC)

* Vegetation and soils monitoring is conducted twice yearly on all wellfields (Rochow 1994)

* We propose an alternative monitoring method

  * Biological indicators are species or groups of species whose presence or abundance or condition are indicative of a specific set of environmental conditions (Adamus 1996).

  * Amphibians are considered sensitive to environmental perturbations and excellent barometers of ecosystem health (Vitt et al. 1990, Wake 1998, Blaustein et al. 1994).
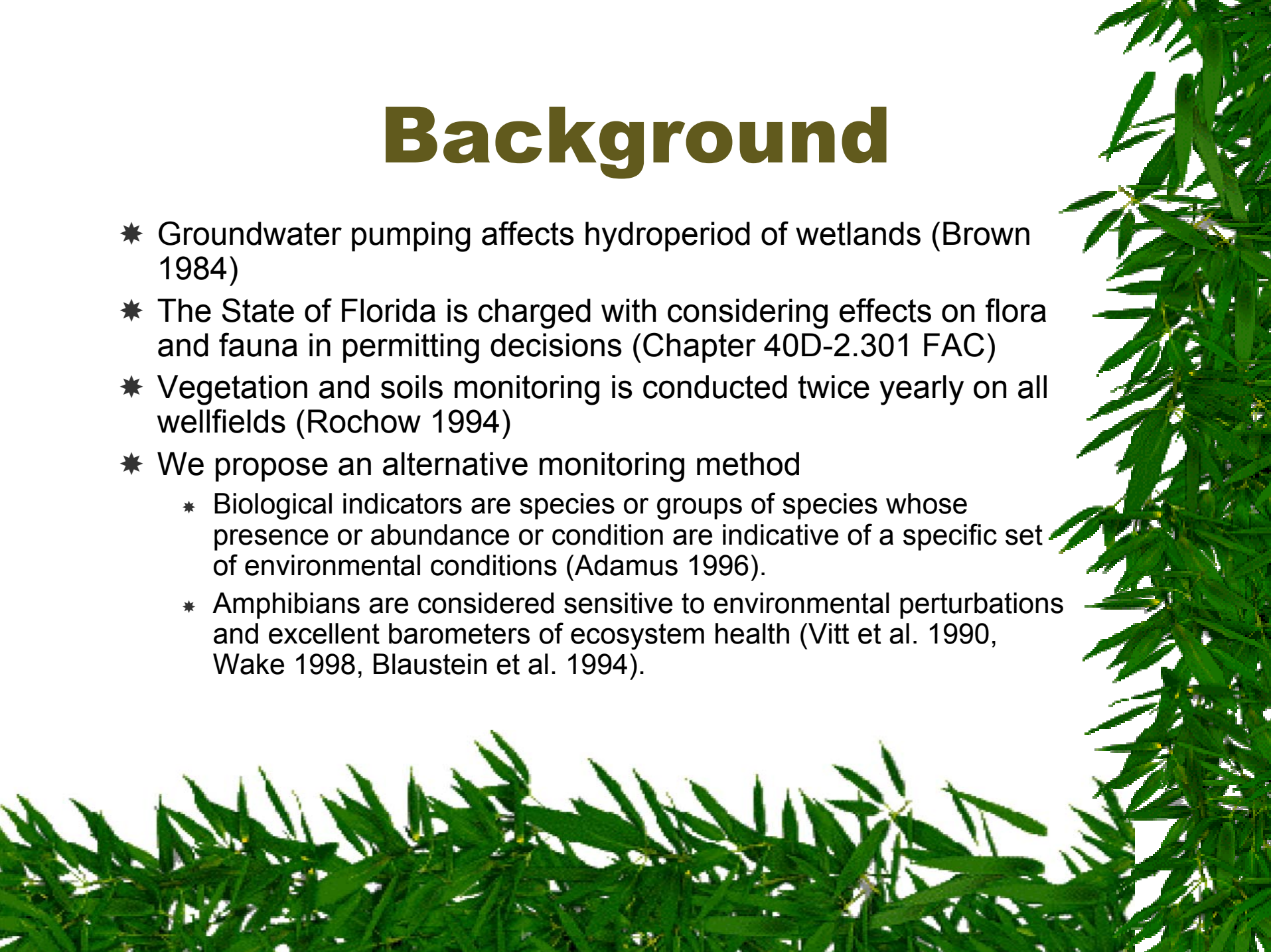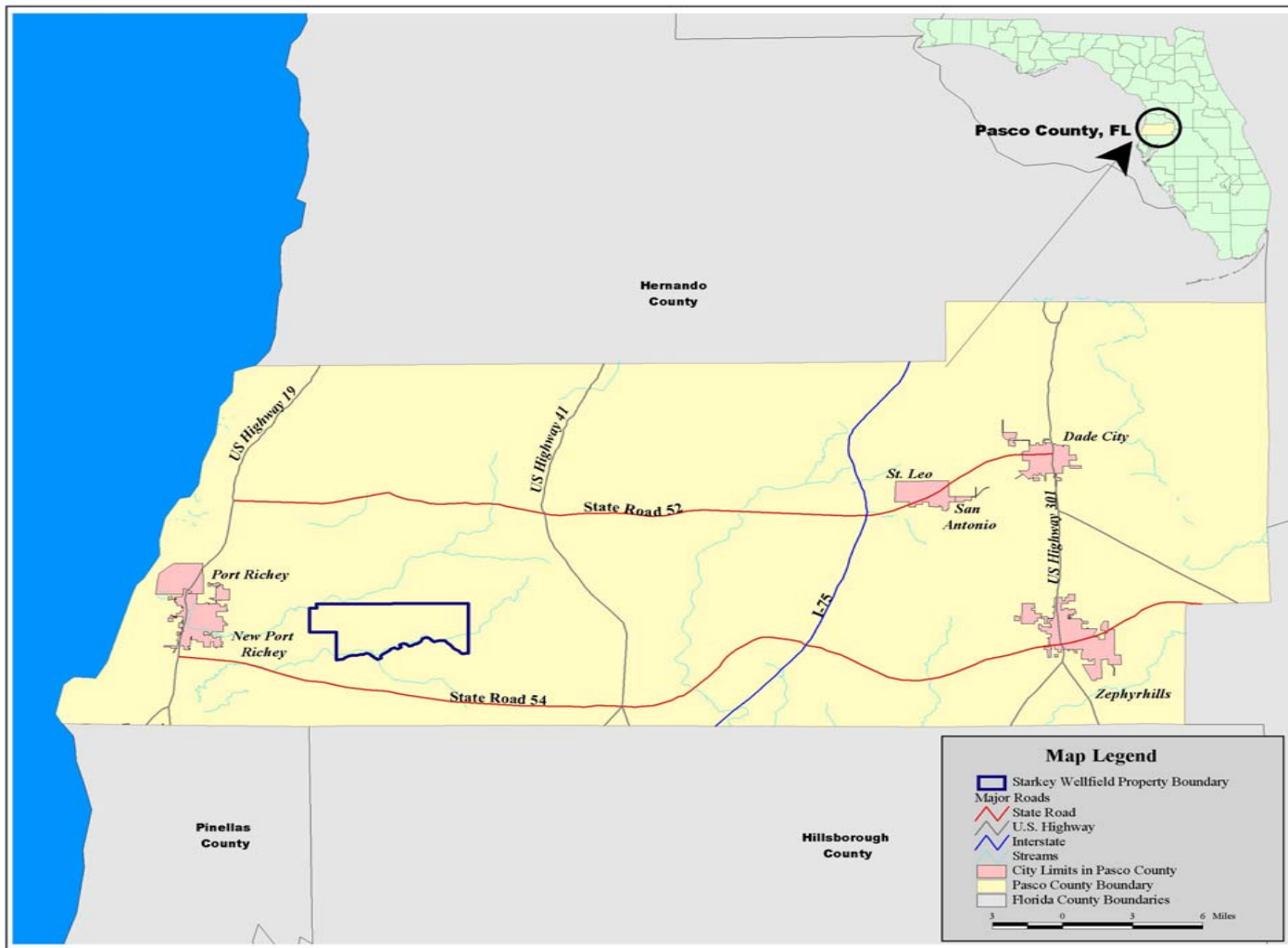
Questions

- Can the reproductive success of anurans be used to predict health of wetland systems?

- Do the vegetation observations of wetland health mirror the reproductive success of the anurans on the site?

- What environmental factors can be used to predict the reproductive success of anurans?
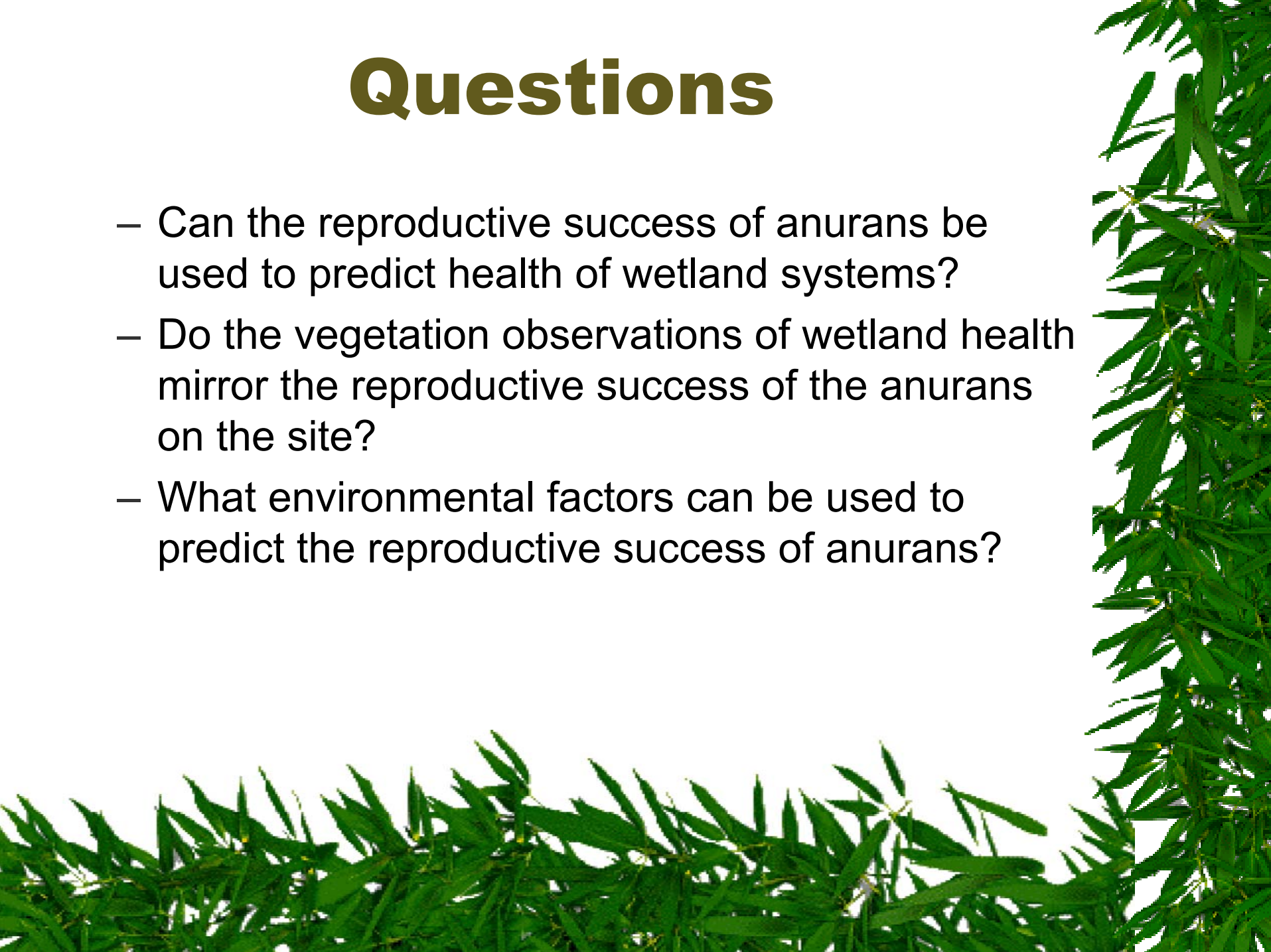
Pieces of the Puzzle

* Site Selection
* Collection Methods
* Wetland (Sampling Unit) Selection
* Expected Species

Pasco County, FL

Hernando County

US Highway 19

US Highway 41

State Road 52

St. Leo

San Antonio

Dade City

US Highway 301

Port Richey

I-75

New Port Richey

State Road 54

Zephyrhills

Pinellas County

Hillsborough County

Map Legend

- Starkey Wellfield Property Boundary
- Major Roads
  - State Road
  - U.S. Highway
  - Interstate
  - Streams
- City Limits in Pasco County
- Pasco County Boundary
- Florida County Boundaries

3   0   3   6   Miles

**Starkey Wellfield
Pasco County, Florida
Location Map**

APR Name:

Original Preparation Date:

Revision Date:

Project Manager:

GIS Operator:

GIS QA/QC:

Project Number:

North
Scale:
1" = 3 mi.

Starkey Wellfield Monitoring Locations
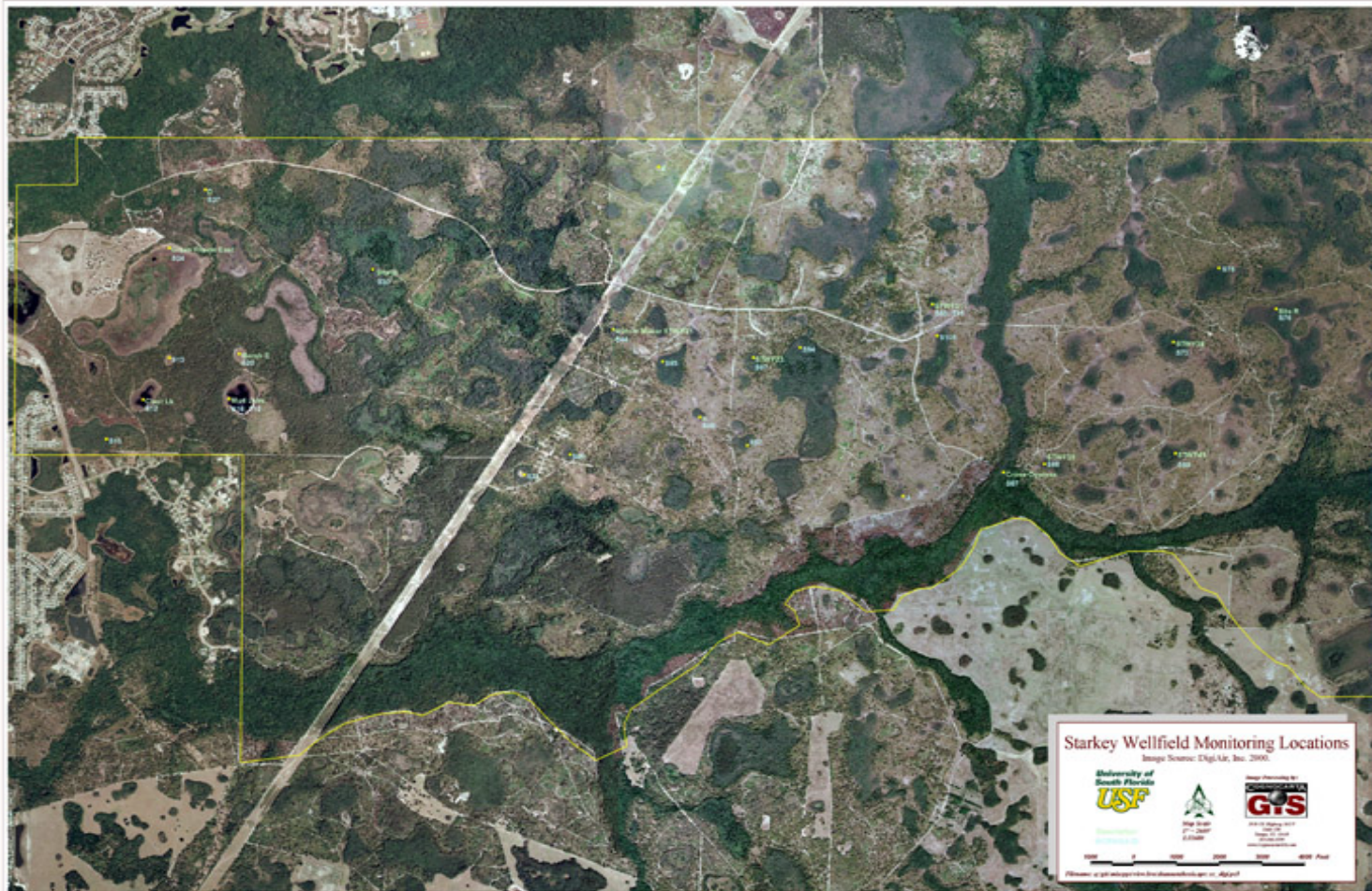
Typical Habitat

Data Collection Methods

* Call Census
  - 3 minute observations
  - Expanded sample size

* Tadpole Census
  - Funnel traps
  - Dip nets

* Environmental Factors
  - Temperature and pH
  - Water level

Wetland Selection

✳ Wetlands Chosen with SWFWMD Based on Vegetative Health Rating (VHR)

- Five "Blue" Wetlands
- Five "Green" Wetlands
- Two "Red" Wetlands
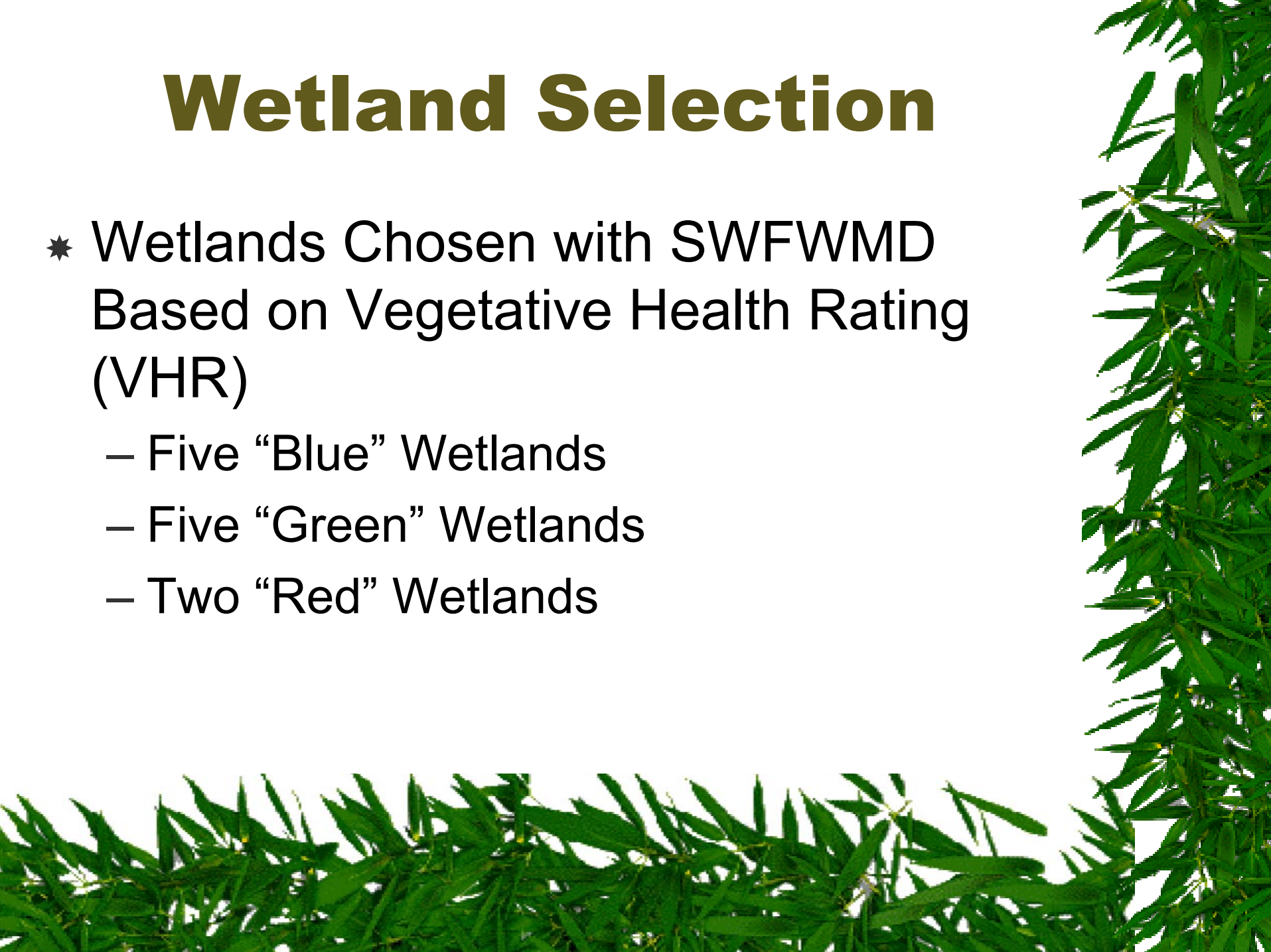
Blue Wetlands

* Do not show signs of impact from wellfield pumping
  - Healthy trees
  - Normal "zonation"
  - Hydrophytic vegetation
  - Signifies normal water level fluctuation (hydroperied)

Green Wetlands

* Show moderate signs of impact from wellfield pumping
  - Tree stress and falling
  - Changes in "zonation"
  - Mix of hydrophytic and upland/transitional vegetation
  - Signifies changes in hydroperiod.

Red Wetlands

✳ Show severe signs of impact from wellfield pumping
- Major treefall
- Extreme soil degradation
- Abnormal "zonation"
- Upland vegetation throughout
- Signifies long term and severe changes in hydroperiod

Expected Species

* Bufonids
  - oak toad
  - southern toad
* Ranids
  - bullfrog
  - pig frog
  - southern leopard frog
  - Florida gopher frog

* Hylids
  - pinewoods treefrog
  - green treefrog
  - squirrel treefrog
  - barking treefrog
  - southern cricket frog
  - little grass frog
  - southern chorus frog
* Others
  - eastern narrowmouth toad
  - eastern spadefoot

southern toad
(*Bufo terrestris*)

oak toad
(*Bufo quercicus*)

pinewoods treefrog
(*Hyla femoralis*)

barking treefrog
(*Hyla gratiosa*)

barking treefrog
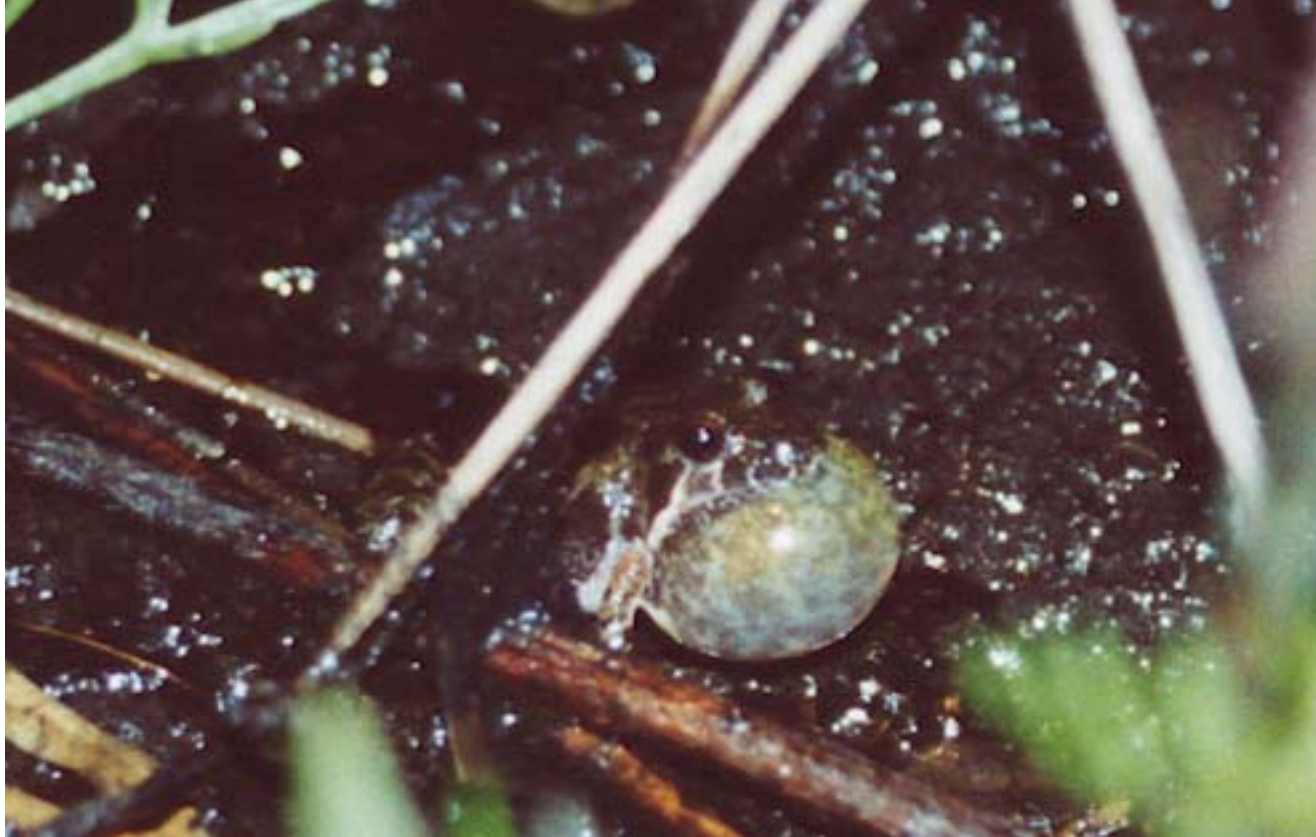## (*Hyla gratiosa*)

little grass frog
(*Pseudacris ocularis*)

cricket frog
(*Acris gryllus*)

cricket frog
(*Acris gryllus*)

southern leopard frog
(*Rana uticularia*)

Florida gopher frog
(*Rana capito*)

Florida gopher frog
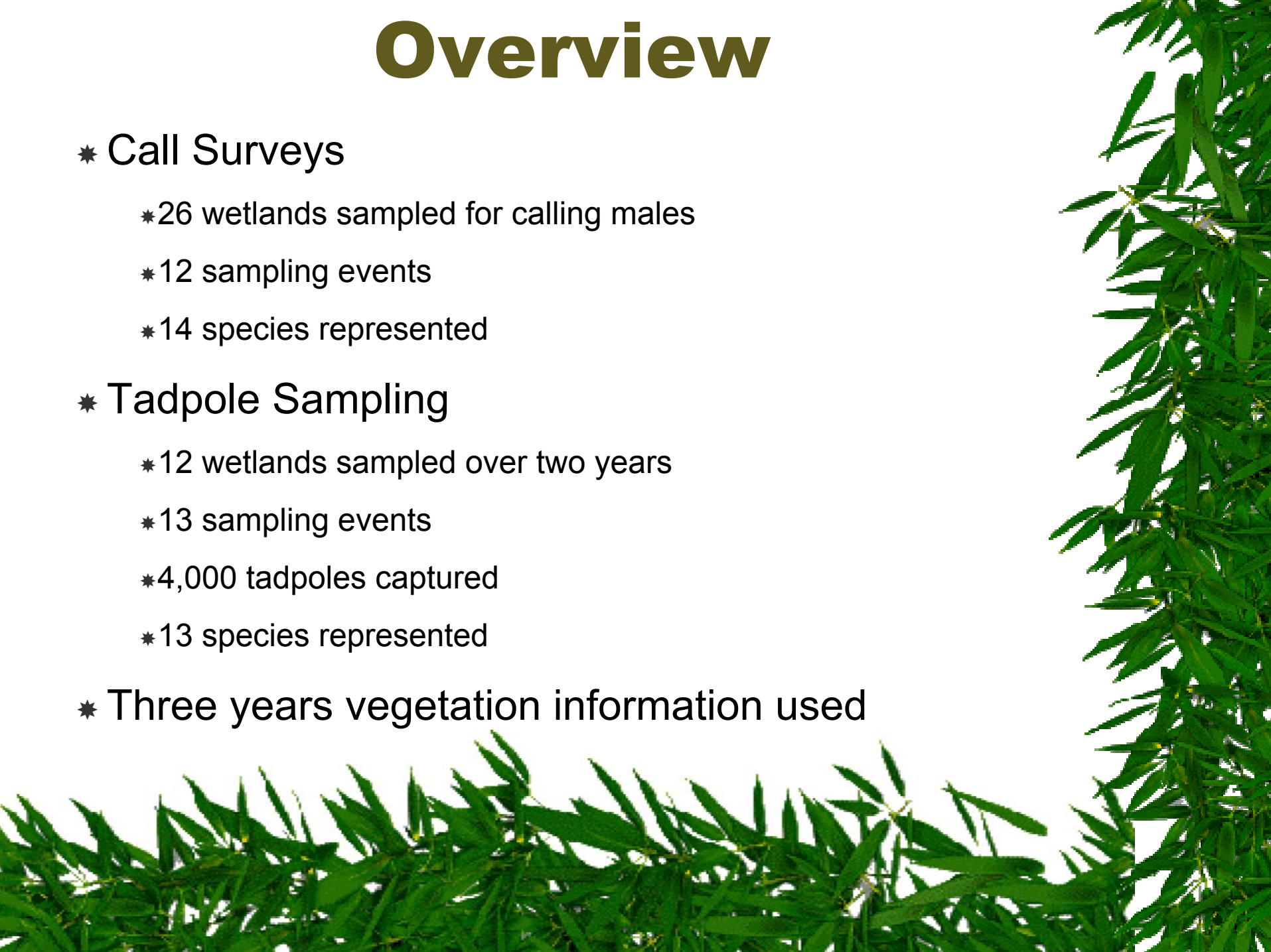## (*Rana capito*)

eastern spadefoot
(*Scaphiopus holbrookii*)

Overview

* Call Surveys

    * 26 wetlands sampled for calling males

    * 12 sampling events

    * 14 species represented

* Tadpole Sampling

    * 12 wetlands sampled over two years

    * 13 sampling events

    * 4,000 tadpoles captured

    * 13 species represented

* Three years vegetation information used

Statistics

* Nonmetric Multidimensional Scaling
  - Vegetative variables
    * Wetland Assessment Procedure Variables
  - Tadpole and predator variables used
    * Individuals per unit effort
    * Taxa per event
    * Taxa per year

* Nonparametric correlation
 - Hydroperiod variables, calling males and tadpole species
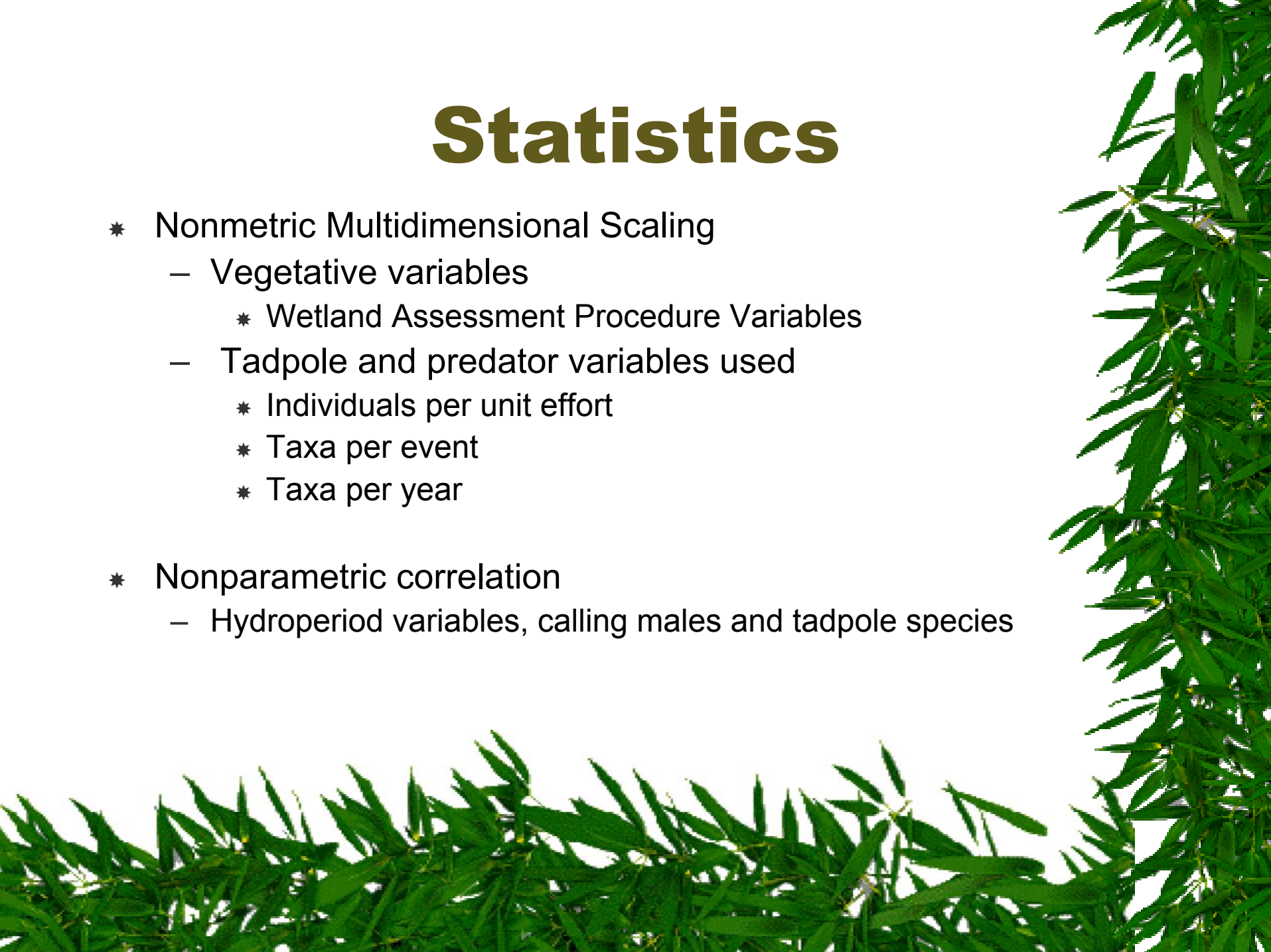
NMDS plot created using average quantitative vegetation variables and a Euclidean distance dissimilarity matrix. (440 iterations Stress 0.028, Alienation 0.048, D-Hat: Raw stress 0.112, D-Star: Raw Stress 0.333).
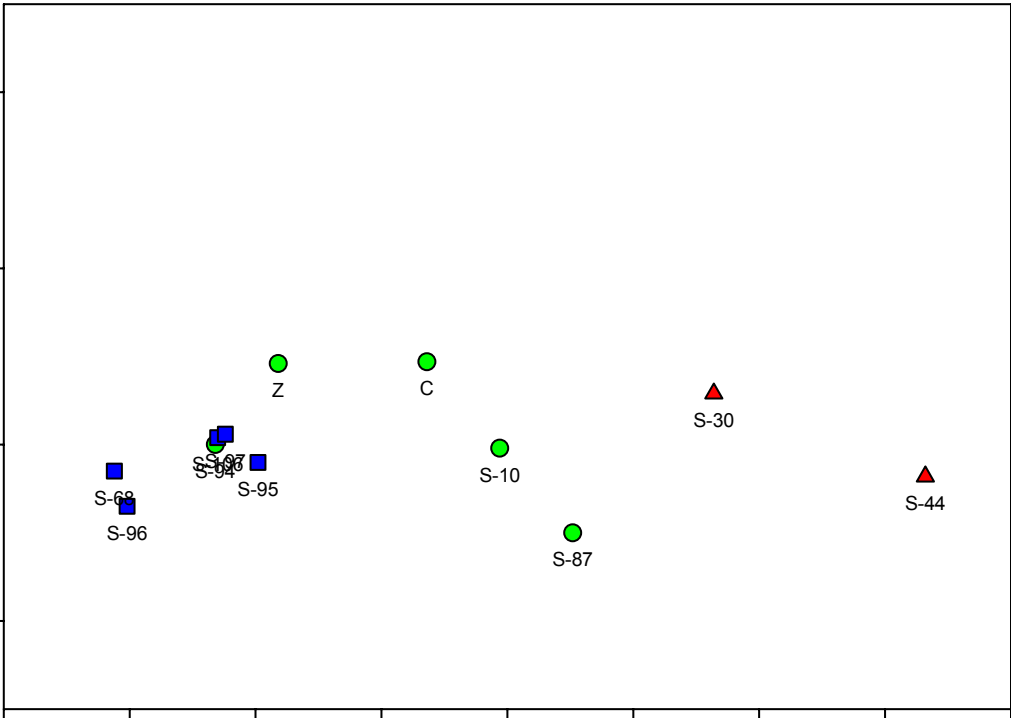
NMDS plot created using nine anuran and anuran predator variables and a Euclidean distance dissimilarity matrix. (329 iterations, Stress .0199, Alienation .0321, D-Hat Raw Stress .0576, D-Star Raw Stress .1476).
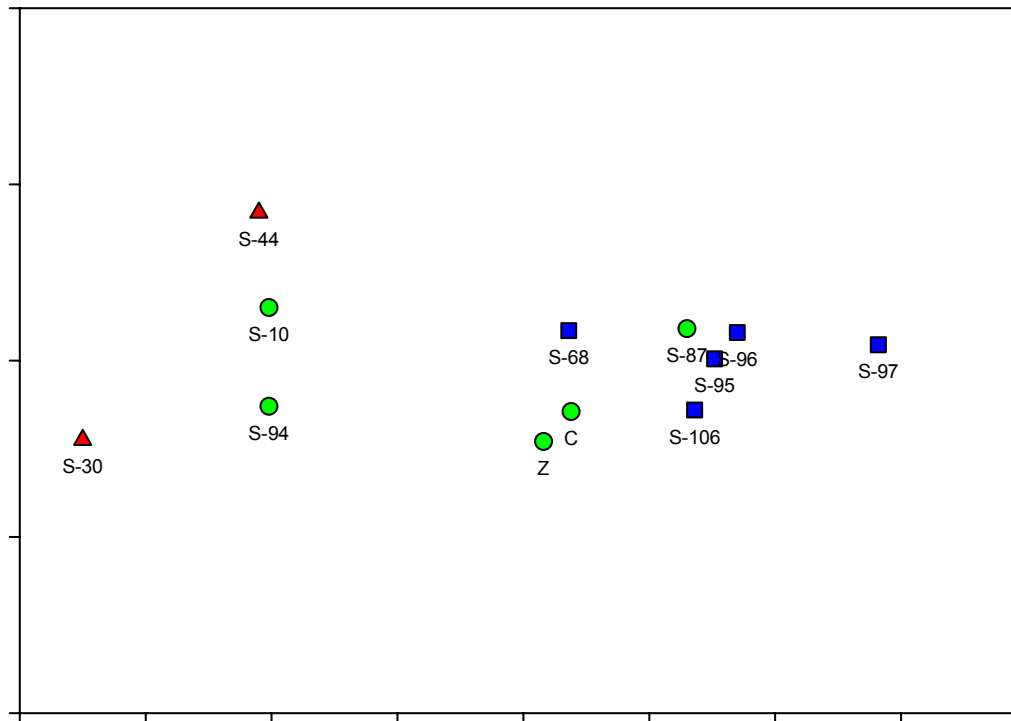
NMDS plot created using seven anuran variables and a Euclidean distance dissimilarity matrix. (Stress .0166, Alienation .0287, D-Hat Raw Stress .0396, D-Star Raw Stress .1188).
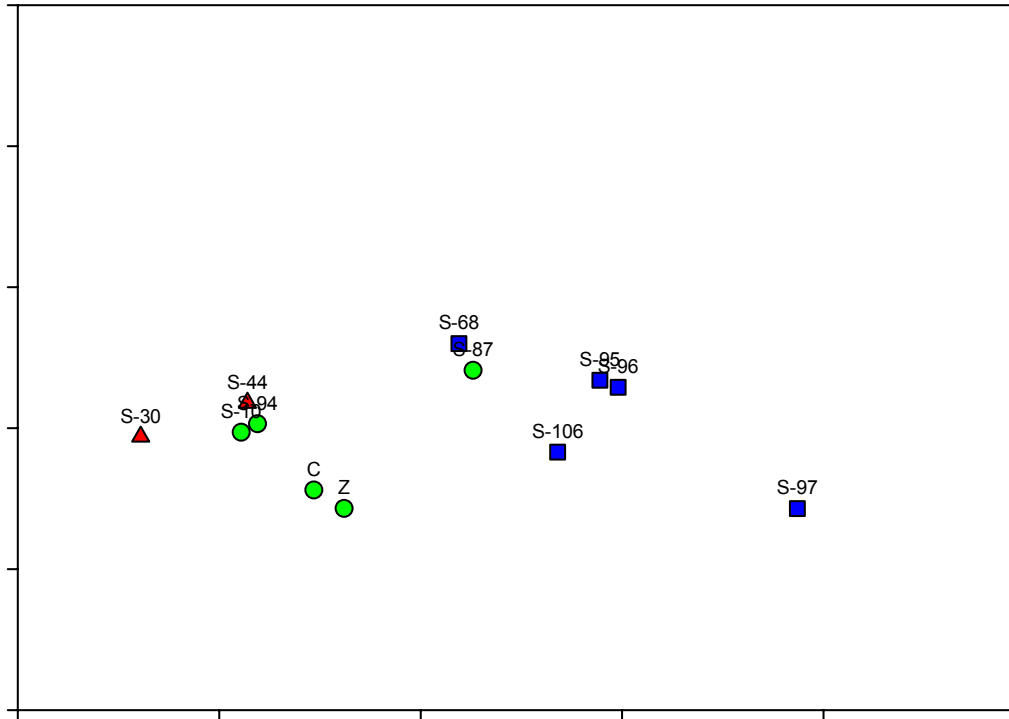
Spearman Rank Correlation between average length of inundation in 2001 and 2002 and number of tadpole species captured each year in 2001 and 2002 (Spearman r = .70, p < .05).
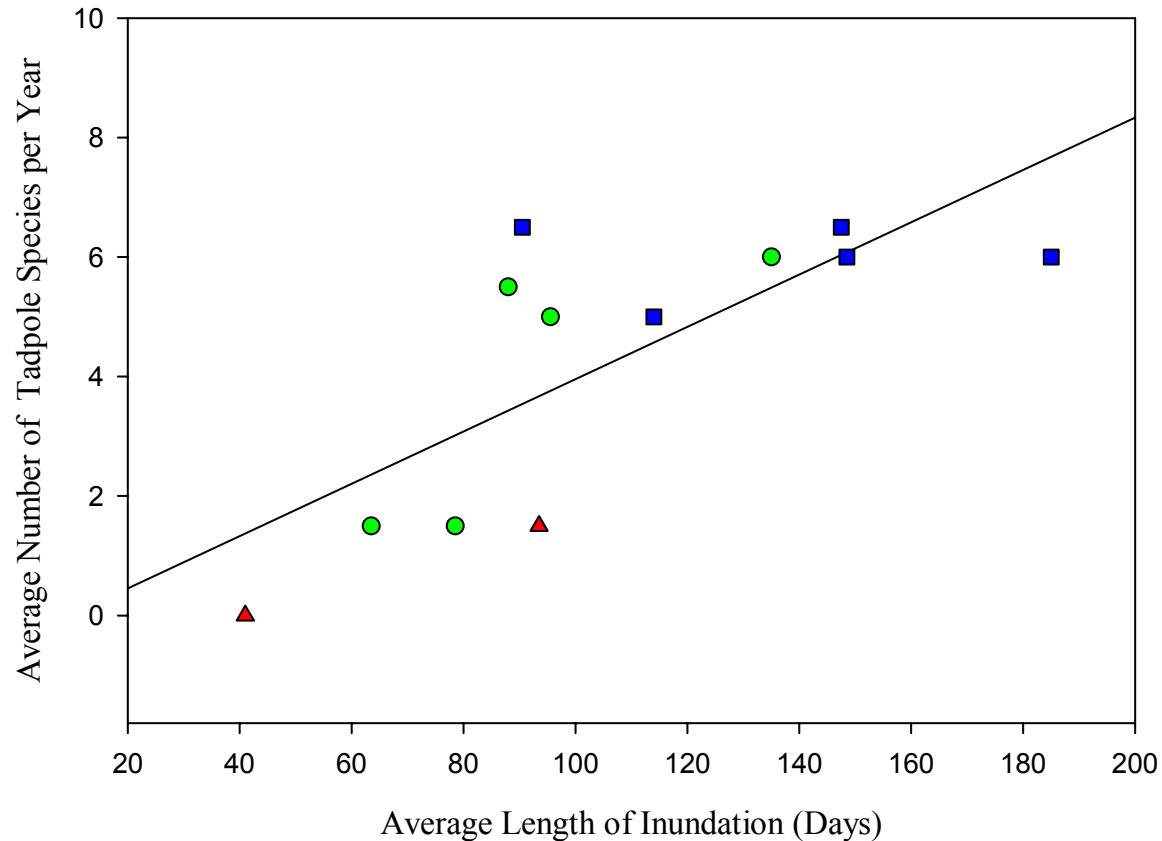
Spearman Rank Correlation between average Julian Date of inundation in 2001 and 2002 and number of tadpole species captured each year in 2001 and 2002 (Spearman r = .78, p < .01).
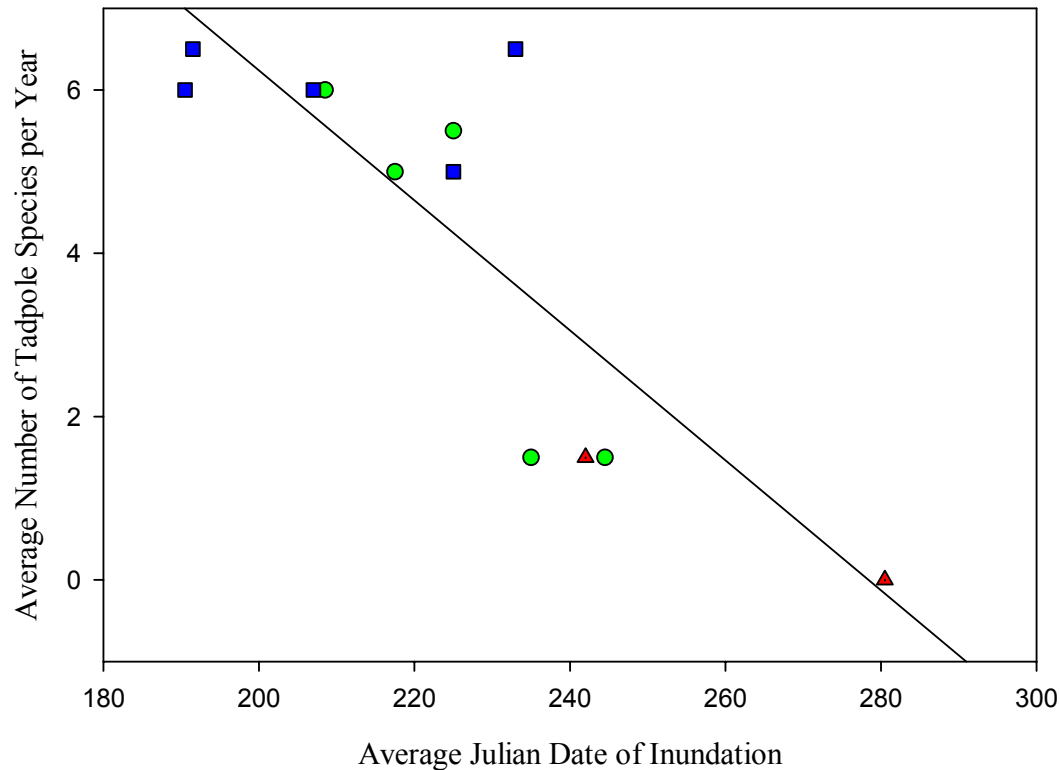
Spearman Rank Correlation between average number of species heard calling and the average number of tadpole species captured in 2001 and 2002 (Spearman r = .87, p < .001).
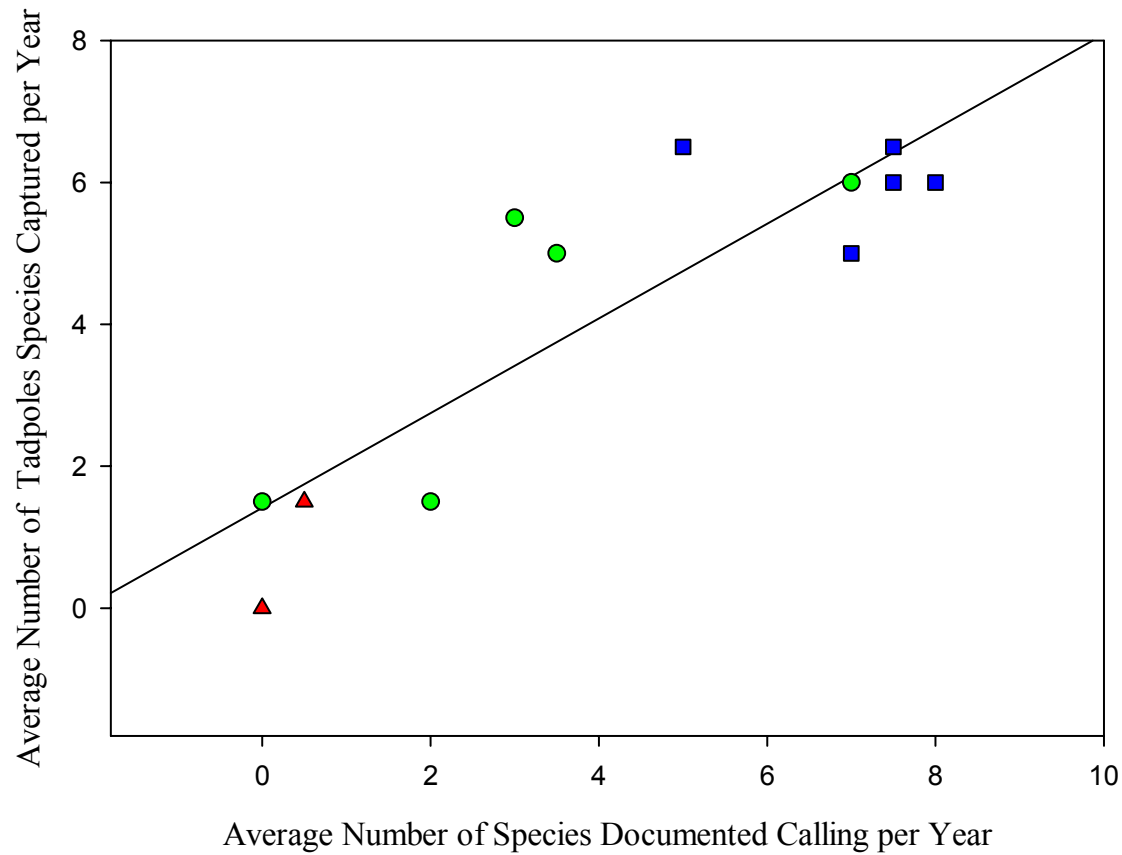
Discussion

* We determined through statistical analysis that it is possible to distinguish differences in wetland health based upon frog reproductive success.

* We found that there was overlap between the vegetative measures and the frog measures.

* We see that there is variation between years in reproductive success among wetlands.

* We established that it is possible to measure reproductive success by documenting frog calls or tadpole captures.

* We identified two important factors in the reproductive success of the frogs.
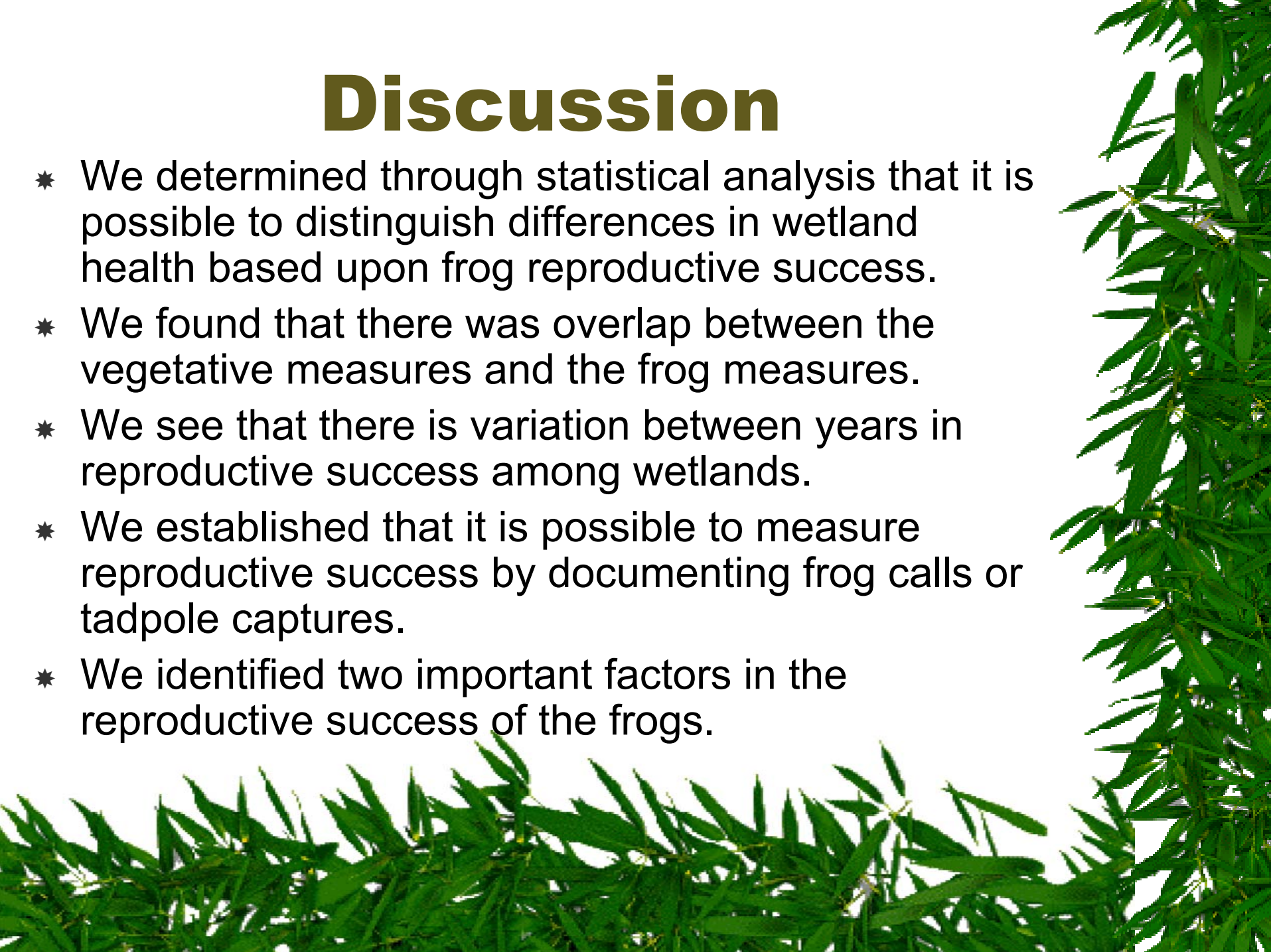
Further Discussion

* What are the implications of the study on wellfield management?
    – Two group or three groups of wetland categories?

* Does this study bring up further questions?
    – Combination of anuran and vegetative variables?
    – How can we separate natural variation from anthropogenic change?
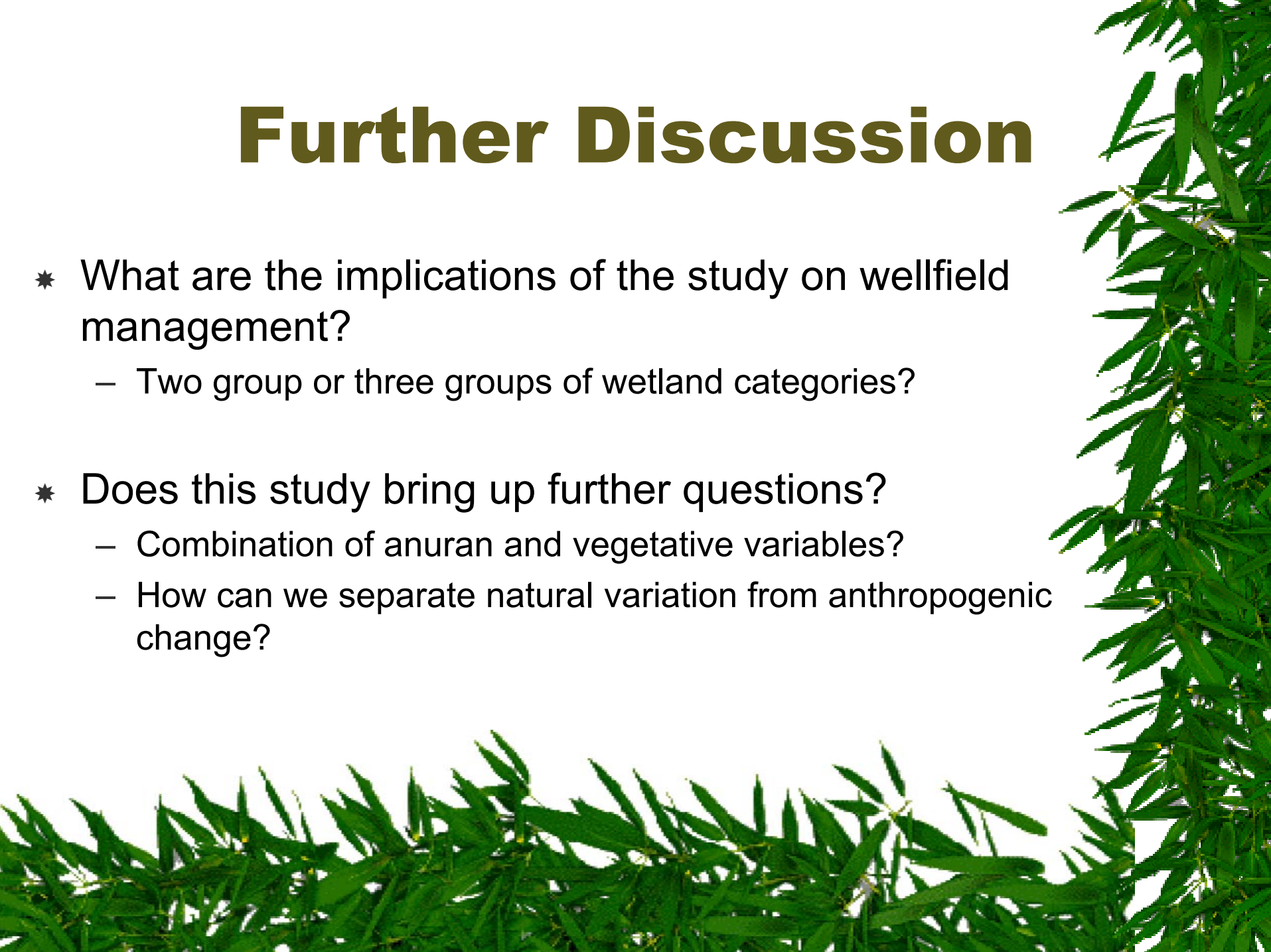
Acknowledgements

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Questions?