3 WATSONVILLE SLOUGHS WATERSHED
Upland Vegetation

***Habitat continuity has decreased** dramatically since the mid-1800s, resulting from the degradation of the slough system and the reduction of surrounding upland ecosystems. Habitat fragmentation is especially critical for species, such as the endangered Santa Cruz long-toed salamander* (Ambystoma macrodactylum croceum)*, that spend part of their life cycle away from marshes in the live oak* (Quercus agrifolia) *and chaparral woodlands (USFWS 1999).*

Images from the Wieslander Vegetation Type Mapping Collection are courtesy of the Marian Koshland Bioscience and Natural Resources Library, University of California, Berkeley, www.lib.berkeley.edu/BIOS/vtm/.

Imagery courtesy USDA NAIP 2005

As the modern landscape may indicate, coast live oaks and willows once lined the marsh edges and "hollows" (Day 1854). For example, just south of Highway 1 in Harkins Slough, GLO surveyor Richard Howe (1851) noted "a streak of timber 30 rods North along an arm of marsh," and Abram Thompson (1857) describes the entrance of Harkin Slough into Watsonville Slough with, "good second rate with a growth of black oak trees [probably live oaks] along the margin of the estuary." The wooded estuary margins merged into the flat bench land, which was covered in herbaceous vegetation, described as "plains" or "prairies" by early surveyors. On the land between the upper reaches of Struve Slough and West Struve Slough, Howe (1851) describes being "on a high rolling plain, rich black soil covered with weeds that look like dead clover." Also near Struve Slough, Thompson (1857) reports that there is "no timber except near the estuary," with steepening topography, grassland transitioned into coast live oak woodland and dense chaparral. Richard Howe (1851) found, on his survey line west of Harkin Slough and south of Highway 1 (shown below), a "thick forest of thick brush brambly mountain gently sloping" and live oaks (which he used for his bearing trees).

Map courtesy The Bancroft Library, UC Berkeley

An early land grant map of the Rancho de San Andres, depicts the pattern described below. The "Lomarias" (hills) are covered with "Chemisal" (chaparral). Also, "Encinal" (live oaks) border the "Bolsas" (pockets or low-lying areas).

In summary, *historical ecology provides a tool for developing action plans for Critical Coastal Areas. Historical ecology research provides both technical information and an educational perspective that can help us recognize and respond to environmental change. While this preview shows some of the types of analysis that could be useful for the Watsonville Sloughs Watershed, much more historical information about the local landscape is available and remains to be compiled. For more information about historical ecology methods and resources, please go to www.sfei.org/HEP.*

West Struve Slough — K. Ridolfi

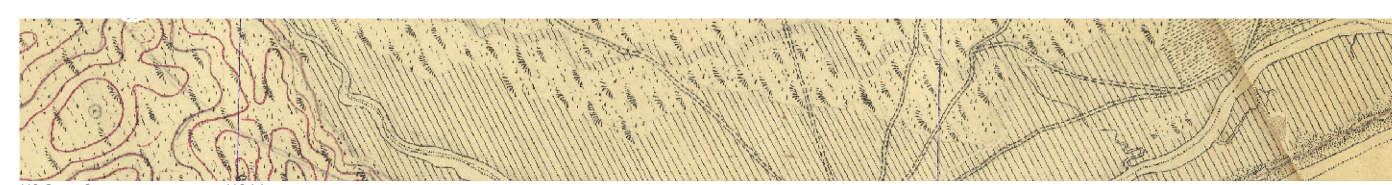
AN INTRODUCTION TO THE HISTORICAL ECOLOGY OF THE WATSONVILLE SLOUGHS WATERSHED

A tool for developing an action plan for the Critical Coastal Areas program

***Scattered throughout local and regional archives,** historical information represents a valuable and often untapped resource for watershed management. Can an understanding of the historical landscape help us guide future landscape modifications? Can this understanding help re-establish native habitats and ecosystem function? How did natural and cultural processes create the historic ecosystems that still persists as fragments in the current landscape?*

This publication is intended as an introduction to how historical ecology can help local residents and resource managers understand current conditions and develop strategies for environmental recovery in the Watsonville Sloughs watershed and the Central Coast. The watershed has experienced dramatic physical and ecological change due to agricultural and urban development. However, there are still many opportunities to restore natural watershed function within the contemporary landscape. This document highlights areas of interest for potential restoration, focusing on three ecosystem types: coastal salt marshes, freshwater wetlands, and upland vegetation. The opportunity areas highlighted will provide information for the stakeholders of the Watsonville Sloughs watershed participating in the Critical Coastal Areas (CCA) Program pilot study to identify and prioritize actions that will improve watershed health. The CCA Program seeks to improve water quality along the California coast through the implementation of management measures to reduce the effects of diffuse sources of pollution including urban and agricultural runoff.

For more information on the CCA program, please visit http://www.coastal.ca.gov/nps/cca-nps.html.



US Coast Survey map courtesy NOAA

***Authors** Alison Whipple and Robin Grossinger • **Design and layout** Ruth Askevold and Alison Whipple*

***Thanks to** Kat Ridolfi, Chuck Striplen, Erin Beller, and Micha Salomon*

Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

www.sfei.org

MAY 2008

WATSONVILLE SLOUGHS WATERSHED

OPPORTUNITY AREAS

1 Coastal Salt Marshes (Page 4-5)

2 Freshwater Wetlands (Page 6-7)

3 Upland Vegetation (Page 8)

Watsonville Sloughs Watershed (boundary in orange) = 12,500 acres

Imagery courtesy USDA NAIP 2005

Map courtesy of the Earth Science & Map Library, UC Berkeley

USDA

A "laguna" is depicted in the San Andres land grant map (A) south of the point where the county landfill sits today, where Galligan Slough joins Harkins Slough. The 1908 soils map (B), which predates the first USGS mapping efforts, depicts a water body as well - indicating that open water persisted despite drainage for agricultural production (see inset quote). The soil survey text notes that the "swamps were shallow and filled with a heavy growth of tules, cattails, and other water-loving plants" (Mackie 1908). Observations from several GLO surveyors support this evidence as well, using the terms "swamp" and "tulares" (Day 1854) to describe the area. Also, in July of 1857, Thompson noted the "water and mud in the estuary are too deep" to set a corner post. The 1914 USGS topographic quad (C) depicts a small freshwater marsh that is likely the remnant of the water body shown in earlier sources.

Another significant feature noted by the GLO surveys was a large willow "patch" or "thicket" (Day 1854) at the mouth of Harkins Slough, growing on the Pajaro clay loam adobe ("Pad") soils depicted in the 1908 soils map (B). These soils are characterized by "poor natural drainage" and are "often covered with water for a considerable time" (Mackie 1908). This region is slightly higher in elevation than the slough areas to the north, where the open water is shown, which likely allowed the willows to become established. By 1931 (D), almost all of the slough areas were drained, cleared and farmed. In the 1931 aerial photography, narrow channels replace the broader sloughs, few marsh areas can be detected, the large willow swamp is gone, and trees no longer border the slough branches. Today, open water now exists again in this region, but the large willow thicket is still absent. These returning marshes reflect a changing hydrologic regime and shifts in sedimentation rates. Are components still missing that would aid the recovery of a functioning and stable wetland system?

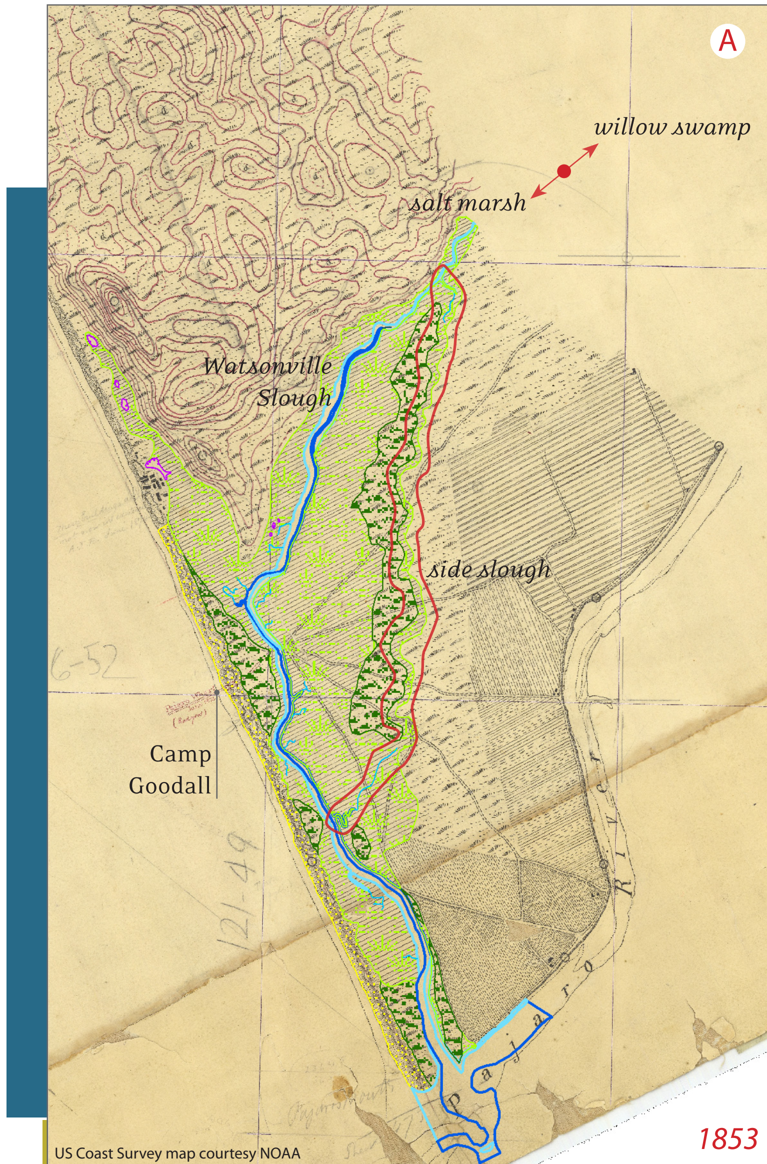
The U.S. General Land Office (GLO) Public Land Survey, which mapped the Watsonville region in the early 1850s, provides valuable descriptive and quantitative ecological information (shown in several locations within this publication). In the process of dividing the land into the 6-mile-square townships we are familiar with today, surveyors were instructed to note the species, diameter, distance and azimuth of up to four "bearing" trees at every mile and half-mile point. The surveyors also described distinctive features along their survey lines, such as creeks, lakes, marshes, or areas of thick brush, and commented on general soils and land characteristics. In the image to the right of the Harkins Slough area intersected by Highway 1, key phrases excerpted from the survey point descriptions provide evidence of a wetter marsh system than what is seen in the contemporary 2005 imagery.

Imagery courtesy USDA NAIP 2005

1 WATSONVILLE SLOUGHS WATERSHED
Coastal Salt Marshes

These pages illustrate changes in the hydrology and ecology of lower Watsonville Slough. Historic cartographic and narrative sources, such as the United States Coast Survey (USCS) topographic maps (T-sheets) (described below right), can help answer questions about changing connections between the coastal environment and upland hydrologic systems, and the associated vegetation. Along with a dramatic decrease in marsh extent, these sources show the ecosystem boundary between the fresh and salt water systems and the historic extent and location of side channels connected to the main Watsonville Slough. For a hydrologic system this highly modified, understanding the historic coastal slough form and function can help establish a baseline from which to compare future planning and restoration.

This drawing by William B. McMurtrie (1856) depicts the historic Pajaro Landing, near the historic Camp Goodall (see location in T-sheet to above right). It operated as Port Watsonville (also called Port Rogers) beginning in 1903 and serviced the growing Pajaro Valley agricultural industry. In the foreground a donkey powers an arrastre-like device (for pulverizing ore) and a side-wheel steamship sits in the Monterey Bay (courtesy The Bancroft Library, UC Berkeley).



US Coast Survey map courtesy NOAA

USDA

Imagery courtesy USDA NAIP 2005

Initiated in 1807 by the U.S. Government, the USCS T-sheets provide an early and detailed cartographic depiction of the coastal environment. The unprecedented use of geodetic surveying techniques, which employs a common reference, or datum, to which points are tied, produced remarkably accurate maps for that time period. Despite the absence of a standardized legend, T-sheets show hydrologic patterns and absolute and relative distribution of coastal habitats, which can be interpreted through a standard methodology (Grossinger and Askevold 2005).

T-sheet 442 (above), covering the lower Watsonville Slough (Harrison 1853), shows the intertidal channel and subtidal extent connected to a broad salt marsh. The T-sheet already shows influence of European contact in the Pajaro Valley. A spider-web of roads converge at Watsonville slough where Palm Beach sits today. The agricultural fields have not yet encroached upon the marsh extent, indicating that the wetland systems drawn here generally represent unmodified conditions. The T-sheet wetland features are seen overlaying the 1931 USDA aerial photography.

PICKLEWEEDS, RUSHES, AND TULES grow in the overflow portions, while salt grass, cressa, atriplex, and water foxtail grow on the drier portions. On the portions protected by levees and later washed with fresh water, crops of barley have been grown, otherwise it is an unproductive salt marsh containing over 3 percent of sea salts.

- MACKIE 1908

This series of images above show ***significant changes in the tidal channels,*** as well as the marsh extent. Compared to the 1853 USCS T-sheet, the alignment of the main Watsonville Slough is similar to that of today, although the width appears to have narrowed. The small side channels shown in the T-sheet are no longer present in the 1931 aerial photography and by 2005, the large branch "side slough" that once connected the upper and lower Watsonville Slough (within the extent shown) is drained to accommodate surrounding agricultural fields. Hydrologic modifications such as Beach Street ditch and the pumping station at Shell Road have been introduced and further studies are needed to determine the ecological services lost by the introduction of these new hydrologic features and the loss of the side slough.

Map courtesy The Bancroft Library, UC Berkeley

The ***boundary between salt marsh and willow swamp*** near the present-day San Andres Road is clearly demarcated by the 1860 confirmation map (shown at left) of the official U.S. survey of the Rancho de San Andres (C. C. Tracy). This ecosystem boundary point is included in the series of images above. While the boundary between salt marsh and willow "swamp" persists in the 1931 aerial photography (the darker vegetation), contemporary imagery suggests westward movement of the salt marsh to Shell Rd., likely as a result of a reduction of the tidal prism or a change in freshwater hydrology.

2

WATSONVILLE SLOUGHS WATERSHED

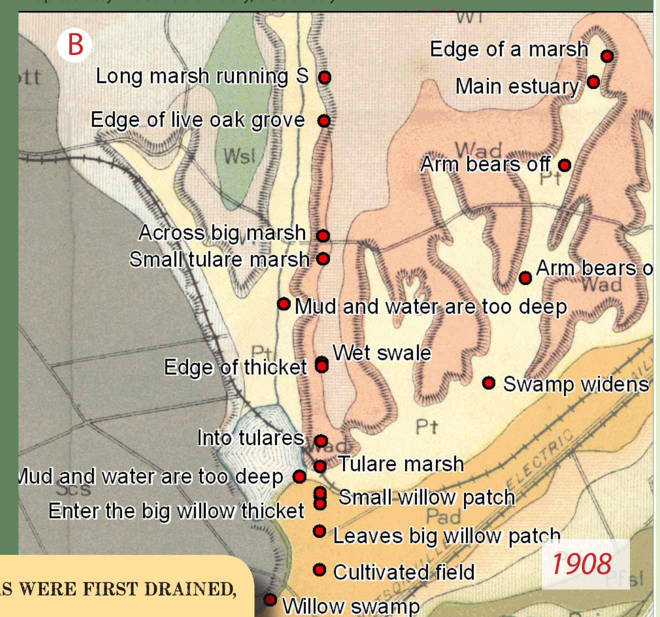
Freshwater Wetlands

Understanding the form and function of the sloughs prior to the late 1800s can inform interpretation of the current hydrologic regime and perhaps aid recovery and restoration in progress today. Constructing this baseline is especially important considering that the functional wetland and marsh ecosystems were significantly reduced at the onset of agricultural intensification early in the 20th century, as indicated by the 1931 aerial photography.

Habitat composition and location has undergone dramatic transformation in a relatively short time period; responding to active channel modification for land drainage, altered timing of surface and groundwater availability from pumping, winter withdrawals, and summer return flows, increased sedimentation rates, and altered drainage patterns and runoff rates due to urban development. In most cases, general patterns seen in the present landscape reflect historic conditions. However, local patterns often reflect shifts in relative species composition and changes in hydrologic connectivity resulting from modifications made during the more recent agricultural era. The images at right show how multiple sources can help define ecosystem boundaries and inform interpretation of change over time. Overall, sources from the 1800s indicate the presence of broad tule marshes and open water marked by large willow swamps.

"WHEN THESE PEAT AREAS WERE FIRST DRAINED, by cutting a deep channel for Larkin Creek through to the ocean, immense crops of onions, potatoes, and grain were produced." - MACKIE 1908

Map courtesy The Bancroft Library, UC Berkeely



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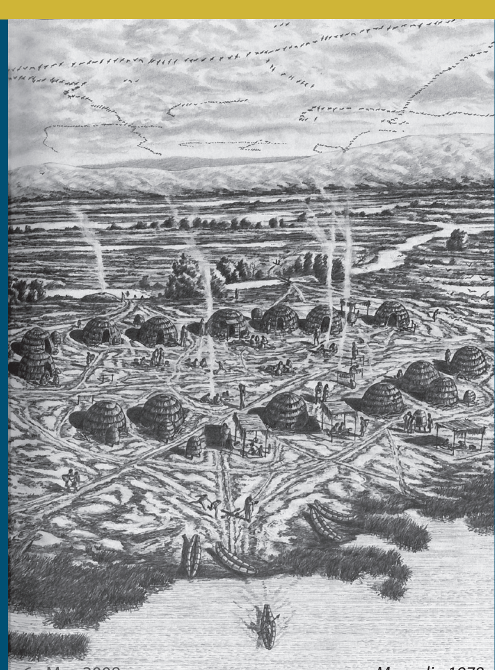
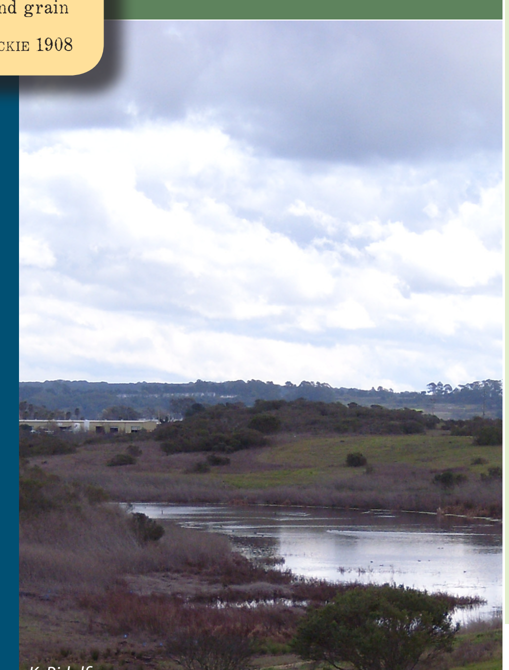


Margolin 1978

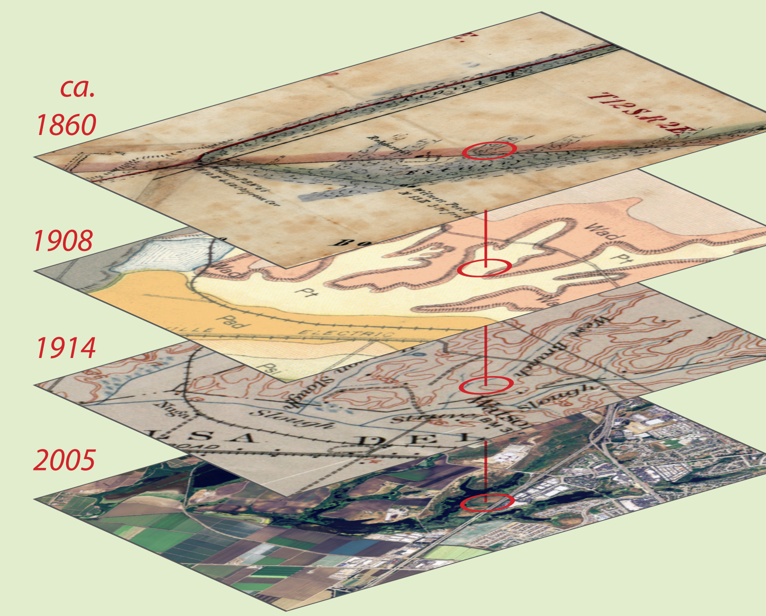
The sloughs provided rich natural resources which supported the Calendarruc, a Mutsun-speaking Costanoan/Ohlone group. Estimates show that between 500 and 900 people lived within the Pajaro Valley prior to European contact, and that there was significant interaction between this group and other Mutsun-speaking peoples upstream (Milliken et al 2008 in press). As with other groups in the area, the Calendarruc utilized fire, selective harvesting, copicing, pruning, and scores of other physical modifications to shape the local ecology to fit their seasonal needs.



K. Ridolfi

Building a **HISTORICAL ECOLOGY** Project

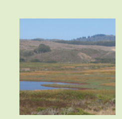
DATA COLLECTION • Research begins with the acquisition of historical materials from a broad range of institutions, including local museums and historical societies, city and county archives, and regional libraries. Journals, diaries, and newspaper articles about the landscape and notable environmental features document historical conditions. Early maps, surveys, and aerial photography provide the locations of historical features, such as streams, wetlands, and plant communities, as well as remaining property boundaries and roads that are valuable links to the contemporary landscape. Other important sources include landscape photography, sketches, and paintings.



DATA COMPILATION • Sources are drawn together for synthesis and analysis along the themes of historical vegetation types, channel geometry, seasonality, and land use. We georeference early maps and aerial photography in a geographic information system (GIS), which allows historical evidence to be compared to modern conditions. We also extract and organize pertinent quotes from early land surveys and narrative sources and, where possible, place them on maps of the past and present. This process of comparing multiple, independent sources of historical and modern information facilitates a detailed and accurate depiction of environmental change.

SYNTHESIS AND ANALYSIS • We rely heavily on GIS to synthesize the data into layers that represent historical landscape characteristics. Mapped features may include channels, perennial and seasonal wetlands, coastal features, woodlands and savanna, and other habitats — each coded independently with their supporting sources and relative certainty level. A variety of methods are used to compare past and present landscapes, describing changes in habitat form and distribution. These depictions of habitat change are used by ecologists and other environmental scientists to describe changes in ecological functions, such as wildlife support. As a reliable map of the pre-modification landscape is developed, it begins to reveal the relationships between native habitats and physical gradients such as topography, salinity, and hydrology, providing a basis for identifying adaptive restoration and management strategies for the contemporary landscape.

REPORTS, GRAPHICS, AND PRESENTATIONS • The analysis is brought together into broadly accessible tools, including illustrated reports, websites (such as wetlandtracker.org), and maps. These present trends in habitat types and extent, discuss conceptual models and areas of interest for future environmental improvements, and provide direct access to many of the most significant historical data sources.



APPLICATIONS • Understanding the historical landscape and how it has changed over time can help address many of the challenges associated with managing and planning for the future of local watersheds. Historical ecology can help set priorities for restoring natural functions to local creeks, identify natural ways to reduce flood hazards, and reveal previously unrecognized conservation opportunities. The historical analysis often reveals ways to restore native habitats within our developed landscape for recreational benefits as well as wildlife conservation. Historical ecology can also reveal management constraints resulting from historical landscape changes, providing a more realistic basis for planning the future.