California Coastal Wetlands Monitoring Venture

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California Coastal Commission

California Coastal Wetlands Monitoring Venture

Landscape Profiles

1. Fragmentation Analysis
2. Cross-scale exploration of stressor-state correlations

Part 1: Bayland Fragmentation

Sponsors

USEPA Section 104b

USFWS San Francisco Bay Program

San Francisco Foundation

Collaborators

Diana Stralberg & Nadav Nur
@ Point Reyes Bird Observatory

Howard Shellhammer @ San Jose State U

Maggi Kelly @ UC Berkeley

Purpose

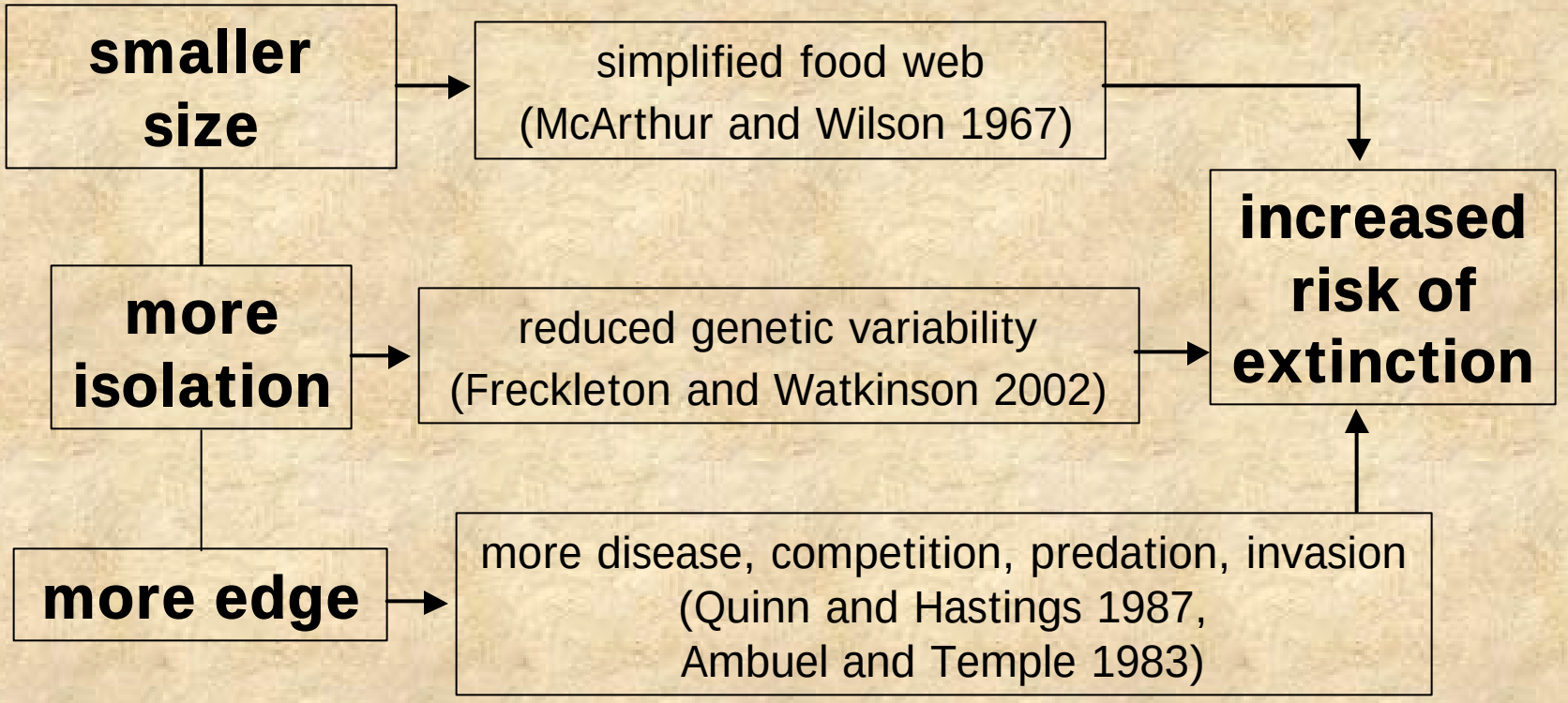
Start regional fragmentation studies

- Illustrate the scale-dependency of fragmentation analysis
- Develop hypotheses of habitat fragmentation that can be genetically tested at the landscape scale

Fragmentation Definition

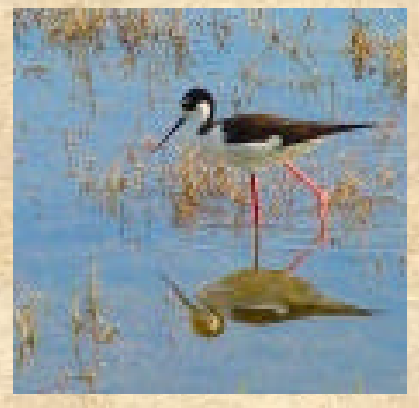
Reduction in size and increase in separation between areas of like habitat, often with changes in patch shape.

Conceptual Model



Steps in Fragmentation Analyses

Species-specific, *so* ***need to select species and develop heir rule sets***.

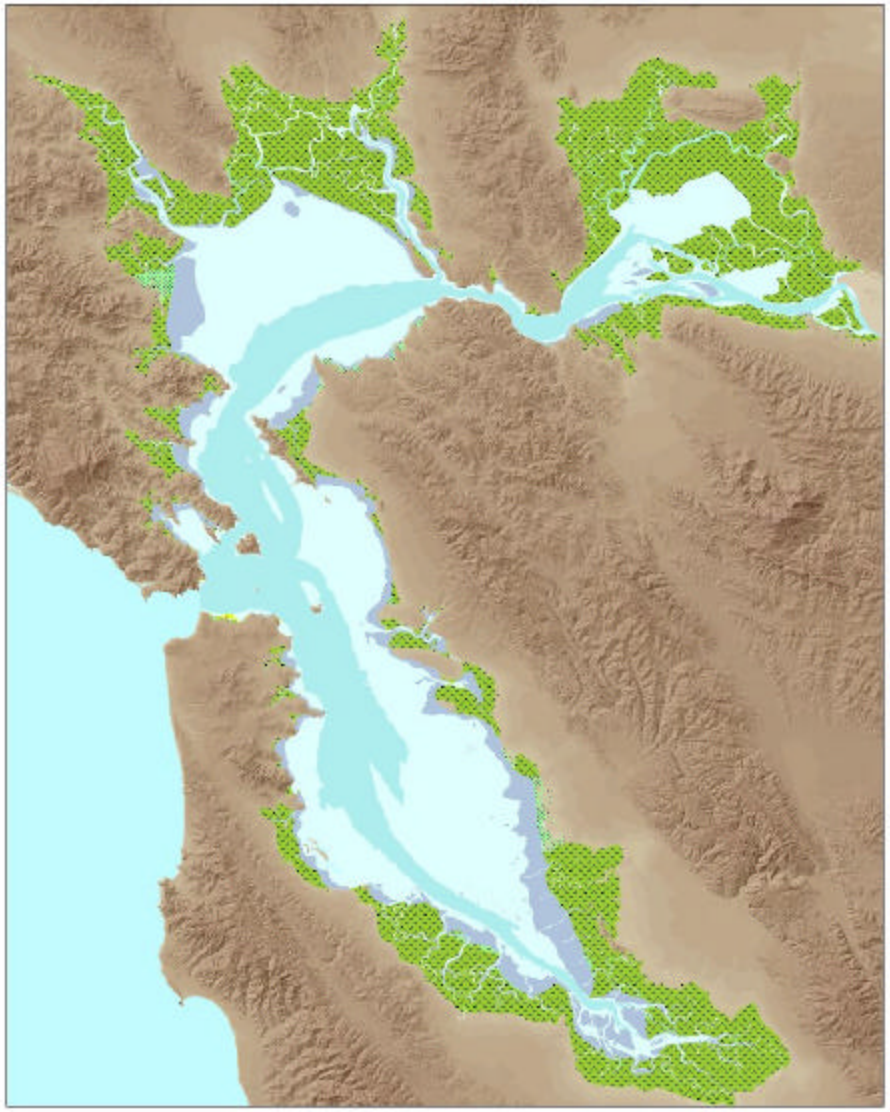


Focus on Patch *Type 1*

resident rails rule set

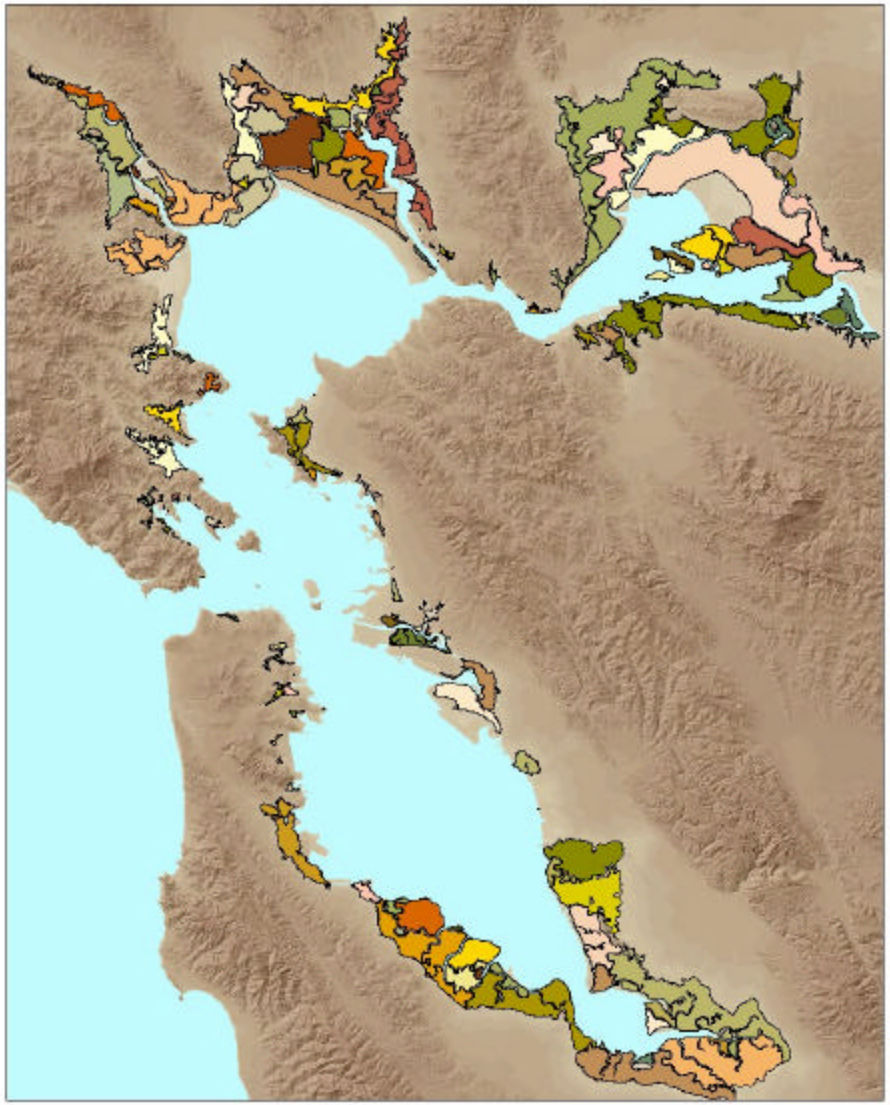
- ✓ Upland areas > 200 ft wide
- ✓ Open water areas > 200 ft wide at low tide
- ✓ Tidal channels > 200 ft wide from bank-top to bank-top.
- ✓ Man-made levees on 1:24k scale USGS maps
- ✓ Paved Roads of any size

Distribution of Patch Type 1



Historical
Distribution
of
Tidal Marsh
(pre Euro-American
contact)

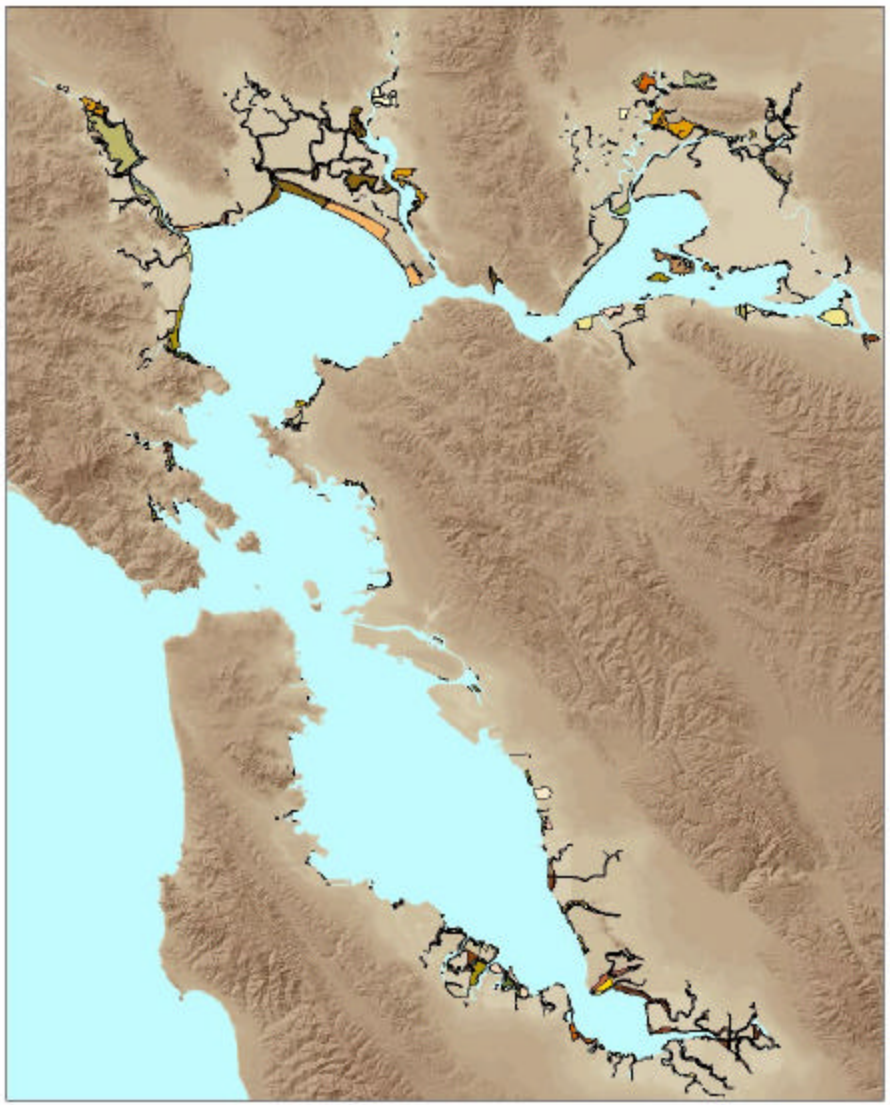
Distribution of Patch Type 1



Map of the historical Type 1 patches

313 patches total

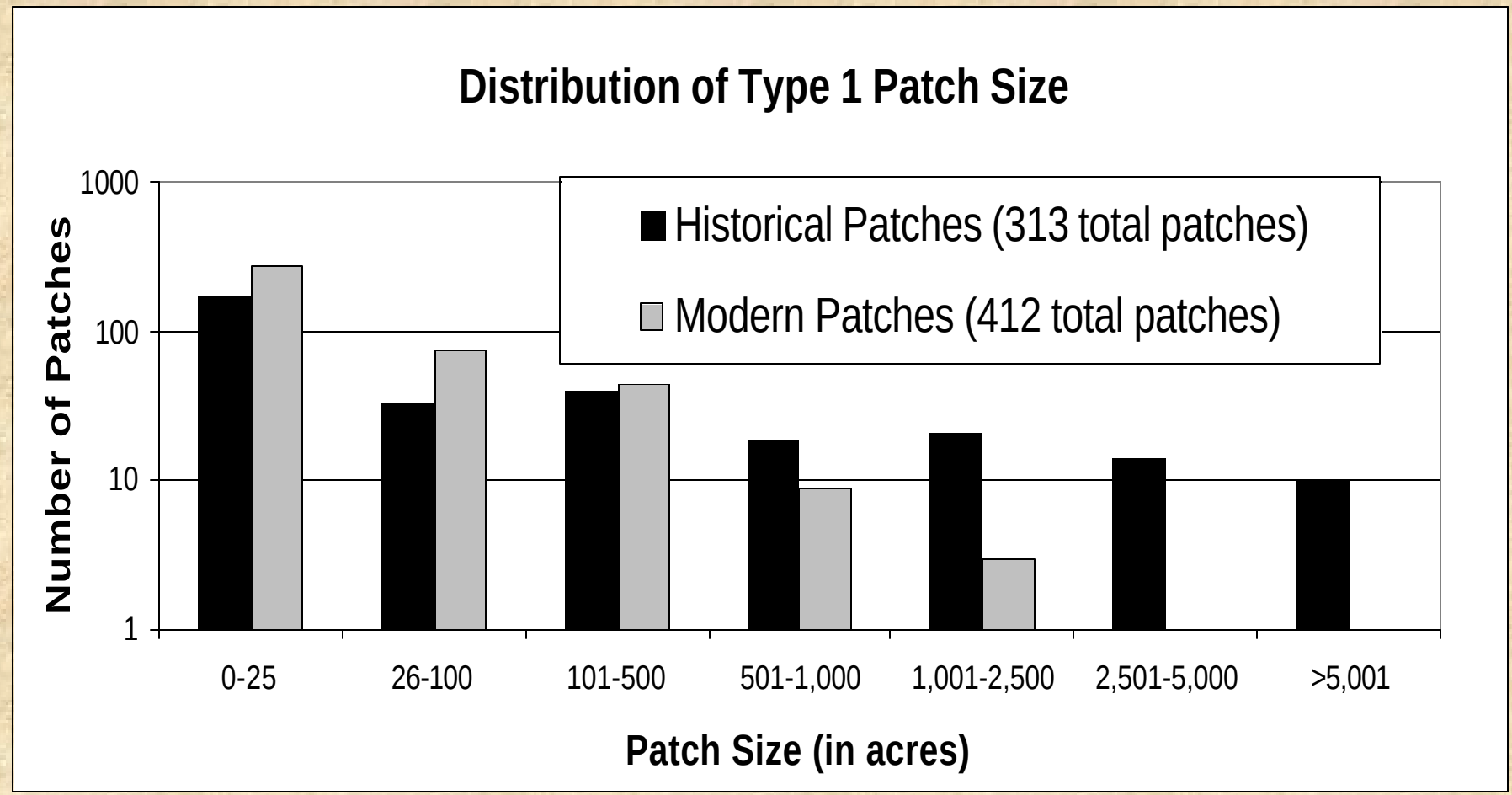
Distribution of Patch Type 1



Map of the modern Type 1 patches

412 patches total

Distribution of Patch Size



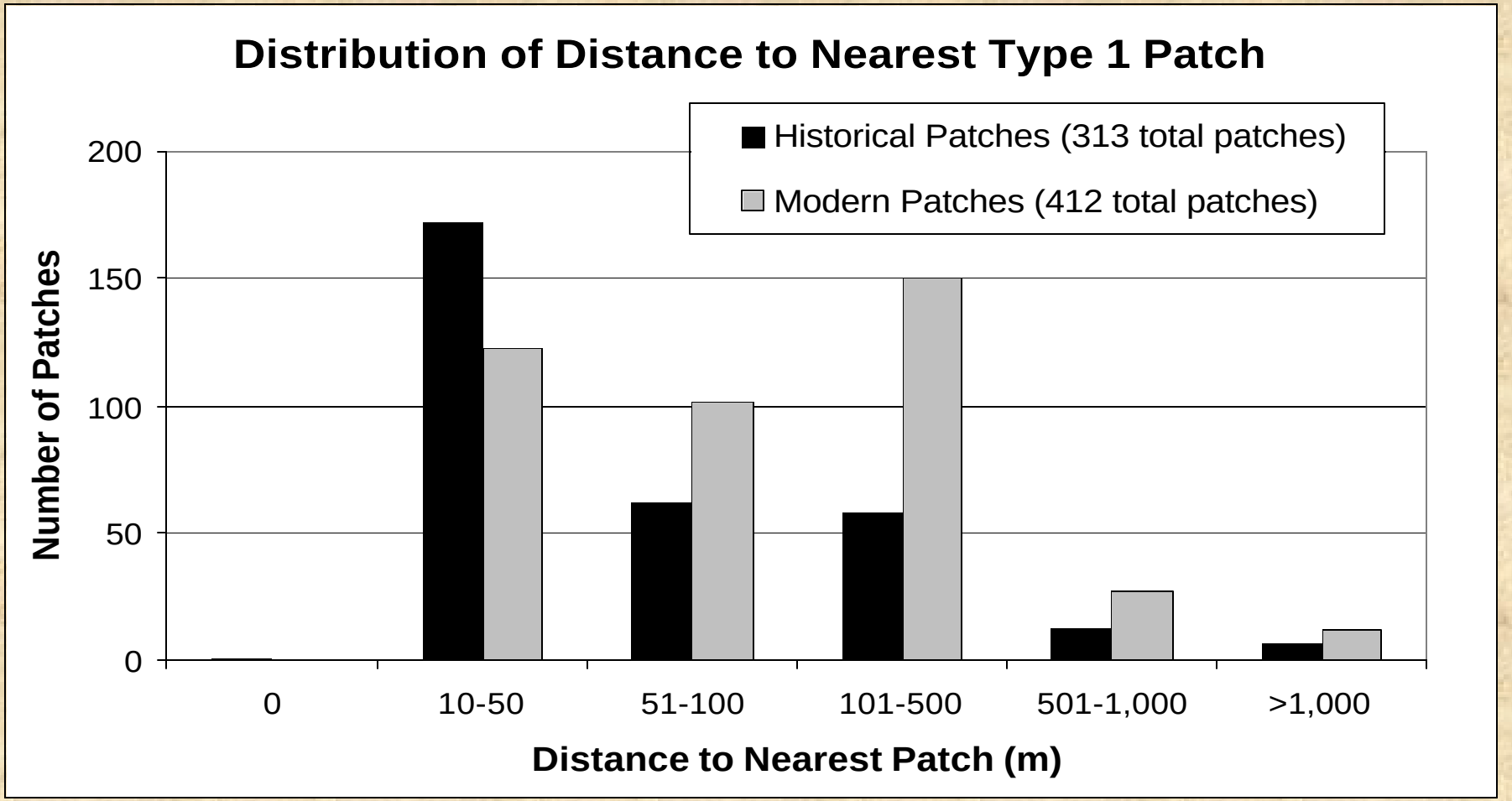
Distribution of Patch Size

Small patches were historically abundant.

Historical small patches are gone; most small patches are relics of large patches.

Maximum patch size has been cut in half.

Distance between Patches



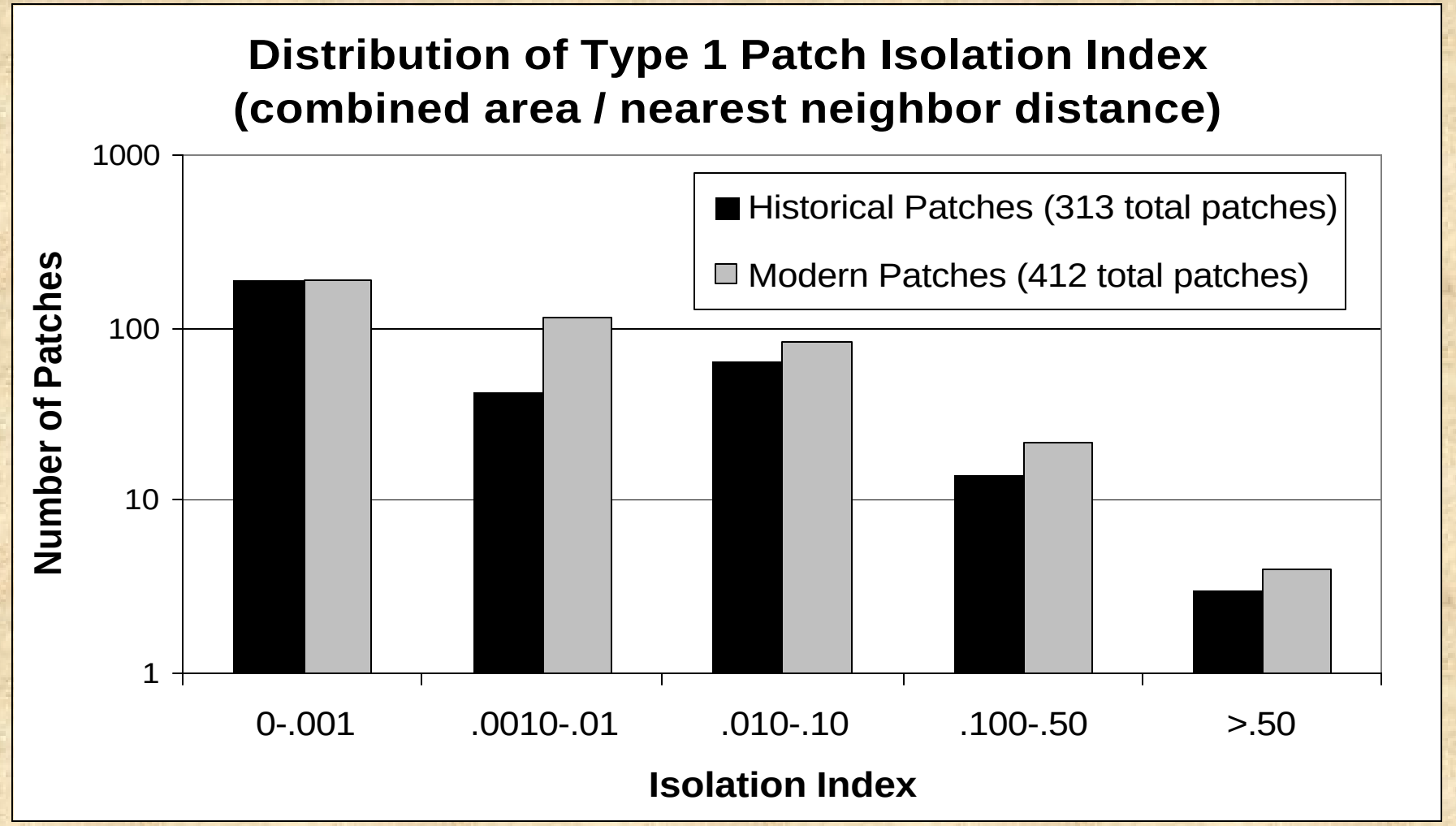
Distance between Patches

The frequency of close patches has increased 50%.

The frequency of moderately close patches has increased 200%.

The frequency of far apart patches has increased 100%.

Patch Type 1 Isolation



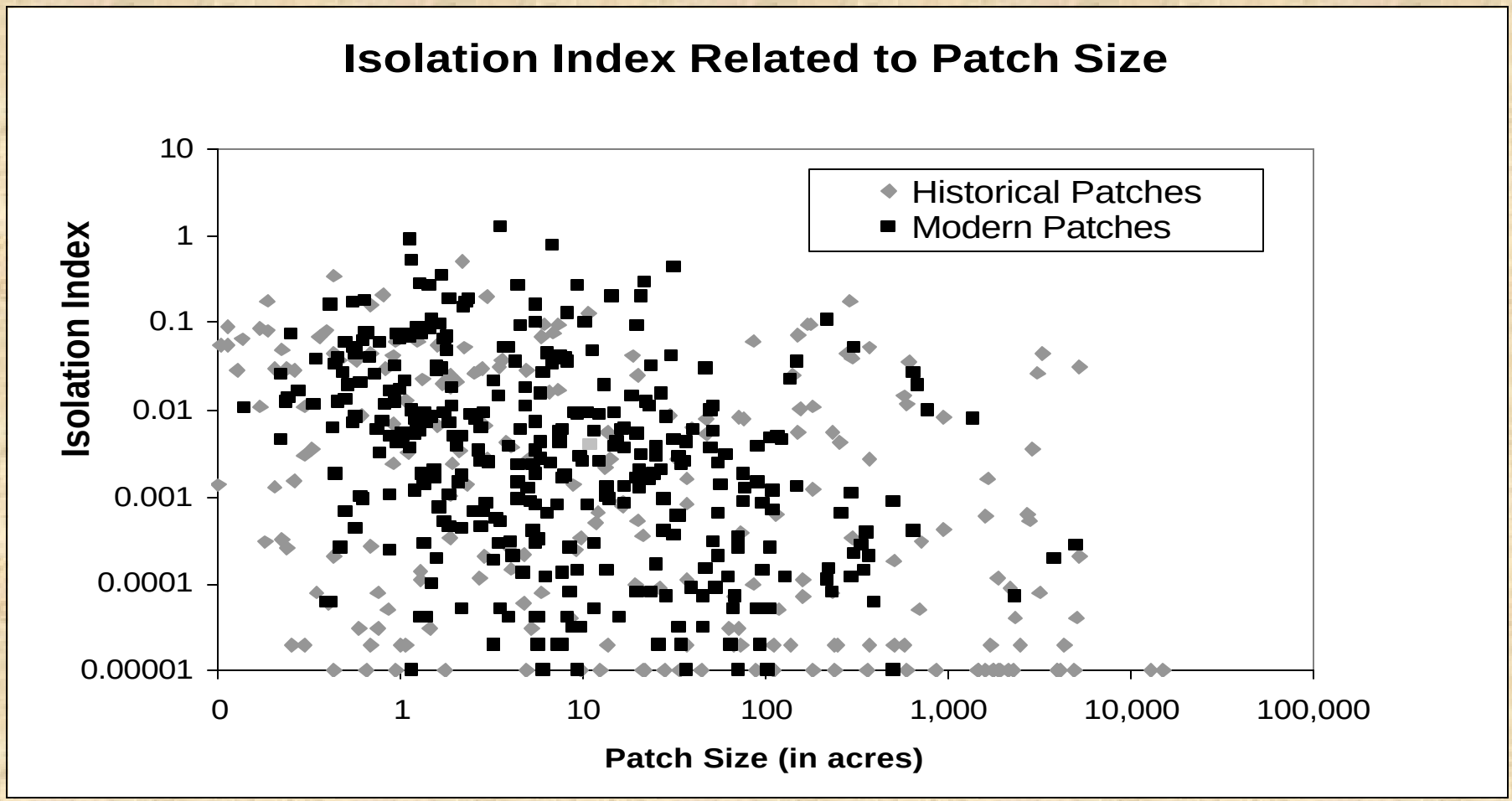
Patch Type 1 Isolation

The frequency of minor isolation has not changed.

The frequency of moderate isolation has increased 50-75%.

The frequency of major isolation has increased 25%.

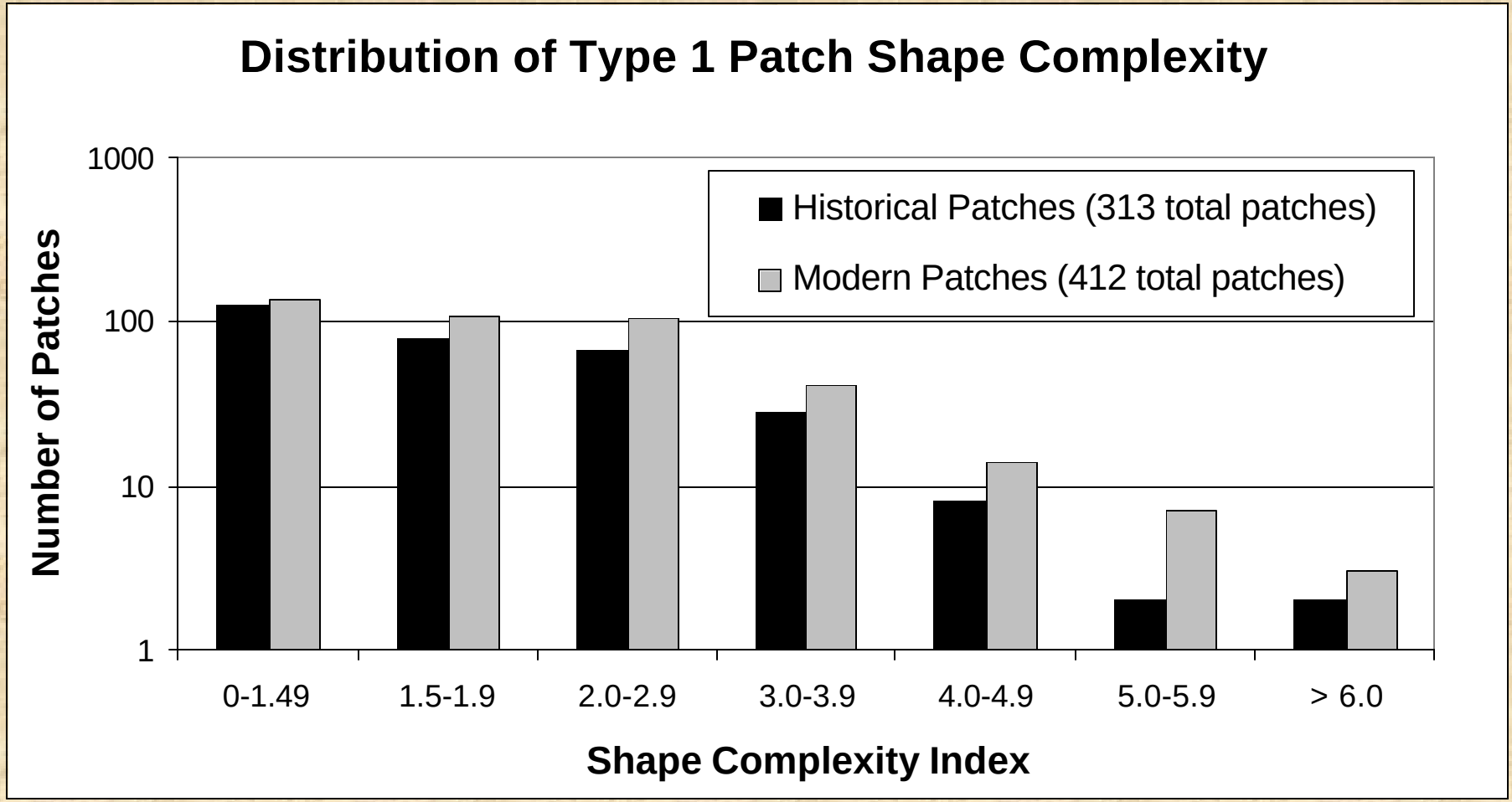
Patch Size and Isolation



Patch Size and Isolation

Isolation is not related to patch size.

Patch Shape


Distribution of Type 1 Patch Shape Complexity
Historical Patches (313 total patches)
Modern Patches (412 total patches)
Number of Patches
1000
100
10
1
0-1.49
1.5-1.9
2.0-2.9
3.0-3.9
4.0-4.9
5.0-5.9
> 6.0
Shape Complexity Index

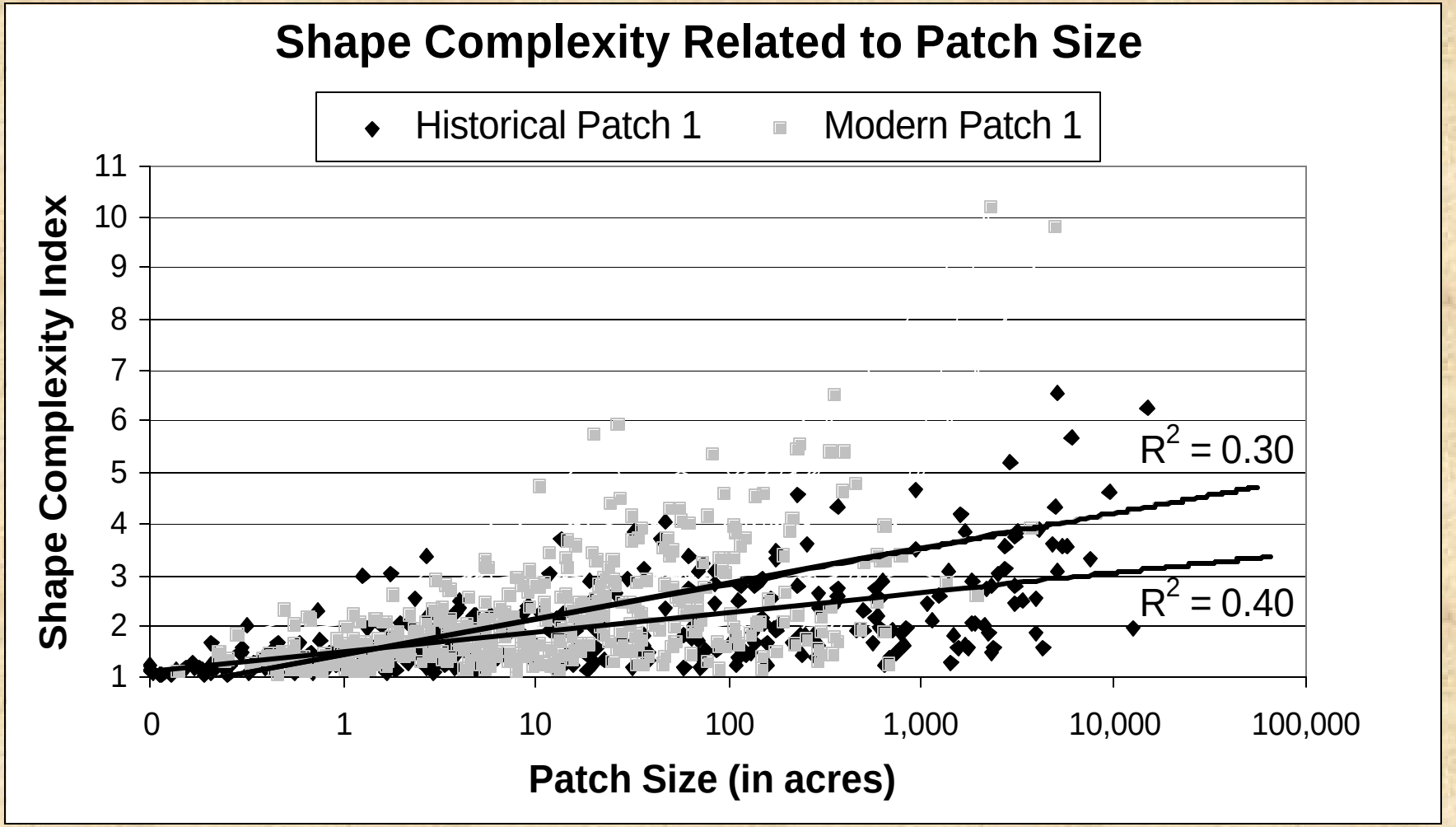
Patch Shape

Shape complexity (perimeter:area) has generally increased.

The frequency of moderate complexity has increased about 75%.

The frequency of very complex patches has increased 100-200%.

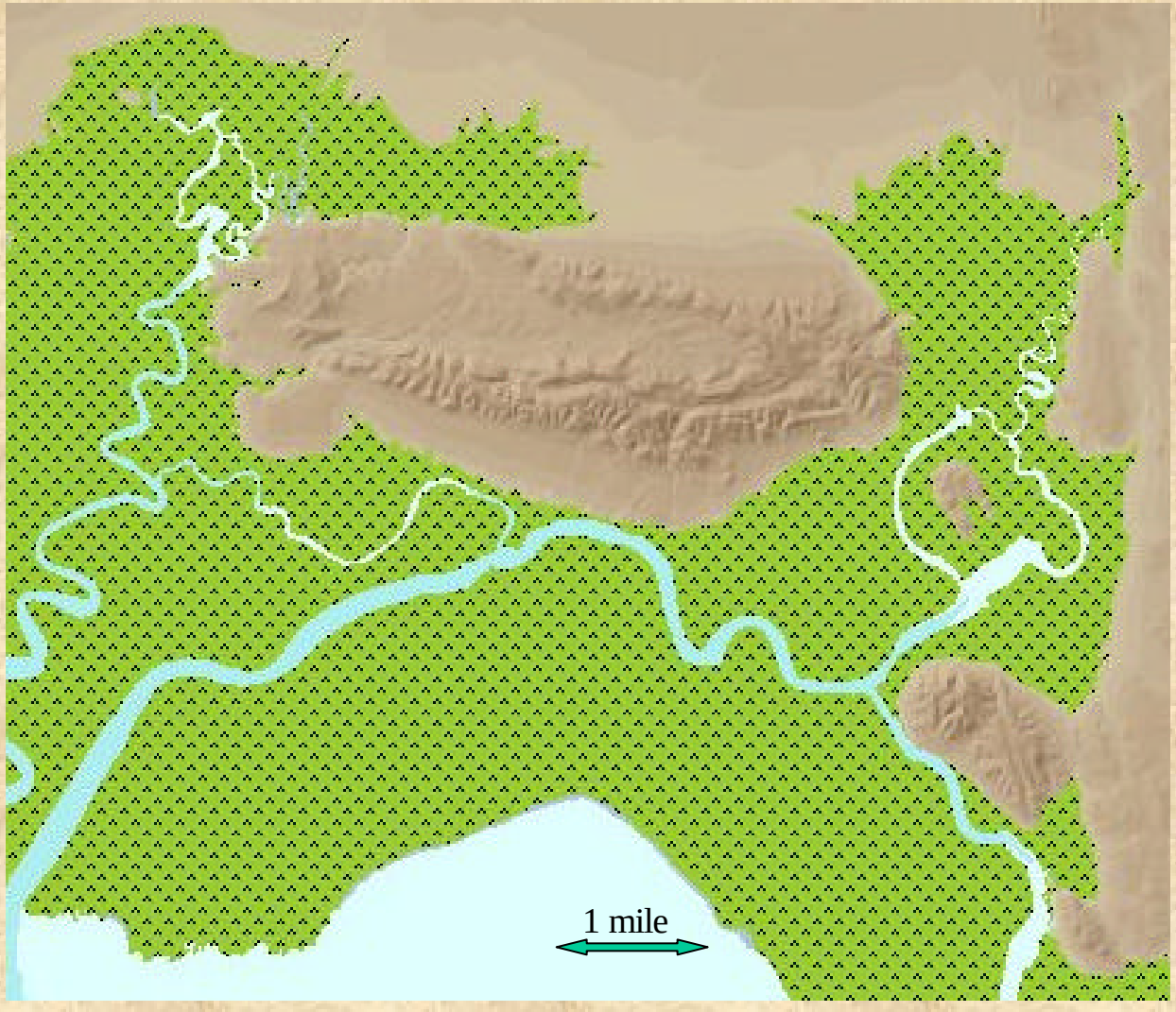
Patch Shape


Shape Complexity Related to Patch Size
Historical Patch 1
Modern Patch 1
Shape Complexity Index
11
10
9
8
7
6
5
4
3
2
1
0
1
10
100
1,000
10,000
100,000
Patch Size (in acres)
$R^2 = 0.30$
$R^2 = 0.40$

Patch Shape

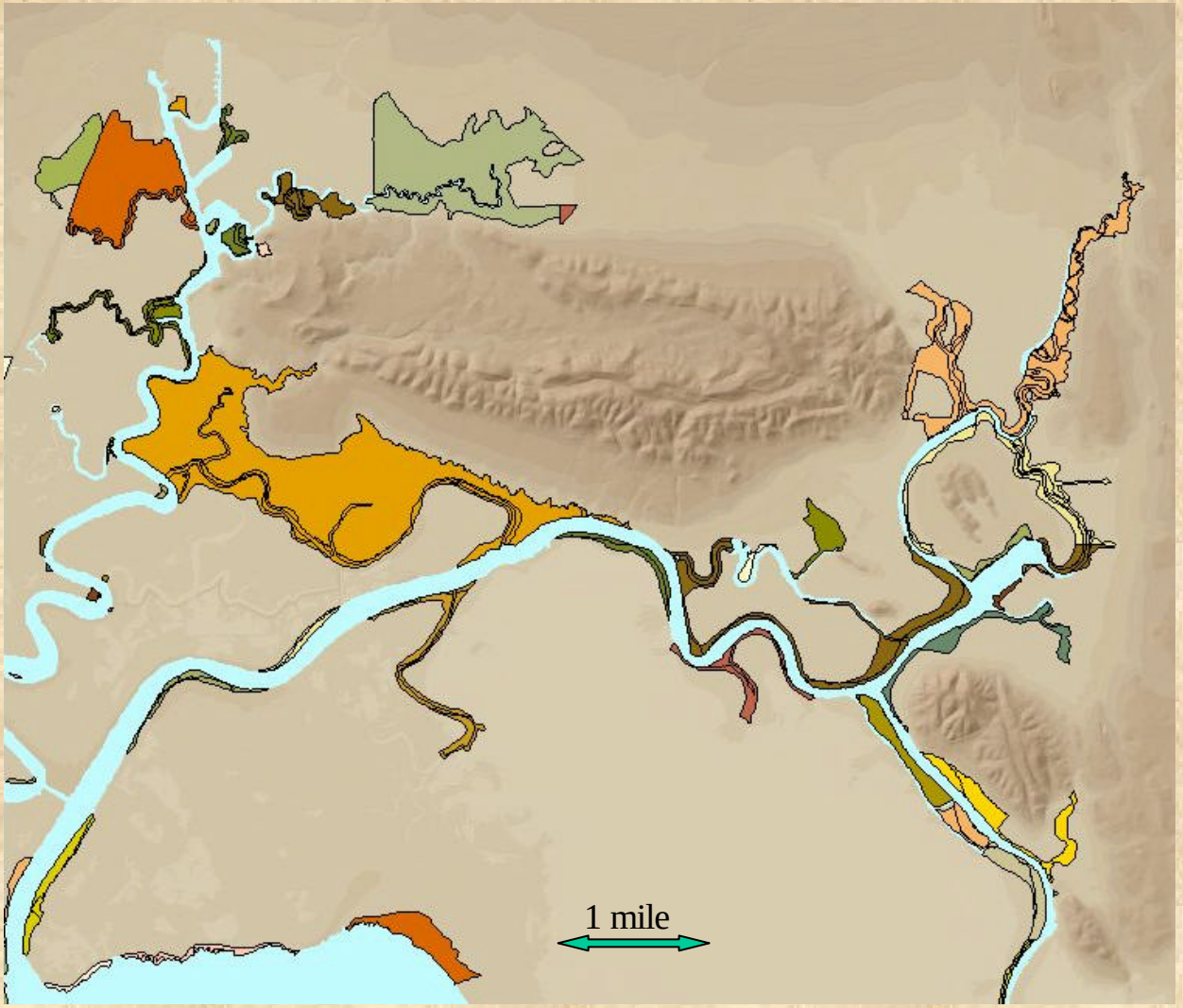
Patch shape complexity increases with patch size.

Historical Patch Shape



Wide patches exist between uplands and open water

Modern Patch Shape



Narrow patches exist between uplands and levees

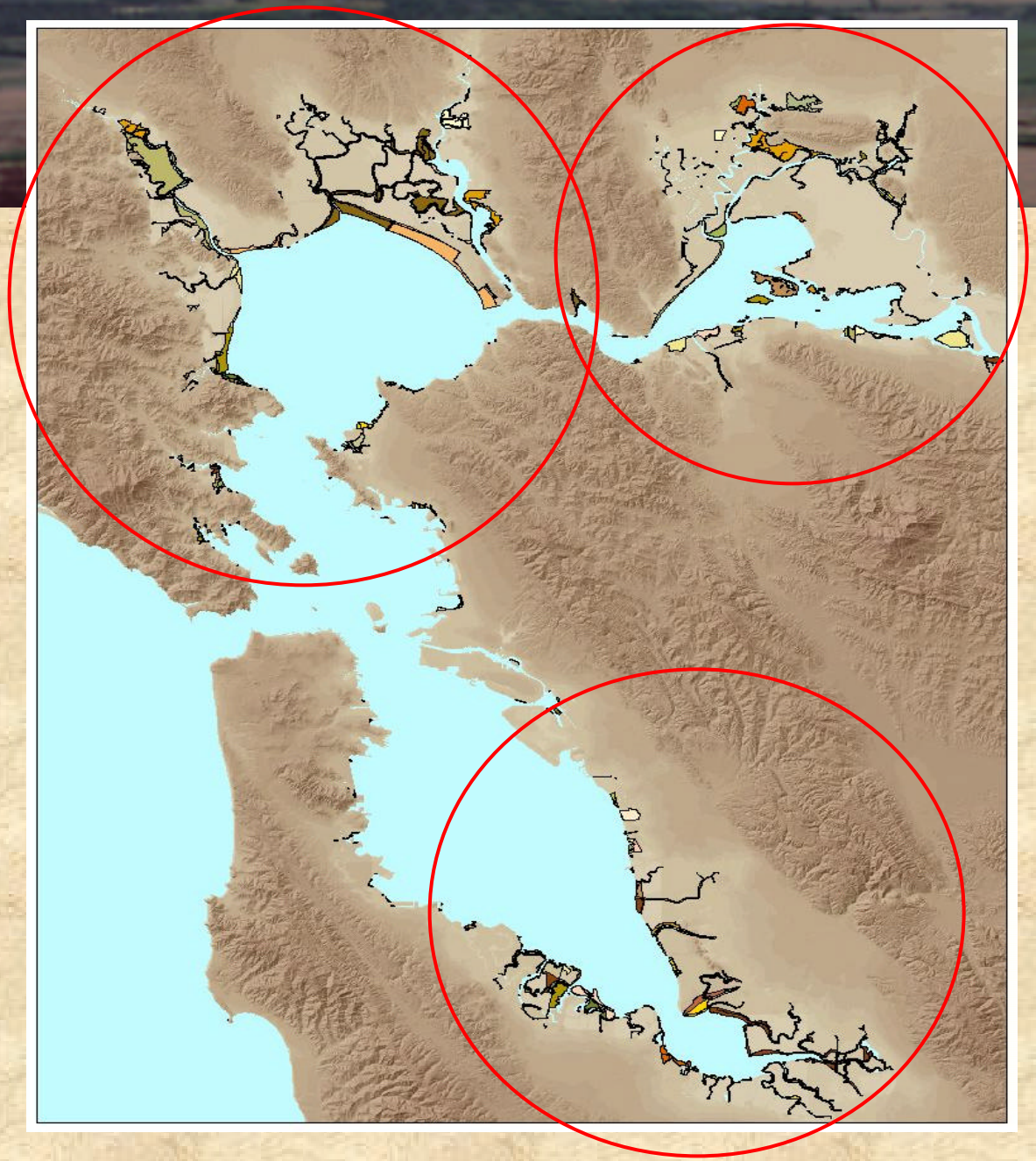
Observations about Fragmentation

- Small patches were historically abundant.
- Maximum patch size has decreased.
- Proportion of small patches has increased.
- Complexity of patch shape has increased.
- Shape complexity increases with patch size.
- Isolation has increased for all patches sizes.

Emerging View

For rails and turtles, historical habitat array featured 3 areas of very large adjacent patches and many small patches between.

Emerging View



In the modern habitat array, the 3 areas are smaller, further apart, have fewer large patches, and fewer patches between.

Part 2: Cross-scale Exploration of Stressor-State Correlations

EMAP Estuaries Intensification Project SF Bay Inter-tidal

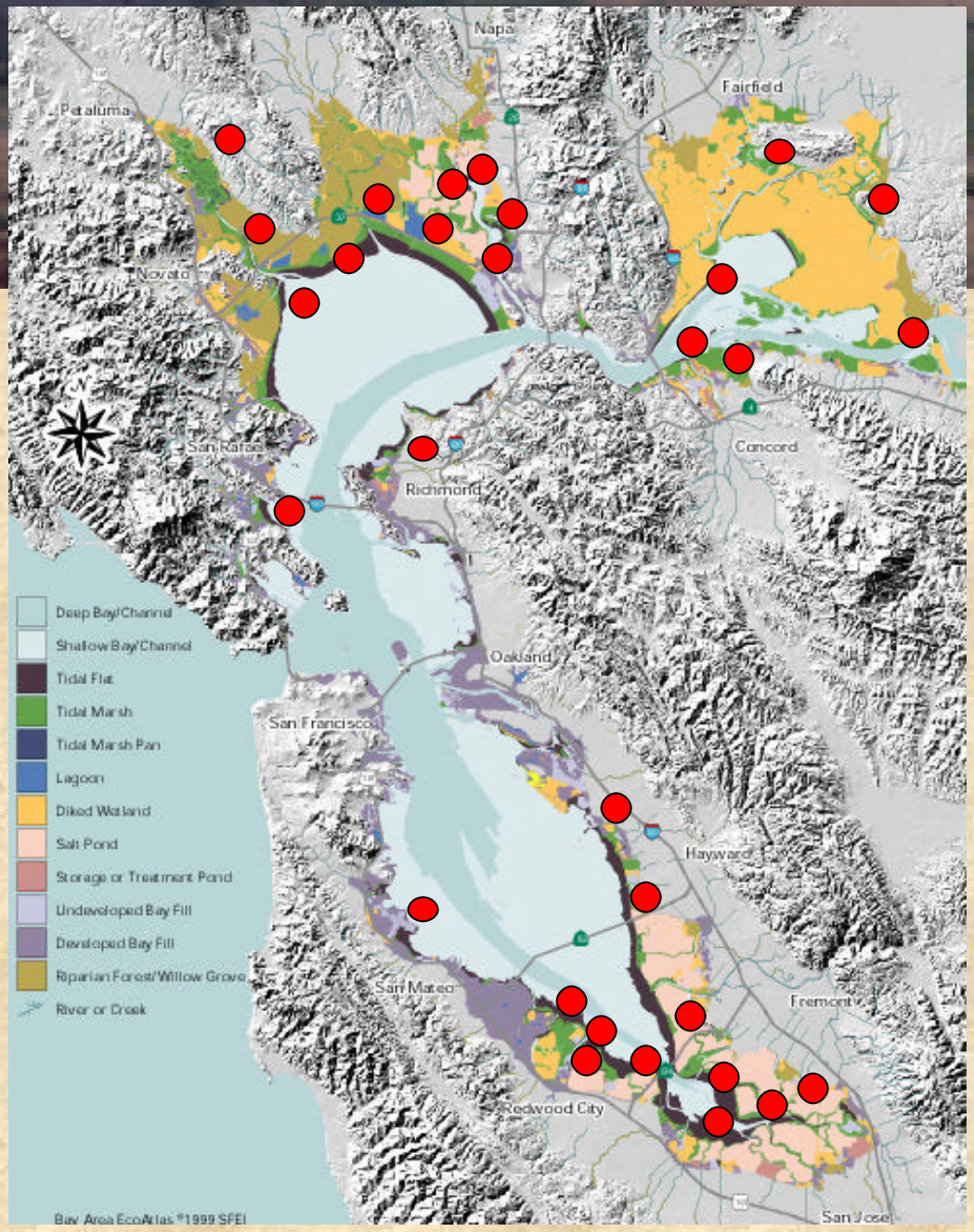
Collaborators

John Callaway @ University of SF

Mike Vasey & Tom Parker @ San Francisco State U

Eric Wittner @ SF Estuary Institute

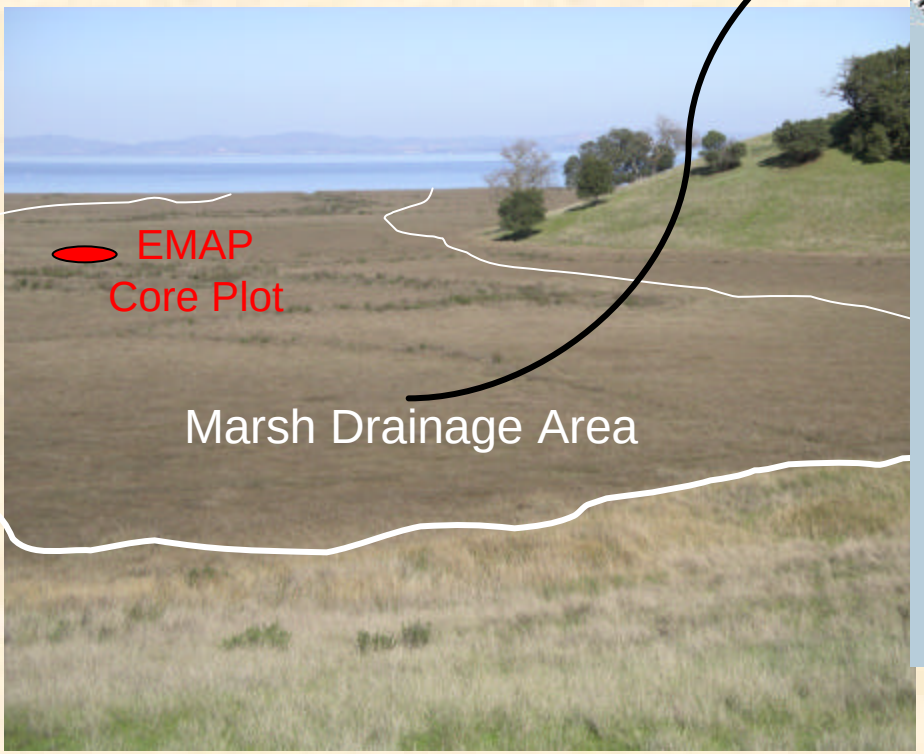
Cross-scale Stressor-State Correlations

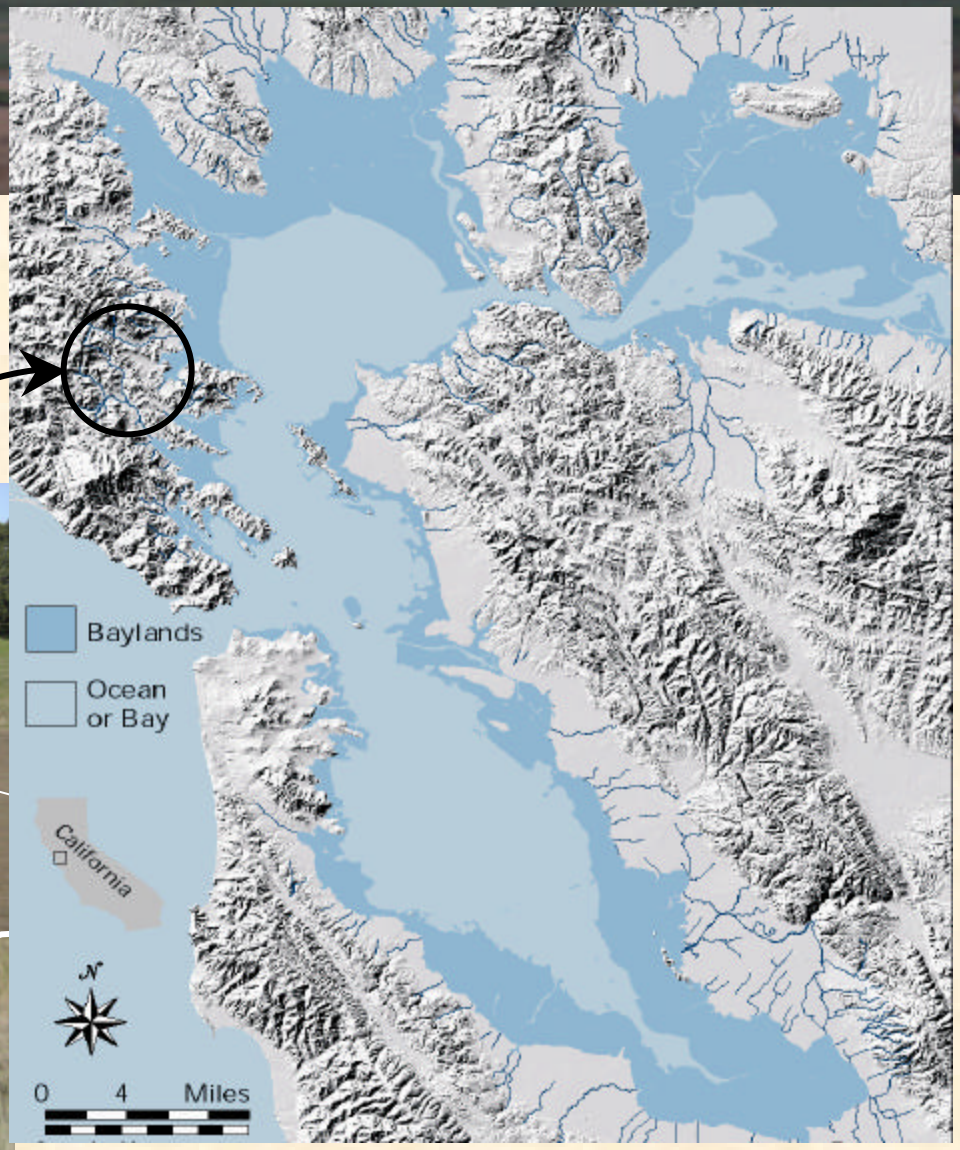


30 randomly chosen 1-m^2 EMAP Core stations in vegetated tidal marsh

Cross-scale Stressor Analysis

Nested Systems



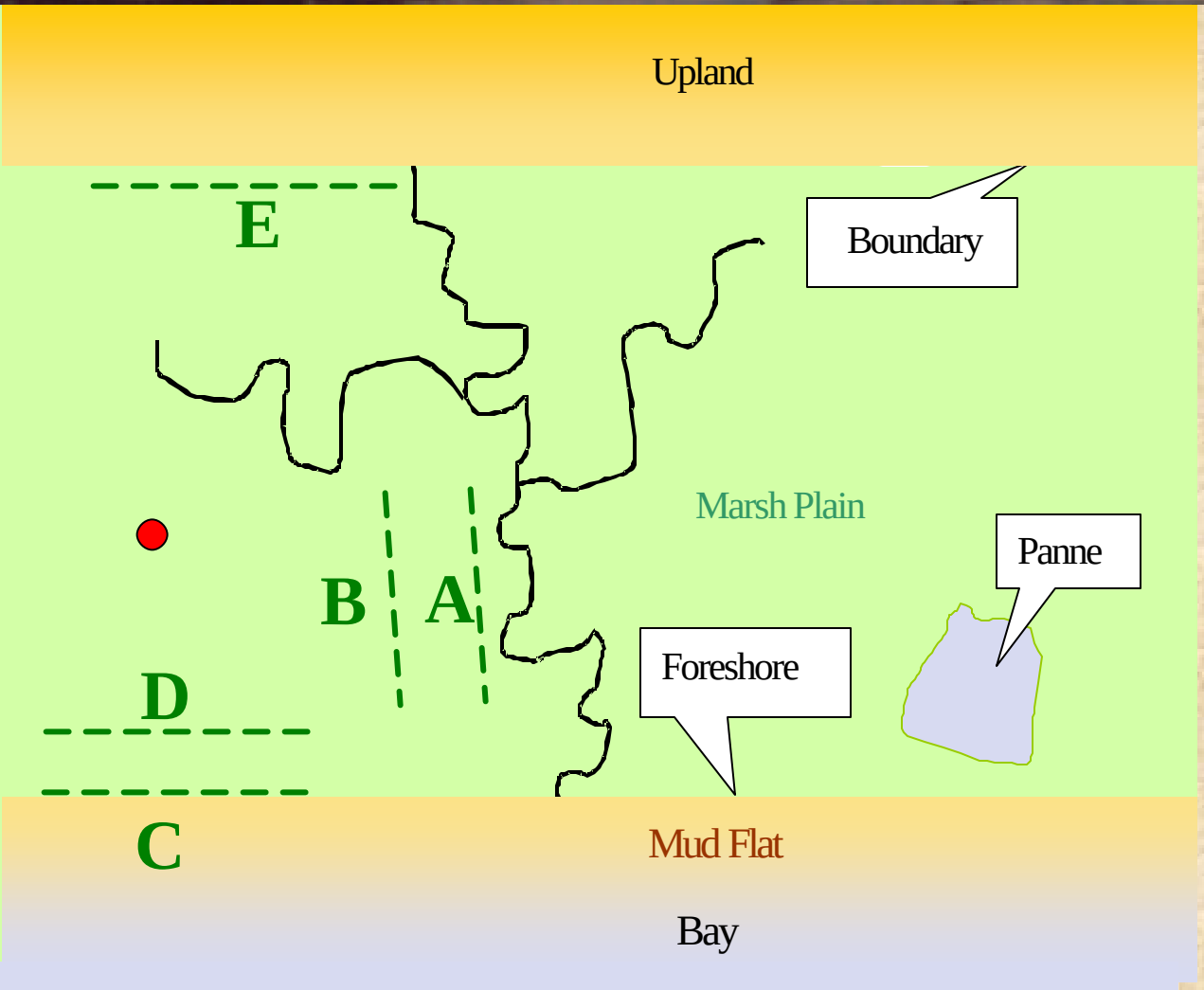


Cross-scale Stressor Analysis

Core Station Data

- Sediment Metals
- Sediment Trace Organics
- Sediment Nutrients
- Total Carbon
- Benthos
- Vascular Vegetation

Cross-scale Stressor Analysis



Five transects to characterize the drainage system plant community of each EMAP Core Station

Cross-scale Stressor Analysis

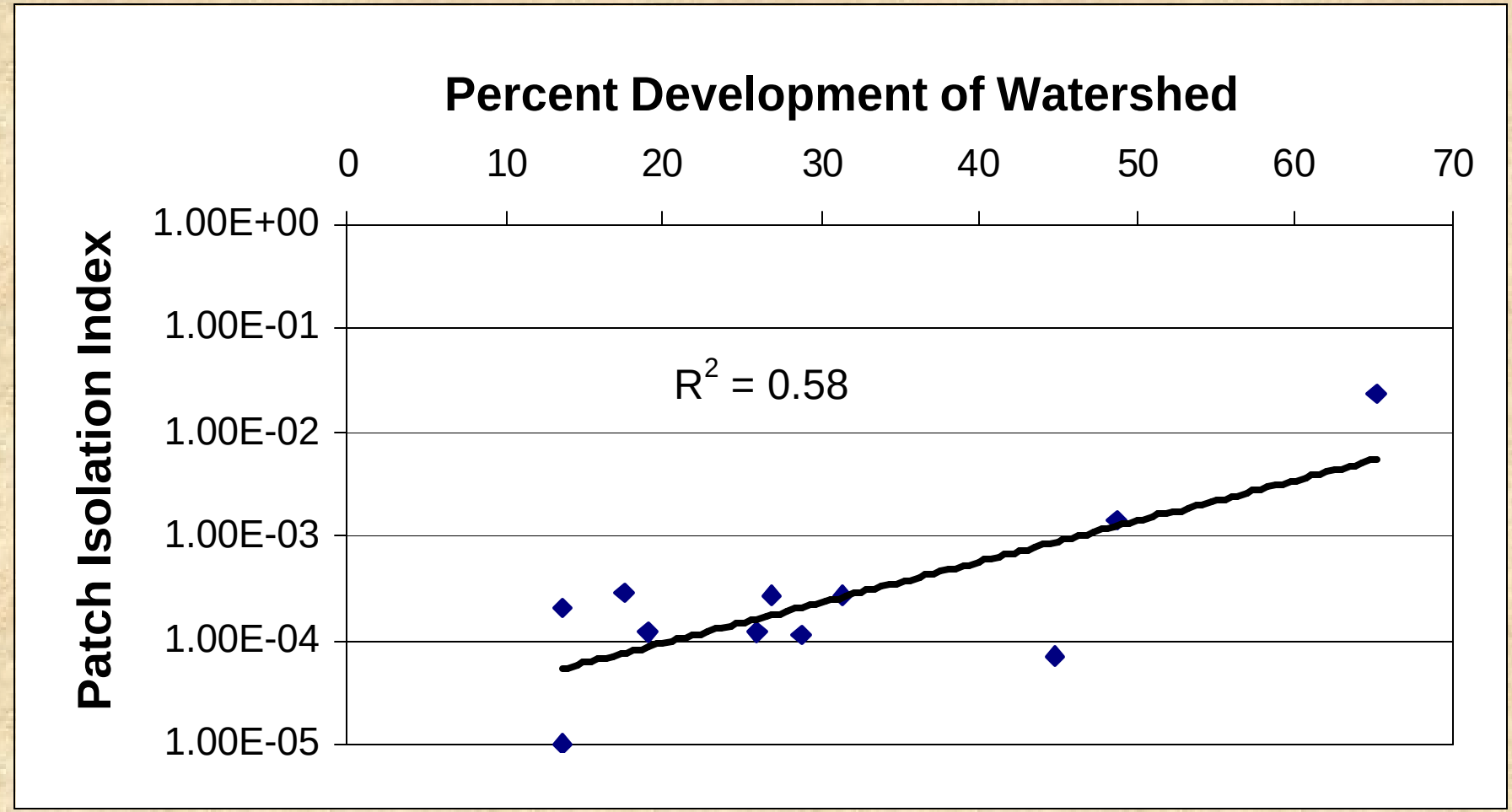
Stressors at Scales of Watersheds and Marsh Buffers

Landcover

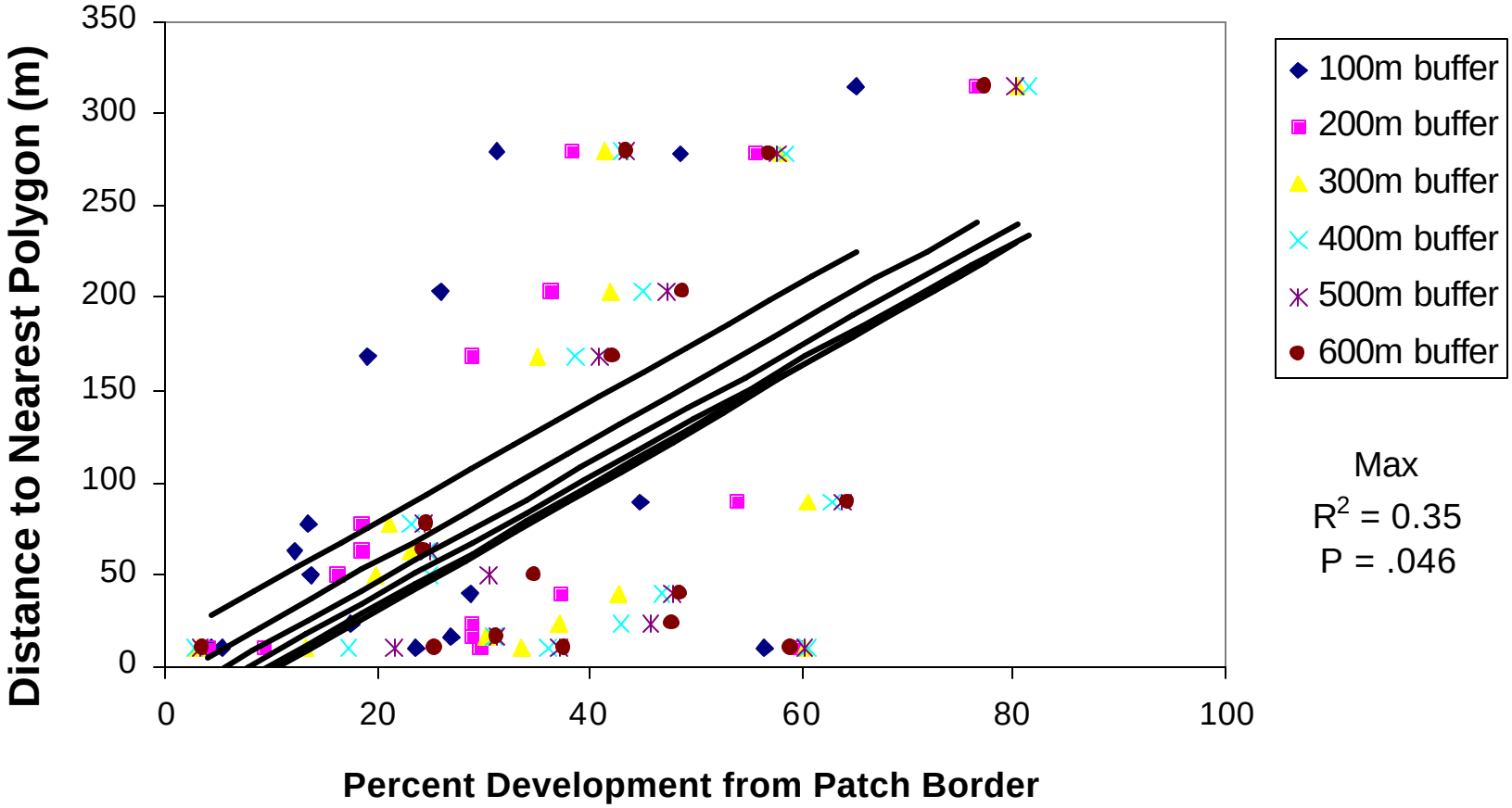
Human Demographics

Patch Shape (perimeter:area)

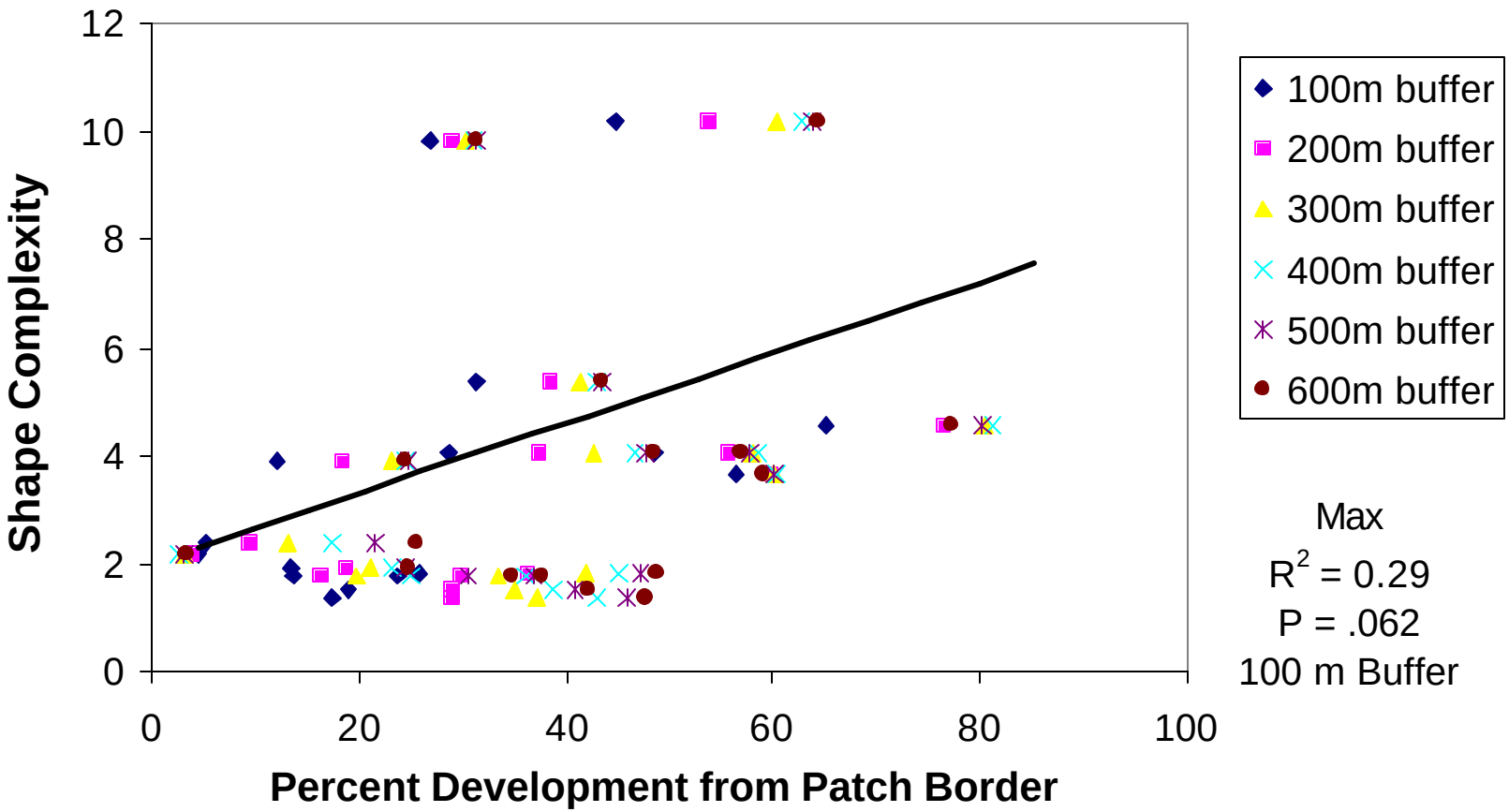
Patch Isolation Relates to Whole Watershed Development



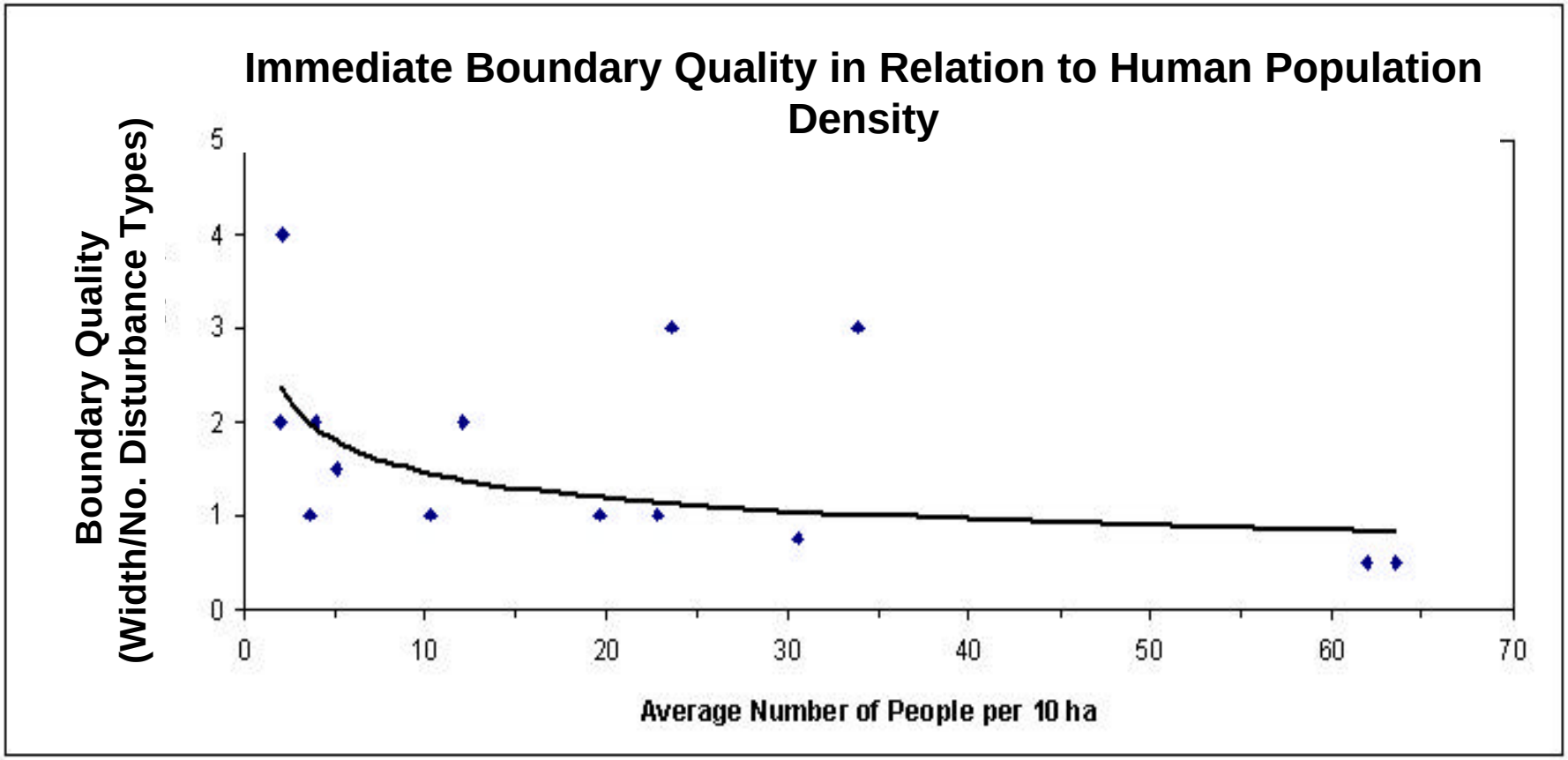
Inter-patch Distance Relates to Buffer Development



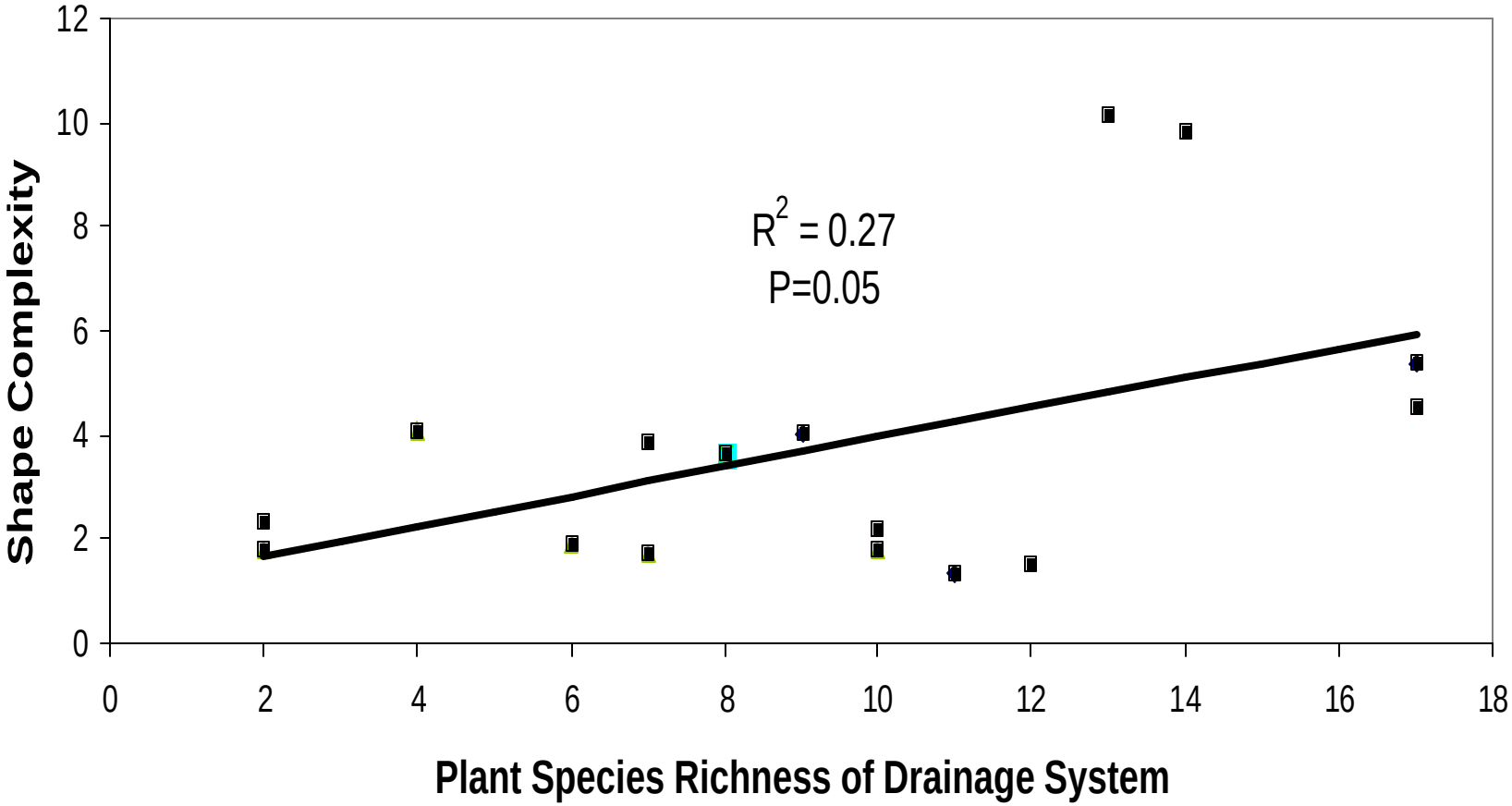
Patch Shape Relates to Buffer Development



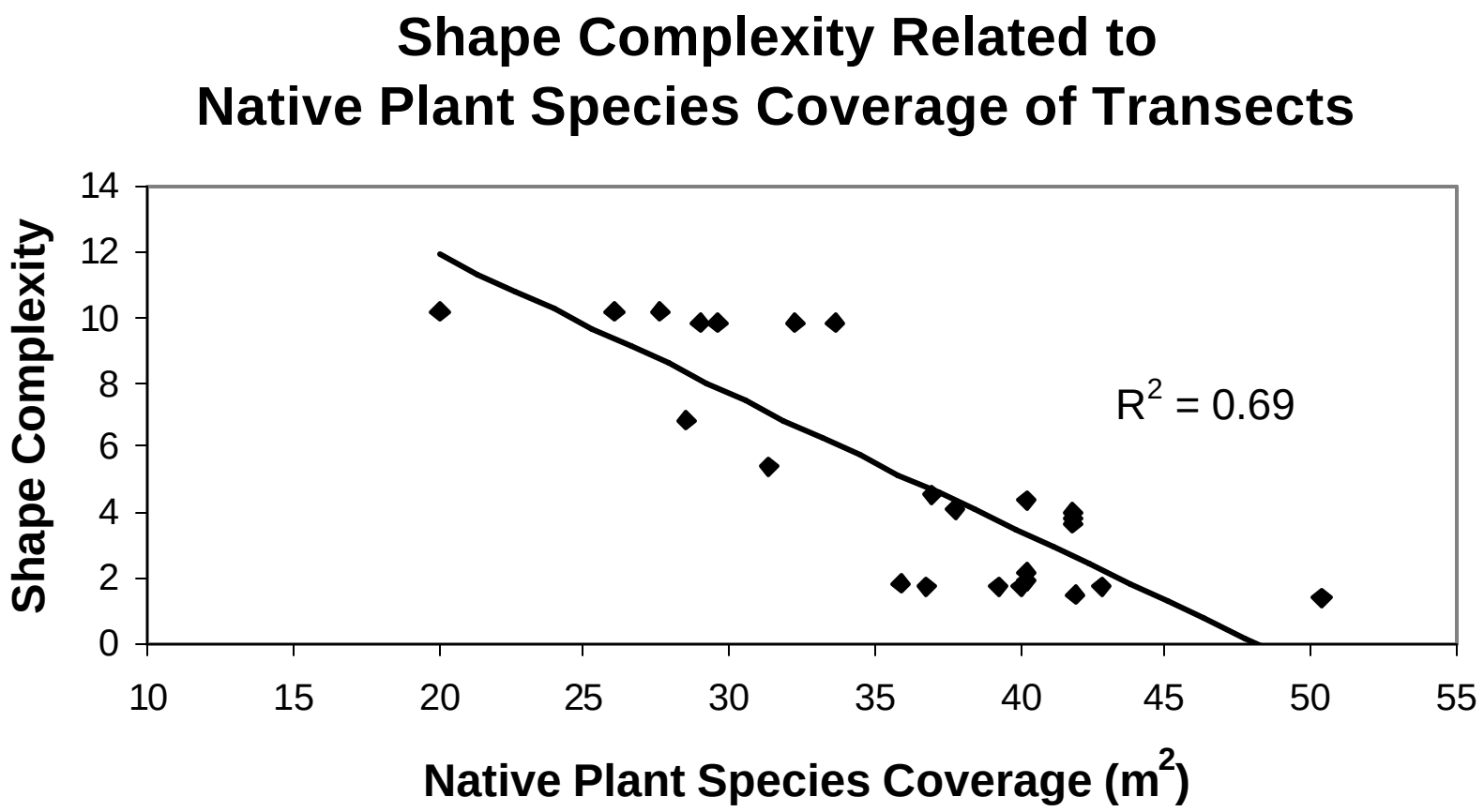
Quality of Patch Boundary Relates to Number of People in Watershed



Drainage System Plant Species Richness Relates to Patch Shape



Drainage System Plant Community Integrity Relates to Patch Shape



Overarching hypotheses
From initial stressor-state analysis for Vegetation

Watershed development has led to unnaturally complex tidal marsh shapes …

with an overabundance of upland edge …

that tends to be disturbed by adjacent land uses …

resulting in local decreases in plant community integrity.

Thank You