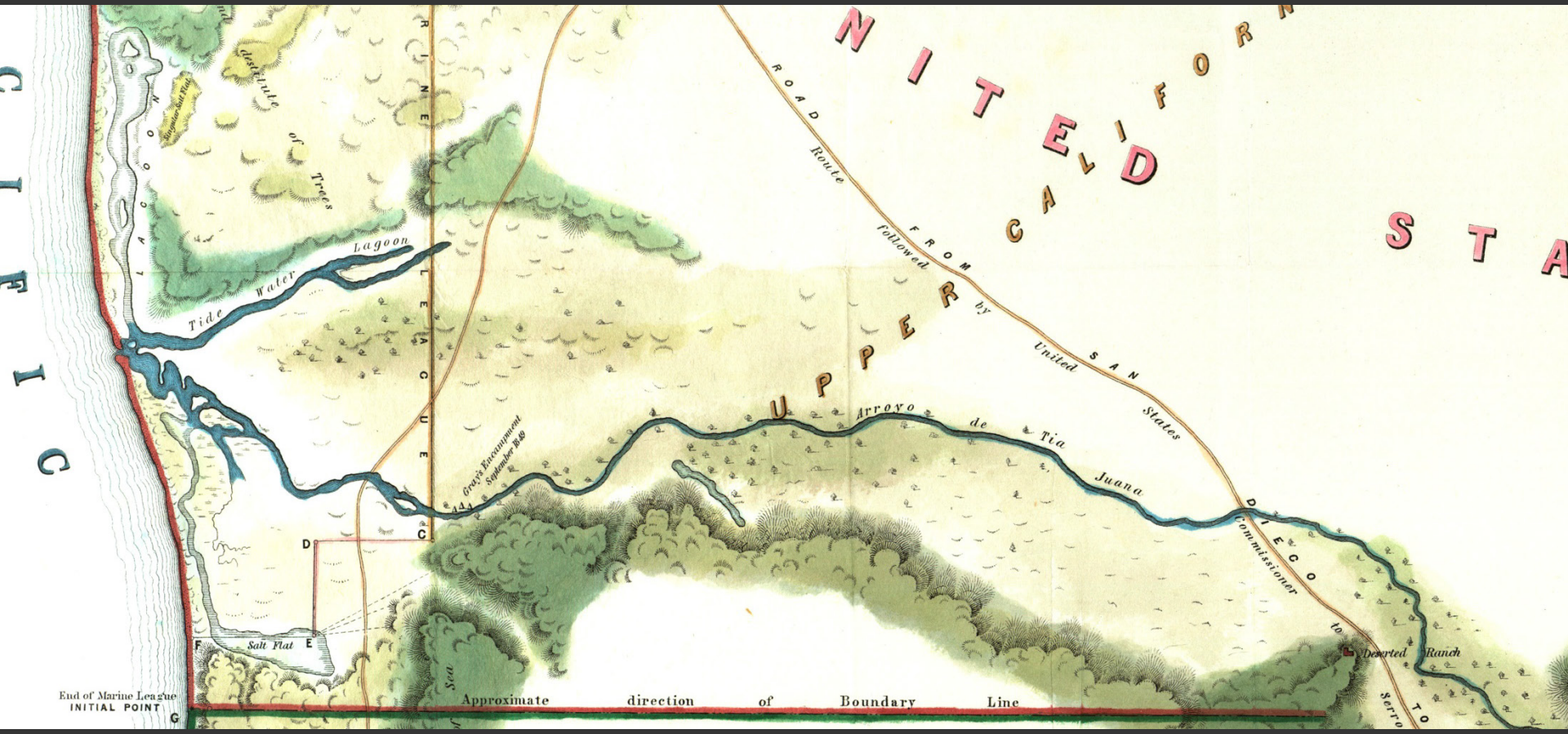
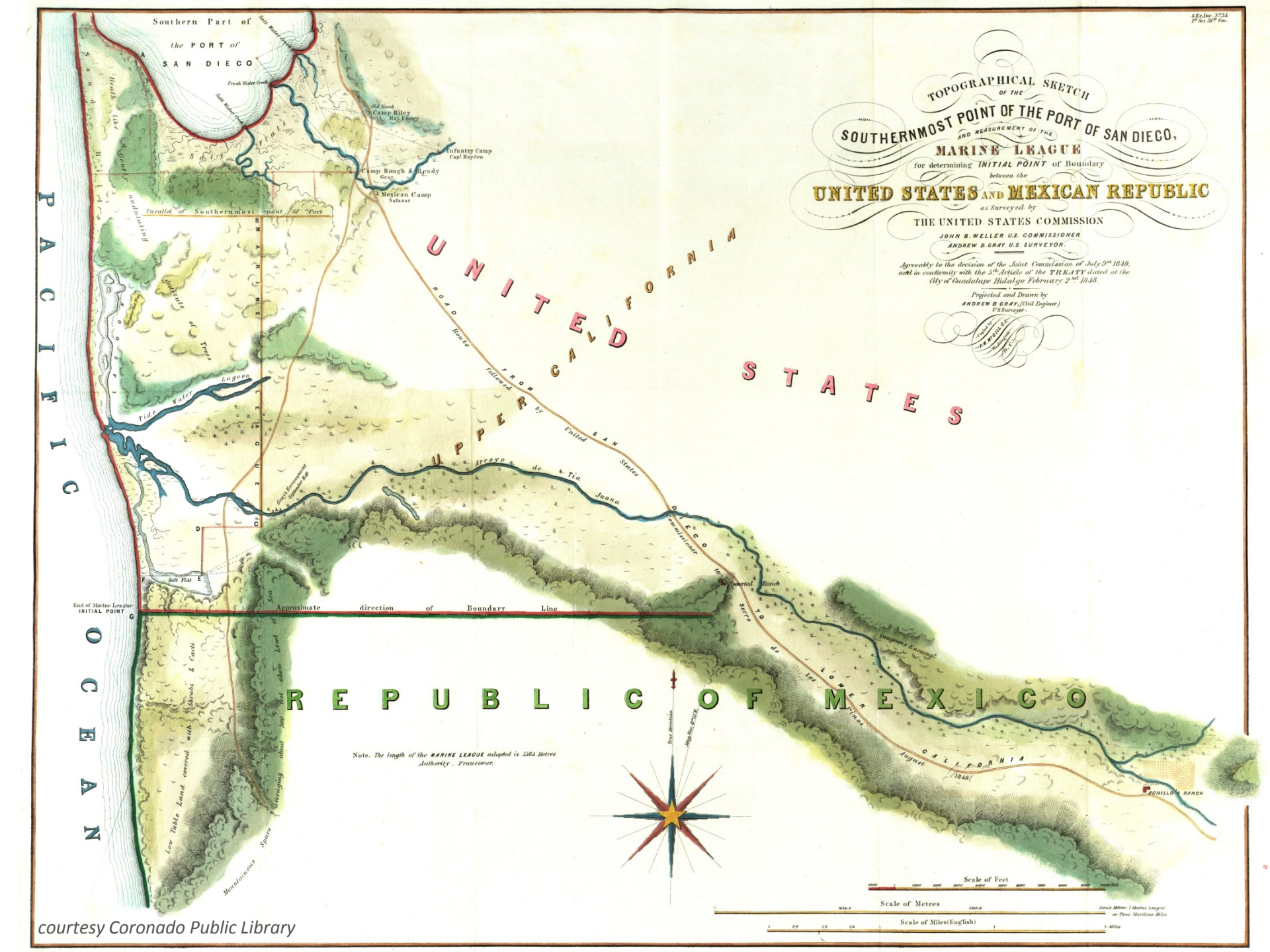
The Tijuana River Valley: An Ecological Look into the Past



Sam Safran
San Francisco Estuary Institute
Resilient Landscapes Program

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

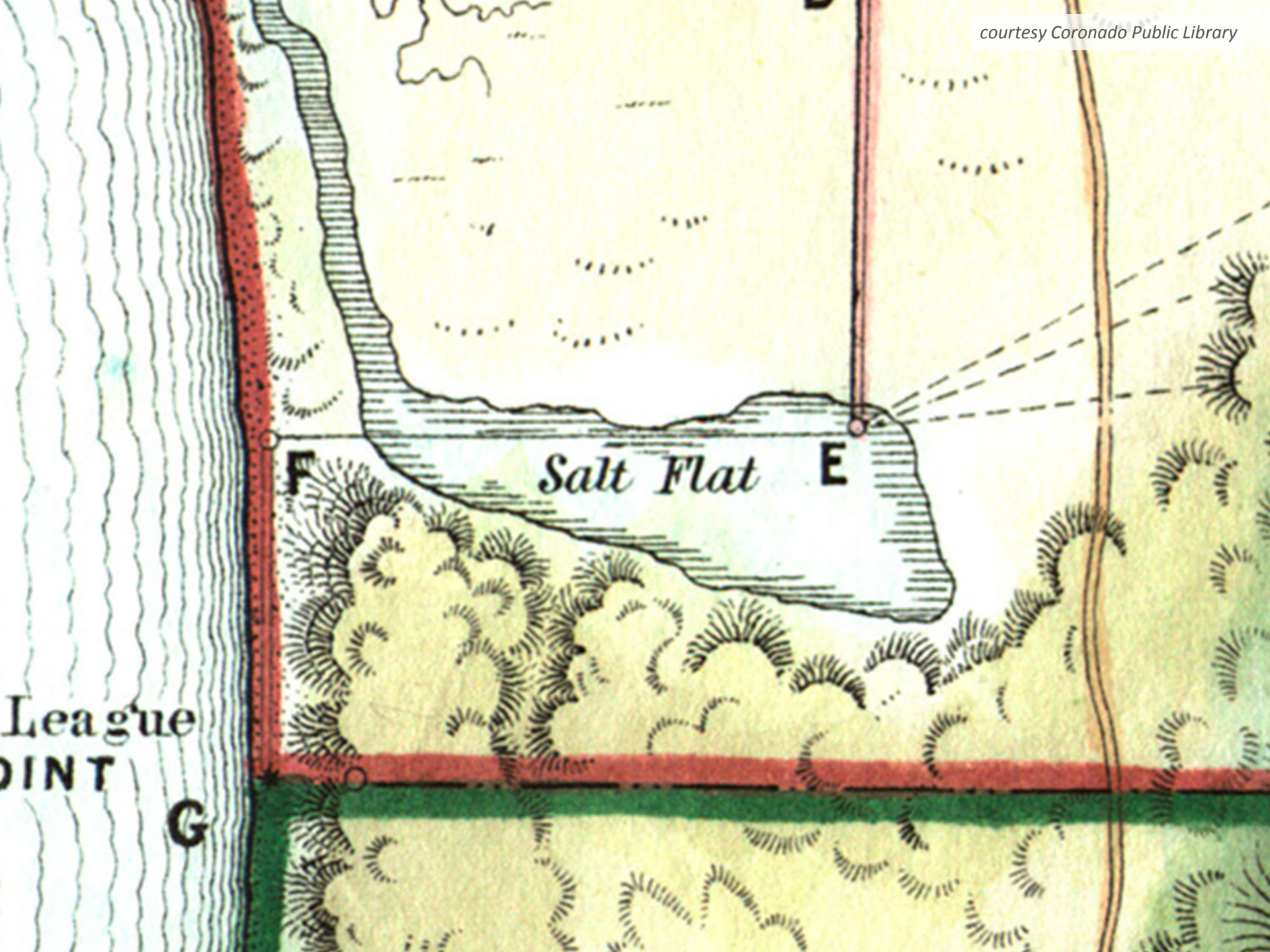


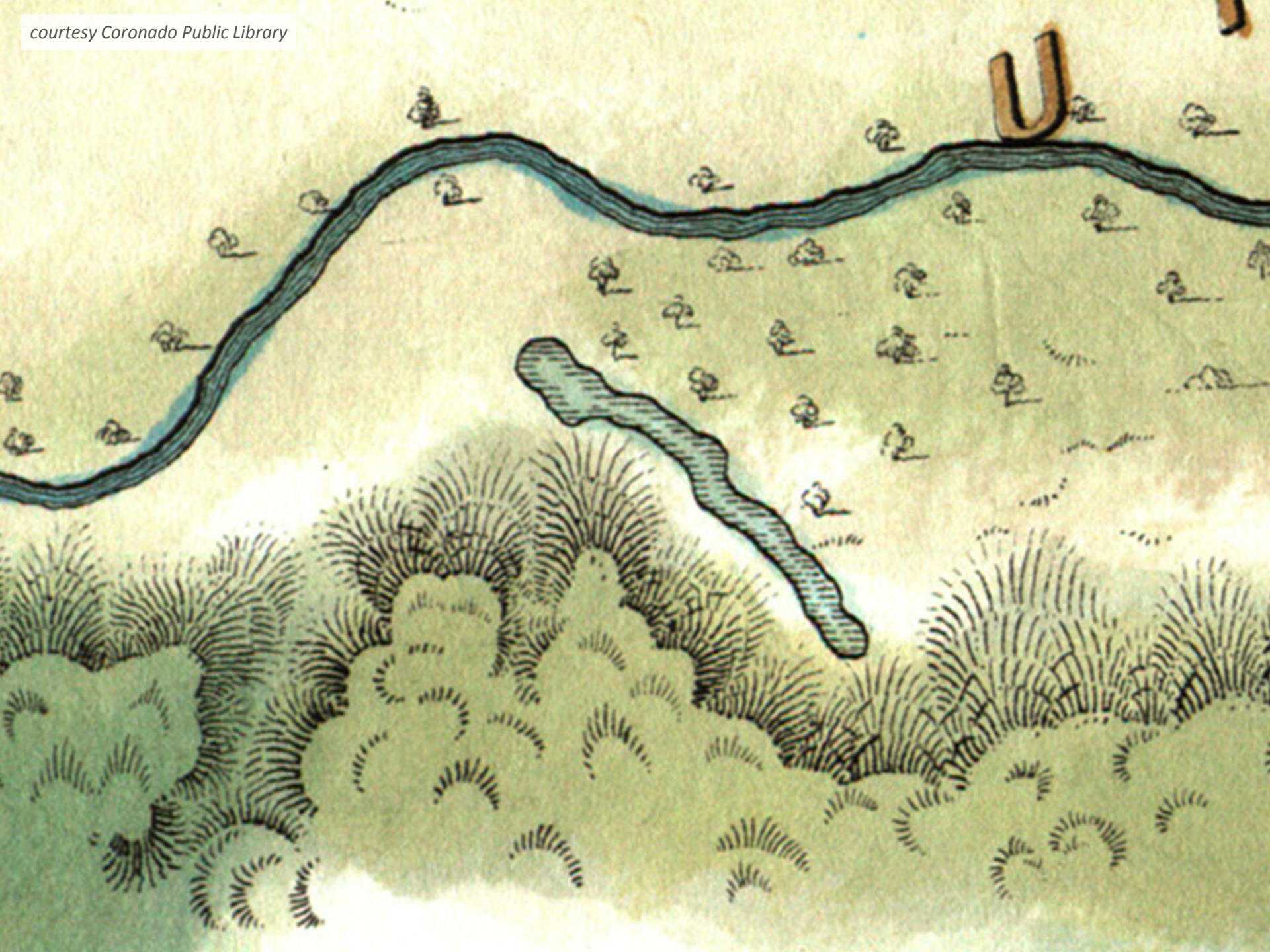
TOPOGRAPHICAL SKETCH
OF THE
SOUTHERNMOST POINT OF THE PORT OF SAN DIEGO,
AND MEASUREMENT OF THE
MARINE LEAGUE
for determining INITIAL POINT of Boundary
between the
UNITED STATES AND MEXICAN REPUBLIC
as Surveyed by
THE UNITED STATES COMMISSION
JOHN B. WELLER U.S. COMMISSIONER
ANDREW B. GRAY U.S. SURVEYOR.

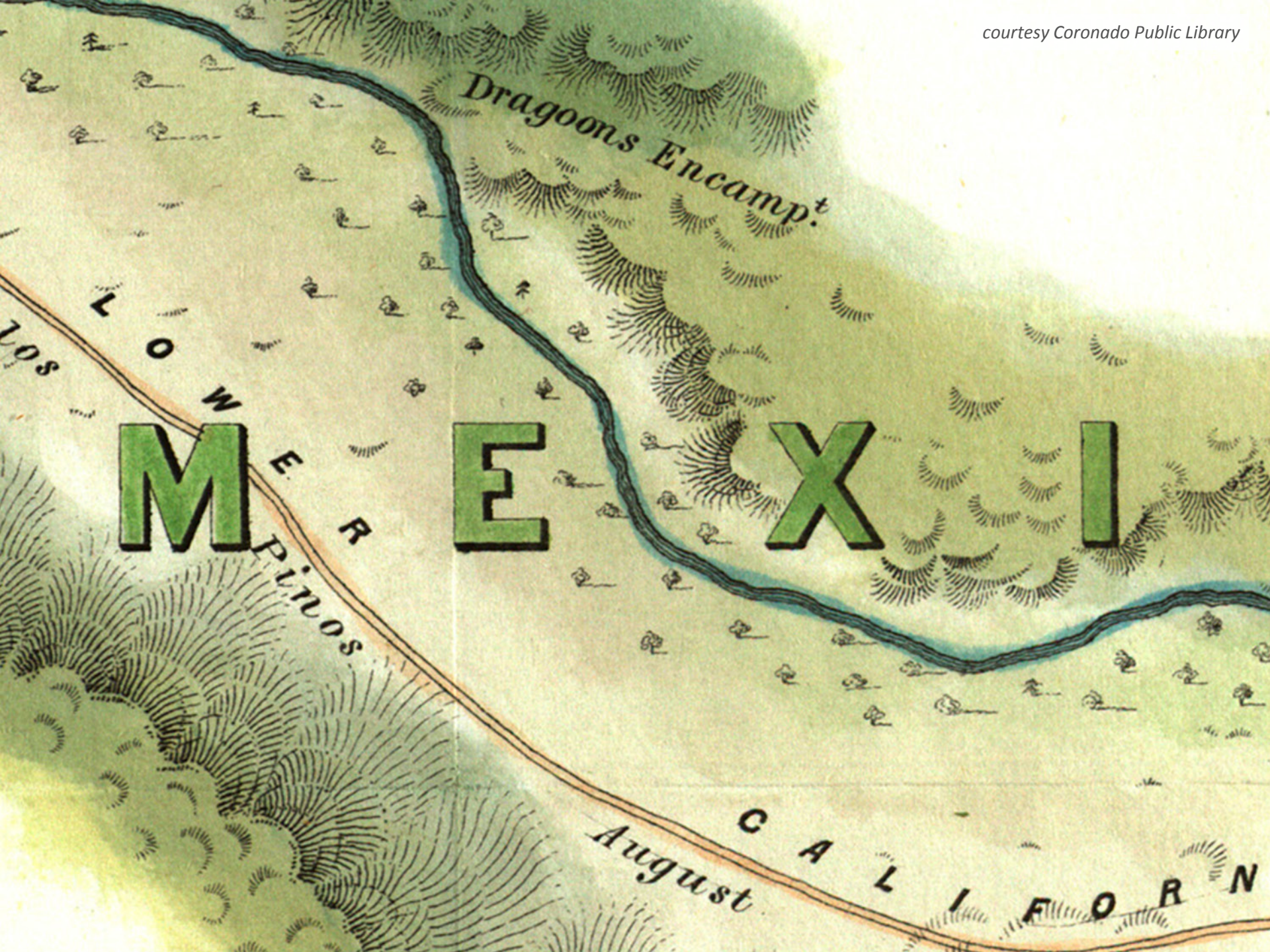
Agreeably to the decision of the Joint Commission of July 5th 1849, and in conformity with the 5th Article of the TREATY dated at the City of Guadalupe Hidalgo February 2nd 1848.

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

Note. The length of the MARINE LEAGUE adopted is 5565 Metres
Authority, Francoeur.


courtesy Coronado Public Library
F
Salt Flat
E
Leagu
DINT
G


courtesy Coronado Public Library



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.

Unknown 1923, courtesy San Diego Natural History Museum

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

Unknown ca. 1890, courtesy San Diego History Center

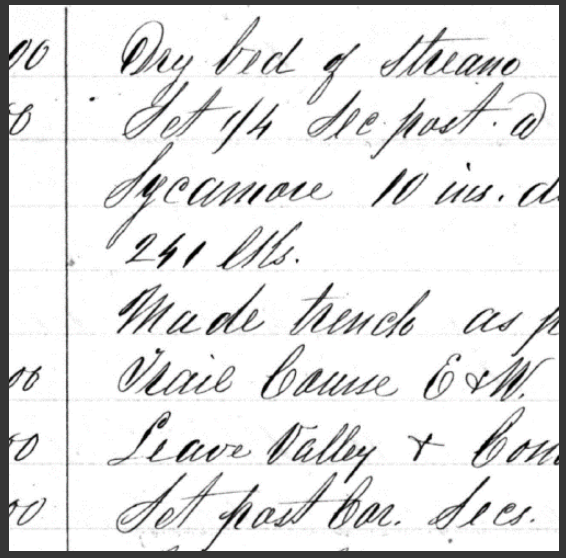

Sand In My Shoes
by
Mary Louise Richards
Life in the Tijuana Sloughs 1931-1944
Codgrass
Pickleweed
3 0650 01891 4404
CALIFORNIA ACADEMY OF SCIENCES
№ 572794
1
Field Book
of
Willis Linn Jepson
If lost finder will receive
five Dollars Reward.
11 Rosswood Road
Berkeley,
— 1928 —

Archives are a treasure trove of data…

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

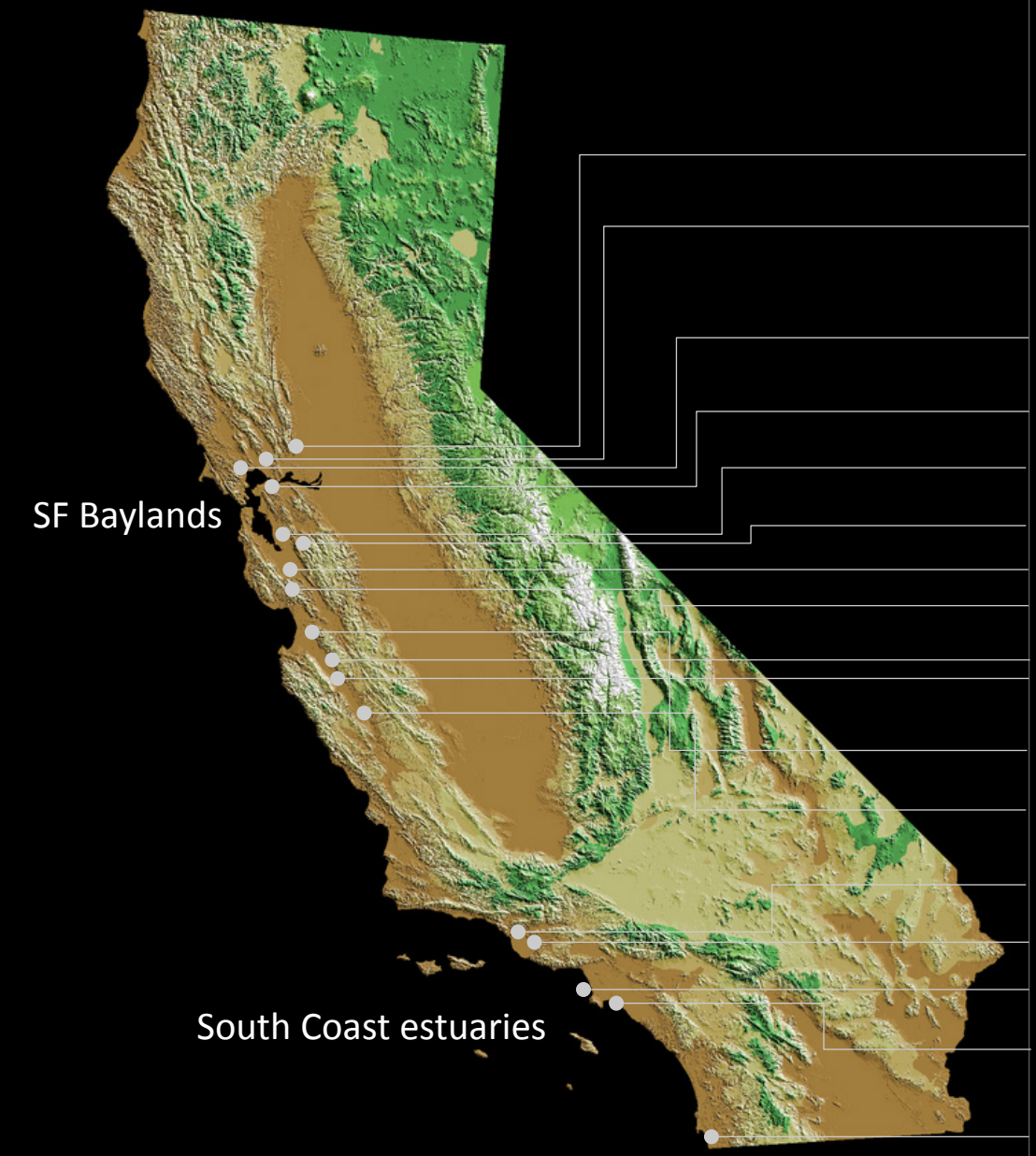
Using the past to understand the present landscape and envision its future potential

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



Sacramento-San Joaquin Delta

Napa River

Mark West Creek

Marsh Creek

Alameda Creek

Penitencia Creek

Coyote Creek

Guadalupe River

Uvas Creek

Llagas Creek

Pajaro River

Salinas River

Ventura River

Santa Clara River

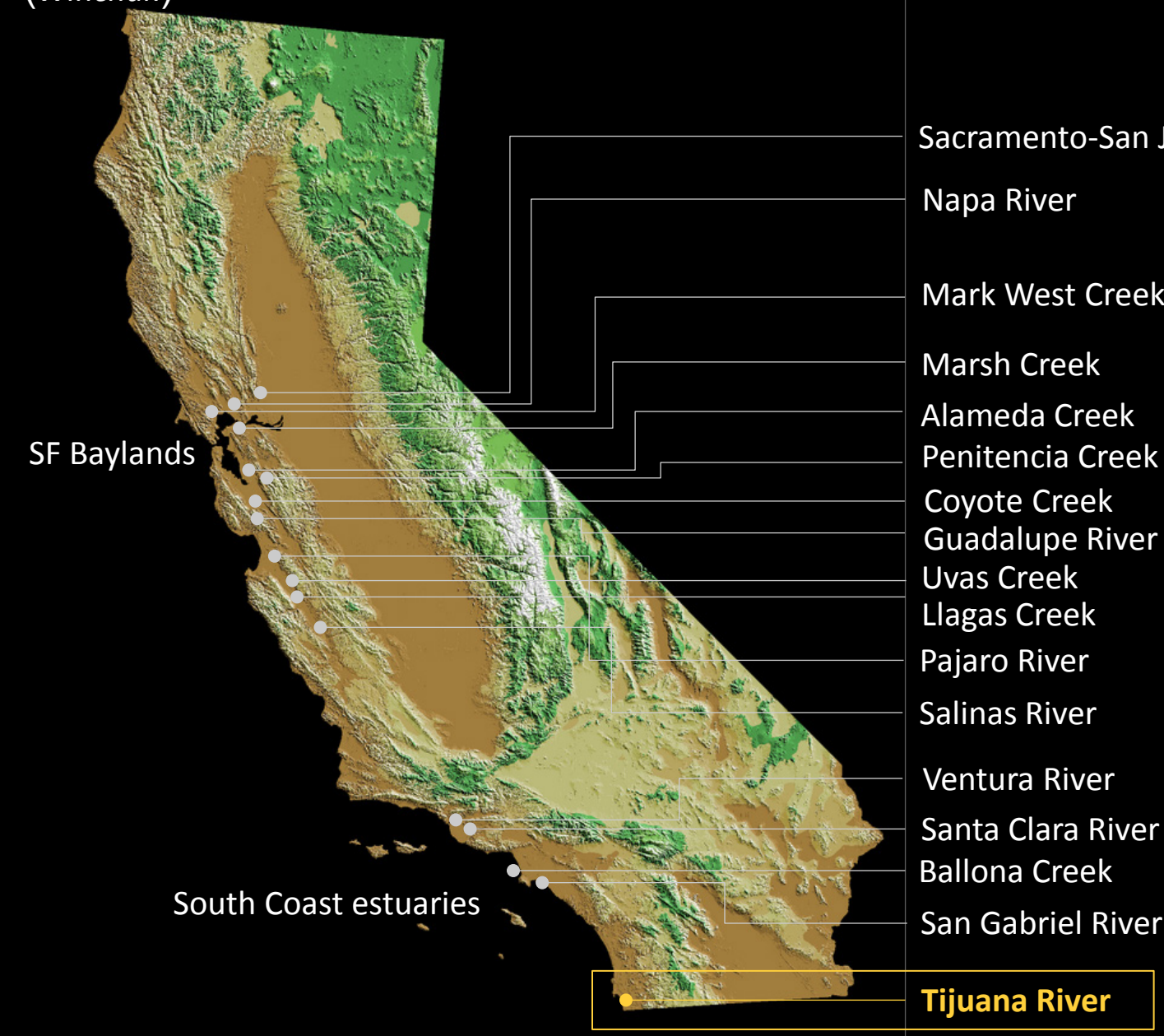
Ballona Creek

San Gabriel River

Tijuana River

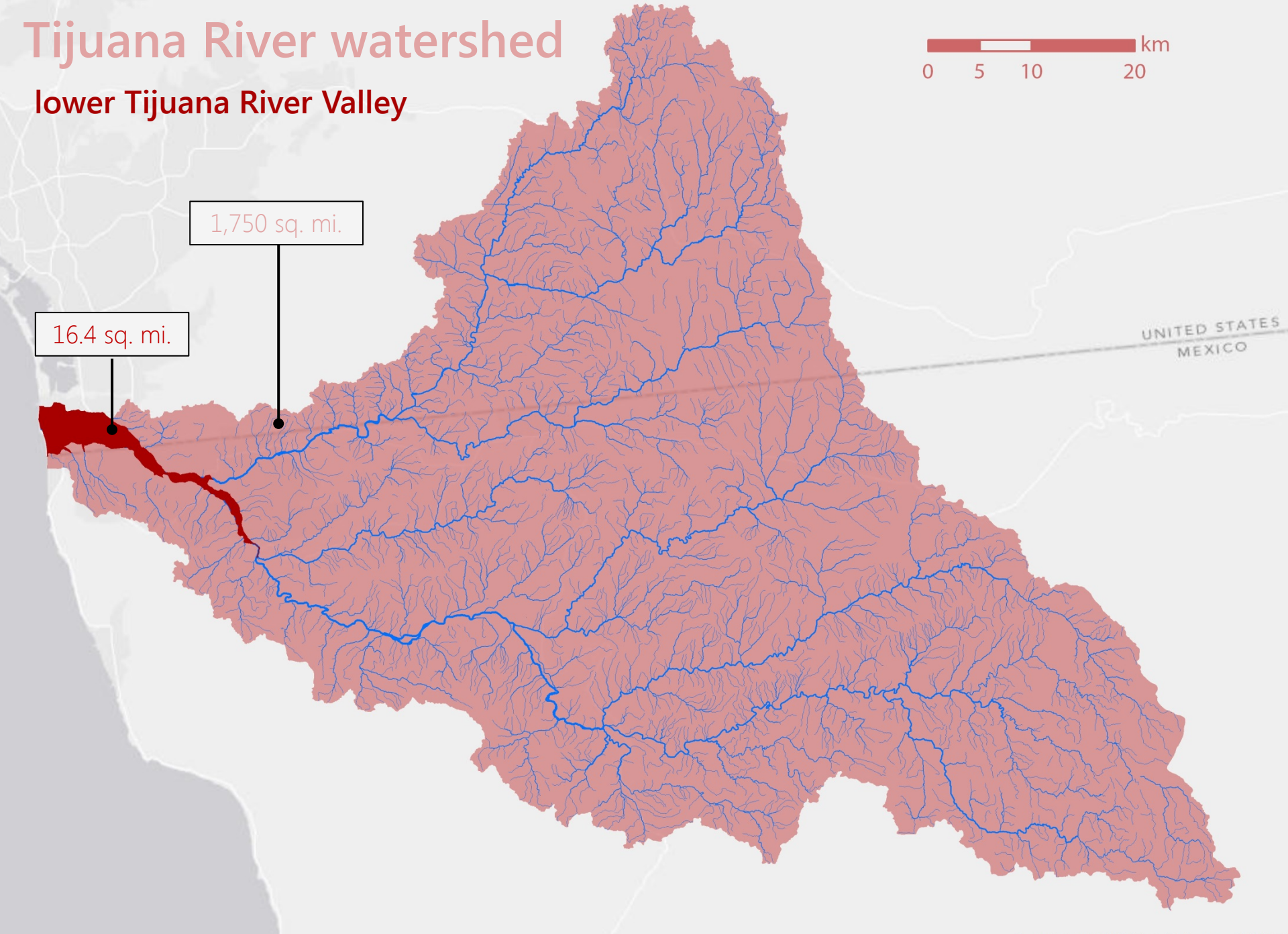
Streams and estuaries reconstructed

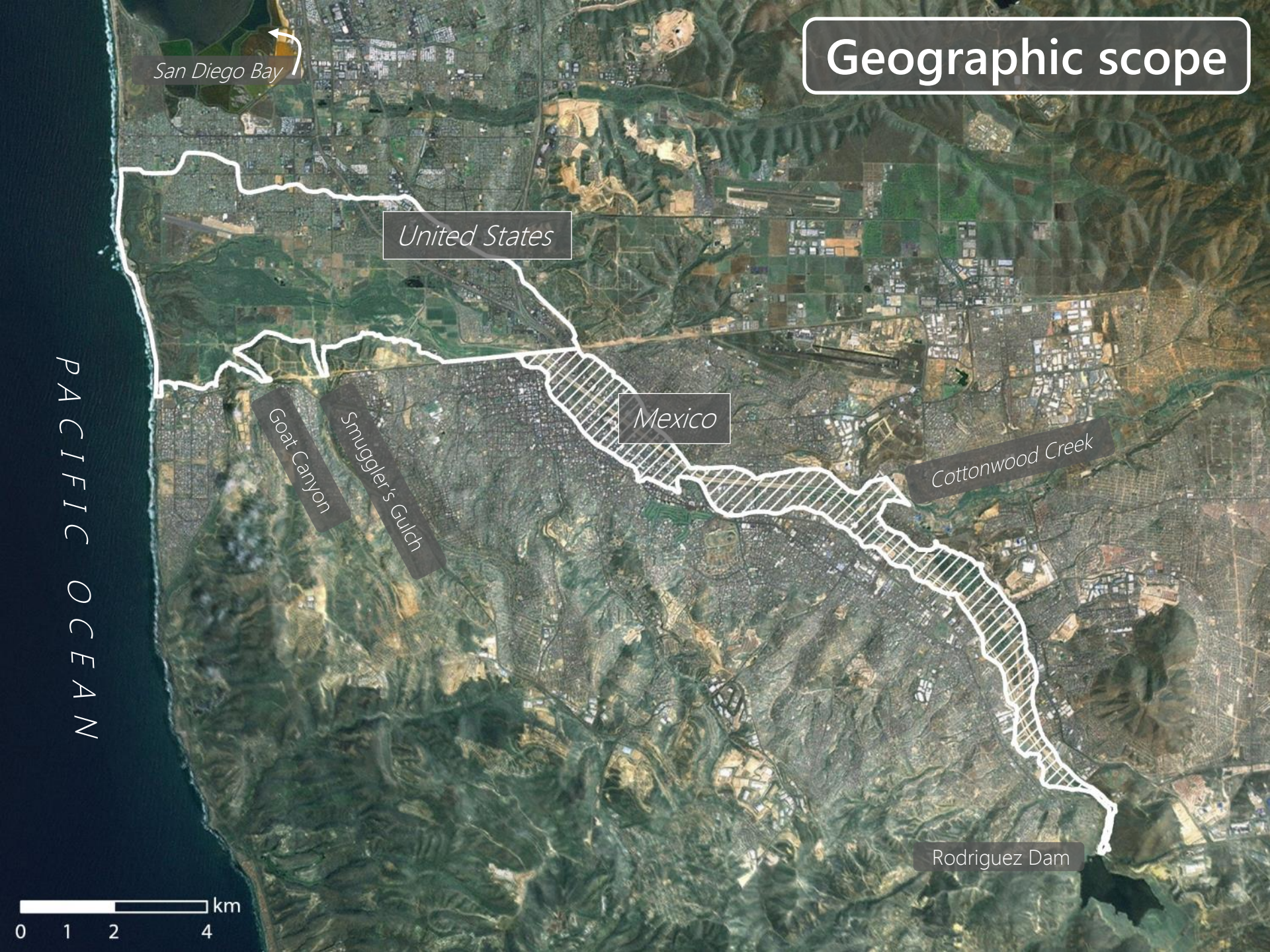
(*Winchuk*)



Tijuana River watershed

lower Tijuana River Valley

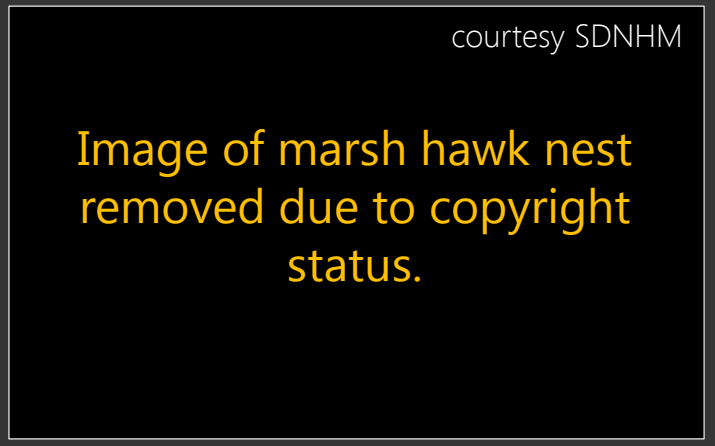



Geographic scope
San Diego Bay
United States
Mexico
Goat Canyon
Smuggler's Gulch
Cottonwood Creek
Rodriguez Dam
PACIFIC OCEAN
km
0 1 2 4

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



courtesy San Diego History Center

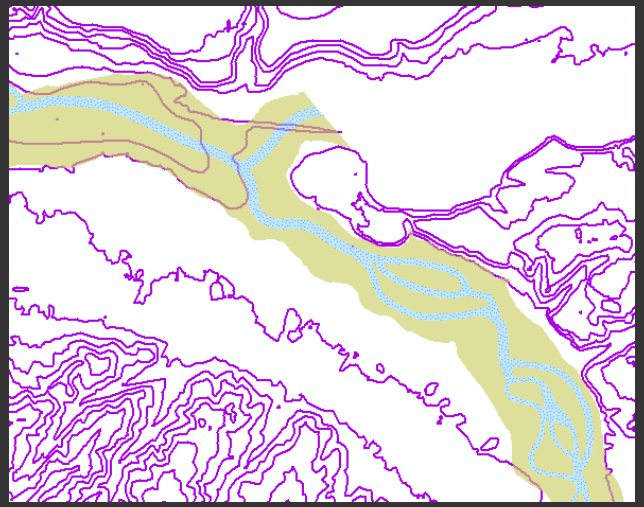
courtesy WRCA

Methods

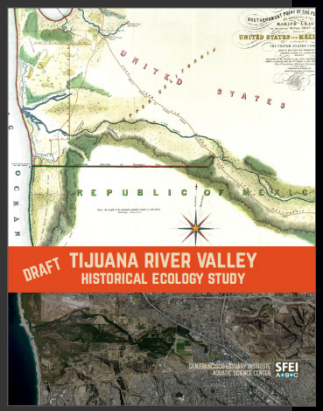
Collect archival data

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.

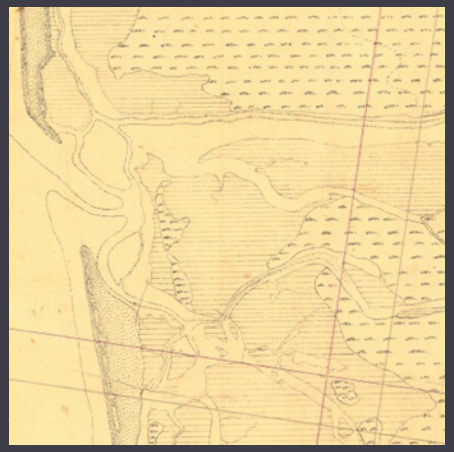
Image removed due to copyright status.

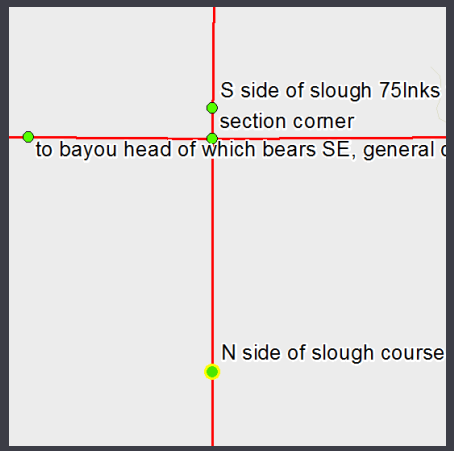
Photographs

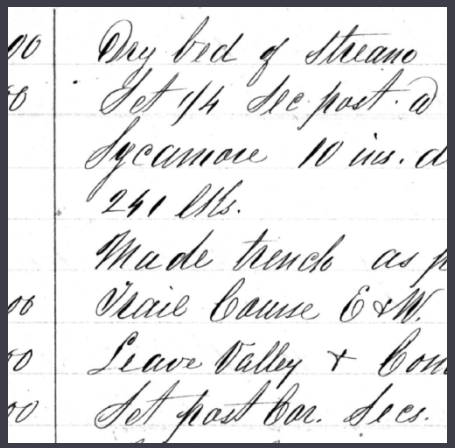
> 200 landscape photos
67 mosaicked aerials

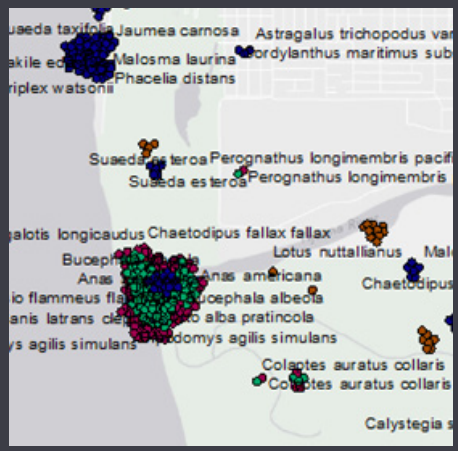
Maps

~180 maps
***45** georeferenced*





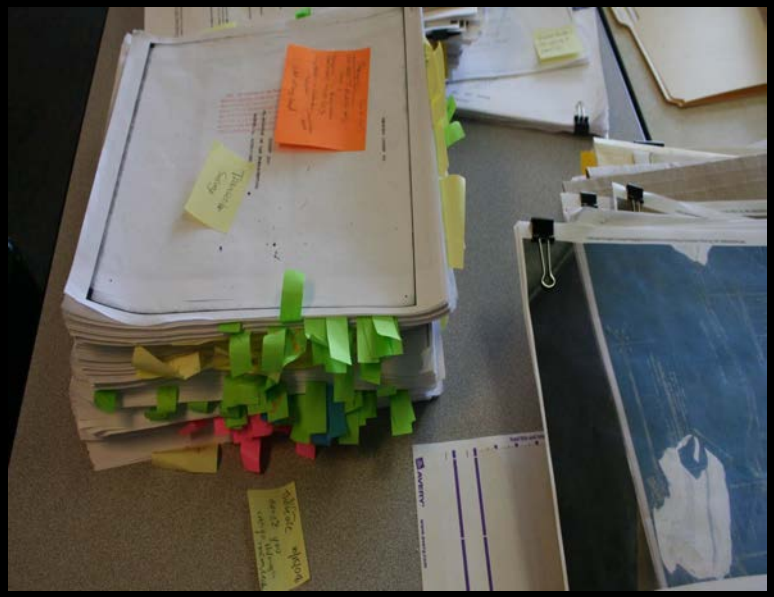




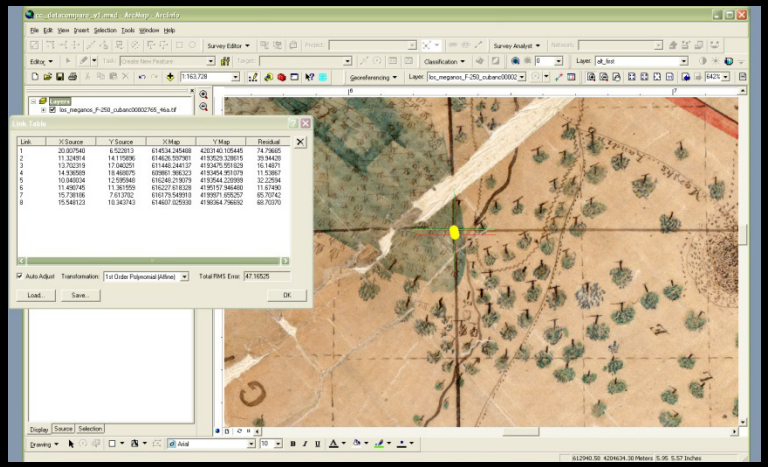
Texts

~ 400 textual documents
***246** pages transcribed*

Data compilation

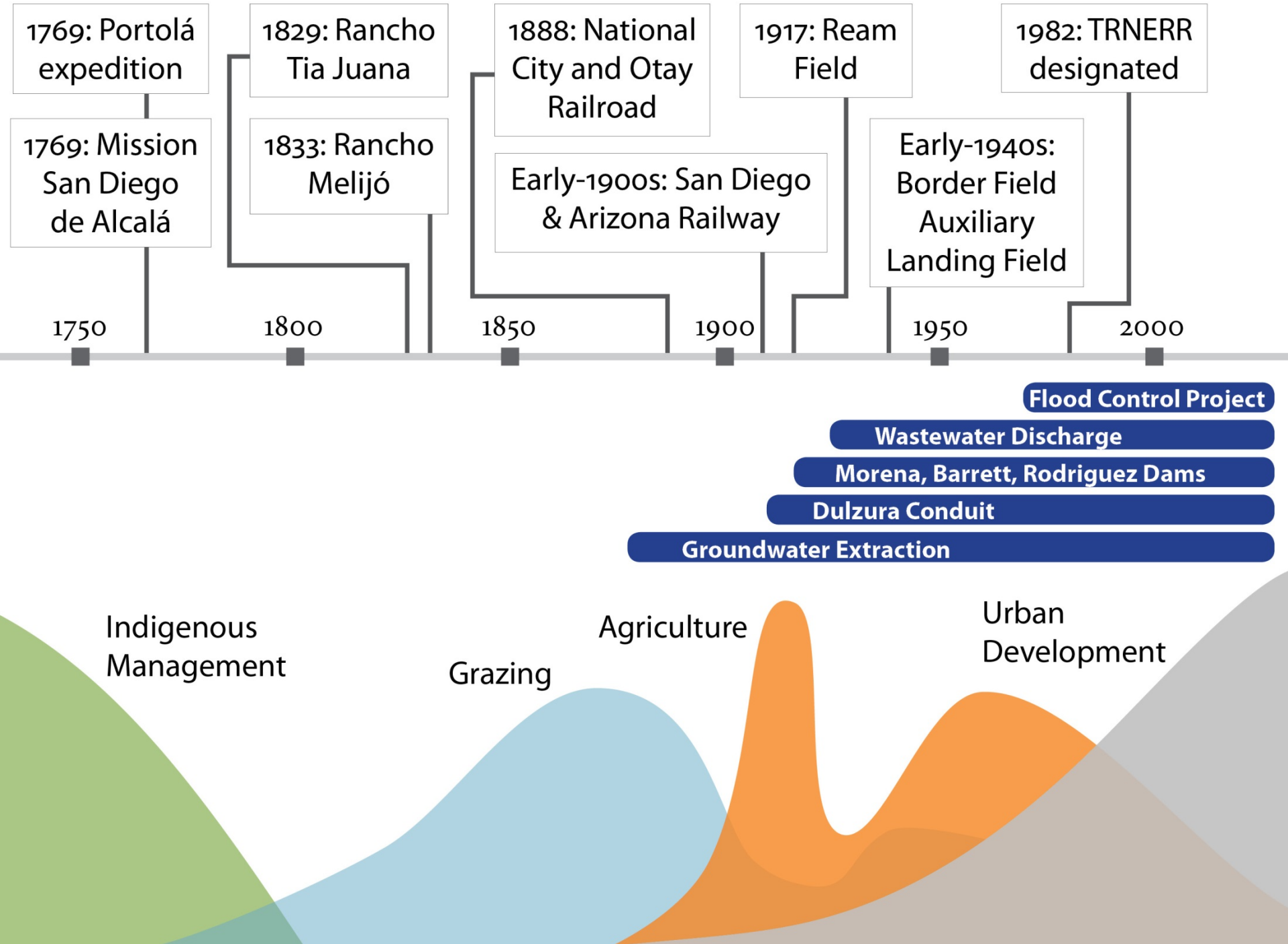


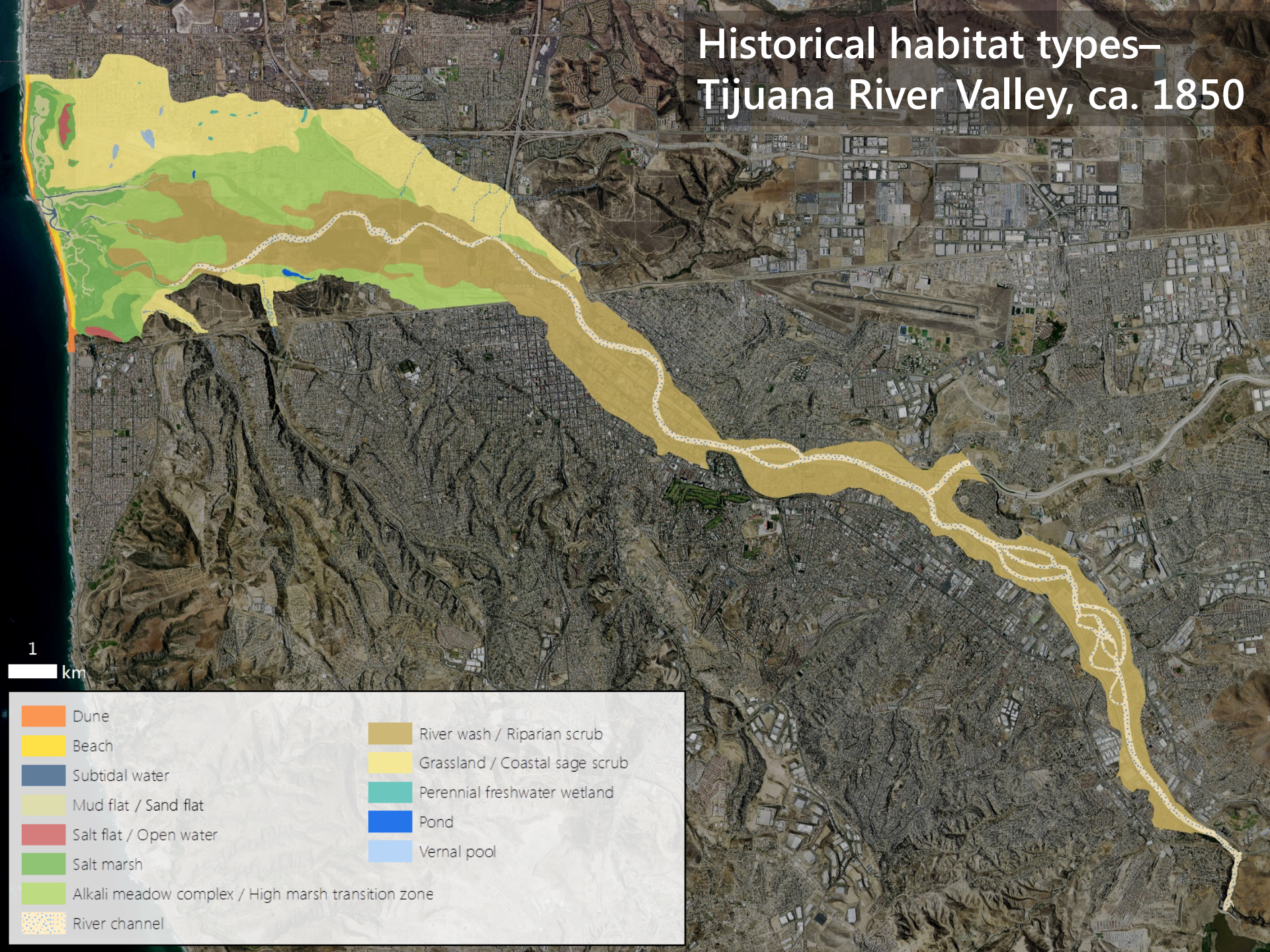
annotate, translate, transcribe

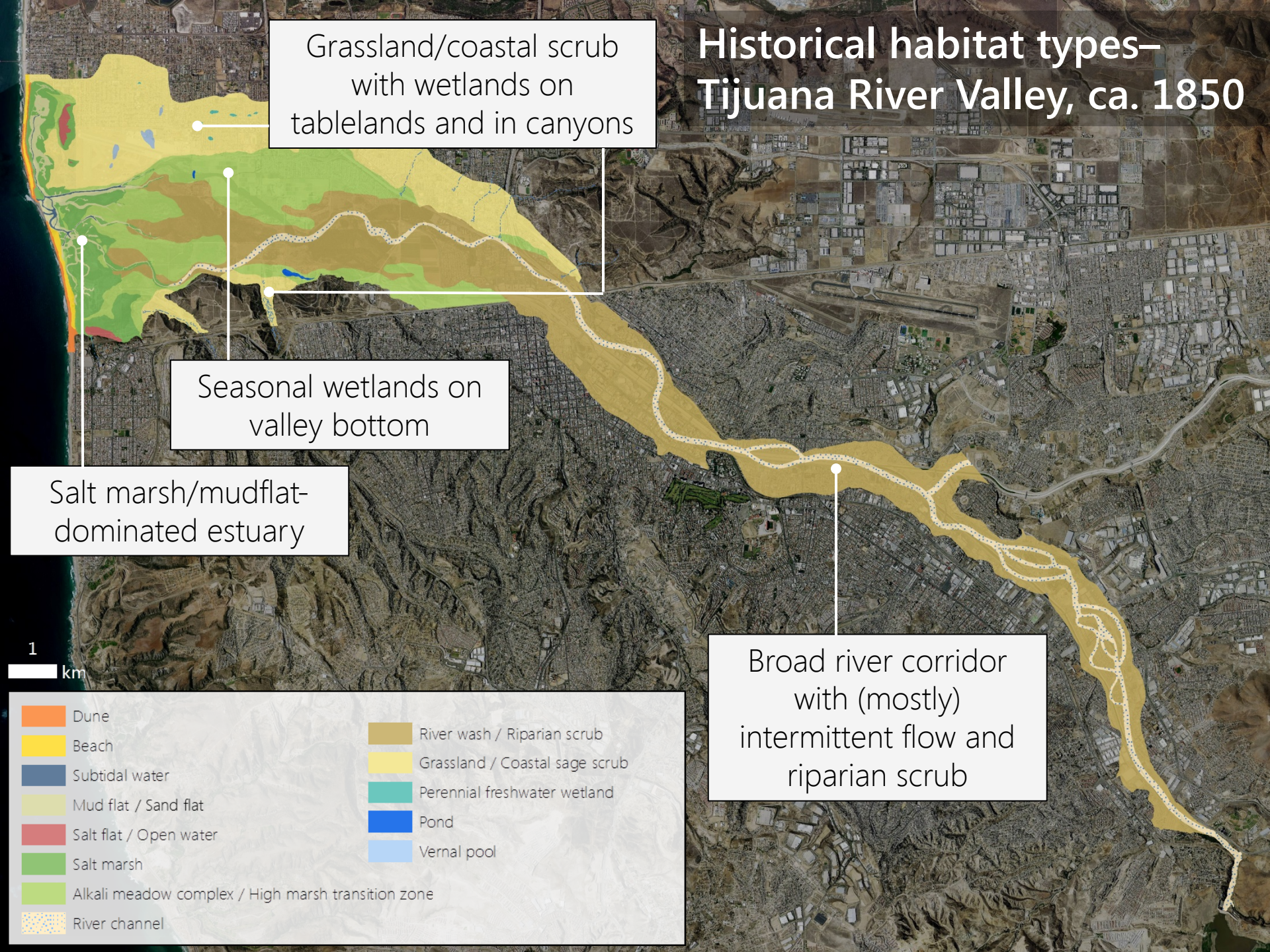


georeference, rectify, mosaic

sort, organize, prioritize


1769: Portolá expedition
1769: Mission San Diego de Alcalá
1829: Rancho Tia Juana
1833: Rancho Melijó
1888: National City and Otay Railroad
Early-1900s: San Diego & Arizona Railway
1917: Ream Field
Early-1940s: Border Field Auxiliary Landing Field
1982: TRNERR designated
1750
1800
1850
1900
1950
2000
Flood Control Project
Wastewater Discharge
Morena, Barrett, Rodriguez Dams
Dulzura Conduit
Groundwater Extraction
Indigenous Management
Grazing
Agriculture
Urban Development


Historical habitat types–
Tijuana River Valley, ca. 1850
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

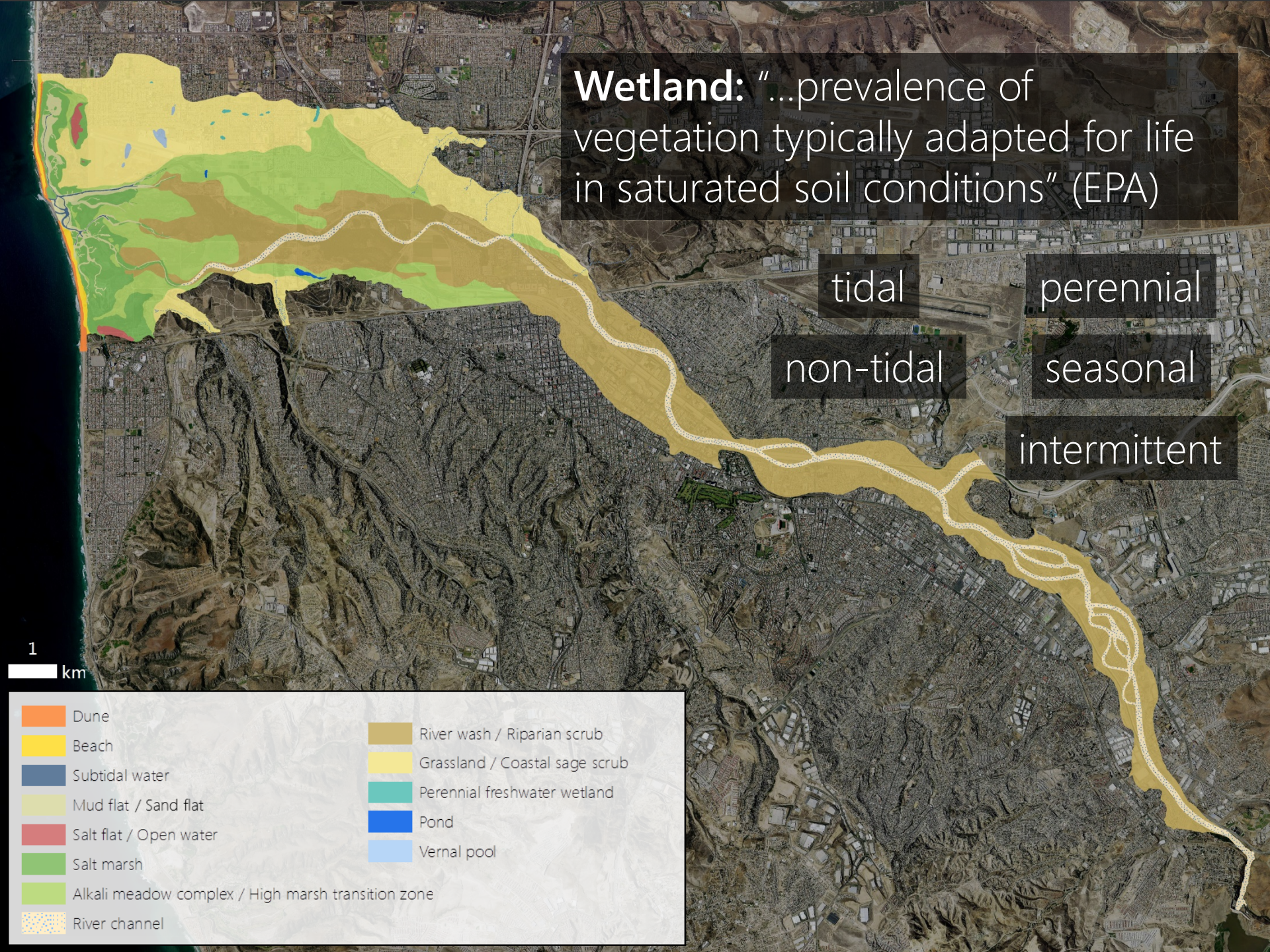

Historical habitat types–
Tijuana River Valley, ca. 1850
Grassland/coastal scrub with wetlands on tablelands and in canyons
Seasonal wetlands on valley bottom
Salt marsh/mudflat-dominated estuary
Broad river corridor with (mostly) intermittent flow and riparian scrub
1
km
Dune
Beach
Subtidal water
Mud 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

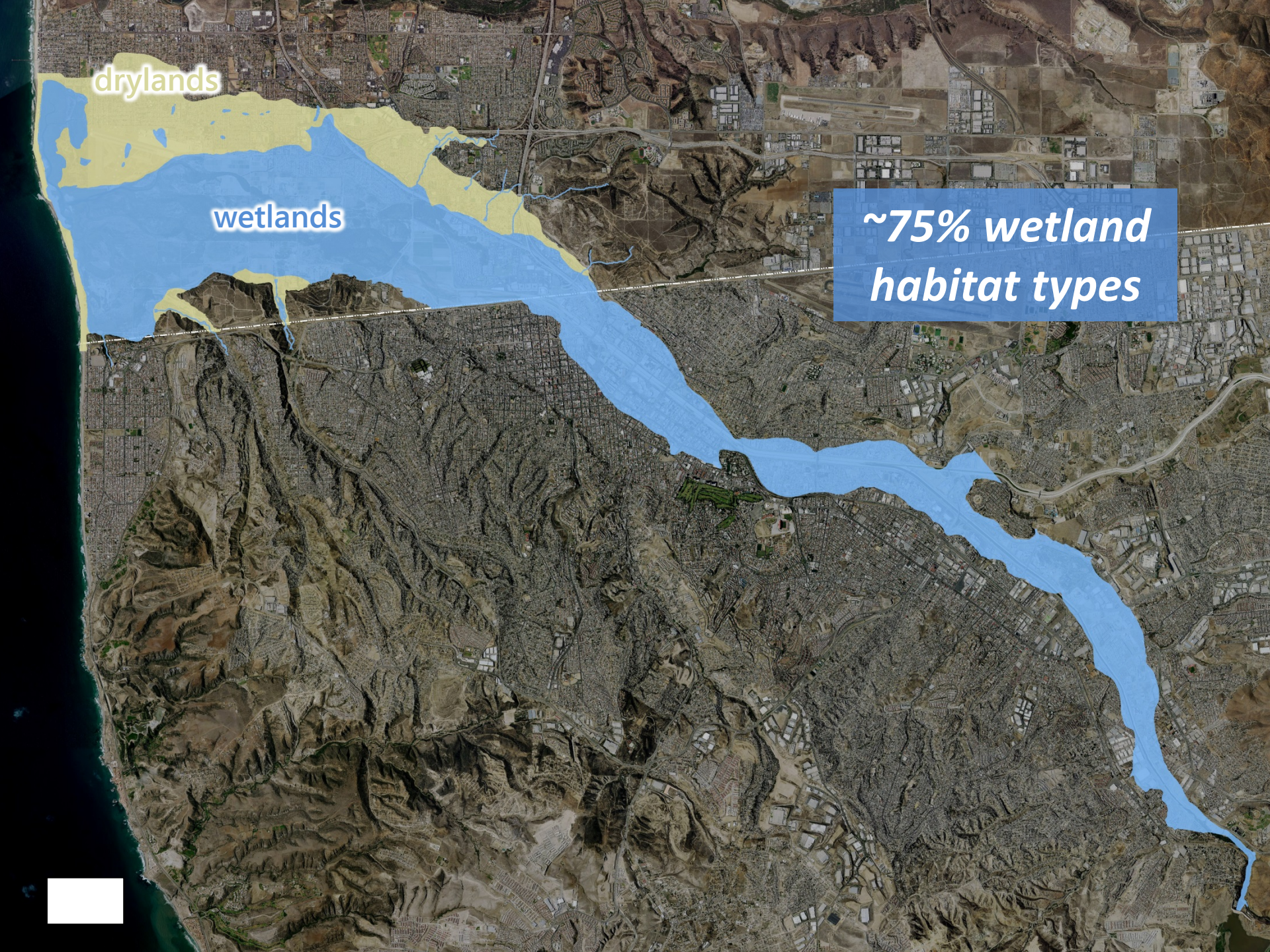
Key messages for today

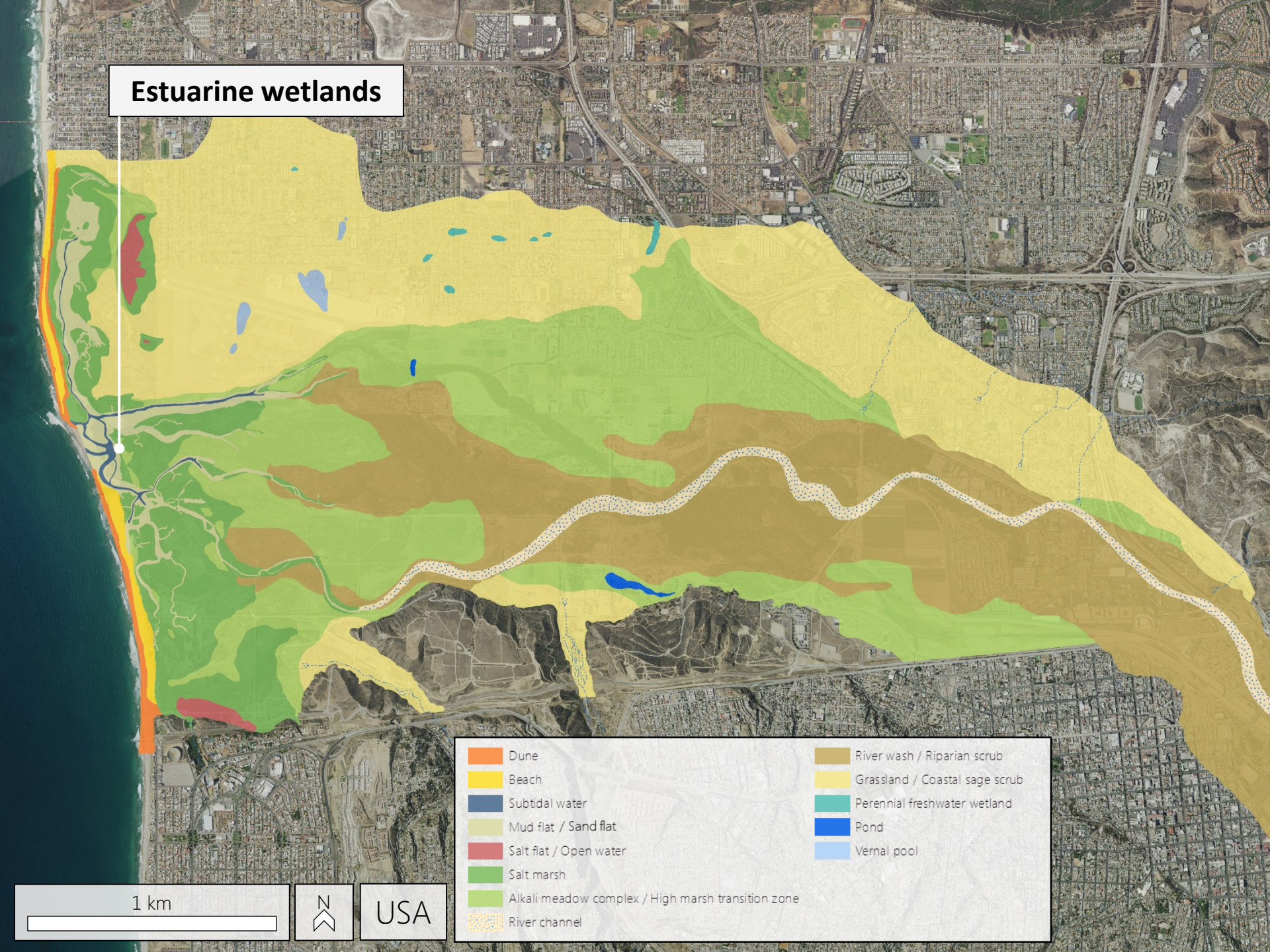
1. The valley supported a diverse array of wetlands in a dry climate.

2. Floods maintained a large and dynamic river corridor.

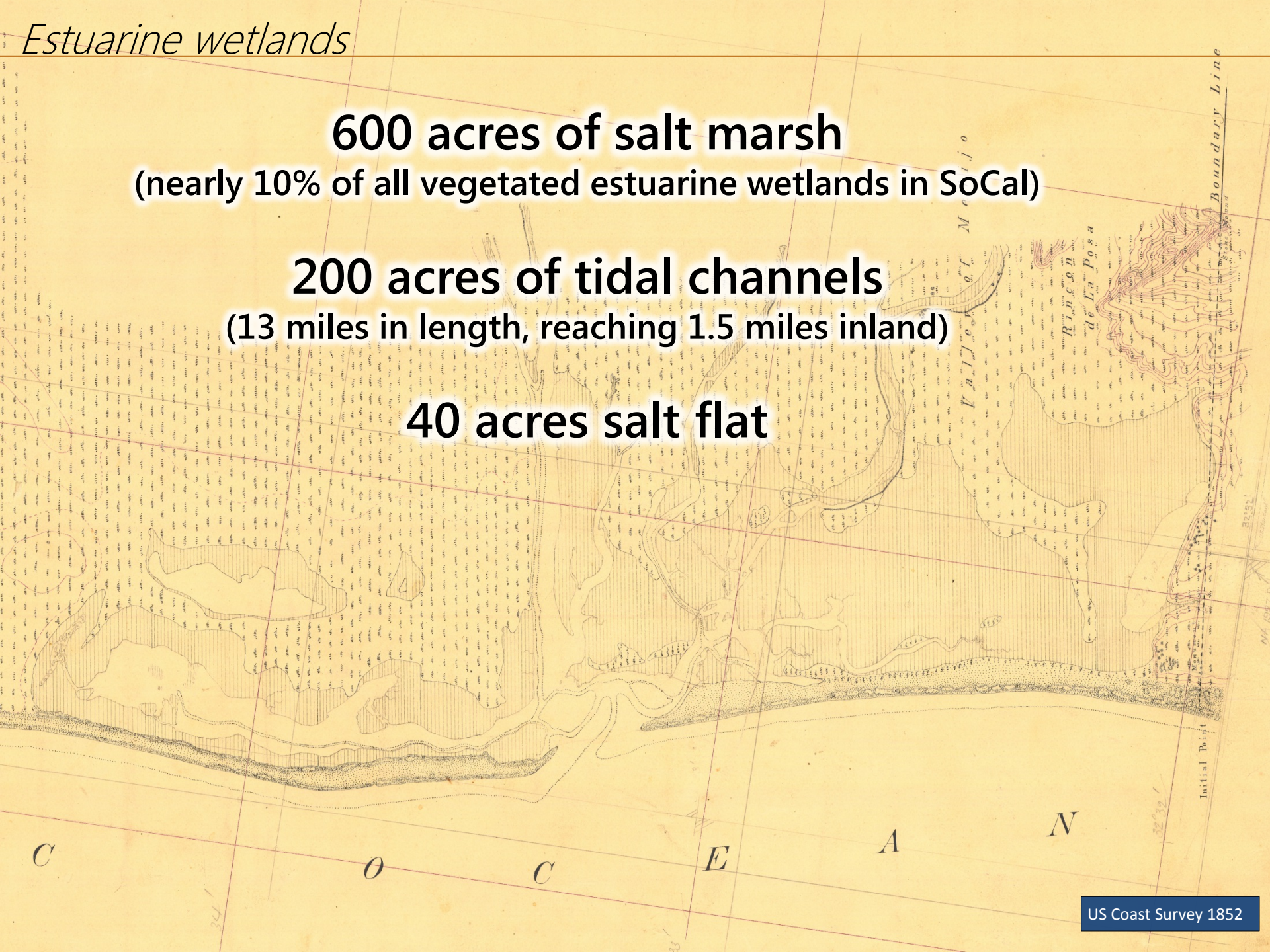
3. The valley has undergone significant changes in habitat distribution and extent.


Wetland: "…prevalence of vegetation typically adapted for life in saturated soil conditions" (EPA)
tidal
non-tidal
perennial
seasonal
intermittent
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


drylands
wetlands
~75% wetland habitat types


Estuarine wetlands
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
1 km
N
USA

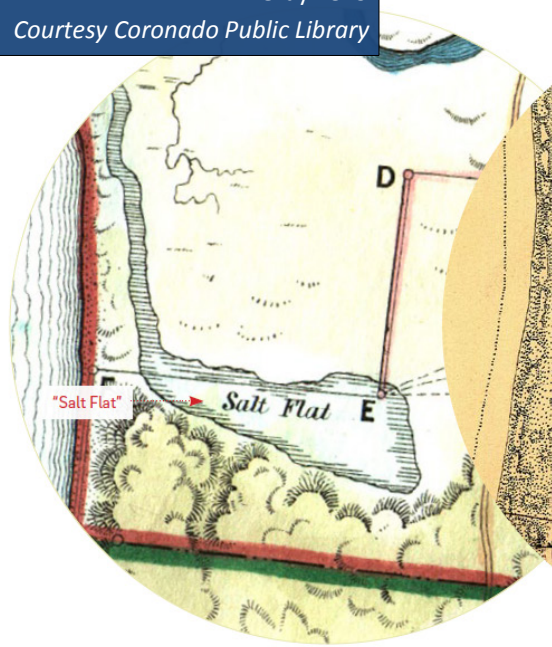
Estuarine wetlands



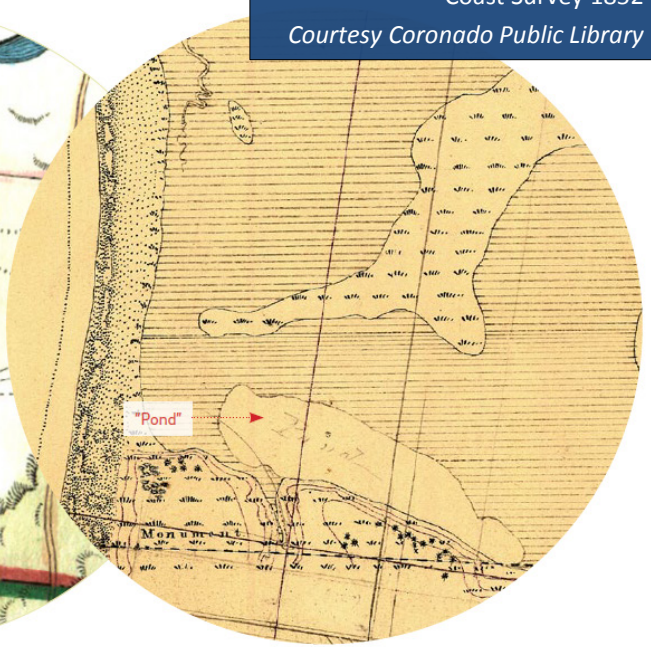
Estuarine wetlands

Gray 1849
Courtesy Coronado Public Library

Gray 1849
Courtesy Coronado Public Library



Coast Survey 1852
Courtesy Coronado Public Library

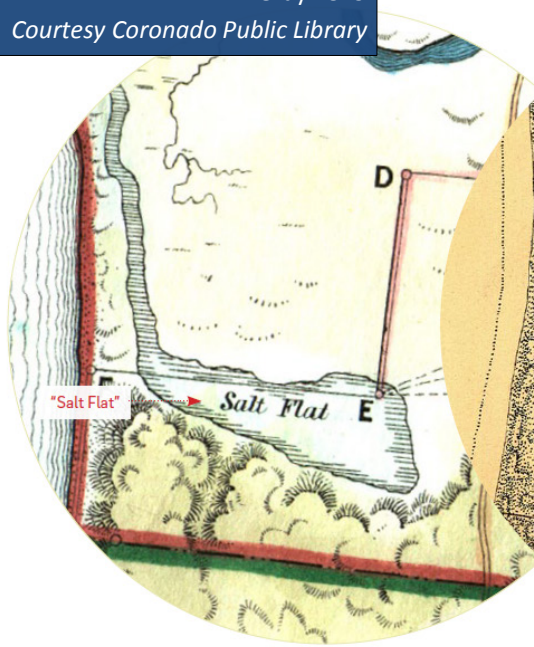


US Coast Survey 1852

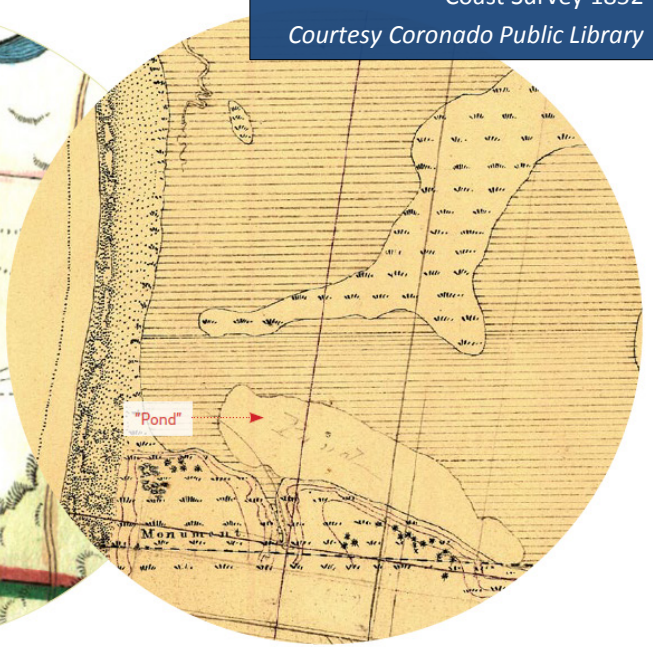
Estuarine wetlands

Gray 1849
Courtesy Coronado Public Library

Gray 1849
Courtesy Coronado Public Library



Coast Survey 1852
Courtesy Coronado Public Library



California Least Tern

Rinus Baak, USFWS

Snowy Plover

Larry D. Brown (larrydbrown.com)

Belding's Savannah Sparrow

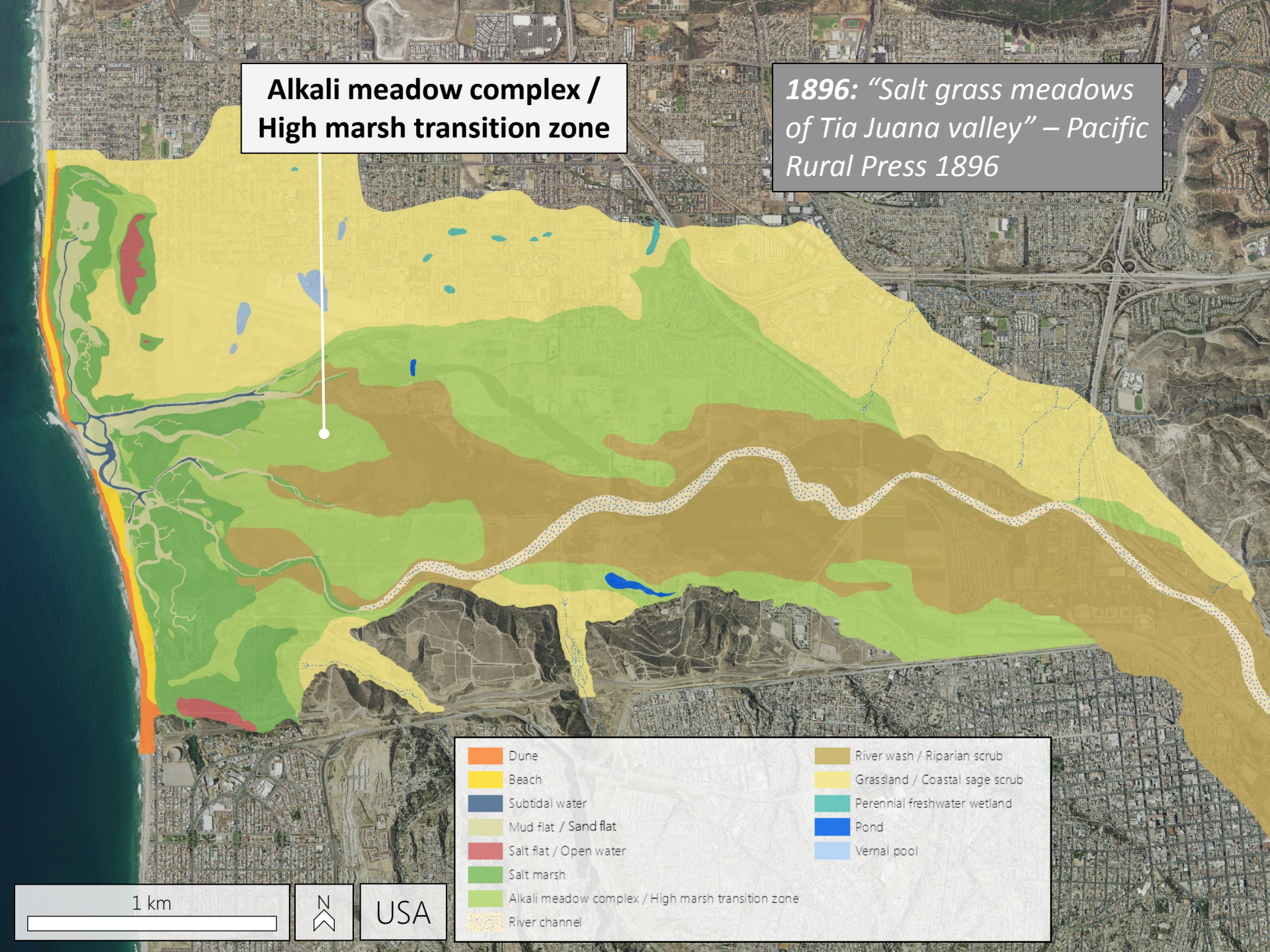
San Elijo Lagoon Conservancy

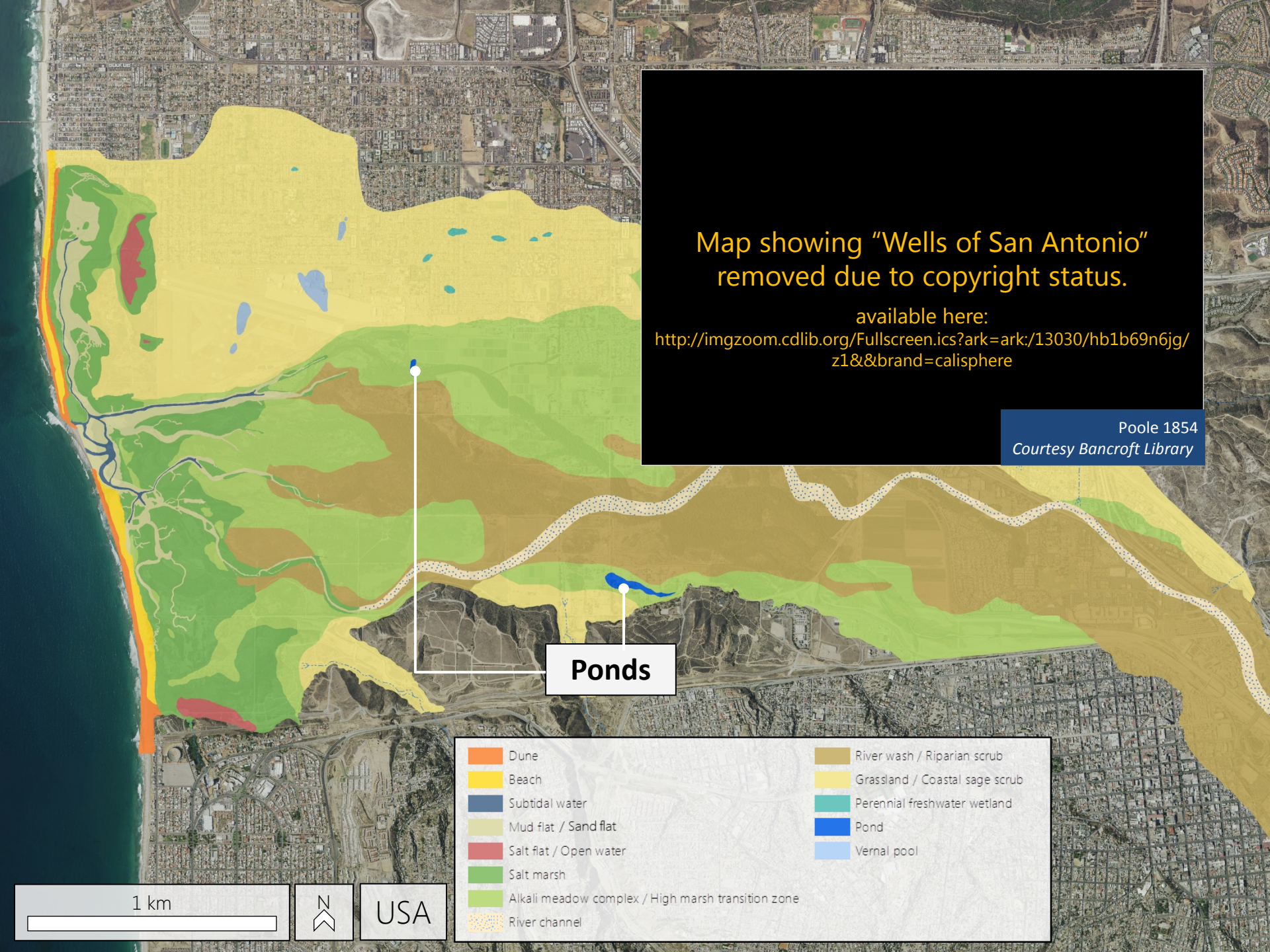
kelp forests

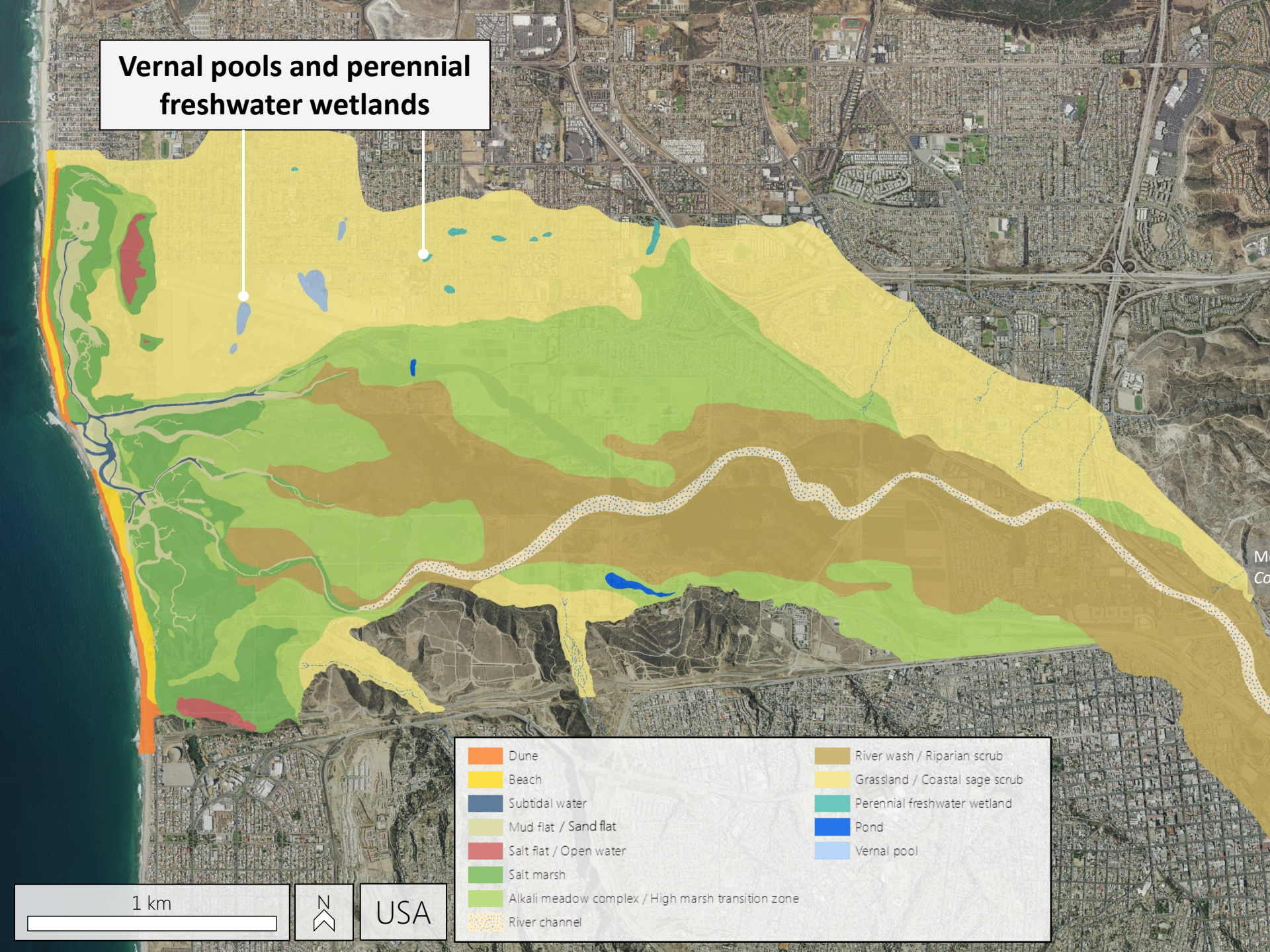
holdfasts

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
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
1 km
N
USA


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
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
1 km
N
USA


Vernal pools and perennial freshwater wetlands
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
1 km
N
USA

Vernal pools

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

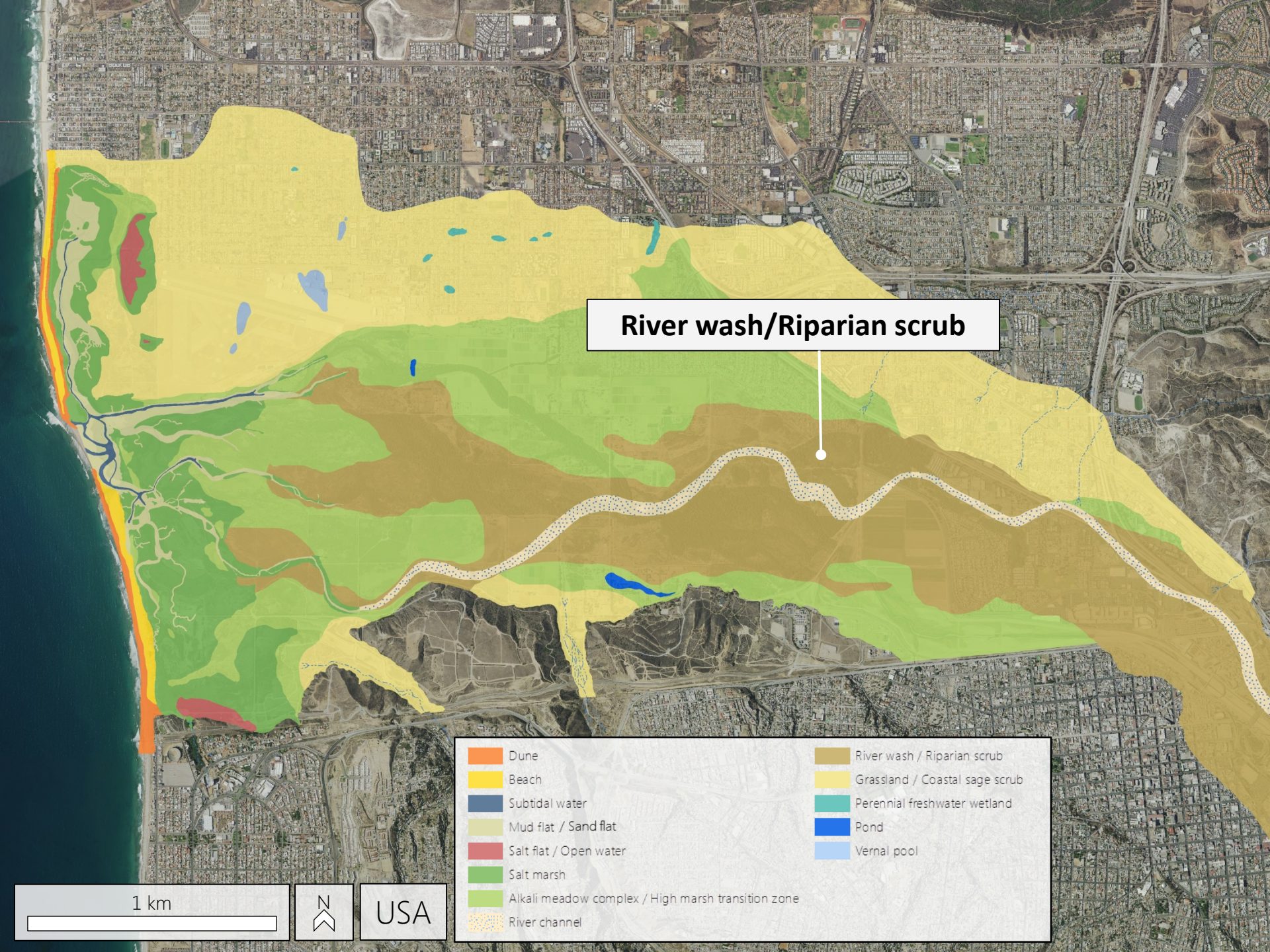
San Diego County 1928

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)

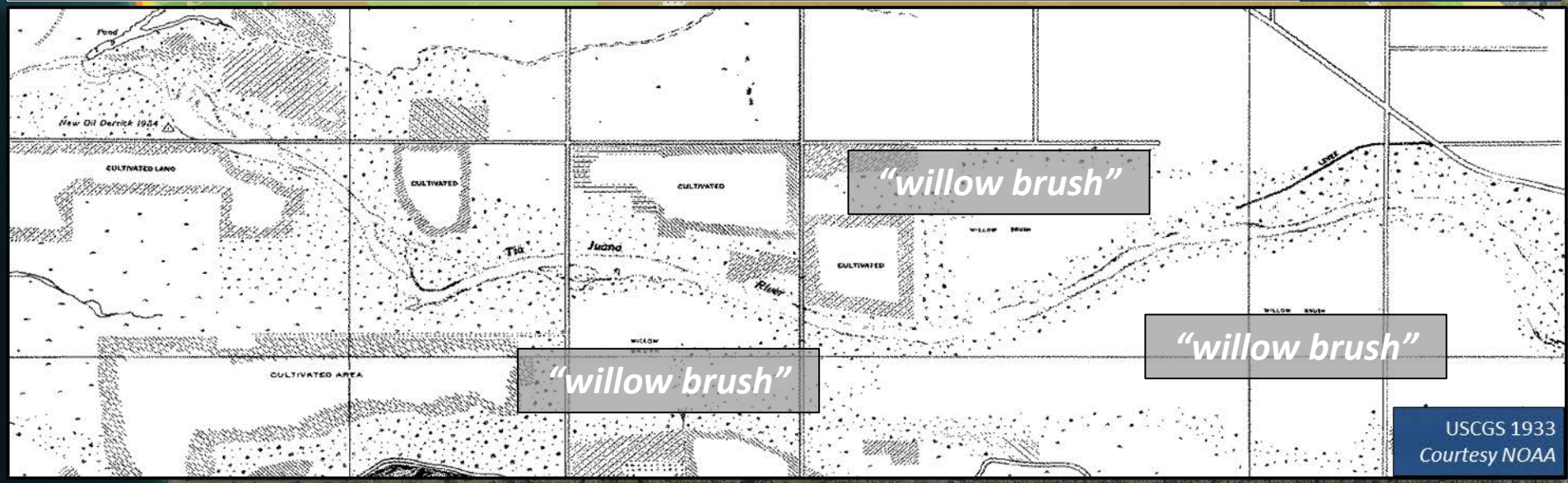
Mendenhall 1905
courtesy of USGS


River wash/Riparian scrub
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
1 km
N
USA

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

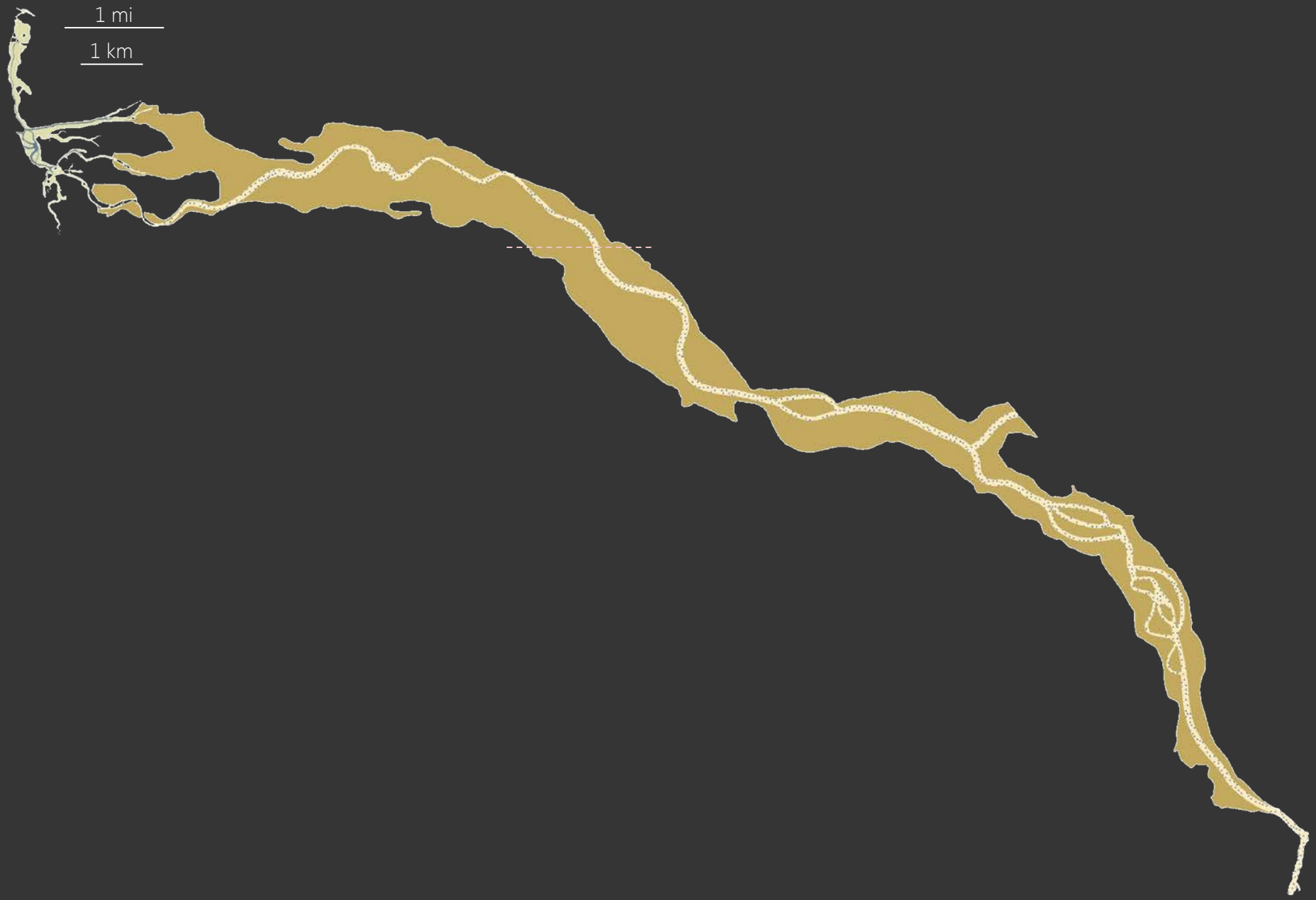
available here:
http://imgzoom.cdlib.org/Fullscreen.ics?ark=ark:/13030/hb6489p09n/z2&order=3&brand=calisphere

USDC ca. 1840
Courtesy Bancroft Library

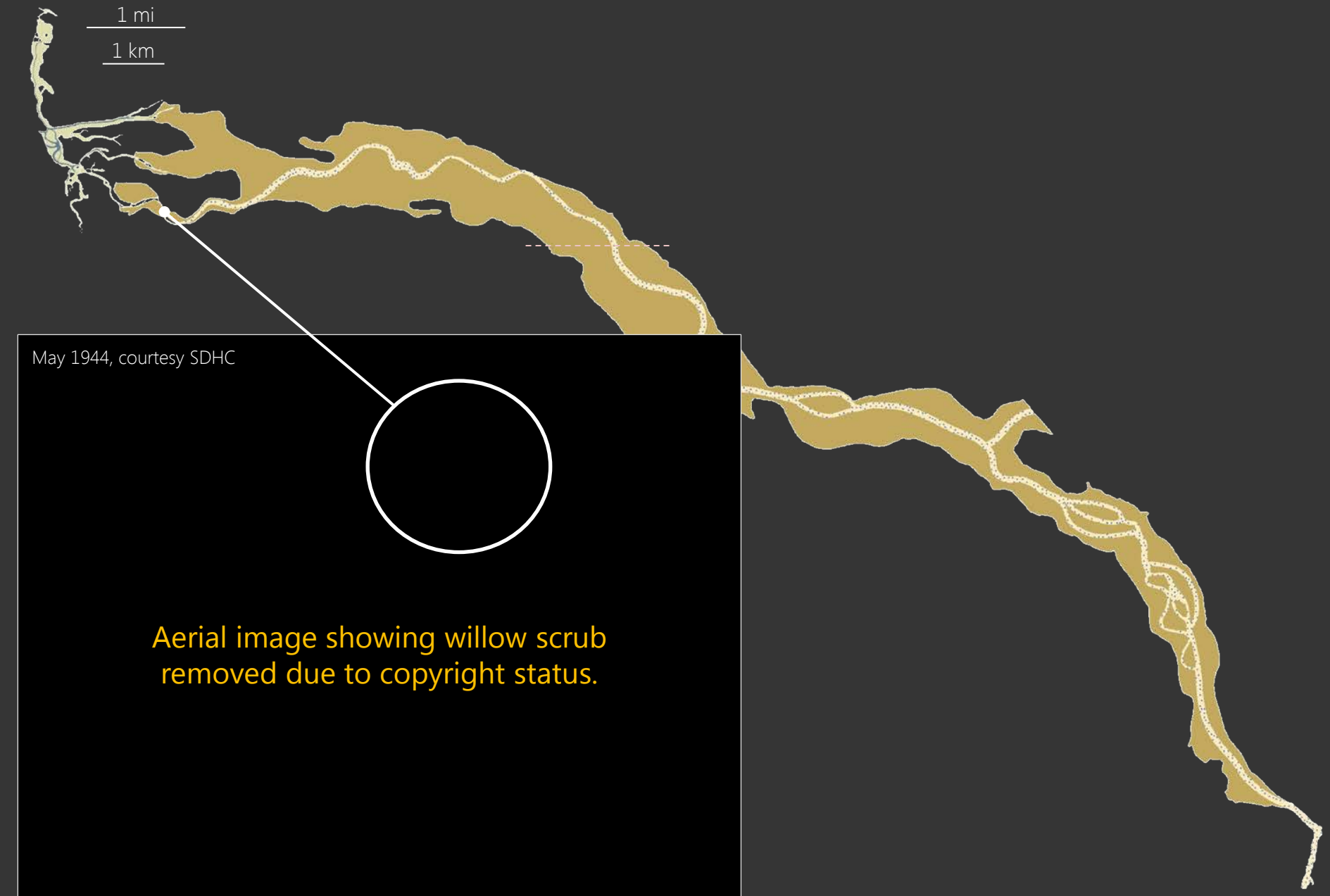


USCGS 1933
Courtesy NOAA

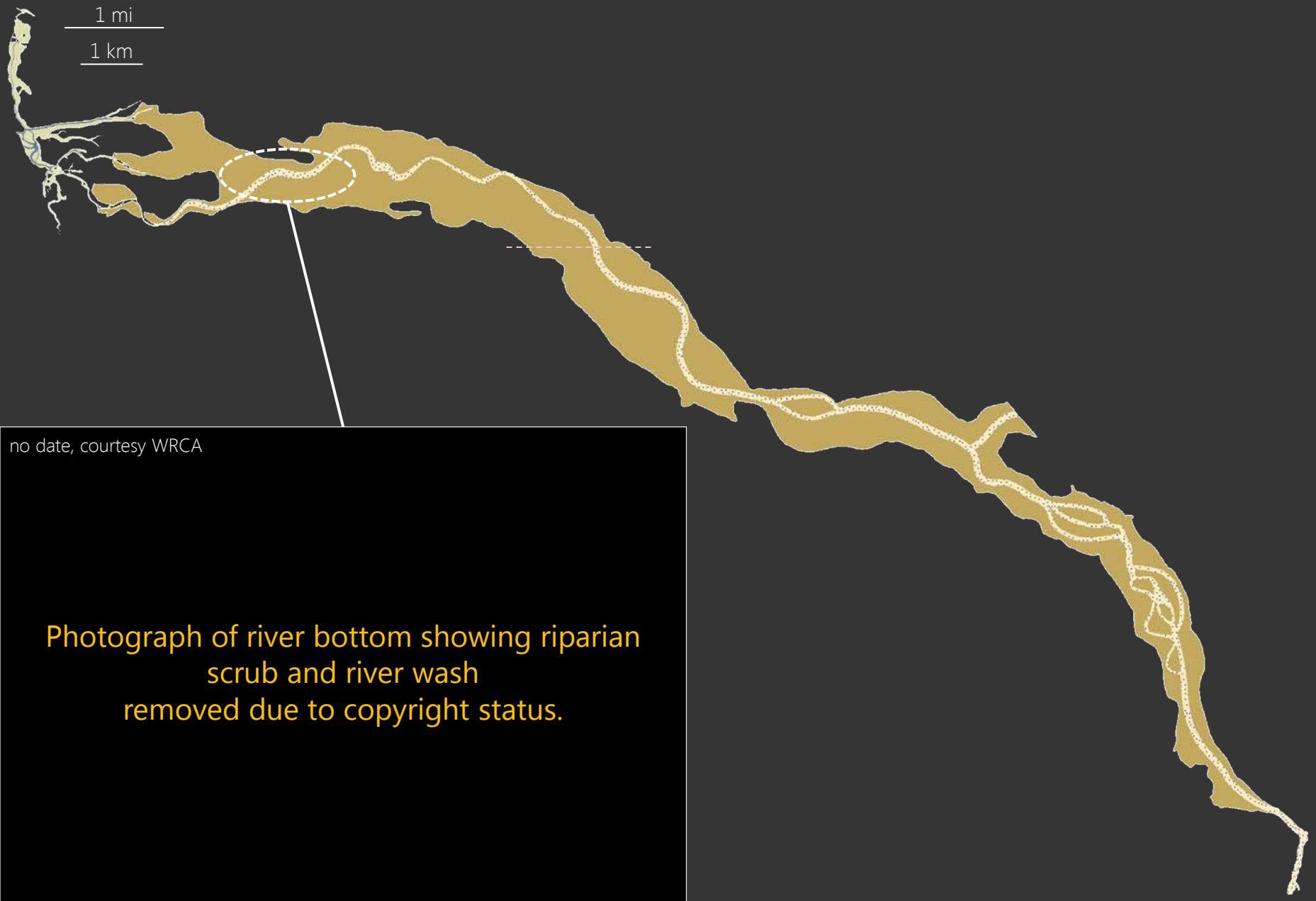
River wash / riparian scrub



River wash / riparian scrub



River wash / riparian scrub



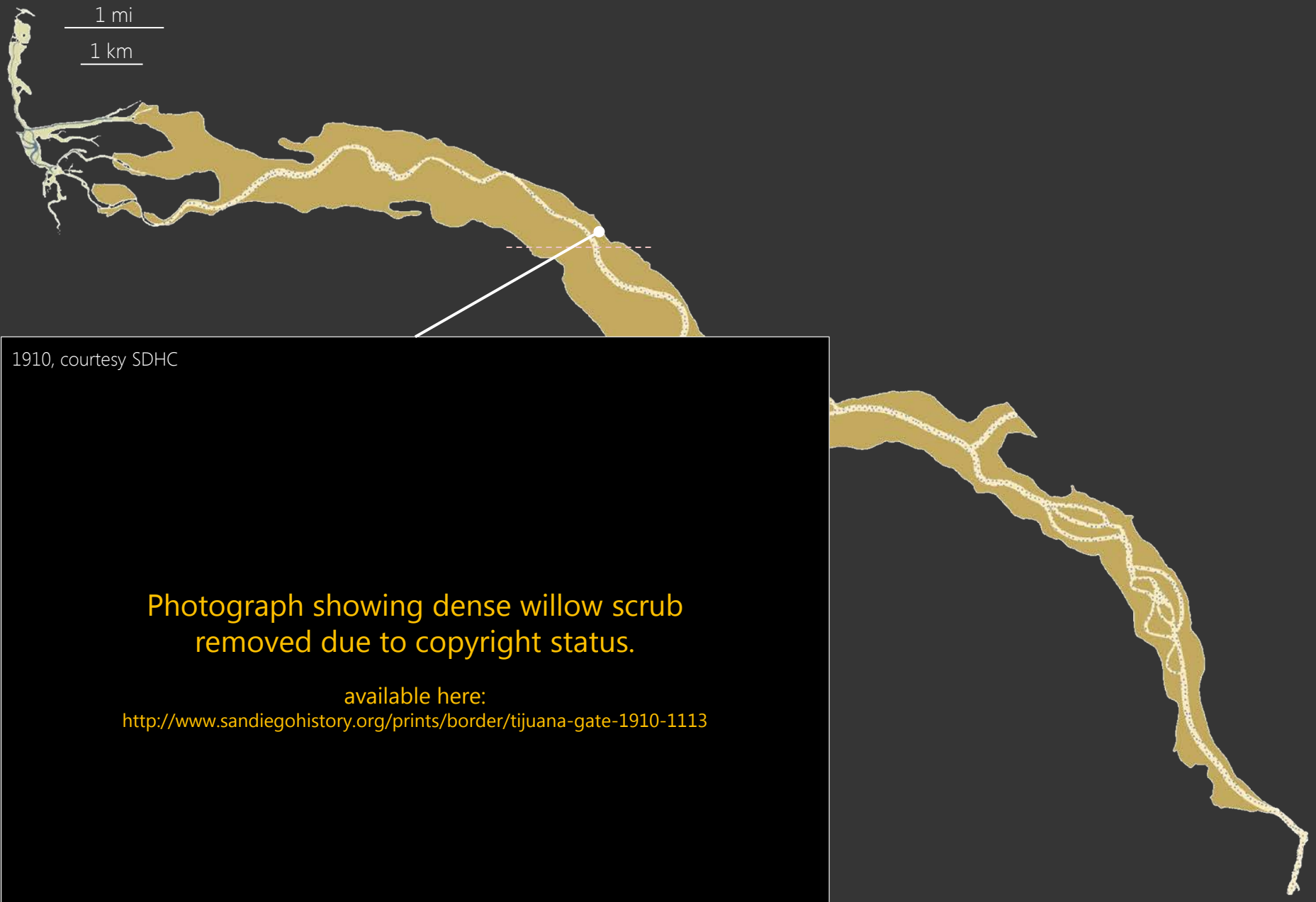
no date, courtesy WRCA

Photograph of river bottom showing riparian scrub and river wash
removed due to copyright status.

River wash / riparian scrub

Unknown 1903, courtesy Special Collections & Archives, UCSD Library

River wash / riparian scrub



1910, courtesy SDHC

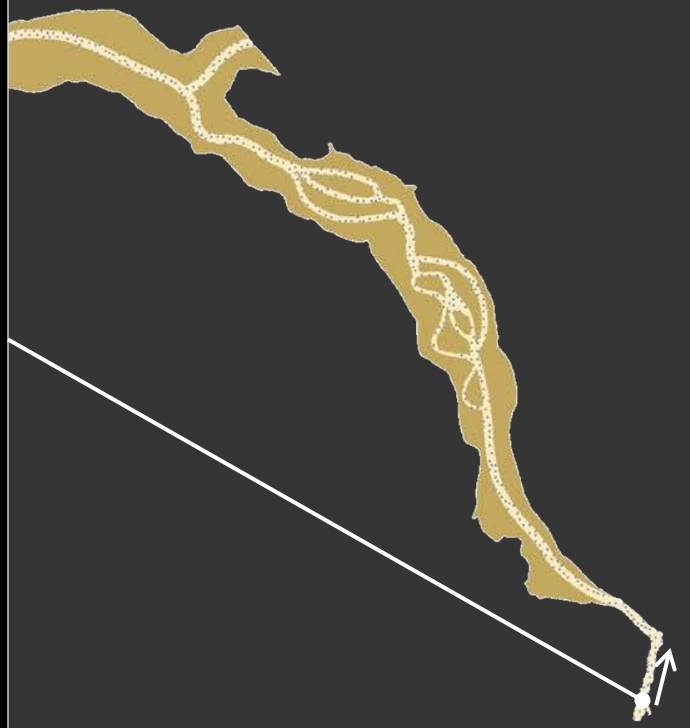
Photograph showing dense willow scrub removed due to copyright status.

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.



River wash / riparian scrub

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

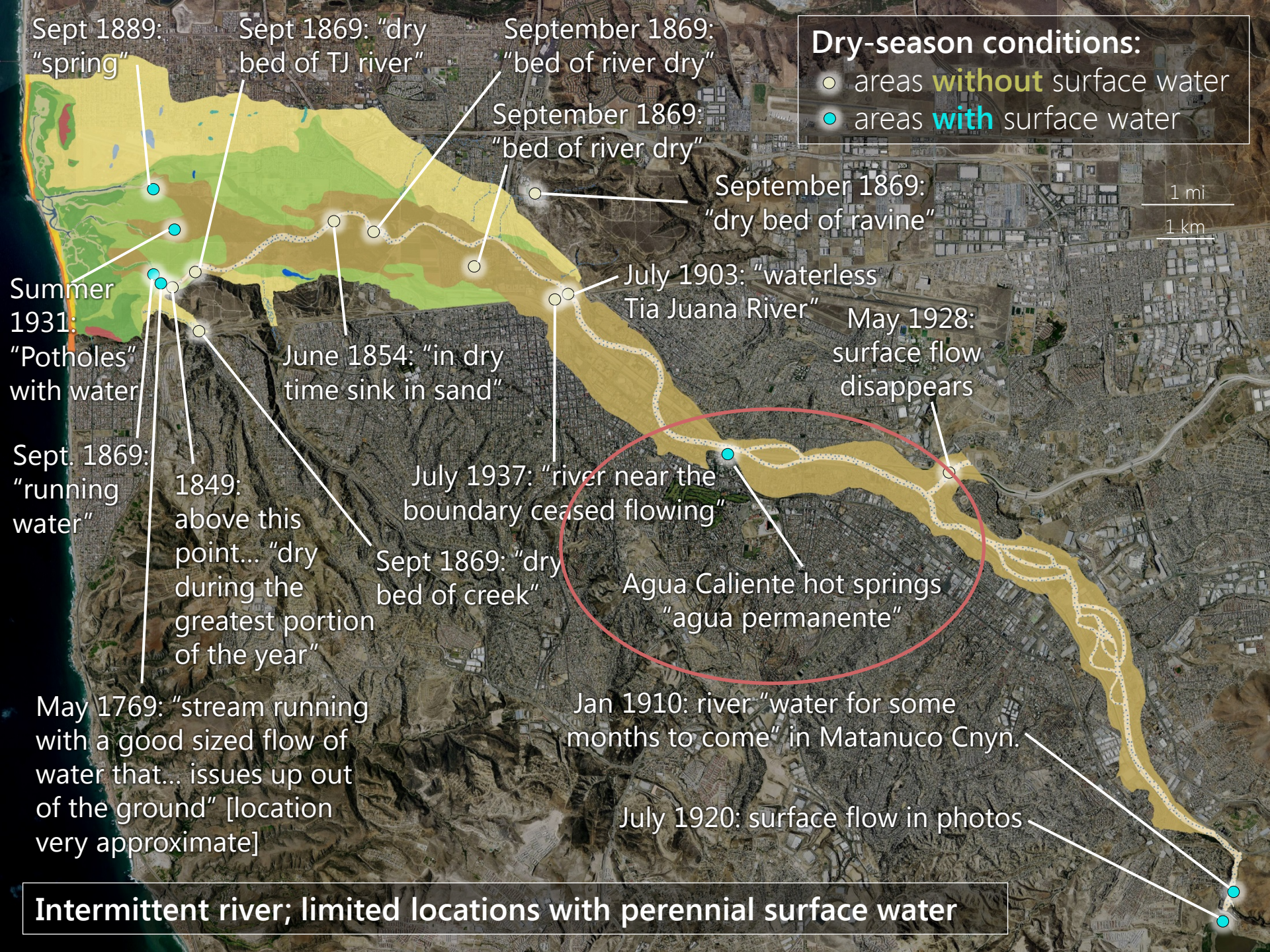
Common Name	Latin Name
Trees	
sandbar willow	*Salix exigua*
Goodding's willow	*S. gooddingii*
red willow	*S. laevigata*
arroyo willow	*S. lasiolepis*
cottonwood	*Populus* sp.
California sycamore	*Platanus racemosa*
Shrubs	
mulefat	*Baccharis salicifolia*
black sage	*Salvia mellifera*
white sage	*S. apiana*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

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

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

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

Records from 1849-1949


Dry-season conditions:
areas without surface water
areas with surface water
1 mi
1 km
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
Summer 1931: "Potholes" with water
June 1854: "in dry time sink in sand"
Sept. 1869: "running water"
1849: above this point... "dry during the greatest portion of the year"
July 1937: "river near the boundary ceased flowing"
Sept 1869: "dry bed of creek"
Agua Caliente hot springs "agua permanente"
May 1769: "stream running with a good sized flow of water that... issues up out of the ground" [location very approximate]
Jan 1910: river "water for some months to come" in Matanuco Cnyn.
July 1920: surface flow in photos
Intermittent river; limited locations with perennial surface water

Perennial wetlands within the river corridor

courtesy Archivo Histórico del Agua

Perennial wetlands within the river corridor

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

courtesy Archivo Histórico del Agua

Perennial wetlands within the river corridor

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

courtesy Archivo Histórico del Agua

Perennial wetlands within the river corridor

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

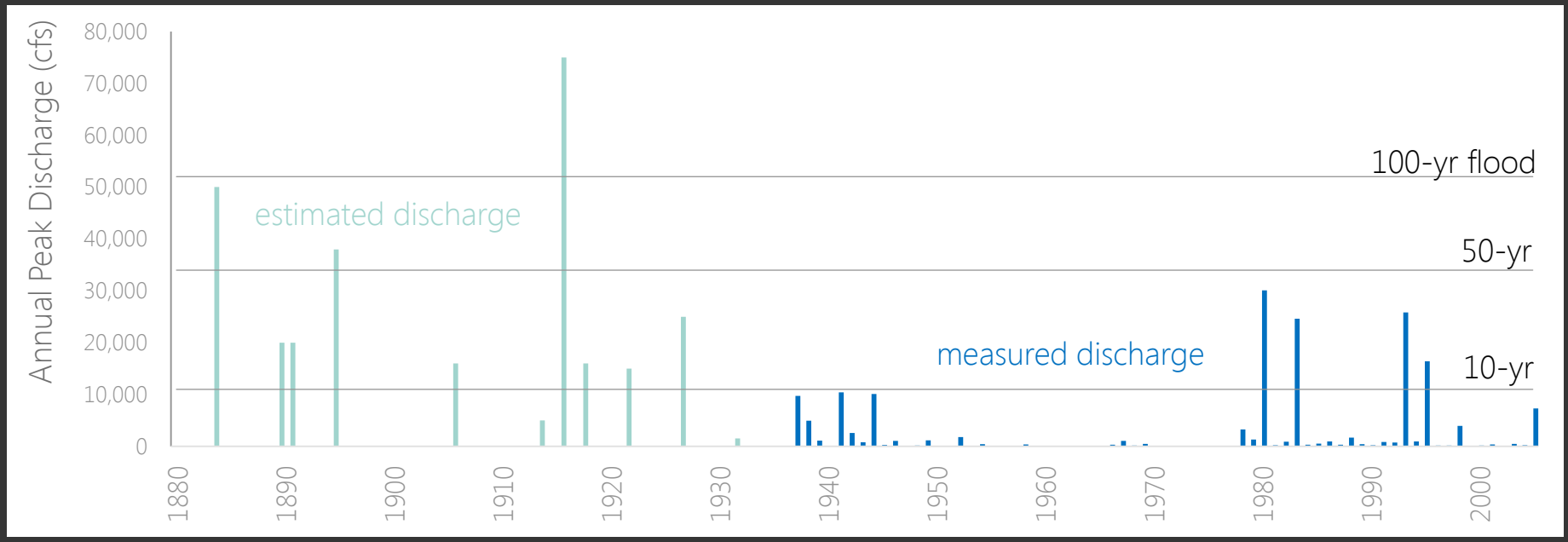
Image of Tijuana River during dry season removed due to copyright status.

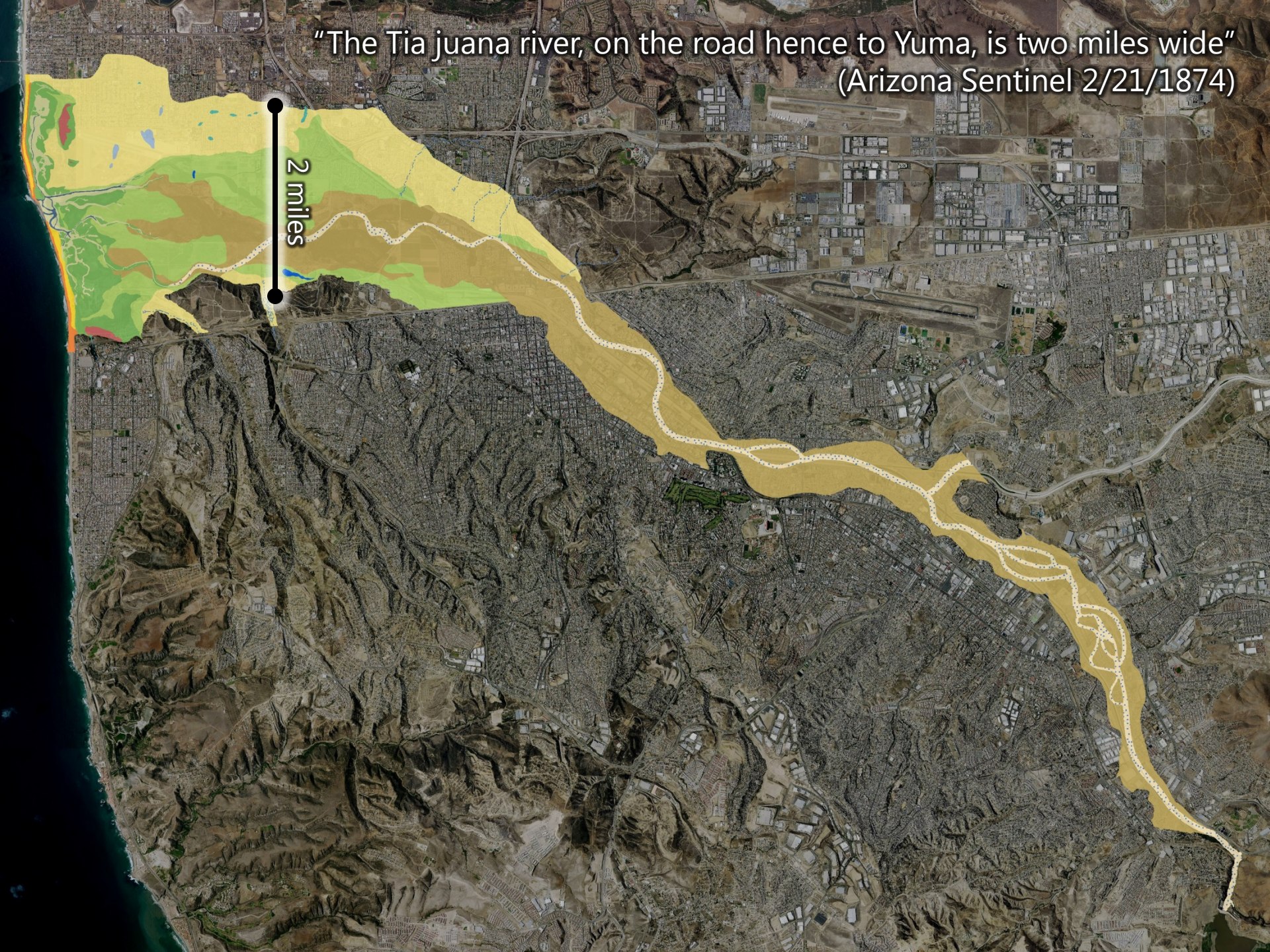
available here:
http://www.sandiegohistory.org/photostore/product/auto-crossing-mexico-border-c-1921-6661-4//

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)
2 miles


"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)

Morris 1916
from USACE 1937

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/

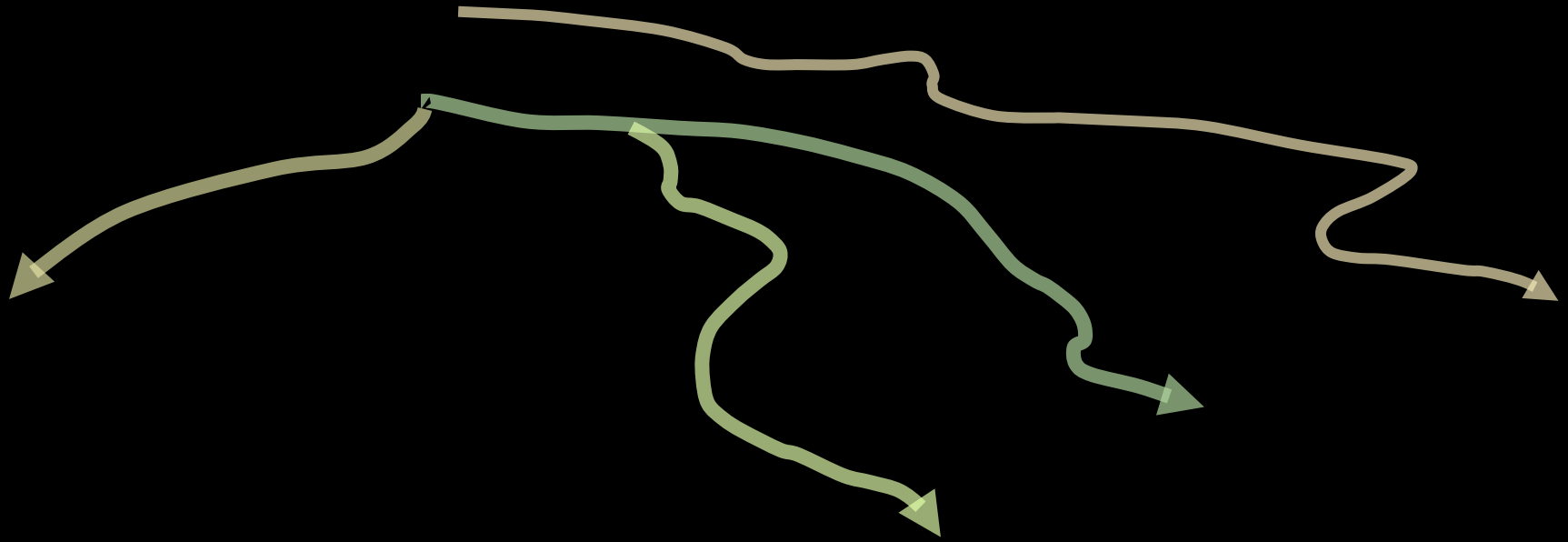
courtesy San Diego History Center

Method 2: **Zip**

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

courtesy Sociedad de Historia de Tijuana

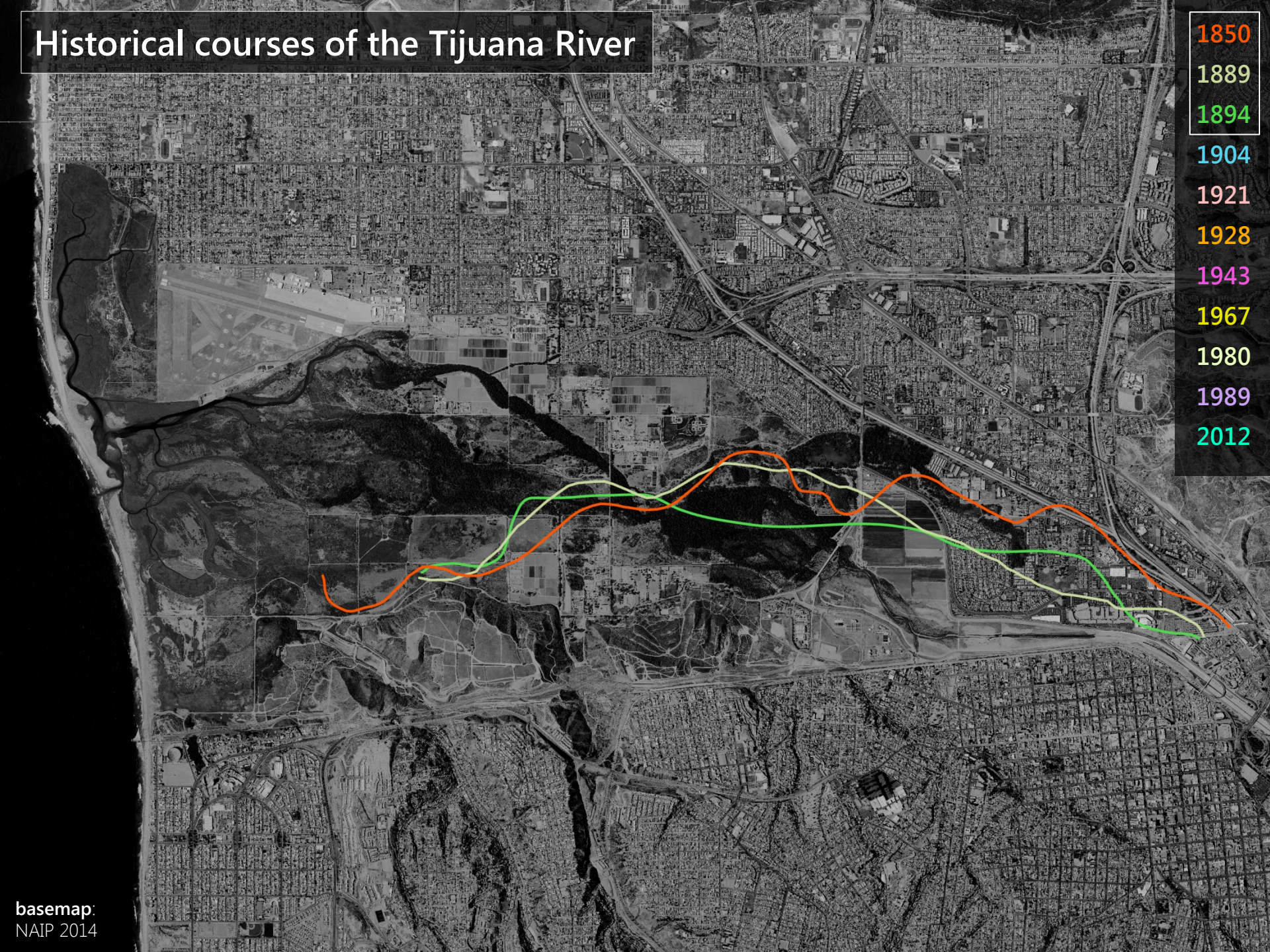
Floods drove river movement

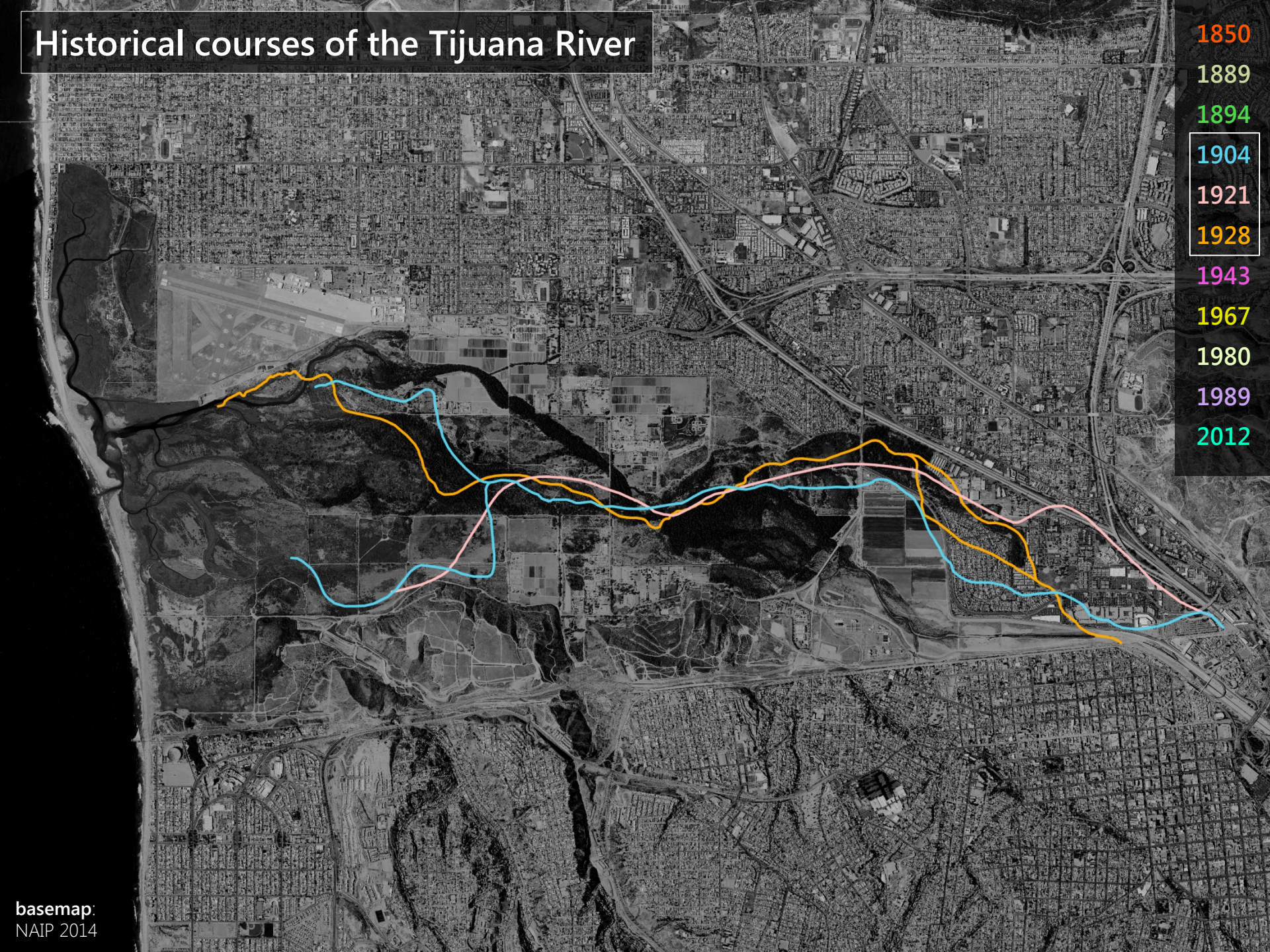


Aerial image of Tijuana River showing multiple channel courses removed due to copyright status.

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
basemap:
NAIP 2014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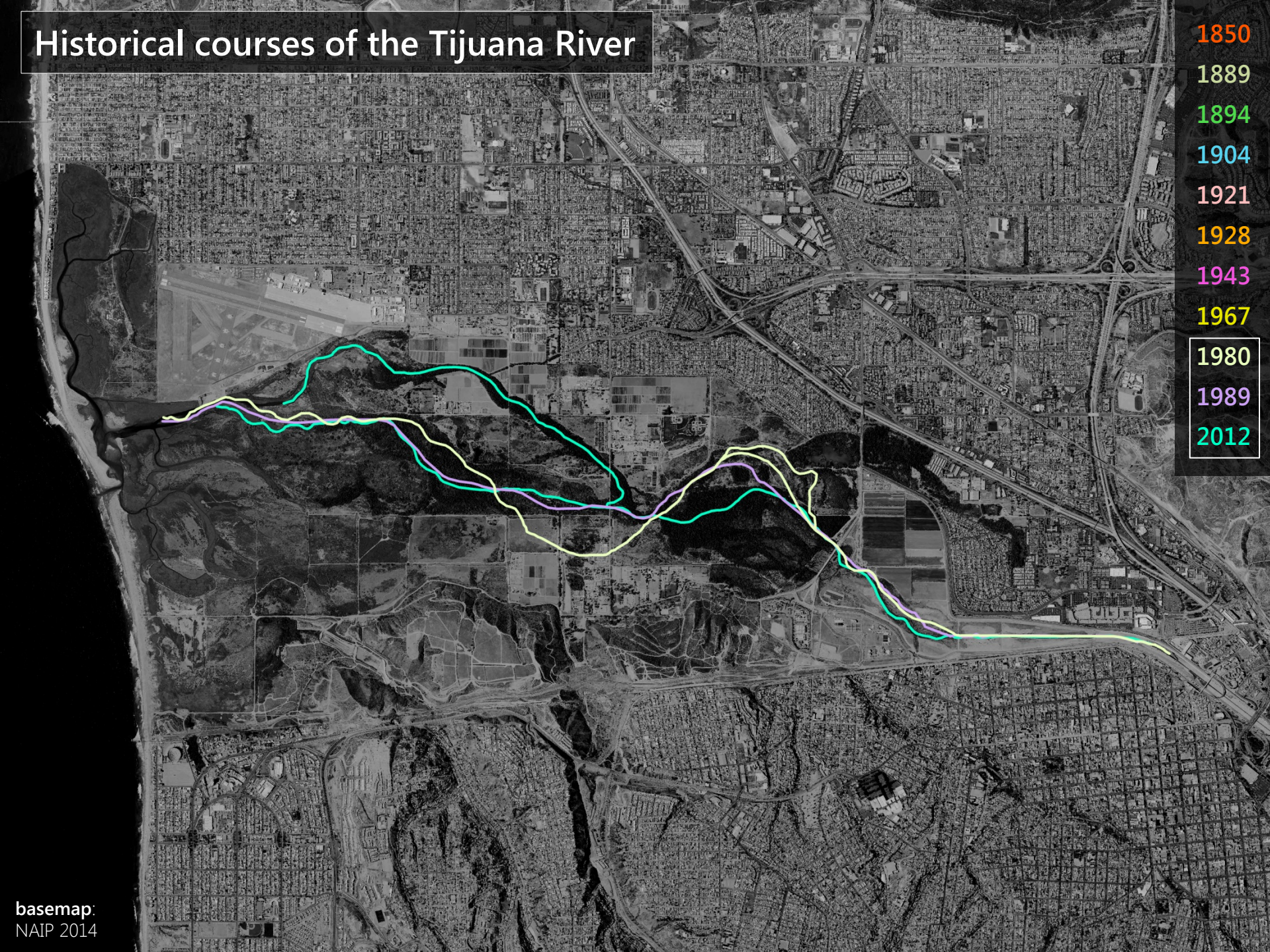
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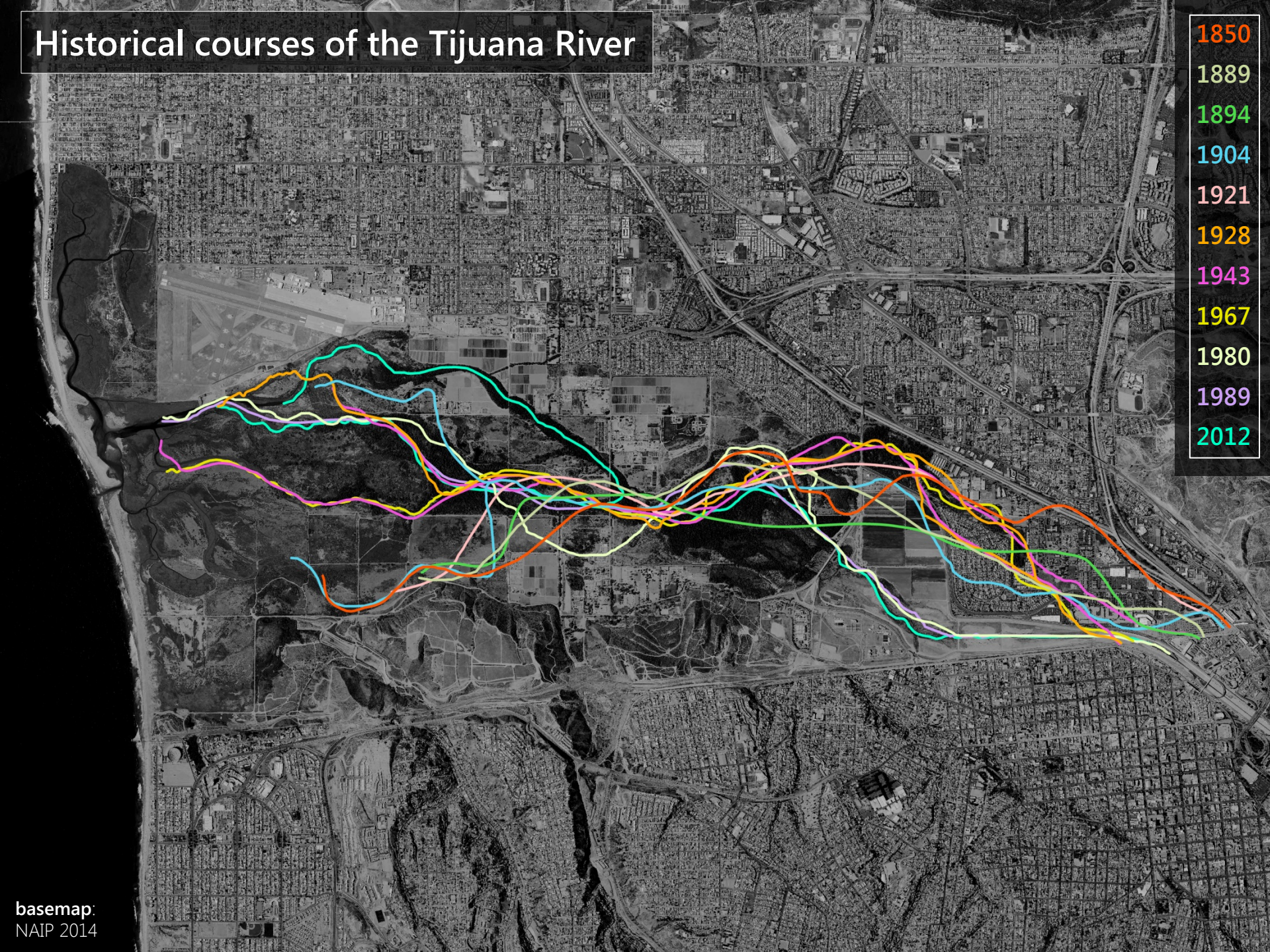

basemap:
NAIP 2014

Floods created habitat variability

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

“spatial variability”

Erickson 1941, courtesy San Diego History Center

Floods created habitat variability

Bonillas and Urbina 1912

8 years
2 large floods

1920

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

Savage 1920

"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"

ca. 1890, courtesy SDHC

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"

ca. 1900, courtesy SDHC

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"

ca. 1890, courtesy SDHC

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

ca. 1918-1920, courtesy Special Collections & Archives, UCSD Library

"temporal variability"

Key messages for today

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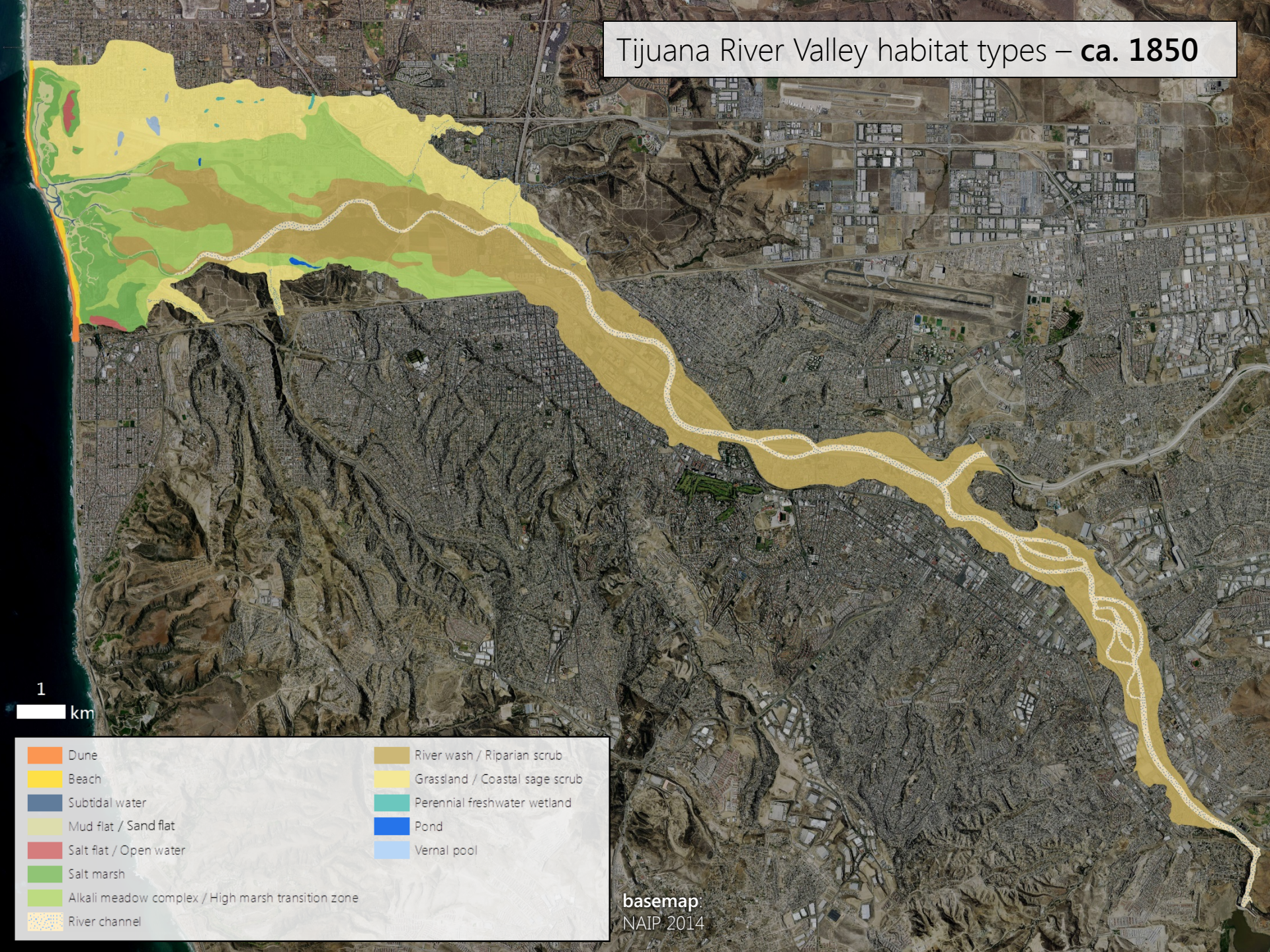
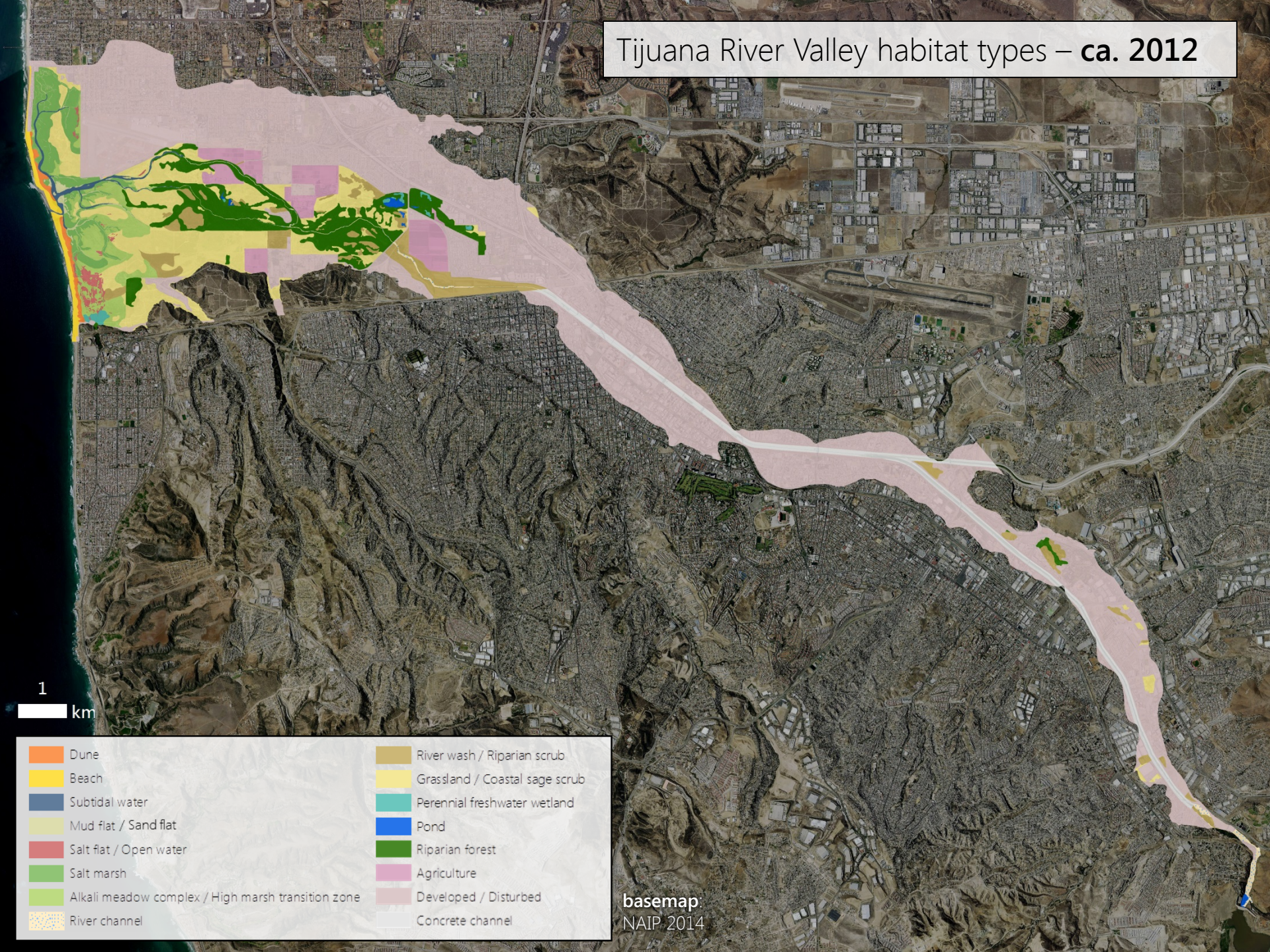
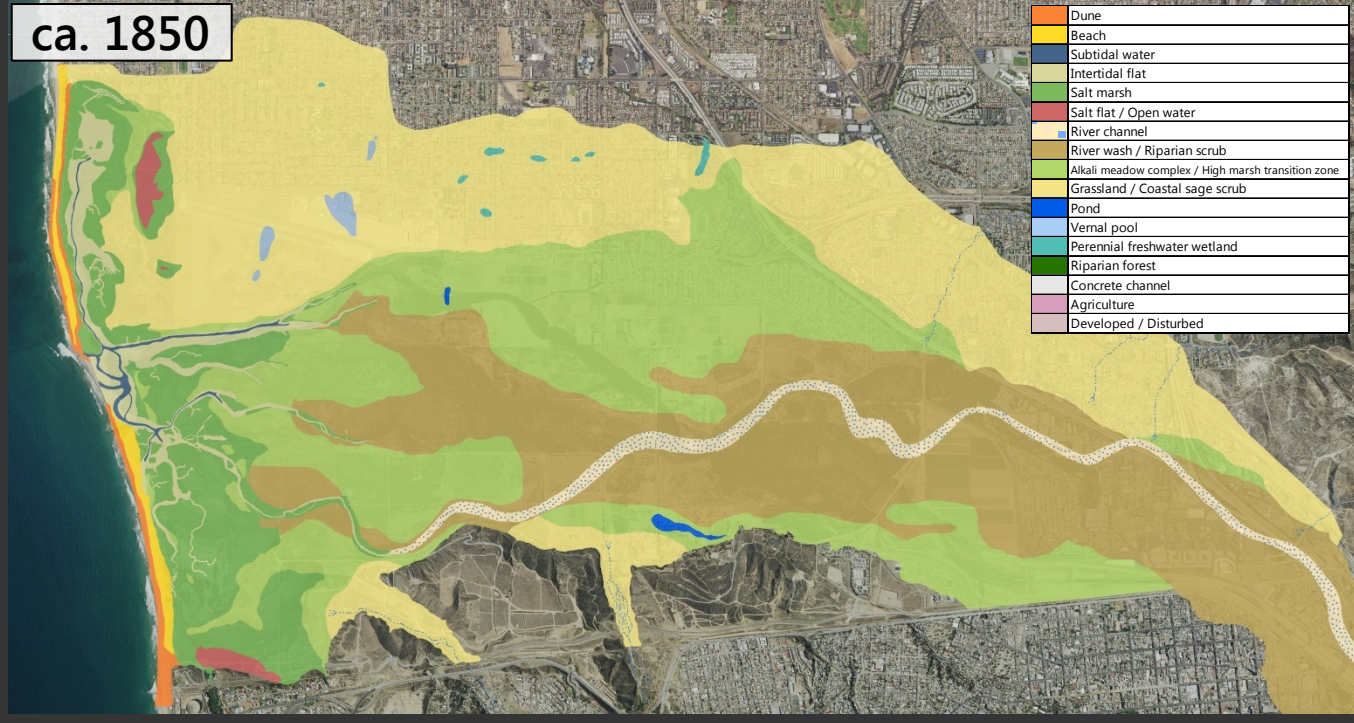
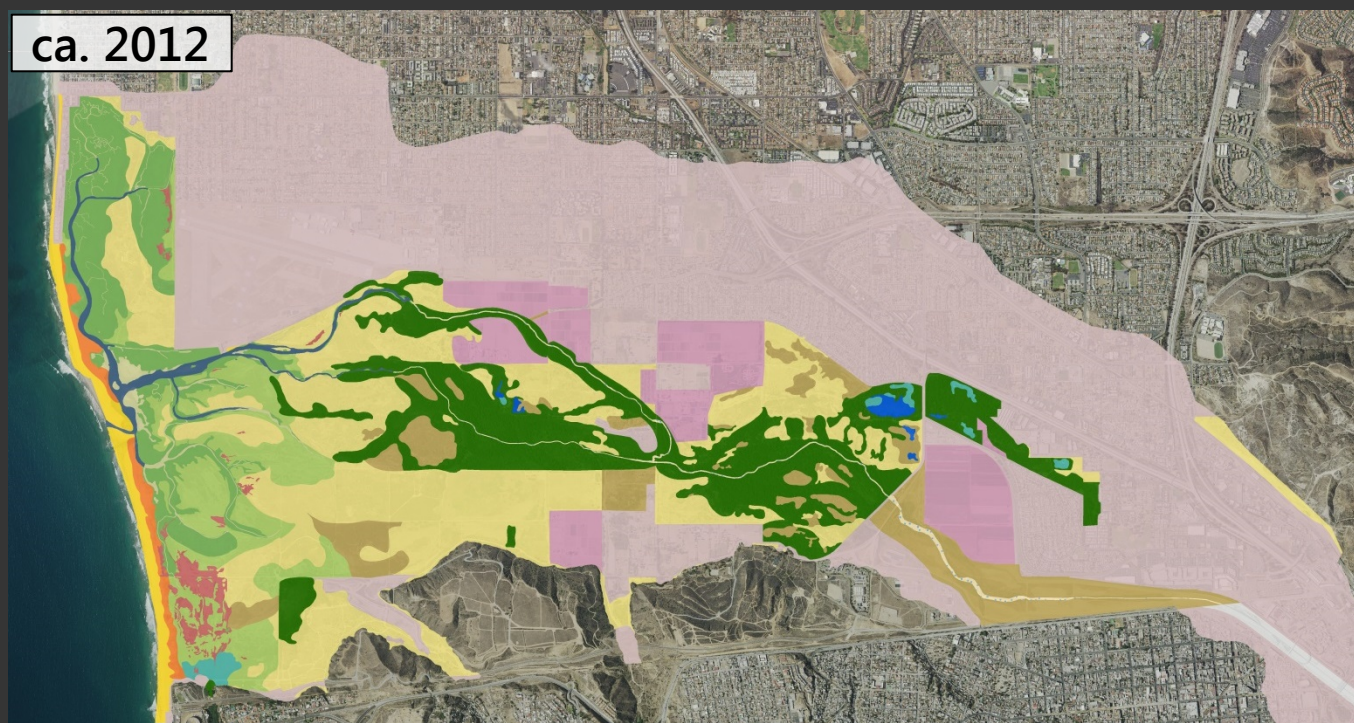

Tijuana River Valley habitat types – ca. 1850
1
km
Dune
Beach
Subtidal water
Mud flat / Sand flat
Salt flat / Open water
Salt marsh
Alkali meadow complex / High marsh transition zone
River channel
River wash / Riparian scrub
Grassland / Coastal sage scrub
Perennial freshwater wetland
Pond
Vernal pool
basemap:
NAIP 2014


Tijuana River Valley habitat types – **ca. 2012**
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
Riparian forest
Agriculture
Developed / Disturbed
Concrete channel
basemap:
NAIP 2014

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**)





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.

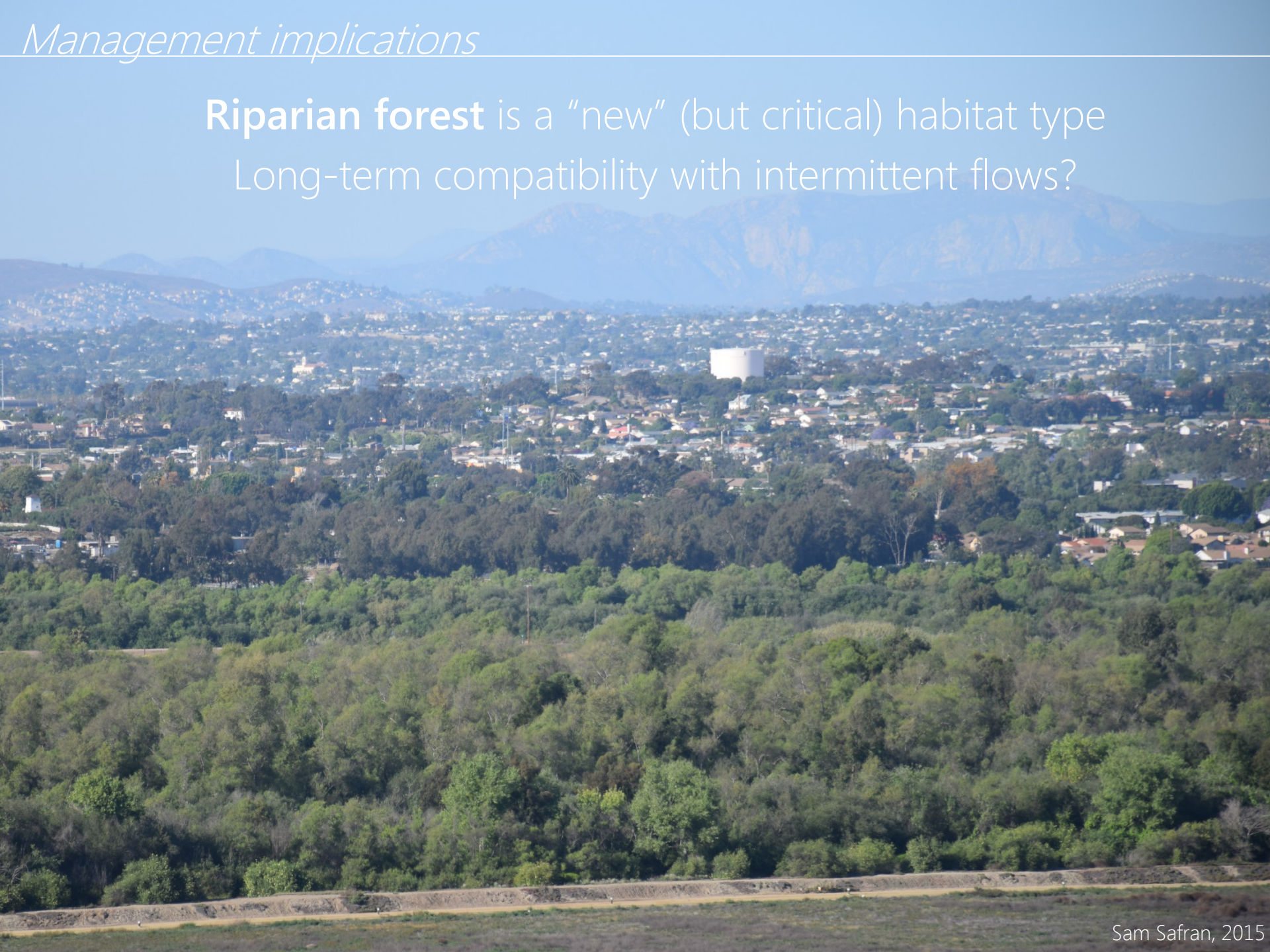
2. featured a dynamic river corridor – but with some stable aspects.

3. experienced major changes in habitat distribution and extent.

Management implications

Riparian forest is a "new" (but critical) habitat type

Long-term compatibility with intermittent flows?

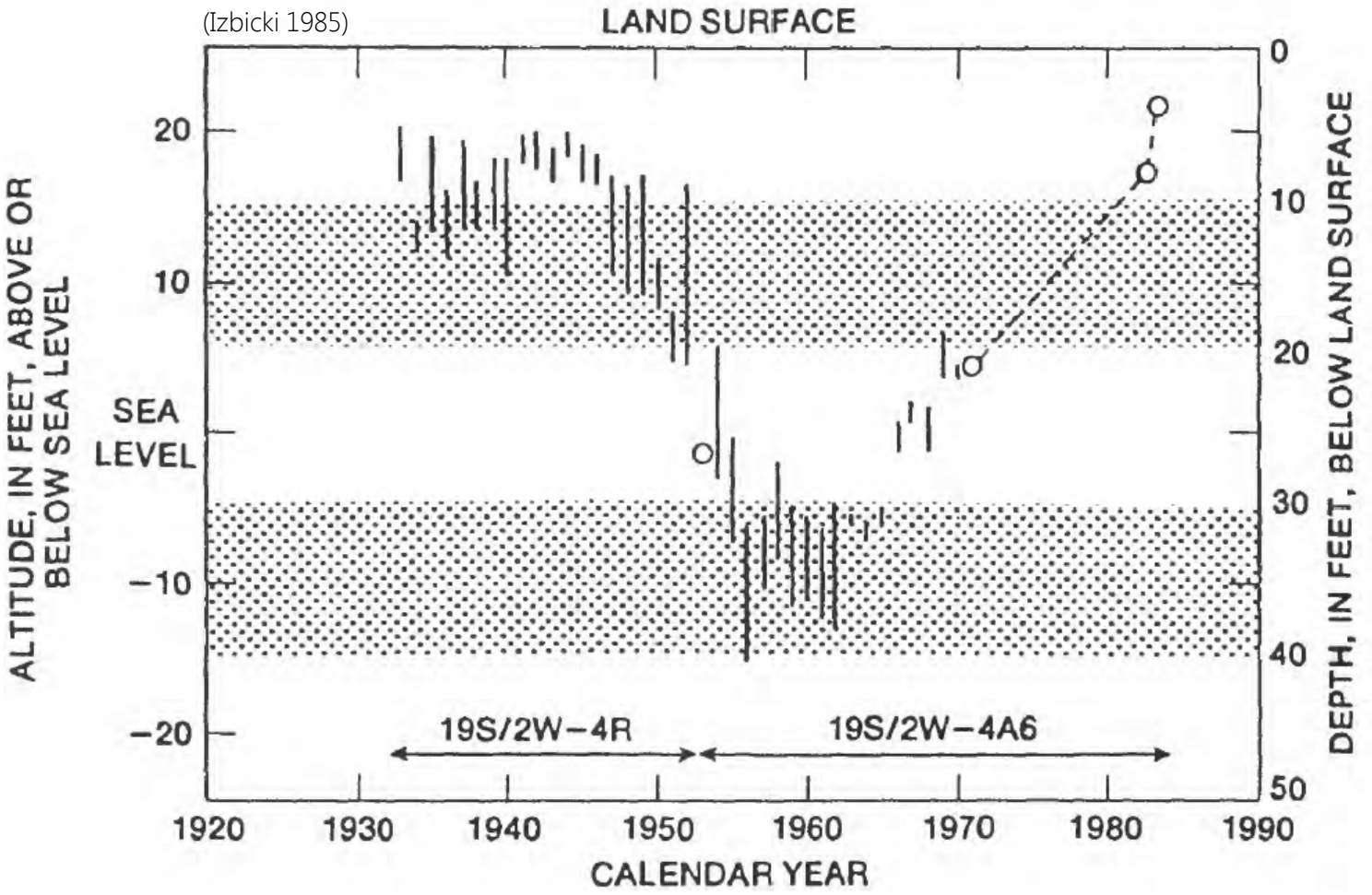


Sam Safran, 2015

Groundwater levels have rebounded

Can "missing" historical wetland types be supported?

(Izbicki 1985)



Management implications

Recent **channel movement** events have historical precedence

Implications for how to treat "new" channels?

Some parting thoughts…

- 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 & Architves, UCSD Library

Funder

California State Coastal Conservancy

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