Bay Area Stream-Side Encampments In The Context Of Stream Habitats, Natural Hazards, And Climate Action

Prof. Gregory B. Pasternack

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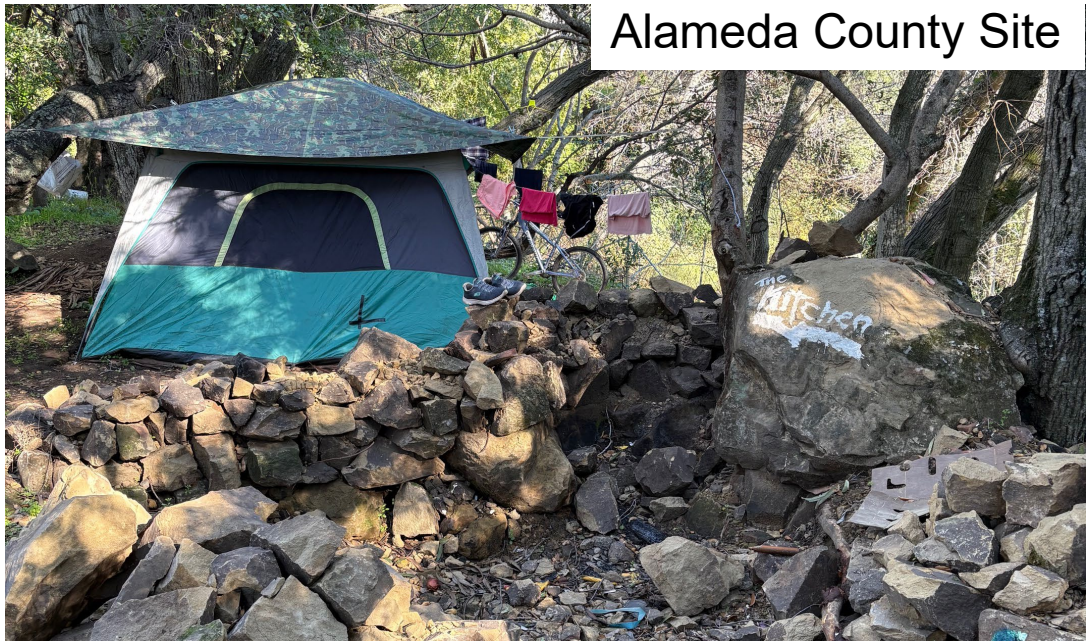
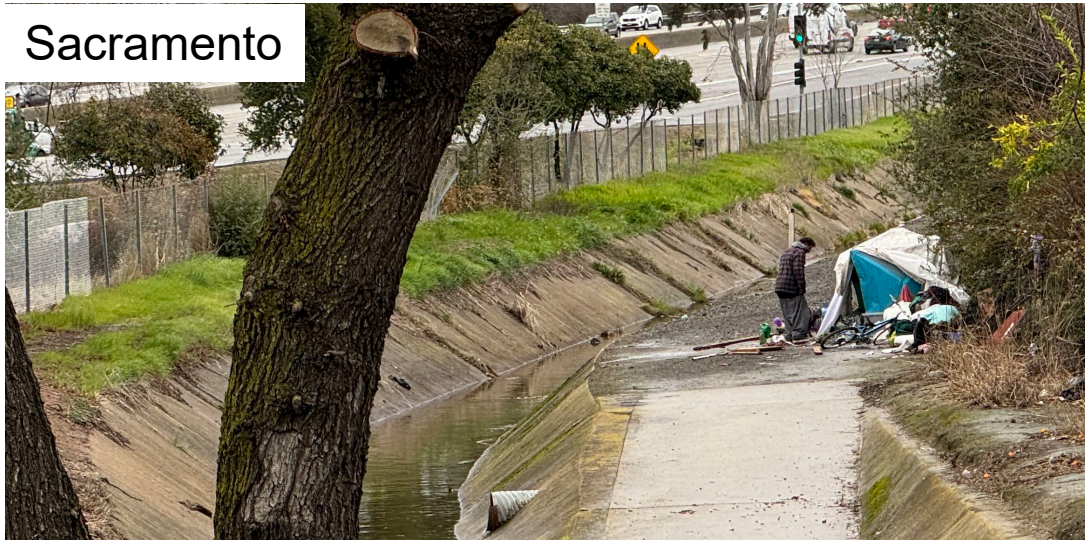
Stream-Side Encampments

In California, thousands to tens of thousands of unsheltered folk are living along streams.


Alameda County Site


San Jose


Sacramento

SF Bay Area Climate Action Stream Encampment Study

UC DAVIS
UNIVERSITY OF CALIFORNIA

- 2 Professors
- 2 Postdocs
- 1 PhD student
- 4 Field researchers
- 2 Undergrad employees
- 6 Undergrad interns

SJSU SAN JOSÉ STATE UNIVERSITY

- 2 Professors
- 3 MS students
- 8 Undergrad employees
- 5 Undergrad interns

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

- 1 County Advisor

NAPA RCD

- 1 Ex director
- 2 river scientists
- 1 outreach coordinator
- 1 planner

North Santa Clara Resource Conservation District

- 1 Ex director
- 1 env. scientist
- 1 social services intern

CONTRA COSTA RESOURCE CONSERVATION DISTRICT

- 1 Ex director
- 2 Watershed coordinators
- 1 stream restorer

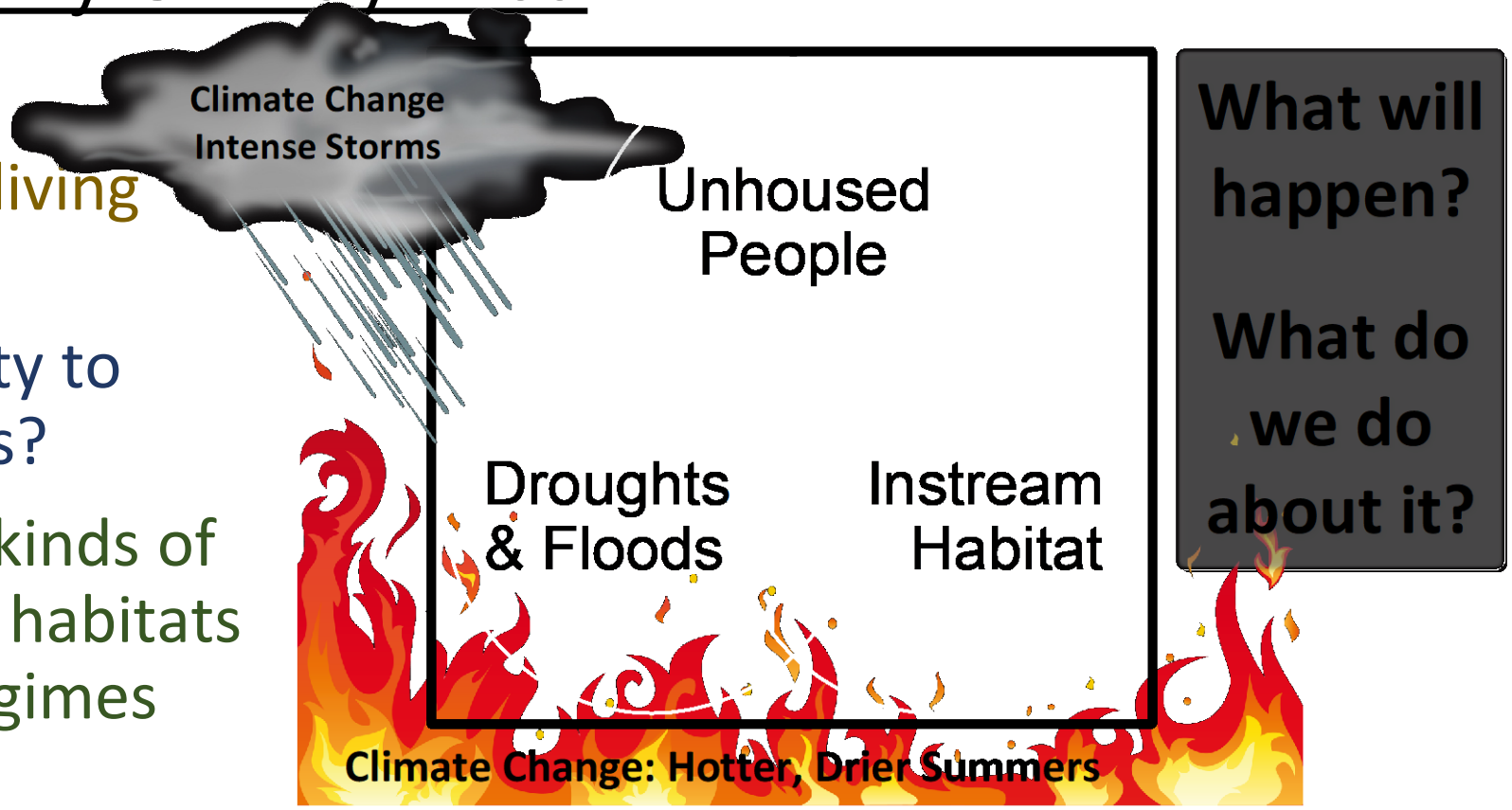
Safety • Risk-Reduction
SafeR³
Resilience • Reliability

- 1 Engineer

SF Bay Area Climate Action Stream Encampment Study

Throughout the 9-County SF Bay Area

- Who are unhoused folk living along streams?
- What is their vulnerability to wind, rain, & flash floods?
- Do we even know what kinds of streams we have? What habitats we have? What flood regimes we have?



Project Team: UC Davis, SJSU, RCDs (Napa, Contra Costa, and North Santa Clara), UC ANR, and SafeR3

Study Research Components

Camp social survey

Camp condition observational survey

Camp trash survey

Pollution, public transit, and land-use context of camps

Predictions of encampment, habitat, and flood probabilities per 200-m stream interval

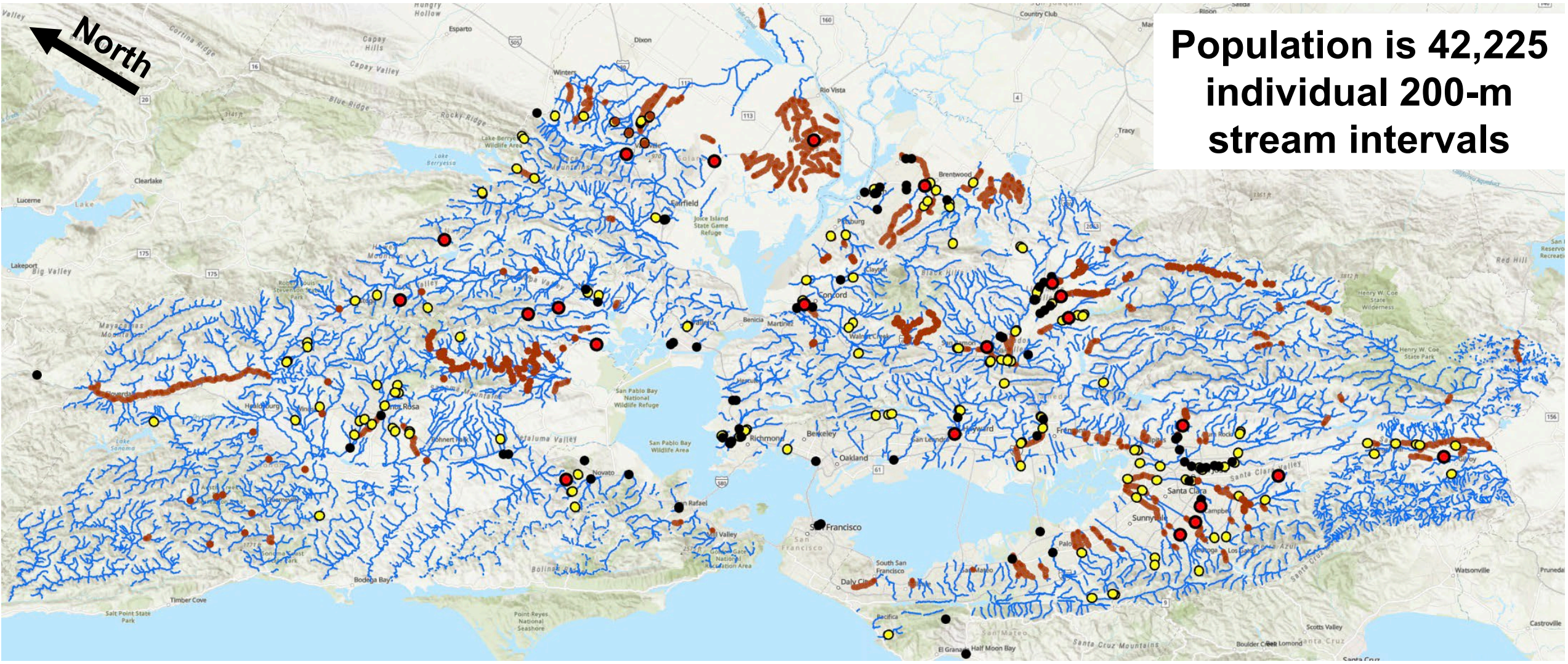
Socio-ecological vulnerability & resilience assessment

Compound rain & wind extreme events 1982-2022, 2034-2066, 2067-2099

Stream geophysical surveys, regional stream classification, and ML prediction of type for all 200-m stream intervals

Mechanistic studies of fish habitat and flooding among stream types

Treating The 9-County Region As A Single System



Study streams in blue. Geophysical sampling sites in yellow. Known stream-side encampments in black. Machine learning stream type label sites in brown. High-resolution survey sites in red.

Insights from 300 Interviews With Residents

Climate & Natural Hazard Awareness?

- Many do not actively seek information about weather, ‘take it as it comes’.
- Most never received early warning about heatwave or flash floods, only word of mouth.
- Almost none have gone to a cooling center or warming center to protect themselves against extreme weather events.
- Spend more time in local stores when it gets really hot and they spend more time in their tents when it’s raining
- Living with floods: putting pallets under tents, adding tarps, moving to higher ground
- Almost everyone has experienced a fire.

Burned Tree From Fire In Camp

Analysis by Prof. Costanza Rampini & Abby Espinosa-Gonzalez Bellolio

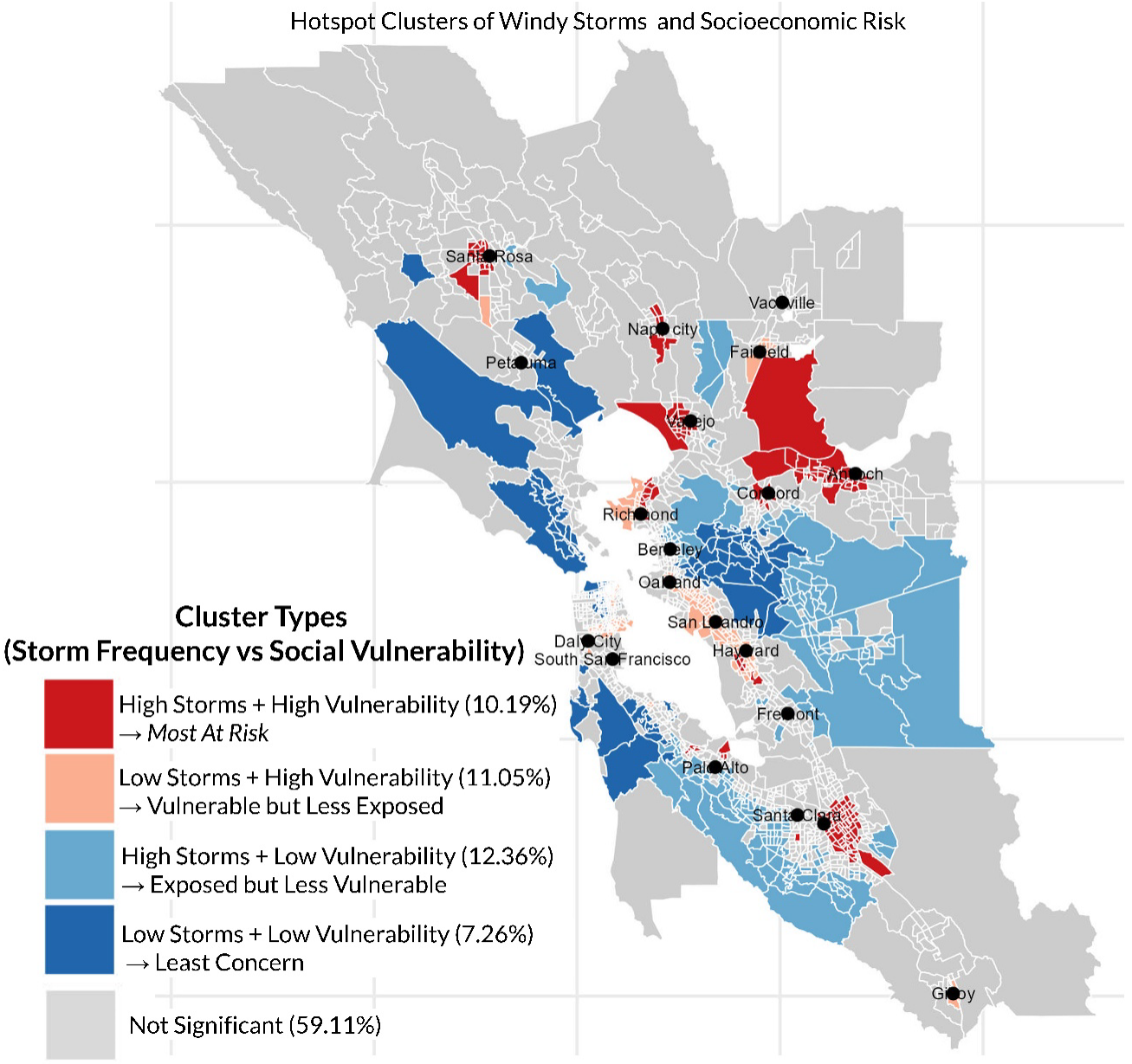
Compound Wind-Rain Extreme Events

Rain risks

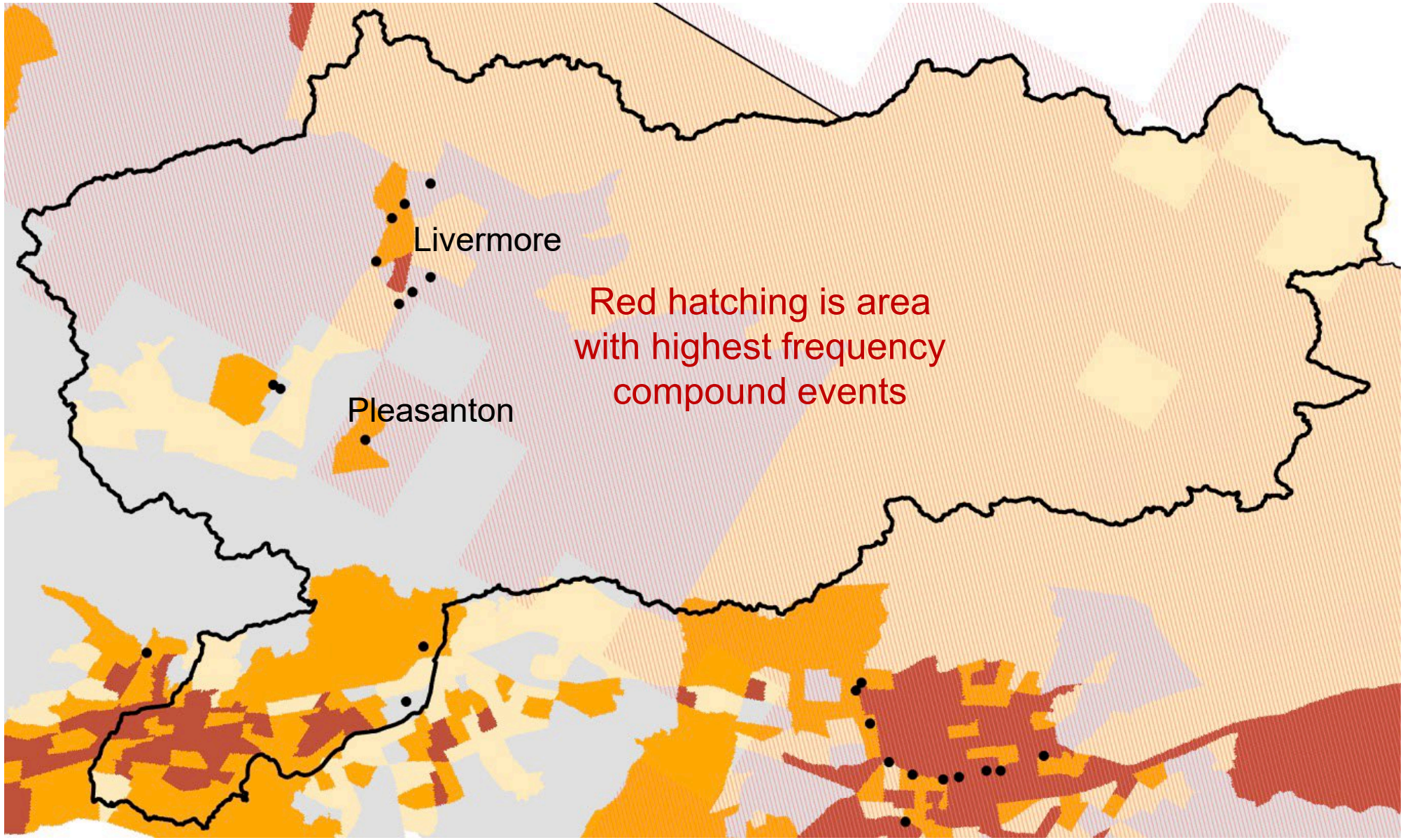
- Drives people into ad hoc shelte on site.
- Mud widespread; fall hazard
- Drives flash floods.

Wind risks

- Damage and destroy ad hoc shelters.
- Cause trees and large branche to fall on people.

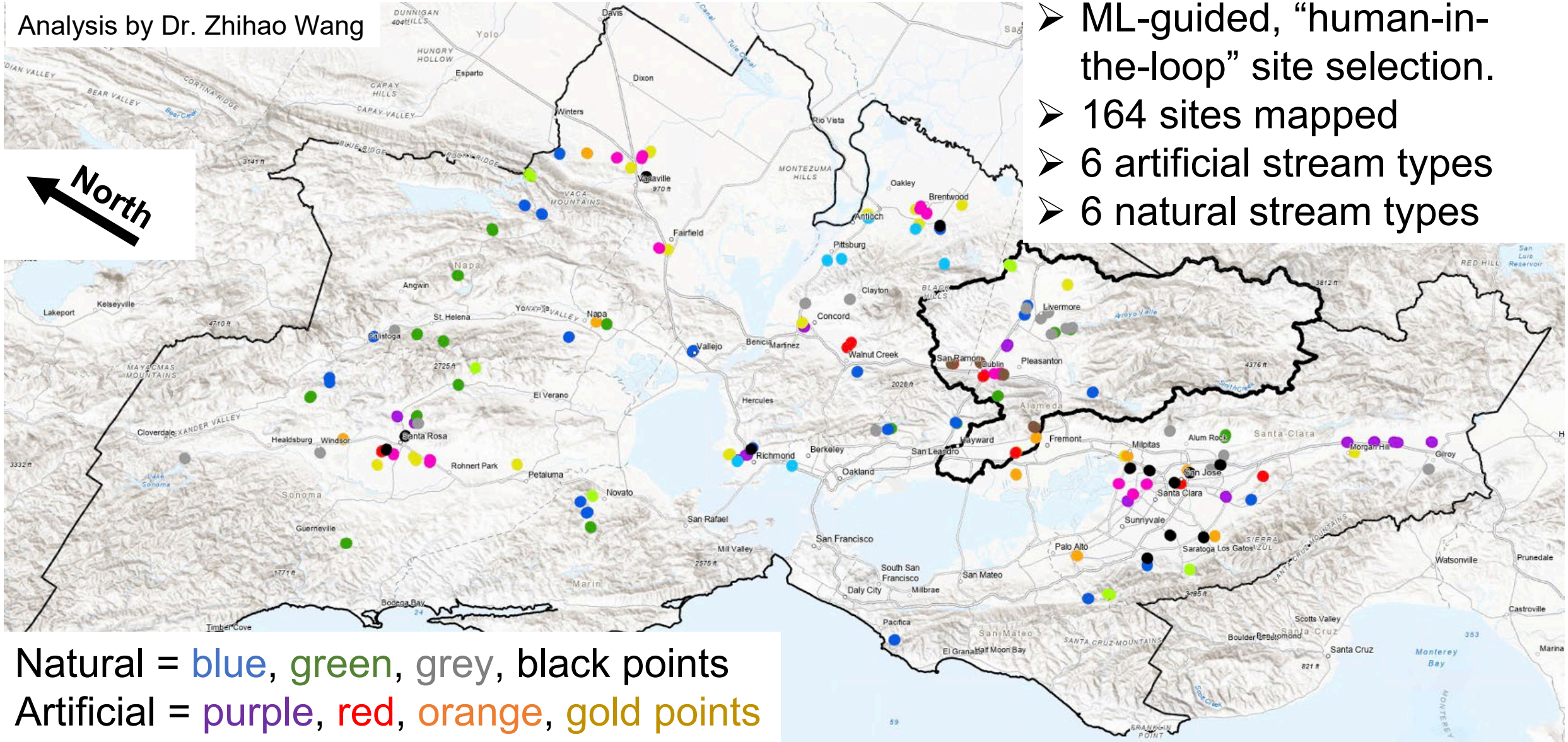


Climate Overlay With Vulnerability



SF Bay Area Stream Classification

Analysis by Dr. Zhihao Wang

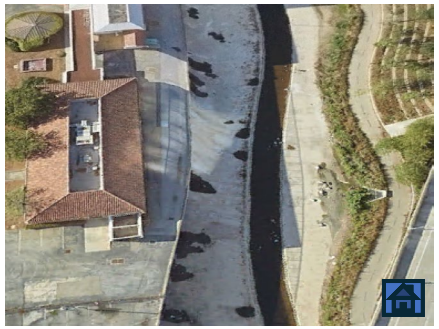


- ML-guided, “human-in-the-loop” site selection.
- 164 sites mapped
- 6 artificial stream types
- 6 natural stream types

Natural = blue, green, grey, black points

Artificial = purple, red, orange, gold points

A1 – Armored channel

A2 – Bank-protected river. Steep, artificial bank composition, mixed-size natural bed composition including coarse sediment

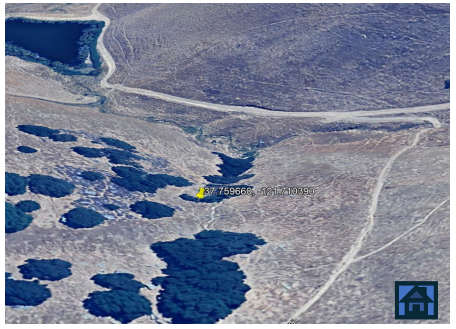

A3 – Naturalizing canal. Deeply entrenched, wide, natural bank composition, strong bed undulations, coarse bed sediment


A4 – Large canal. Deeply entrenched, wide, natural bank composition, plane bed, fine sediment


A5 – Bank-protected canal. Gentle slope, artificial bank composition, and fine bed sediment


A6 – Ditch. Low to moderate entrenchment, gently sloped, natural bank composition, plane bed, fine bed sediment

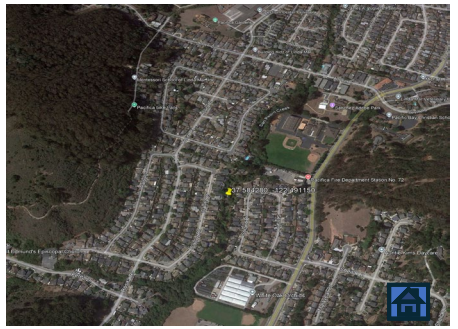

N1 – Headwater steep stream. Highly confined, steep, gravel-to-boulder sediment, and strong undulations

N2 – Lowland small stream. Unconfined, low-slope, fine sediment, strong bed undulations; may have poorly-defined banks


N3 – Mountain stream. Confined, moderate slope, gravel sediment and strong undulations


N4 – Entrenched riffle-pool stream. Partially confined, moderate slope, deeply entrenched, gravel sediment, bed undulations

N5 – Valley floor riffle-pool stream. Partial to low confinement, moderate to low entrenchment, gravel sediment, and bed-elevation undulation


N6 – Large, entrenched lowland stream. Large unconfined valley, deeply entrenched, low slope, wide/deep, strong bed undulations, & fine sediment


Stream Type Prediction ML Model

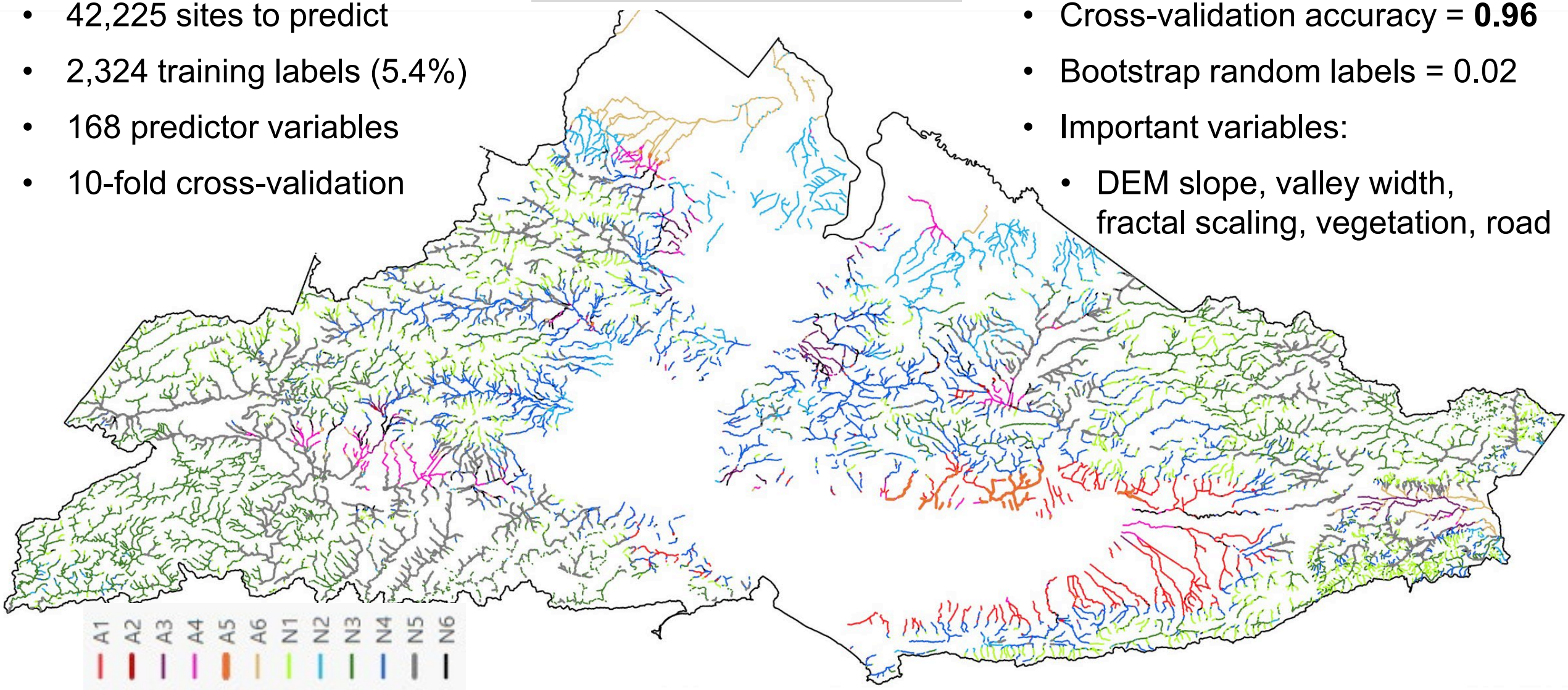
(Preliminary)

Random Forest Algorithm

- 42,225 sites to predict
- 2,324 training labels (5.4%)
- 168 predictor variables
- 10-fold cross-validation

Prediction Performance

- Cross-validation accuracy = **0.96**
- Bootstrap random labels = 0.02
- Important variables:
  - DEM slope, valley width, fractal scaling, vegetation, road



More Encampments Are In Artificial Streams

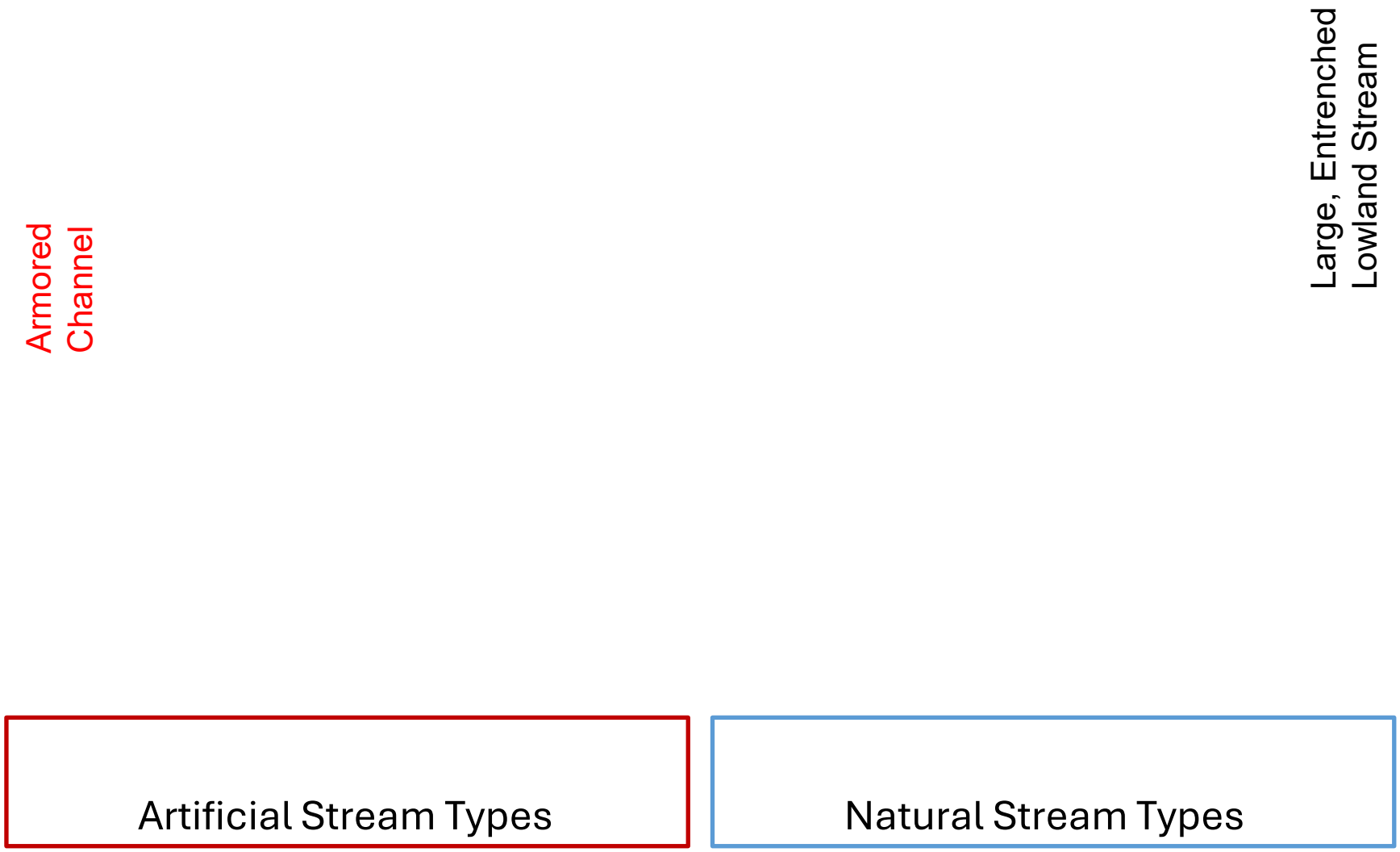
Ratio of Occupation of Stream Type by Camps To The Availability of Each Type

Avoided

23 camps, 35904 stream intervals

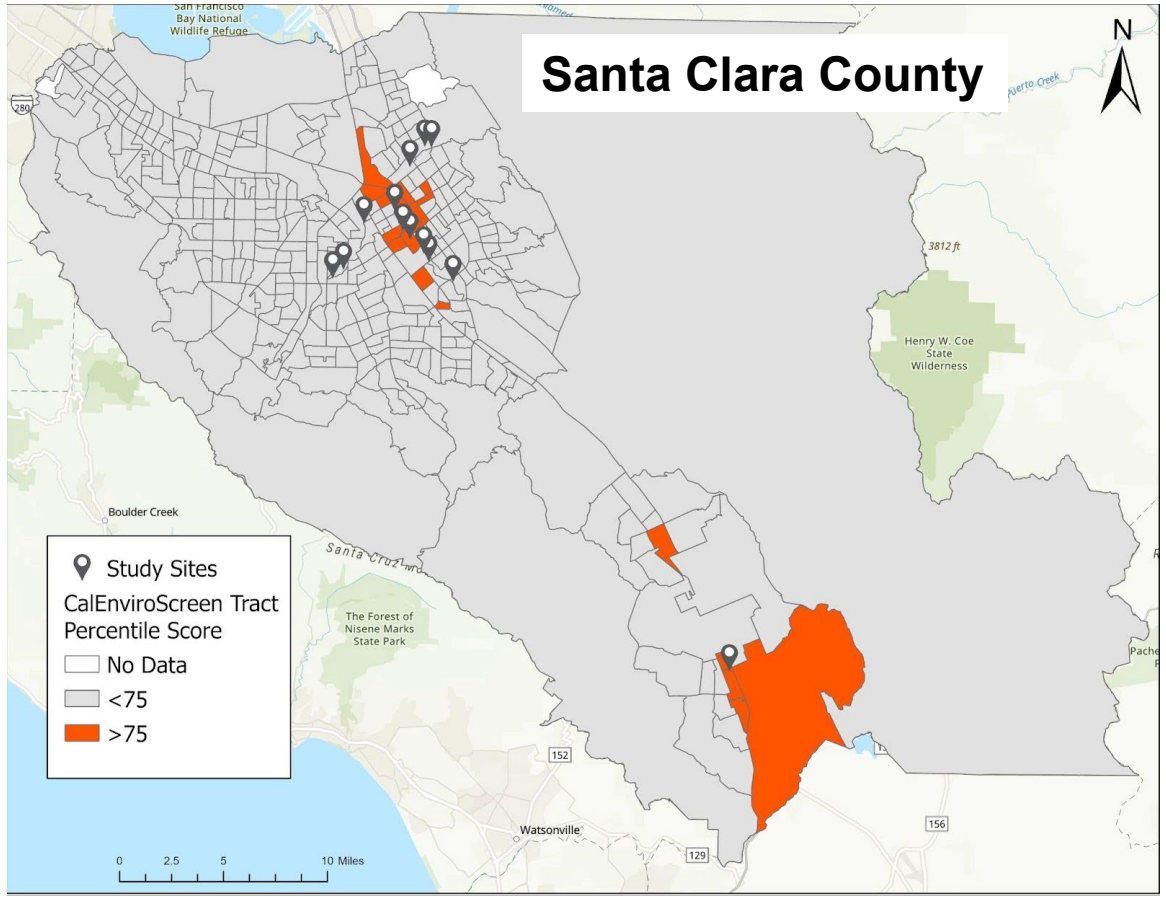
Encampments Vary Significantly By Stream Type

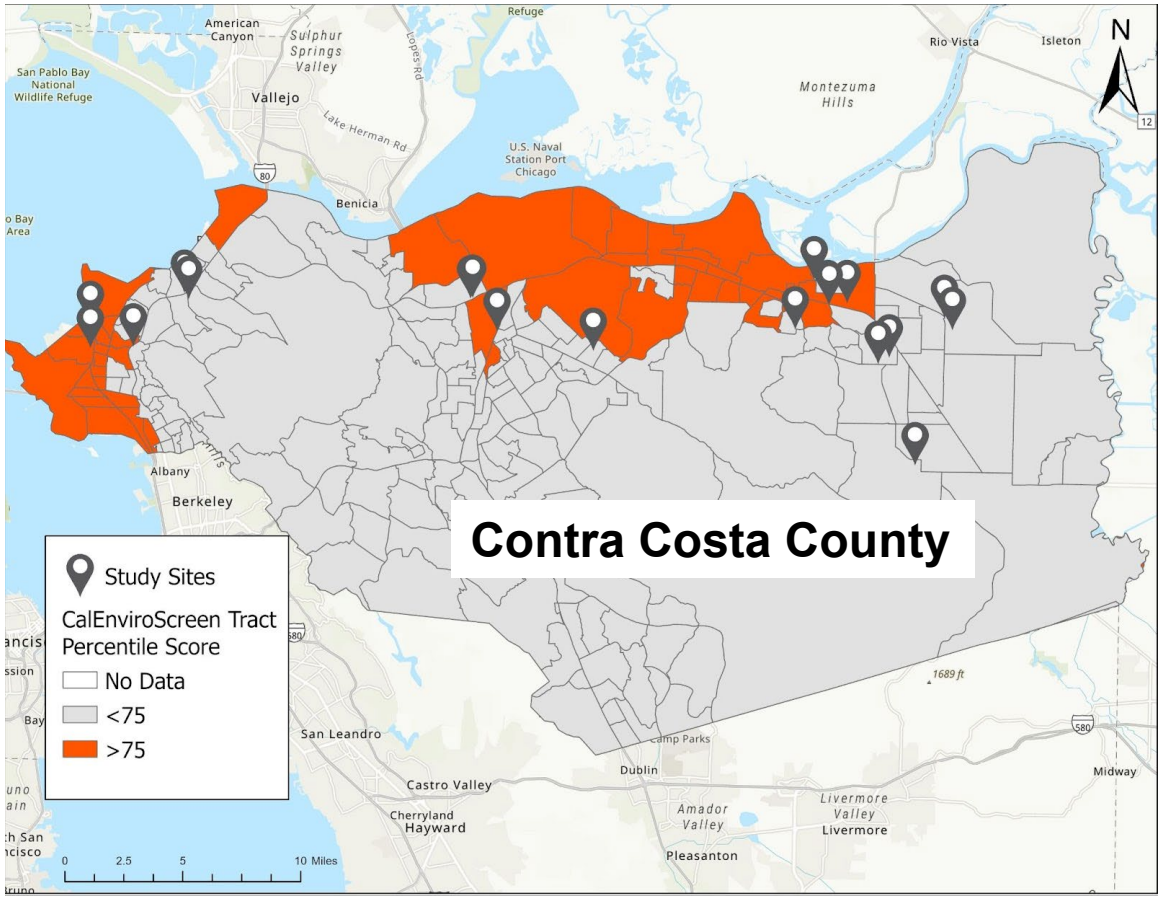
Ratio of Occupation of Stream Type by Camps To The Availability of Each Type



Encampments Are Located In Highly Polluted Areas

Camps are 3 times more likely to occur in highly polluted areas than would occur by random chance, >95% statistical confidence.





Analysis by Jeff Wooton and Bennett Williamson, SJSU

CalEnviroScreen 4.0 data

4 Major Outreach Efforts

River Cleanup BMPs

Extreme Wind-Rain Storm Event Education

Encampment Trash Management Systems

Regional Stream Typing Supporting Environmental Management

Where To Go From Here?

- Social & environmental groups need engagement regarding concerns about what each other is doing and how to coordinate activities. Leadership needed to foster team-building, perhaps from UC ANR.
- Deploy stream dataset to produce systemic analysis of aquatic and riparian habitats for environmental planning and hazard reduction.
- Create a pipeline for generating products and services that people can use to benefit from this project.
- Promote pro-active services at camps, including trash management systems, because clean-ups and tiny houses cost much more.