HISTORICAL ECOLOGY OF THE DELTA

Emerging Concepts about a Spatially Complex and Temporally Dynamic System

Robin Grossinger and Alison Whipple
San Francisco Estuary Institute

CALFED Science Program Workshop
November 18, 2009

Ecological theory

Historical Ecology

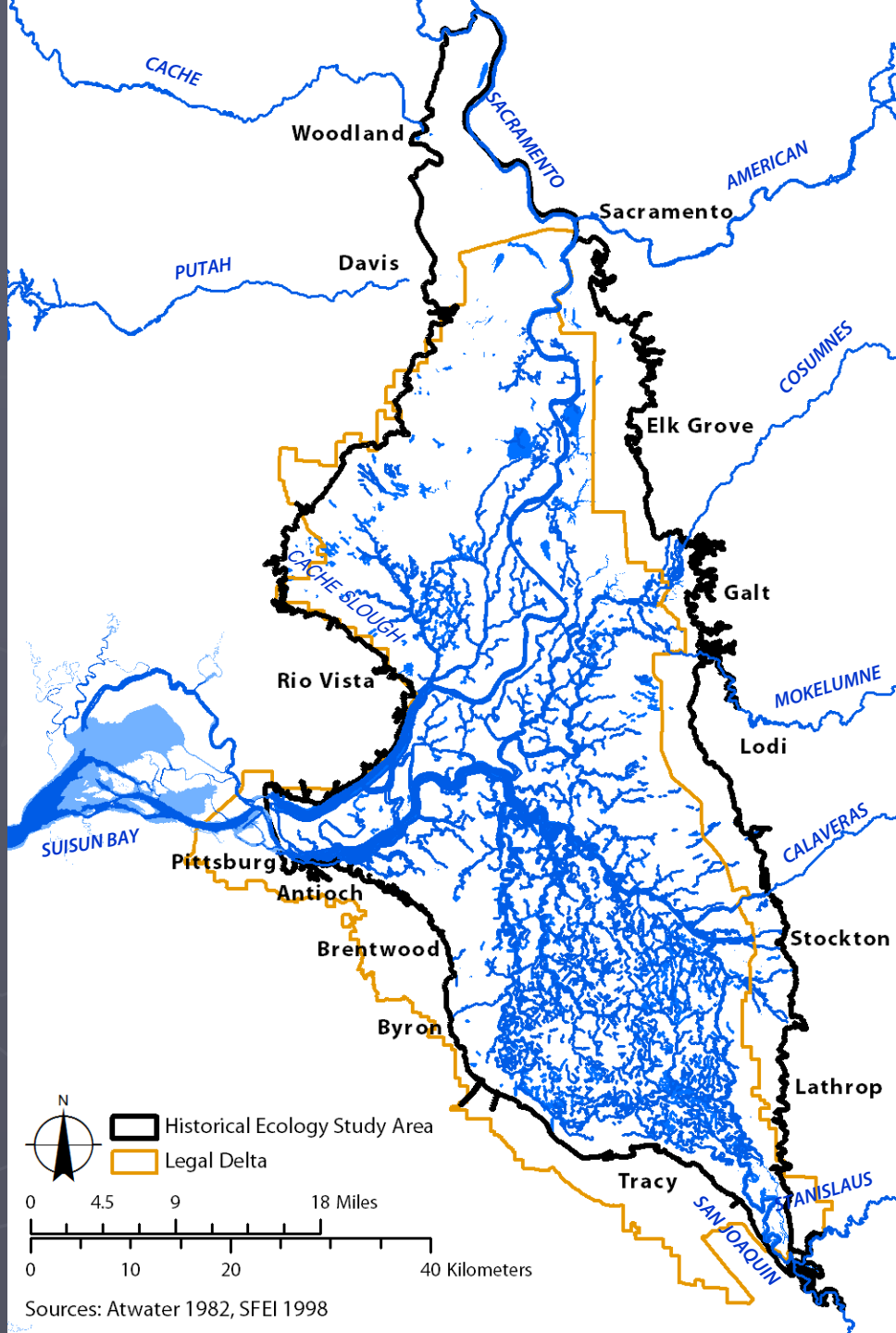
Contemporary data and research

Conceptual Models

ecosystem form and function along physical gradients

Restoration Strategies
Project Design

STUDY AREA


CACHE
Woodland
SACRAMENTO
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Sacramento
PUTAH
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Elk Grove
CACHE SLOUGH
Galt
Rio Vista
MOKELUMNE
Lodi
SUISUN BAY
CALAVERAS
Pittsburg
Antioch
Stockton
Brentwood
Byron
Lathrop
Tracy
STANISLAUS
SAN JOAQUIN
N
Historical Ecology Study Area
Legal Delta
0 4.5 9 18 Miles
0 10 20 40 Kilometers
Sources: Atwater 1982, SFEI 1998

1800

Archaeology Reports, Tribal Representatives

Explorer Journals

1850

Travelogues/Memoirs

Diseños, Mexican Land Grant testimony

1900

Maps/Surveys

Landscape photos and paintings

1950

Aerial photography

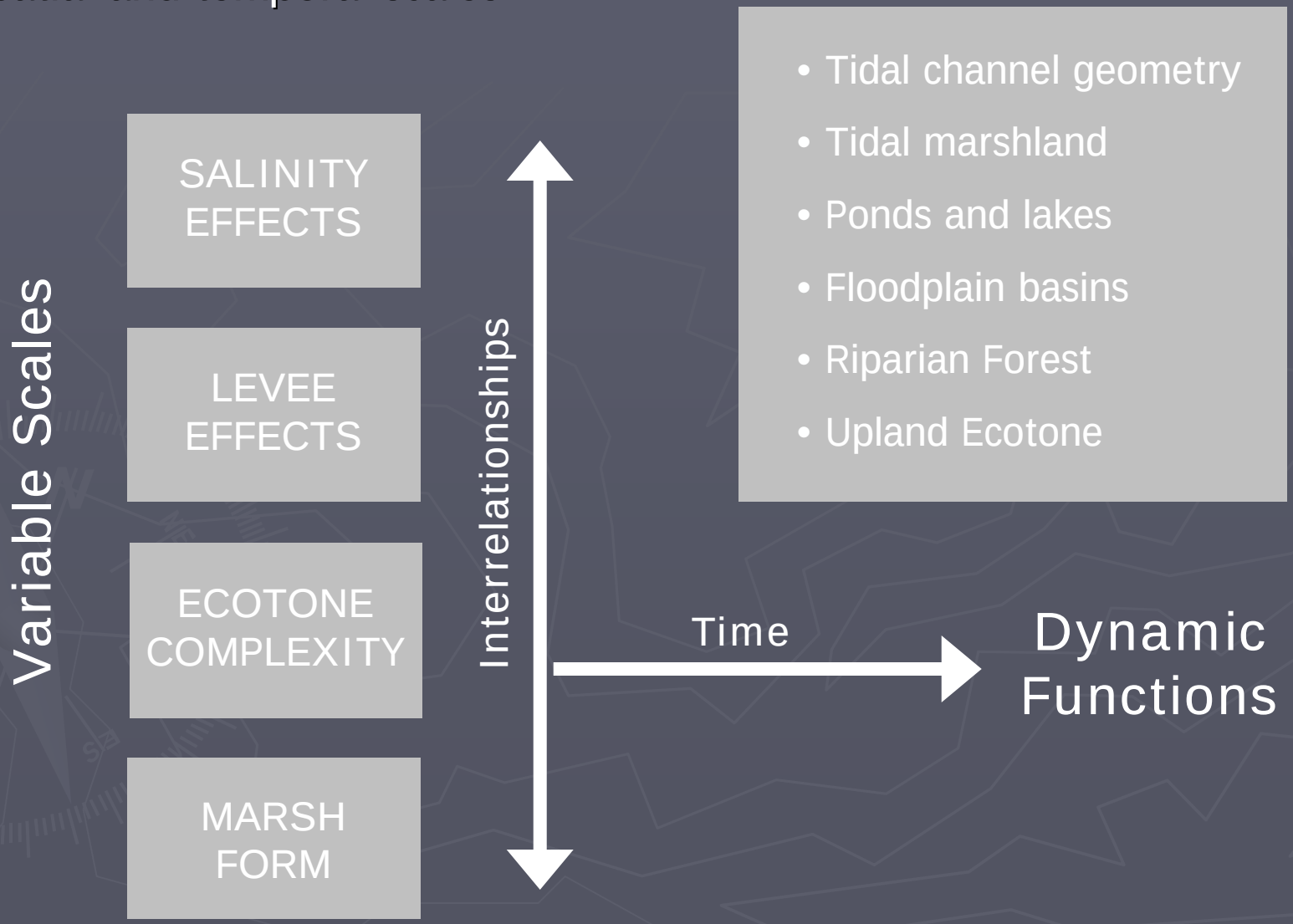
Interviews with long-time residents

2000

Scholarly & professional reports & records

Initial Concepts

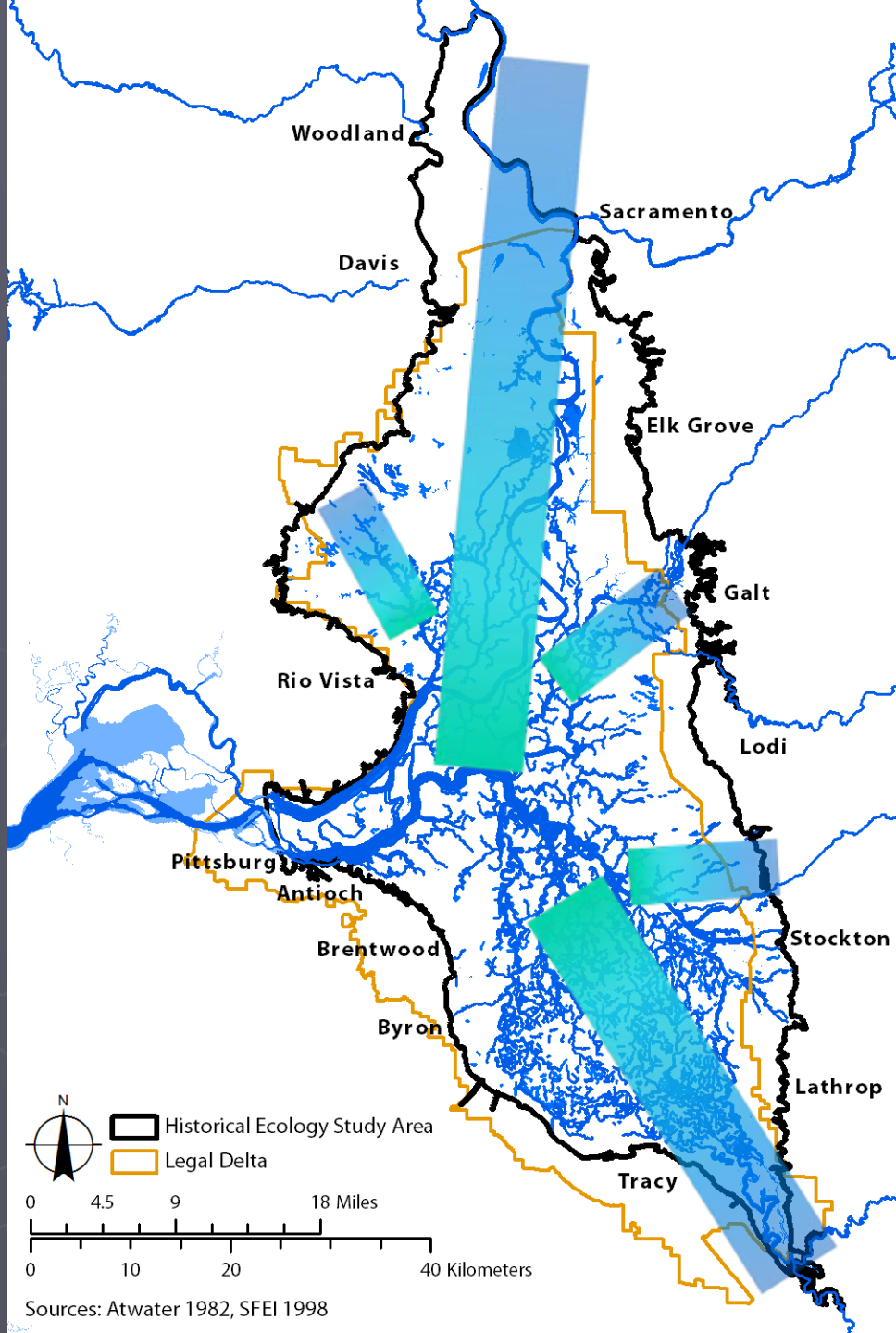
Physical gradients of various steepness were expressed over a variety of spatial and temporal scales



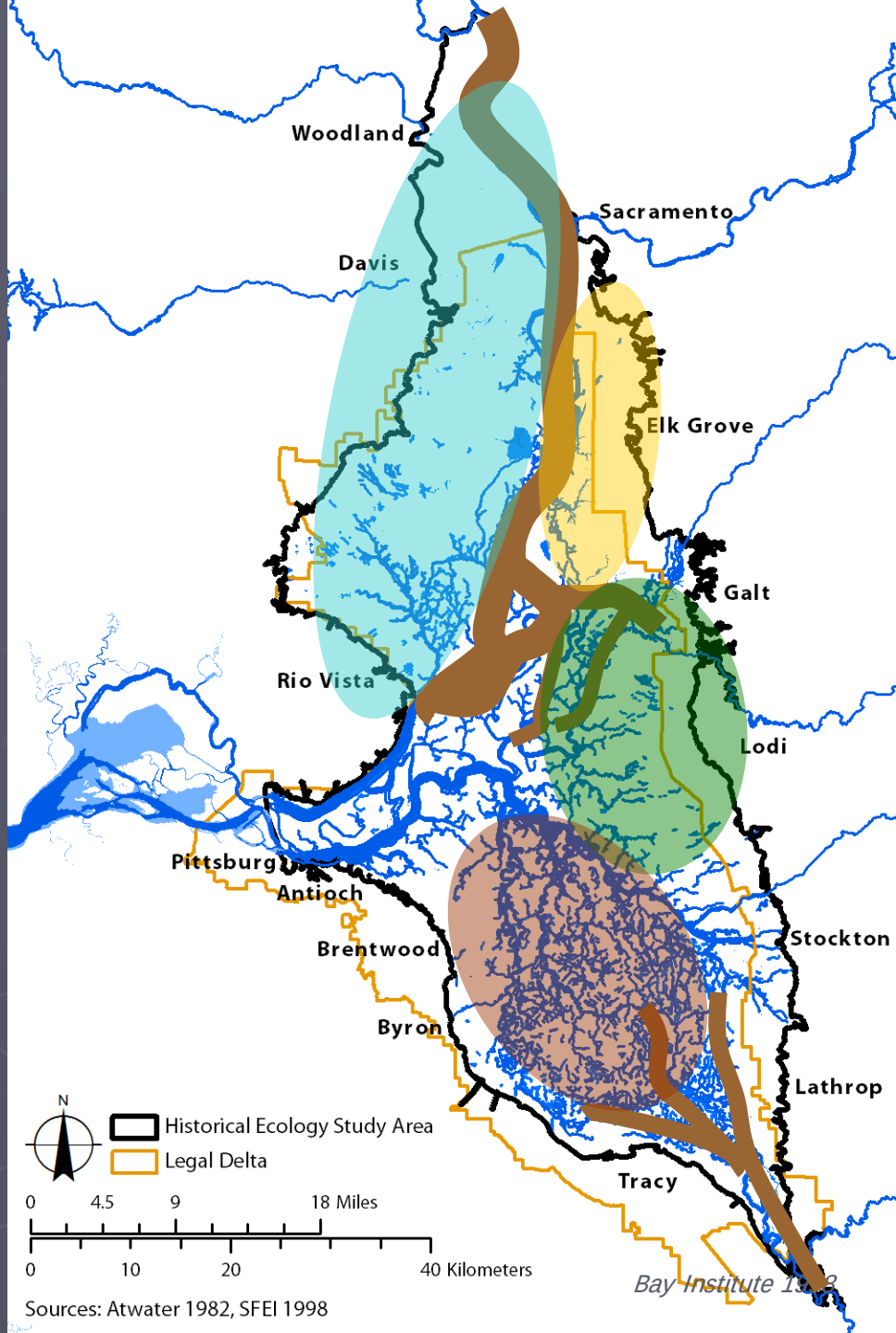
Fluvial-tidal relationship creates salinity gradients at many scales

Distinct sources of tidal and fluvial input

Fluvial Tidal



Natural levees create separate hydrological subregions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0 10 20 40 Kilometers
Sources: Atwater 1982, SFEI 1998
Bay Institute 1998

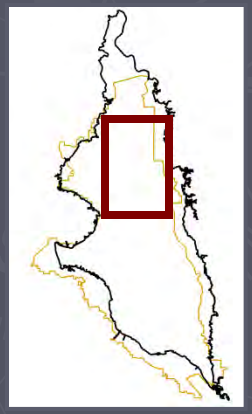
FLOOD BASINS

Natural levee: **“**about ½ mile in width”

Tule: “grows even all over the ground and not in bunches or on tusick [sic]...”

Open water: “it gets too deep for Tola and then comes the Lake or Pond.”

- *Browning 1851*



Courtesy UC Davis, Dept. of Special Collections

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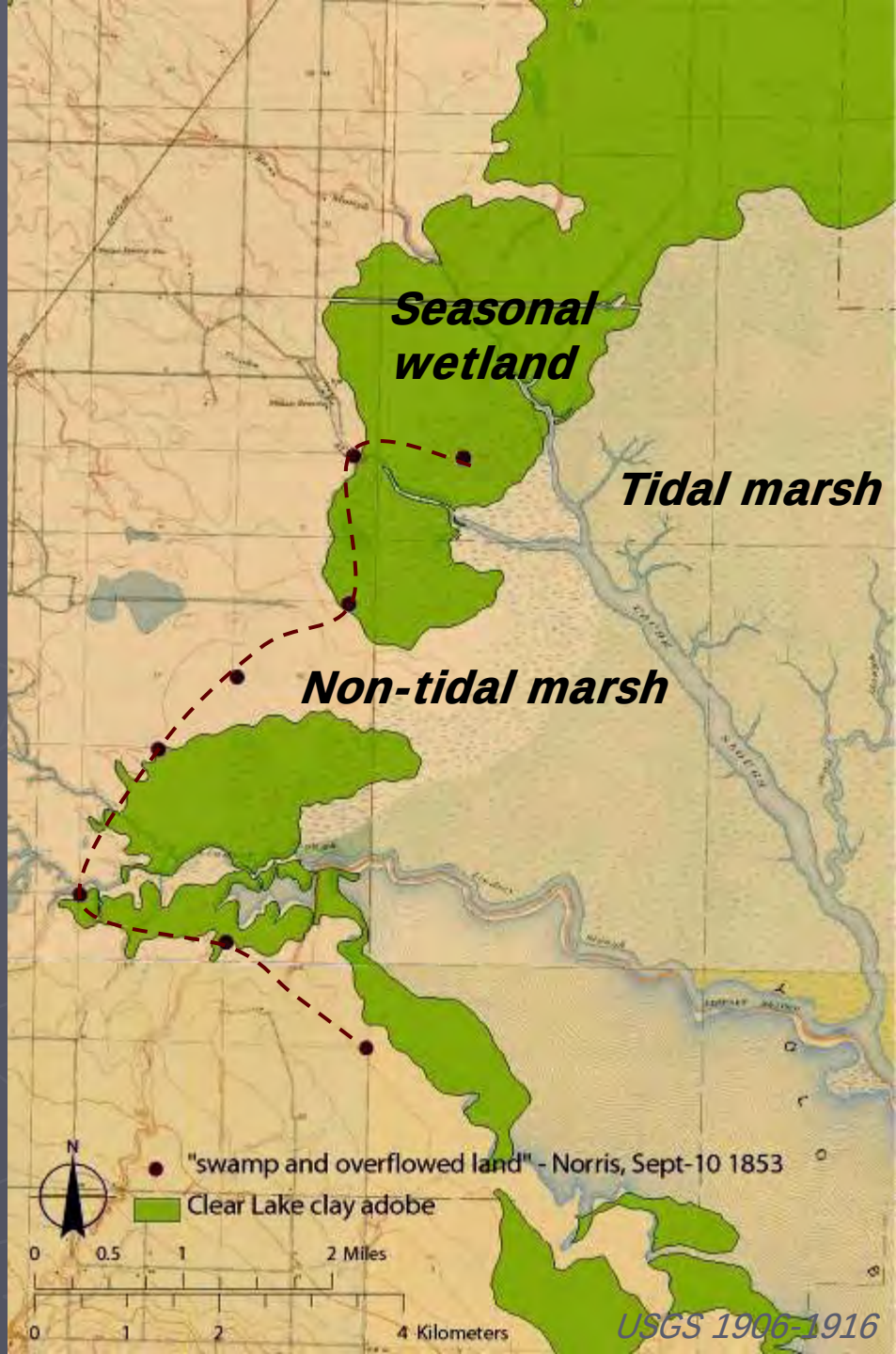
Browning 1851

Upland marsh edge is a complex and dynamic ecotone

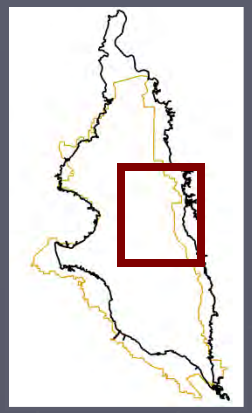
CACHE SLOUGH

Components of the upland ecotone

- Complex mosaic
- Not a smooth edge
- Estuarine transgression



MOKELUMNE



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"at the time of low waters there are points and ridges which can be followed in for some distance"

- *W.C. Miller 1859*

Fall 1856: "I took up from the M into the tule to open spaces which were covered with water where ducks and geese would light."

- *Samuel Thornton 1859*

E. A. Sherman 1859

SOUTH DELTA

Transition zone between tidal marsh and riverine floodplain

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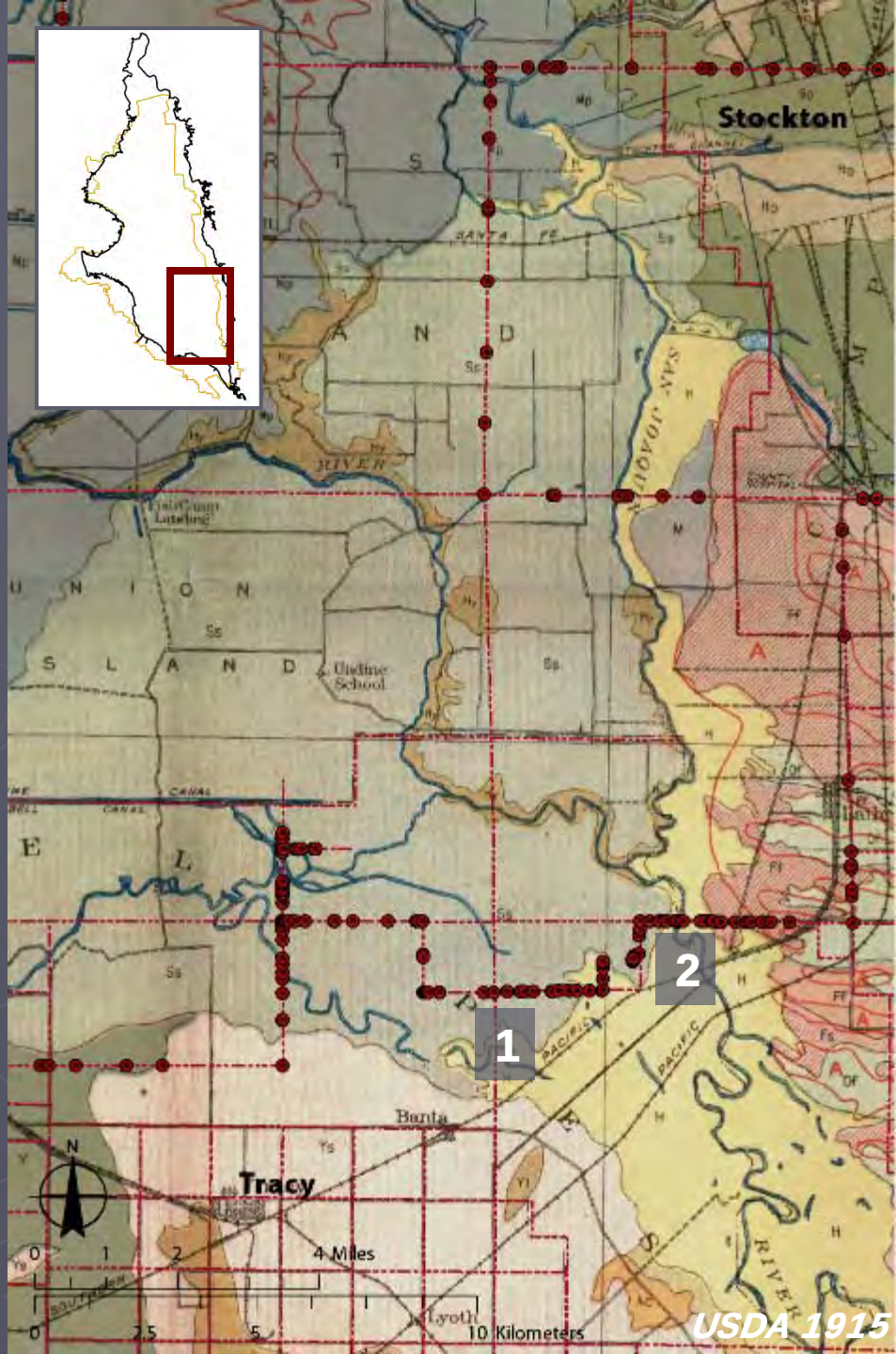
Transition zone between tidal marsh and riverine floodplain



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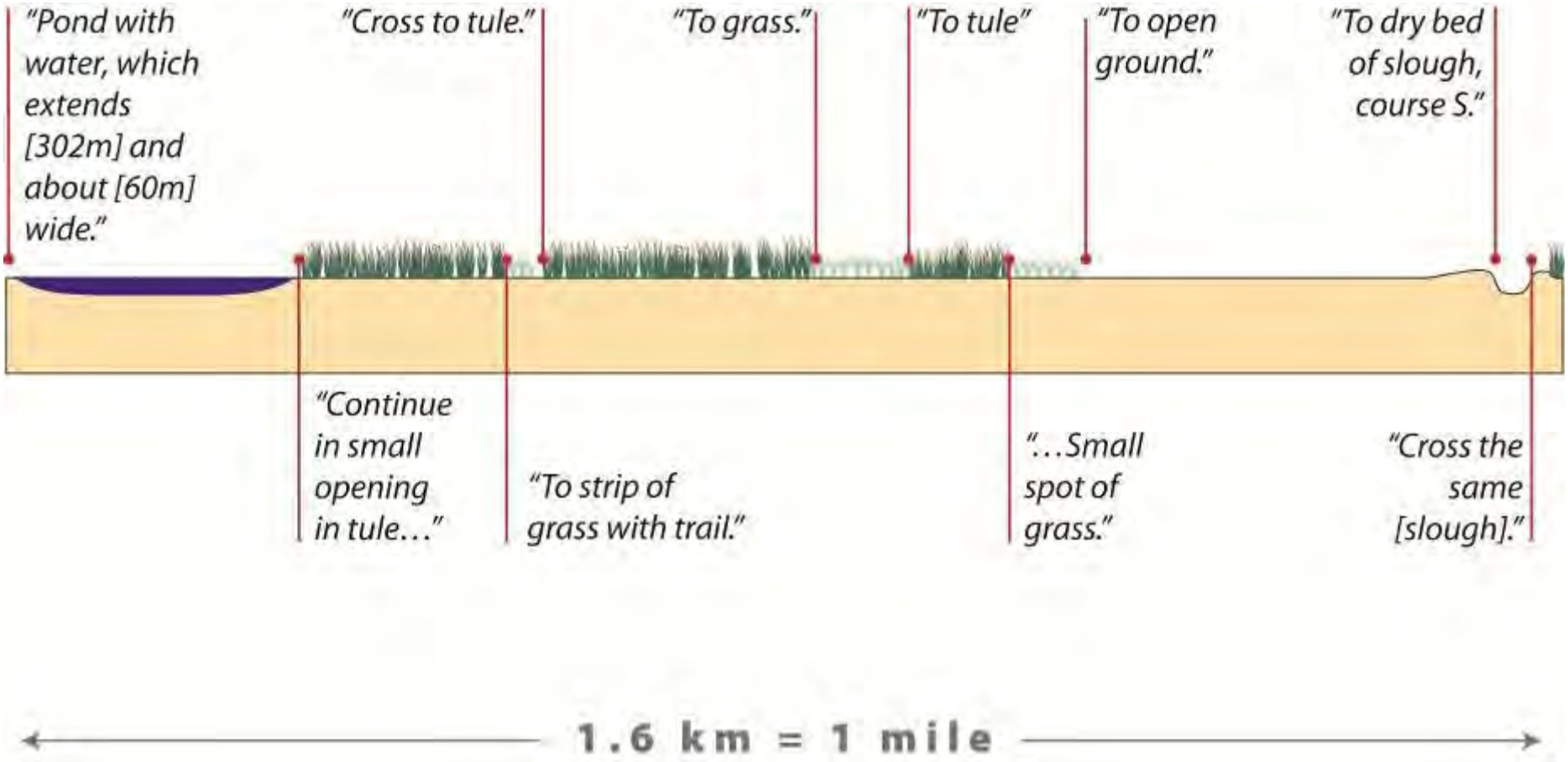
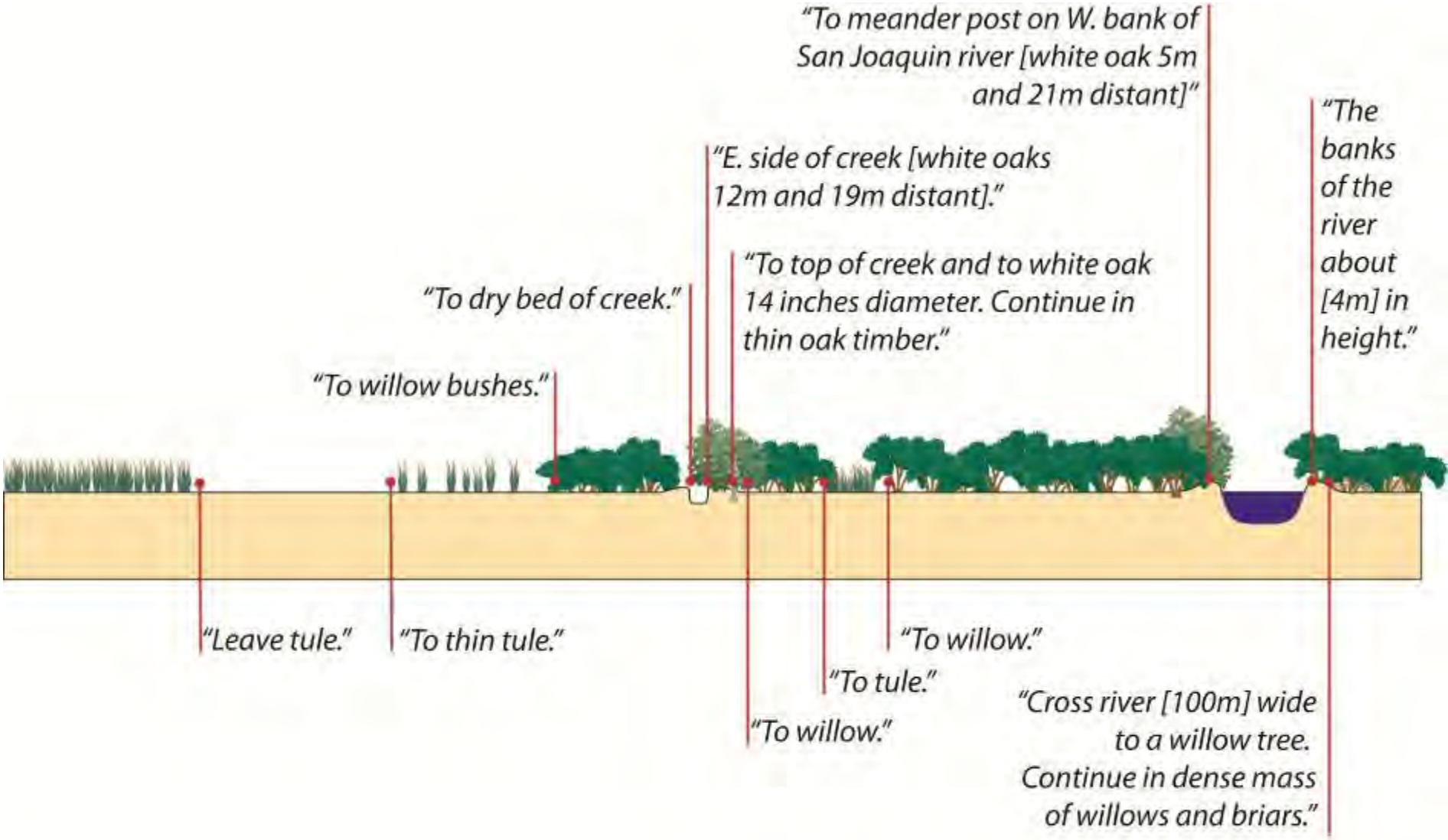


General Land Office survey notes, Ralph W. Norris, October 1851

MILE 2 TRANSECT



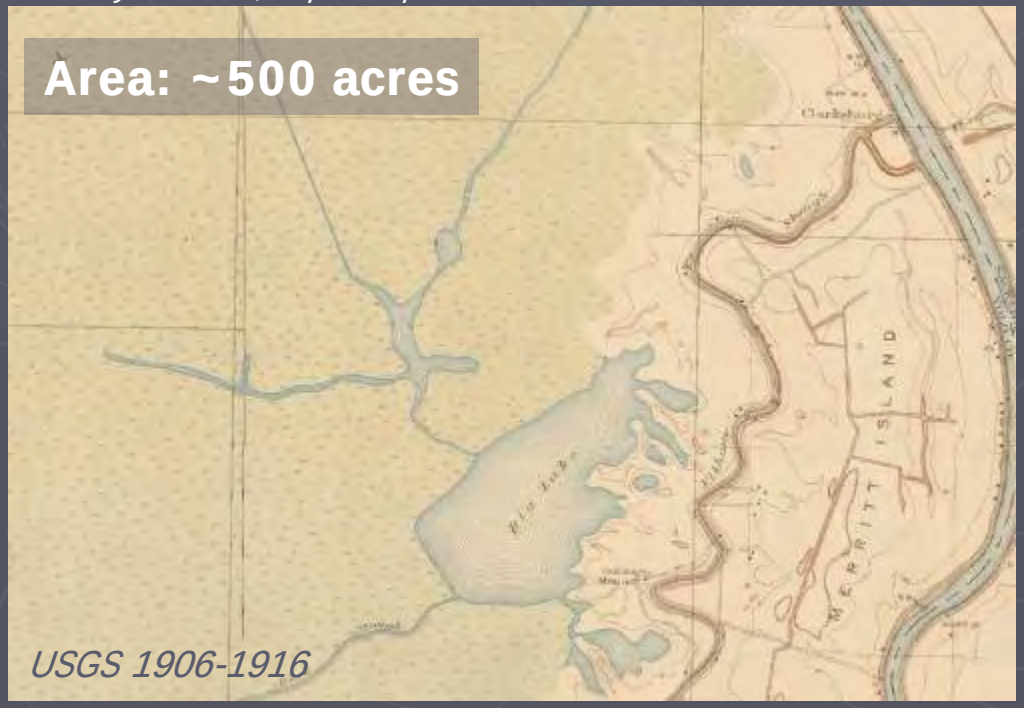
General Land Office survey notes, Ralph W. Norris, October 1851

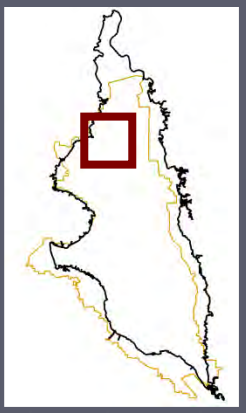
Fluvial-tidal processes affect tidal marsh form

(water storage and conveyance)

BIG LAKE – YOLO BASIN

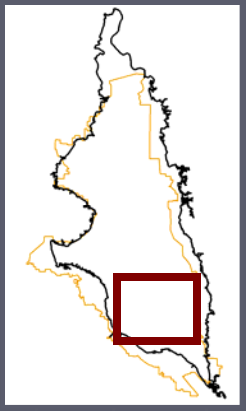
Courtesy UC Davis, Dept. of Special Collections





Large open water bodies as freshwater reservoirs

SOUTH DELTA



Depth: 1 ½ fathoms = 9 ft

Area: 150-200 acres

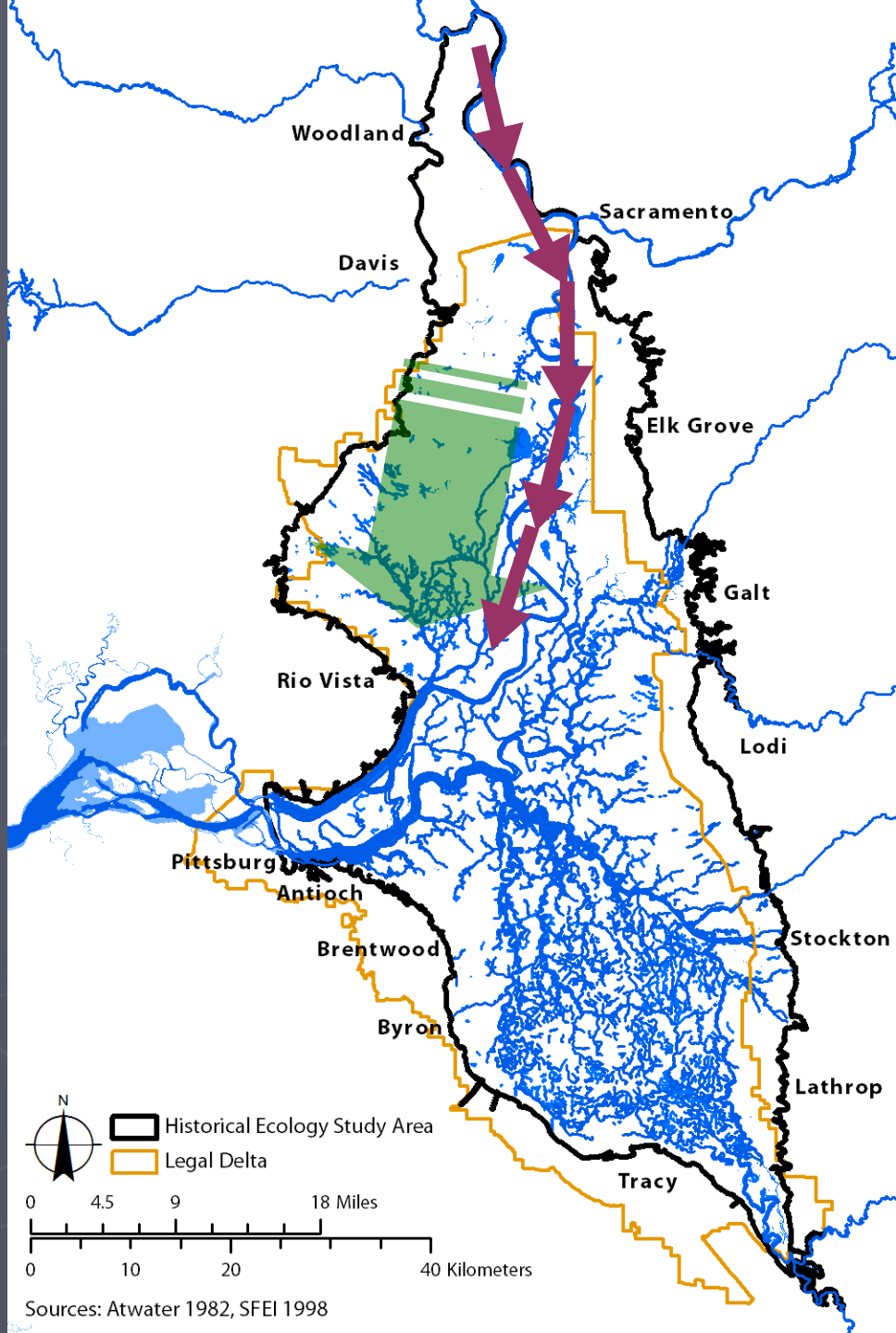
Gibbes 1850

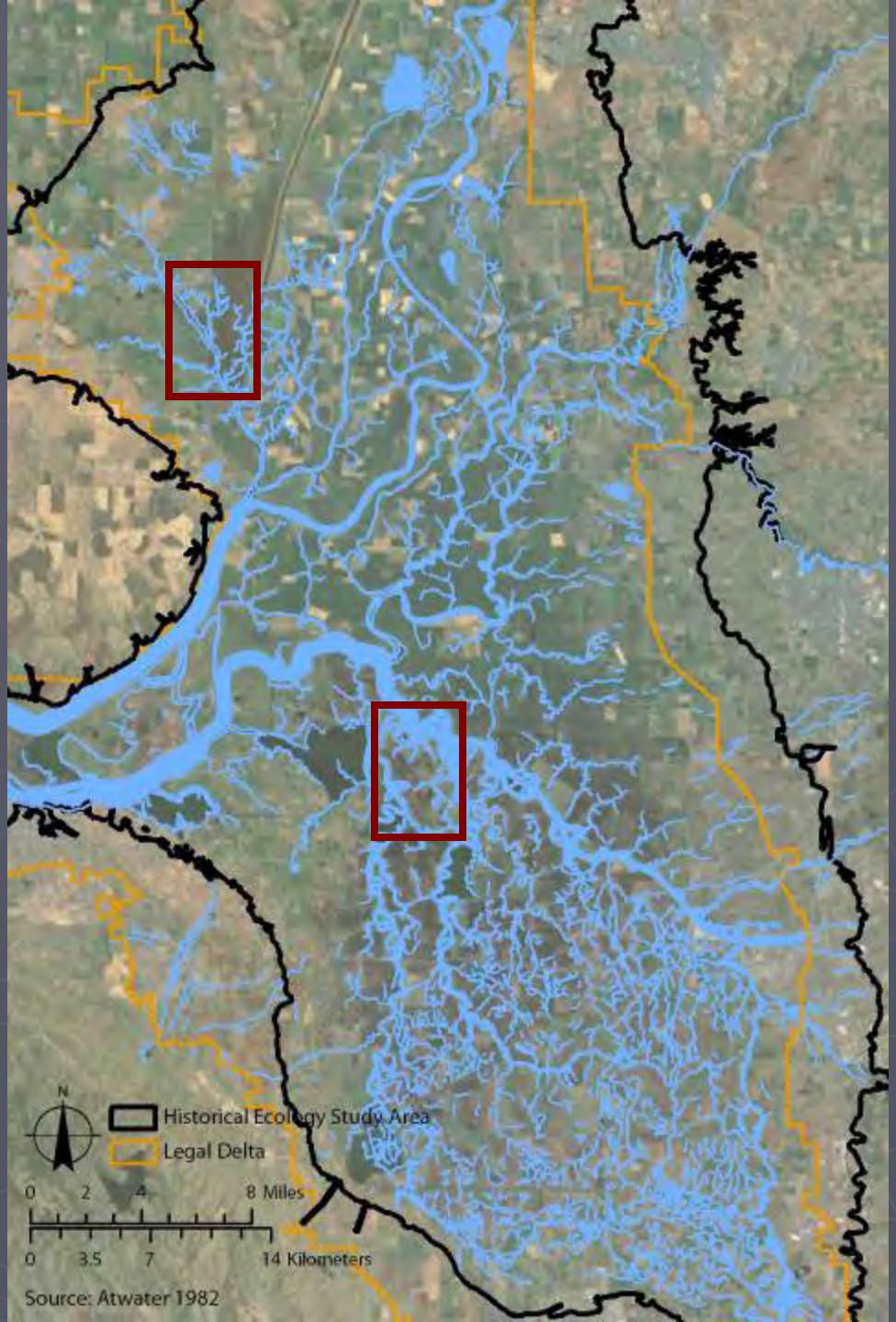
Courtesy UC Davis, Dept. of Special Collections

Different “expressions” of freshwater input

In-stream flows: inorganic sediment, short residence time, colder temperatures?

Tidal marsh discharge: organic material, longer residence time, capacity for nutrient exchange

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Historical Ecology Study Area
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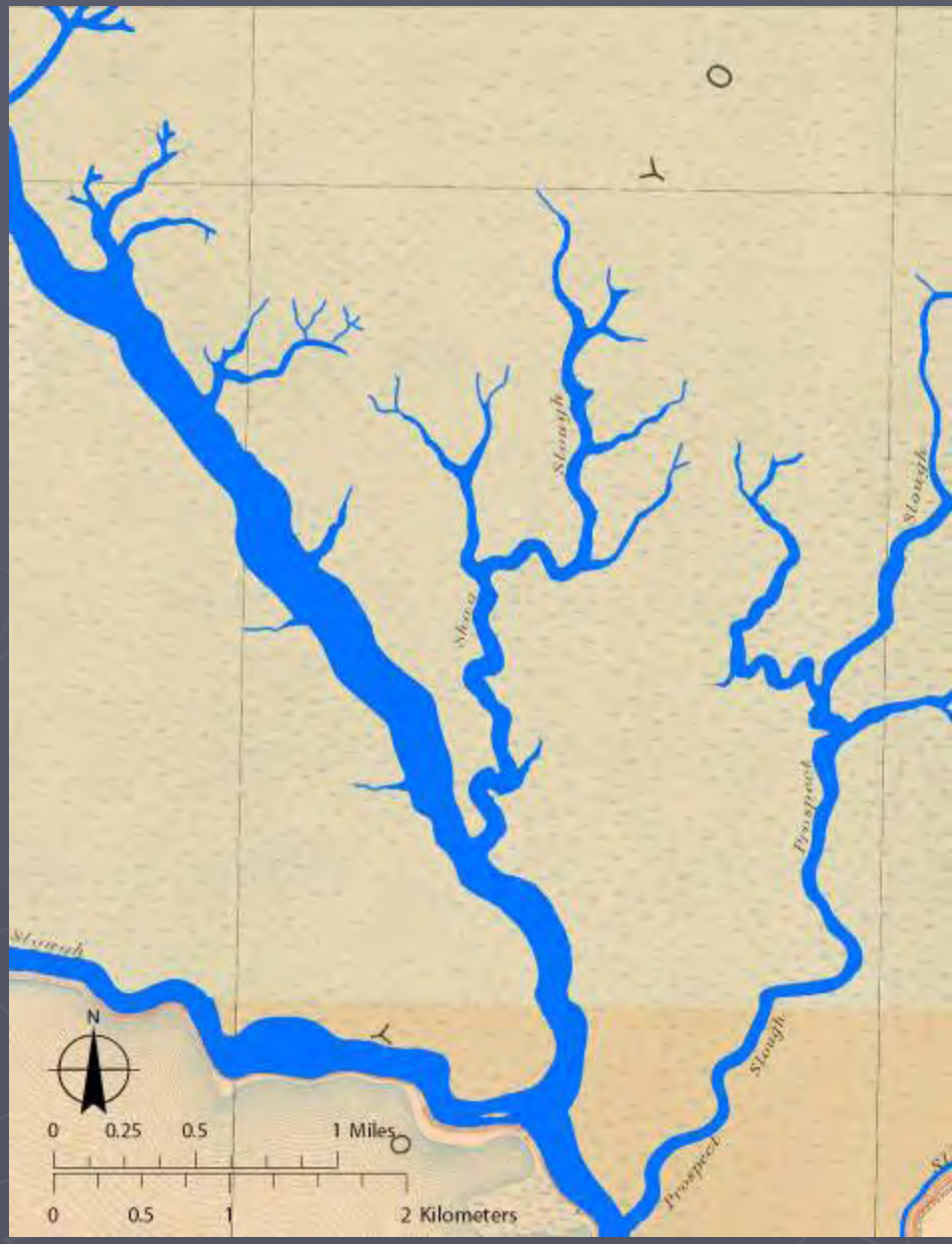
0 2 4 8 Miles
0 3.5 7 14 Kilometers
Source: Atwater 1982

CENTRAL DELTA

CACHE SLOUGH



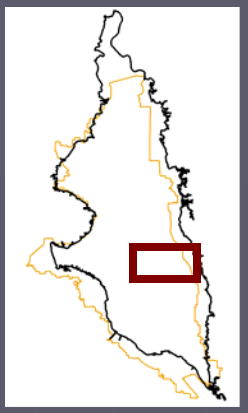
USGS 1909-1916

TYLER ISLAND

Toward channel density

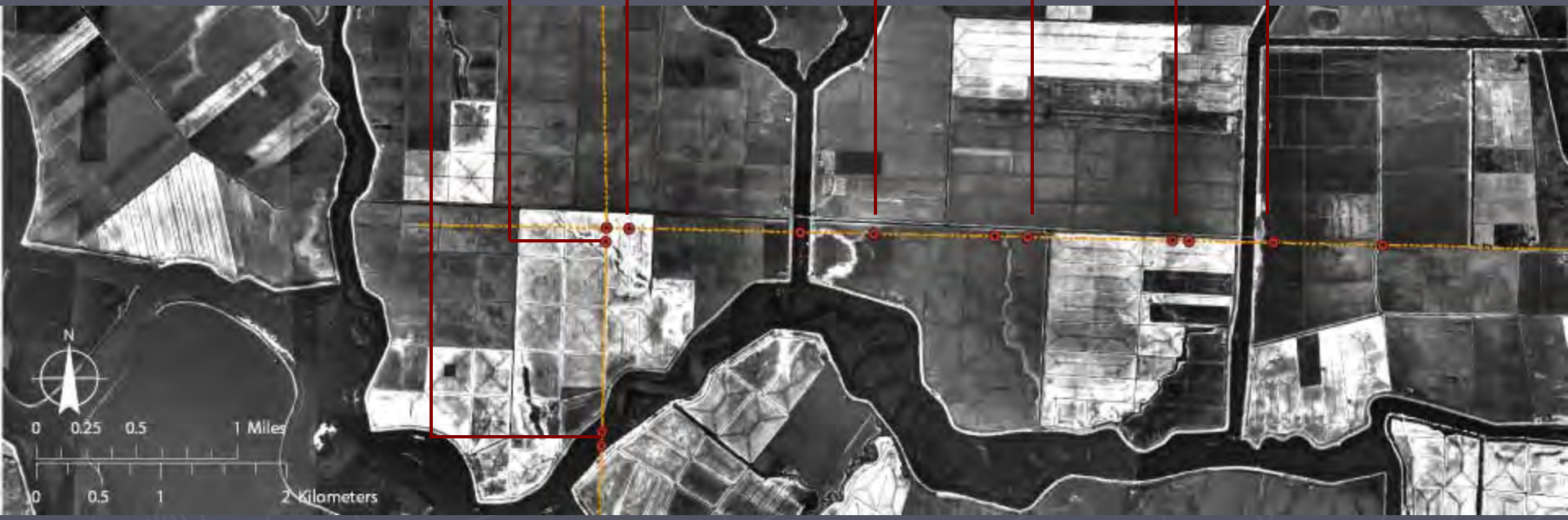
DISAPPOINTMENT SLOUGH

Toward channel width



Disappointment Slough

~100m 10m 10m 13m 8m 8m 12m



General Land Office Survey
W. F. Benson 1878

EMERGING CONCEPTS: LANDSCAPE FORM

- Physical gradients of various steepness were expressed over a variety of spatial and temporal scales
  - Fluvial-tidal relationship creates salinity gradients at many scales
  - Natural levees create separate hydrological subregions
  - Upland marsh edge is a complex and dynamic ecotone
  - Fluvial-tidal processes affect tidal marsh form (water storage and conveyance)

EMERGING CONCEPTS: LANDSCAPE FUNCTIONS

- All of the physical gradients translate into complex habitat mosaics
- A complex channel geometry reflected diverse tidal routing, variable sediment and nutrient transport, and longer residence time
- Seasonal flood events affected tidal marsh characteristics (e.g. open water features, sediment, temperature, salinity)
- Winter flows were held and released through the dry season in freshwater marsh basins, lakes/ponds, groundwater

Sacramento River
William Jewett 1851

San Joaquin with Mount Diablo in background
Thomas Moran 1873

THANKS TO

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UC Berkeley and The Bancroft Library

UC Davis and The Shields Library

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The State Lands Commission

Bob Webber and Reclamation District 999

Sacramento River Delta Historical Society

Thank You

NIGHT SCENE ON THE SAN JOAQUIN RIVER—
MONTE DIABLO IN THE DISTANCE
- Hutchings 1862

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