

# A Virtual Field Trip to South Manchester Beach and *p'da hau* (Garcia River Mouth) Marshlands

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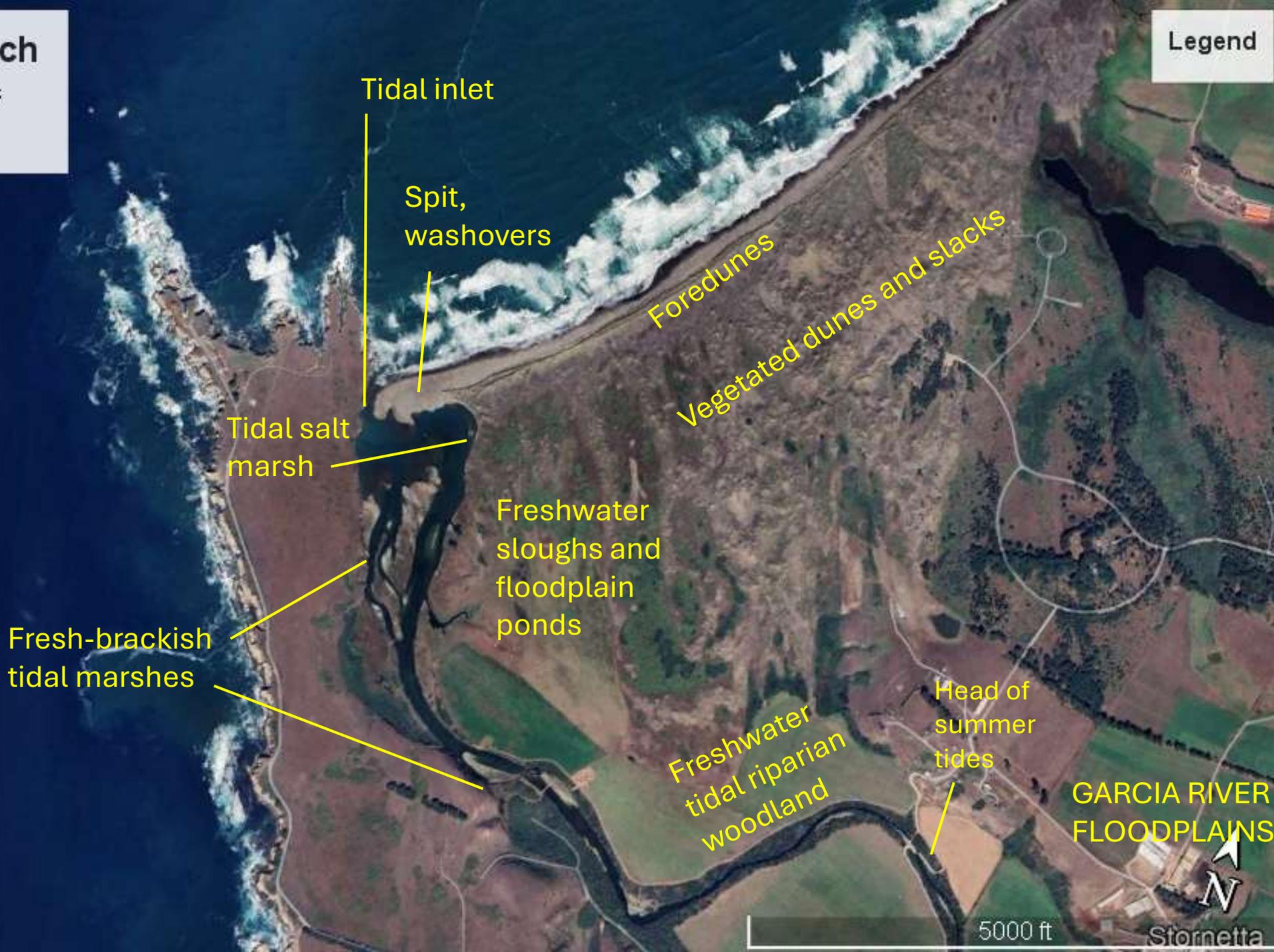


# South Manchester Beach

Garcia River Estuary [p'da hau] Marshes  
Manchester Dunes  
2023

Legend

## HABITAT DISTRIBUTIONS IN THE LANDSCAPE



Google Earth

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Stornetta



U.S. COAST SURVEY.  
Benjamin Peirce Superintendent  
**POINT ARENA**  
and  
**VICINITY**  
CALIFORNIA  
SECTION X  
Surveyed during Feb' Mar' & July  
1870  
Scale 1:5000



Point Arena Dunes 1870

Extensive tidal marshes behind dunes; no sand spit at mouth

Tidal marsh filled what is now the wide lower lagoon flats

## BACKSHORE BEACH AND FOREDUNE

Early spring wracks  
of *Verella vellella*,  
“by-the-wind-  
sailors”,  
hydrozoans

Desiccated *Verella*  
blow into  
foredunes,  
**delivering dune  
plant nutrients  
(organic nitrogen)  
beyond where  
waves can deposit  
kelp wracks** as  
nutrient subsidies



## BACKSHORE BEACH AND FOREDUNE

Riparian coarse woody debris from Garcia River forms beach driftwood wracks

- Traps wind-blown sand
- Shelters pioneer beach seedlings
- Wind-shelter zones used by insects, shorebirds



## BACKSHORE BEACH AND FOREDUNE

Local riparian driftwood is most abundant near the river mouth

Large, old driftwood logs are more abundant towards Alder Creek and Irish Beach, north end of the beach



## BACKSHORE BEACH AND FOREDUNE

“Self-buried”  
driftwood traps  
wind-blown sand,  
raises the  
backshore beach  
elevation higher  
above the reach of  
waves.

High, dry beach  
above saltwater  
wave overtopping  
level provides  
habitat for beach  
plant seedlings



## BACKSHORE BEACH AND FOREDUNE

With little or no driftwood, dune sand does not accumulate, or it erodes down to pebble-shell “lag” armor surfaces deposited by waves.

Poor habitat for seed deposition or seedling establishment.



## BACKSHORE BEACH AND FOREDUNE

Pebble lag on  
washovers of the  
sand spit, thin dune  
sand veneer

Without woody  
debris or algal  
wracks to trap and  
shelter seeds and  
seedlings, seedling  
colonization can be  
sparse.



**BACKSHORE BEACH  
SPIT AT TIDAL INLET**  
*(p'da hau, river mouth)*

- **Washover flats**
- **Thin veneer of dune sand trapped by debris, pioneer plants**
- [*Cakile maritima*]
- [*Calamagrostis arenaria* (*Ammophila*)]
- *Abronia umbellata* ssp. *breviflora* NORTH COAST PINK SAND-VERBENA
- *Atriplex leucophylla* BEACH SALTWORT
- *Leymus mollis* BEACH WILDRYE, AMERICAN DUNEGRASS



**BACKSHORE BEACH  
SPIT AT TIDAL INLET**  
(*p'da hau*, river mouth)

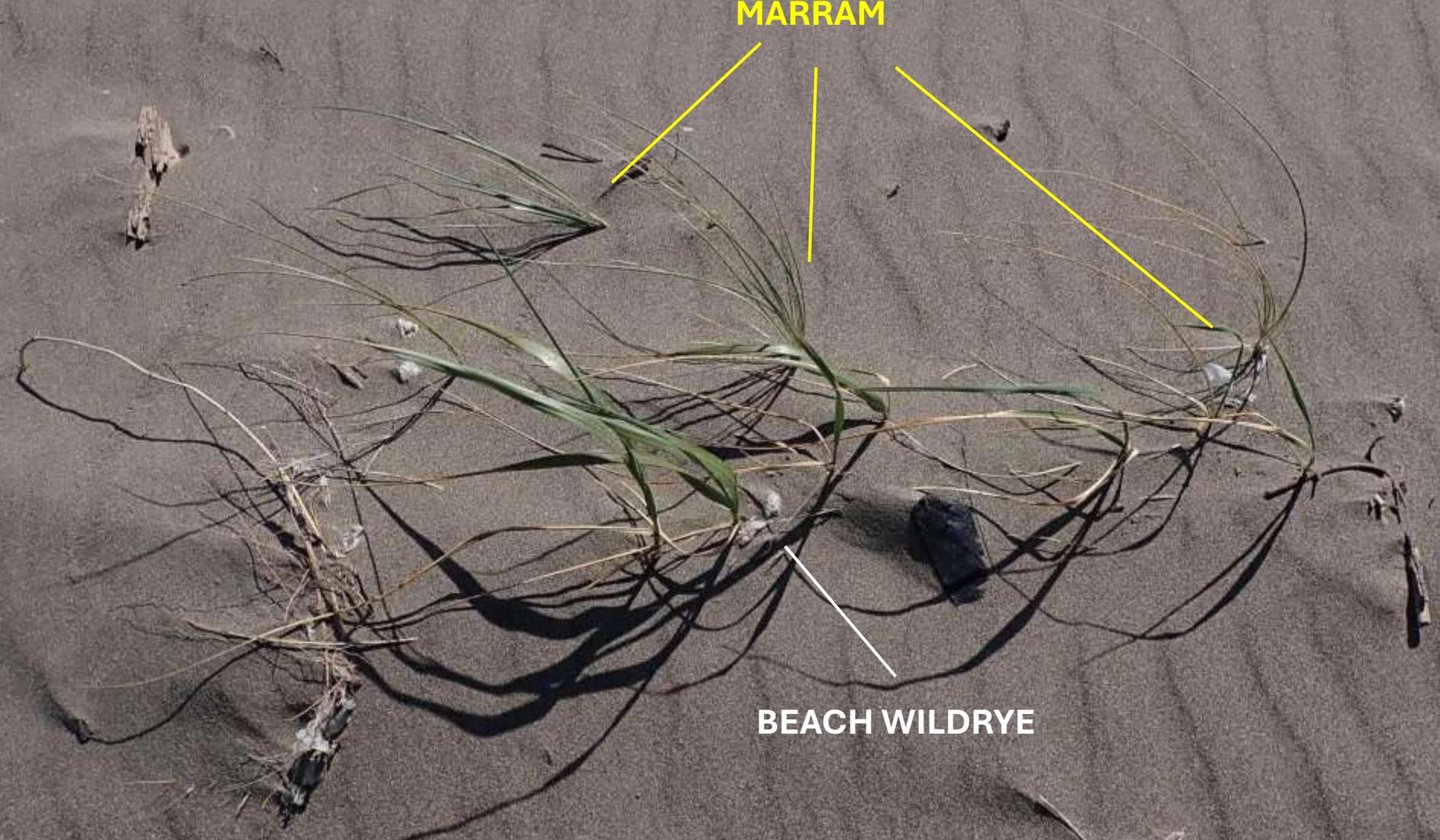
- **Washover flats**
- **Thin veneer of dune sand trapped by debris, pioneer plants**
- [*Cakile maritima*]
- [*Calamagrostis arenaria* (*Ammophila*; marram)]
- *Abronia latifolia*
- *Abronia umbellata* ssp.
- *Ambrosia chamissonis*
- *Atriplex leucophylla*
- *Leymus mollis*

- Potential low foredune growth during low storm year series
- Cyclic “embryo foredune” – overwash erosion and accretion during storm year series
- Marram grass increasingly dominates competition under high dune accretion rates; Beach wildrye competes best with frequent light overwash



**MARRAM**

**BEACH WILD RYE**



## BACKSHORE BEACH AND FOREDUNE

### ***Leymus mollis***

BEACH WILDRYE,  
AMERICAN DUNEGRASS  
(syn. *Elymus mollis* in TJM;  
globally, *Leymus*)

- Native perennial pioneer beach colonizer SLO to AK
- Fast lateral spread by rhizomes; seaward foredunes, beach
- Moderate root salt tolerance; affinity for high sand moisture near shores
- Broad, gray-green glaucous leaf blades



## BACKSHORE BEACH AND FOREDUNE

### ***Leymus mollis***

(still *Elymus mollis* in TJM)

- Limited salinity tolerance in root zone during active growth
- Rhizome connections “share” non-saline water to salt-stressed shoots, enabling survival after brief seawater exposure during the growing season.
- Tolerant of brief seawater immersion during winter dormancy



## BACKSHORE BEACH AND FOREDUNE

### *Leymus mollis*

(still *Elymus mollis* in TJM)

- Tolerant of brief seawater immersion. Non-erosional wave overtopping during winter dormancy
- Well-adapted to sand beach, low foredunes, washover habitats
- Also grows in arctic gravel beaches and raised beach ridges



## BACKSHORE BEACH AND FOREDUNE

### *Leymus mollis*

(still *Elymus mollis* in TJM)

- Wave-eroded rhizome fragments = vegetative (clonal) propagules
- Tolerant of brief seawater immersion.
- Viable seed and seedlings are rare in CA



## BACKSHORE BEACH AND FOREDUNE

### *Leymus mollis*

(still *Elymus mollis* in TJM)

- Vegetative regeneration from wave-eroded shoot cluster and rhizomes
- Shoot emergence through dune sand accreted in wind-shadows of driftwood wracks on washovers, backshore beach
- [No seedlings found in 25+ years]





Marram foredune ridge, old wave-cut scarp

Beach wildrye embryo foredunes  
spread rapidly on backshore beach

**BACKSHORE BEACH AND  
FOREDUNE**

PIONEER PLANTS WITH  
SPREADING GROWTH  
FORMS

***Leymus mollis***  
BEACH WILDRYE,  
AMERICAN DUNEGRASS

***Abronia latifolia***  
YELLOW SAND-VERBENA

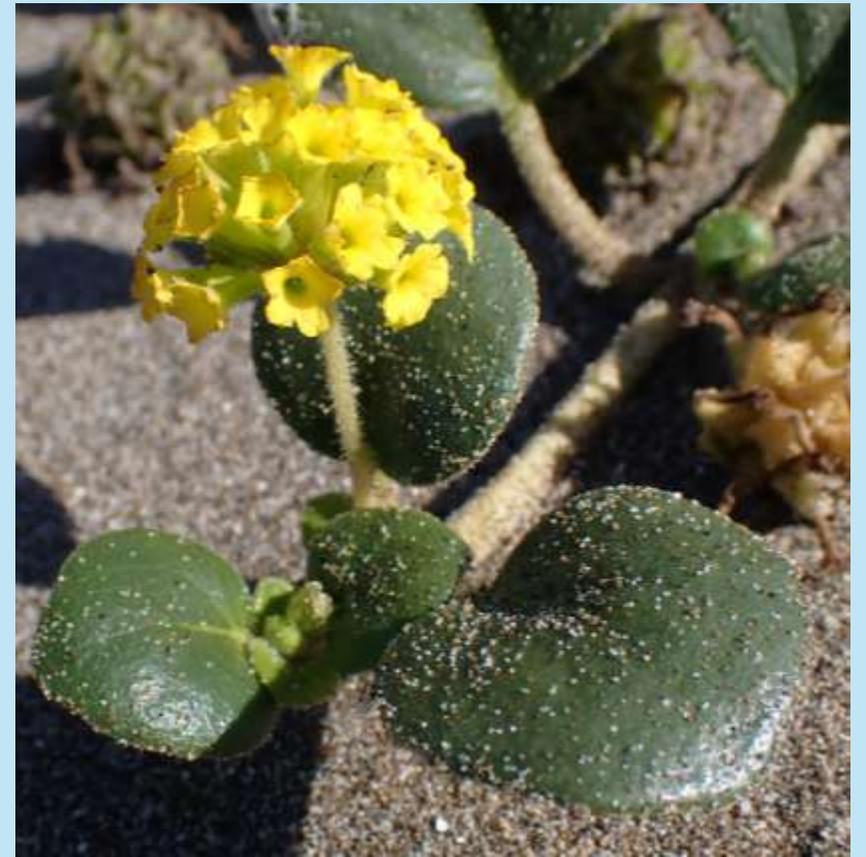


## BACKSHORE BEACH AND FOREDUNE

### *Abronia latifolia*

#### YELLOW SAND-VERBENA

- Prostrate, spreading mat-forming perennial with a massive caudex/taproot.
- Not tolerant of persistent high substrate salinity; habitat above normal tides, wave runup
- Capable of building dome-shaped foredunes slowly
- Can flower first year from seedlings



**BACKSHORE BEACH AND  
FOREDUNE**

*Abronia umbellata* ssp. *breviflora*  
NORTH COAST PINK SAND-VERBENA

- Prostrate short-lived mat-forming perennial ,
- Rapid growth and seed reproduction first year



**BACKSHORE BEACH AND  
FOREDUNE**

***Abronia umbellata* ssp. *breviflora*  
NORTH COAST PINK SAND-VERBENA**

Rare, unstable populations, but sometimes locally abundant



**BACKSHORE BEACH AND  
FOREDUNE**

***Abronia umbellata*  
ssp. *breviflora*  
NORTH COAST PINK  
SAND-VERBENA**

- Thousands of seed per plant in favorable moist sand and buried organic wrack
- Perennial if not eroded





***Abronia umbellata* ssp. *breviflora***  
**NORTH COAST PINK SAND-VERBENA**

- Mostly self-pollinated, inbred, low genetic diversity [OR}
- Though bees work flowers, hawk-moths (sphyngidae) actually cross-pollinate

]

## BACKSHORE BEACH AND FOREDUNE

### *Ambrosia chamissonis* BEACH-BUR

- Prostrate, spreading mat-forming perennial with a massive caudex/taproot.
- Not tolerant of persistent high substrate salinity; habitat above normal tides, wave runup
- Capable of building dome-shaped foredunes slowly



## BACKSHORE BEACH AND FOREDUNE

### *Atriplex leucophylla* BEACH SALTWORT

- Tolerates some summer wave overtopping near high tide line, seawater salinization of root zone.
- Not tolerant of persistent high substrate salinity; habitat above normal tides, wave runup



## BACKSHORE BEACH AND FOREDUNE

### *Atriplex leucophylla* BEACH SALTWORT

- Native perennial pioneer beach colonizer
- Prostrate; forms broad, low mounds with dune sand accretion; does not build foredunes
- Fast growth
- Moderate root salt tolerance
- White-gray leaves, waxy coating = salt spray resistance, reflects heat from sand surface



## BACKSHORE BEACH AND FOREDUNE

### *Atriplex leucophylla* BEACH SALTWORT

- **High seed predation** by small mammals – mice – where marram grass cover is extensive, high and close to beach
- Dispersal of cork-like “seeds” (diaspores) – spongy, waxy bracts enclose fruit with fatty, protein-rich seed





## BACKSHORE BEACH AND FOREDUNE

### *Leymus mollis*

Widely creeping rhizomes, relatively sparse semi-open canopy cover in foredunes

### *Calamagrostis*

### *[Ammophila] arenaria*

Shorter rhizomes, dense erect shoots, continuous closed canopy cover

**River otter trails** sheltered by dense marram, like slough sedge canopies

- **Dense canopy shelters mouse and vole habitat in reach of beach plant seeds**



**River otter trails to beach from dense marram dune cover, like slough sedge canopies**



## DUNE SLACKS

- Most are SEASONAL WETLANDS in Manchester Dunes
- Origins: past **wind erosion down to wet sand above water table** during unvegetated, mobile stages of dune evolution
- Typically flooded or saturated flats, depressions in non-drought winter rainfall season



## DUNE SLACKS

- Shallow seasonal ponds, lakes 1-2 feet, drawdown in spring
  - ***Juncus lescurii-***  
***J. breweri*** complex  
DUNE RUSH  
/BREWER'S RUSH
  - ***Carex obnupta***  
SLOUGH SEDGE
  - ***Eleocharis macrostachya***  
COMMON SPIKERUSH
  - ***Trifolium wormskioldii***  
SPRINGBANK CLOVER
  - ***Argentina egedii***  
PACIFIC SILVERWEED
- + Pacific chorus frogs,  
copepods, ostracods,  
California toads, egrets...



## DUNE SLACKS

- Shallow seasonal ponds, lakes 1-2 feet, drawdown in spring to wet sedge-rush meadows
- ***Juncus lescurii-***  
***J. breweri*** complex  
DUNE RUSH  
/BREWER'S RUSH
- ***Carex obnupta***  
SLOUGH SEDGE
- ***Eleocharis macrostachya***  
COMMON SPIKERUSH



## DUNE SLACKS

- Shallow seasonal ponds, lakes 1-2 feet, drawdown in spring to wet sedge-rush meadows
- *Juncus lescurii*-  
*J. breweri* complex DUNE RUSH /BREWER'S RUSH
- Inflorescence morphology varies with habitat, shoot density in same populations
- Populations of *J. breweri*, *J. lescurii* near *J. balticus* in fresh-brackish tidal marsh



## DUNE SLACKS

*Ranunculus flammula*

CREEPING CROWFOOT, CREEPING SPEARWORT

Stoloniferous colonies in winter-flooded dune slacks



## DUNE SLACKS

*Veronica scutellata*  
MARSH  
SPEEDWELL

Winter-flooded dune  
slacks, emerging in  
spring to wet sedge-  
rush meadows



## DUNE SLACKS

### *Stellaria littoralis* SHORE CHICKWEED

Winter-wet, but not flooded, seep margins of dune slacks, moist in summer.

Often in *Juncus lescurii* meadows.



## DUNE SLACKS

*Tanacetum  
bipinnatum*, syn. *T.  
camphoratum*

### DUNE TANSY

Drained, mesic margins  
of dune slacks,  
spreading to adjacent  
dune slopes

**The only population  
between Tomales Bay  
and Mendocino: Davis  
Lake and South  
Manchester  
Dunes/Garcia River**

Shorter than Tomales  
Bay and San Francisco  
populations.



## DUNE SLACKS

*Tanacetum  
bipinnatum*,  
syn. *T.  
camphoratum*  
**DUNE TANSY**

Transitional  
habitat  
between dune  
and slack



**OLD REMNANT  
STABLE LOW-RELIEF  
DUNES**

***Tanacetum  
bipinnatum*, syn. *T.  
camphoratum*  
DUNE TANSY**

Old, weathered dunes  
locally never reached  
by marram grass  
invasion, locally  
dominated by sparse,  
low creeping dune  
tansy



Transitional  
habitat between  
dune and slack,  
formed by dune  
migration into  
slacks, arrested  
and dominated  
by *Juncus  
breweri*

Escaped historic  
marram grass  
invasion.



## TIDAL BRACKISH MARSH and SLOUGH

### *Carex lyngbyei* LYNGBYE'S SEDGE

- Northern California, Pacific NW, to Alaskan estuaries

- Rare but locally abundant in N California
- Large populations in, Mendocino estuaries except Gualala
- Obligate tidal fresh-brackish marsh, along channel banks
- Productive juvenile salmonid habitat [OR-WA; CA?]



**TIDAL BRACKISH MARSH  
and SLOUGH**

***Carex lyngbyei*  
LYNGBYE'S SEDGE**

Limiting local factors:

Bank erosion

Heavy *Ulva* wrack  
deposition

High salinity during  
droughts, low freshwater  
stream discharge in  
summer



**TIDAL BRACKISH MARSH and SLOUGH**

*Carex lyngbyei* LYNGBYE'S SEDGE  
tidal pond and slough banks



**TIDAL BRACKISH MARSH  
and SLOUGH**

*Carex lyngbyei*  
LYNGBYE'S SEDGE  
tidal pond and slough  
banks

Productive juvenile  
salmonid foraging,  
velocity refuge habitat



## TIDAL BRACKISH MARSH SLOUGH

“Algae” –  
misidentification.

Epiphytic green  
filamentous algae ON  
submerged aquatic  
vascular plants:

***Ruppia cirrhosa*,**

**SPIRAL**

**WIGEONGRASS,**

***Stuckenia pectinata***

**SAGO PONDWEED**

Fresh-brackish slough  
in marsh, lower estuary





*Conioselinum pacificum*, HEMLOCK PARSLEY



TIDAL BRACKISH MARSH

## TIDAL FRESH-BRACKISH MARSH

### *Trifolium wormskioldii* SPRINGBANK CLOVER

Fresh-brackish marsh  
and wet freshwater  
meadows

Before flowering,  
traditionally the most  
highly valued edible  
clover greens by Central  
Pomo, Kashaya Pomo,  
northward.

Traditional native  
cultivation plots in  
Pacific Northwest tidal  
marshes



**TIDAL FRESH-BRACKISH  
MARSH**

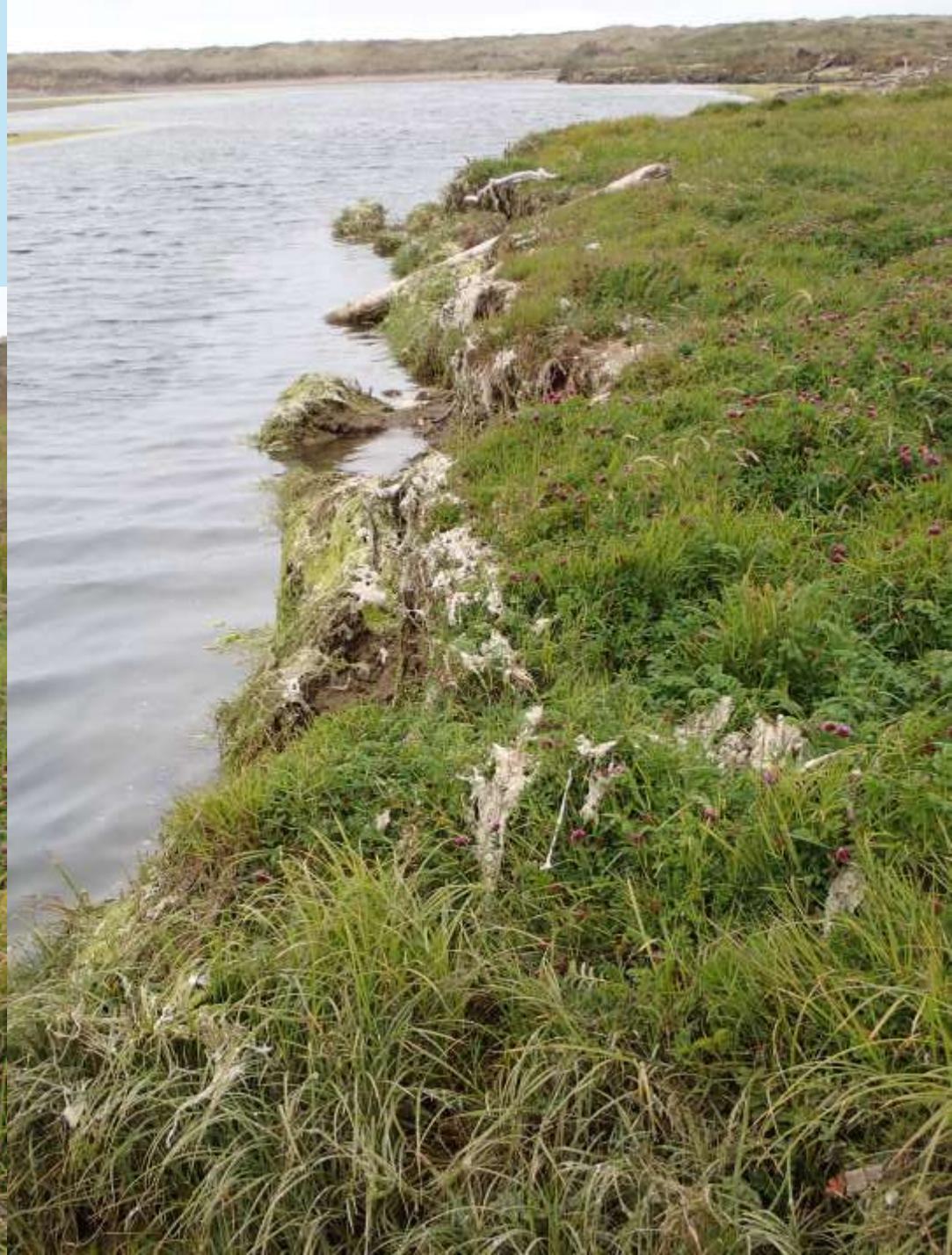
*Trifolium wormskioldii*  
**SPRINGBANK CLOVER**

Associated with  
*Hordeum*  
*brachyantherum*,  
MEADOW BARLEY



## TIDAL FRESH-BRACKISH MARSH

Rapid, long-term progressive marsh bank erosion driven by tidal current and shoal changes, wind-waves



## **HIGH TIDAL BRACKISH MARSH**

- Sandy high brackish marsh near the tidal inlet, sand spit
- The highest end of the salinity gradient: salt and brackish marsh plant species
- High species richness, local unique species



## HIGH TIDAL BRACKISH MARSH

- Unique sandy high brackish marsh assemblages
- *Argentina egedii* PACIFIC SILVERWEED
- *Deschampsia cespitosa* ssp. *holciformis* TUFTED HAIRGRASS
- *Distichlis spicata* SALTGRASS
- *Castilleja ambigua* var. *humboldtiensis*, HUMBOLDT BAY OWL'S-CLOVER [rare]



## HIGH TIDAL BRACKISH MARSH

- Unique sandy high brackish marsh assemblages
- *Distichlis spicata*  
SALTGRASS
- *Castilleja ambigua* var. *humboldtiensis*,  
HUMBOLDT BAY OWL'S-CLOVER [rare]



## HIGH TIDAL SALT MARSH

- *Jaumea carnosa* JAUMEA
- *Castilleja ambigua* var. *humboldtiensis*, HUMBOLDT BAY OWL'S-CLOVER [rare]
- *Sarcocornia pacifica* PACIFIC PICKLEWEED



***Castilleja ambigua* var. *humboldtiensis*, HUMBOLDT BAY OWL'S-CLOVER [rare]**



Gopher burrows  
and mounds in high  
salt-brackish  
marsh



**HIGH TIDAL SALT  
MARSH**

*Armeria maritima*  
SEA-PINK

*Distichlis spicata*,  
SALTGRASS



**HIGH TIDAL SALT  
MARSH**

*Extriplex californica*,  
syn. *Atriplex*  
*californica*  
CALIFORNIA  
SALTBUSH

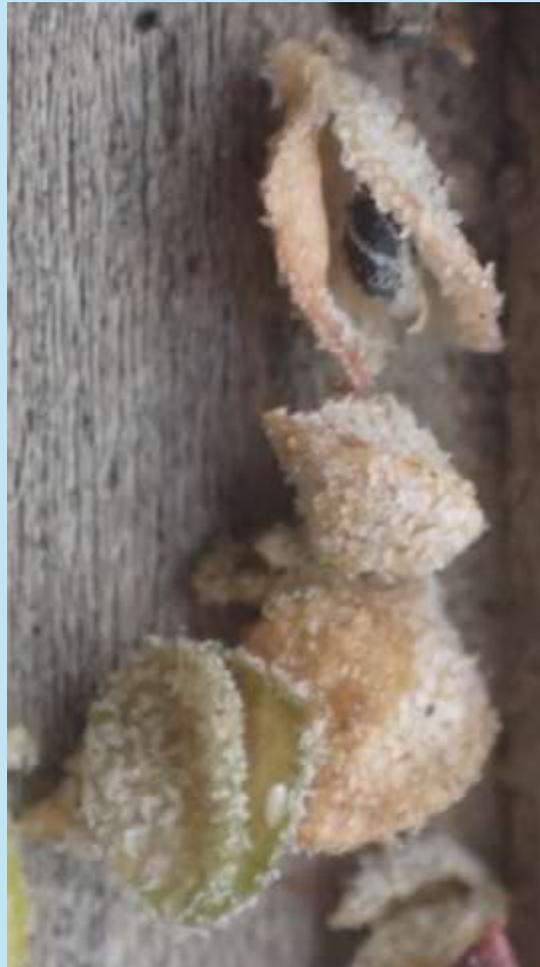
*Distichlis spicata*,  
SALTGRASS

- Range extension  
from Salt Point,  
Sonoma County
- Northern limit



## HIGH TIDAL SALT MARSH

*Extriplex californica*,  
syn. *Atriplex californica*  
CALIFORNIA SALTBUSH



## HIGH TIDAL SALT MARSH

*Extriplex californica*,  
syn. *Atriplex*  
*californica*  
CALIFORNIA  
SALTBUSH

*Distichlis spicata*,  
SALTGRASS

Naturally unstable,  
precarious habitat in  
high tide line: wrack  
deposition, bank  
erosion



## HIGH TIDAL SALT MARSH

*Extriplex californica*,  
syn. *Atriplex*  
*californica*  
CALIFORNIA  
SALTBUSH

*Distichlis spicata*,  
SALTGRASS

Naturally unstable,  
precarious habitat in  
high tide line:  
**progressive bank  
erosion**



## TIDAL GRAVEL SALT MARSH

Residual, immobile gravel bar and shoal deposits from high flood events.

Colonized by pioneer intertidal salt marsh plants in muddy gravel



**TIDAL GRAVEL SALT MARSH**

*Castilleja ambigua* var. *humboldtensis*,  
HUMBOLDT BAY OWL'S-CLOVER [rare]

*Plantago maritima* SEA PLANTAIN

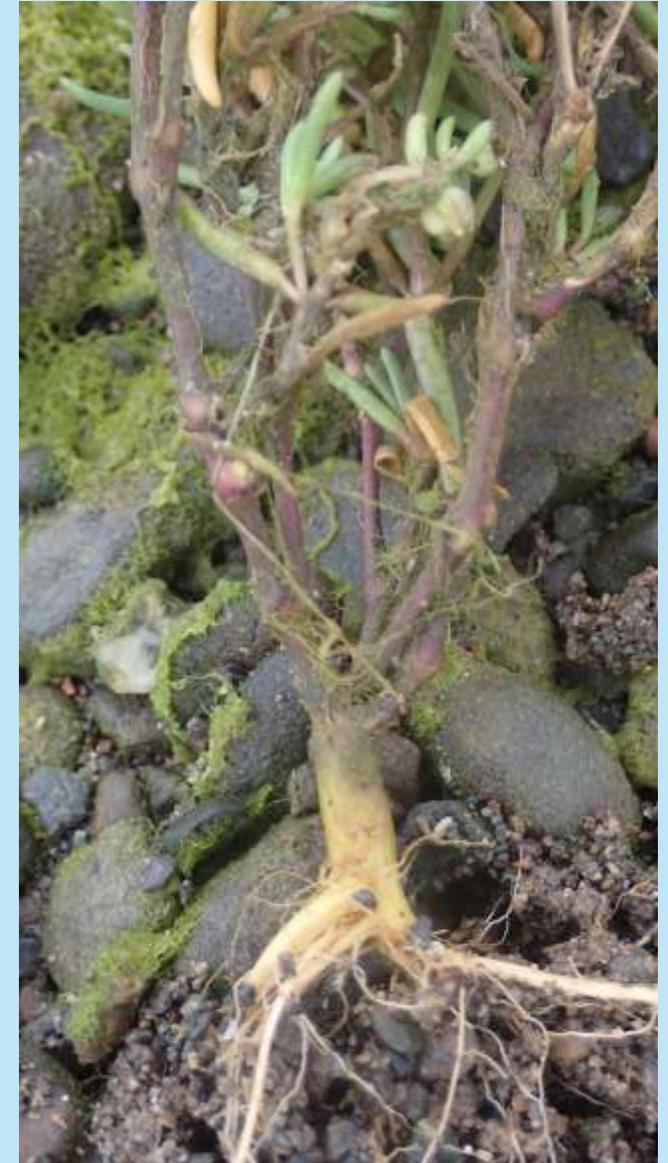
*Sarcocornia pacifica* PACIFIC PICKLEWEED



## TIDAL GRAVEL SALT MARSH

*Spergularia salina* syn. *S. marina* SEA SPURREY

Annual



## FLOODPLAIN MARSH FRESHWATER PONDS – STORM TIDAL ECOTONE

- Freshwater marsh and submerged to emergent aquatic vegetation
- Dominant emergent marsh spp:
- *Juncus lescurii*, *J. balticus*
- *Eleocharis macrostachya*
- *Schoenoplectus pungens*
- *Carex obnupta*



# FLOODPLAIN MARSH FRESHWATER PONDS – STORM TIDAL ECOTONE

## COMPLEX HYDROLOGY!

- Fresh groundwater inflows from dune field
- Garcia River extreme flooding during high tides
- Marginal estuarine “backwater” influence
- Very shallow; late summer drawdown or perennial pond
- Physiologically “freshwater” – 0- < 3 ppt (fresh to about 1/10 seawater)





**FLOODPLAIN MARSH  
FRESHWATER PONDS –  
STORM TIDAL ECOTONE**

***Eleocharis  
macrostachya***  
COMMON SPIKERUSH

***Schoenoplectus  
pungens***  
COAST BULRUSH

River otter trails



**FLOODPLAIN  
MARSH/  
FRESHWATER  
POND MARGINS**

***Ranunculus  
aquatilis***

**WHITE WATER-  
CROWFOOT,  
AQUATIC  
BUTTERCUP**



**FLOODPLAIN  
MARSH/  
FRESHWATER  
POND  
MARGINS**

***Ranunculus  
aquatilis***

**WHITE  
WATER-  
CROWFOOT,  
AQUATIC  
BUTTERCUP**



**FLOODPLAIN MARSH/  
FRESHWATER POND**

***Ranunculus aquatilis***  
WHITE WATER-  
CROWFOOT, AQUATIC  
BUTTERCUP

***Stuckenia pectinata***  
SAGO PONDWEED

***Hippuris vulgaris***  
MARE'S TAIL



*Hippuris vulgaris*

FLOODPLAIN MARSH/  
FRESHWATER POND

*Hippuris vulgaris*  
MARE'S TAIL



## FLOODPLAIN MARSH/ FRESHWATER POND

*Hippuris vulgaris*  
MARE'S TAIL



2011 cattle grazing, wallowing in  
drawdown ponds

## **FLOODPLAIN MARSH FRESHWATER PONDS – DUNE SLACK ECOTONE**

- Freshwater ponds, marsh
- High groundwater emergence from dune aquifer – usually perennial ponds



**FLOODPLAIN MARSH  
FRESHWATER PONDS –  
DUNE SLACK ECOTONE**

Nearly impenetrable  
dense, tall stands of  
slough sedge, *Carex  
obnupta* – to 2 m high!

Deceptive narrow  
deer trails to **dead  
ends**.

**NEXT? South p'da  
hau / Garcia Estuary  
and upstream  
freshwater estuary  
ecotone!**

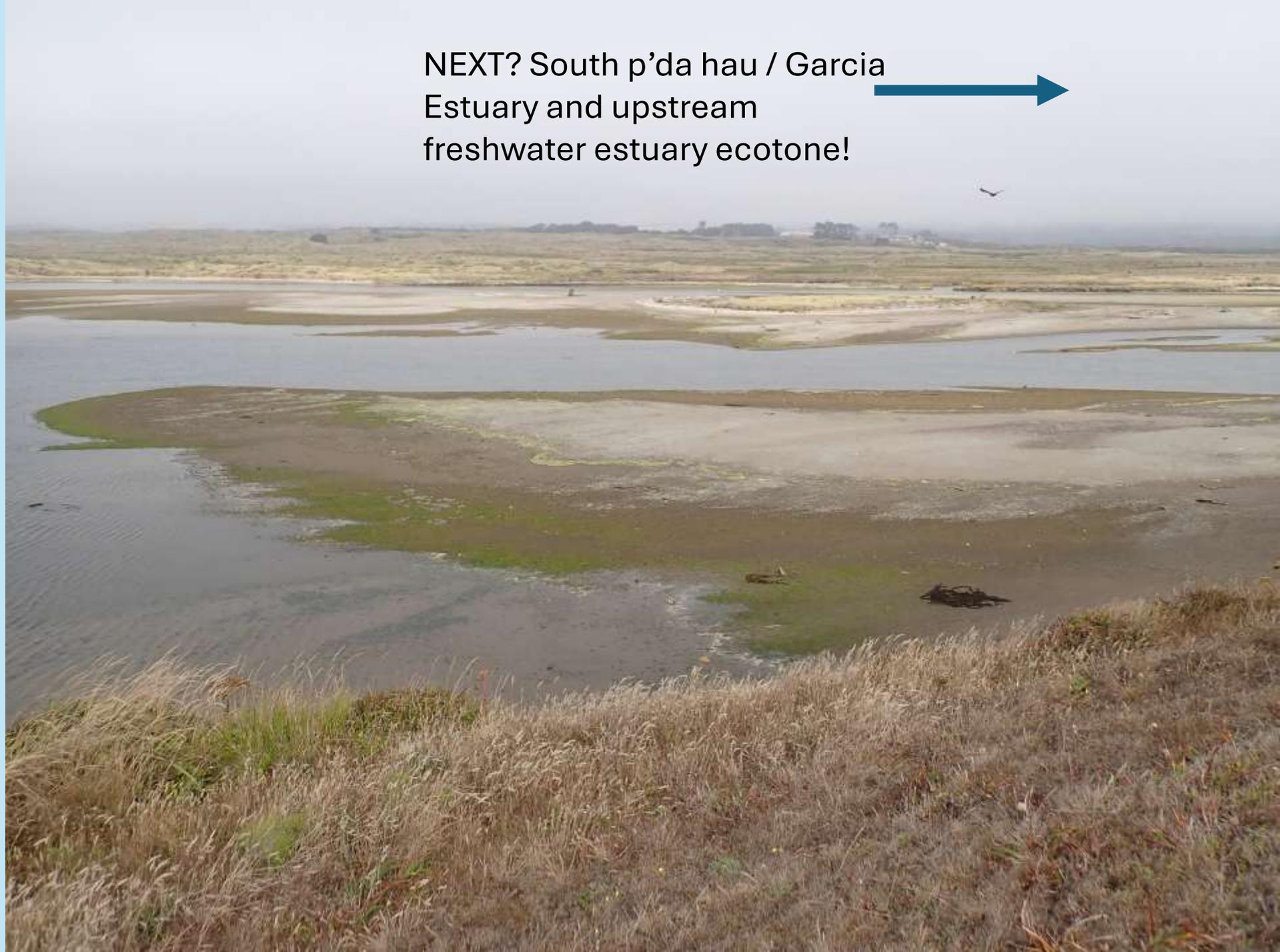


## HISTORIC TIDAL SALT MARSH LOST

Why so little salt marsh vegetation on the seaward sand and gravel shoals today, compared with 1870?

- Washover flats on sand spit instead of extensive dunes across mouth?
- Large tidal prism – volume of tidal water in lagoon – maintains excessively dynamic shoals for vegetation to stabilize ?

NEXT? South p'da hau / Garcia Estuary and upstream freshwater estuary ecotone!



## SELECTED COASTAL GEOGRAPHY TERMS

BACKSHORE [BEACH] – normally dry beach above non-storm wave reach

DUNE SLACKS [syn. “hollows”, “swales” – wind-eroded flats or basin depressions in dunes; usually moist, wet, or flooded at times

ESTUARIES – tidal waterbodies or streams with at least some mixing and gradations of freshwater and salt water between tidal inlets and streams

FOREDUNES – vegetation-built dunes at the back of the beach

FLOODPLAINS – flats bordering streams, intermittently flooded when stream high water levels flow over banks

SALINITY RANGES – various classifications.

*Marine/haline*: 35 parts salt per thousand [ppt]

*Brackish*: diluted seawater, maximum about 18 ppt.

*Fresh-brackish* – 0-5 ppt range.

SLOUGHS – dead-end tidal creeks in marshes or floodplains

SPIT (BARRIER BEACH) – beach enclosing an embayment, lagoon or tidal marsh

TIDAL MARSH – vegetated wetlands influenced by periodic tidal flooding

WASHOVERS – sandy flats or fans across spits or dune breaches, deposited by storm waves