Validation of the California Rapid Assessment Methodology for Bar-built Estuaries

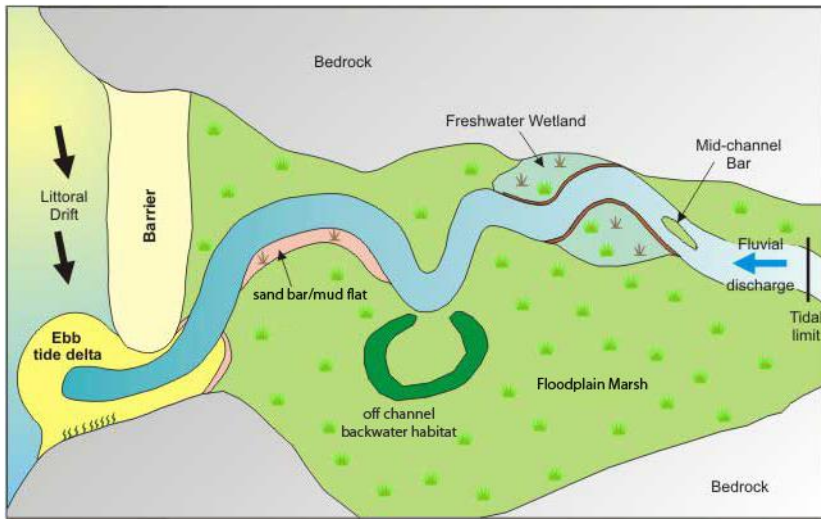
CCWG
central coast wetlands group

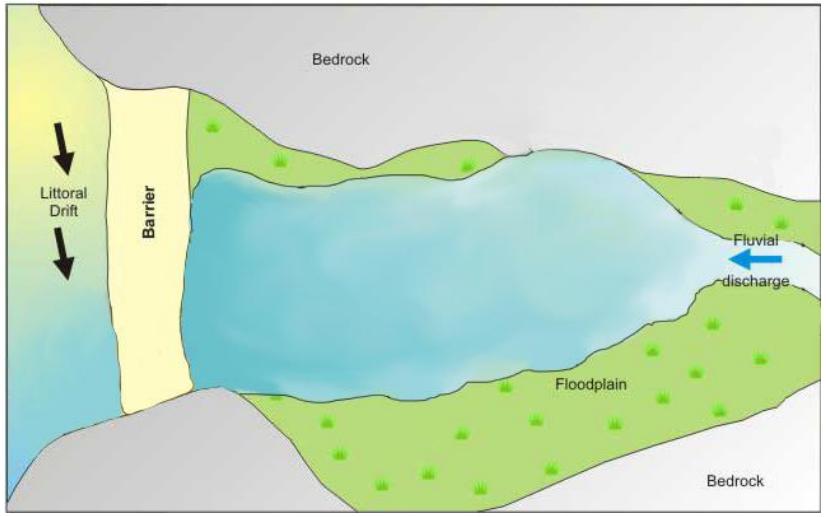
Validation of the California Rapid Assessment Methodology for Bar-built Estuaries

592 Coastal Confluences

278 Bar-built estuaries

Bar-built estuaries are dynamic





Bar-built estuaries vary in condition

Laguna Creek

- Functional marsh plain
- No levees
- No bridge restriction

Scott Creek

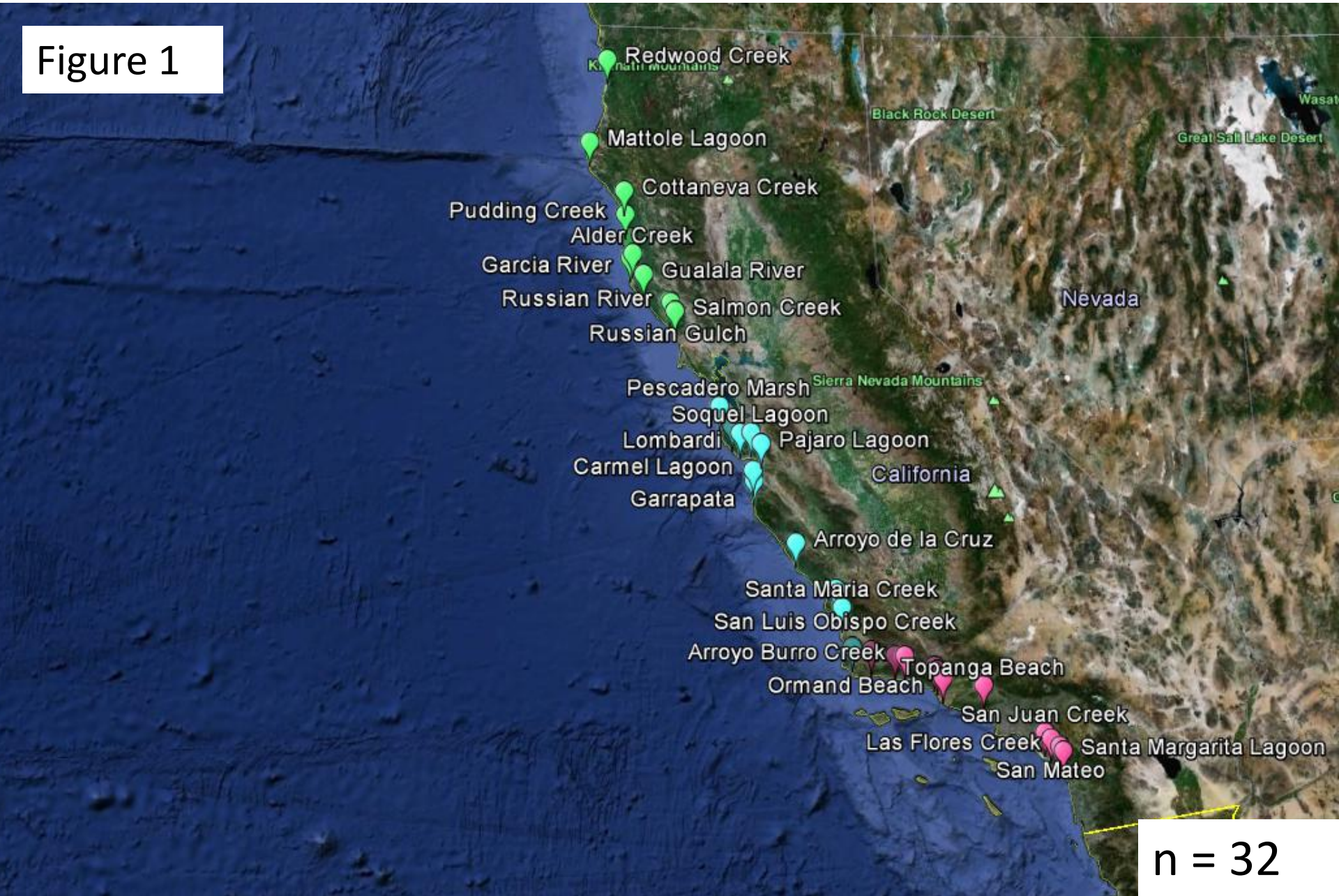
- Functional marsh plain
- Levees – disconnection
- Bridge restricting mouth

Soquel Creek

- No marsh plain
- Hard structure restrict
- Managed mouth

Lagoon CRAM validation sites

Figure 1



CRAM for bar-built estuaries

Attributes	Metrics
Buffer and Landscape Context	stream corridor continuity
	adjacent aquatic area
	marine connectivity
	percent area with buffer
	average buffer width
	buffer condition
Hydrology	water source
	hydroperiod
	hydrologic connectivity
Physical Structure	structural patch richness
	topographic complexity
Biotic Structure	number of plant layers
	number of co-dominants
	percent invasive species
	horizontal interspersion
	vertical biotic structure

Buffer and Landscape Context

Attributes	Metrics	Assessed by
Buffer and Landscape Context	stream corridor continuity	combined total length of non-buffer land cover segments within a distance of 500m upstream
	adjacent aquatic area	extent of aquatic habitat within along four 500m transects parallel to the coast line
	marine connectivity	the extent of anthropogenic disruption of littoral and nutrient exchange with lagoon and adjacent beach (e.g. piers, seawalls, beach cleaning, excessive human visitation)
	percent area with buffer	percent of area surrounded by at least 5m of buffer habitat
	average buffer width	average of eight evenly spaced buffer width measurements up to 250m
	buffer condition	the quality (i.e. native) of vegetation cover, degree of soil disturbance, and degree of human visitation

Hydrology and Physical Structure

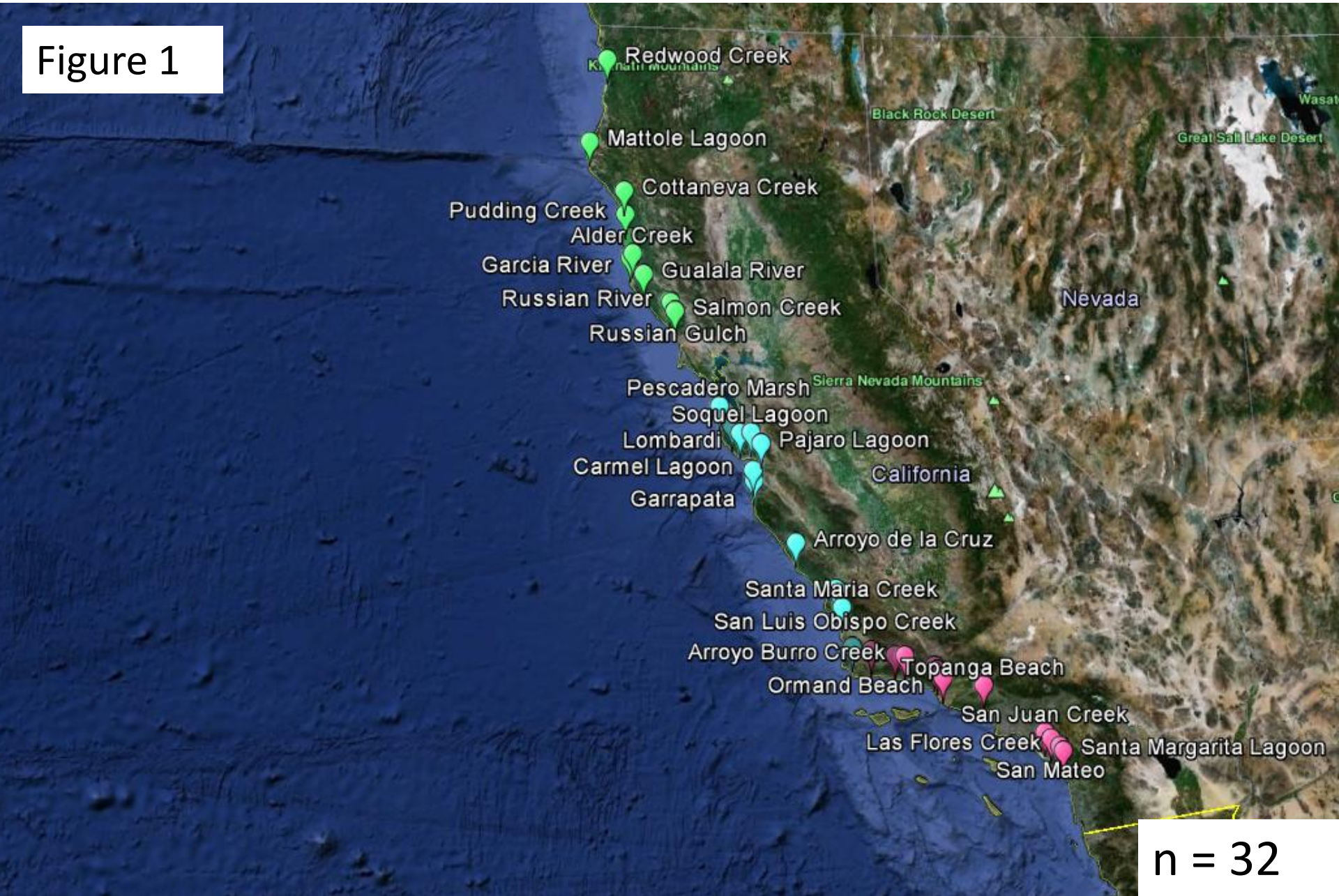
Attributes	Metrics	Assessed by
Hydrology	water source	degree of anthropogenic influence on dry season water sources (e.g. extractions or inputs) within 2km watershed boundary of area
	hydroperiod	degree of anthropogenic alteration to opening / closure dynamics of lagoon mouth
	hydrologic connectivity	the ability of rising water to flow laterally across marsh plain unrestricted by levees or dikes
Physical Structure	structural patch richness	number of patch types observed from a pre-selected list of 27 possible
	topographic complexity	the degree of both micro- and macro-topographic features observed along multiple channel / marsh plain cross-sections

Biotic Structure

Attributes	Metrics	Assessed by
Biotic Structure	number of plant layers	number of five possible plant layers that each cover at least 5% of the area
	number of co-dominants	total number of living plants species that comprise at least 10% of any plant layer
	percent invasive species	the percent of the total number of co-dominants that are on the Cal-IPC invasive species list
	horizontal interspersion	the complexity of the plant zone mosaic
	vertical biotic structure	Assessed in two possible manners: 1) with dominance of a tall plant layer - the degree of overlap of vertical plant layers; 2) without dominance of a tall plant layer - the extent of dense vegetation and litter collected in the vegetative canopy

Lagoon CRAM validation sites

Figure 1



Lagoon CRAM validation sites

CRAM Data:

- **Buffer / Landscape**
- **Hydrology**
- **Physical structure**
- **Biotic structure**
- **Stressors**

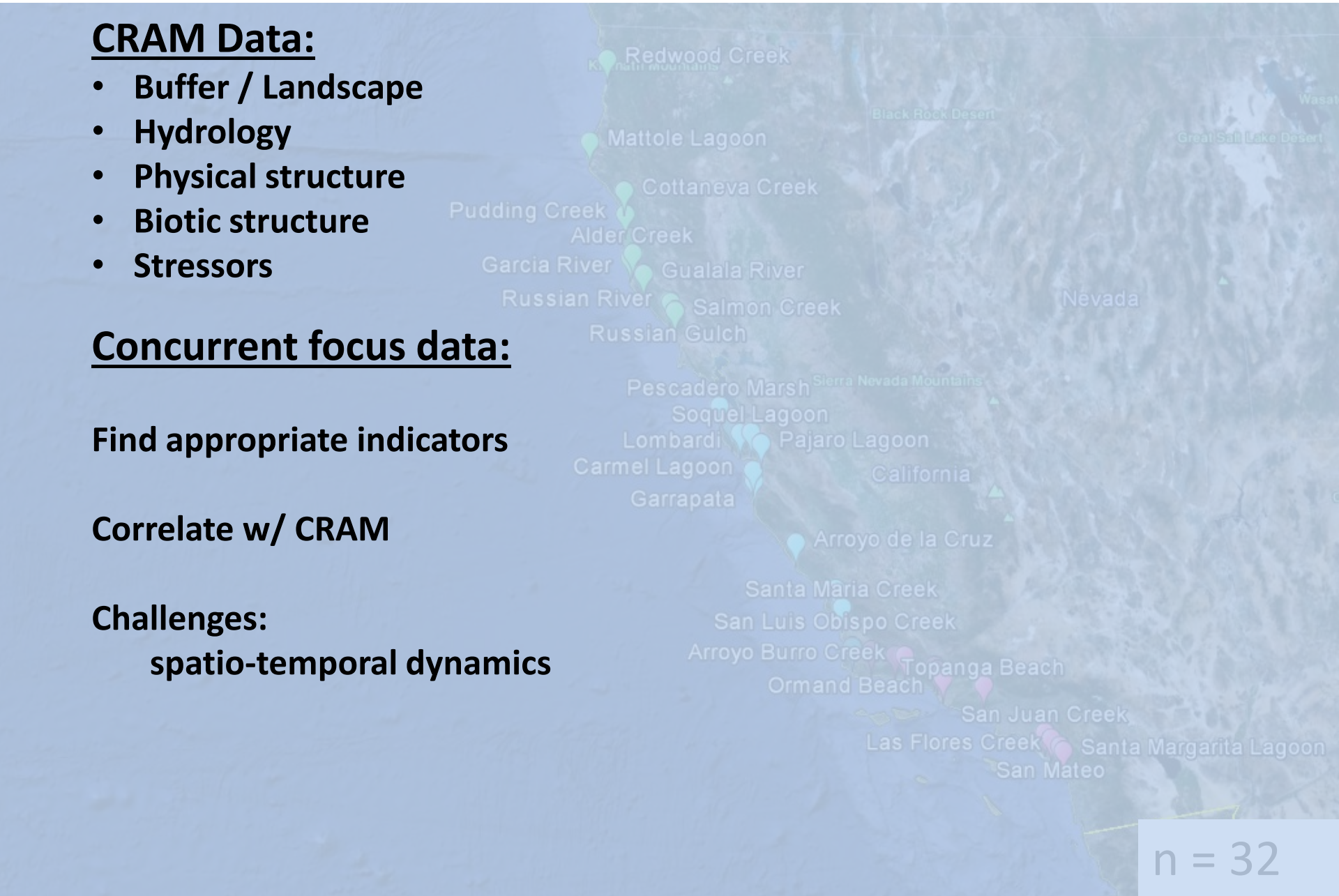
Concurrent focus data:

Find appropriate indicators

Correlate w/ CRAM

Challenges:

spatio-temporal dynamics



n = 32

Data collected at validation sites

CRAM Data:

- Buffer / Landscape
- Hydrology
- Physical structure
- Biotic structure
- Stressors

Bar measurements

Water Quality (3/site):

- Temp
- DO
- Salinity
- PH
- Clarity (Sechi-disc)

Productivity sources:

- Algae –Marine subsidy
- Emergent veg. (CRAM)
- Submergent veg. (CRAM)

GIS landscape stressors

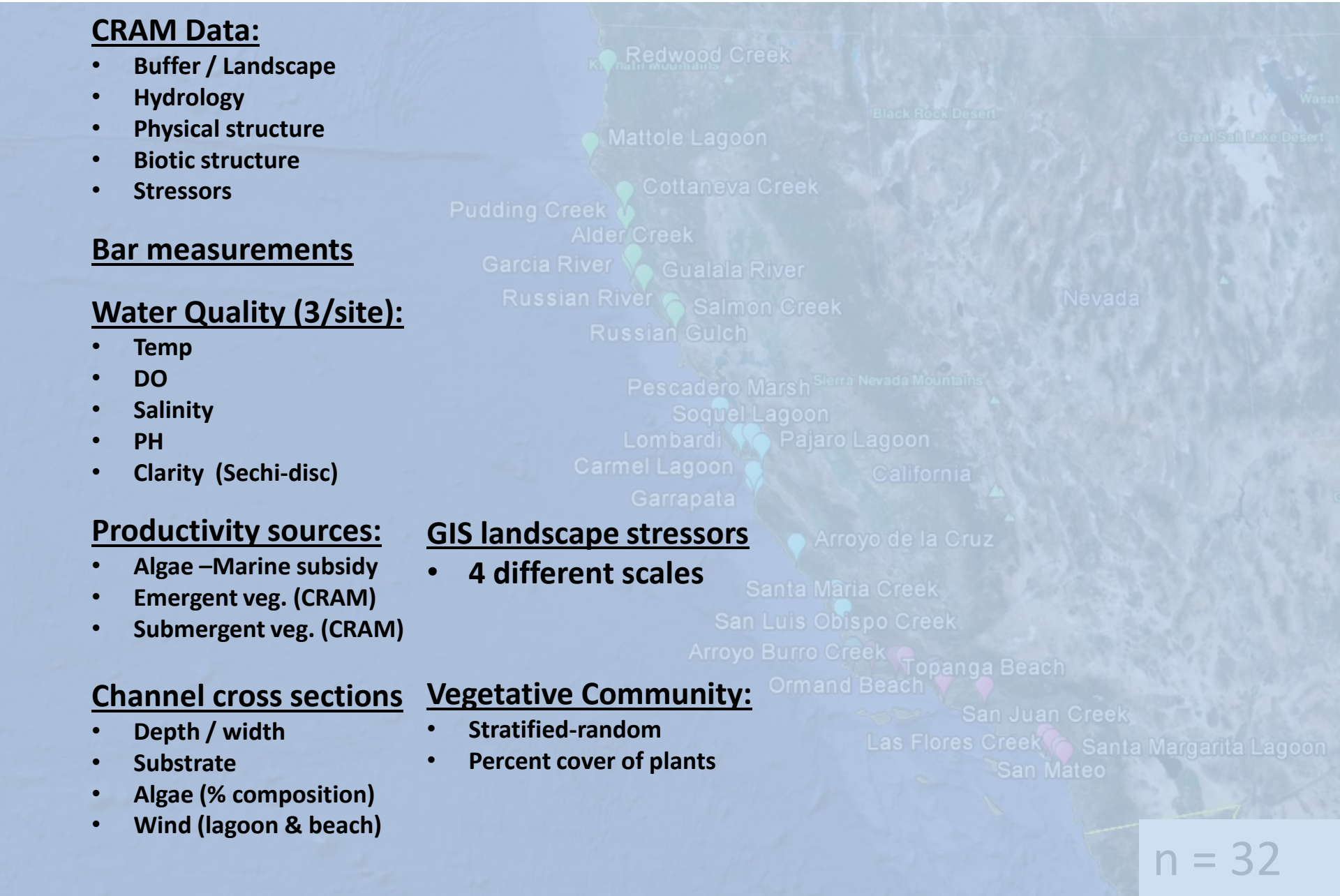
- 4 different scales

Channel cross sections

- Depth / width
- Substrate
- Algae (% composition)
- Wind (lagoon & beach)

Vegetative Community:

- Stratified-random
- Percent cover of plants



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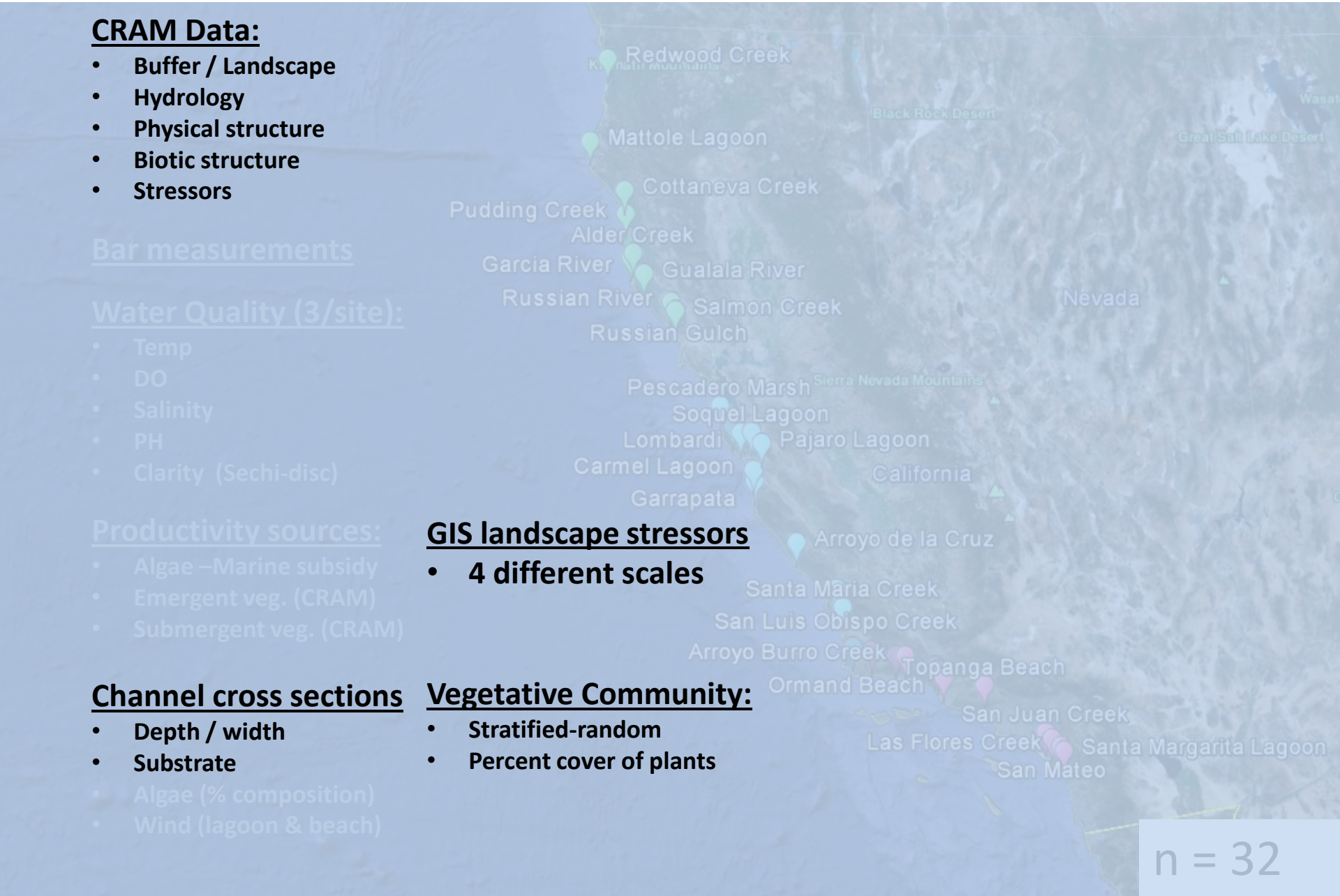


n = 32

expected relationships between CRAM &EMAP

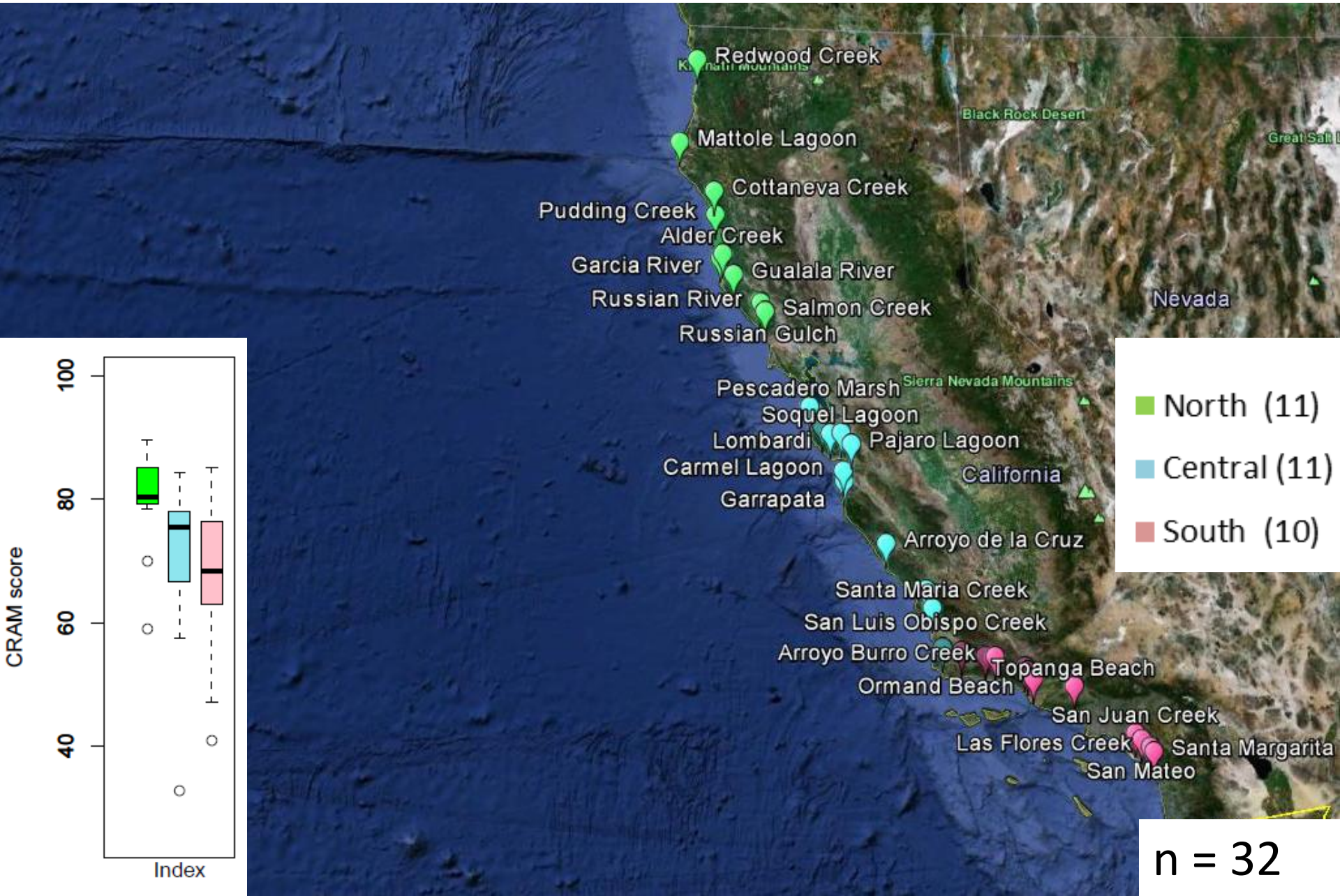
	EMAP metrics				
CRAM Attribute metric	Percent cover of non-natives	Percent cover of invasives	Number of natives	Percent cover of non-natives along backshore	Total species richness
Buffer and Landscape Context	-	-	+	-	+
percent area with buffer	-	-	+	-	+
average buffer width	-	-	+	-	+
buffer condition	-	-	+	-	+
Hydrology	-	-	+	-	+
hydrologic connectivity			+		
hydroperiod	-	-	+		+
Physical	-	-	+	-	+
topographic complexity			+		+
structural patch richness					+
Biotic Structure	-	-	+	-	+
number of co-dominants			+		+
percent invasive species	-	-		-	
Index	-	-	+	-	+

expected relationships between CRAM &Nutrients

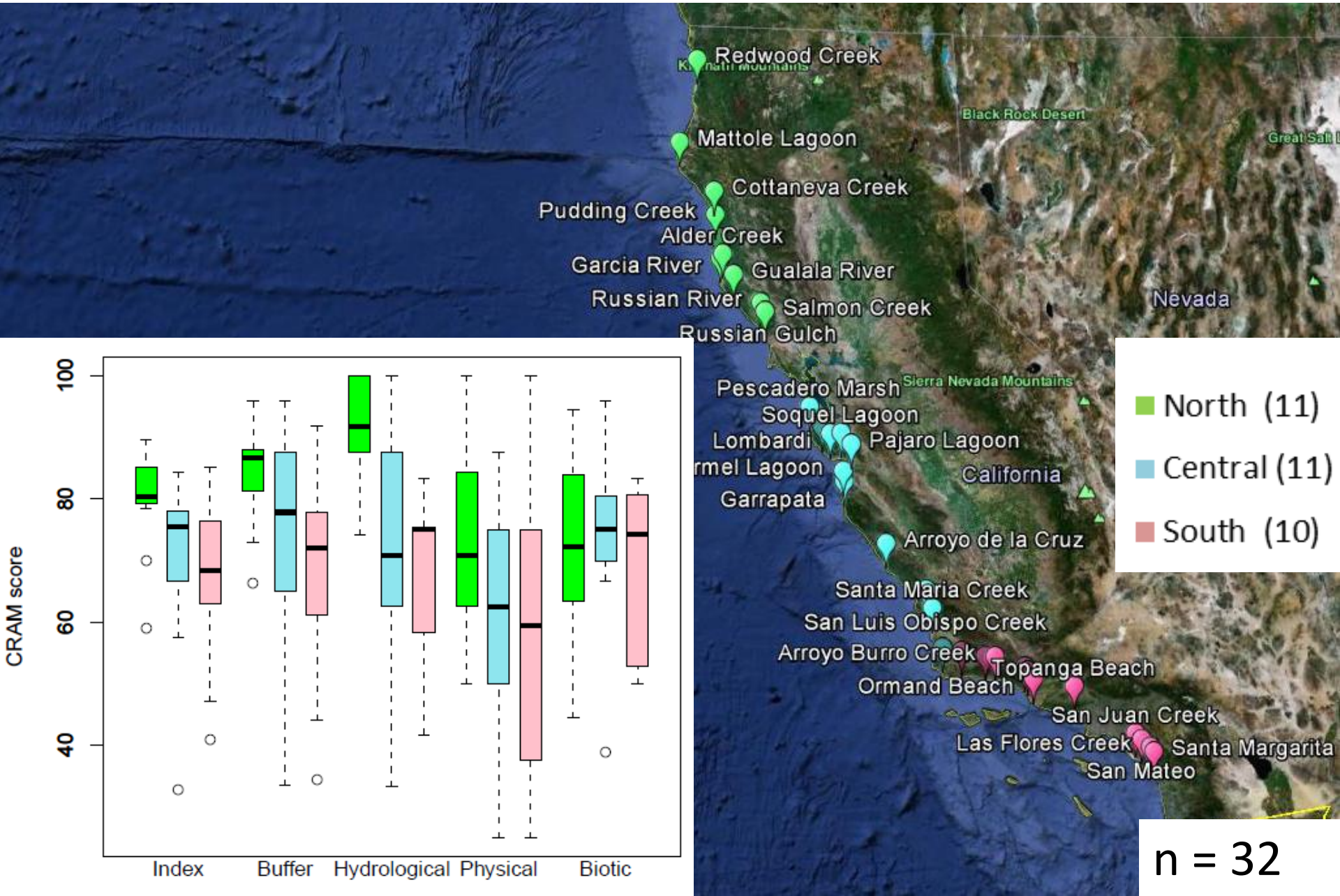
CRAM Attribute metric	Nutrients			
	NH_3	NO_2^-	NO_3^-	PO_4^{-3}
Buffer and Landscape Context	-	-	-	-
percent area with buffer	-	-	-	-
average buffer width	-	-	-	-
buffer condition	-	-	-	-
Hydrology	-	-	-	-
water source	-	-	-	-
hydroperiod	-	-	-	-
Physical	-	-	-	-
Biotic Structure	-	-	-	-
Index	-	-	-	-

CRAM	Level 1 landscape measures					
Attribute metric	Percent impervious surfaces	Percent agriculture	Percent dams*	Density artificial channel**	Density CWIQS **	Density gravel mines ***
Buffer and Landscape	ws,wsb, 2k, 2kb	ws,wsb, 2k, 2kb	ws	ws, 2k	ws, 2k	ws,wsb,
stream corridor	2k, 2kb			2k		
adjacent aquatic	2k, 2kb	2k, 2kb		2k		
Hydrology	ws,wsb, 2k, 2kb	ws,wsb, 2k, 2kb	ws	ws, 2k	ws, 2k	ws,wsb
water source	2k, 2kb	2k, 2kb				
Physical	ws,wsb, 2k, 2kb	ws,wsb, 2k, 2kb	ws	ws, 2k	ws, 2k	ws,wsb
topographic complexity	ws,wsb, 2k, 2kb	ws,wsb, 2k, 2kb	ws	ws, 2k		ws,wsb
structural patch richness	ws,wsb, 2k, 2kb	ws,wsb, 2k, 2kb	ws	ws, 2k		ws,wsb
Biotic Structure	ws,wsb, 2k, 2kb	ws,wsb, 2k, 2kb	ws	ws, 2k	ws, 2k	ws,wsb
Index	ws,wsb, 2k, 2kb	ws,wsb, 2k, 2kb	ws	ws, 2k	ws, 2k	ws,wsb

Validation site index scores by region



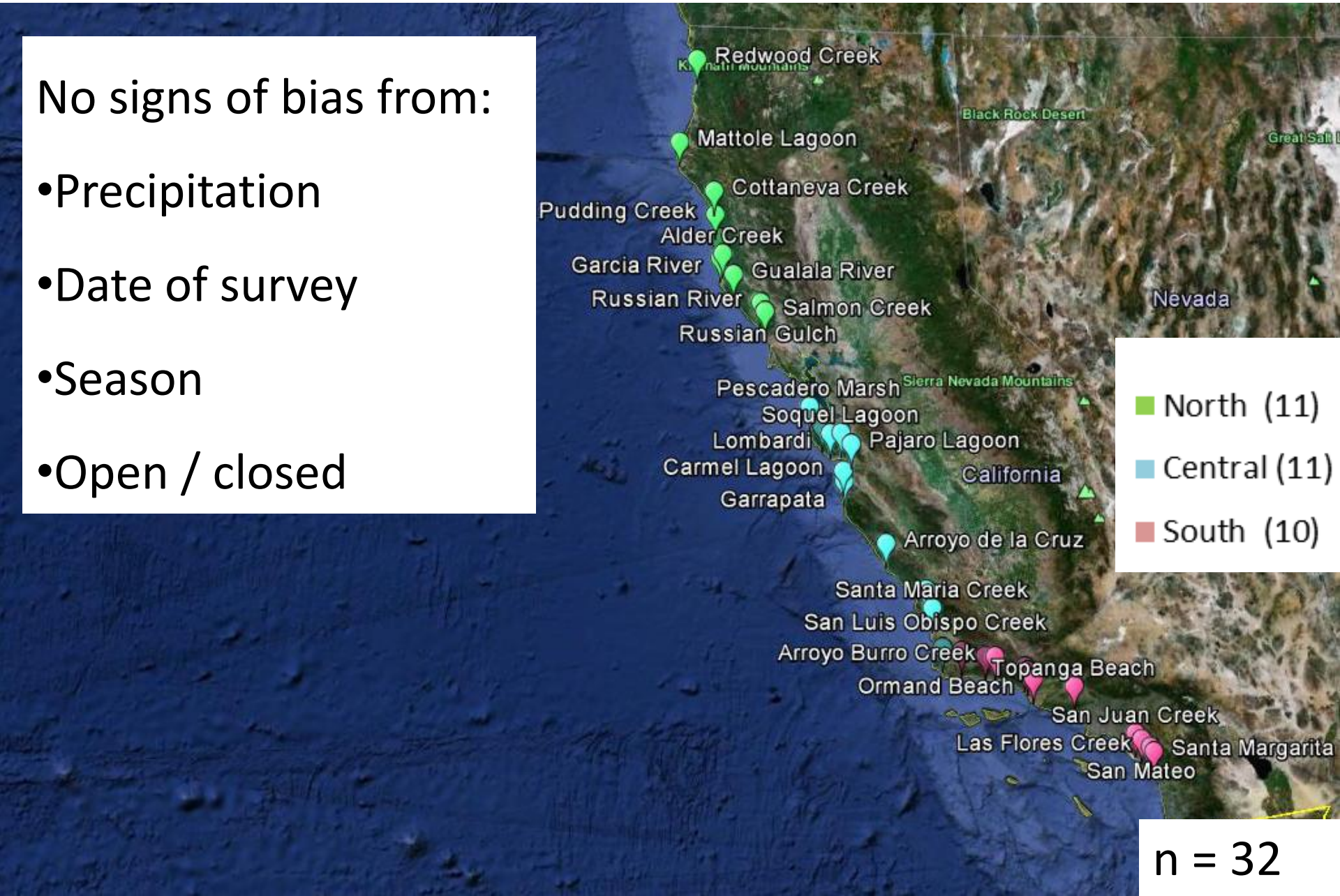
Validation site scores by region

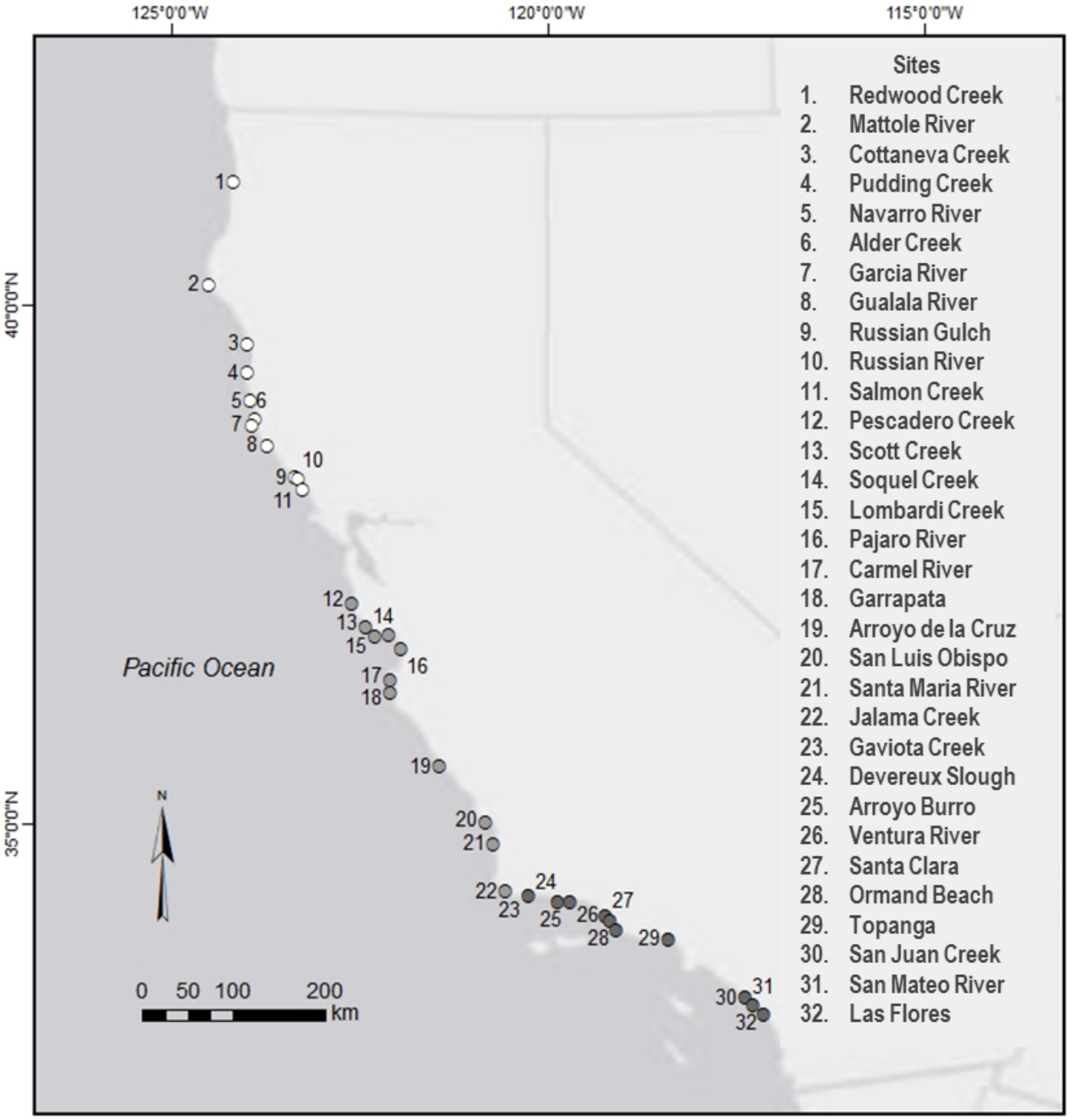


Validation site scores by region

No signs of bias from:

- Precipitation
- Date of survey
- Season
- Open / closed



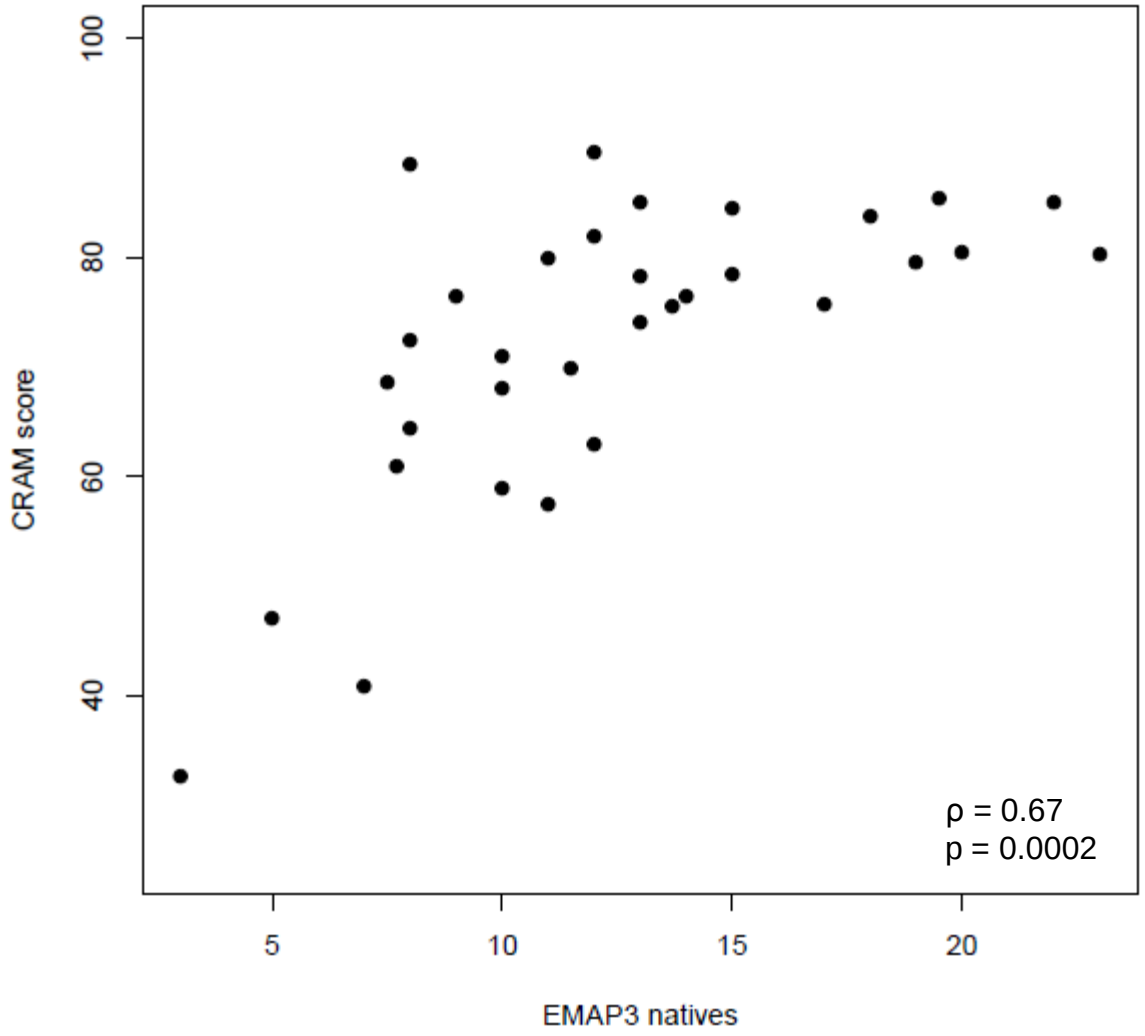

125°0'0"W
120°0'0"W
115°0'0"W
40°0'0"N
35°0'0"N
Pacific Ocean
N
0 50 100 200
km
Sites
1. Redwood Creek
2. Mattole River
3. Cottaneva Creek
4. Pudding Creek
5. Navarro River
6. Alder Creek
7. Garcia River
8. Gualala River
9. Russian Gulch
10. Russian River
11. Salmon Creek
12. Pescadero Creek
13. Scott Creek
14. Soquel Creek
15. Lombardi Creek
16. Pajaro River
17. Carmel River
18. Garrapata
19. Arroyo de la Cruz
20. San Luis Obispo
21. Santa Maria River
22. Jalama Creek
23. Gaviota Creek
24. Devereux Slough
25. Arroyo Burro
26. Ventura River
27. Santa Clara
28. Ormand Beach
29. Topanga
30. San Juan Creek
31. San Mateo River
32. Las Flores

significant correlations
CRAM & EMAP

Metric	L3	ρ	p-value
Buffer and Landscape	Number of natives	0.59	0.0069
buffer width	Total species richness	0.55	0.0105
Hydrology	Number of natives	0.51	0.0135
Hydrology	Total species richness	0.46	0.0262
hydroperiod	Total species richness	0.45	0.0260
hydrologic connectivity	Number of natives	0.54	0.0156
Physical	Number of natives	0.53	0.0146
topographic complexity	Number of natives	0.49	0.0195
Biotic	Number of natives	0.51	0.0282
number of codominants	Number of natives	0.51	0.0141
number of invasives	Percent non-natives	-0.50	0.0117
number of invasives	Percent non-natives along backshore	-0.42	0.0397
Index	Number of natives	0.67	0.0002

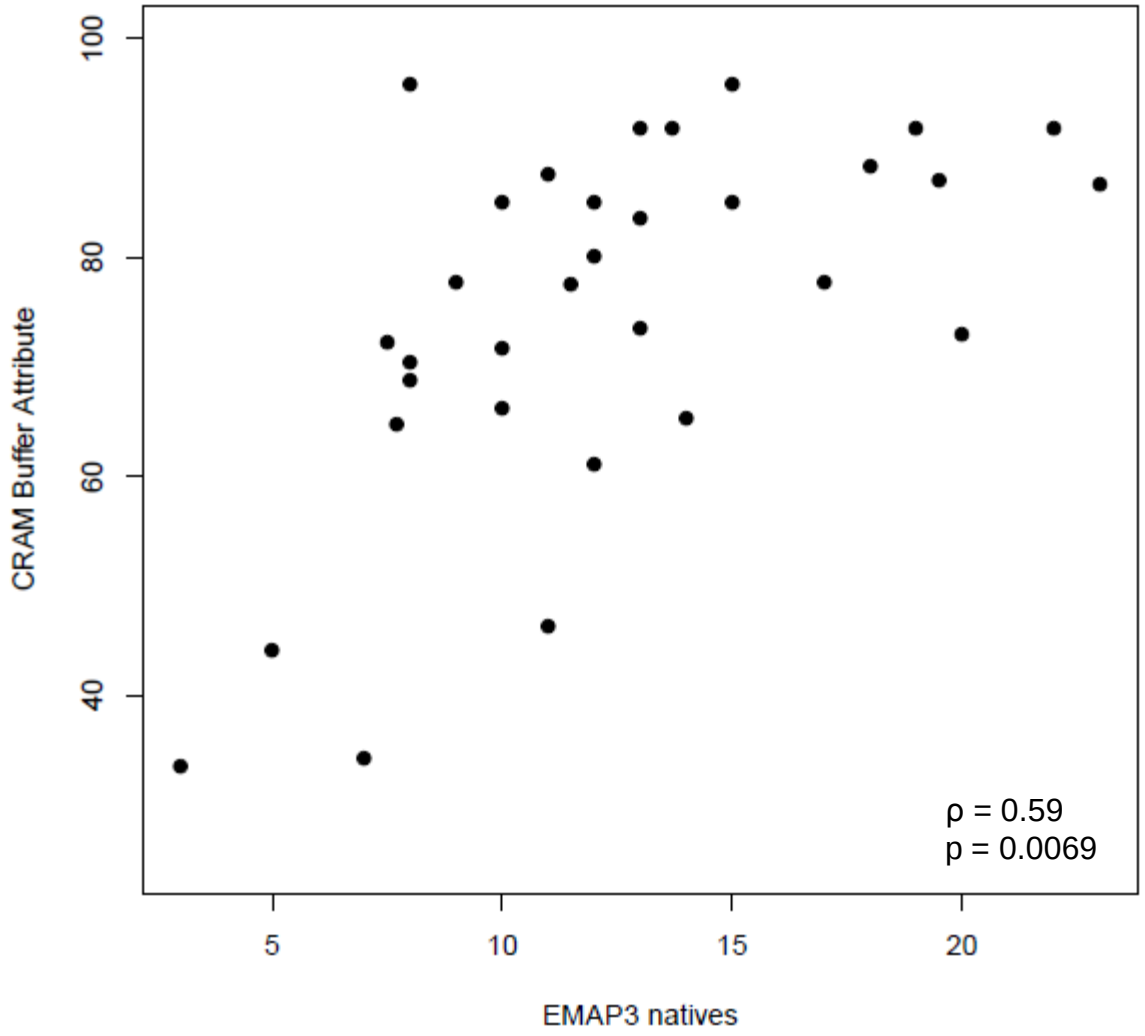
CRAM Index vs EMAP natives

Figure 3.



CRAM Buffer vs EMAP natives

Figure 4.

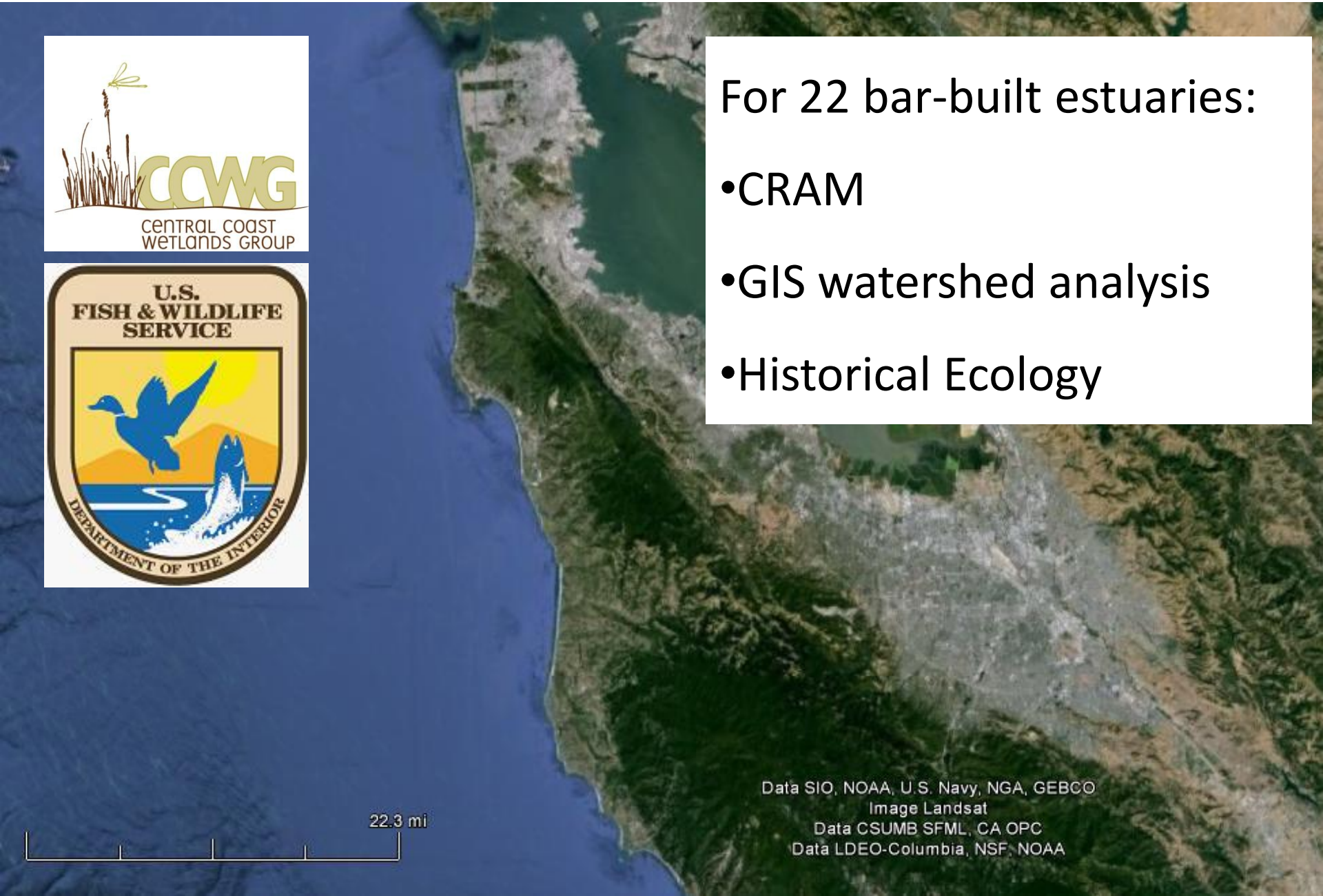


significant correlations
CRAM & Nutrients

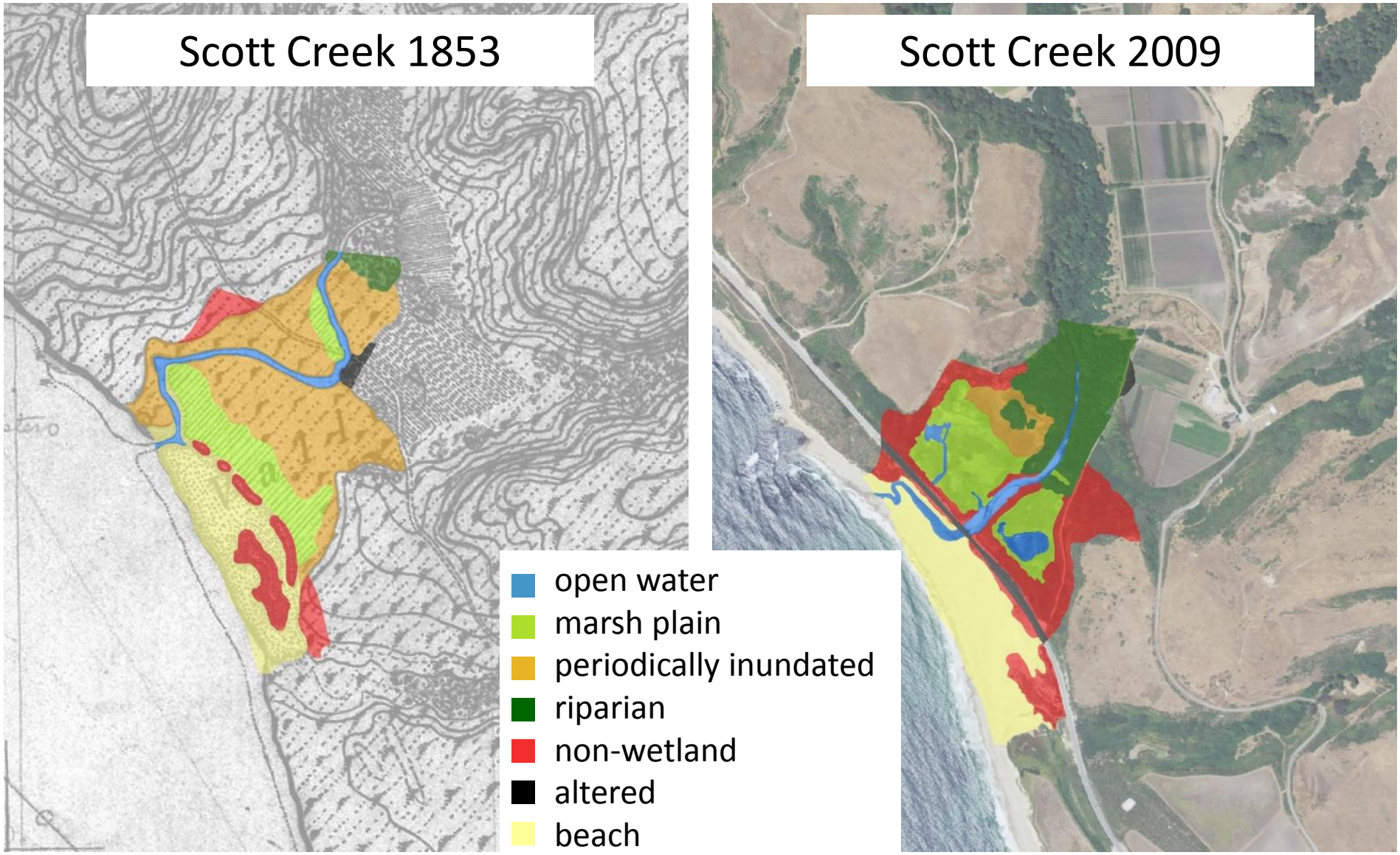
CRAM	Nutrient	ρ	p-value
Hydrology	NH_3	-0.45	0.0321
Hydrology	NO_2^-	-0.59	0.0022
Hydrology	NO_3^-	-0.40	0.0469
hydrologic connectivity	NO_2^-	-0.43	0.0385
water source	NH_3	-0.66	0.0003
water source	NO_2^-	-0.73	0.0000
water source	NO_3^-	-0.41	0.0453
water source	PO_4^{-3}	-0.48	0.0238

		Watershed		2km Boundary		Watershed stream buffer		2km stream buffer	
CRAM	GIS data	ρ	p-value	ρ	p-value	ρ	p-value	ρ	p-value
Buffer and Landscape	Percent Impervious	-0.61	0.0015	-0.68	0.0002	-0.58	0.0014	-0.69	0.0001
stream corridor	Percent Impervious			-0.49	0.0213			-0.44	0.0214
adjacent aquatic area	Percent Impervious							-0.40	0.0295
adjacent aquatic area	Percent Agricultural			0.47	0.0218			0.44	0.0299
Hydrology	Percent Impervious	-0.63	0.0006	-0.51	0.0110	-0.61	0.0007	-0.48	0.0232
Hydrology	Percent Agriculture	-0.44	0.0356	-0.47	0.0163	-0.44	0.0174	-0.40	0.0309
Hydrology	Percent Dams	-0.42	0.0332	--	--	--	--	--	--
Hydrology	Density of Gravel Mines			--	--	-0.42	0.0166	--	--
water source	Percent Impervious			-0.53	0.0115			-0.45	0.0211
water source	Percent Agricultural			-0.45	0.0175				
Index	Percent Impervious	-0.58	0.0032	-0.53	0.0070	-0.55	0.0030	-0.49	0.0085

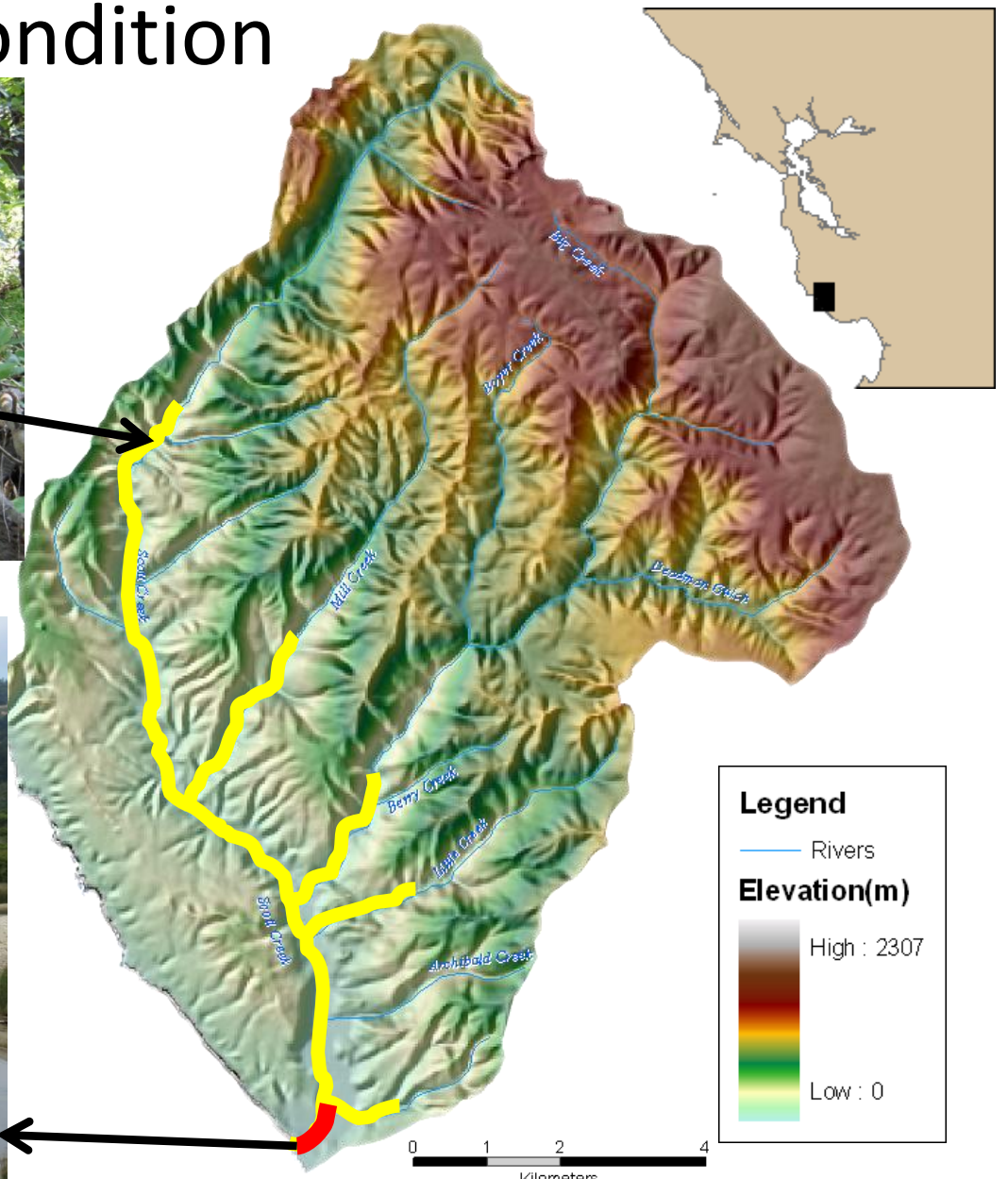
A partnership to direct applied management



Analysis of habitat loss and change in past 150 years



Benefit local, watershed, and bar-built estuary condition



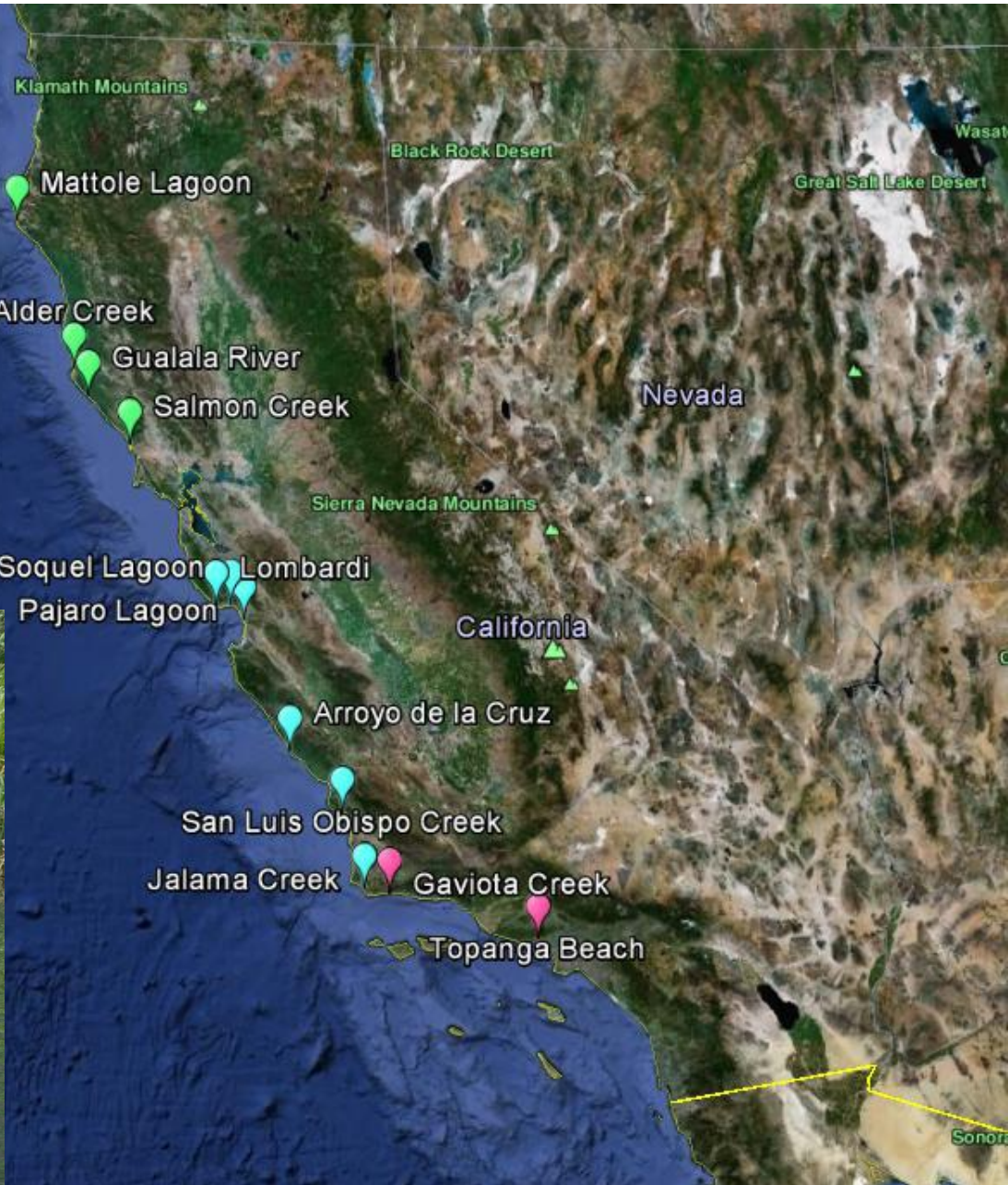
Map: Rob Schick, NMFS

Management and conservation prioritization

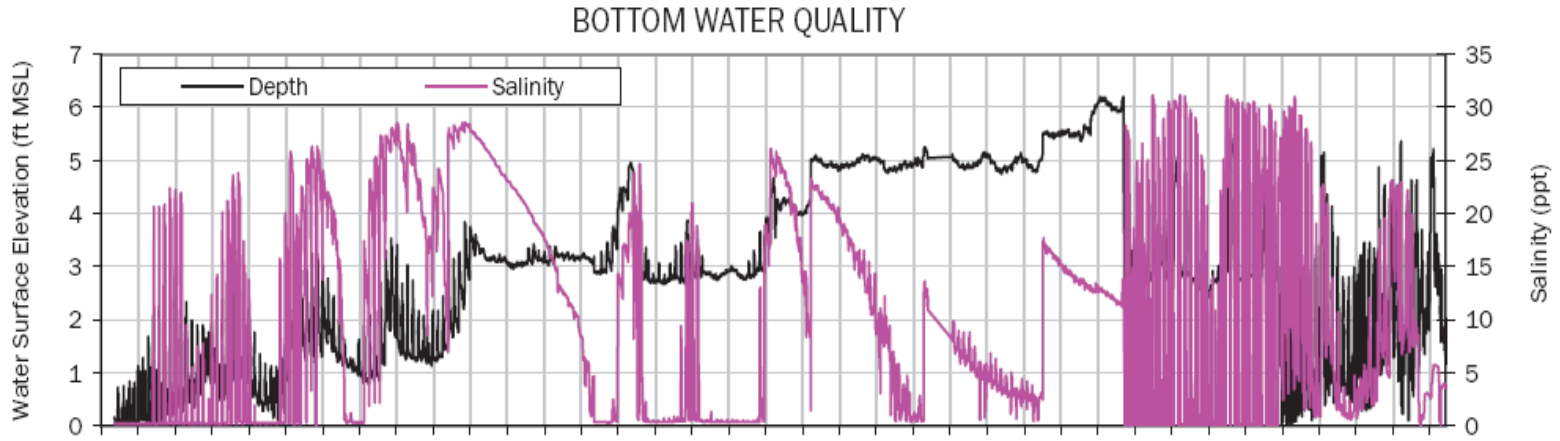
For 22 bar-built estuaries:

- Watershed health
- Bar-built estuary health
- Historic loss/alteration
- Combined to direct restoration and conservation

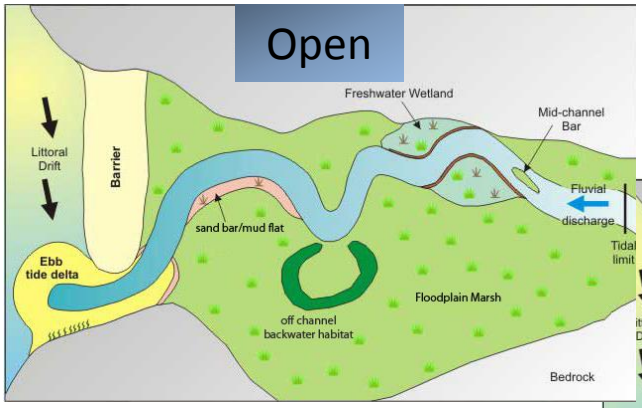
Water elevation data at 12 lagoons

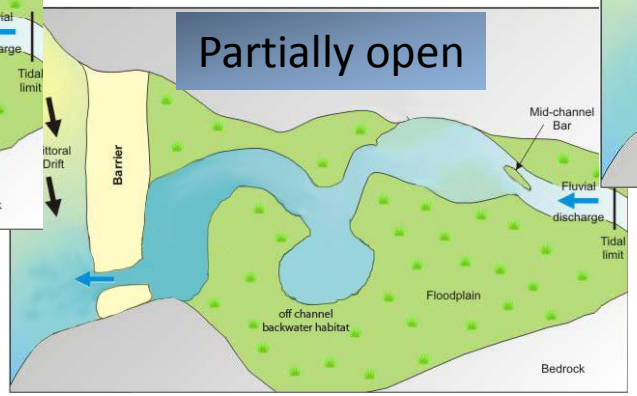


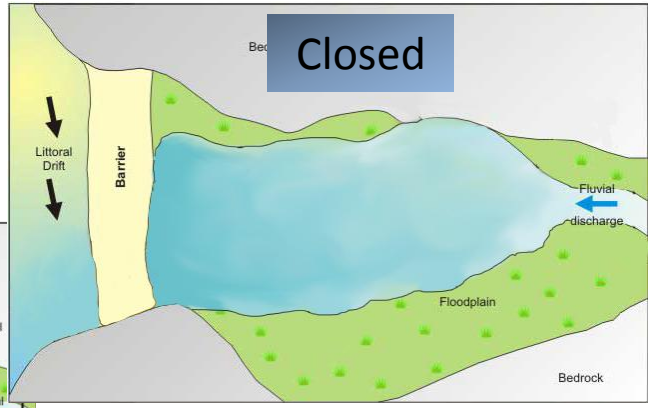
The characterization of spatio-temporally variable systems using CRAM…



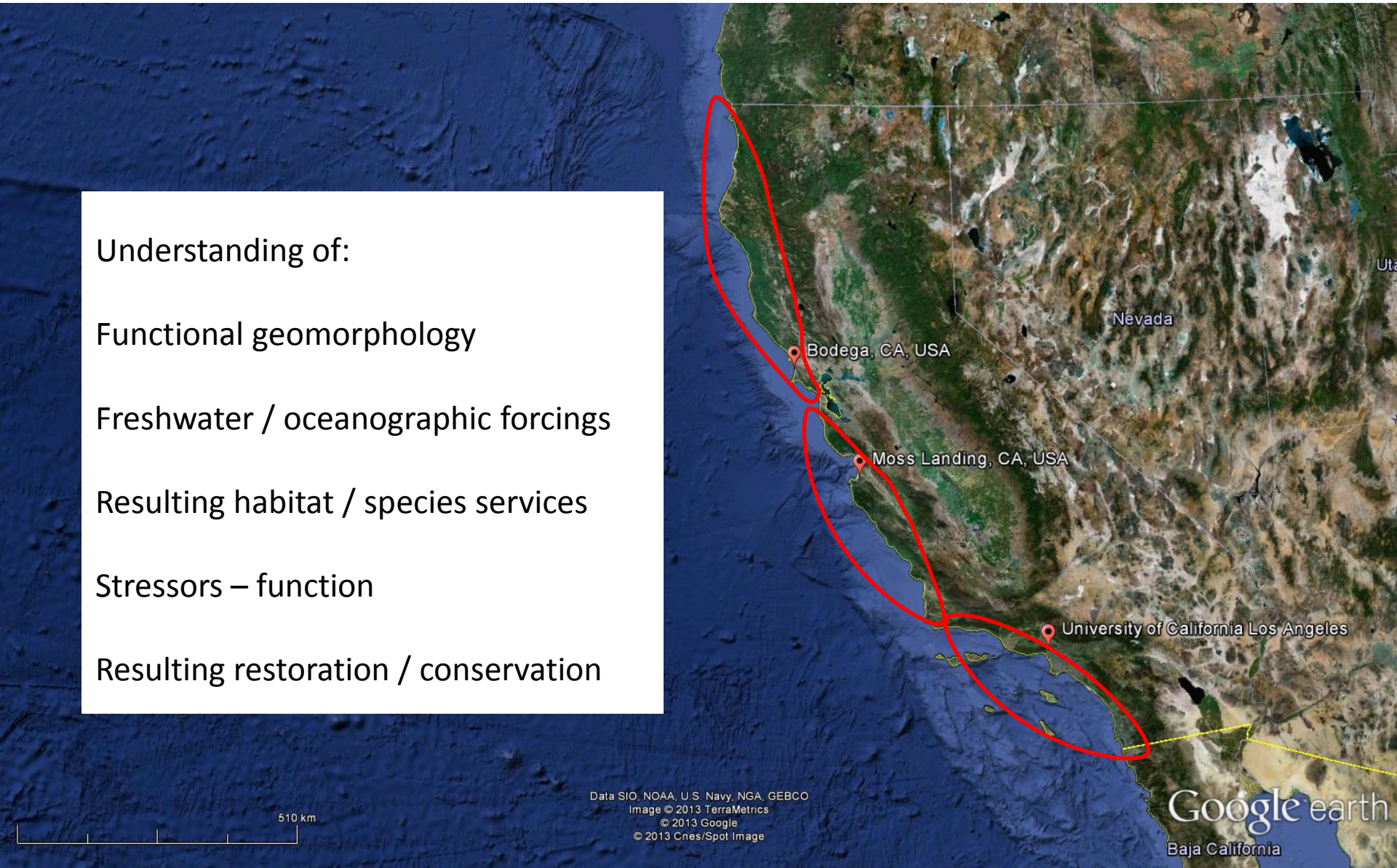
Open Partially open Closed Open







Tri-institute collaboration



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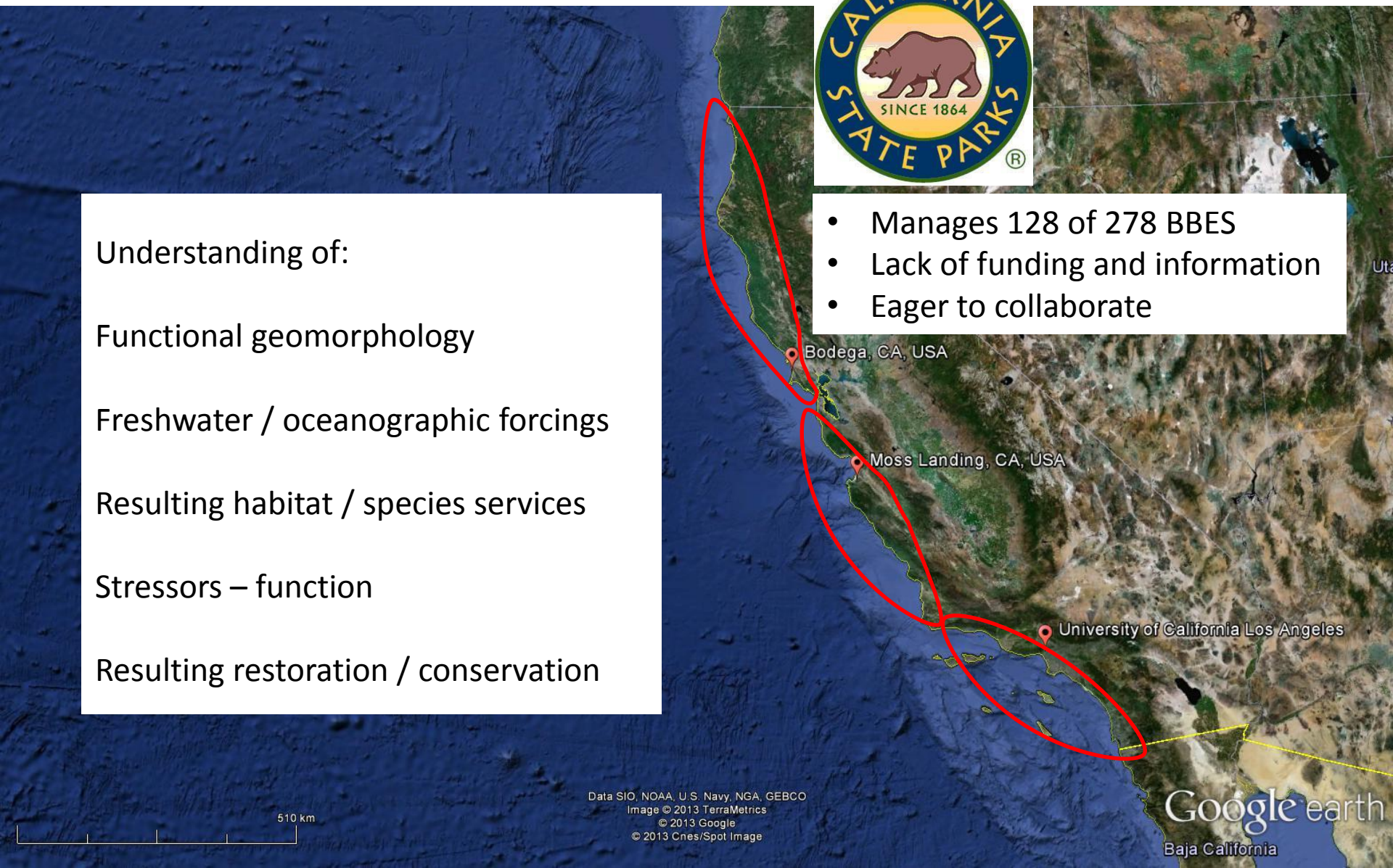


Understanding of:

Functional geomorphology

Freshwater / oceanographic forcings

Resulting habitat / species services

Stressors – function

Resulting restoration / conservation

- Manages 128 of 278 BBES
- Lack of funding and information
- Eager to collaborate

Data collected for ambient survey

<u>CRAM Data:</u>

- Buffer / Landscape
- Hydrology
- Physical structure
- Biotic structure
- Stressors

<u>Bar measurements</u>

<u>Water Quality (3/site):</u>

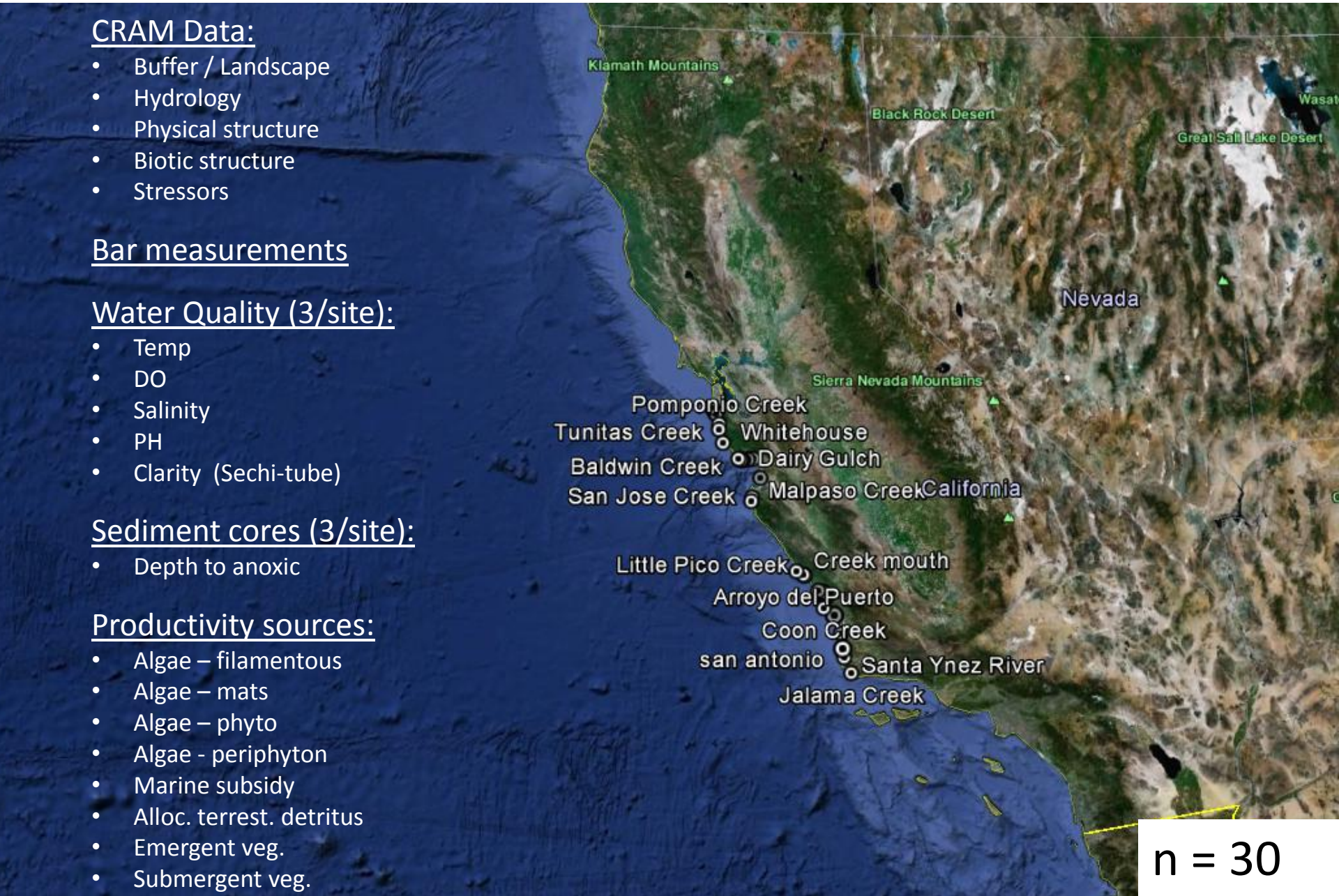
- Temp
- DO
- Salinity
- PH
- Clarity (Sechi-tube)

<u>Sediment cores (3/site):</u>

- Depth to anoxic

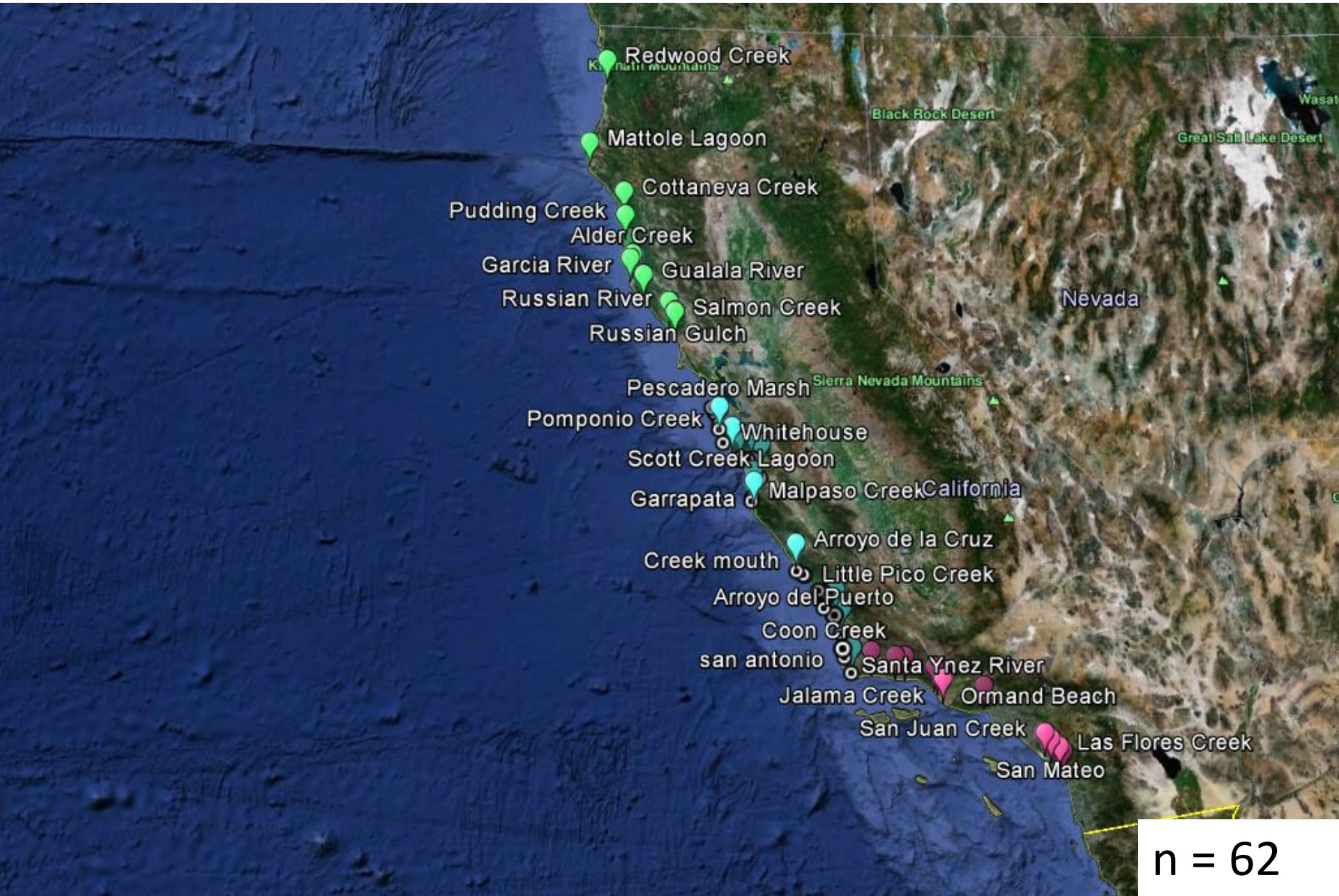
<u>Productivity sources:</u>

- Algae – filamentous
- Algae – mats
- Algae – phyto
- Algae - periphyton
- Marine subsidy
- Alloc. terrest. detritus
- Emergent veg.
- Submergent veg.



n = 30

All lagoon CRAM sites



n = 62

Coastal confluence inventory of California

Pacific Marine and Estuarine

NATIONAL FISH HABITAT PARTNERSHIP

The Nature Conservancy
Protecting nature. Preserving life.™

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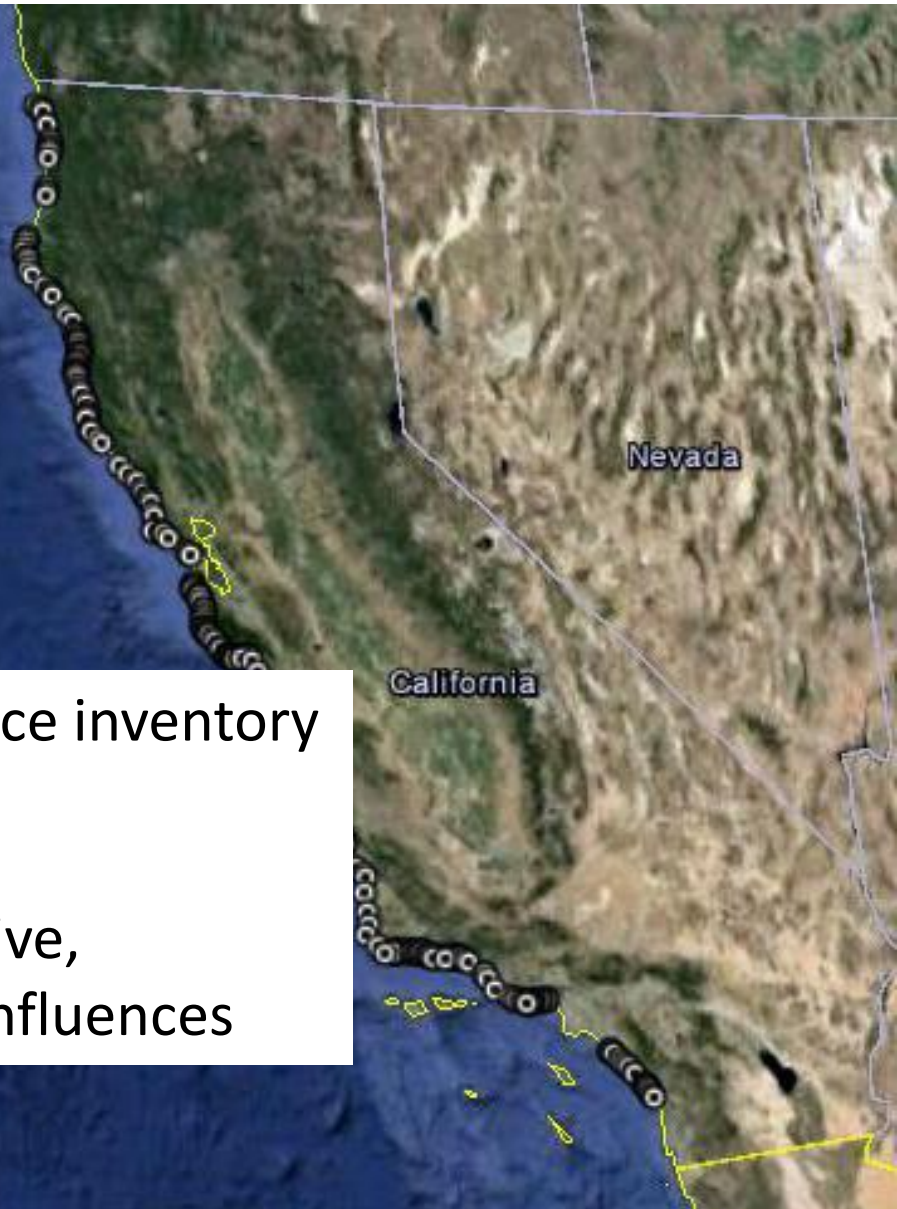
Central Coast Wetlands Group



- Finalize California coastal confluence inventory
- Update geodatabase for inventory
- Help create updatable, authoratative, geodatabase for all 592 coastal confluences

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