

# The Tijuana River Valley: An Ecological Look into the Past



Sam Safran  
San Francisco Estuary Institute  
Resilient Landscapes Program

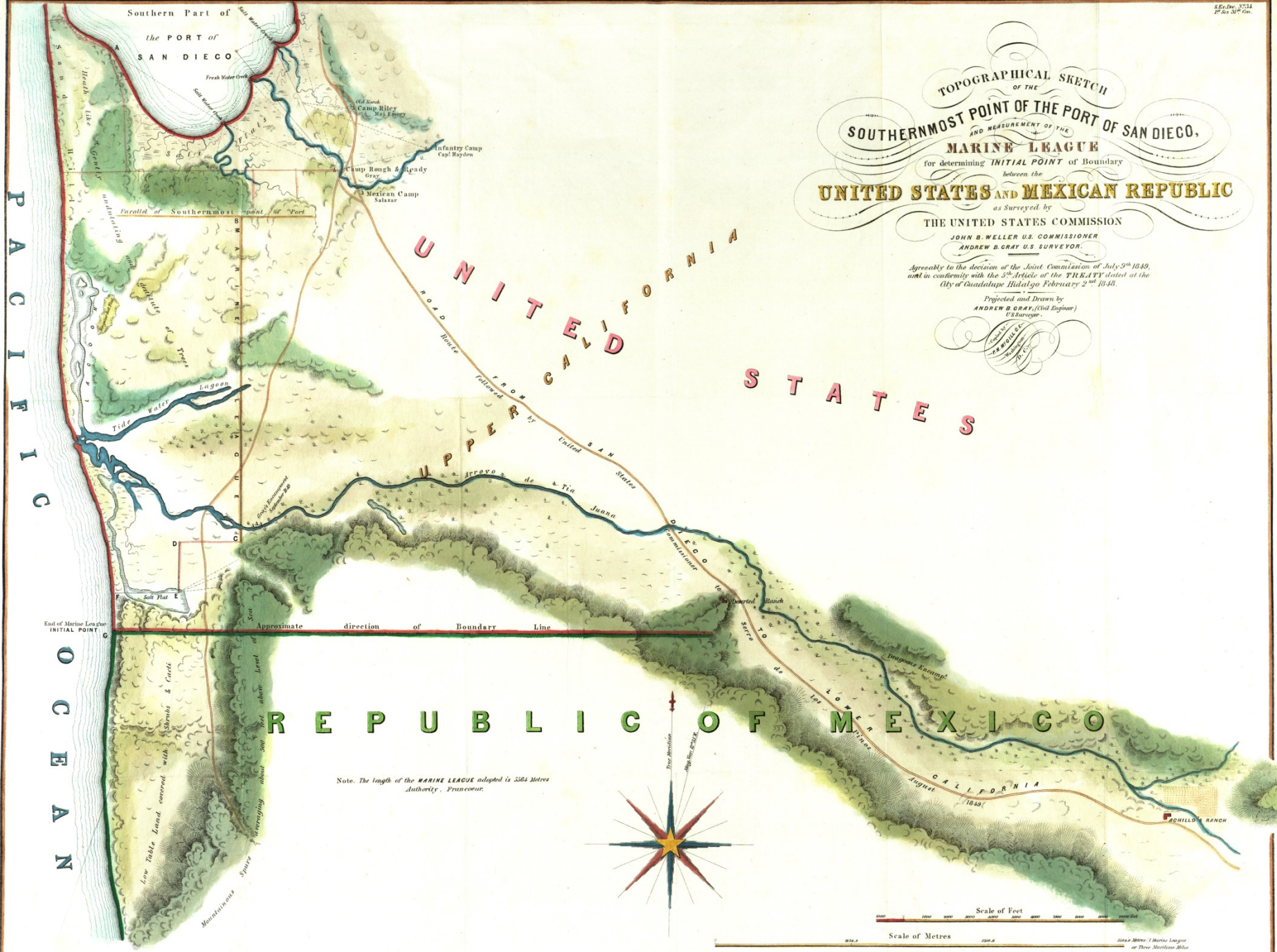
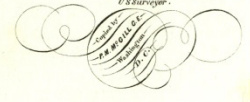
TRNERR Saturday Speaker Series  
*Imperial Beach, CA • October 17, 2015*



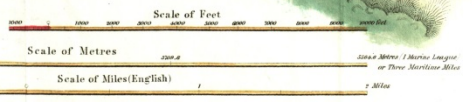
TOPOGRAPHICAL SKETCH  
OF THE  
SOUTHERNMOST POINT OF THE PORT OF SAN DIEGO,  
AND MEASUREMENT OF THE  
MARINE LEAGUE  
for determining INITIAL POINT of Boundary  
between the  
**UNITED STATES AND MEXICAN REPUBLIC**  
as Surveyed by  
THE UNITED STATES COMMISSION  
JOHN B. WELLER U.S. COMMISSIONER  
ANDREW B. GRAY U.S. SURVEYOR.

Agreeable to the decision of the Joint Commission of July 5<sup>th</sup> 1849,  
and in conformity with the 5<sup>th</sup> Article of the TREATY dated at the  
City of Guadalupe Hidalgo February 2<sup>nd</sup> 1848.

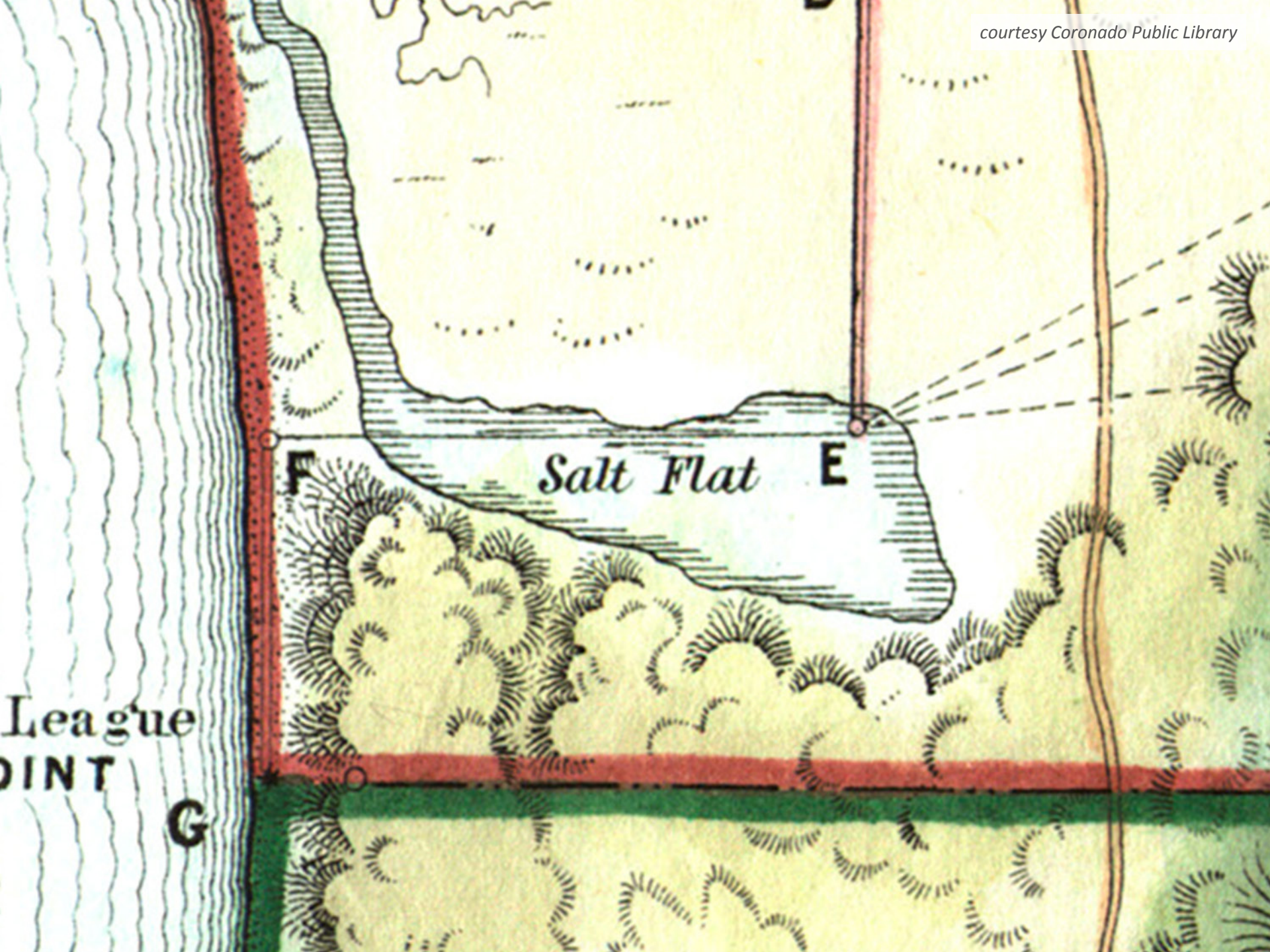
Projected and Drawn by  
ANDREW B. GRAY, (Civil Engineer)  
U.S. Surveyor.



Note. The length of the MARINE LEAGUE adopted is 3364 Metres  
Authority, Franceour.







League  
POINT

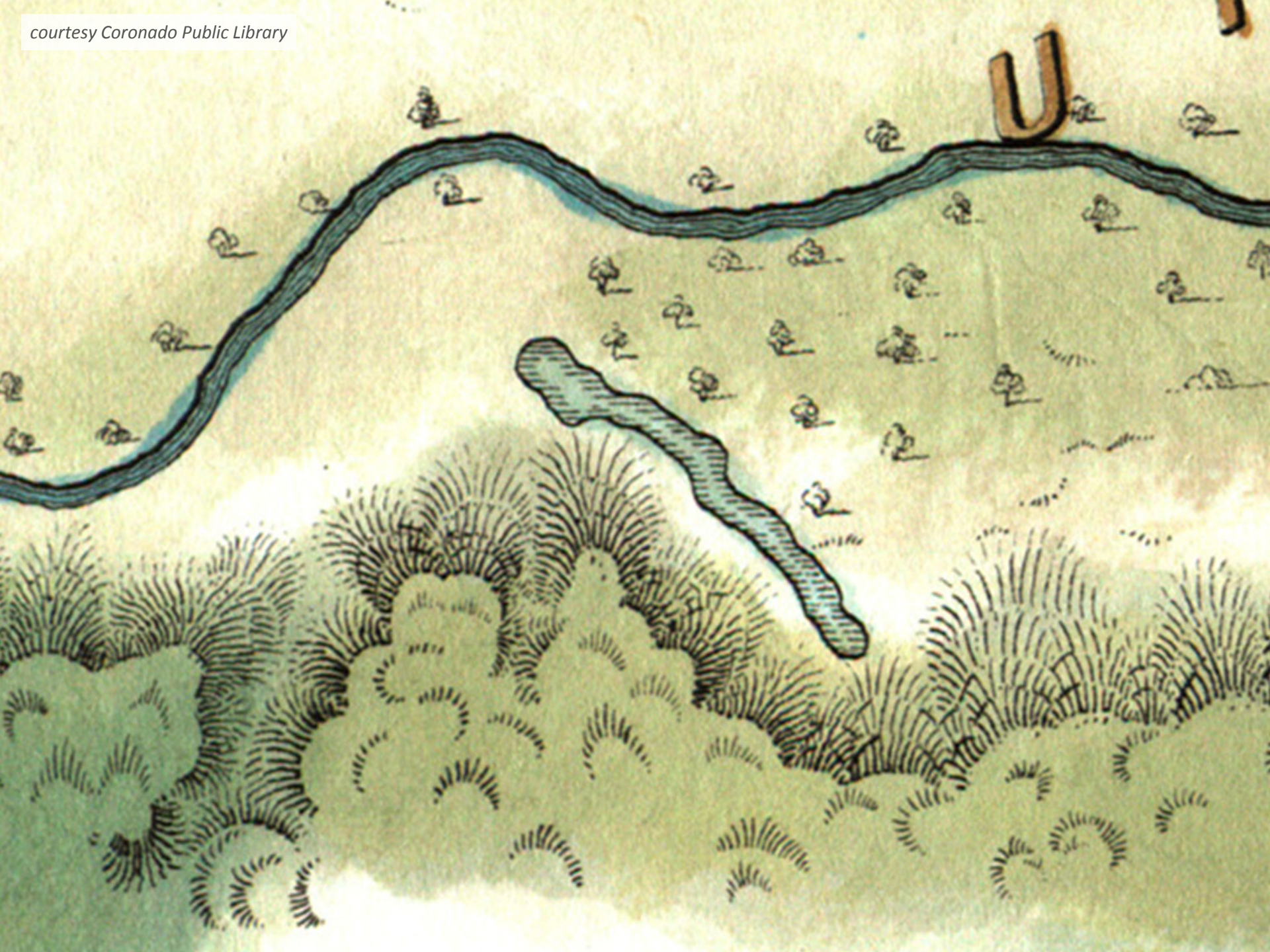
G

F

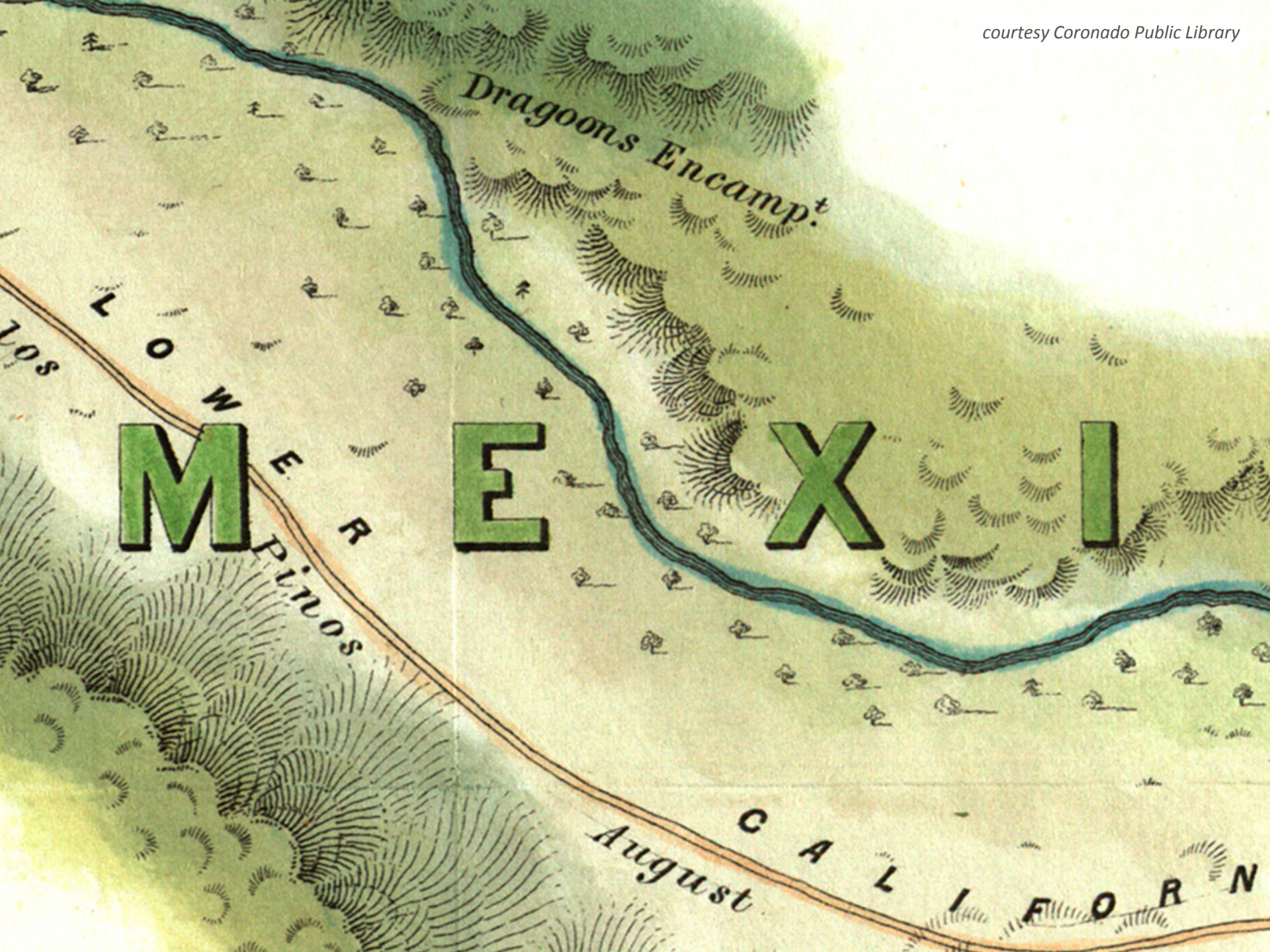
*Salt Flat*

E











# Remarking the boundary, ca. 1894

IBC 1898, courtesy University of North Texas





*Mendenhall 1905, courtesy USGS*

## Botanizing on Mesa, 1905





## Collecting specimens near San Diego, 1923

Image of naturalists in San Diego County  
removed due to copyright status.



## Travelling to Mexico, ca. 1890

Image of tourists crossing the Tijuana River  
removed due to copyright status.

available here:

<http://content.cdlib.org/ark:/13030/kt5290183w/?docId=kt5290183w&order=1&layout=printable>



Sand In My Shoes  
by

Mary Louise Richards

Life in the Tijuana Sloughs 1931-1944



CALIFORNIA ACADEMY  
OF SCIENCES  
No. 572794



Field Book  
of  
Willis Linn Jepson

If lost finder will receive  
Five Dollars Reward.

11 Mosswood Road  
Berkeley,  
- 1928 -



# Archives are a treasure trove of data...

(if you know where to find it)  
(and how to interpret it)



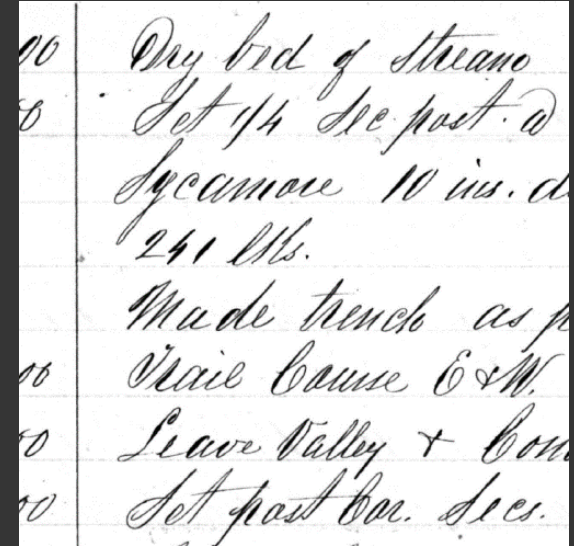


# Historical Ecology

Using the **past** to understand the **present** landscape and envision its **future** potential



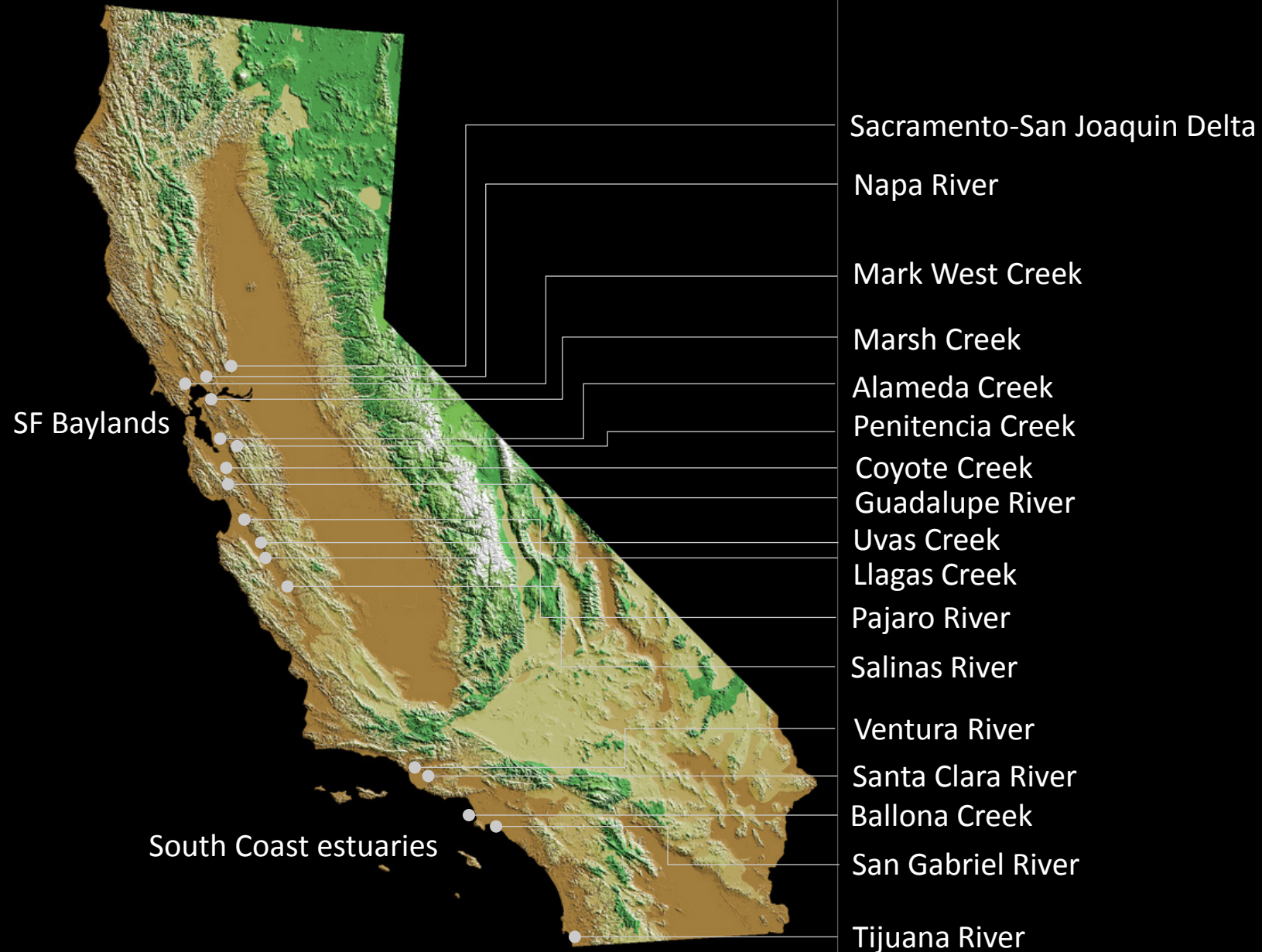
Image removed due to copyright status.



- Not just the "way things were," but the "**way things work**"
- Understand system **pattern and process** at broad temporal and spatial scales
- Not about recreating the past!



# *Streams and estuaries reconstructed*





# *Streams and estuaries reconstructed*

*(Winchuk)*





# Tijuana River watershed

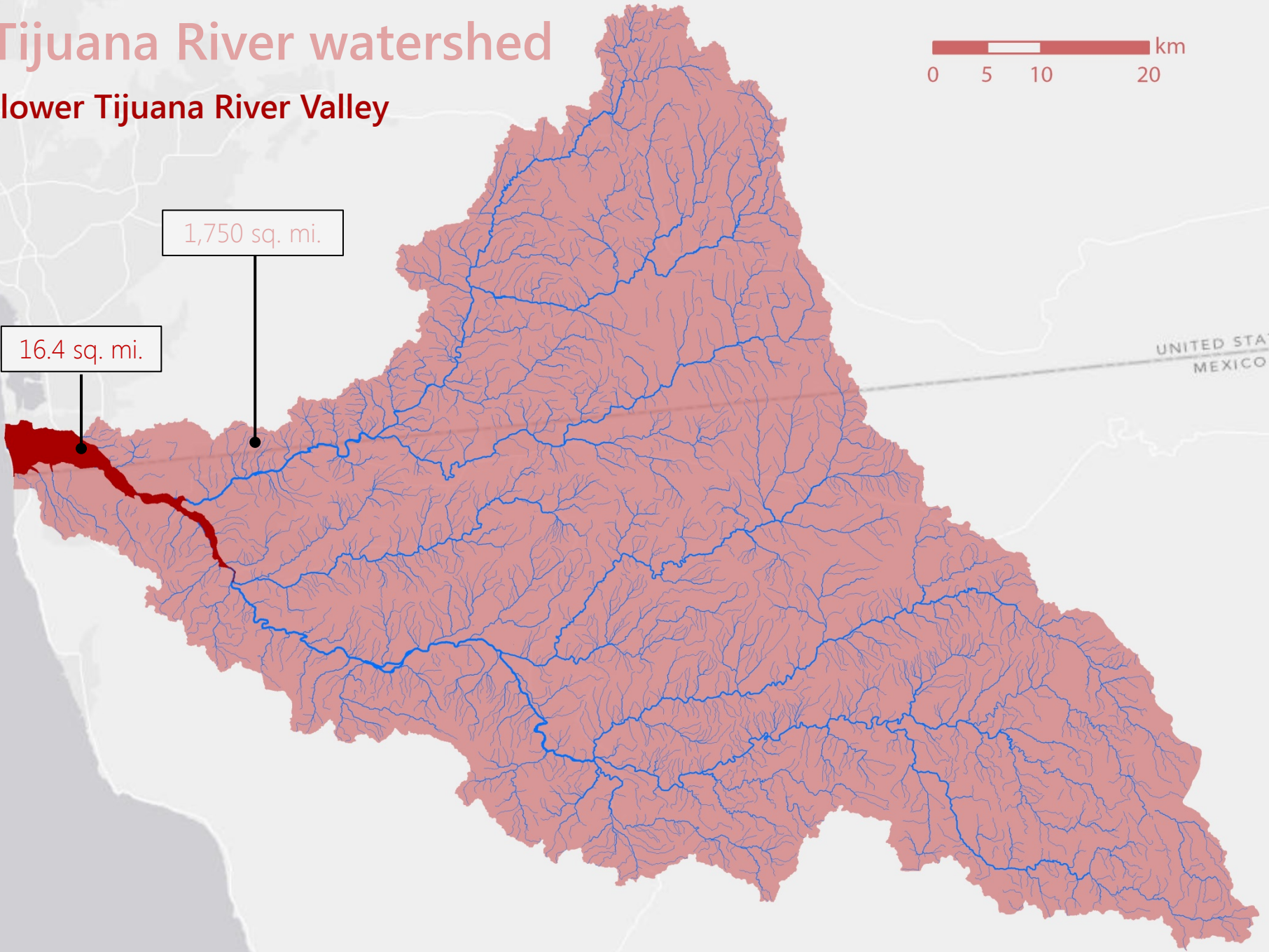
## lower Tijuana River Valley

0 5 10 20 km

1,750 sq. mi.

16.4 sq. mi.

UNITED STATES  
MEXICO





# Geographic scope

San Diego Bay

United States

Mexico

Goat Canyon

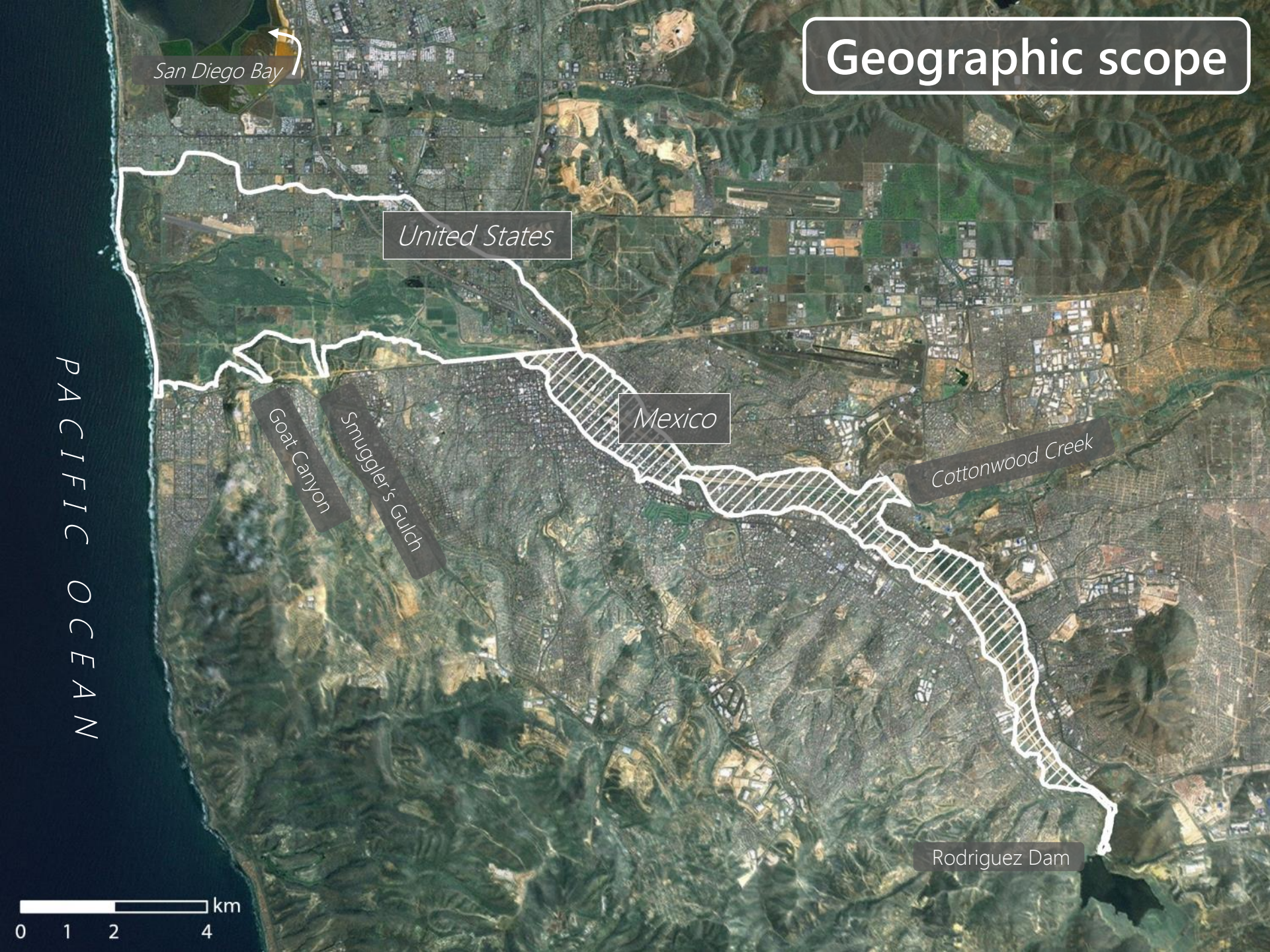
Smuggler's Gulch

Cottonwood Creek

Rodriguez Dam

PACIFIC OCEAN

0 1 2 4 km





## Key questions

- What **ecological patterns** characterized the Tijuana River Valley prior to substantial Euro-American modification?
- What were the **physical processes** and drivers that shaped the landscape?
- How have ecological mosaics and physical processes **changed** from the mid-1800s to the present?

courtesy SDNHM

**Image of marsh hawk nest removed due to copyright status.**

courtesy San Diego History Center

**Image of floods removed due to copyright status.**

available here:

<http://www.sandiegohistory.org/photostore/product/tijuana-river-tourists-crossing-c-1890/>

courtesy WRCA

**Image of habitat mosaics within river removed due to copyright status.**



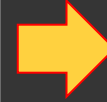
# Methods



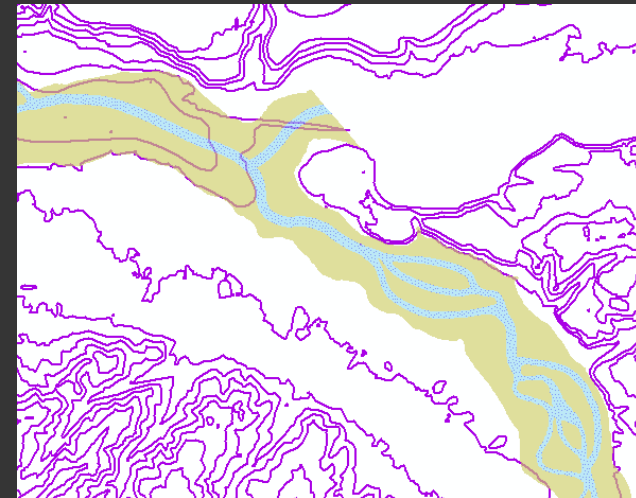
Collect archival data



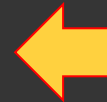
Extract relevant information



Overlay, synthesize



Align with geophysical data



Create map  
(and other products)



## **Searched > 30 online collections, including:**

- Online Archive of California
- Bancroft Digital Collections
- Library of Congress
- Smithsonian Archives of American Art
- Society of California Pioneers
- USC Digital Archive
- MVZ Field Notes Archive
- Claremont Colleges Digital Library
- University of North Texas Digital Library
- Searchable Ornithological Research Archive
- Mapoteca Manuel Orozco y Berra
- Archivo Histórico del Agua
- California Digital Newspaper Collection
- Google Books
- David Rumsey Historical Map Collection
- Coast Survey Historical Map & Chart Collection

# Visited 23 local, regional & national archives:

## Bay Area

- The Bancroft Library
- Hearst Anthropology Museum
- California Historical Society
- Society of California Pioneers
- UC Berkeley Map Library
- Stanford Library & Special Collections

## San Diego

- San Diego Natural History Museum
- SDSU Special Collections
- SDSU Malcolm A. Love Library
- UCSD Mandeville Department of Special Collections
- UCSD Geisel Library
- Scripps Institution of Oceanography Archives
- San Diego History Center
- IBWC Records Office
- Coronado Public Library
- San Diego Public Library

## Los Angeles

- Water Resources Center Archives
- Huntington Library
- CSU Northridge
- National Archives- Riverside
- UCLA Spence/Fairchild Collection
- Seaver Center for Western History

## Other

- National Archives- Arlington





## Visited 9 Mexican archives:

### Tijuana

- Sociedad de Historia de Tijuana
- Instituto de Investigaciones Históricas UABC
- Instituto Municipal de Arte y Cultura
- Biblioteca Alberto Limón Padilla



### Mexico City

- Archivo Histórico del Agua
- Mapoteca Manuel Orozco y Berra
- Archivo General de la Nación
- Fundación ICA
- Instituto de Investigaciones Históricas UNAM



Image removed due to  
copyright status.



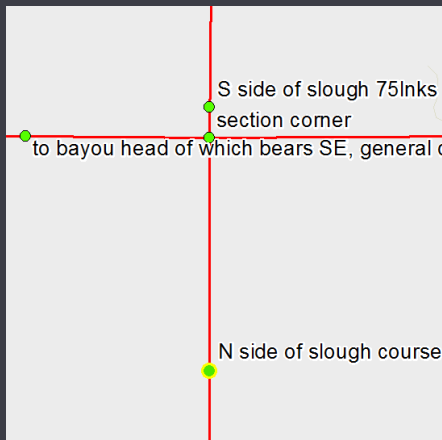
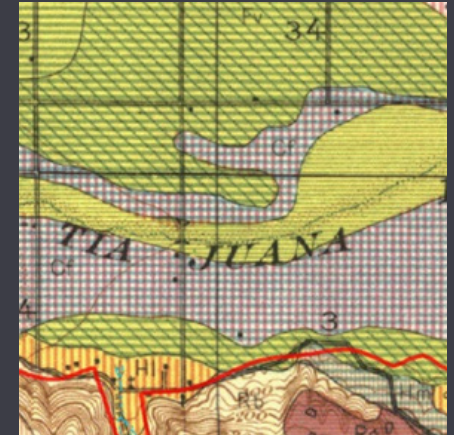
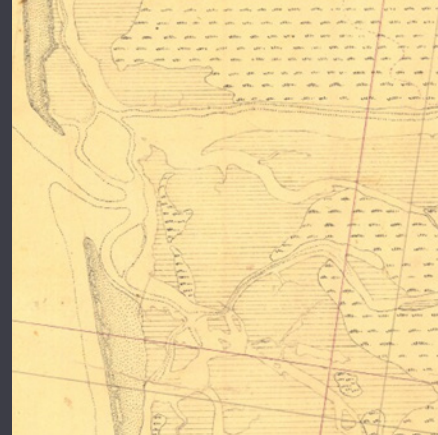
Image removed due to  
copyright status.

## Photographs

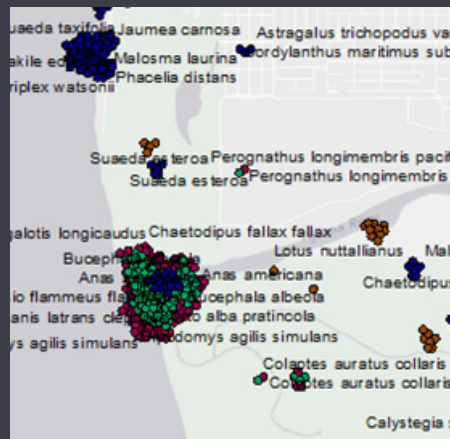
> 200 landscape photos  
67 mosaicked aerials

## Maps

~180 maps  
45 georeferenced



Dry bed of stream  
Set 44 Sec post. @  
Sycamore 10 ins. d  
241 lbs.  
Made trench as p  
Vine Cause & M.  
Leave Valley + Com  
Set post bar. Sec.

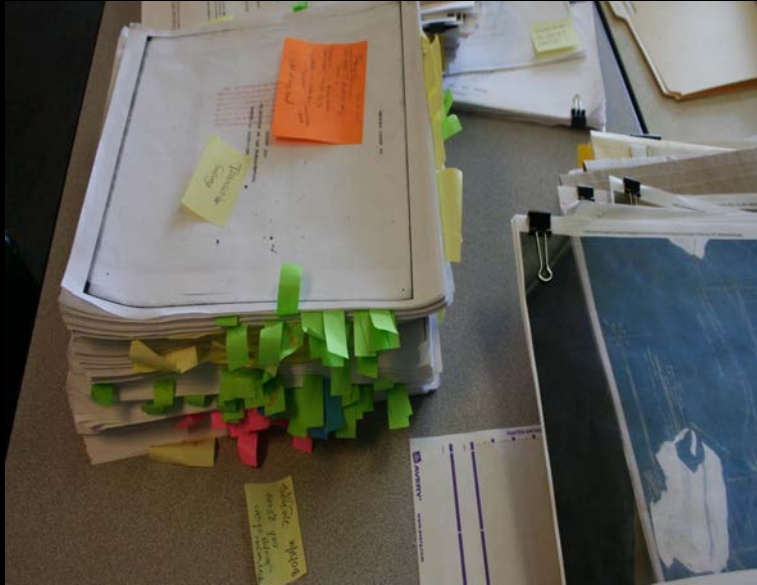


## Texts

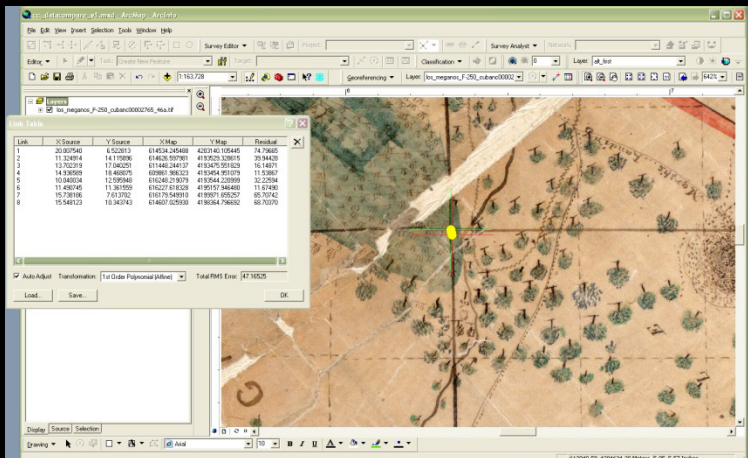
~ 400 textual documents  
246 pages transcribed



# Data compilation



annotate, translate, transcribe

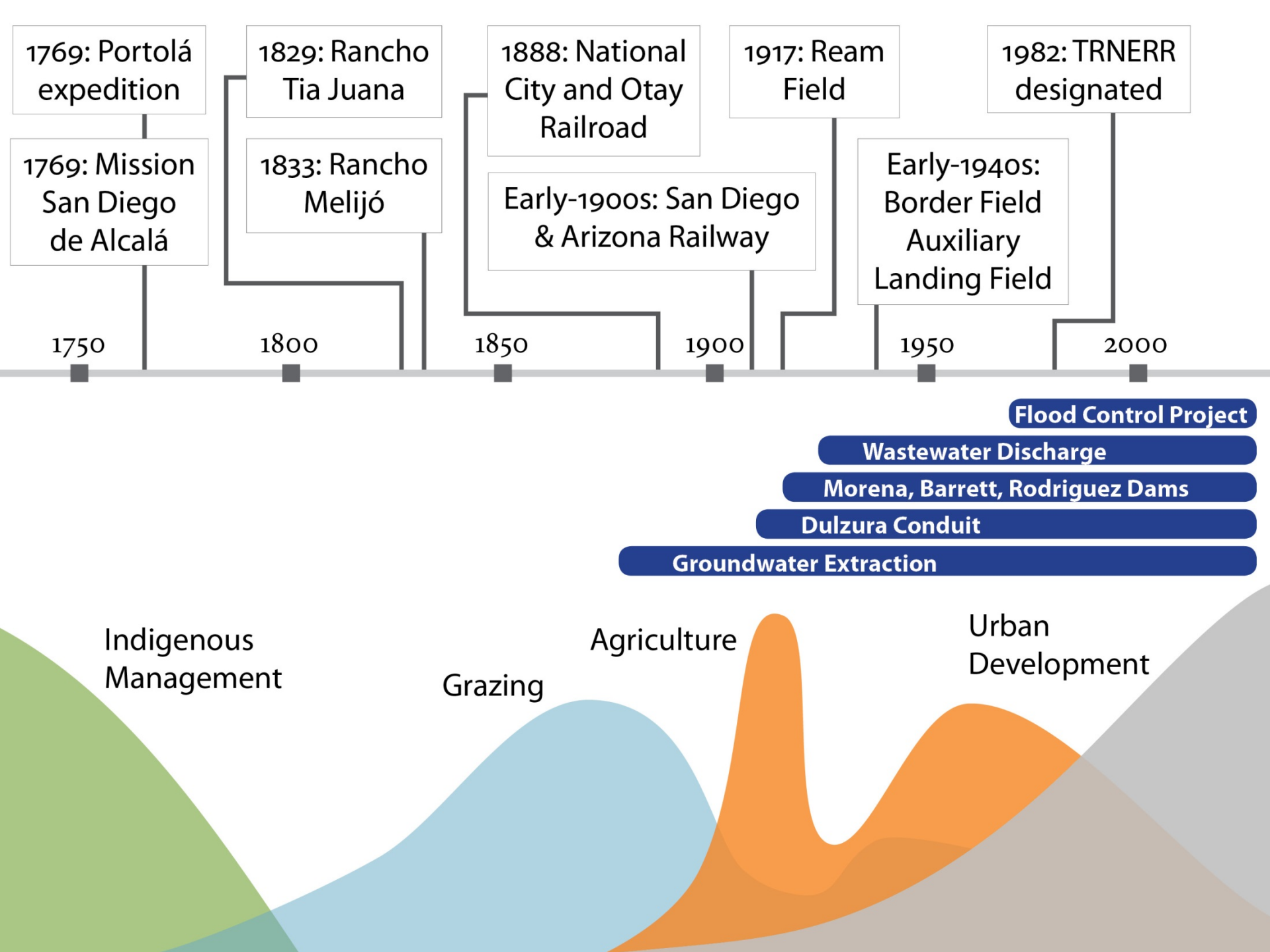


georeference, rectify, mosaic



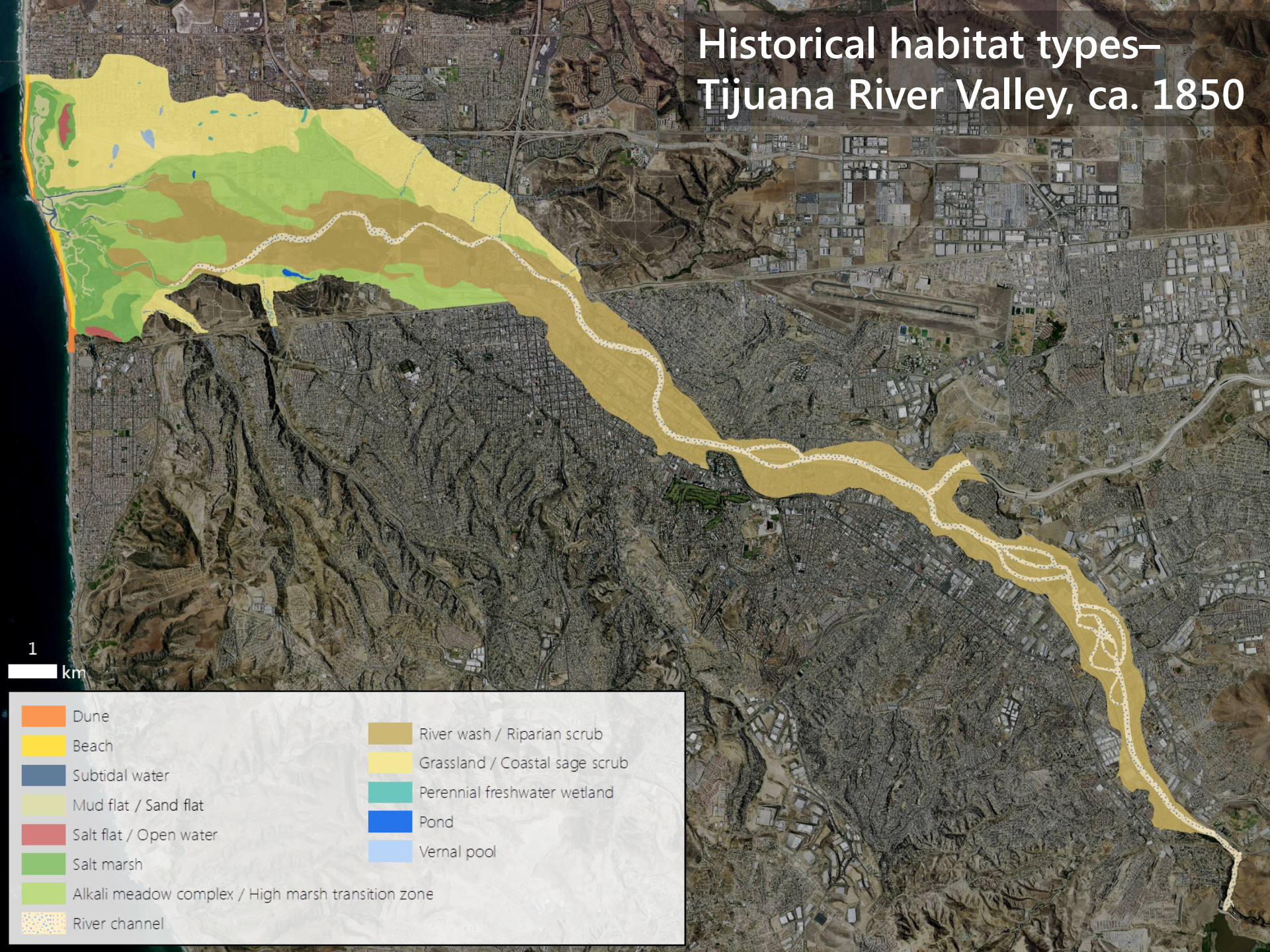
sort, organize, prioritize




















# Historical habitat types— Tijuana River Valley, ca. 1850



- |  |  |
|--|--|
|  Dune   |  River wash / Riparian scrub    |
|  Beach  |  Grassland / Coastal sage scrub |
|  Subtidal water                                     |  Perennial freshwater wetland   |
|  Mud flat / Sand flat                               |  Pond                           |
|  Salt flat / Open water                             |  Vernal pool                    |
|  Salt marsh   |  |
|  Alkali meadow complex / High marsh transition zone |  |
|  River channel                                      |  |



# Historical habitat types— Tijuana River Valley, ca. 1850

Grassland/coastal scrub  
with wetlands on  
tablelands and in canyons

Seasonal wetlands on  
valley bottom

Salt marsh/mudflat-  
dominated estuary

Broad river corridor  
with (mostly)  
intermittent flow and  
riparian scrub

1

km

Dune

Beach

Subtidal water

Mud flat / Sand flat

Salt flat / Open water

Salt marsh

Alkali meadow complex / High marsh transition zone

River channel

River wash / Riparian scrub

Grassland / Coastal sage scrub

Perennial freshwater wetland




Pond

Vernal pool



## *Key messages for today*

---

-  The valley supported a diverse array of wetlands in a dry climate.
-  Floods maintained a large and dynamic river corridor.
-  The valley has undergone significant changes in habitat distribution and extent.



**Wetland:** "...prevalence of vegetation typically adapted for life in saturated soil conditions" (EPA)

tidal

perennial

non-tidal

seasonal

intermittent

1

km





**drylands**

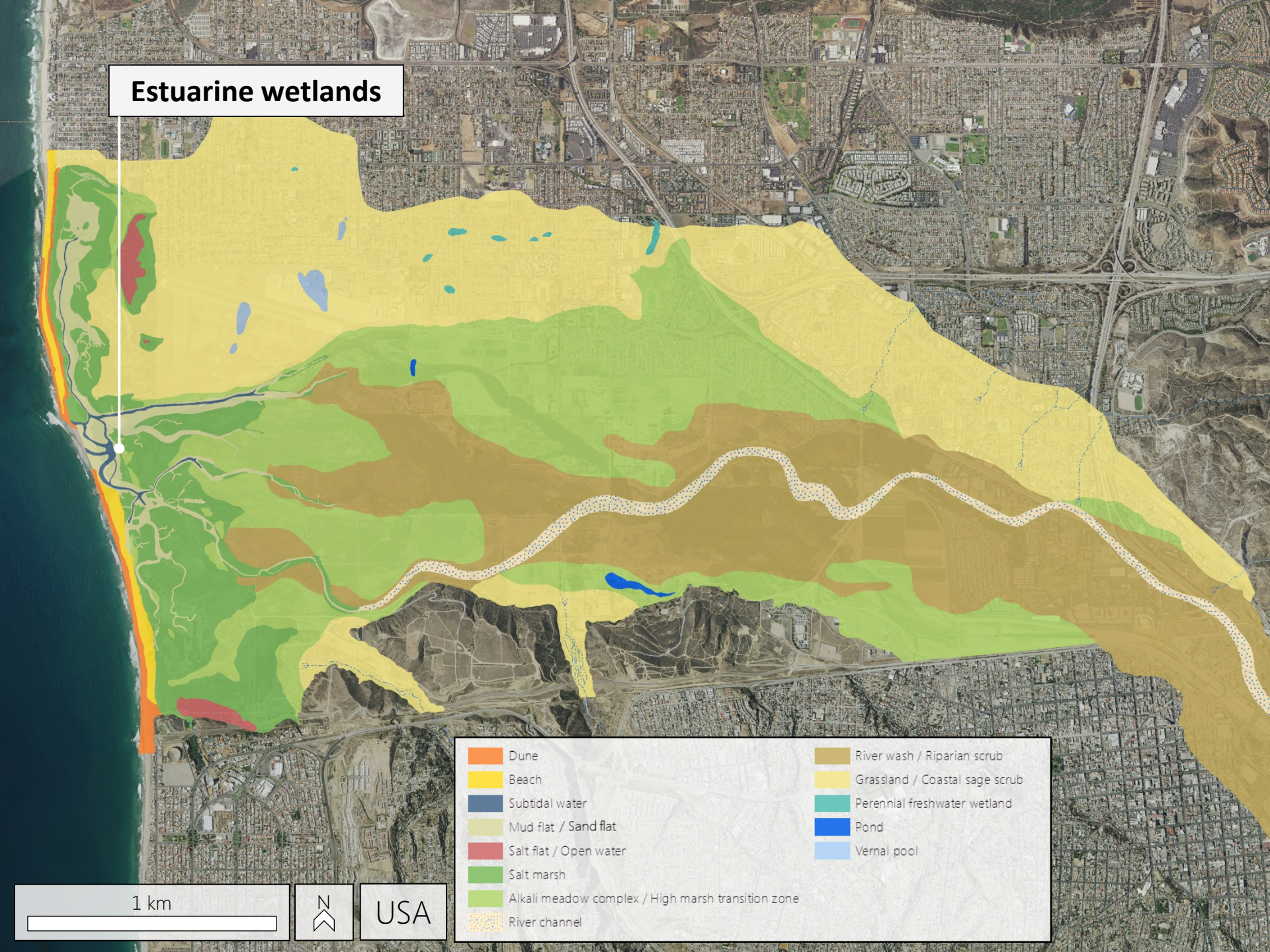
**wetlands**

***~75% wetland  
habitat types***





## Estuarine wetlands

- 
- |  |                                |
|--|--------------------------------|
| Dune   | River wash / Riparian scrub    |
| Beach  | Grassland / Coastal sage scrub |
| Subtidal water                                     | Perennial freshwater wetland   |
| Mud flat / Sand flat                               | Pond                           |
| Salt flat / Open water                             | Vernal pool                    |
| Salt marsh   |                                |
| Alkali meadow complex / High marsh transition zone |                                |
| River channel                                      |                                |

1 km



USA

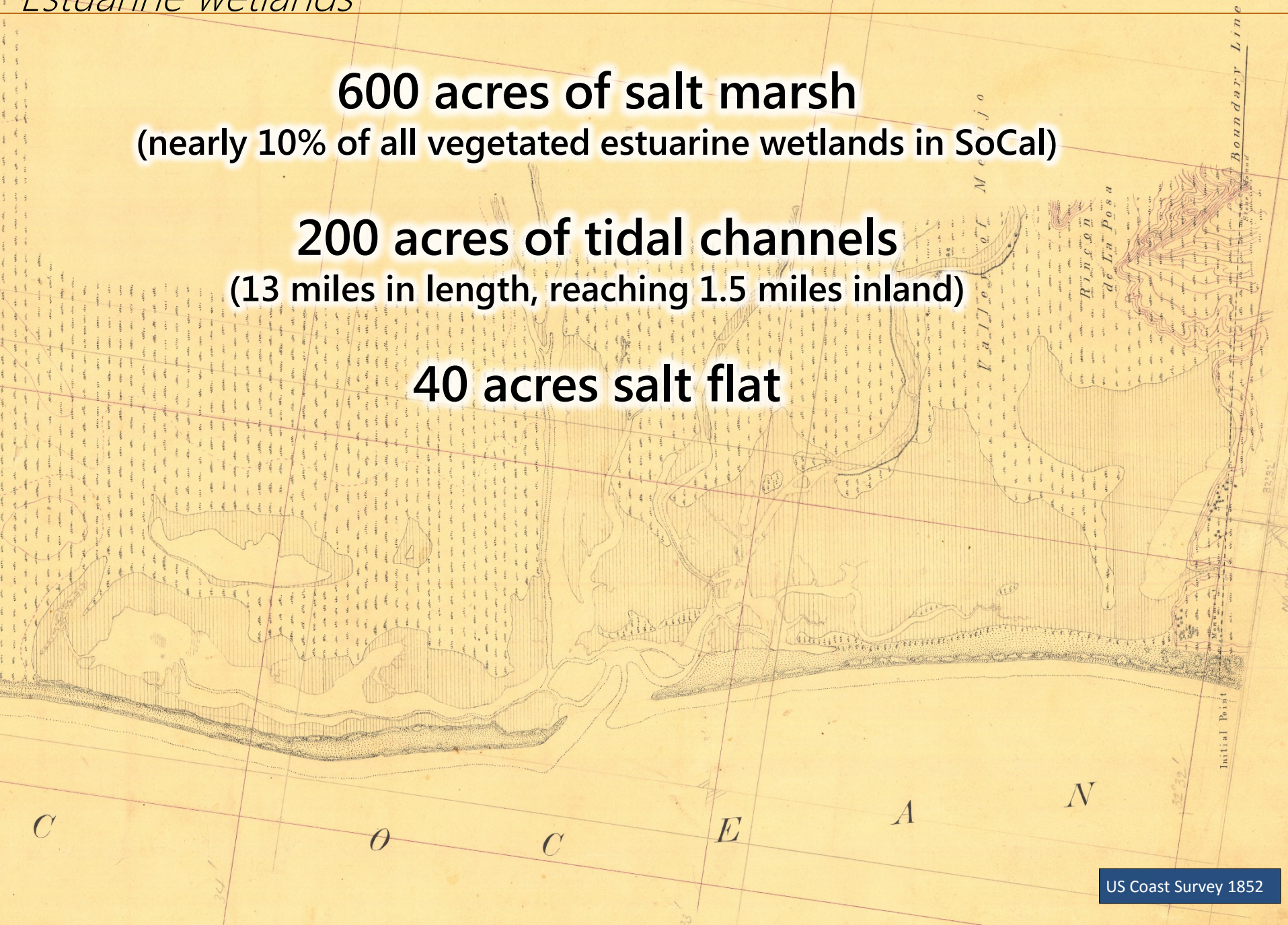


# Estuarine wetlands

**600 acres of salt marsh**  
(nearly 10% of all vegetated estuarine wetlands in SoCal)

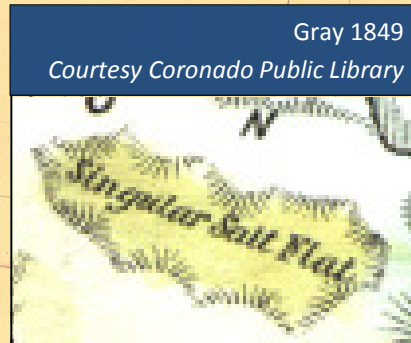
**200 acres of tidal channels**  
(13 miles in length, reaching 1.5 miles inland)

**40 acres salt flat**

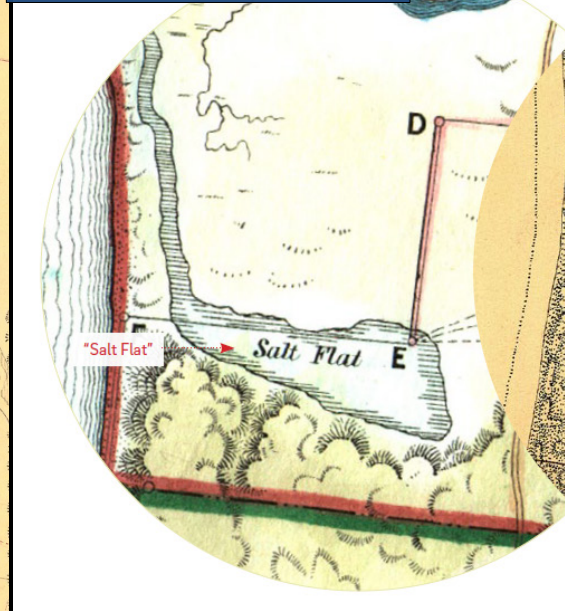




# Estuarine wetlands



Gray 1849  
Courtesy Coronado Public Library



Coast Survey 1852  
Courtesy Coronado Public Library

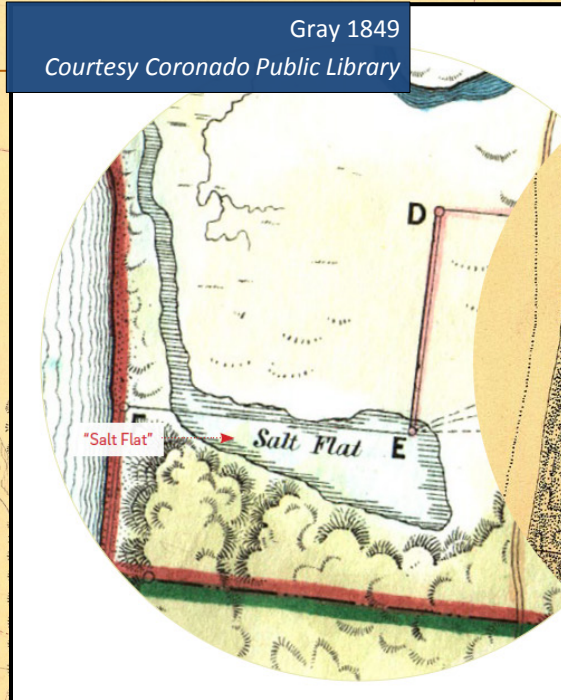




# Estuarine wetlands

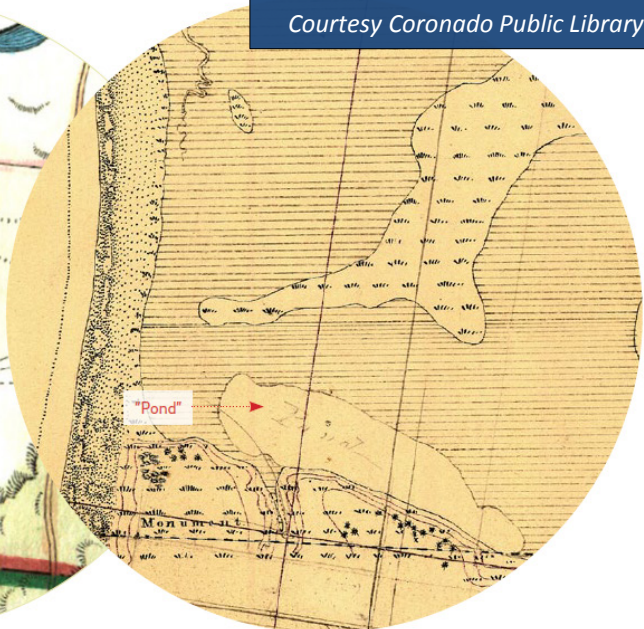
Gray 1849

Courtesy Coronado Public Library



Coast Survey 1852

Courtesy Coronado Public Library



Gray 1849

Courtesy Coronado Public Library



California Least Tern



Rinus Baak, USFWS

Snowy Plover



Larry D. Brown (larrydbrown.com)

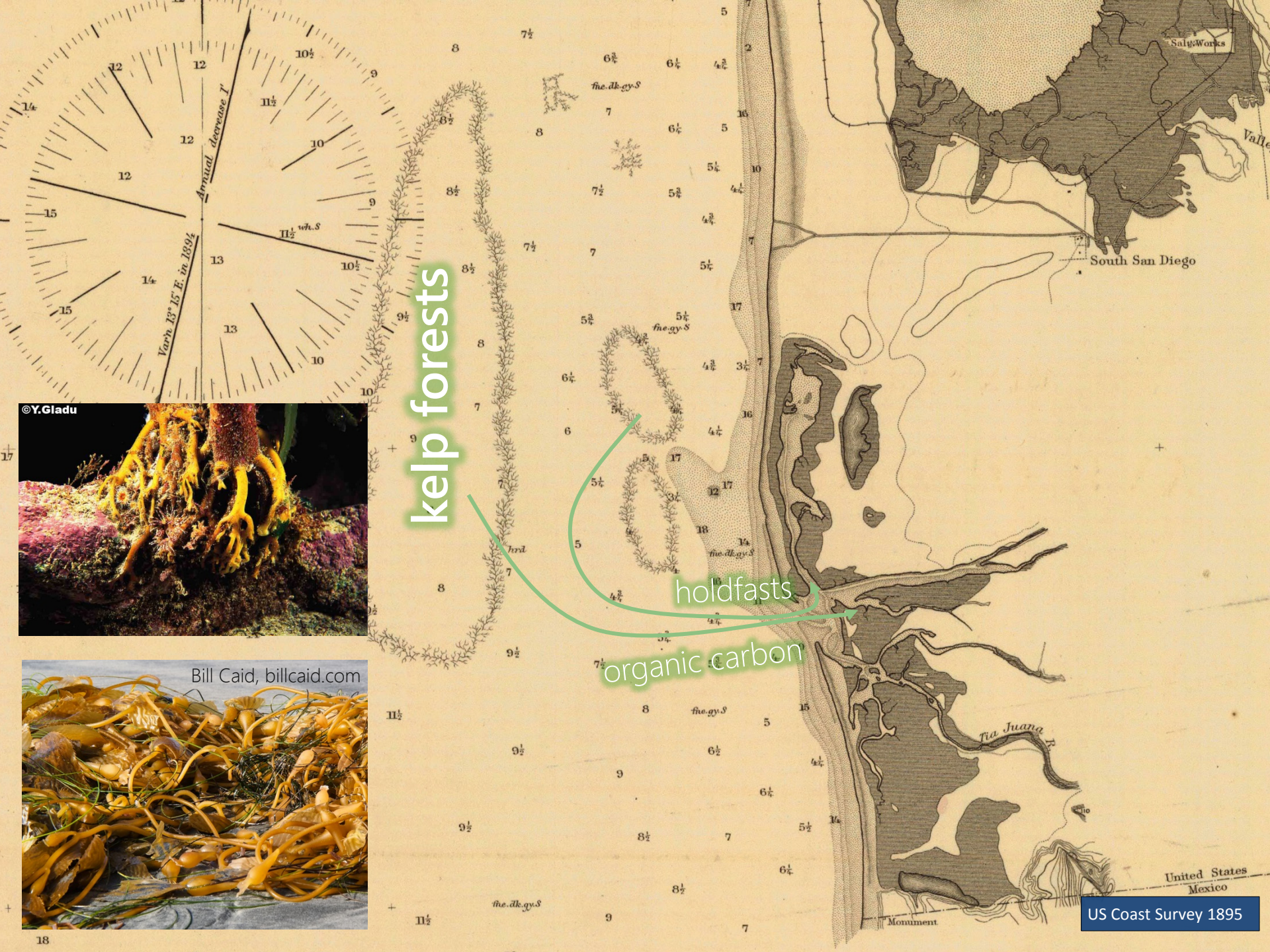
© Larry D. Brown

Belding's Savannah Sparrow



San Elijo Lagoon Conservancy





©Y.Gladu

Bill Caid, billcaid.com

kelp forests

holdfasts

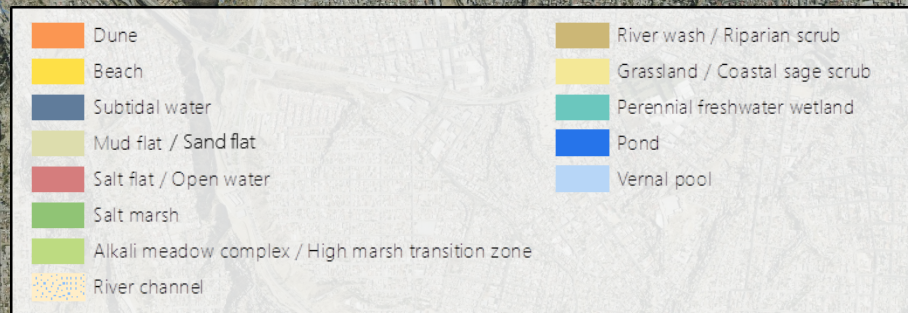
organic carbon

US Coast Survey 1895



**Alkali meadow complex /  
High marsh transition zone**

*1896: "Salt grass meadows  
of Tia Juana valley" – Pacific  
Rural Press 1896*





Map showing "Wells of San Antonio"  
removed due to copyright status.

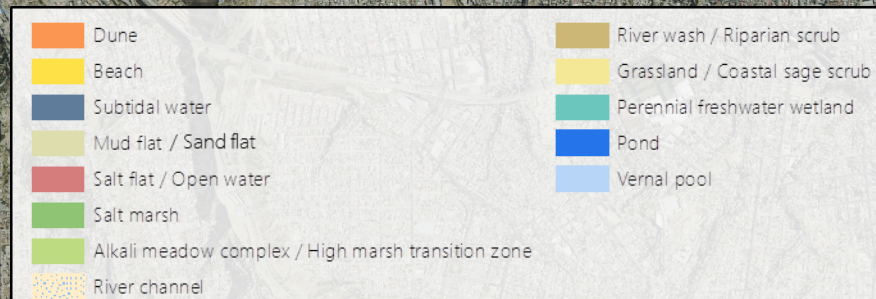
available here:

<http://imgzoom.cdlib.org/Fullscreen.ics?ark=ark:/13030/hb1b69n6jg/z1&&brand=calisphere>

Poole 1854

Courtesy Bancroft Library

Ponds



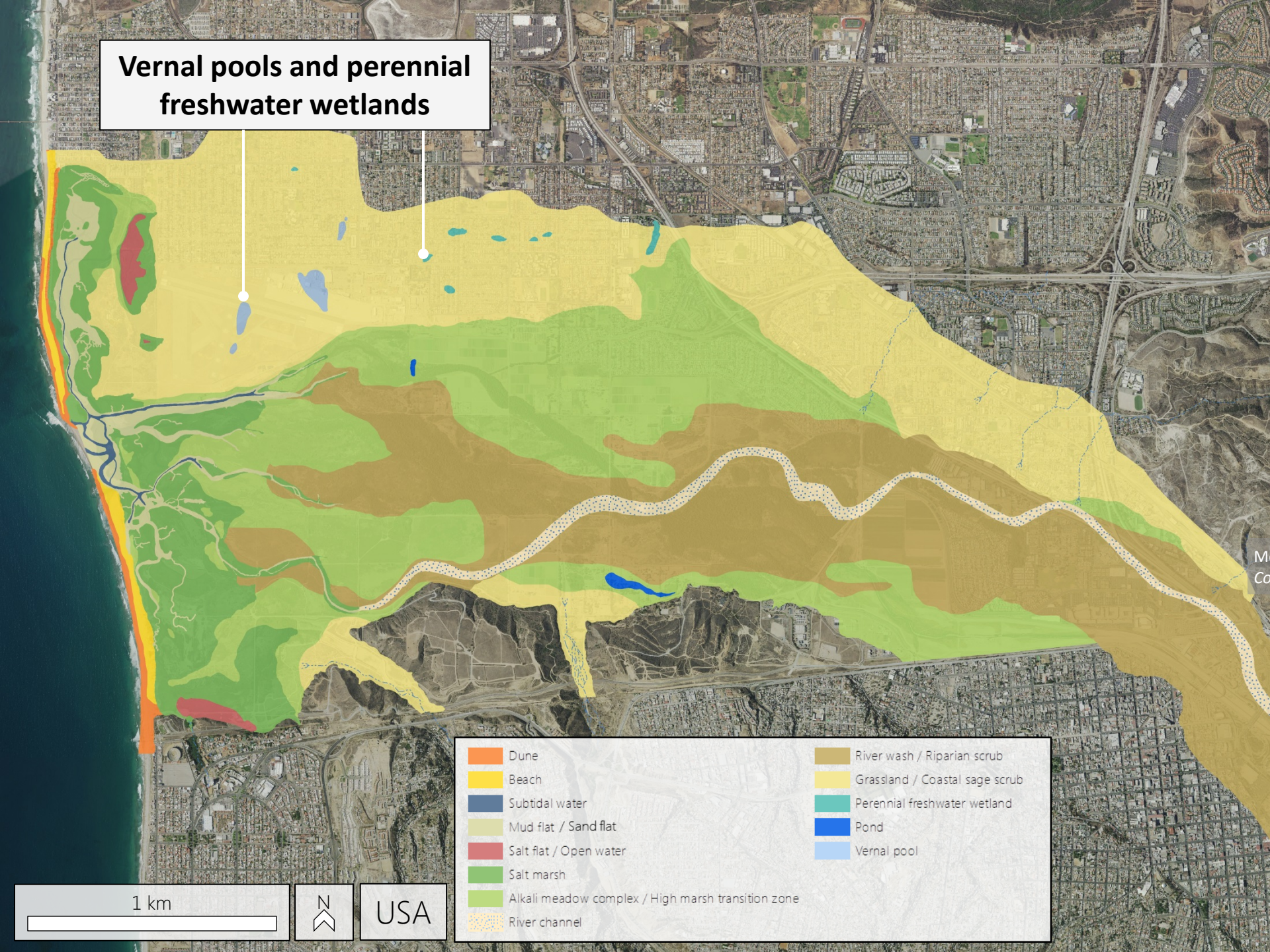
1 km



USA



# Vernal pools and perennial freshwater wetlands



1 km



USA



# *Vernal pools*



77B2

San Diego County 1928



# Vernal pools

W.P. Armstrong 2010, waynesword.com

Map showing modern picture of a vernal pool  
removed due to copyright status.

available here:

<http://waynesword.palomar.edu/images2/10verpool2b.jpg>



A.G. Vandergast, USGS



San Diego County 1928



## *Vernal pools*

"Especially on our mesas were to be found **thousands of miniature lagoons** [within] innumerable hillocks ..."

"Thus, the lakes were formed, their surface and bottoms grown over with plants till the water was hid from view, and gradually disappeared by evaporation, leaving only **dense jungles on a minute scale**"  
(Orcutt 1887)

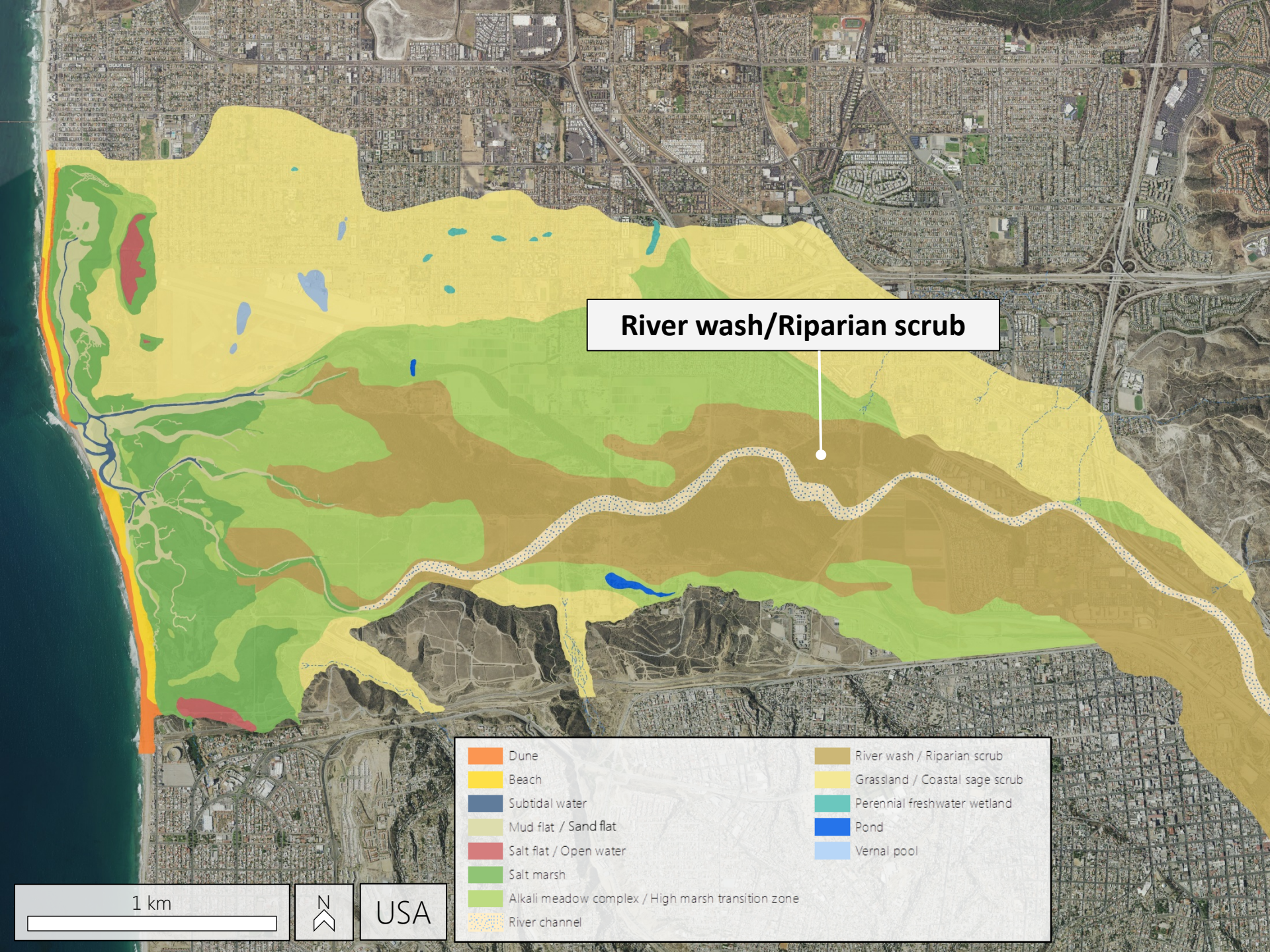


San Diego County 1928



Mendenhall 1905  
courtesy of USGS





River wash/Riparian scrub

1 km



USA

Dune

Beach

Subtidal water

Mud flat / Sand flat

Salt flat / Open water

Salt marsh

Alkali meadow complex / High marsh transition zone

River channel

River wash / Riparian scrub

Grassland / Coastal sage scrub

Perennial freshwater wetland

Pond

Vernal pool

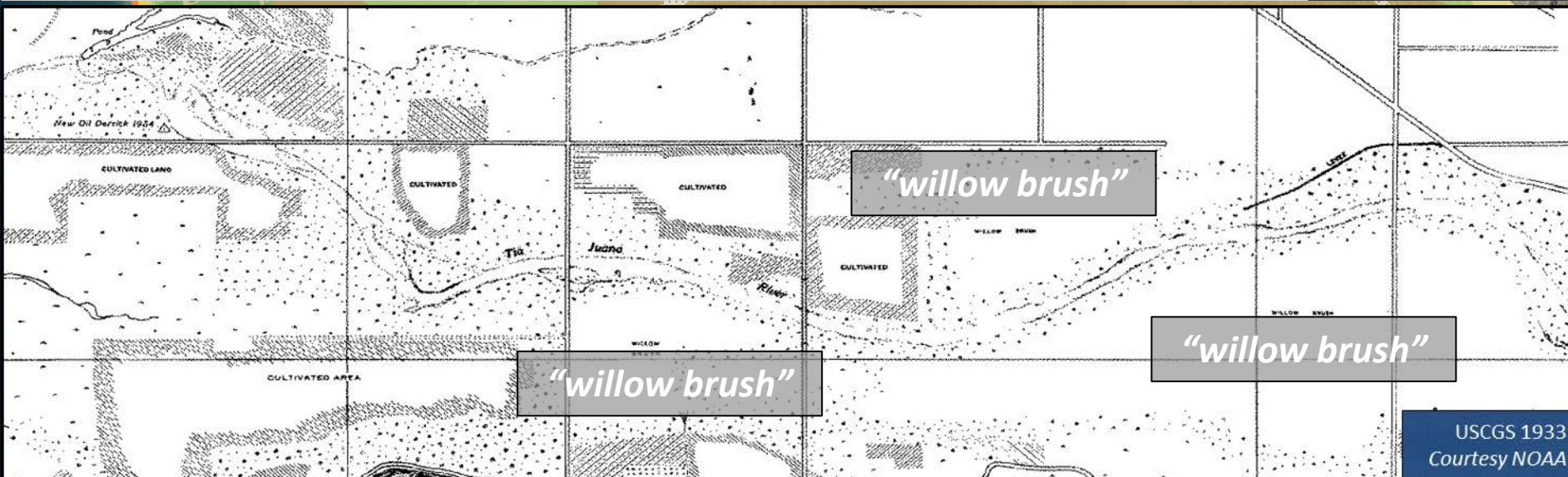


Diseño del Rancho Milijo (map) showing “monte de saus” (willow thicket)  
removed due to copyright status.

available here:

<http://imgzoom.cdlib.org/Fullscreen.ics?ark=ark:/13030/hb6489p09n/z2&order=3&brand=calisphere>

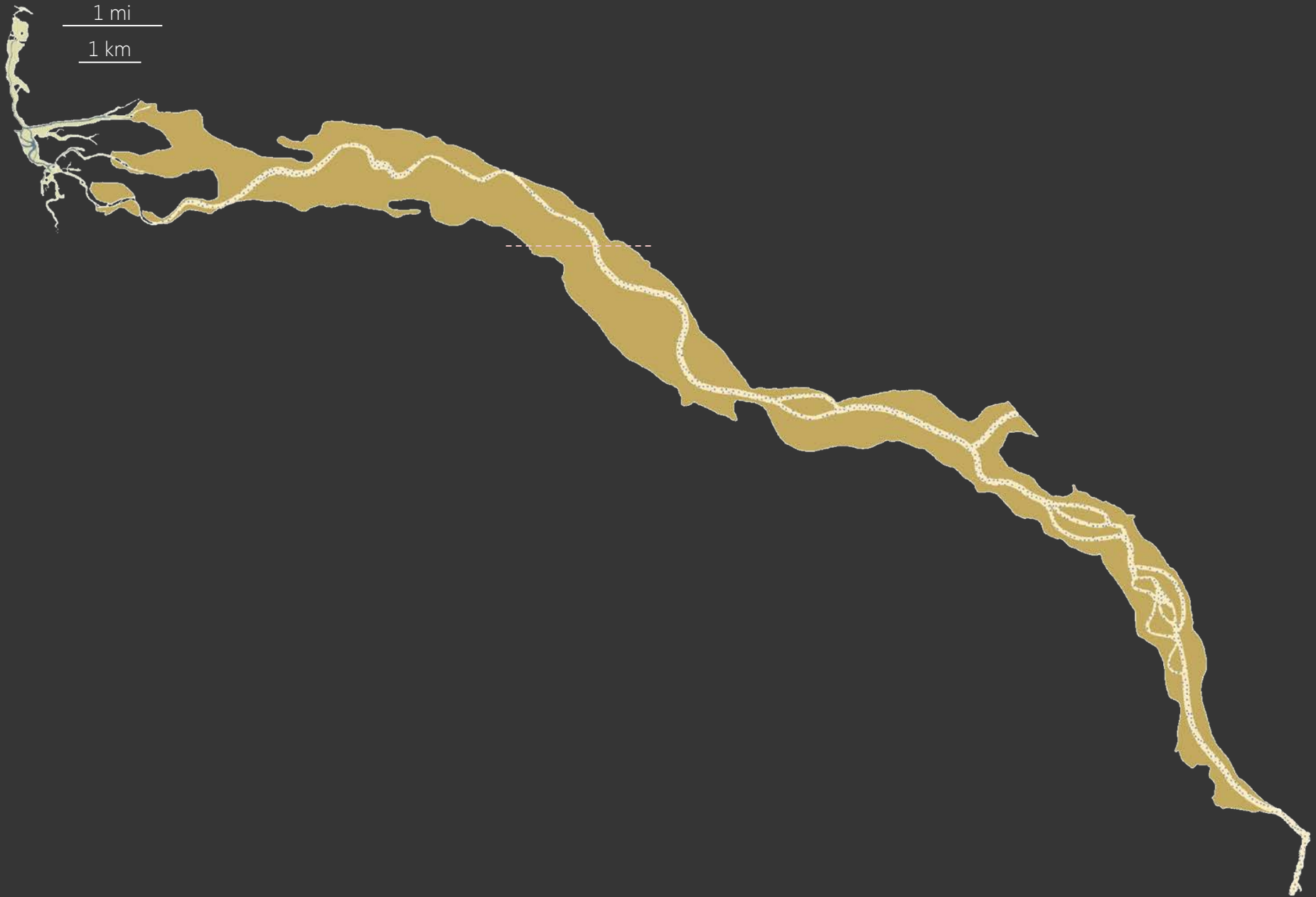
USDC ca. 1840  
Courtesy Bancroft Library



USCGS 1933  
Courtesy NOAA

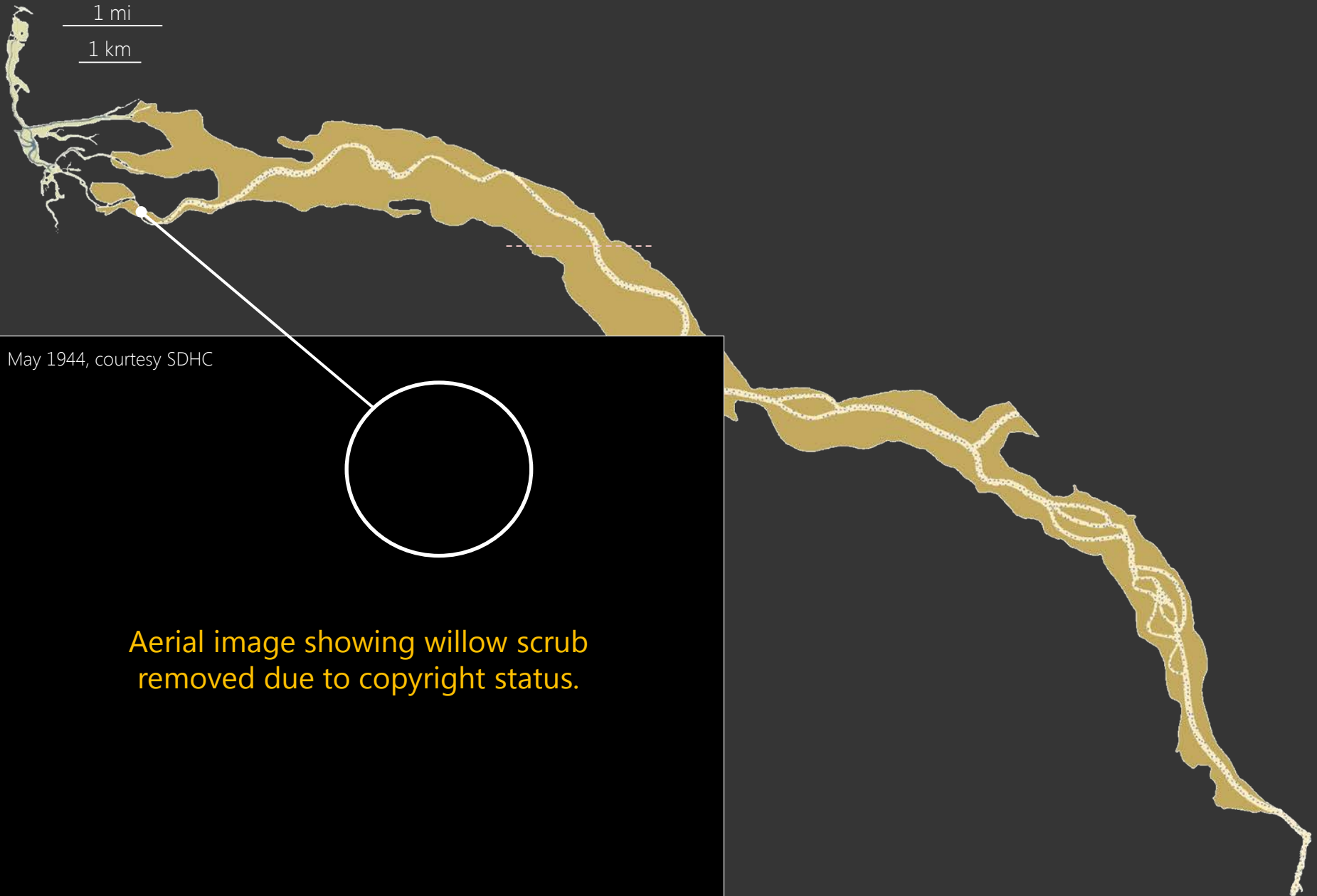


# *River wash / riparian scrub*



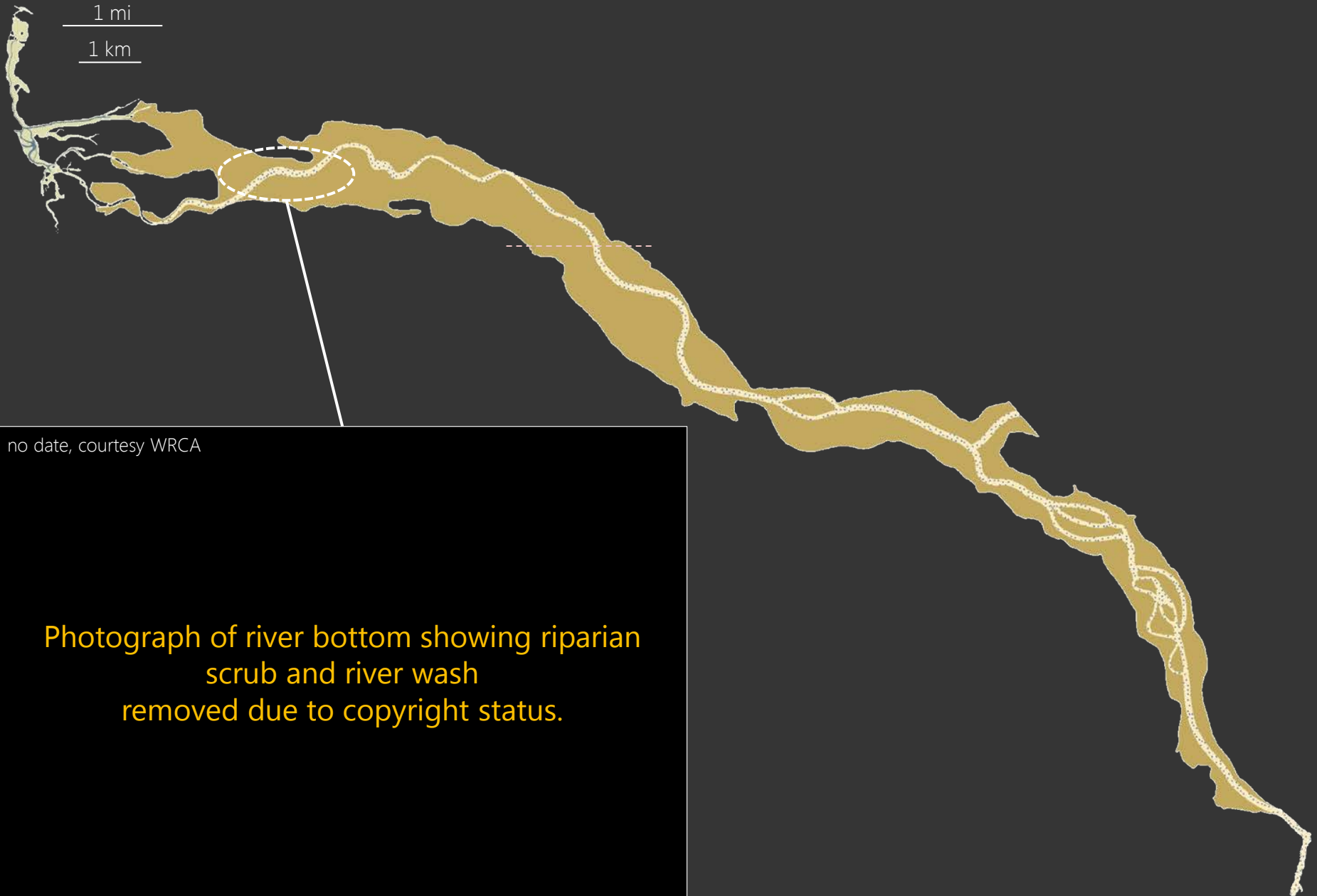


# *River wash / riparian scrub*





# *River wash / riparian scrub*





# *River wash / riparian scrub*



Unknown 1903, courtesy Special Collections & Archives, UCSD Library



# *River wash / riparian scrub*



1910, courtesy SDHC

Photograph showing dense willow scrub  
removed due to copyright status.

available here:

<http://www.sandiegohistory.org/prints/border/tijuana-gate-1910-1113>



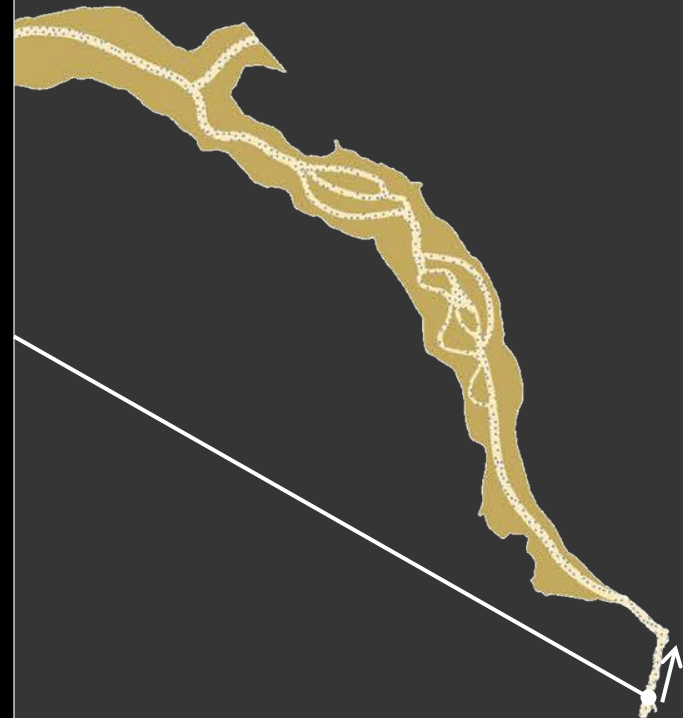


# *River wash / riparian scrub*



July 1920, courtesy WRCA

Photograph showing river wash and riparian scrub in  
Matanuco Canyon  
removed due to copyright status.





Aerial photograph of Tijuana River broad patterns  
of river wash and riparian scrub (and lack of trees)  
removed due to copyright status.

A similar photograph available here:

<http://www.sandiegohistory.org/photostore/product/tijuana-river-tourists-crossing-c-1890/>



# Primarily willow scrub, but broad range of species

Common Name	Latin Name
<i>Trees</i>	
→ sandbar willow	<i>Salix exigua</i>
→ Goodding's willow	<i>S. gooddingii</i>
→ red willow	<i>S. laevigata</i>
→ arroyo willow	<i>S. lasiolepis</i>
cottonwood	<i>Populus</i> sp.
California sycamore	<i>Platanus racemosa</i>
<i>Shrubs</i>	
→ mulefat	<i>Baccharis salicifolia</i>
→ black sage	<i>Salvia mellifera</i>
→ white sage	<i>S. apiana</i>
→ common sagebrush	<i>Artemisia tridentata</i>
→ arrowweed	<i>Pluchea sericea</i>
→ Bush senecio	<i>Senecio douglasii</i>
→ fourwing saltbush	<i>Atriplex canescens</i>
→ chaparral mallow	<i>Malacothamnus fasciculatus</i>
northwest willow	<i>Salix sessilifolia</i>
California fagonia	<i>Fagonia laevis</i>
blue elderberry	<i>Sambucus nigra</i> subsp. <i>caerulea</i>

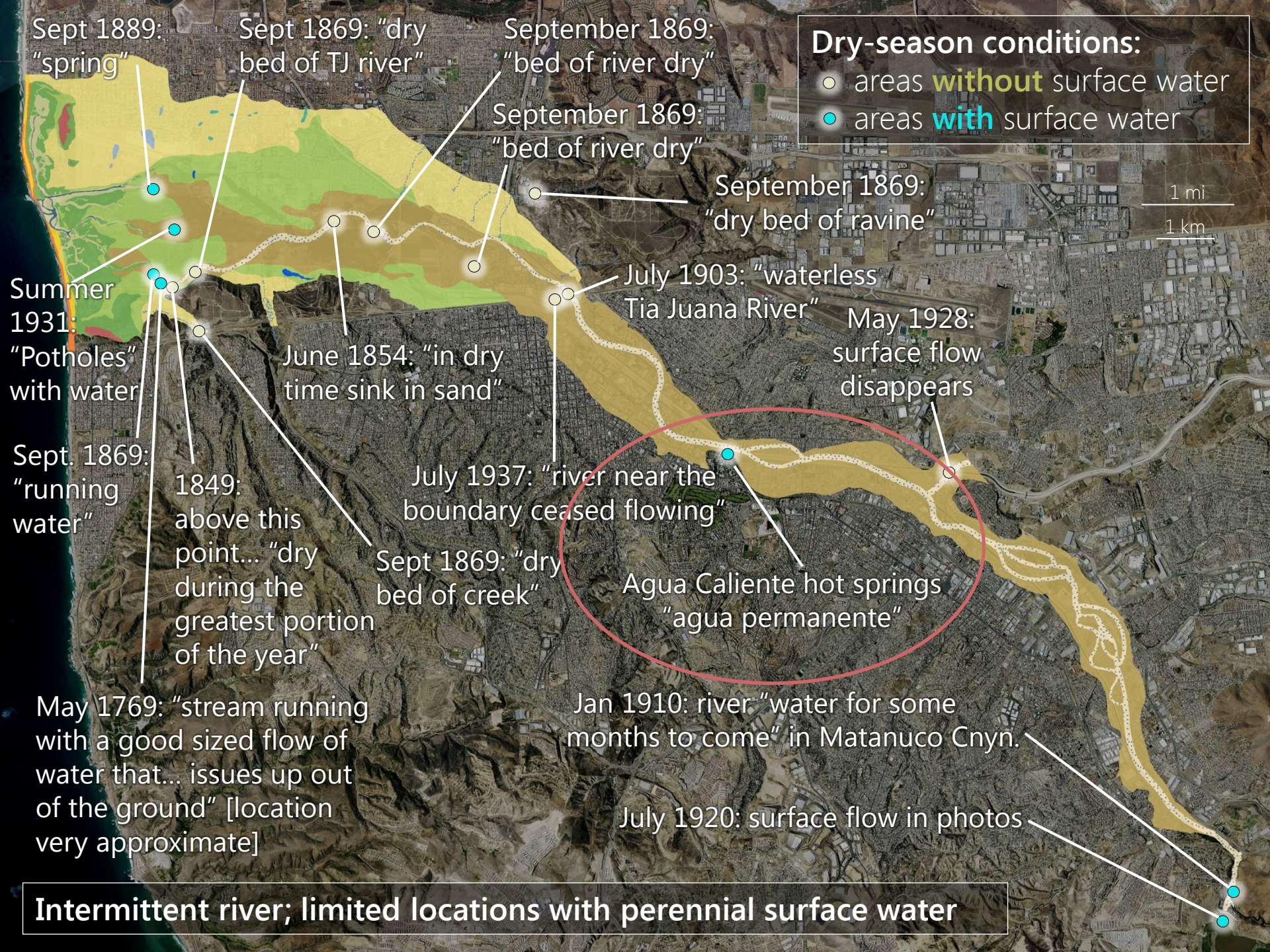
<i>Herbs</i>	
→ nightshade	<i>Solanum</i> sp.
clematis	<i>Clematis ligusticifolia</i>
→ branching phacelia	<i>Phacelia ramosissima</i>
→ Chinese parsley	<i>Heliotropium curassavicum</i>
→ rigid bird's beak	<i>Cordylanthus rigidus</i>
→ bladderpod	<i>Peritoma arborea</i>
→ skunkbush	<i>Navarretia squarrosa</i>
→ Matilija poppy	<i>Romneya coulteri</i>
→ California evening primrose	<i>Oenothera californica</i>
→ spiny rush	<i>Juncus acutus</i>
→ southwestern spiny rush	<i>Juncus acutus</i> subsp. <i>leopoldi</i>
→ California croton	<i>Croton californicus</i>
→ Heermann's lotus	<i>Acmispon heermannii</i>
→ Nuttall's lotus	<i>Lotus nuttallianus</i>
→ Beardless wild rye	<i>Elymus triticoides</i>
→ spiny goldenbush/ spiny chloracantha	<i>Chloracantha spinosa</i> , <i>C. spinosa</i> var. <i>spinosa</i>
→ bush seepweed	<i>Suaeda nigra</i>
→ slender woolly-heads	<i>Nemacaulis denudata</i> var. <i>gracilis</i>
→ scarlet lupine	<i>Lupinus concinnus</i>
→ California sealavender	<i>Limonium californicum</i>
→ Indian hemp	<i>Apocynum cannabinum</i>
→ mugwort	<i>Artemisia douglasiana</i>
→ wide throated yellow monkeyflower	<i>Mimulus brevipes</i>
→ volcanic gilia	<i>Gilia ochroleuca</i> ssp. <i>Exilis</i>
→ ropevine clematis	<i>Clematis pauciflora</i>

Records from 1849-1949

→ Species indicative of **wetter** zones (obligate and facultative wetland species)

→ Species indicative of **drier** zones (sage scrub species, generally more xeric)





Sept 1889: "spring"

Sept 1869: "dry bed of TJ river"

September 1869: "bed of river dry"

September 1869: "bed of river dry"

September 1869: "dry bed of ravine"

July 1903: "waterless Tia Juana River"

May 1928: surface flow disappears

July 1937: "river near the boundary ceased flowing"

Agua Caliente hot springs "agua permanente"

Jan 1910: river "water for some months to come" in Matanuco Cnyn.

July 1920: surface flow in photos

Summer 1931: "Potholes" with water

June 1854: "in dry time sink in sand"

Sept 1869: "dry bed of creek"

1849: above this point... "dry during the greatest portion of the year"

Sept. 1869: "running water"

May 1769: "stream running with a good sized flow of water that... issues up out of the ground" [location very approximate]

**Dry-season conditions:**

- areas **without** surface water
- areas **with** surface water

1 mi  
1 km

**Intermittent river; limited locations with perennial surface water**



Photograph of hot springs in Tijuana River  
removed due to copyright status.



Photograph of "cienega" wetlands associated with hot springs in Tijuana River  
removed due to copyright status.



Photograph of “cienega” wetlands associated with hot springs in Tijuana River  
removed due to copyright status.



## *Perennial wetlands within the river corridor*

Sam Safran, 2015



Modern day comparison photograph of hot springs site.



## *Key messages for today*

---

1

The valley supported a diverse array of wetlands in a dry climate.

2

Floods maintained a large and dynamic river corridor.

3

The valley has undergone significant changes in habitat distribution and extent.



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# *Periodic floods inundated most of the valley*

courtesy San Diego History Center

Image of Tijuana River during  
dry season removed due to  
copyright status.

available here:

<http://www.sandiegohistory.org/photostore/product/au-to-crossing-mexico-border-c-1921-6661-4//>

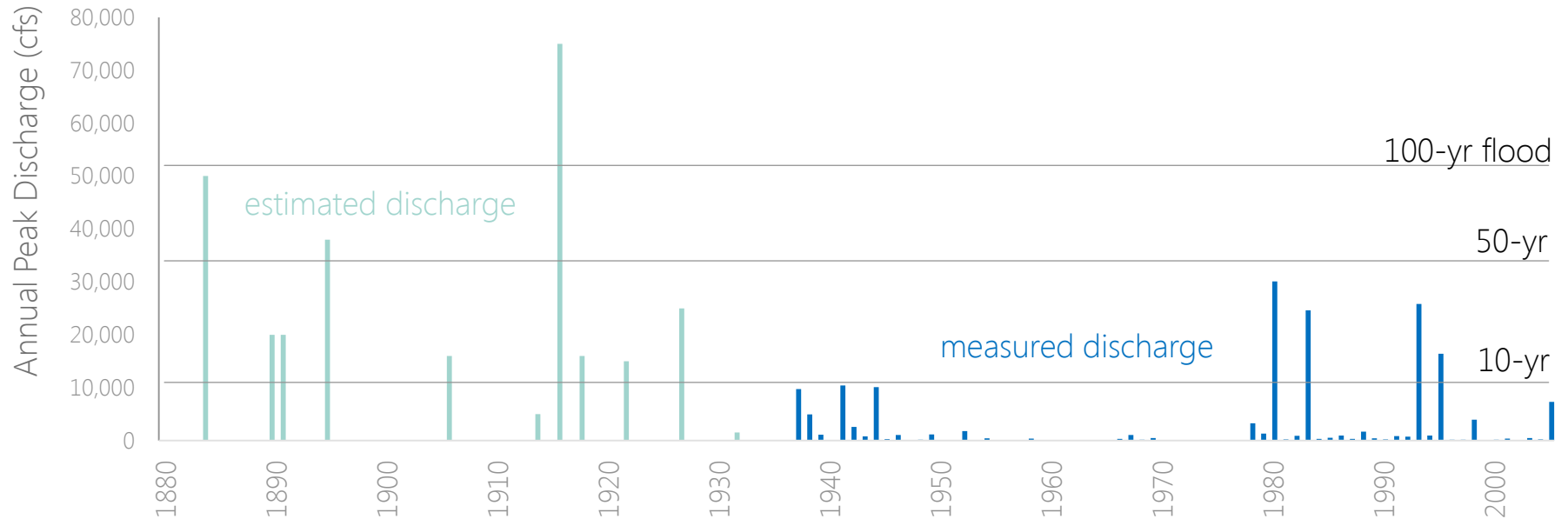


courtesy San Diego History Center

Image of Tijuana River during  
flood removed due to  
copyright status.

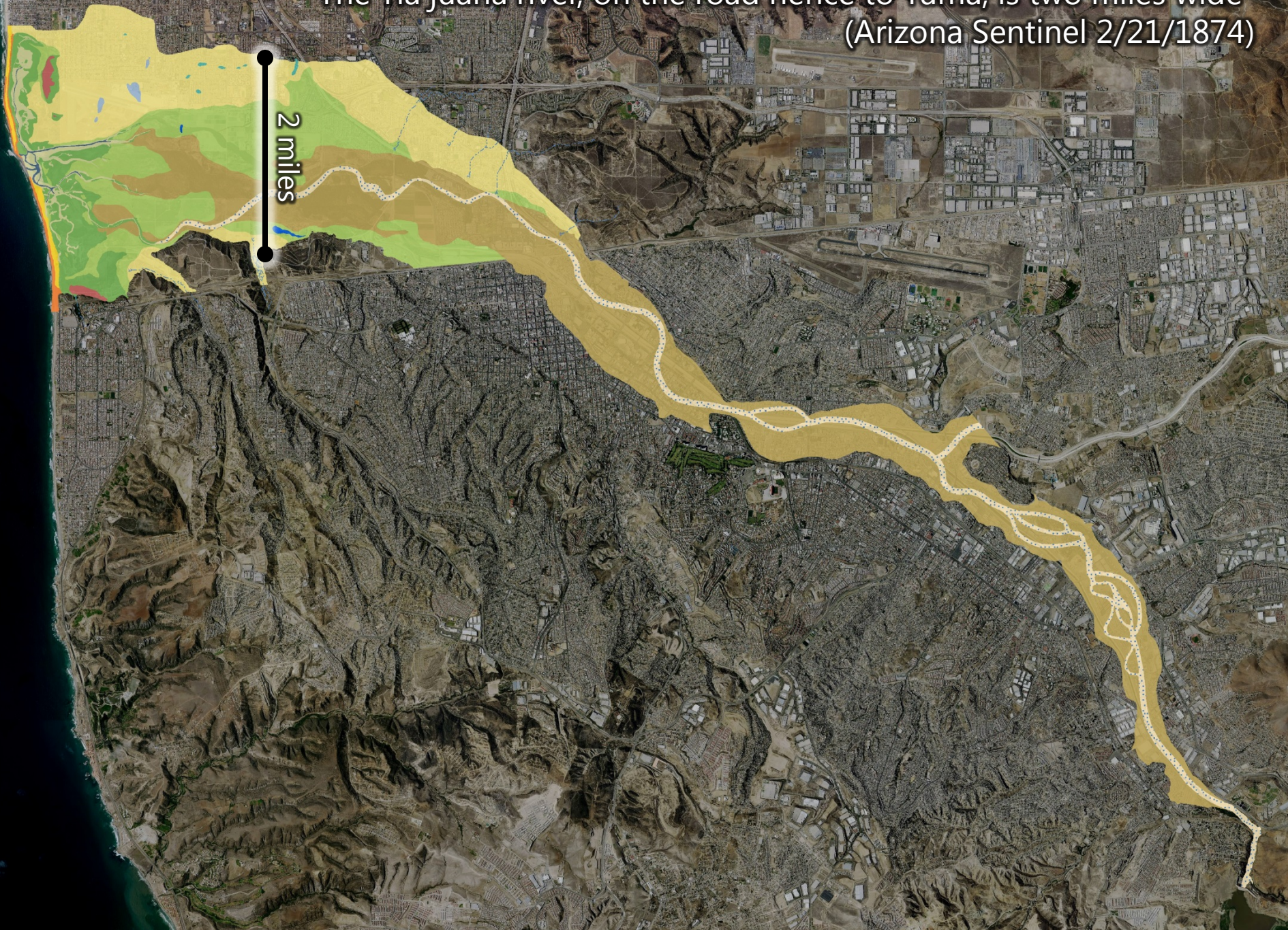
similar photo available here:

<http://www.sandiegohistory.org/prints/baja-california/tijuana-flood-1916-20295>





"The Tia juana river, on the road hence to Yuma, is two miles wide"  
(Arizona Sentinel 2/21/1874)





An aerial photograph of the Tia Juana river valley, showing the river's path from the top left towards the bottom right. The river is highlighted with a yellow border. A large area to the left of the river is shaded in blue and yellow, representing the 'overflow area'. The surrounding landscape is a mix of urban development, agricultural fields, and rugged, hilly terrain. The ocean is visible on the far left edge.

"The Tia juana river, on the road hence to Yuma, is two miles wide"  
(Arizona Sentinel 2/21/1874)

"It just flooded more or less the whole valley."  
(Bruhlmeier 1937)

"overflow area" (Cruse 1937)



"The Tia juana river, on the road hence to Yuma, is two miles wide"  
(Arizona Sentinel 2/21/1874)

"It just flooded more or less the whole valley."  
(Bruhlmeier 1937)

"overflow area" (Cruse 1937)

Tijuana River overflow into San Diego Bay  
1891, 1916, 1927 (also possibly 1825 and 1862)

Picture taken a few days after the flood of  
Jan. 27, 1916.





## Method 1: **Ford**

Image of tourists crossing the flooded Tijuana River  
in horse drawn carriages  
removed due to copyright status.

available here:

<http://www.sandiegohistory.org/photostore/product/tijuana-river-tourists-crossing-c-1890/>

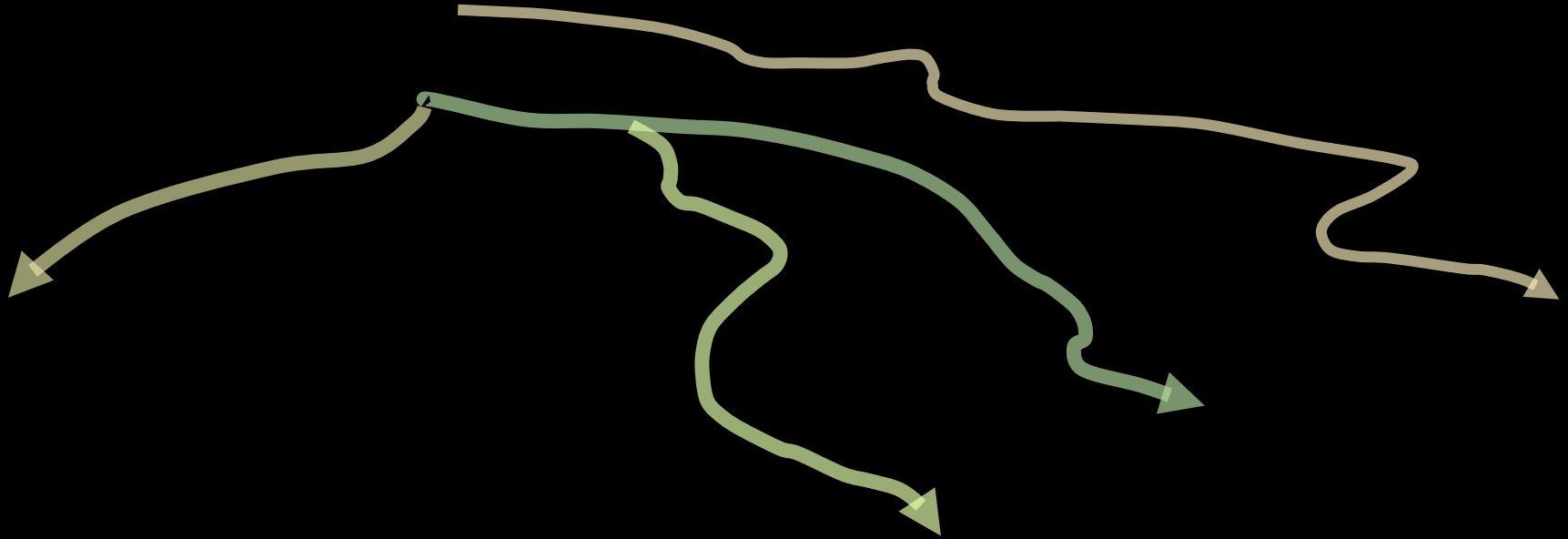


## Method 2: **Zip**

Image of individual crossing the flooded Tijuana River  
using a cable strung across the stream  
removed due to copyright status.



## *Floods drove river movement*



Aerial image of Tijuana River showing multiple channel courses removed due to copyright status.

**May 1941** (after sizeable floods in February, March, and April)

Erickson 1941, courtesy San Diego History Center



# Historical courses of the Tijuana River

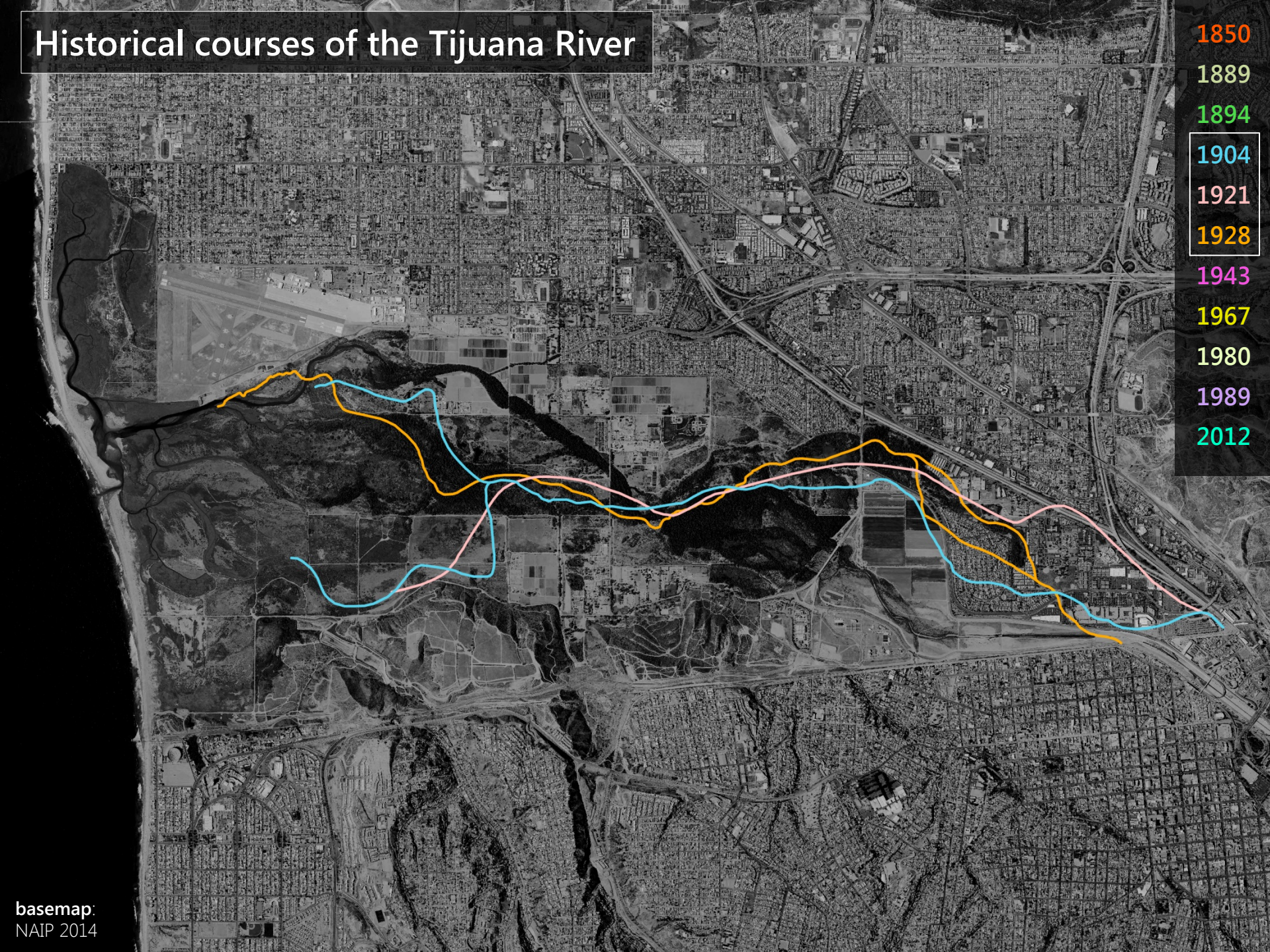
1850  
1889  
1894  
1904  
1921  
1928  
1943  
1967  
1980  
1989  
2012





# Historical courses of the Tijuana River

1850  
1889  
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1904  
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1928  
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# Historical courses of the Tijuana River

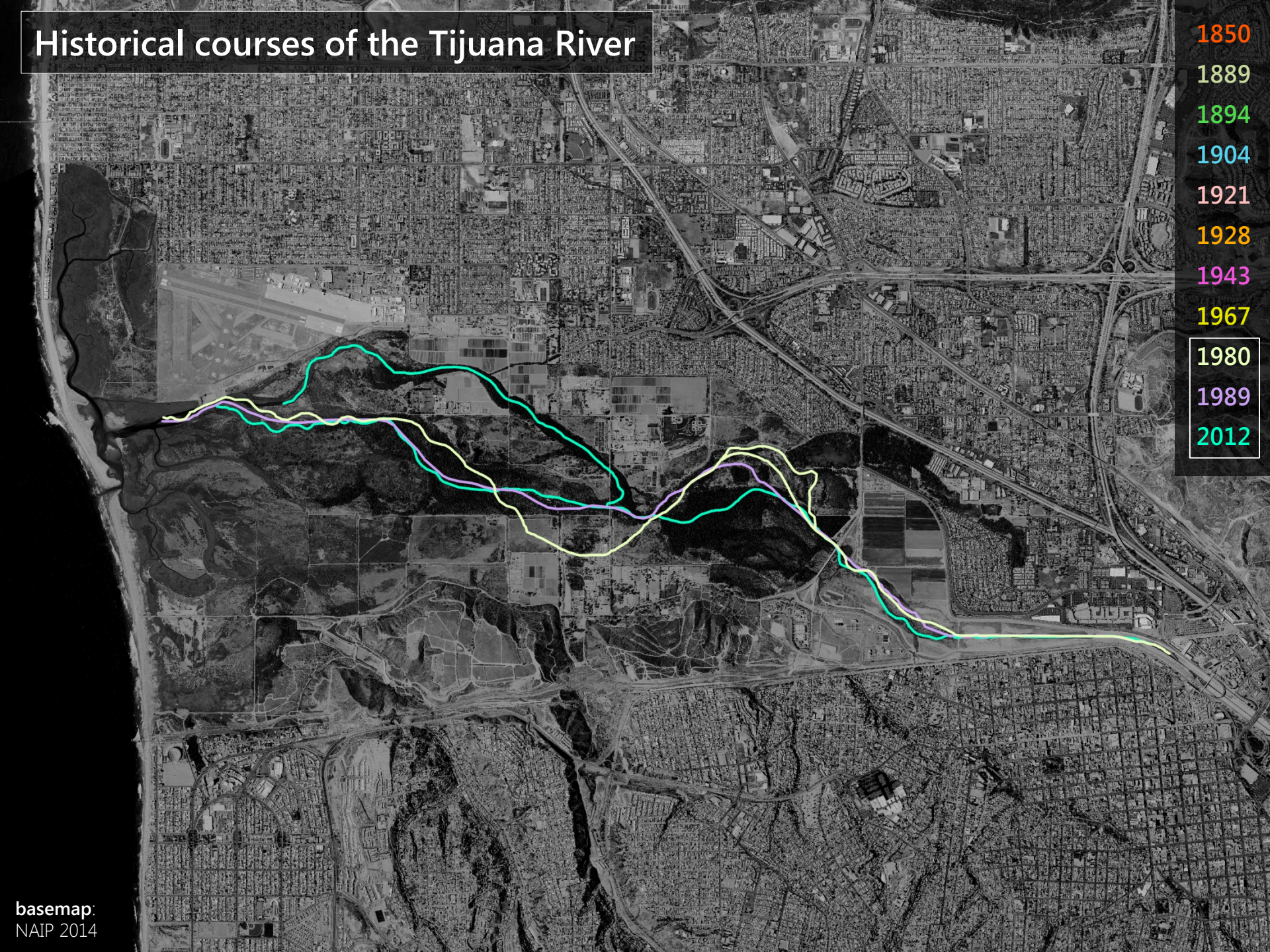
1850  
1889  
1894  
1904  
1921  
1928  
1943  
1967  
1980  
1989  
2012





# Historical courses of the Tijuana River

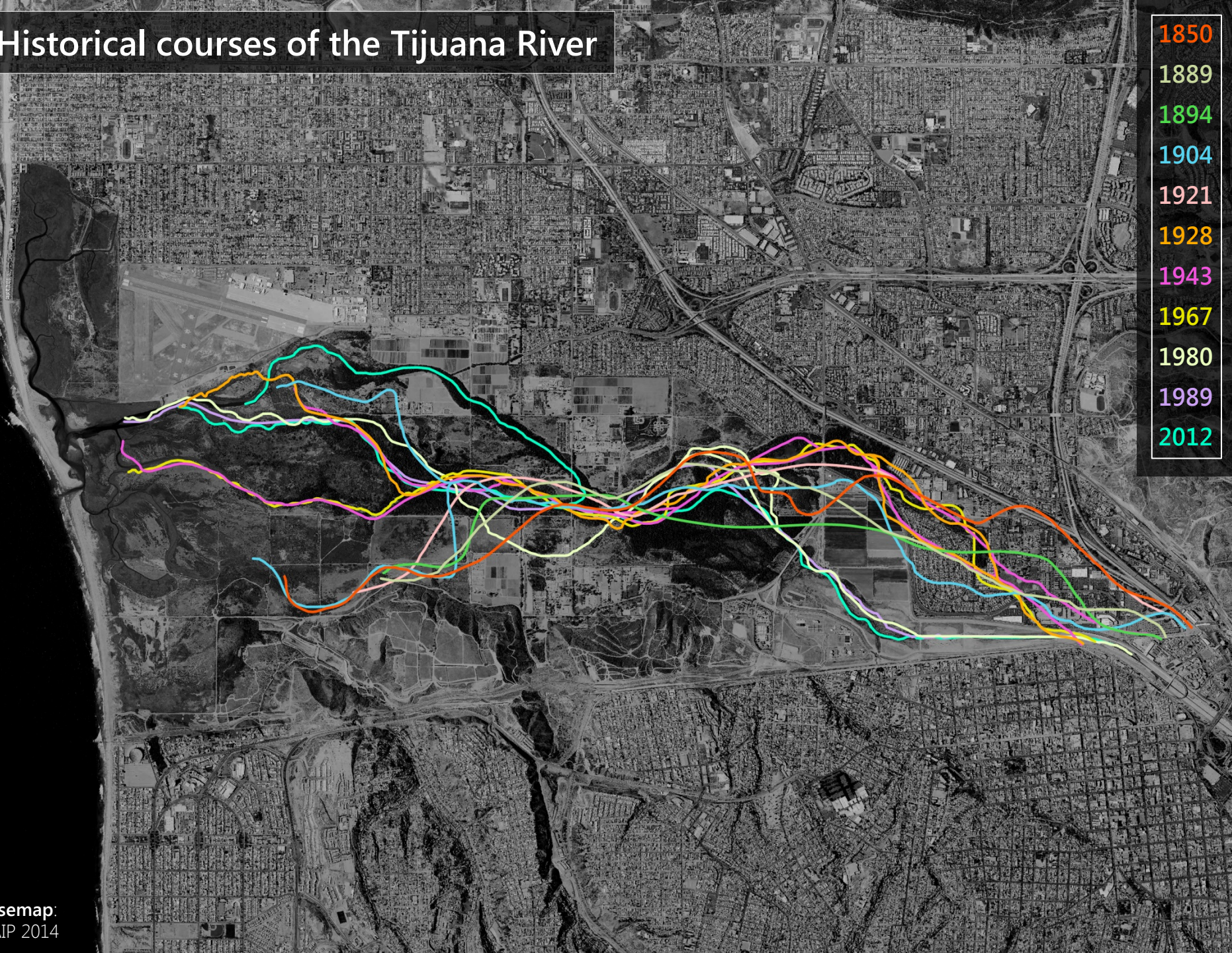
1850  
1889  
1894  
1904  
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1928  
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# Historical courses of the Tijuana River

1850  
1889  
1894  
1904  
1921  
1928  
1943  
1967  
1980  
1989  
2012





## *Floods created habitat variability*

---

Aerial image of Tijuana River showing different densities of riparian vegetation  
removed due to copyright status.

**“spatial variability”**



# *Floods created habitat variability*

Bonillas and Urbina 1912

1912



1920

Image taken from the same location as above, with  
vegetation scoured out  
removed due to copyright status.

Savage 1920

8 years  
2 large floods

**"temporal variability"**



## *Floods created habitat variability*

- Photo likely taken after either flood of 1891 or 1895; vegetation scoured in foreground.

Image of tourists crossing the Tijuana River at the border  
removed due to copyright status.

available here:

<http://content.cdlib.org/ark:/13030/kt5290183w/?docId=kt5290183w&order=1&layout=printable>

**“temporal variability”**



## *Floods created habitat variability*

- Photo likely taken after either flood of 1891 or 1895; vegetation scoured in foreground.
- Re-vegetation between ca. 1895 and 1910

Later image taken at the same location removed due to copyright status.

available here:

<http://www.sandiegohistory.org/prints/border/tijuana-gate-1910-1113>

**“temporal variability”**



## *Floods created habitat variability*

- Photo likely taken after either flood of 1891 or 1895; vegetation scoured in foreground.
- Re-vegetation between ca. 1895 and 1910
- Floods in 1916 and 1918

Photos of floods at the border removed due to copyright status.

Images available here:

- <http://www.oac.cdlib.org/ark:/13030/kt7w1020j2/?docId=kt7w1020j2&order=1&layout=printable>

**“temporal variability”**



## *Floods created habitat variability*

- Photo likely taken after either flood of 1891 or 1895; vegetation scoured in foreground.
- Re-vegetation between ca. 1895 and 1910
- Floods in 1916 and 1918
- Vegetation scoured again



**"temporal variability"**



## *Key messages for today*

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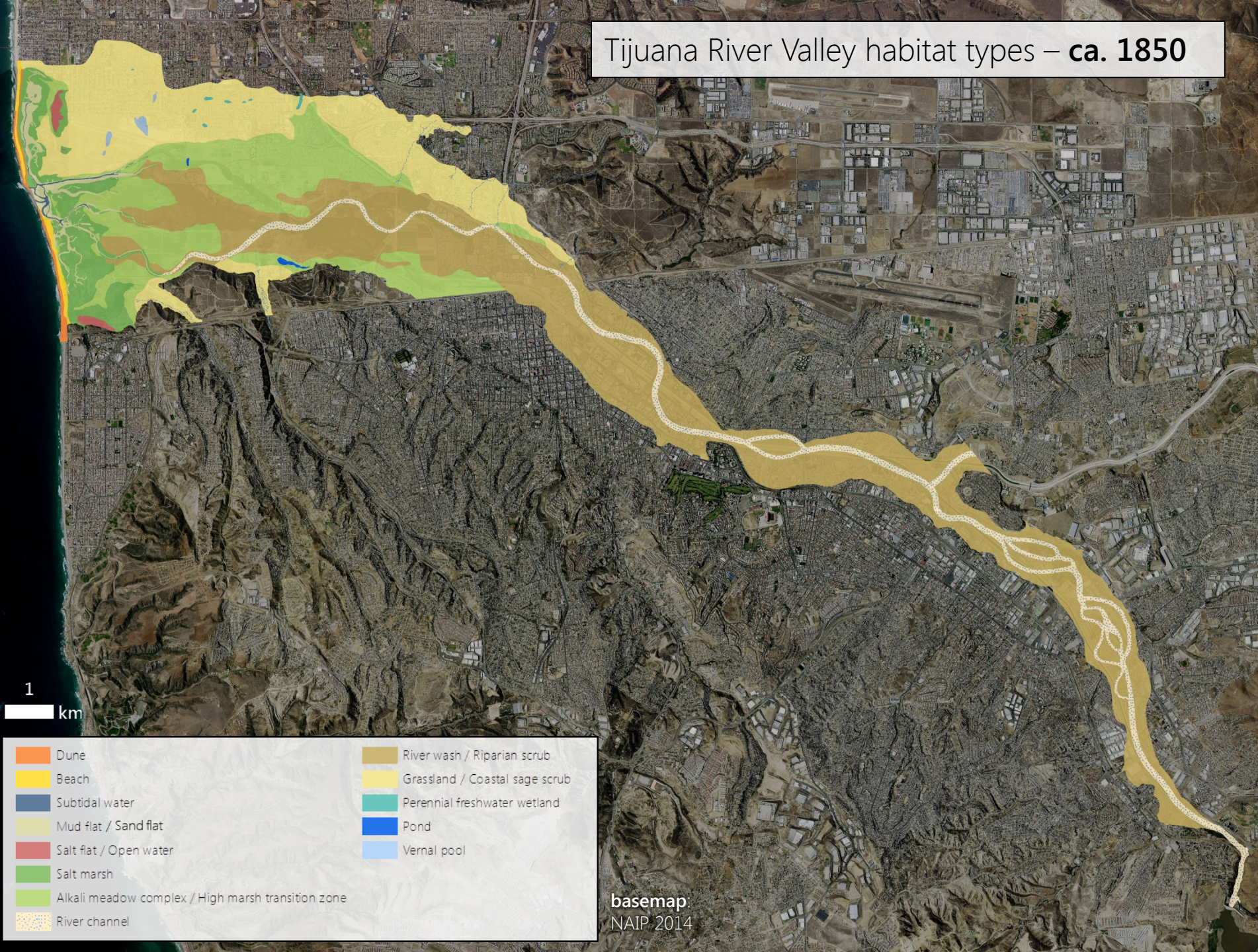
Floods maintained a large and dynamic river corridor.

3

The valley has undergone significant changes in habitat distribution and extent.



# Tijuana River Valley habitat types – ca. 1850



1

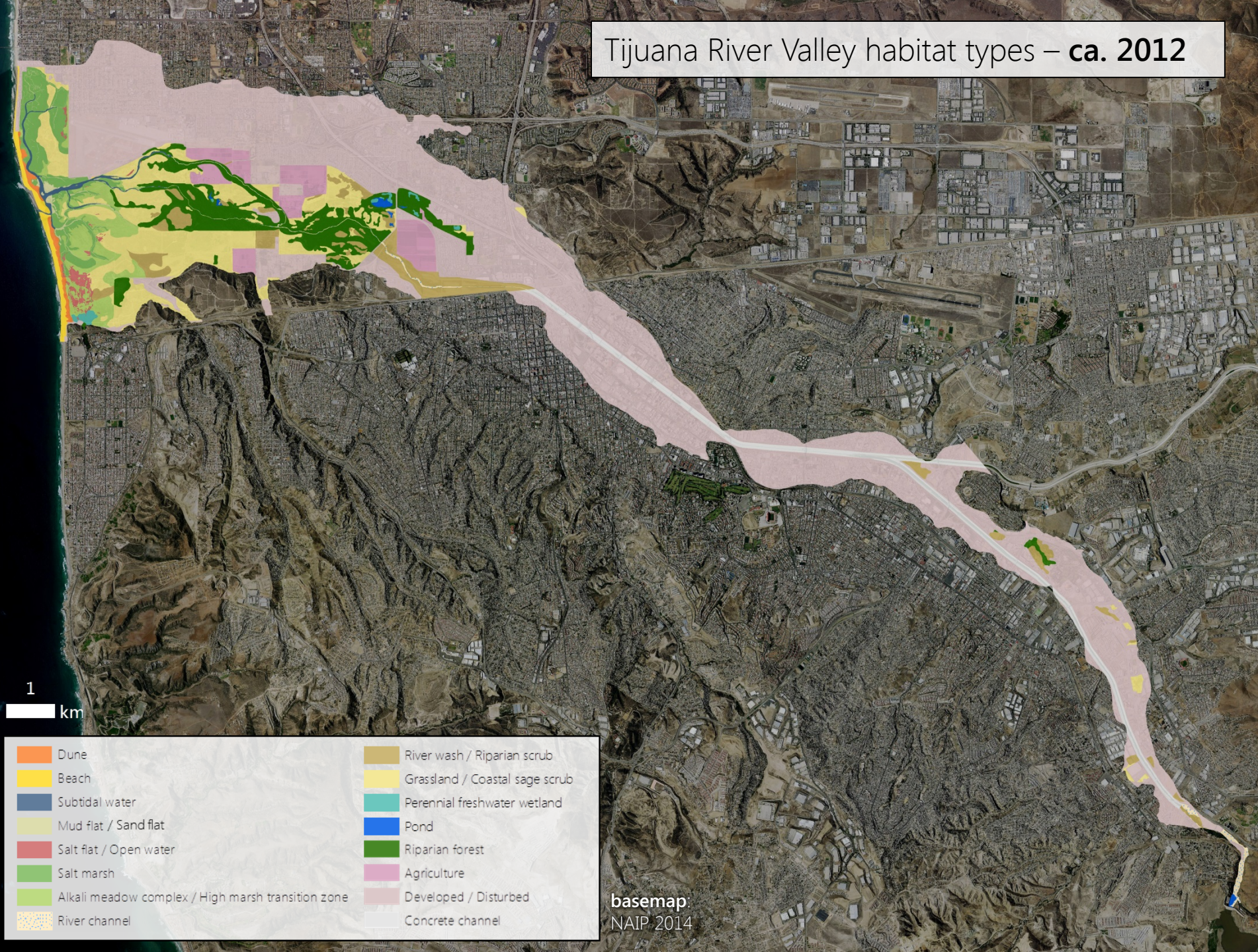
km

- |  |                                |
|--|--------------------------------|
| Dune   | River wash / Riparian scrub    |
| Beach  | Grassland / Coastal sage scrub |
| Subtidal water                                     | Perennial freshwater wetland   |
| Mud flat / Sand flat                               | Pond                           |
| Salt flat / Open water                             | Vernal pool                    |
| Salt marsh   |                                |
| Alkali meadow complex / High marsh transition zone |                                |
| River channel                                      |                                |

basemap:  
NAIP 2014



# Tijuana River Valley habitat types – ca. 2012

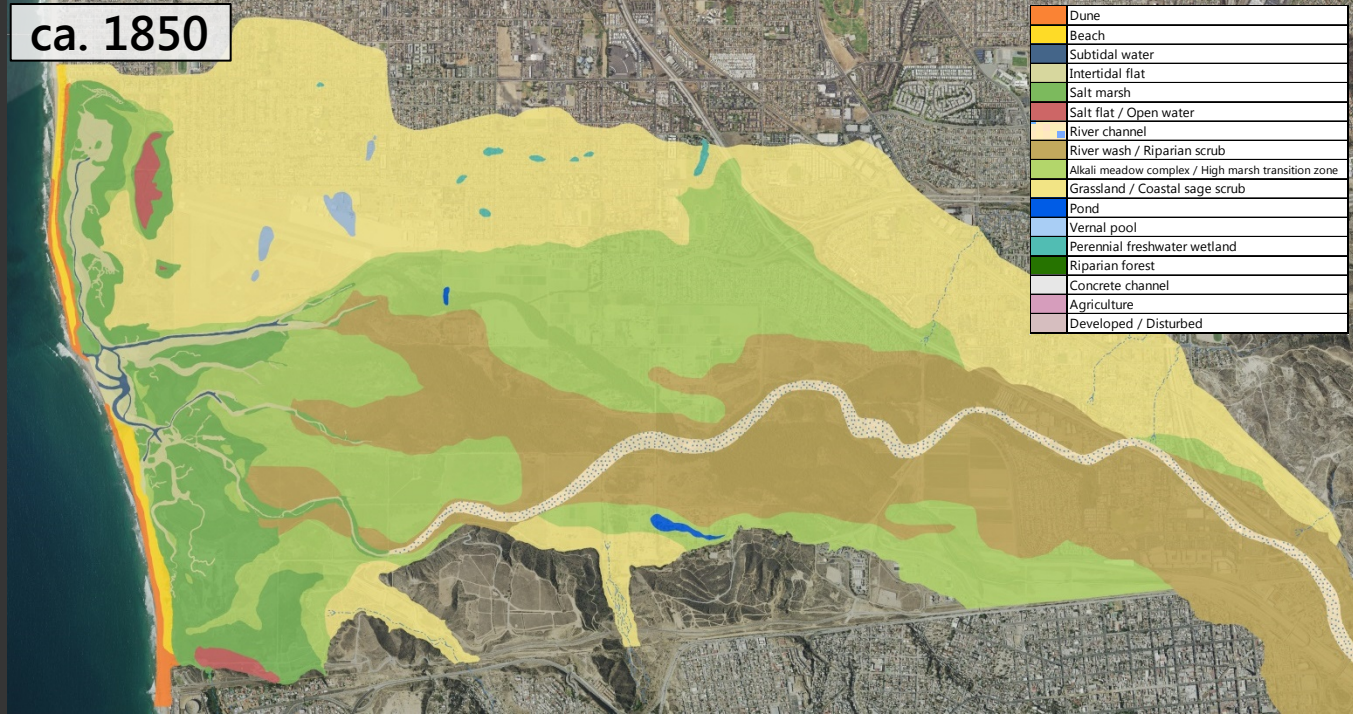




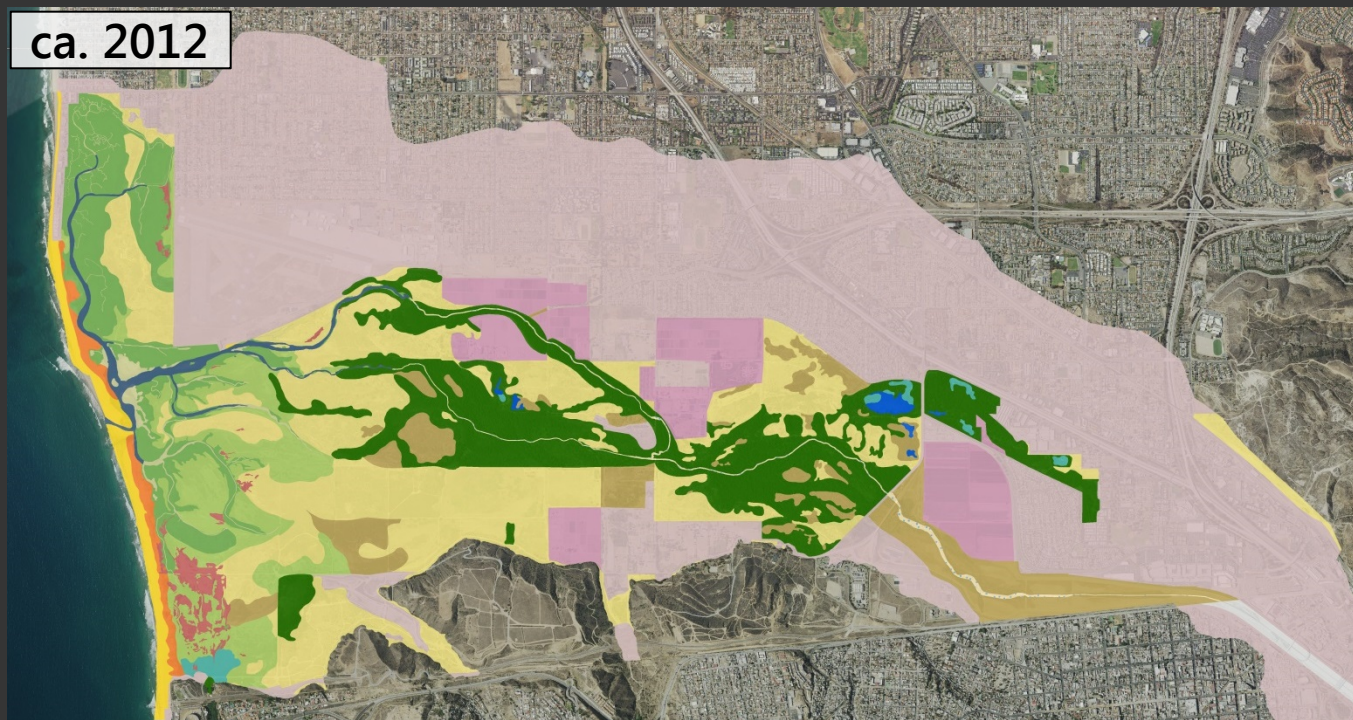
# Findings

- Estuarine habitats situated higher in the tidal frame
- Development of low mesa and 100% loss of **associated wetlands**
- Complete loss of valley floor **alkali meadows**; now supports **grassland/CSS**
- In US, river corridor compressed & wetter (**riparian scrub** → **riparian forest**)

ca. 1850



ca. 2012





# Findings – River Valley (Mexico)

- **River wash / Riparian scrub** almost entirely developed
- **River channel** with multiple braids replaced with straightened **Concrete channel**
- Small patches of **Riparian scrub** now disconnected from river channel
- Historical river corridor 200-1,400 m wide; now uniformly 100 m wide





## *The Tijuana River Valley...*

---

1

supported a diversity of wetland types in a semi-arid region.

2

featured a dynamic river corridor – but with some stable aspects.

3

experienced major changes in habitat distribution and extent.



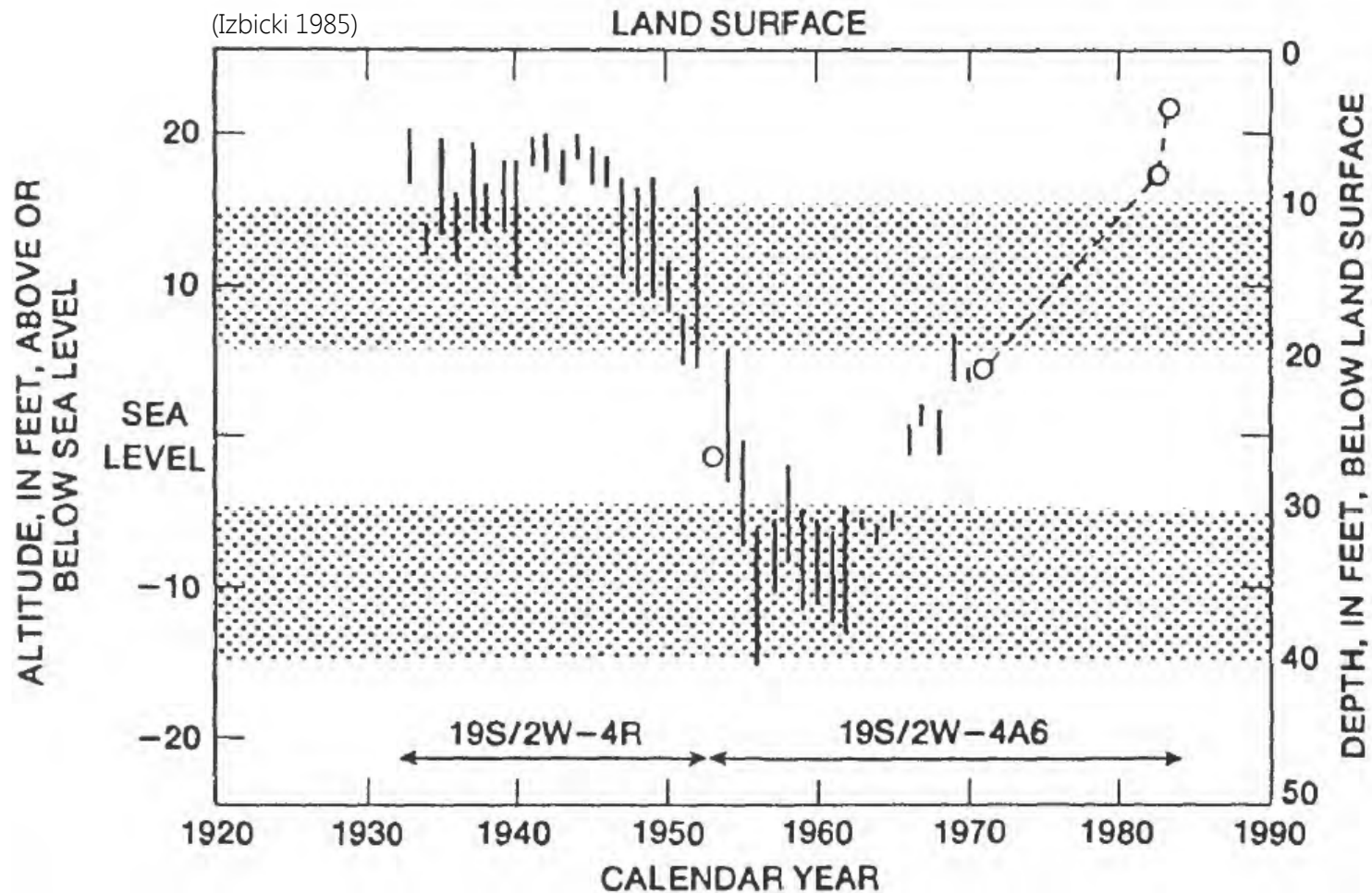
**Riparian forest** is a “new” (but critical) habitat type  
Long-term compatibility with intermittent flows?





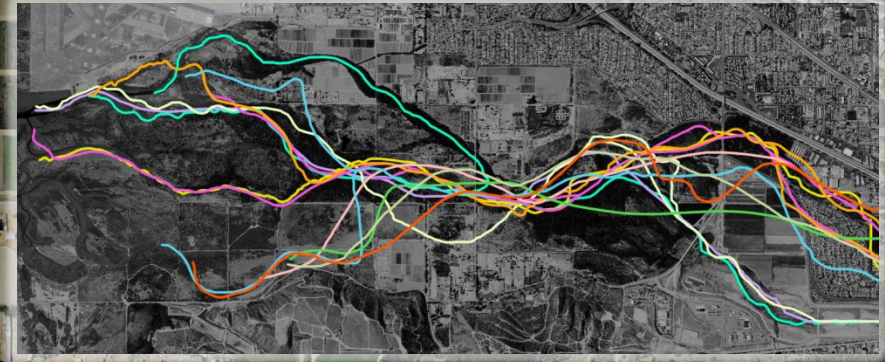
## Groundwater levels have rebounded

Can “missing” historical wetland types be supported?





# *Management implications*



Recent **channel movement** events have historical precedence  
Implications for how to treat "new" channels?



- International boundary is arbitrary from the perspective of historical ecology.
- Shared ecological history is a unifying force.
- Anything we missed?



# THANK YOU.

sams@sfei.org

www.sfei.org/programs/resilient-landscapes



courtesy Special Collections & Archives, UCSD Library



## Funder

California State Coastal Conservancy

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