



# Ambient Survey of Intertidal Ecological Health and Stressors

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## Project Description

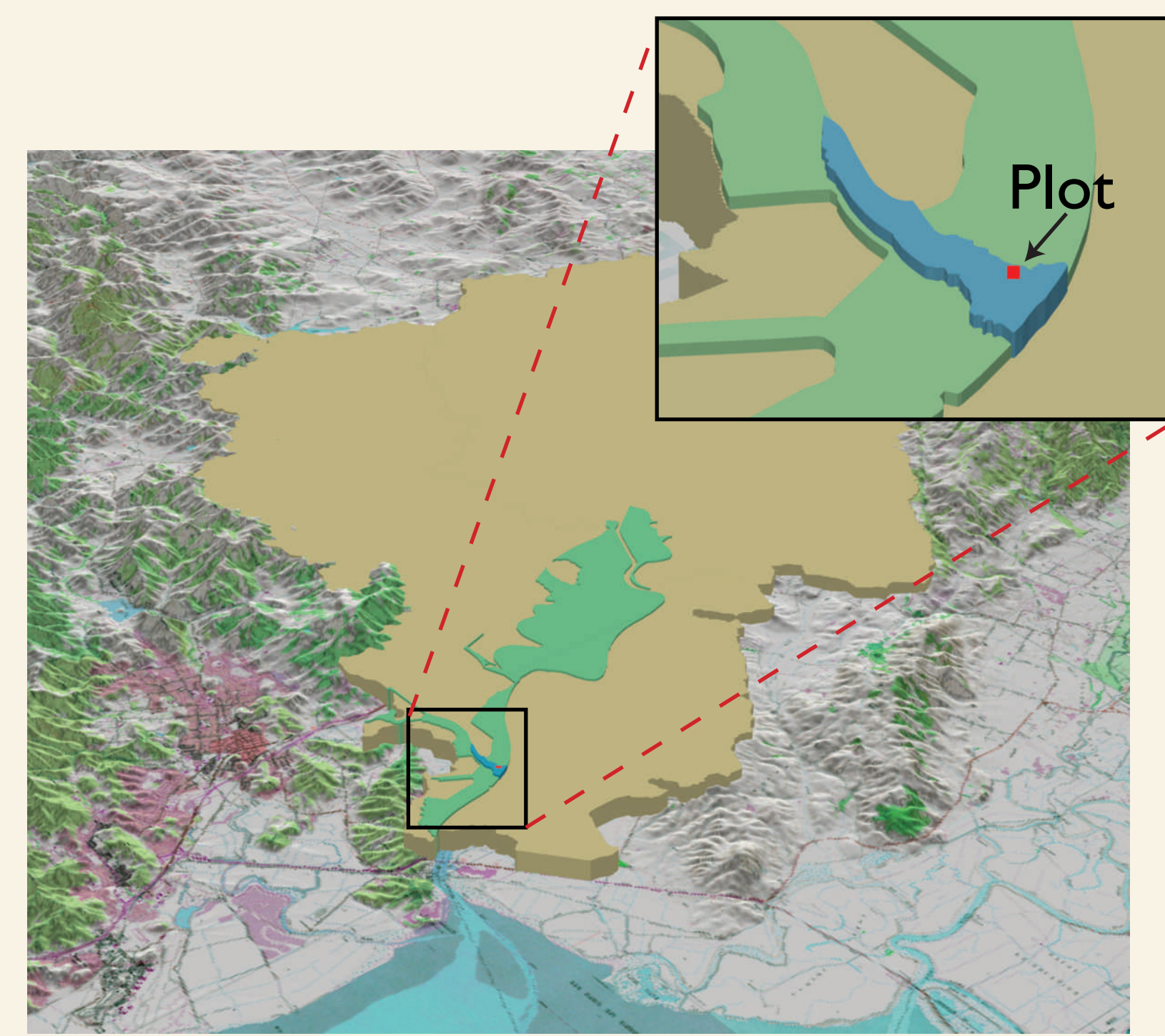
As part of the USEPA Western Pilot of Environmental Monitoring Assessment Program (WEMAP), the Southern California Coastal Water Research Project (SCCWRP) and the San Francisco Estuary Institute (SFEI) are:

- testing a stratified-random sampling design to assess ambient intertidal conditions,
- exploring correlations between intertidal conditions and indicators of anthropogenic stress across spatial scales, and
- developing new tools for profiling habitats and stressors.

This poster displays the study approach, initial landscape profiles, and preliminary assessments of bayland plant community structure for San Francisco Bay. Future analyses will focus on chemical profiles and benthic community structure.

## Random Sampling Design

Thirty (30) 1-m<sup>2</sup> sample plots were randomly selected from all possible plots in the intertidal zone of San Francisco Bay. The sampling design recognizes that each randomly selected plot exists within a local intertidal drainage system, which in turn exists within a patch of intertidal habitat, and that each patch can be assigned to a larger terrestrial watershed. This design yields paired values for stressors and response variables for all spatial scales of habitat restoration and land management.



Example of data hierarchy for a plot in Petaluma Marsh.

## Findings: Simple marsh shapes are better

1. The random design for regional ambient sampling was cost-effective.
2. Measures of intertidal habitat fragmentation are scale- and species-dependent.
3. Small patches are natural components of the intertidal landscape, but modern land use has increased the abundance of small patches.
4. Restoration of small patches can benefit the conservation of tidal marsh plant communities.
5. Tidal marsh plant species richness increases as porewater salinity decreases. Brackish marshes are relatively species-rich.
6. Patches of tidal marsh adjacent to development tend to have abundant edge per unit area.
7. For tidal marsh patches of any size and salinity, patches with less edge per unit area support more species of native plants.
8. The quality of marsh buffer zones declines as the number of people increases in adjacent watersheds.
9. Working hypothesis: adjacent development has led to unnaturally complex tidal marsh shapes with an overabundance of upland margin that becomes degraded as human population density increases, resulting in local decreases in native plant species diversity.

## Bayland Landscape Profile

Habitat fragmentation varies among wildlife species, depending on their habitat affinities and barriers to movement. Using rails, small mammals, passerine birds, shorebirds and waterfowl as examples, four types of habitat patches were delineated.



**Type 1** patches are tidal marsh bounded by tidal flat, any non-tidal area or open water at least 200 feet wide, any man-made levees, and any roads four-lane or larger.



**Type 3** includes Type 2 plus any areas of abandoned salt ponds, ruderal baylands, and diked managed marsh that are separated from Type 2 patches by man-made levees.

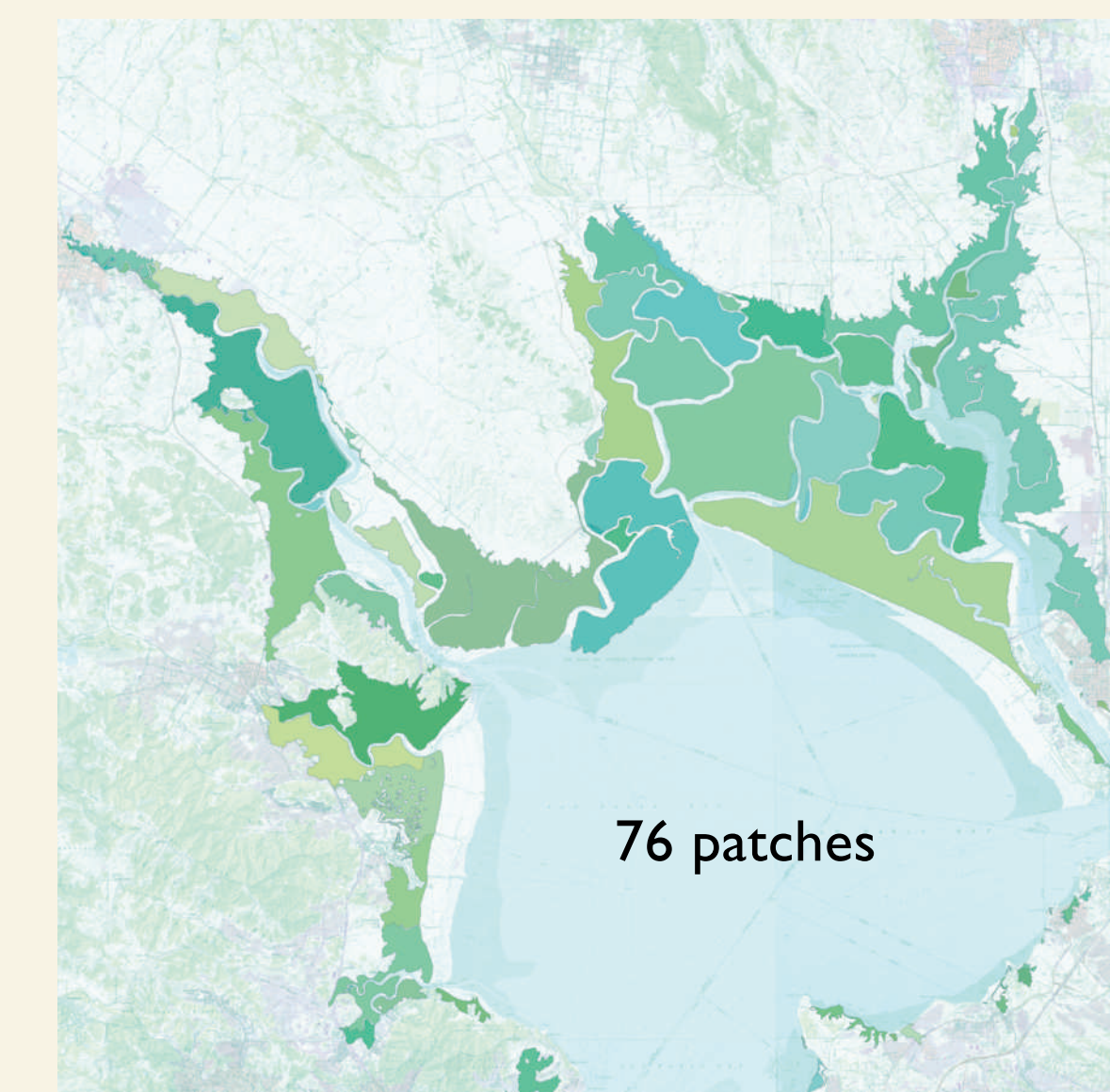


**Type 2** includes Type 1 plus areas of tidal marsh or muted tidal marsh that are separated from Type 1 patches by man-made levees.

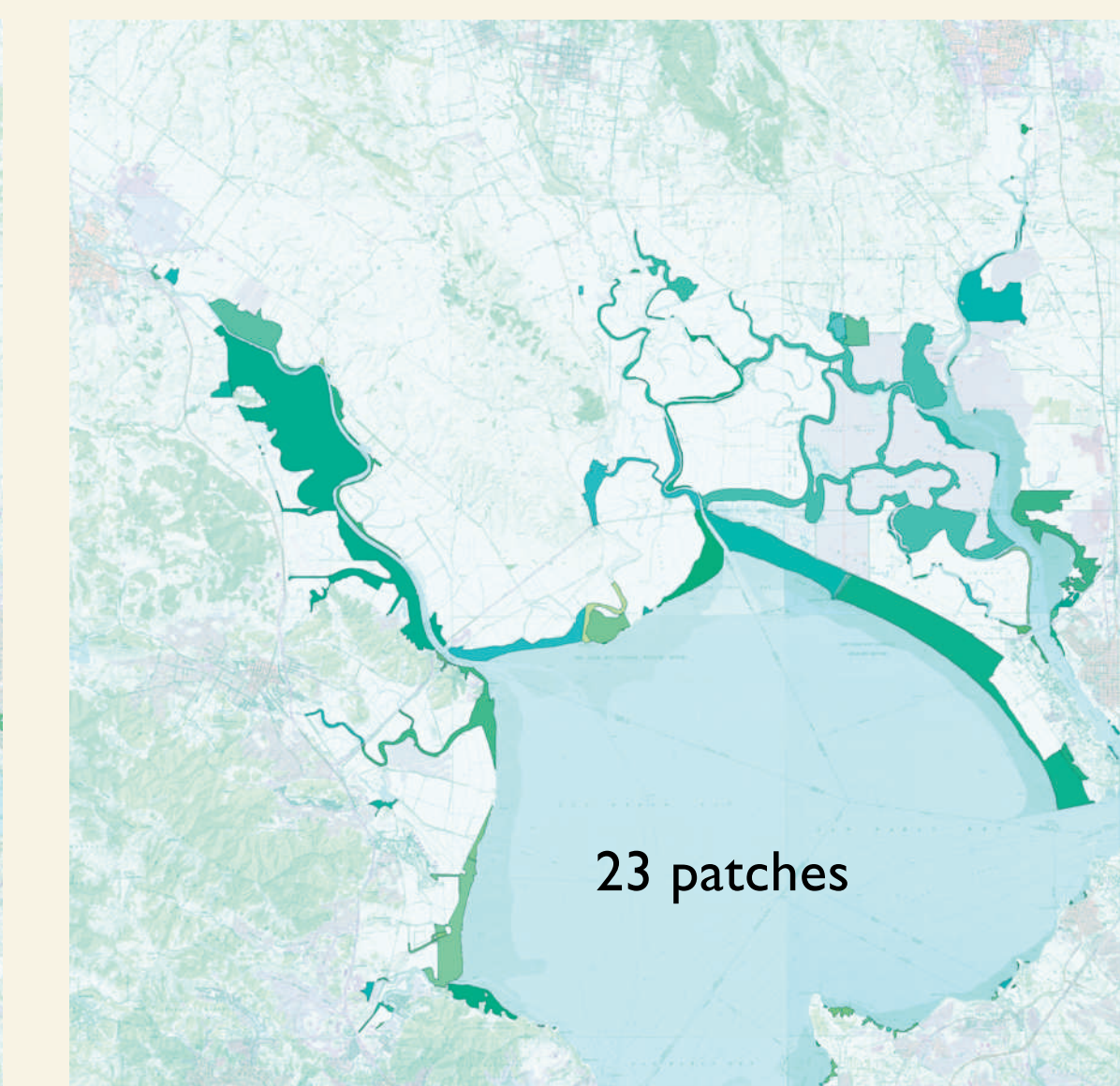


**Type 4** includes Type 3 plus upland fill less than 60 m wide, low- and medium-salinity salt ponds, treatment ponds, and mudflats separated from Type 3 patches by levees, roads, or channels of any width.

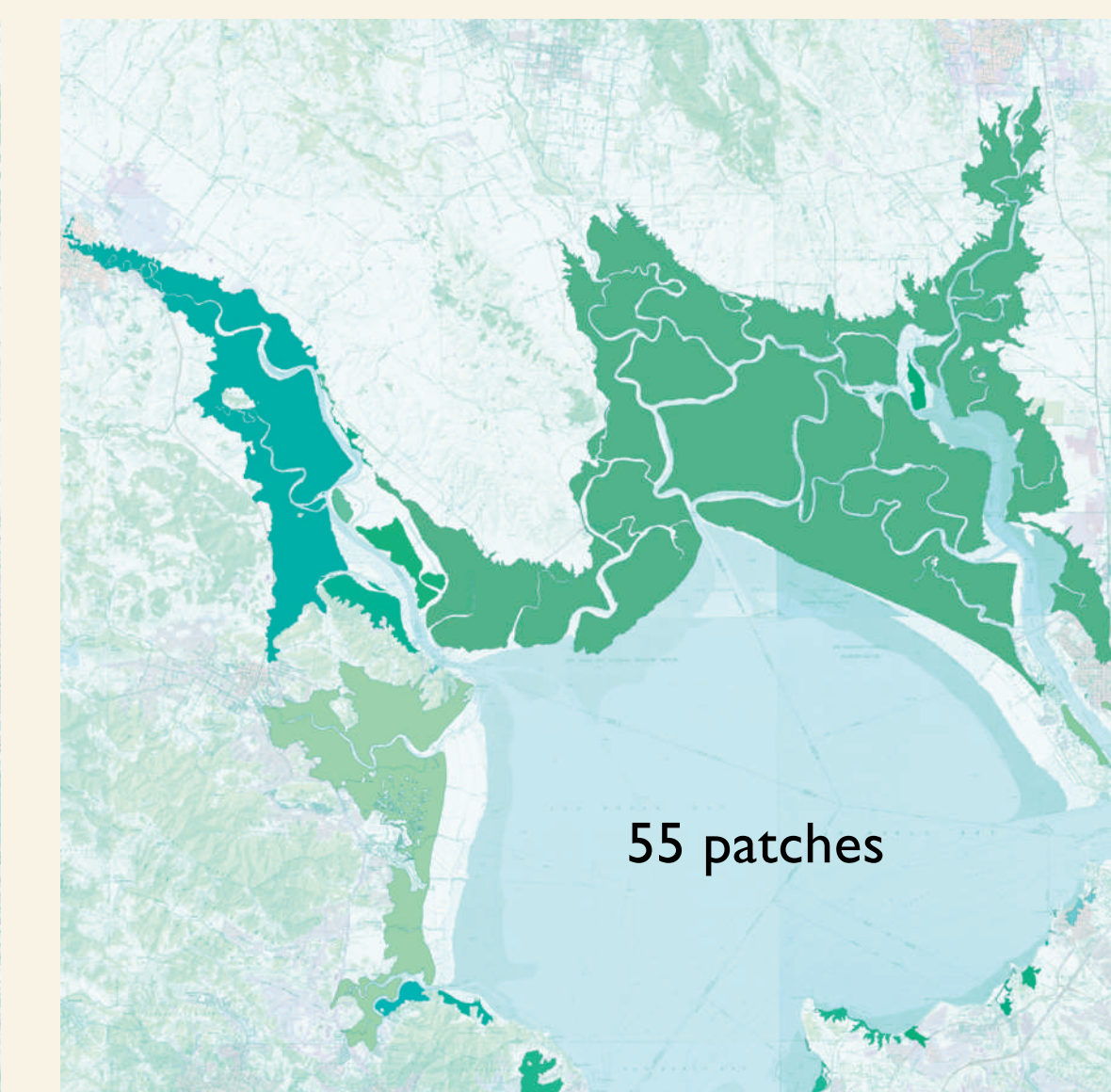
## Types 1 and 4 Bayland Habitat Patches Past and Present in North Bay



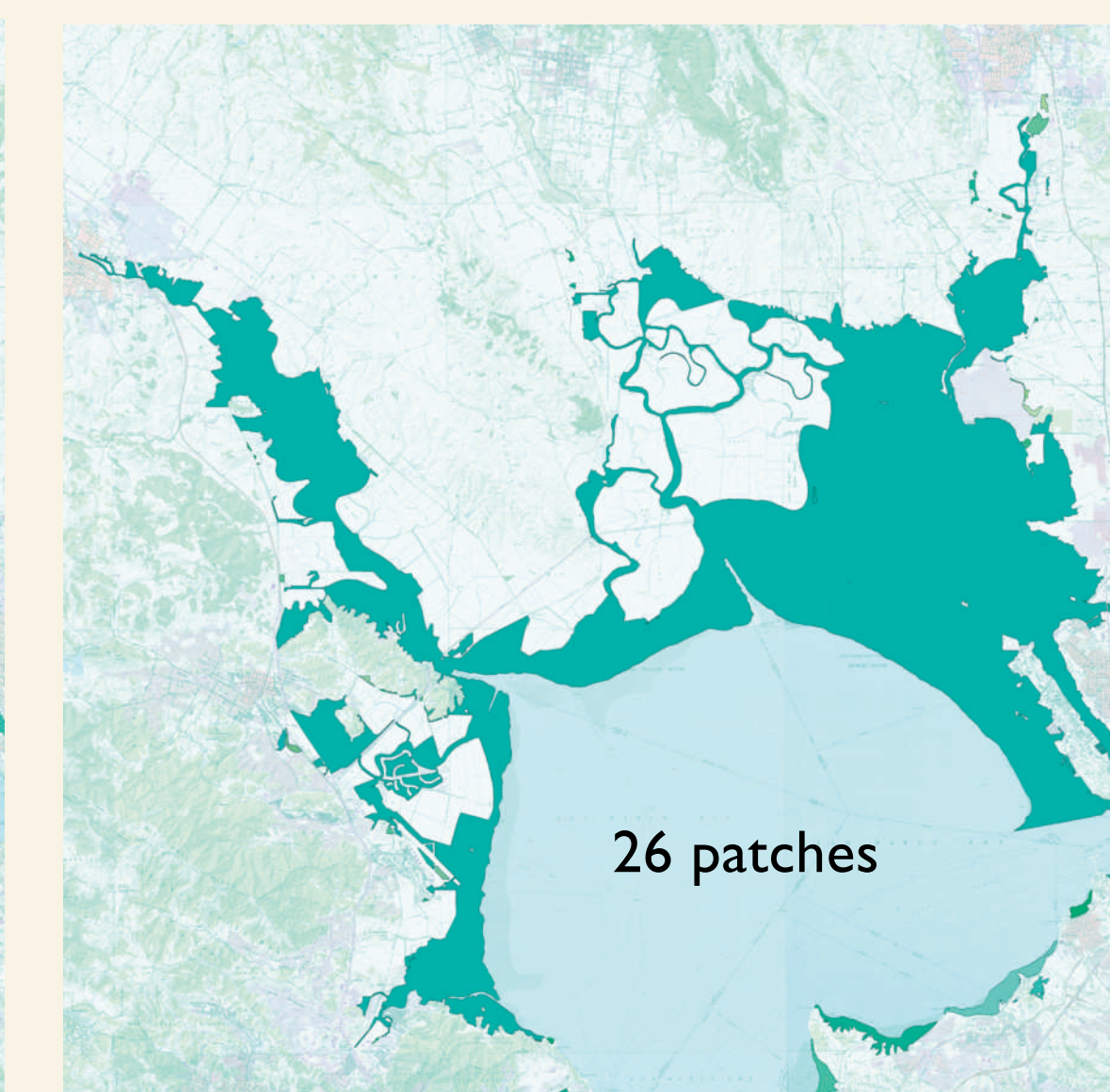
Historical Type 1 Patches



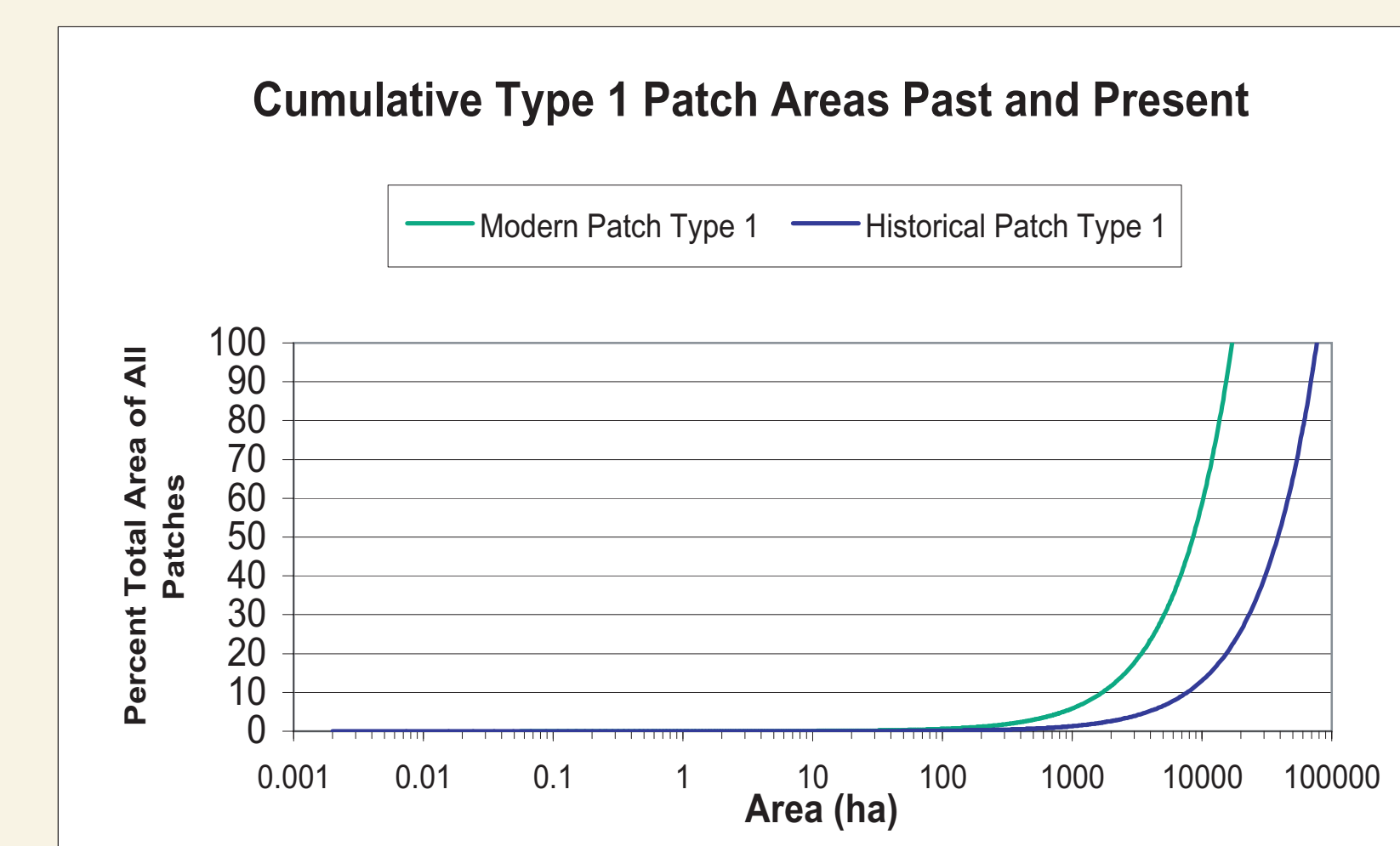
Modern Type 1 Patches



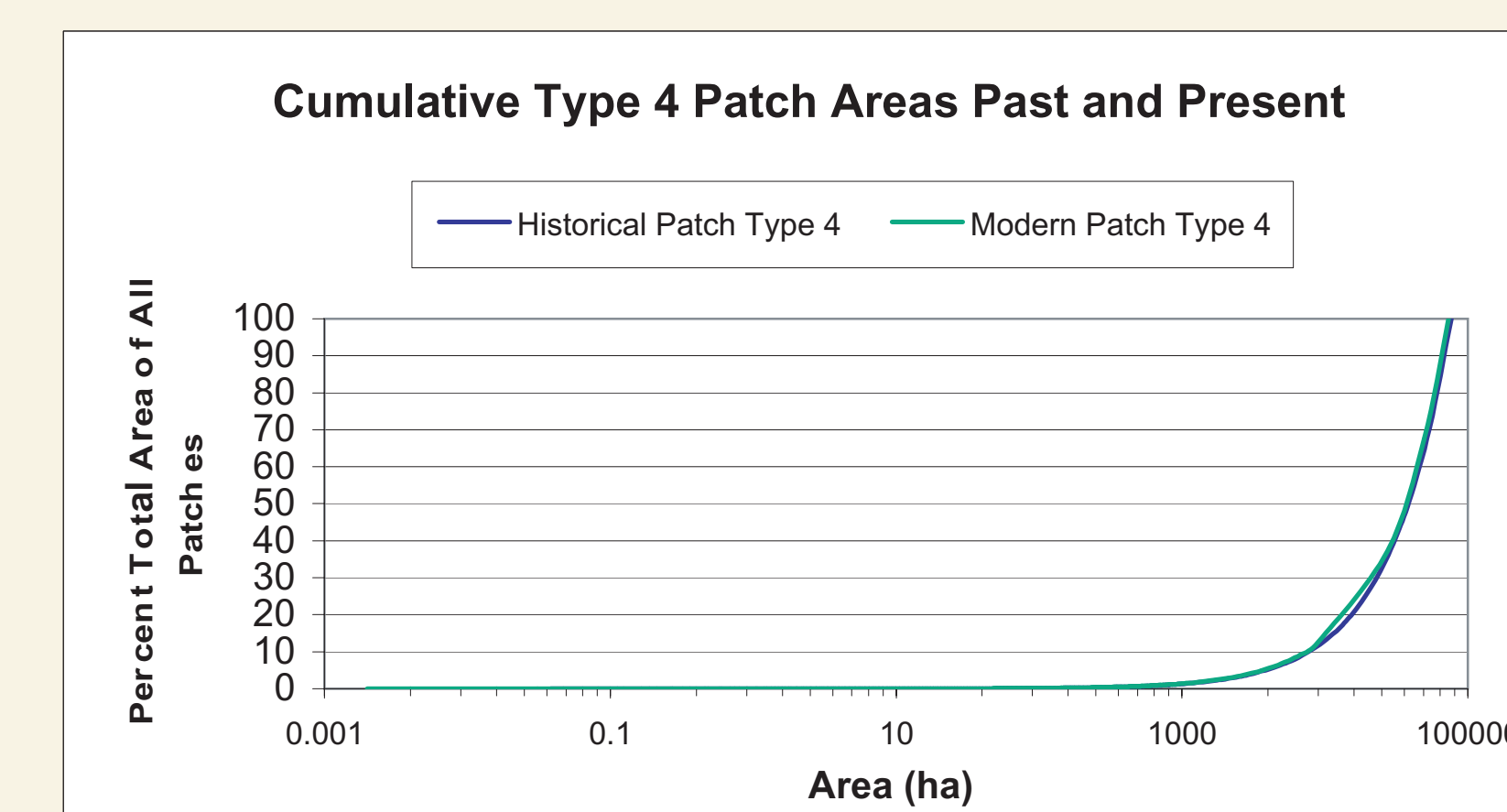
Historical Type 4 Patches



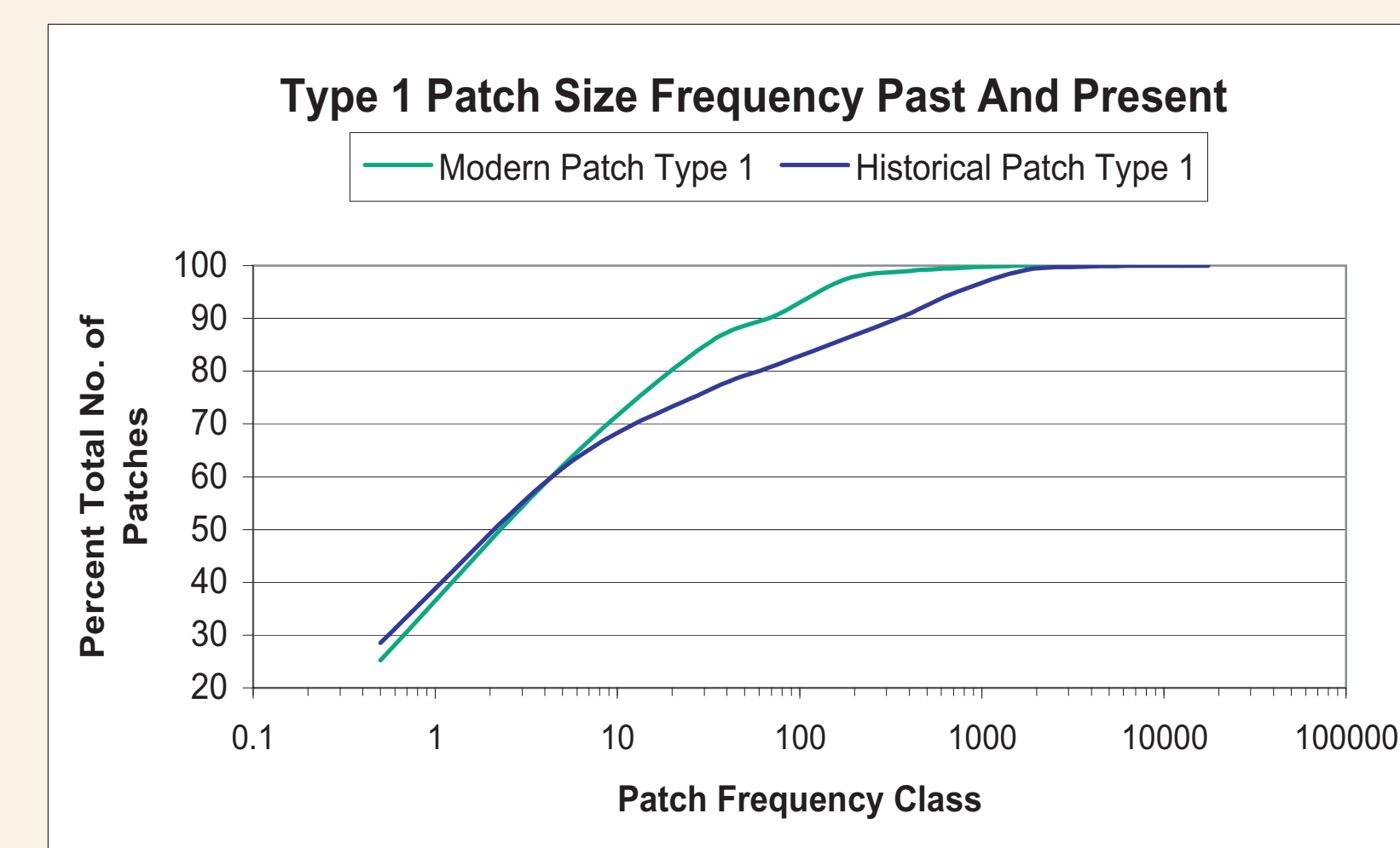
Modern Type 4 Patches



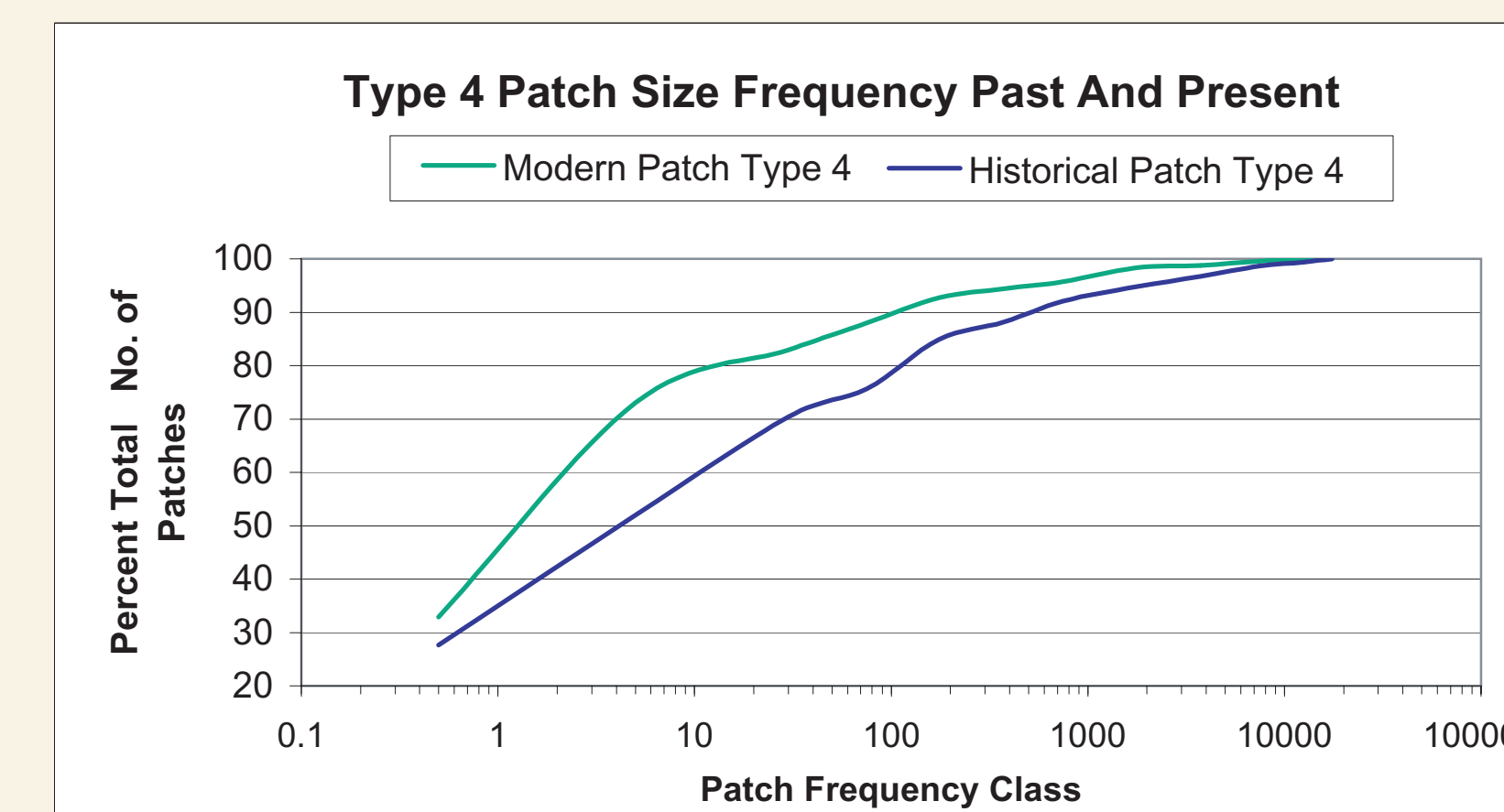
The median size class of Type 1 patches has significantly decreased since Euro-American contact, reflecting the unnatural loss and fragmentation of tidal marshland.



Patch Type 4 includes diked as well as tidal baylands, and the modern condition therefore reflects the historical distribution and abundance of tidal marsh.



These two graphs show that Patch Types 1 and 4 tended to be larger before Euro-American contact. But even then, most patches were less than 10 ha in size, due to natural topographic controls. Small habitat patches were a natural feature of the intertidal zone for all wildlife.



## Exploring Data Across Spatial Scales

Initial analyses focus on correlations between conditions at different spatial scales. These results help generate testable hypotheses about the effects of land use and human demographics at the watershed scale on the conditions of buffers, patches, drainage areas, and local intertidal plots.

### Watershed

The amount of edge per unit area of tidal marsh decreases with development of the adjacent watersheds.



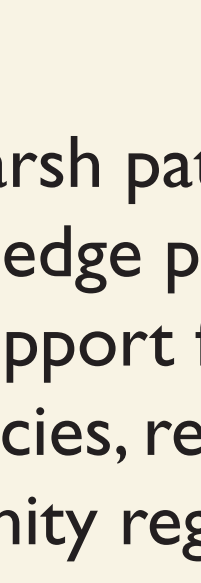
### Buffer

The quality of tidal marsh buffers decreases with adjacent increases in human population density.

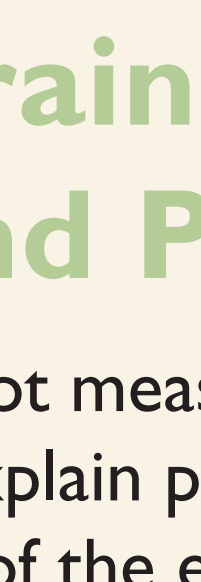


### Patch

Similar numbers of plant species are likely to inhabit small and large patches of tidal marshland.

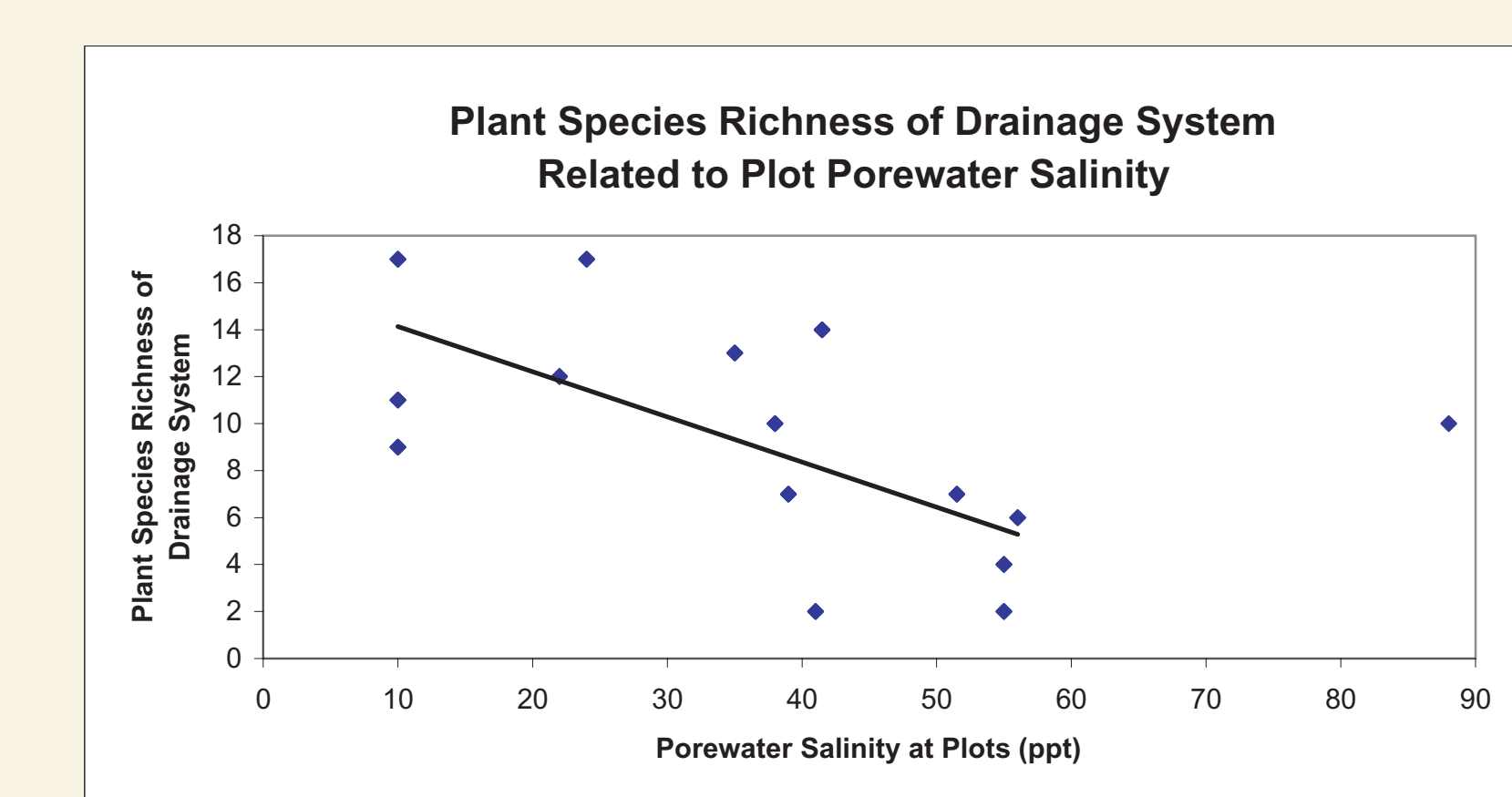
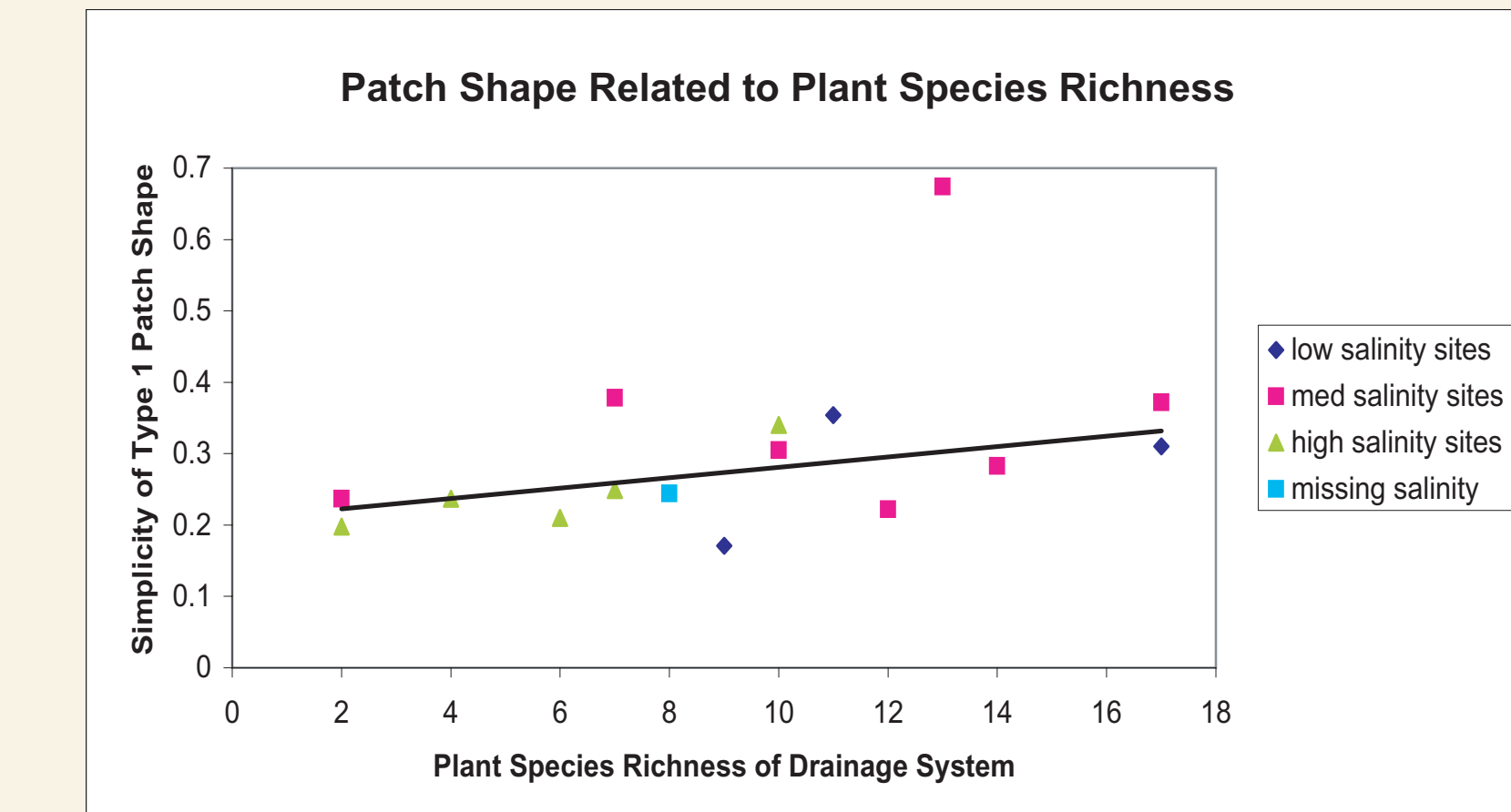
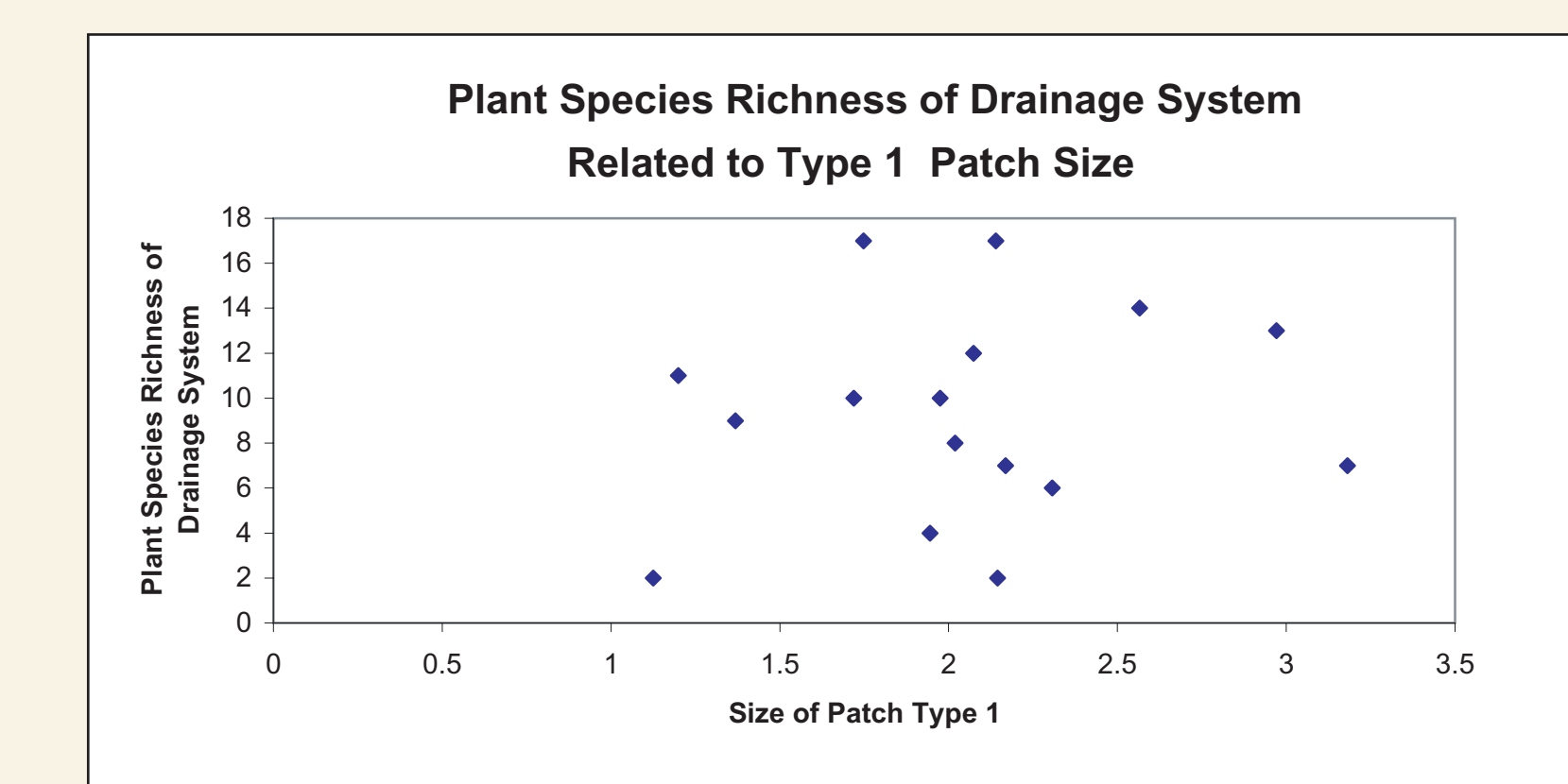
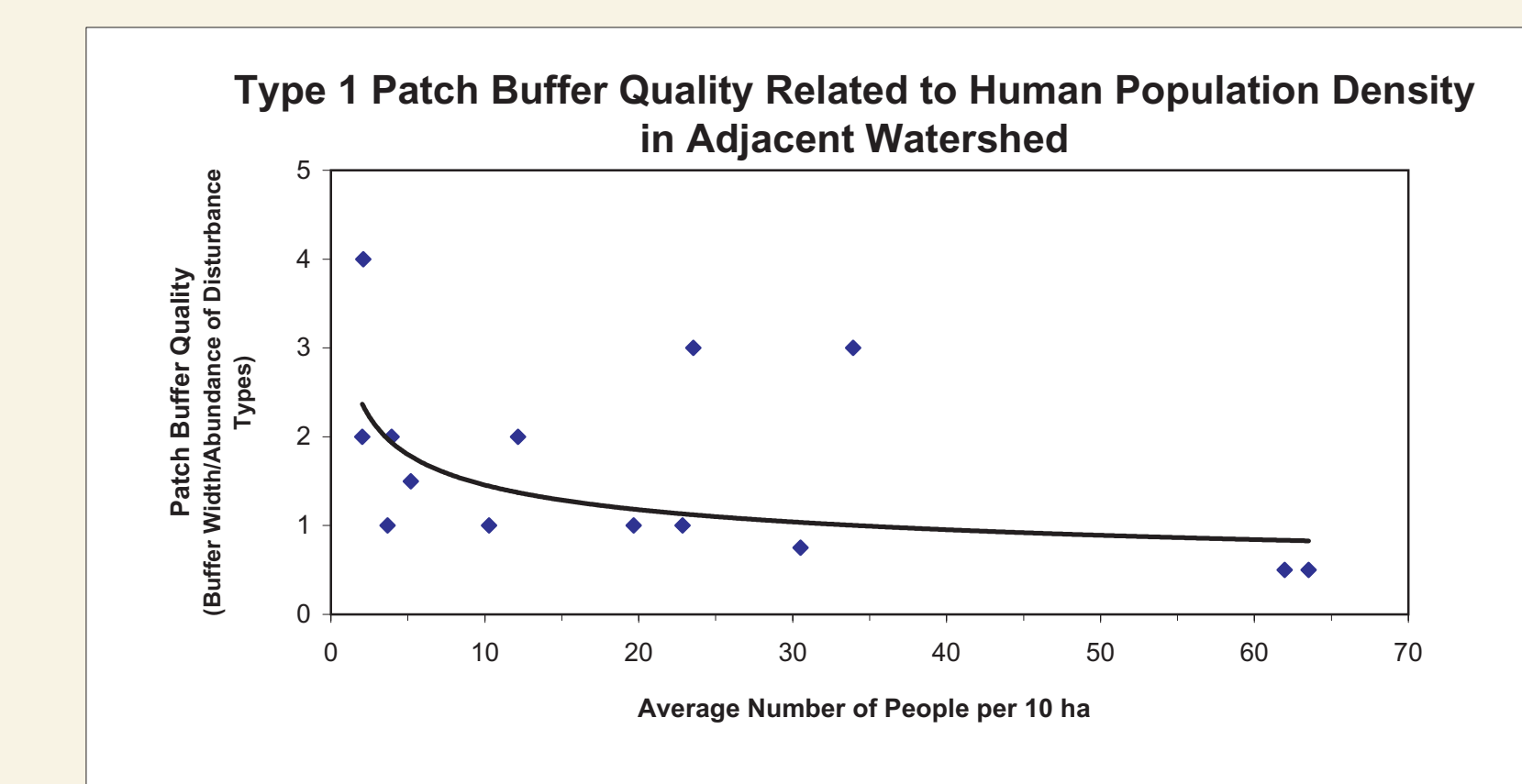
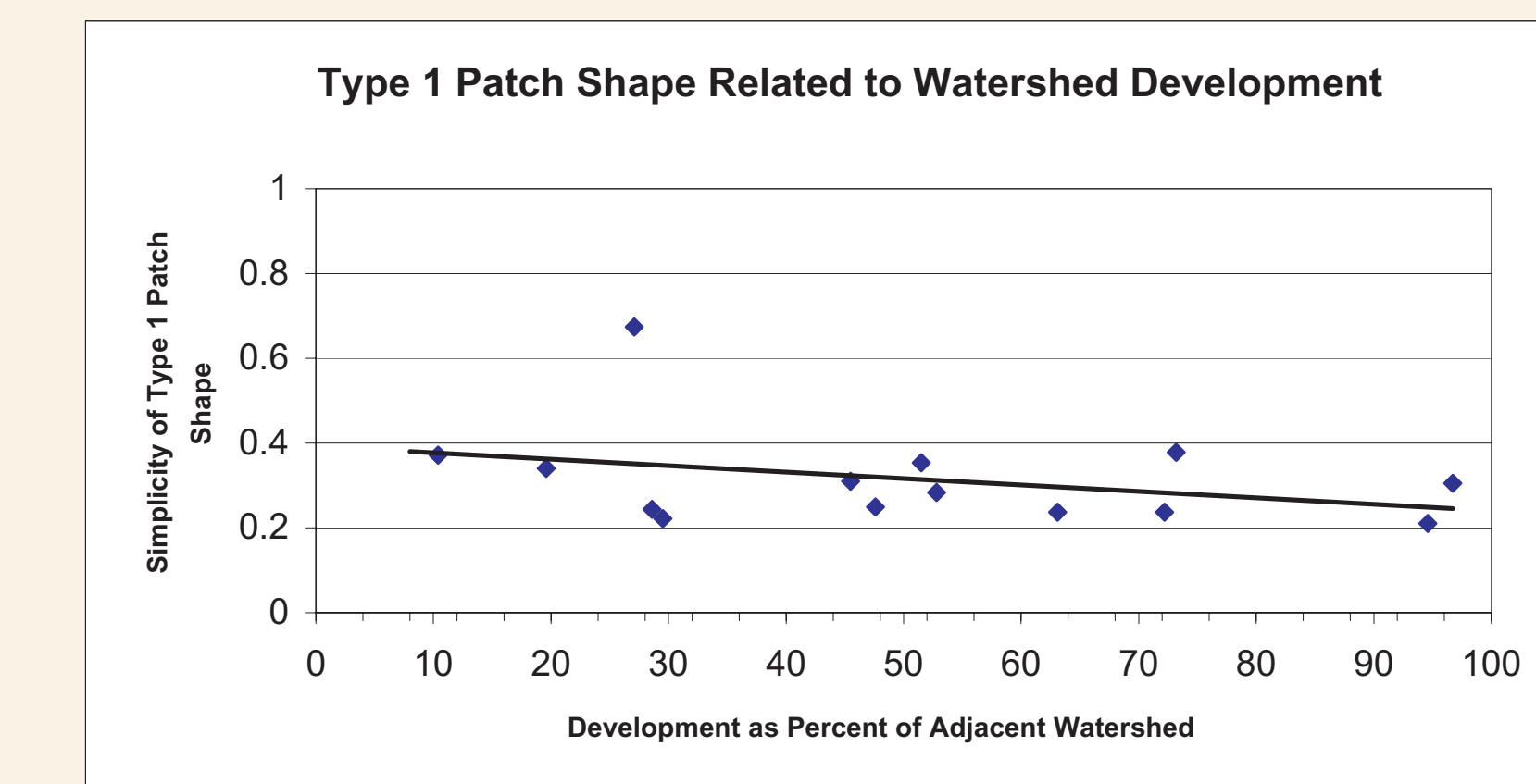


Tidal marsh patches with abundant edge per unit area tend to support fewer native plant species, regardless of salinity regime.



### Drainage and Plot

A single plot measure of salinity helps explain plant species richness of the encompassing marsh drainage system. As salinity decreases, plant species richness increases.



## Acknowledgements

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