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
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 utricularia)
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

* Southwest Florida Water Management District
* Berryman & Heniger
* Biological Research Associates
* Cognocarta GIS
* Pasco County Staff
* Graduate Committee

* Ted Rochow
* Diane Willis
* Dan Schmutz
* Brian Halstead
* Neal Halstead
* Kris Raymond
* Pablo Delis
* Lee Walton
* Jason Lancaster
* Lou Anne Perkins
* Jennifer Gonzalez
* Ronn Altig
* J. Steve Godley
* Doug Durbin
Questions?