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Response of Birds to Vegetation, Habitat Characteristics, and Landscape Features in Restored Marshes

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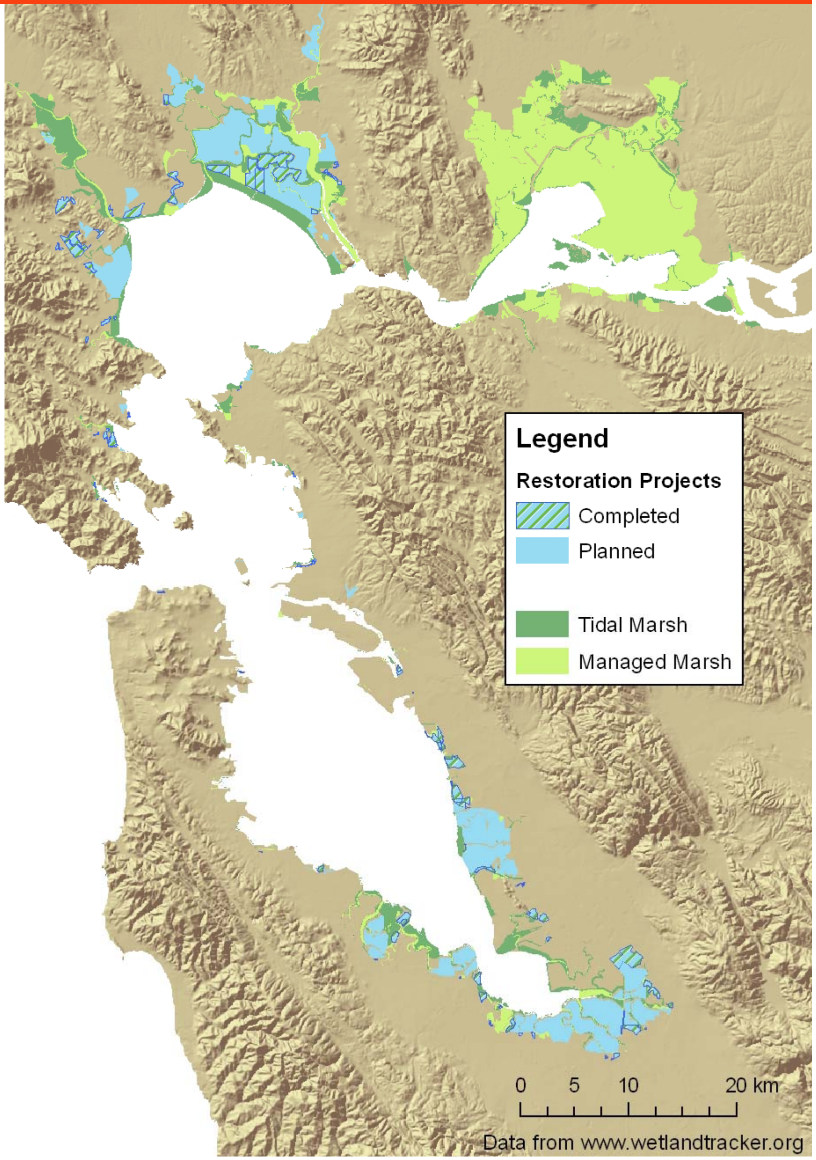
Restoration in the San Francisco Estuary

- Significant restoration occurring in the bay
- Need to evaluate restoration “success”
- Need to be able to predict how the marsh will respond to restoration
- Evaluation requires effective <u>long term</u> monitoring
- Recent research projects have started to investigate restoration
  - BREACH
  - IRWM



Talk Outline

- Introduce Integrated Regional Wetlands Monitoring (IRWM)
- Describe the method of spatial prediction
- Use data from IRWM project to produce predictions of Song Sparrow and Salt marsh Common Yellowthroat
- Examine the uncertainty (spatially) of the predictive model
- Introduce a method of adaptive monitoring

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Integrated Regional Wetlands Monitoring Project (IRWM) Goals

(1) *How are restoration efforts affecting ecosystem processes at different scales*

(2) Develop adaptive strategy for long term monitoring.

IRWM Core

Team	Participating Organizations
Physical Processes Team	Wetlands and Water Resources Philip Williams and Associates
Landscape Ecology Team	University of California, Berkeley Wetlands and Water Resources PRBO Conservation Science
Plant Team	San Francisco State University
Bird Team	PRBO Conservation Science
Fish/Invertebrate/ Primary Production/Nutrients Team	San Francisco State University University of Washington University of California, Davis U.S. Geological Survey
Data Management Team	San Francisco Estuary Institute
Science Support	San Francisco Estuary Institute

IRWM Site Locations

- IRWM initiated a monitoring program at sites with different restoration ages, including mature and restored:
  - Carl's Marsh (1994), Bull Island (1980), Pond 2A(1995), Sherman Lake (1925), Brown's Island (Mature), Coon Island (Mature)

Key Indicators

Song Sparrow

<u>Species of conservation concern</u>

- Song Sparrow
- Salt Marsh Common Yellowthroat
- Black Rail
- Clapper Rail

Black Rail

Clapper Rail

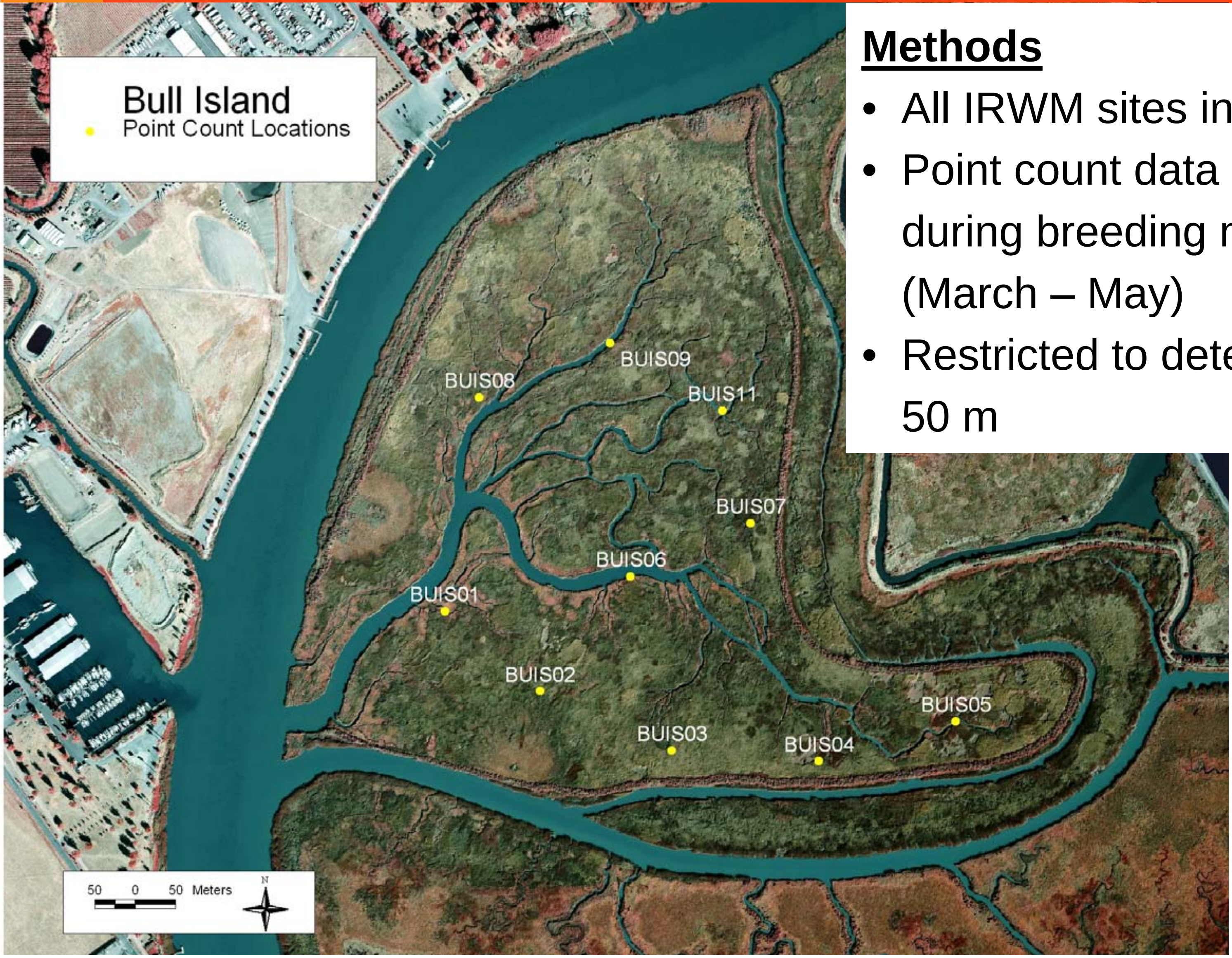
Salt marsh Common Yellowthroat

Photo by Peter La Tourrette

Introduction to Spatial Modeling

- All ecological processes occur in a spatial context
- Excellent method of examining the role of spatial heterogeneity
- Provides a way to extrapolate predictions across spatial and temporal scales.
- The ability to use data derived from remote sensing improves our ability to assess restoration at larger scales than only monitoring would allow
- Note: spatial predictions are still only as good as the model they are based on. Measuring that uncertainty can be as important as the prediction itself.

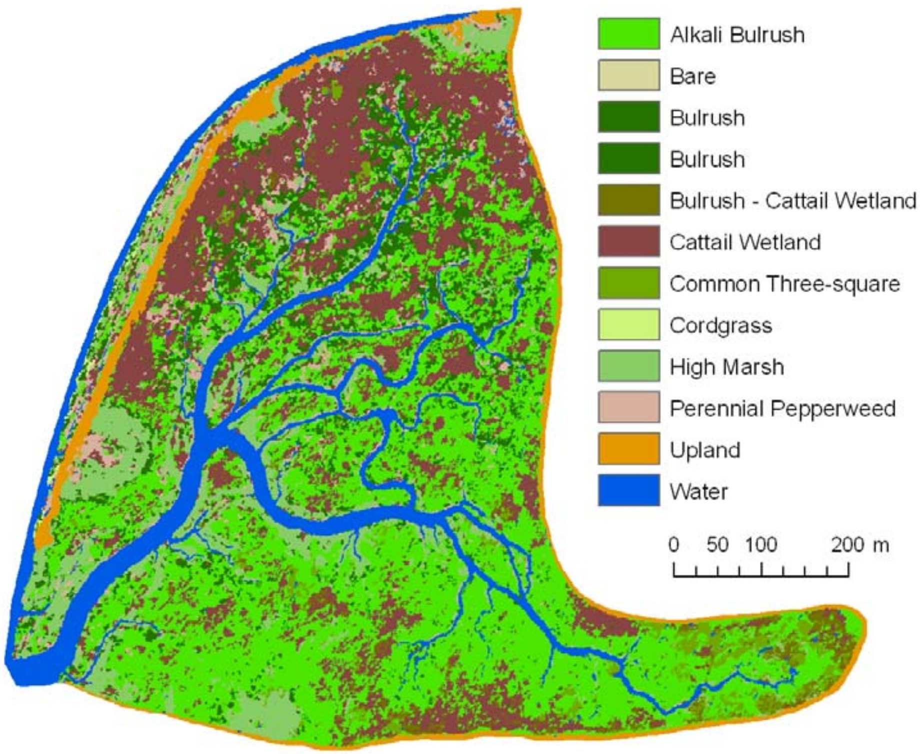
Collect data and estimate bird densities



Methods

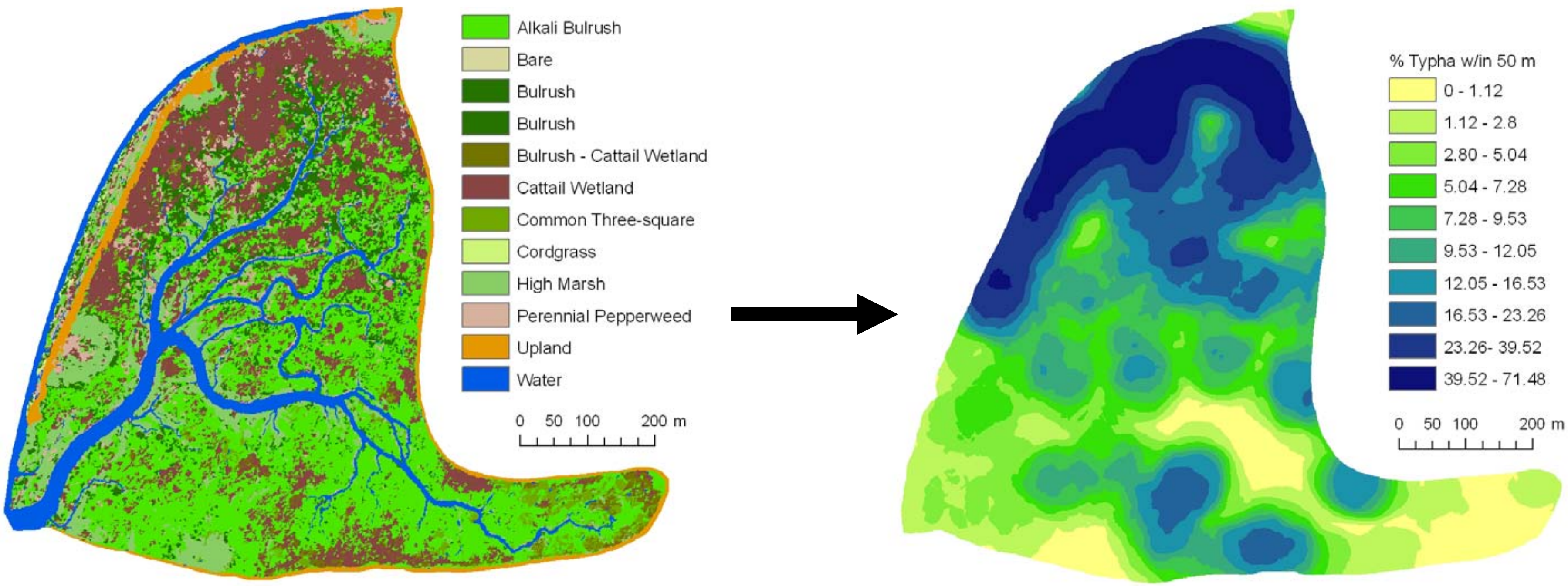
- All IRWM sites included
- Point count data collected during breeding months (March – May)
- Restricted to detections within 50 m

Identify Metrics



- **Vegetation**
  - Diversity
  - Productivity
  - Species Composition
- **Geomorphology**
  - Channel Density
  - Channel proximity
  - Levee proximity

Create GIS layers of metrics



Linear Models - Results

Common Yellowthroat. Photo by Peter La Tourretter

Song Sparrow. Photo by David Gardner

Model Results: Adj. R^2=0.4869

Bay and Site
(+) Distance to nearest channel
(+) Vegetative Diversity
Percentage area covered by:
- **(+)*Scirpus americanus***
- **(+)*Lepidium latifolia***
- **(-)*Typha spp.***

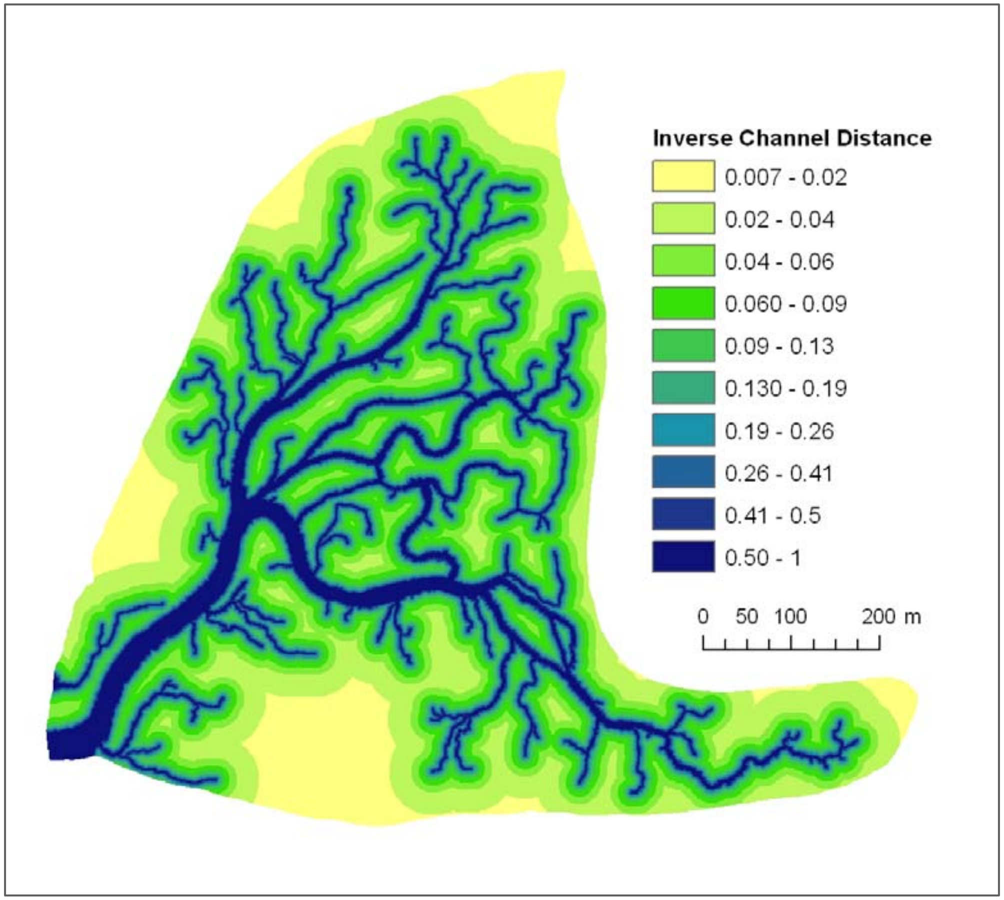
Model selection based on stepwise AIC

Model Results: Adj. R^2=0.2333

Bay and Site
(-) Distance to nearest Levee
(-) Channel density
(+) Channel area
(-) Channel density * Channel area
Percentage area covered by:
- **(-) *Spartina foliosa***
- **(-) *Salicornia* spp.**
- **(-) *Scirpus maritimus***
- **(-) *Typha* spp.**

Building Predictive Models

$$Y=m_1x_1+m_2x_2+m_3x_3+m_4x_4+b$$



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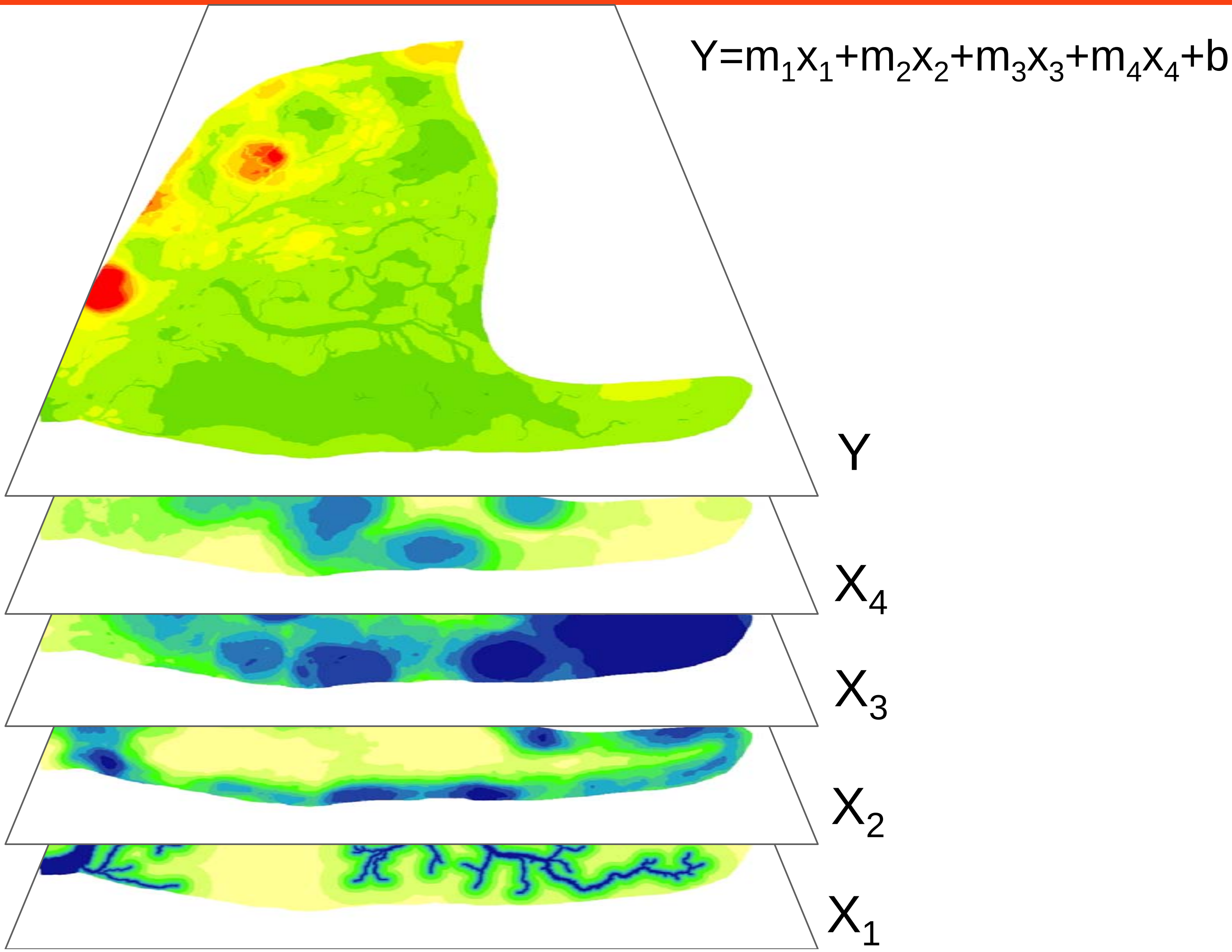
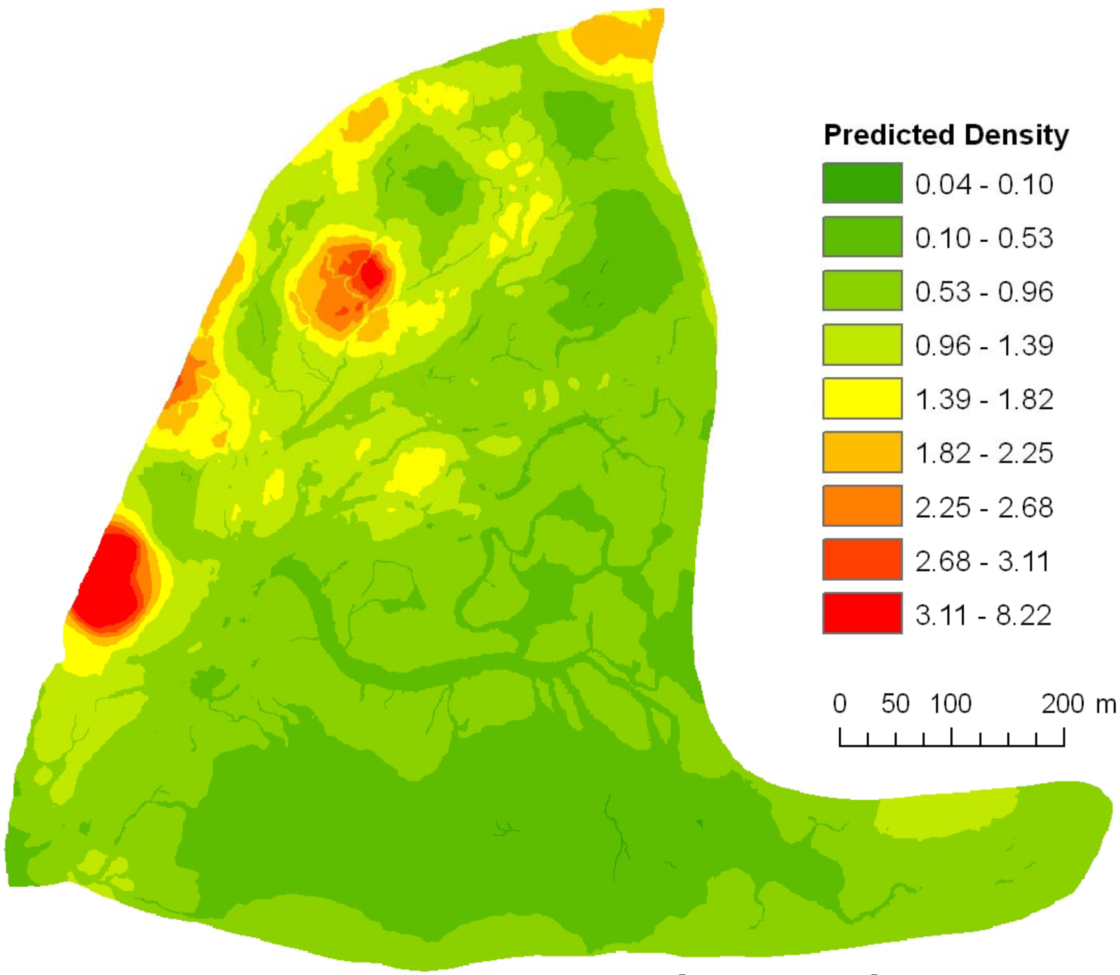
Building Predictive Models



Building Predictive Models



Salt Marsh Common Yellowthroat

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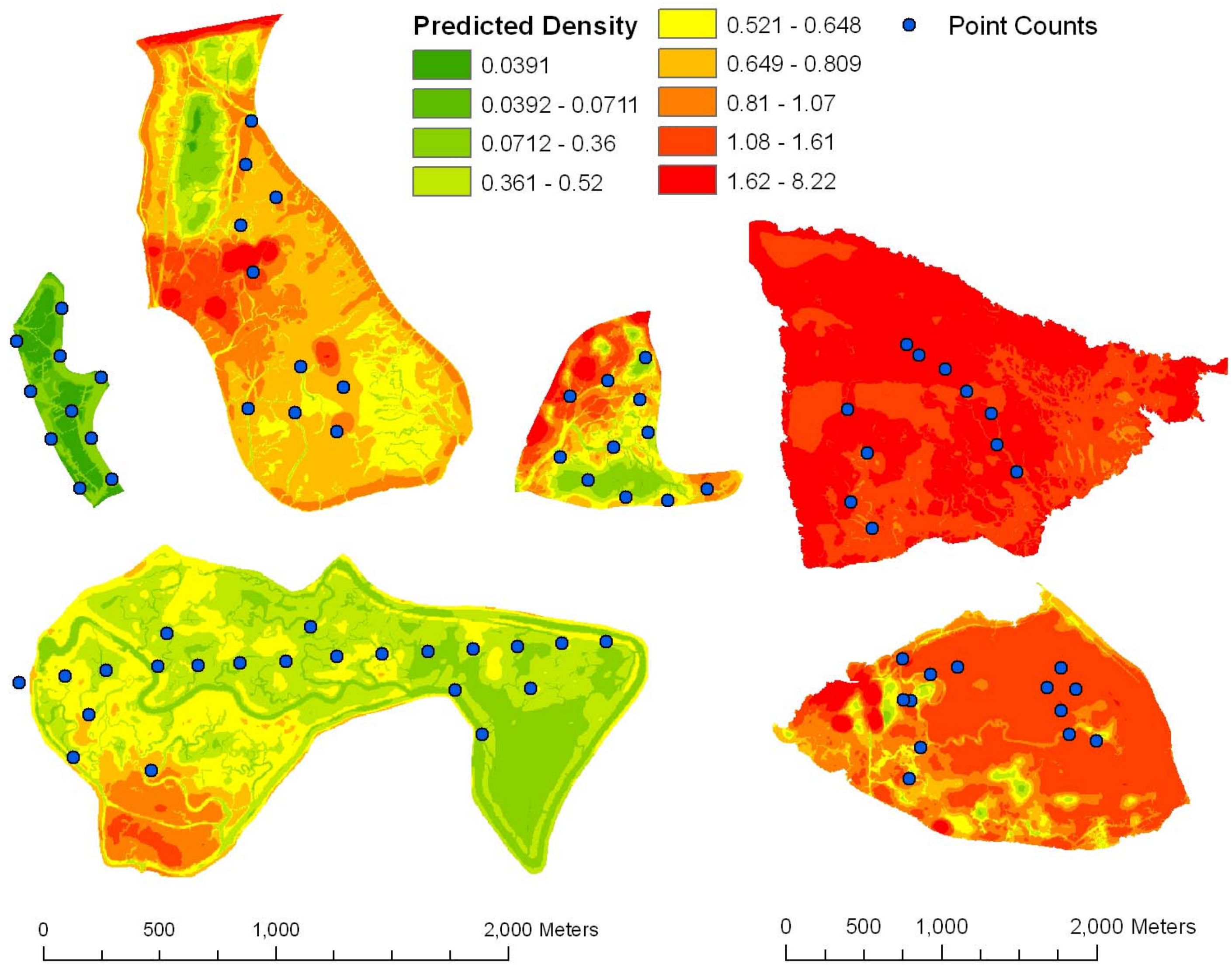
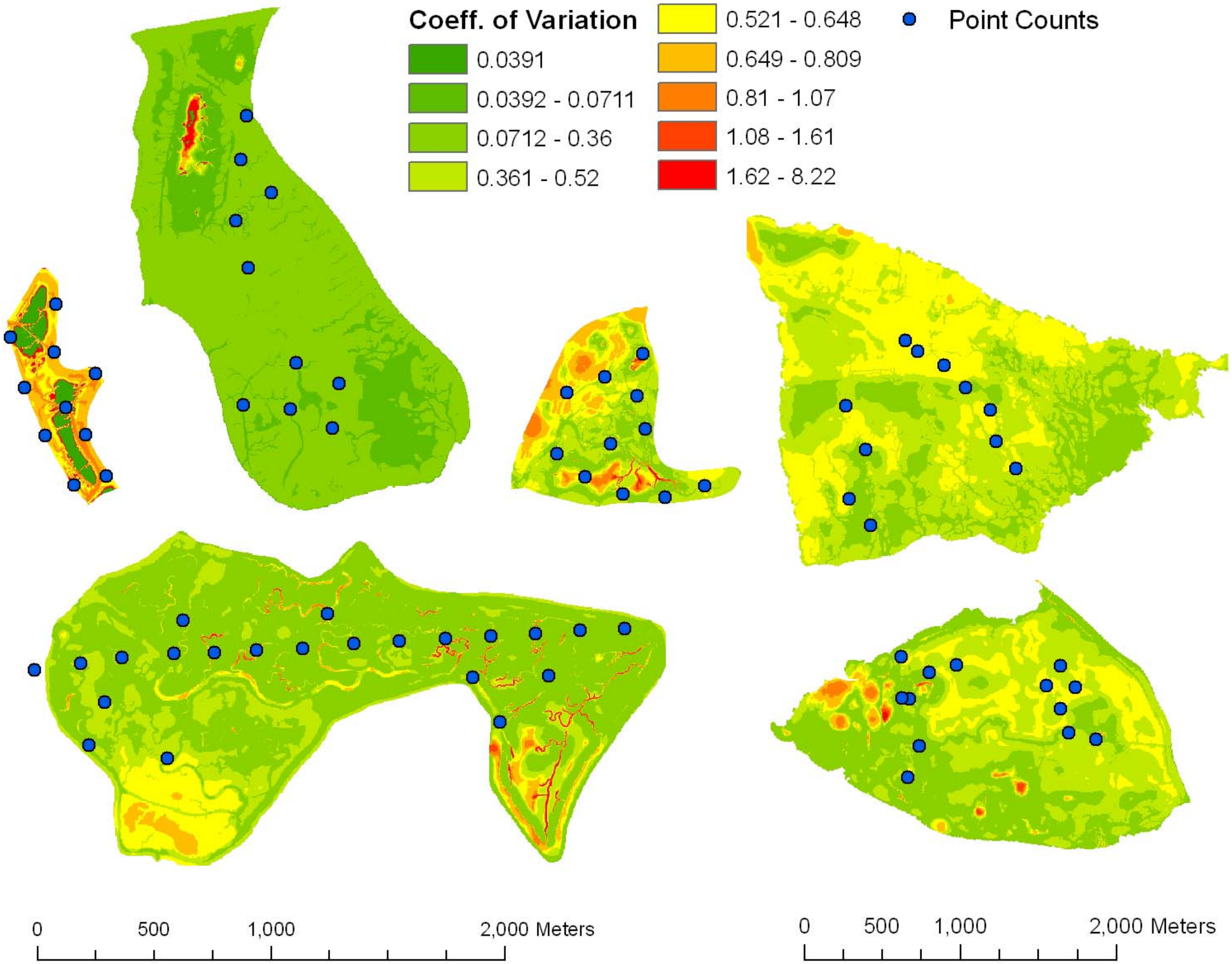
Common Yellowthroat Predictions



Common Yellowthroat Prediction Uncertainty



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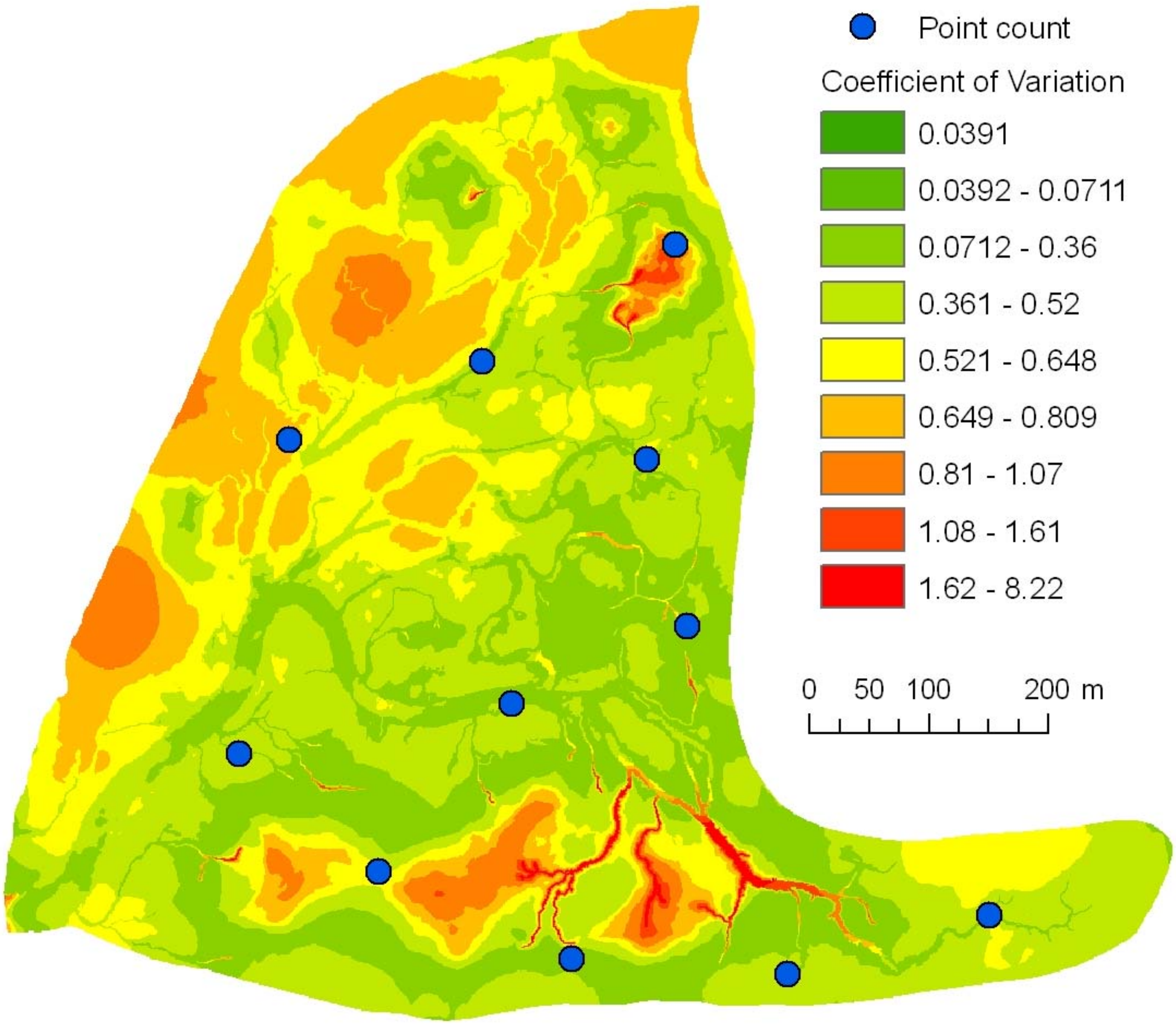

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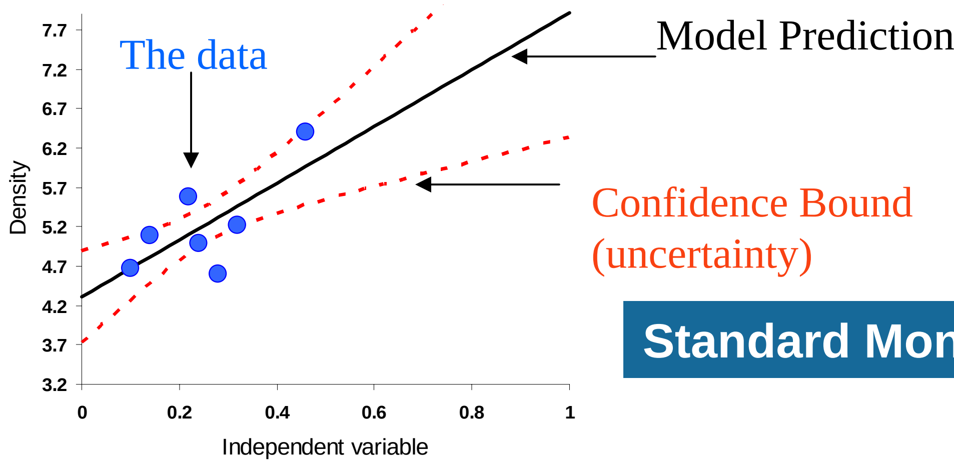
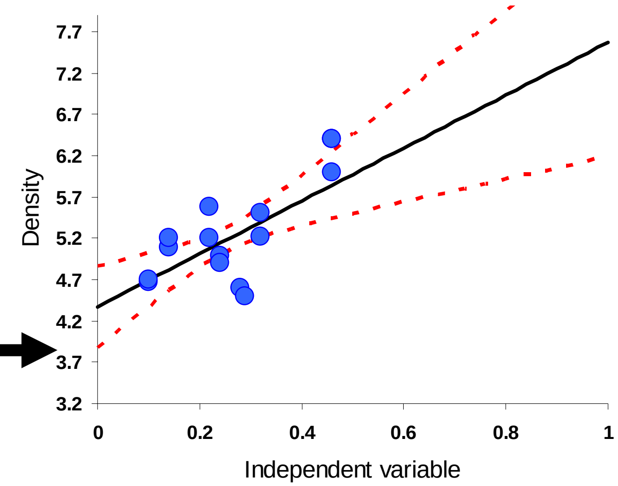
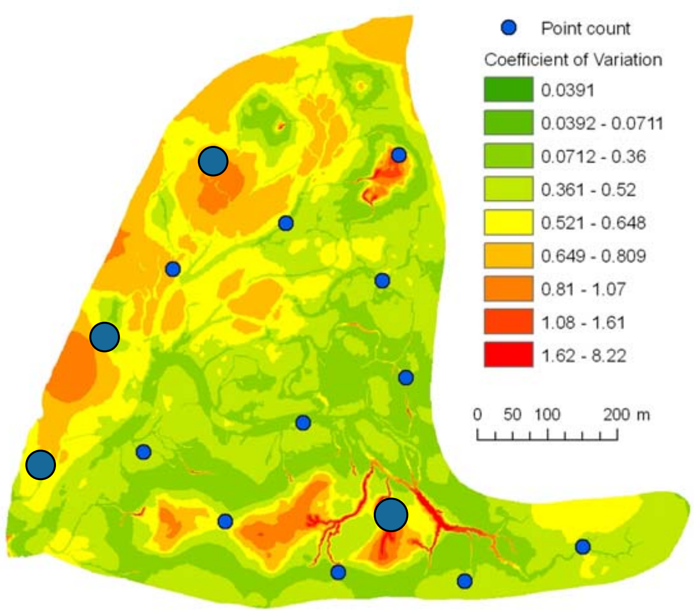
Adaptive Monitoring – Basic Example

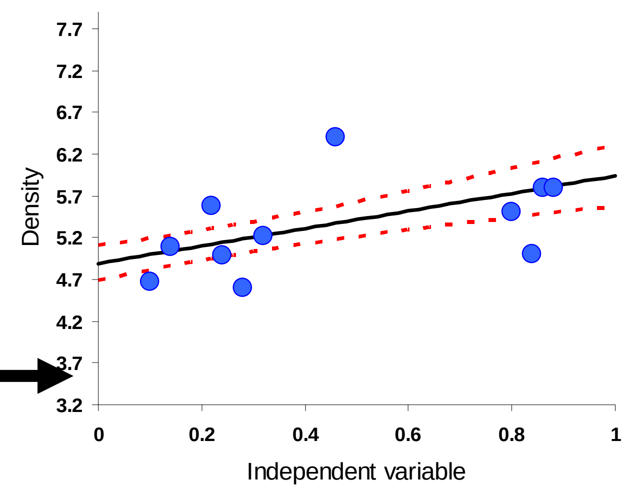


Standard Monitoring →

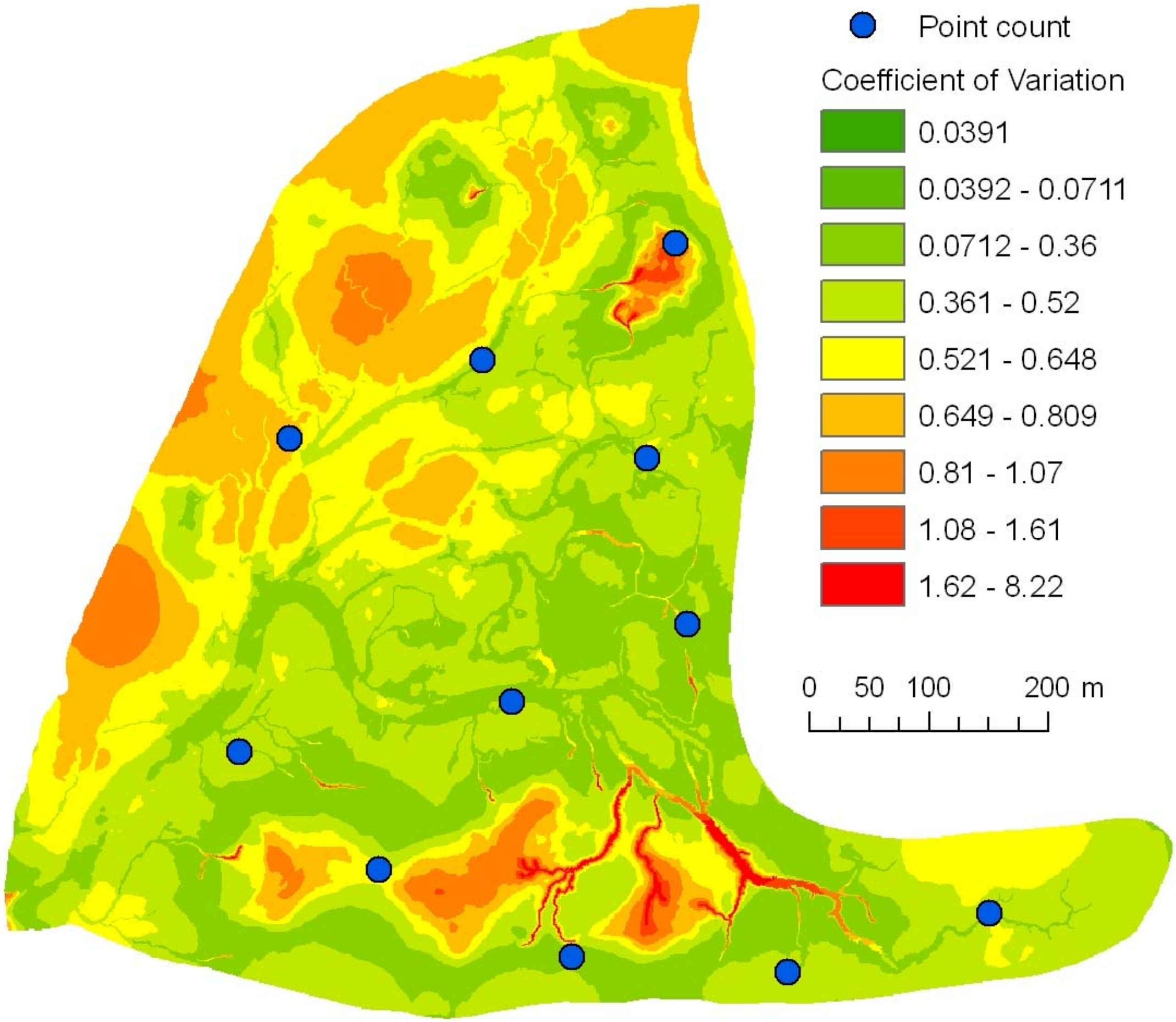




Adaptive Monitoring →



Monitoring and Site selection – using uncertainty to guide



Conclusions

- Spatial modeling provides an excellent tool to evaluate restoration
- Spatial modeling also provides a way to address the uncertainty in our model predictions.
- Adaptive monitoring will enable researchers to more efficiently monitor, and in a way where the goal is as much “to learn” as it is to monitor.

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  - Especially J. Calloway, T.Parker,L.Schile
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