Benthic Index of Biotic Integrity (B-IBI) for San Francisco Bay Area Creeks

Project Update
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Background

➢ **Goal:** develop an assessment tool that will provide an initial evaluation of the status of aquatic life uses in San Francisco Bay Area creeks, and help inform and direct our use of benthic macroinvertebrate communities as water quality indicators in this region.

➢ **Potential Users:**
- Stormwater Programs
- Flood Control Agencies
- Water Districts
- Regional Water Board
- Local Watershed Groups
- Resource Agencies

➢ Southern, Northern & Central Valley California IBIs have been developed

➢ BAMBI – IBI Work Plan developed in 2004

B-IBI Workplan

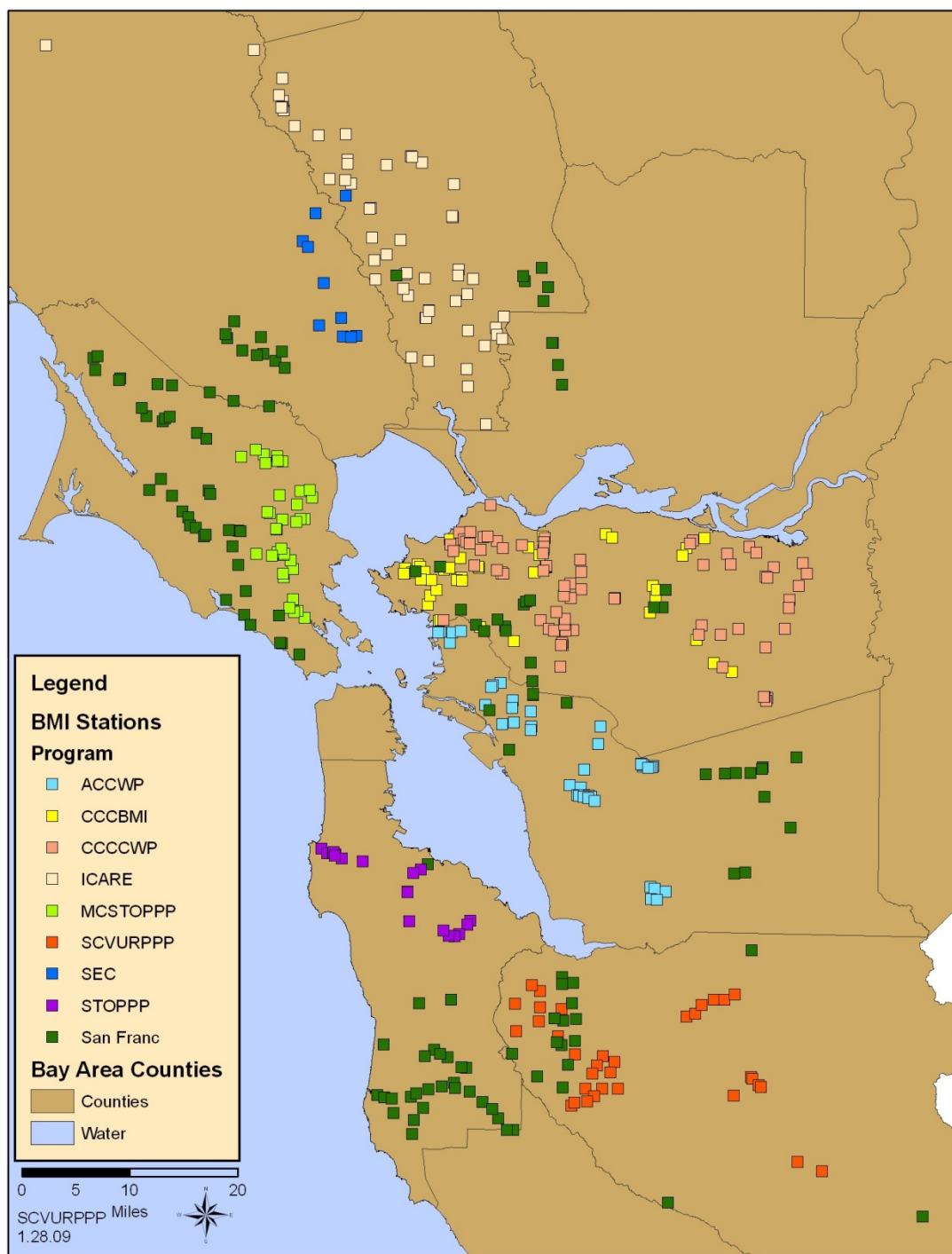| Task	Status
Acquire and Compile Existing Data	✓
Standardize and Import into Central Database	✓
Screen Metrics used in Southern & Northern CA B-IBIs	✓
Reference Site Pilot Study – Contra Costa County	✓
Establish Reference Conditions for Bay Area Creeks (least disturbed sites)	✓
Examine Natural Variability of Reference Sites	✓
Select Metrics (test data set)	
Score Metrics (test data set)	
Confirm Metrics (validation data set)	

Compilation Existing Data

➢ Data from:
- Stormwater Programs
- SWAMP
- Friends of Napa River
- Sonoma Ecology Center
- Contra Costa Citizen's Monitoring Program

➢ Spring 2000-2006
- 2007 for Contra Costa

➢ Total of 722 Data Points from 467 Sites
- Greatest number of sampling events at a single site = 5

➢ Data Quality Criteria:
- Must have used Targeted Riffle Field Methods (e.g., CSBP)
- Professional Identification to Standard Taxonomic Effort (SAFIT)

➢ Data Standardized to 500 organisms
- Monte-Carlo of old CSBP method (e.g., 900 organisms)

Collaborating Programs/Organizations

Program/ Organization	# of Events	# of Sites
Alameda Stormwater (ACCWP)	78	43
Contra Costa Citizens (CCCBMI)	88	50
Contra Costa Stormwater (CCCWP)	164	71
Napa River (ICARE)	66	57
Marin Stormwater (MCSTOPPP)	86	37
San Francisco Water Board	167	146
Santa Clara Stormwater (SCVURPPP)	72	34
Sonoma County (SEC)	27	10
San Mateo Stormwater (STOPPP)	24	19
Total	722	467

Legend

BMI Stations
Program
- ☐ ACCWP
- ☐ CCCBMI
- ☐ CCCCWP
- ☐ ICARE
- ☐ MCSTOPPP
- ☐ SCVURPPP
- ☐ SEC
- ☐ STOPPP
- ☐ San Franc

Bay Area Counties
- ☐ Counties
- ☐ Water

0   5   10   20
SCVURPPP Miles
1.28.09

Establish Reference Conditions for Bay Area Creeks

➢ **Bay Area Approach**

- Similar to those used in North, South, Central Valley, California

- 3-Step Screen

  1. GIS: land use/cover and road density at two spatial scales:

     A. Entire upstream watershed (watershed scale)

     B. 1 km upstream area (local scale)

  2. Physical Habitat (Phab data) Reach Scale

  3. Best Professional Judgement

GIS - Screen #1

➢ ## Data Sources:

Land Use/Land Cover:
- NLCD 2001

Road Density:
- BTS atlas 2003

➢ ## Result:

- Reduced # potential reference sites from 467 to 146.

GIS Attribute	Elimination Thresholds
% Urban	> 3%
% Agriculture	> 5%
% Natural	≤ 95%
Road Density	> 2km/km^2

Physical Habitat - Screen #2

➤ Eliminated sites with Poor or Marginal Phab scores (≤ 10) for Channel modification

- This parameter also used in the N & S CA B-IBIs, and identified by BAMBI IBI workgroup as good indicator of disturbance.

- Total Phab score not used for screen due to inherent subjectivity and uncertainty in available data set about factors driving total score.

➤ Result:

- **Reduced # potential reference sites from 146 to 141.**

Best Professional Judgement -Screen #3

- ➤ Requested input from representatives of programs/agencies that collected BMI data.

- ➤ Criteria to screen local site impacts

- ➤ *Preliminary Result*:
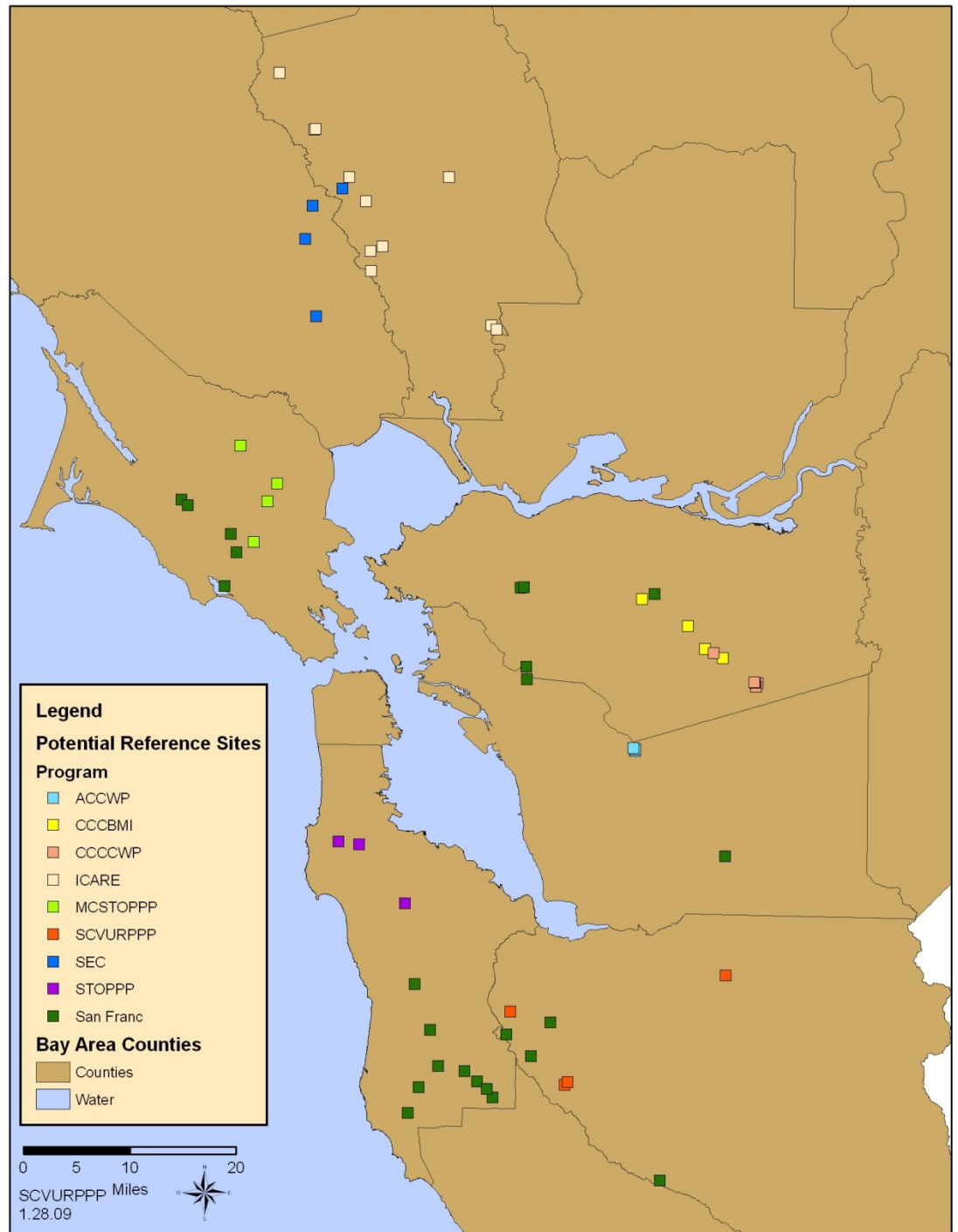 - Reduced # potential reference sites from 141 to 74.

Criteria
Water Quantity
Water Quality
Water Extraction
Channelization at Site
Channelization shortly upstream
Dams
Historic Mines
Current Mines
Agriculture
Other

Reference Site Screen Summary

Steps	# Sites
Cal EDAS query	467
GIS screen #1	146
Physical Habitat screen #2	141
BPJ screen #3	74

Preliminary Reference Sites

➢ 74 sites that passed 3 screens
➢ Good Spatial Representation

Legend
Potential Reference Sites
Program
- ☐ ACCWP
- ☐ CCCBMI
- ☐ CCCCWP
- ☐ ICARE
- ☐ MCSTOPPP
- ☐ SCVURPPP
- ☐ SEC
- ☐ STOPPP
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Bay Area Counties
- Counties
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0   5   10   20
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1.28.09

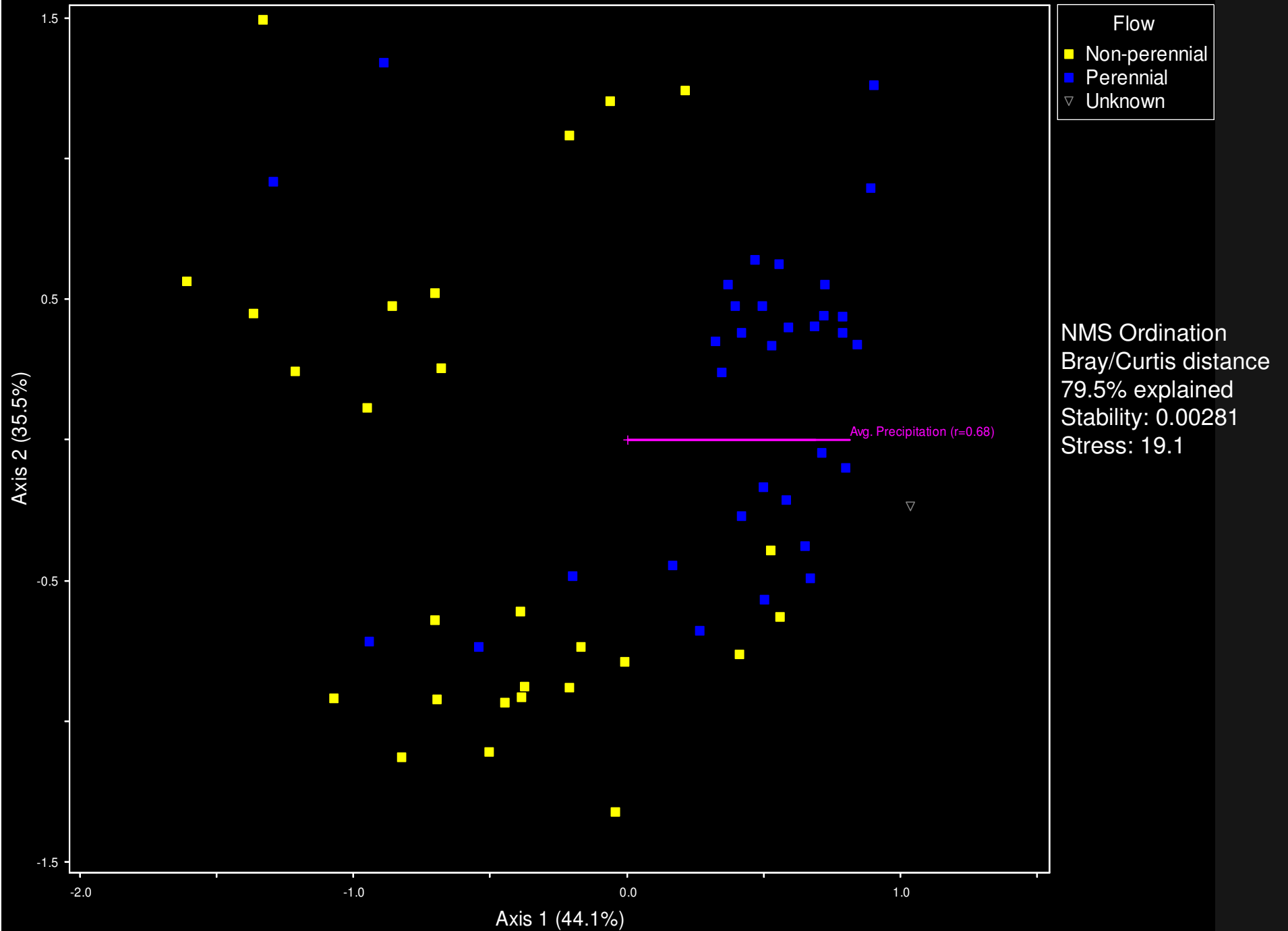# Preliminary Exploration of Natural Variability

- Precipitation
- Flow Status
- Pacific Ocean vs. SF Bay Drainages
- Ecoregion Analysis (4 categories)
- Elevation
- Drainage Area
- Monitoring Program
- Sample Year
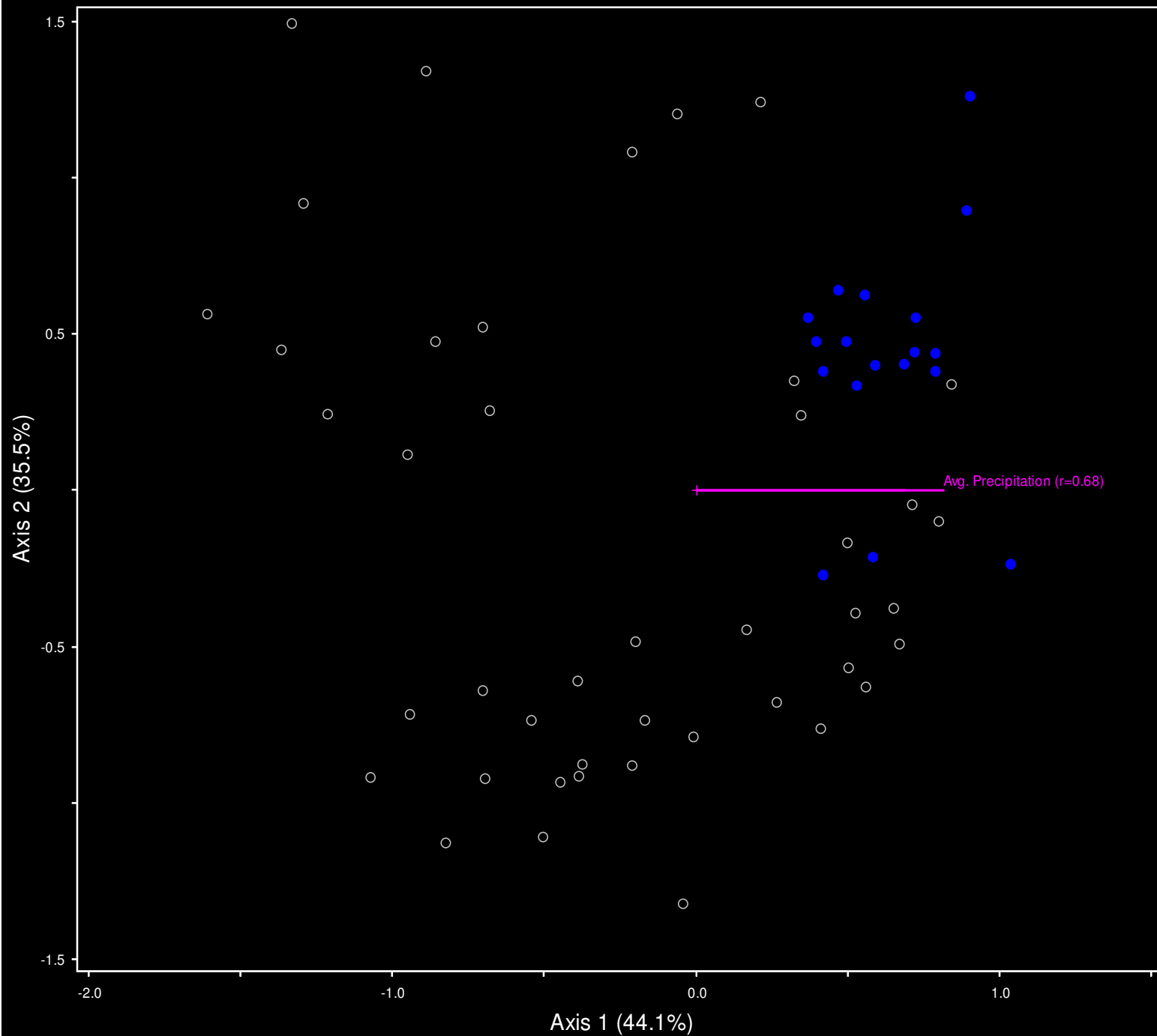- Collection Method (900 vs. 500 organisms)
- Stream Order
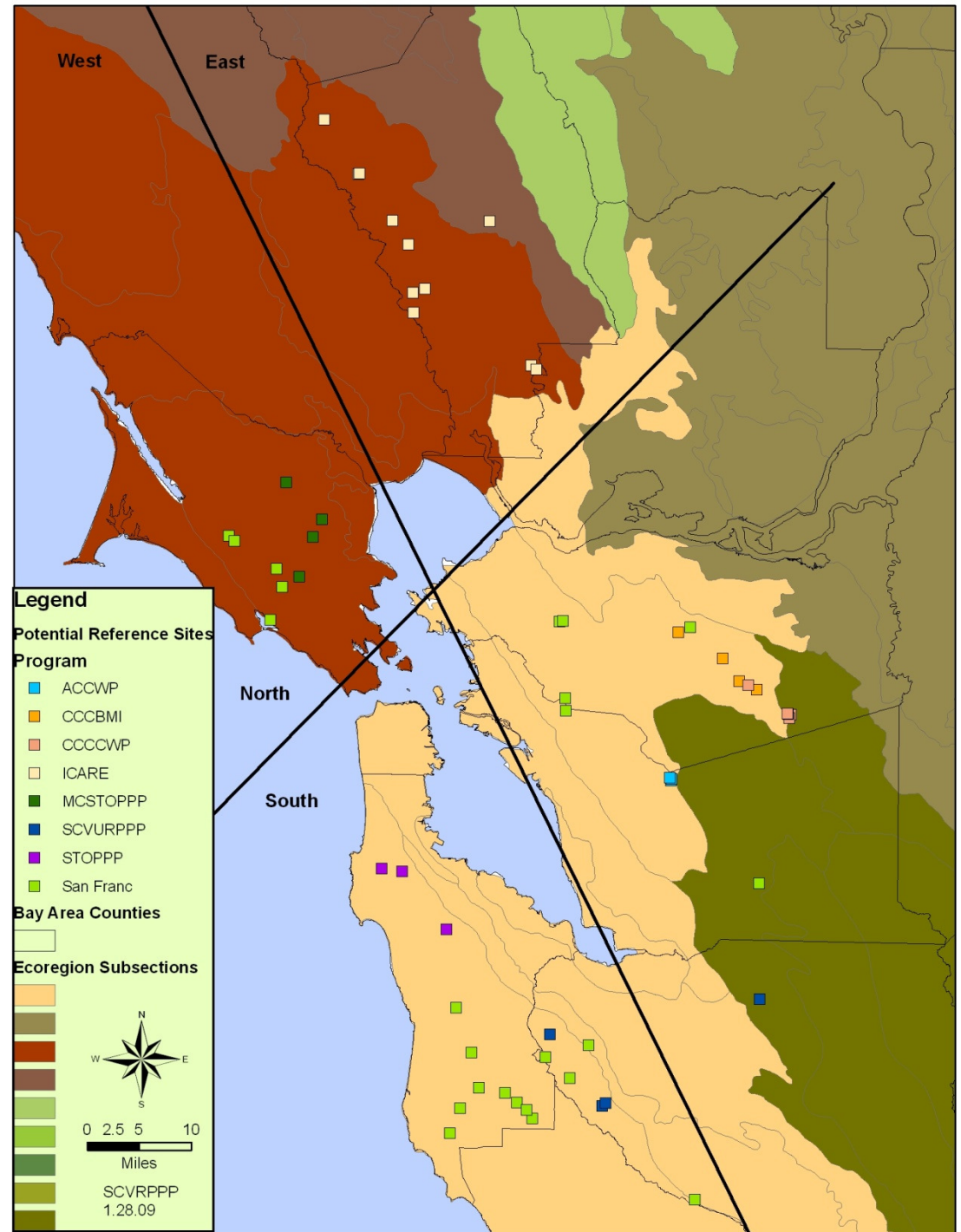
Natural Variability in Reference Pool

➢ Non-metric multidimensional scaling using Bray-Curtis as measure of distance.

➢ Environmental variables associated with macroinvertebrate community composition
- Annual average precipitation
- Flow status (perennial vs. nonperennial)
- Drainage (Pacific Ocean vs. SF Bay)

➢ Non-significant variables
- Elevation, drainage area, ecoregion, Monitoring Program, sample year, collection method, stream order

Environmental Variability of Reference Sites

Flow
- Non-perennial (yellow)
- Perennial (blue)
- ▽ Unknown

Axis 2 (35.5%)

Axis 1 (44.1%)

Avg. Precipitation (r=0.68)

NMS Ordination
Bray/Curtis distance
79.5% explained
Stability: 0.00281
Stress: 19.1

Environmental Variability of Reference Sites

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Outflow
○ SF Bay
● Pacific

Axis 1 (44.1%)

Axis 2 (35.5%)

Natural Variability Implications

Categorize sites by flow status (P/NP) to develop the most accurate B-IBI

- Pro: Determine if different biological metrics respond to urban stressors or if same metrics require different scaling

- Con: Flow status is not known for many of the 467 sites

Next Steps

Step	Description	Method
1. Collect data on flow status?	Collect data on flow status from management agencies. Split the entire dataset into perennial and non-perennial categories.	
2. Split Data	Randomly divide sites into development (3/4) and validation (1/4) data sets. Stratify by flow status and reference and non-reference.	Ode et al. 2005
3. Test, Select Metrics	• Range • Redundancy (Pearson Coefficients) • Responsiveness (to disturbance gradients • Discriminatory power (reference vs. non-reference sites	• Ode et al. 2005, 2008 • " • " • Stribling et al. 1998, Ode et al. 2008

Next Steps – continued…

Steps	Description	Method
4. Score Metrics	• Score sites on scale 1 to 10 using raw metric values (establish floor & ceiling, divide equally between) • Test for differences between physical strata	Hughes et al. 1998, Ode et al. 2005, 2008
5. Validate Metric Selection	• Compare distributions of scores between development and test data sets.	McCormick et al. 2001; Ode et al. 2005, 2008
6. Compare to CA B-IBIs	• Compare site scores between CA B-IBIs	Correlation Coefficients
7. Re-evaluate over Time	• Consider new data on reference sites being sampled (SWAMP) • Integrate with larger geographical areas in CA • Re-evaluate prior to Biocriteria development	Coordinate with SWAMP and at Statewide level

Our thanks to

- ACCWP: Arleen Feng
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- Institute for Conservation Advocacy Research and Education: Chris Malan
- MCSTOPPP: Howard Bunce and Terri Fashing
- SMCWPPP: Paul Randall and Jon Konnan
- SCVURPPP: Paul Randall
- Sonoma Ecology Center: Becca Lawton
- SF Bay Regional Water Board: Matt Cover, Karen Taberski and SWAMP Team
- CDFG Aquatic Bioassessment Lab: Andy Rehn & Pete Ode

...QUESTIONS?