Expanded Pilot Study

April 2012

Why A Pilot Study?

- Play out application of biological objectives on a smaller scale before going statewide
- Identify the biggest challenges
- Use as leverage for technical development
  - Policy development

Up Till Now

- Demonstrated a pilot in the Ventura River watershed at your last meeting
- Provided some excellent insight
  - Assessment tool selection
  - Threshold development
  - Dealing with uncertainty
- The Science Panel recommended we expand the pilot as we address the new challenges
  - All of southern California

What You'll See Today

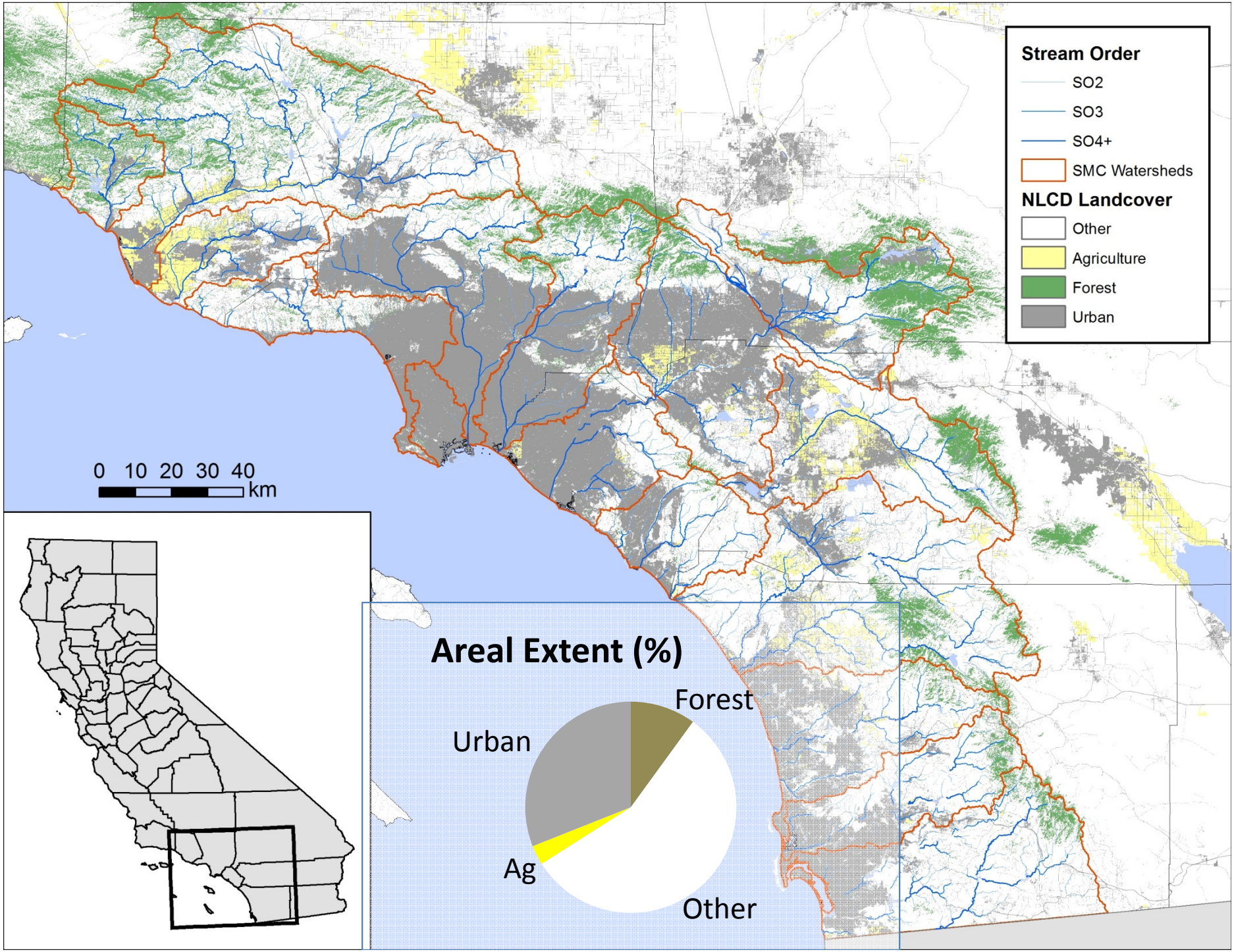
- Description of expanded study area
  - Data inventory
- New assessment tool threshold application
- Dealing with uncertainty
- Regulatory applications
  - Exception classes
  - Antidegradation concepts

Questions for the Science Panel

- How can we improve the balance between Type I and Type II error?
  - What is the preferred approach for threshold selection?
- What is your recommended approach for uncertainty?
  - How would your preferred thresholds differ relative to the Expanded Pilot example?
- What advice can you offer the state on exception classes?
  - How have other states dealt with exception classes, especially thresholds for exception classes?
- What options are most technically sound for the State to consider for anti-degradation?
- Do you have any recommendations when we move statewide?
  - Are there concerns about exporting So Cal approaches to rest of state?
  - Are there additional considerations we should explore for new regions?

So Cal Is A Dynamic Place

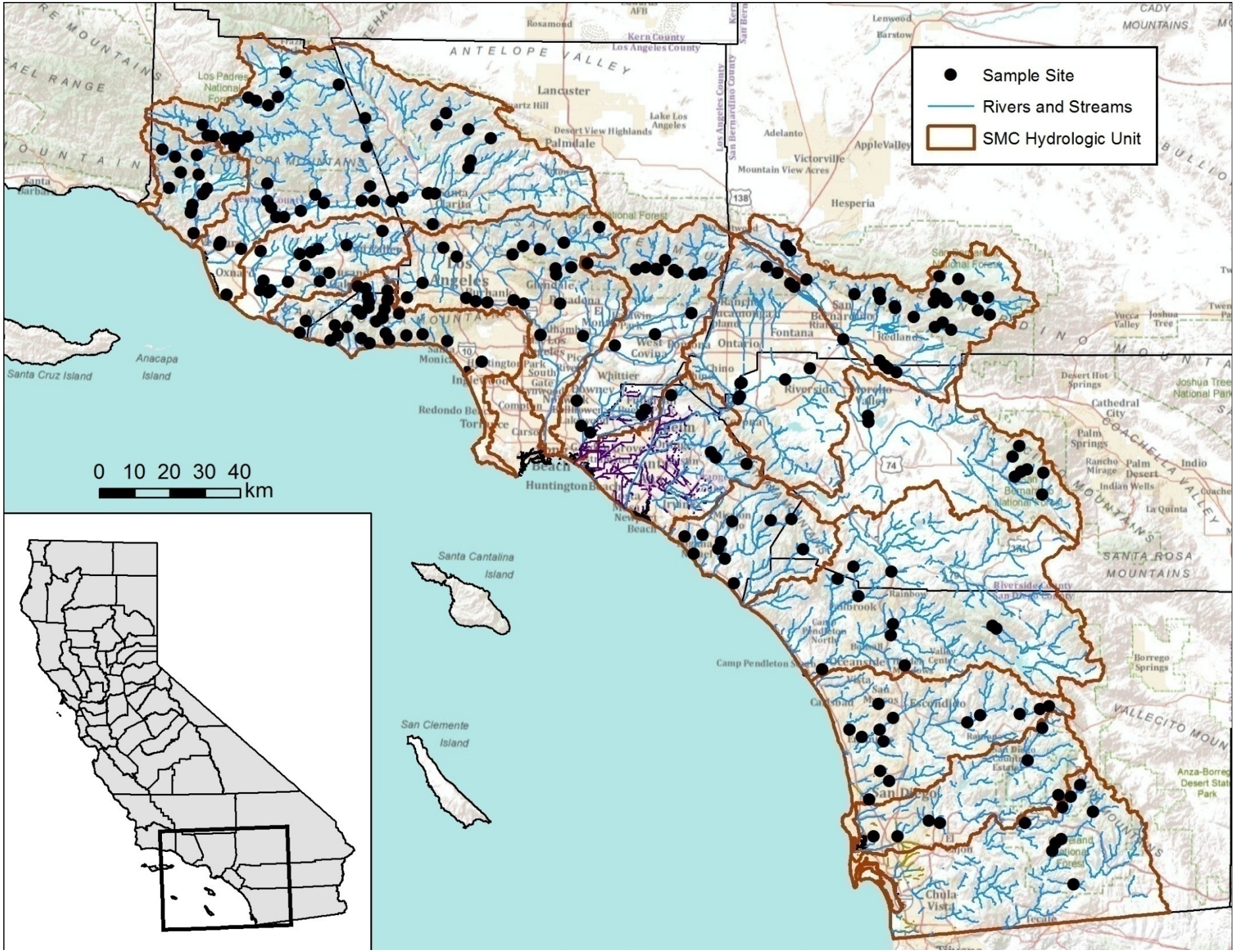
- More than 2,300 km of stream miles (NHDPlus)
  - 86% are non-perennial
- Elevation ranges from 0 to >3,700 m (11,500 ft)
  - Annual mean precipitation < 30 cm to >107 cm (41 in)
- Extremes of open lands and urban land uses
  - Agriculture less prominent than other parts of the state


Stream Order
SO2
SO3
SO4+
SMC Watersheds
NLCD Landcover
Other
Agriculture
Forest
Urban
0 10 20 30 40
km
Areal Extent (%)
Forest
Urban
Ag
Other


1. 31. 1999 12

So Cal Data Inventory

- Selected multiple probabilistic surveys
  - EMAP, WEMAP, CMAP, PSA, SMC
- 243 unique sites
  - 75 sites with multiple samples
- Spans a decade (2000-2009)
  - Some very wet and very dry years


Sample Site
Rivers and Streams
SMC Hydrologic Unit
0 10 20 30 40
km
Santa Cruz Island
Anacapa Island
Santa Cantalina Island
San Clemente Island
ANTELOPE VALLEY
Los Angeles
Lancaster
Palmdale
Victorville
Hesperia
Fontana
Ontario
Riverside
Anaheim
Huntington Beach
Oceanside
San Diego
Chula Vista
Camp Pendleton
Palm Springs
Indio
La Quinta
Borrego Springs
SANTA ROSA MOUNTAINS
COACHELLA VALLEY

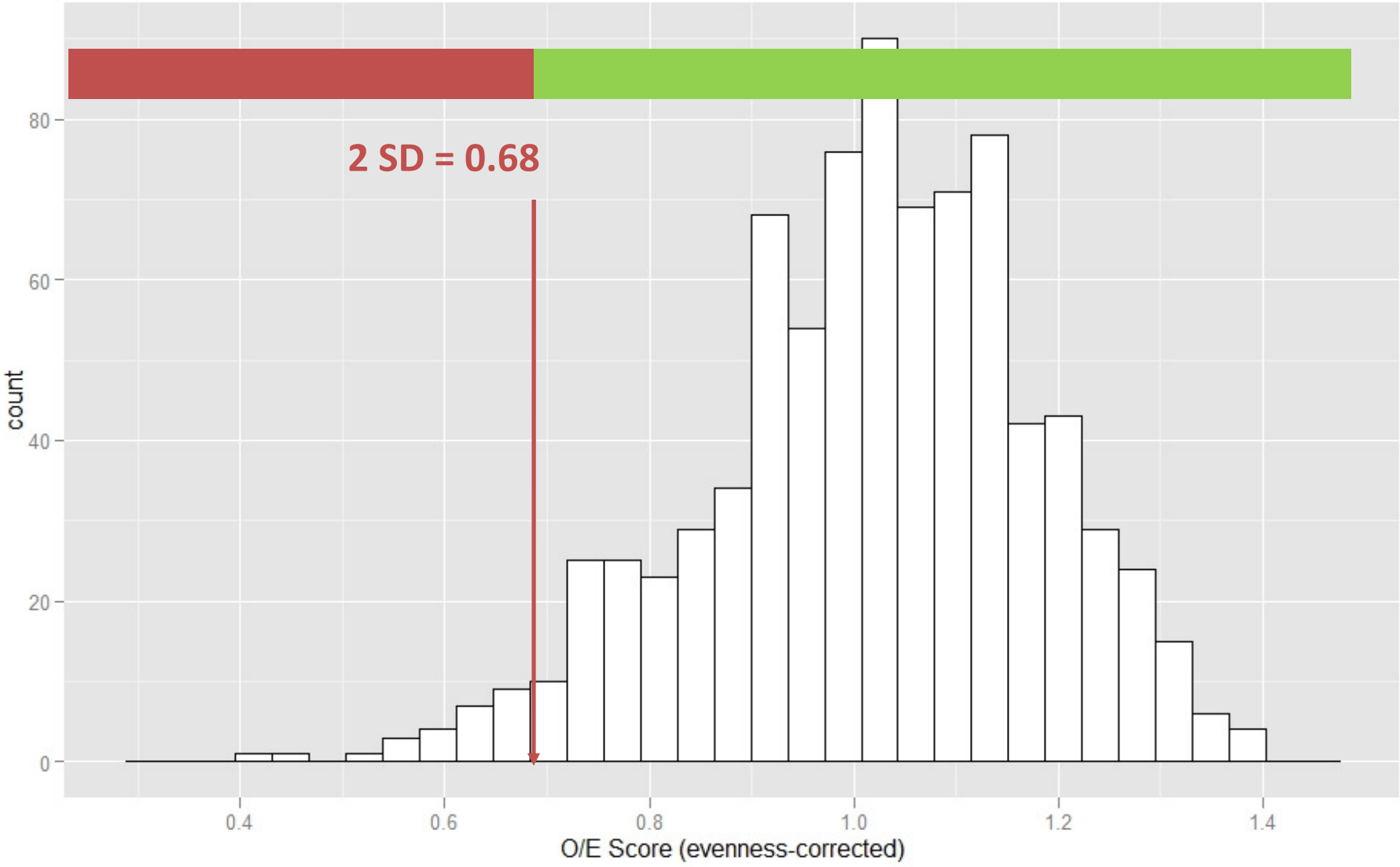
Application of the New Assessment Tool

- Used one of our best performing assessment tools for this application
  - O/E with evenness correction
- Probability based design enables unbiased extrapolation to extent
  - stream kilometers
- Extent questions work best with thresholds
  - Binary answer of “above or below”, “good or bad”, “reference or non-reference”, etc.

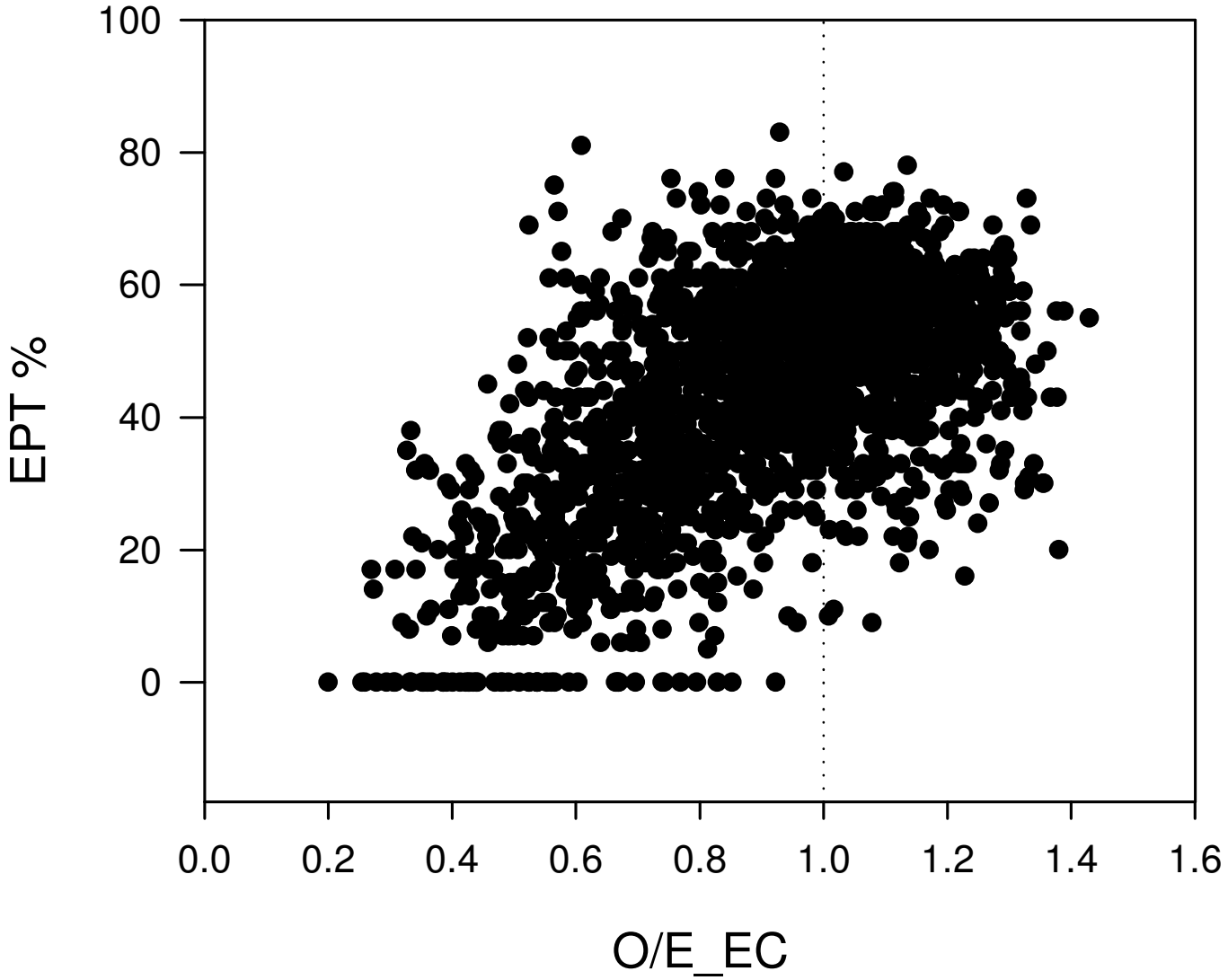
Picking An Assessment Threshold

- We discussed options at our last meeting of the Science Panel
  - Empirically derived population based estimator
  - Modeled using stressor response relationships
  - Ecosystem function based using species traits/metrics
- Panel recommended the population based estimator
  - As a function of reference site distributions
- Common practice is 2 standard deviations
  - Approximates 95% of the reference population
- Panel did recommend exploring ecosystem function/spp traits

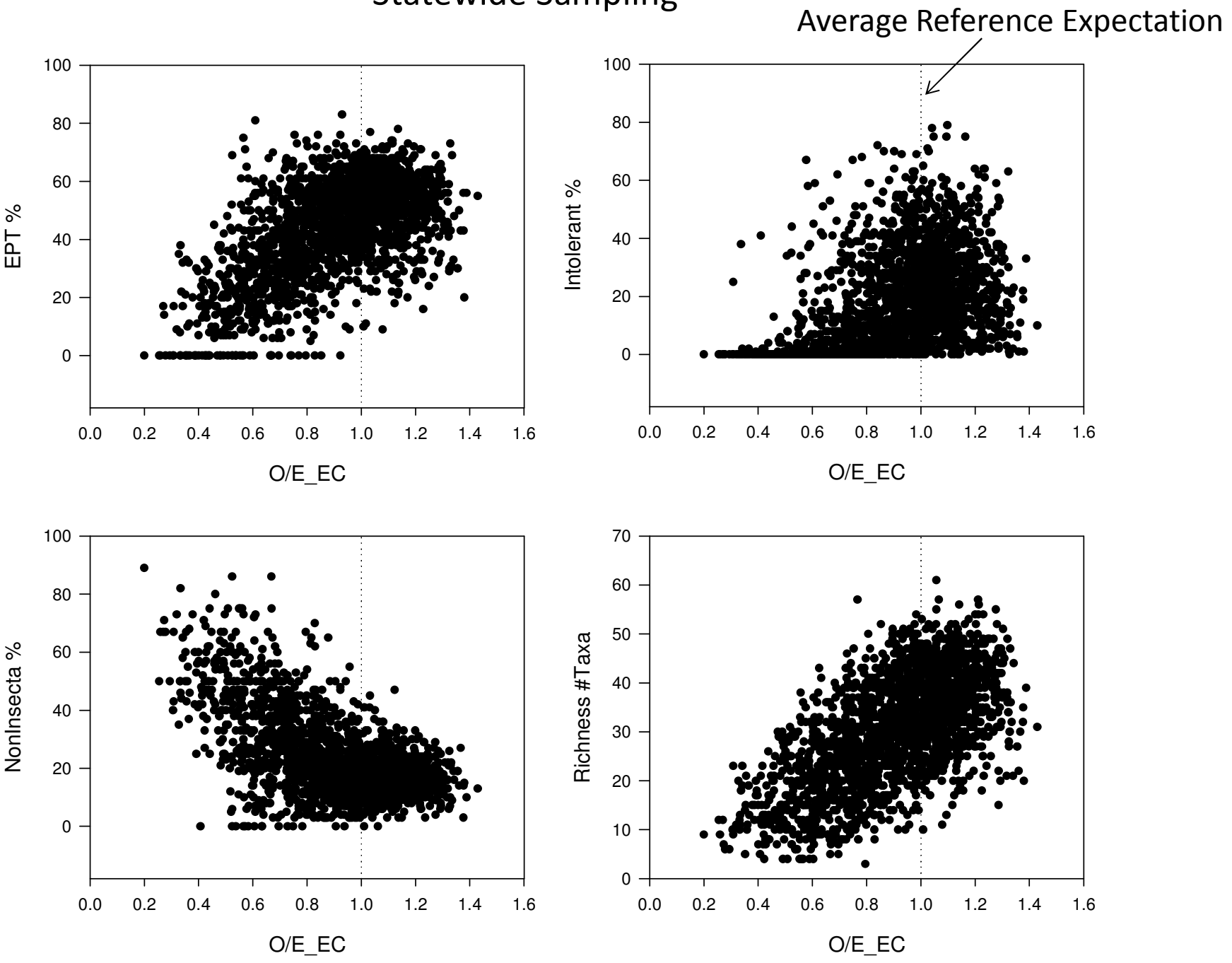
O/E Reference Site Distribution



- Does O/E mimic ecosystem attributes?
  - Statewide data
  - Examine biological metrics
  - Evaluate gradients associated with proposed threshold



Statewide Sampling



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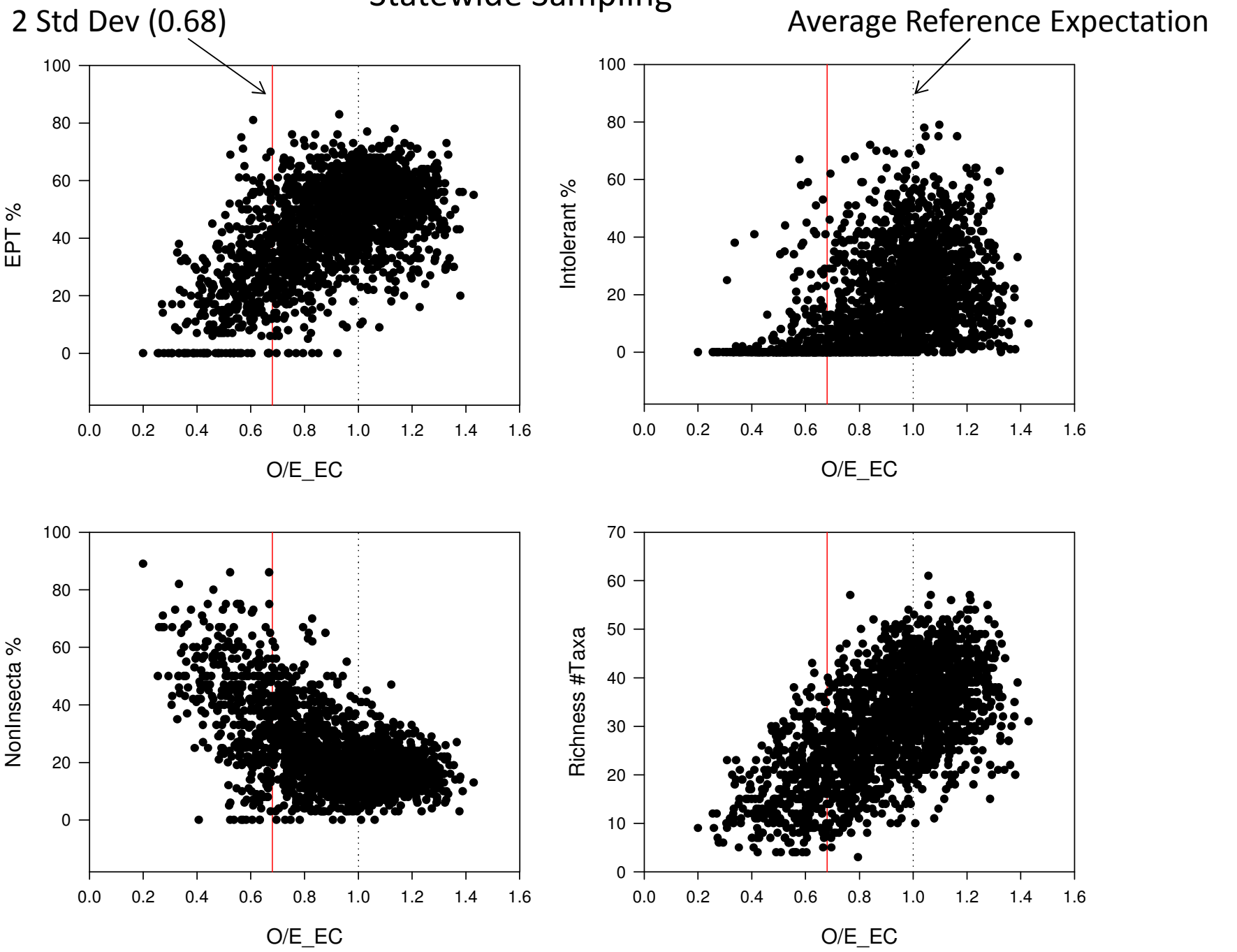

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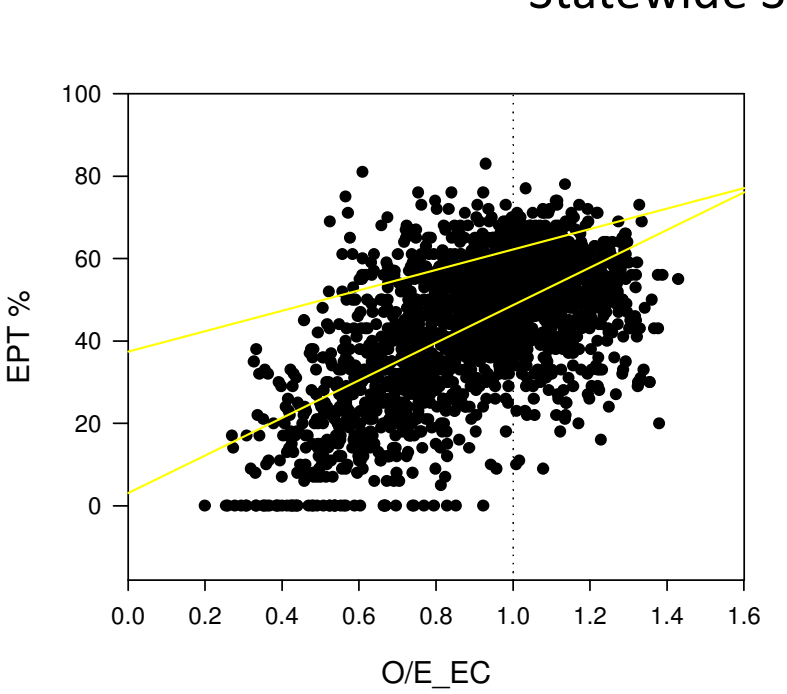
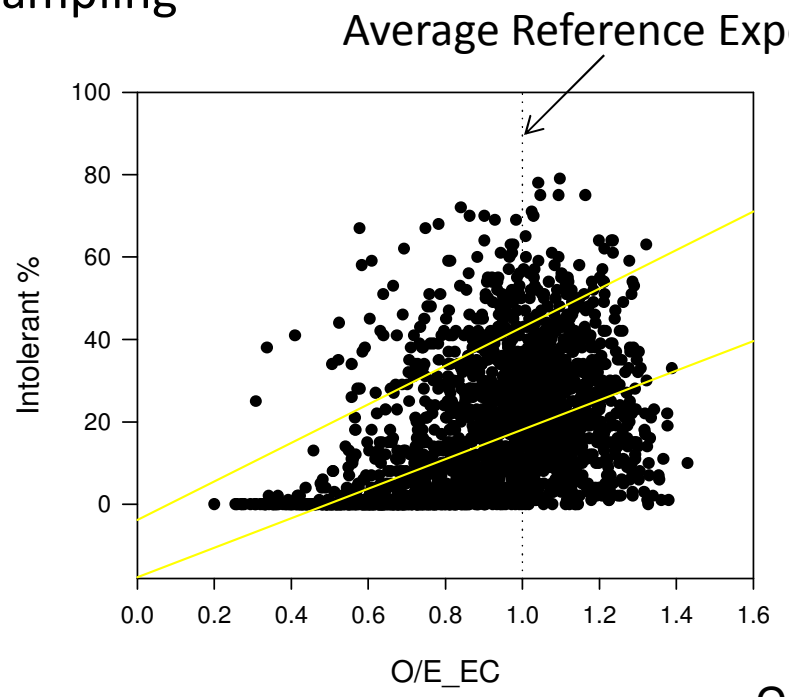
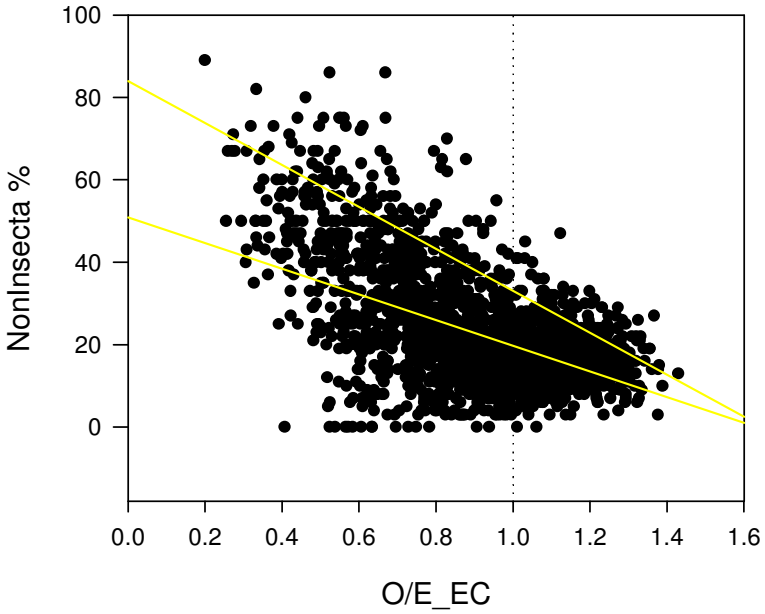
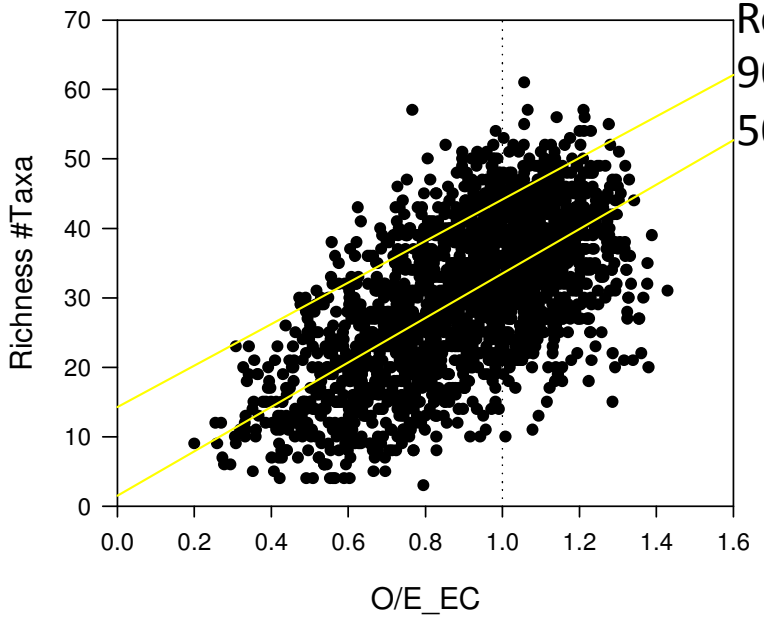






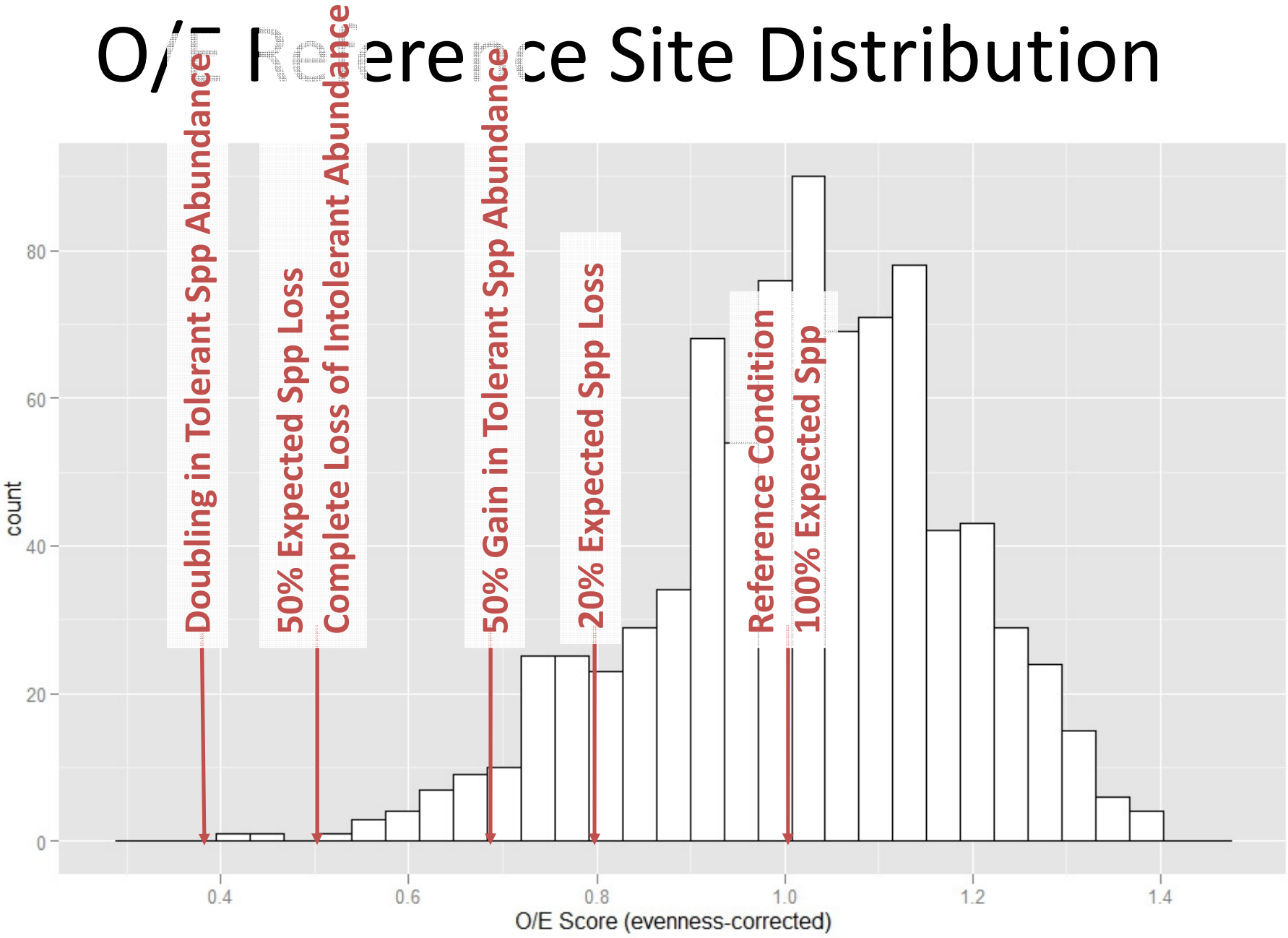


Quantile Regression
90%
50%

Predicted O/E_EC Score (Potential Thresholds)

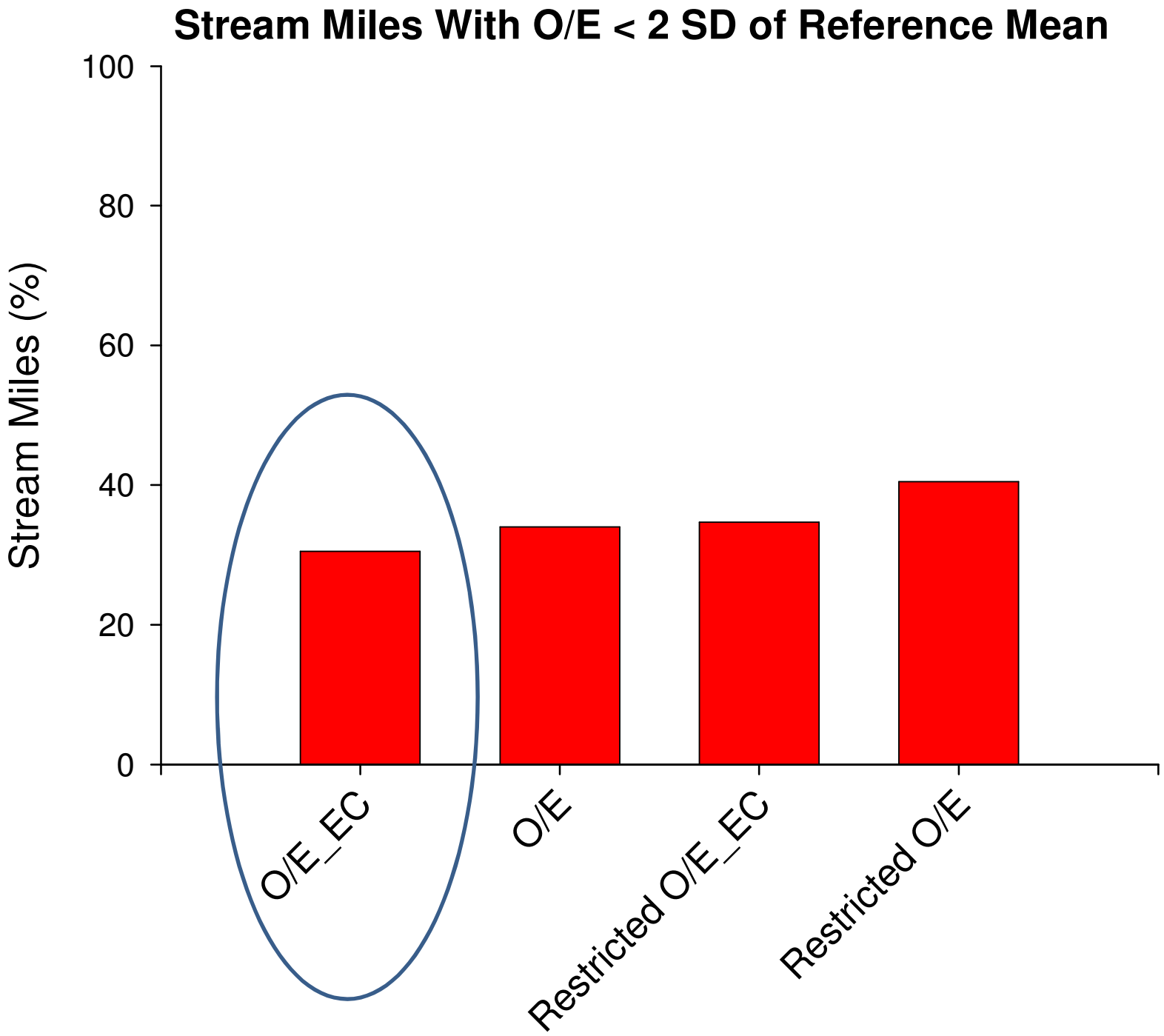
Median Loss or Gain	Taxa Richness	Intolerant Abundance	Tolerant Abundance
10%	0.90	0.95	0.94
25%	0.74	0.87	0.84
50%	0.48	0.75	0.69
75%	0.21	0.62	0.53
100%	0.05	0.49	0.37

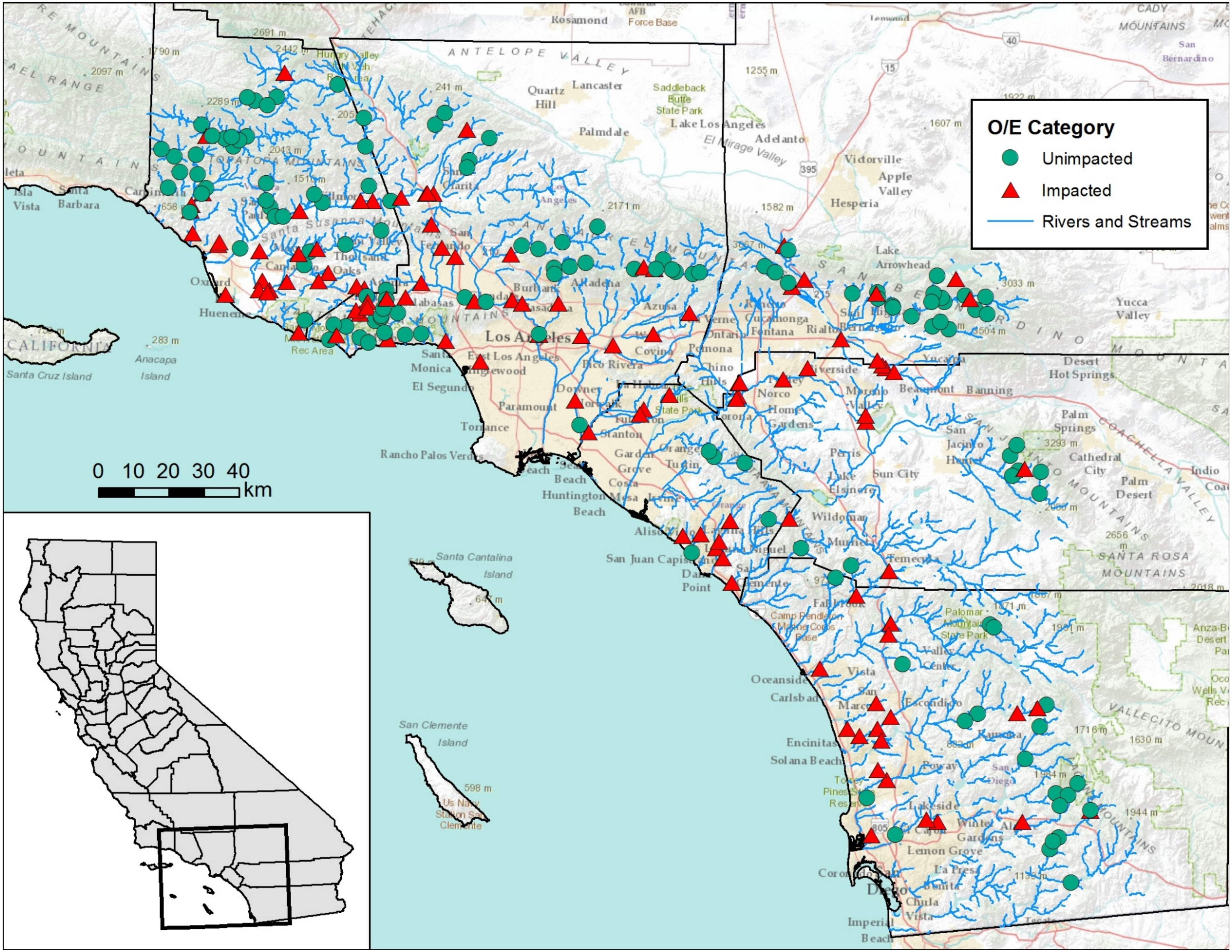
O/E Reference Site Distribution



Refocusing On Threshold Application

- Use the population based estimator
  - Comparison of O/E models
  - Pick one model for application (O/E with eveness correction)
- Apply to single sample scores
  - Map of impacted sites
- Assess extent of impacted sites

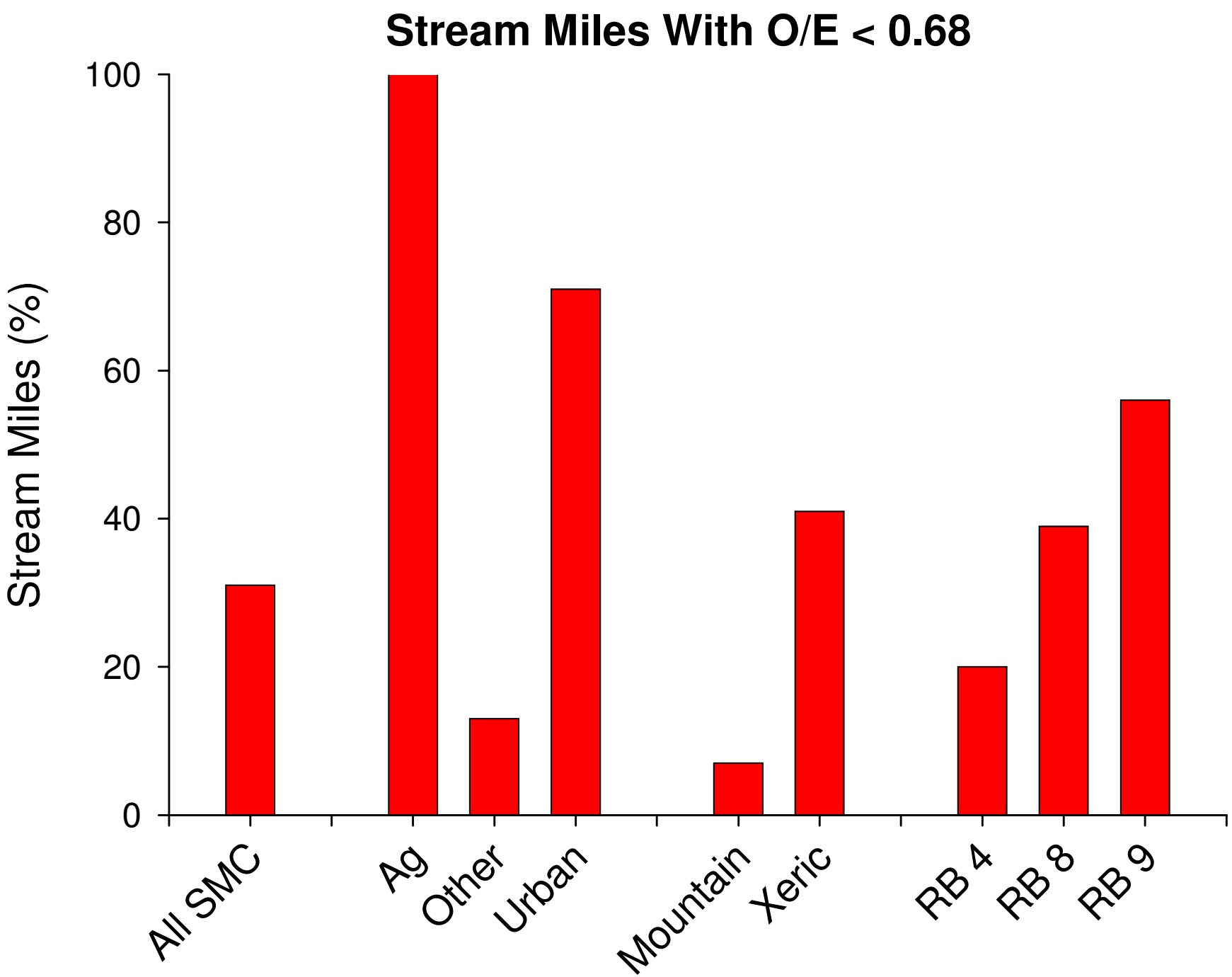

Stream Miles With O/E < 2 SD of Reference Mean
Stream Miles (%)
100
80
60
40
20
0
O/E_EC
O/E
Restricted O/E_EC
Restricted O/E


O/E Category
Unimpacted
Impacted
Rivers and Streams
0 10 20 30 40
km
ANTELOPE VALLEY
Los Angeles
Lancaster
Palmdale
Victorville
Hesperia
Santa Barbara
Oxnard
Thousand Oaks
Burbank
Pasadena
Azusa
Pomona
Ontario
Fontana
Rialto
Riverside
Norco
Corona
Perris
Sun City
Hemet
San Jacinto
Palm Springs
Cathedral City
Palm Desert
Indio
Yucca Valley
Beaumont
Banning
Downey
Torrance
El Segundo
Santa Monica
Long Beach
Huntington Beach
Costa Mesa
Irvine
San Juan Capistrano
Dana Point
Temecula
Wildomar
Fallbrook
Vista
Oceanside
Carlsbad
San Marcos
Escondido
Encinitas
Solana Beach
Ramona
Poway
Lakeside
Lemon Grove
Chula Vista
Imperial Beach
Santa Cruz Island
Anacapa Island
Santa Cantalina Island
San Clemente Island
SAN BERNARDINO MOUNTAINS
SANTA ROSA MOUNTAINS
COACHELLA VALLEY

Southern California Stream Inventory

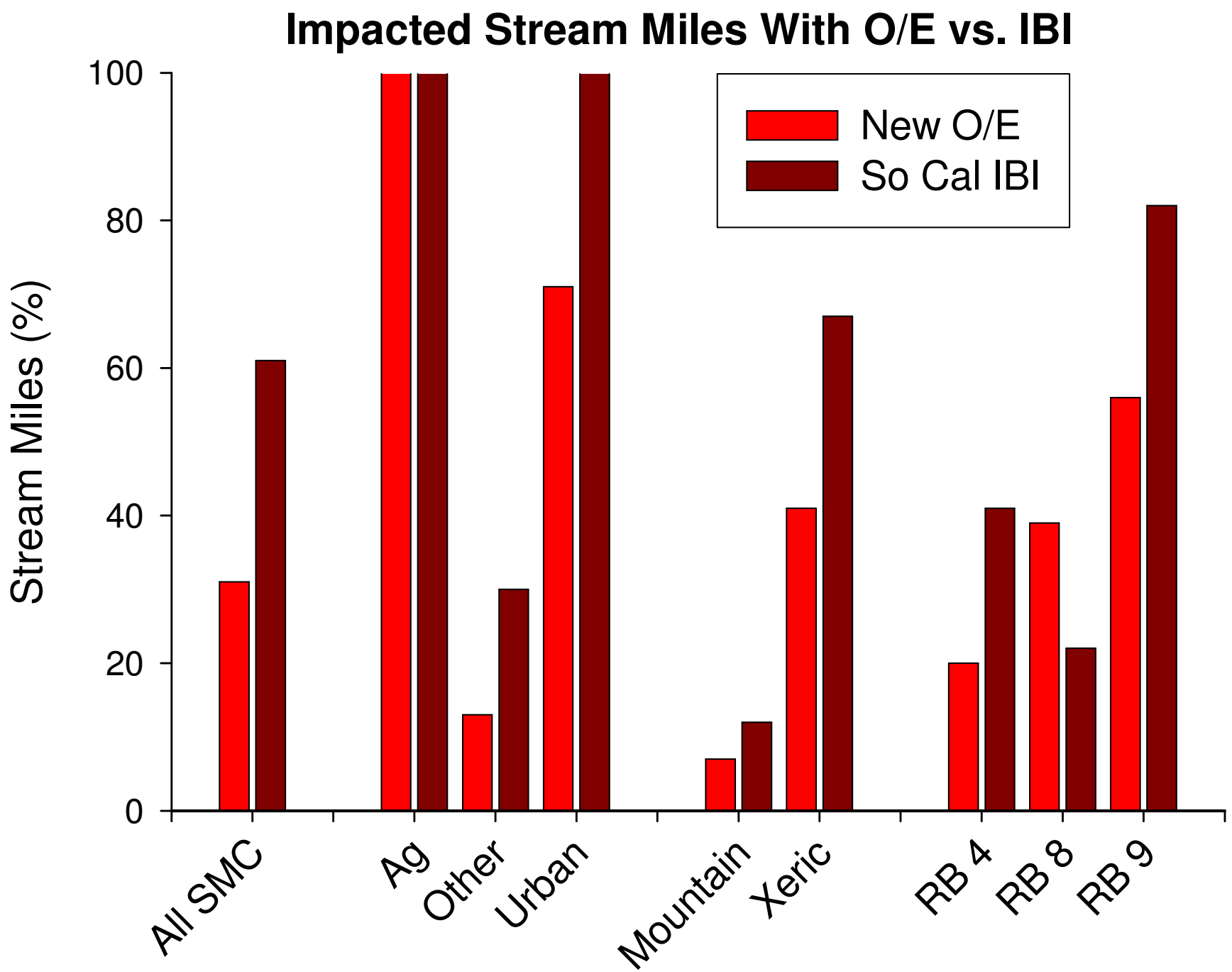
(Based on Probability Site Sampling)

Stratum	Length (Est. km)	Sample Size (N)	Relative Extent (% of Total)
All Streams	2,228	243	100
Habitat			
Mountain	699	86	31
Xeric	1,530	157	69
Land Use			
Agriculture	43	6	2
Forest/Open	1,573	182	71
Urban	612	55	27
RWQCB			
Los Angeles (4)	1,475	136	66
Santa Ana (8)	200	54	9
San Diego (9)	553	53	25


Stream Miles With O/E < 0.68
Stream Miles (%)
100
80
60
40
20
0
All SMC
Ag
Other
Urban
Mountain
Xeric
RB 4
RB 8
RB 9

How Does this Compare To Previous Expectations?

- So Cal Index of Biotic Integrity used in the last pilot
- So Cal IBI used for permits and 303d listing decisions recently
- Estimated stream mile extent based new O/E and So Cal IBI


Impacted Stream Miles With O/E vs. IBI
Stream Miles (%)
100
80
60
40
20
0
New O/E
So Cal IBI
All SMC
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Other
Urban
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- New assessment tool threshold application
- Dealing with uncertainty
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  - Exception classes
  - Antidegradation concepts

Addressing Uncertainty

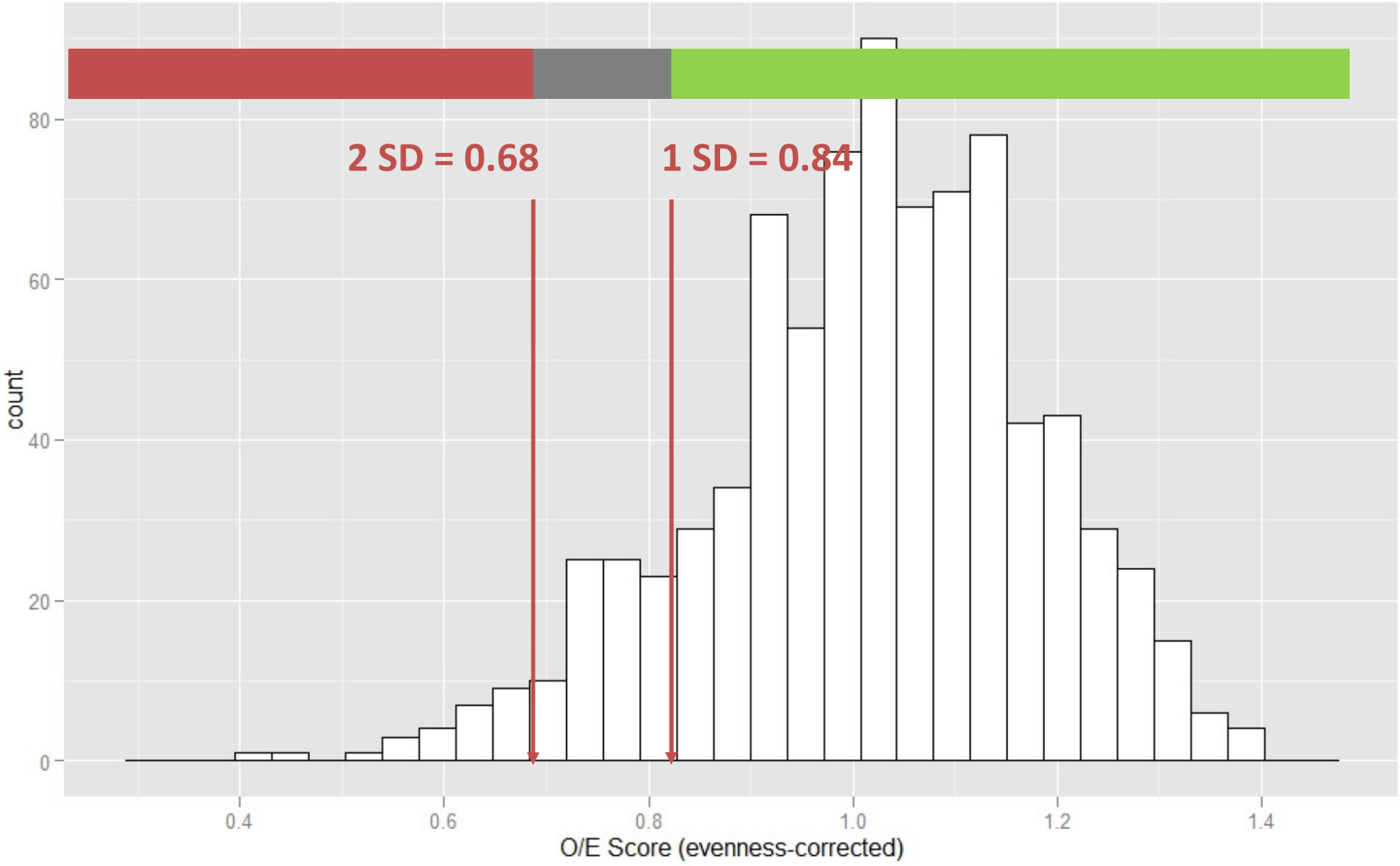
- We discussed sources of uncertainty at our last Science Advisory Panel meeting
  - Spatial, temporal, methodological
- Option 1: Incorporate uncertainty into your threshold
  - Use multiple thresholds
- Option 2: Reduce uncertainty into your site assessment
  - Collect more samples

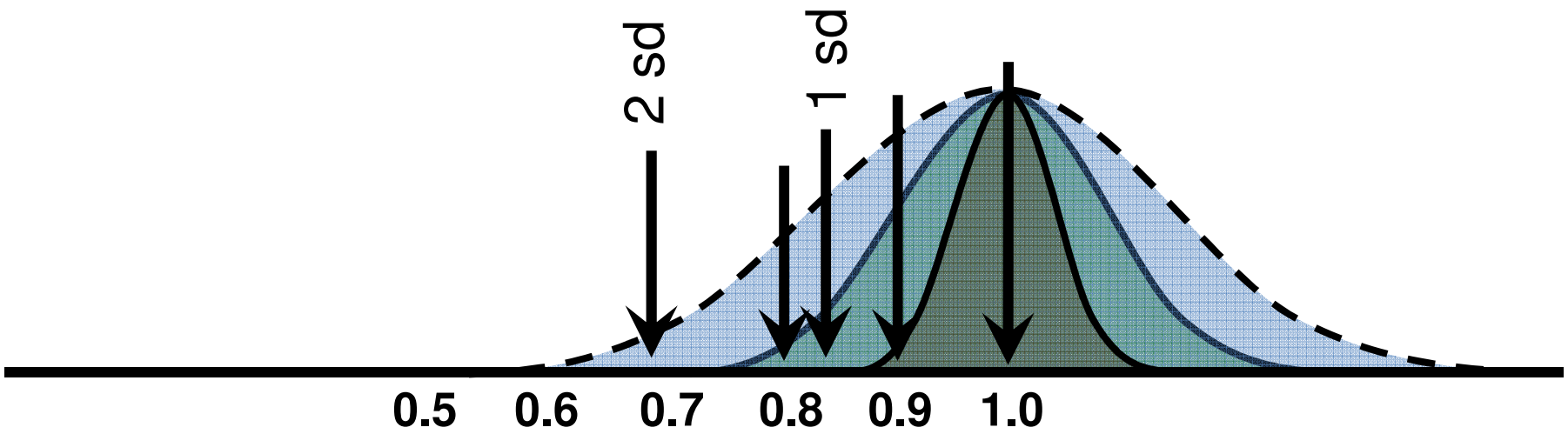
Science Panel Recommended A Hybrid

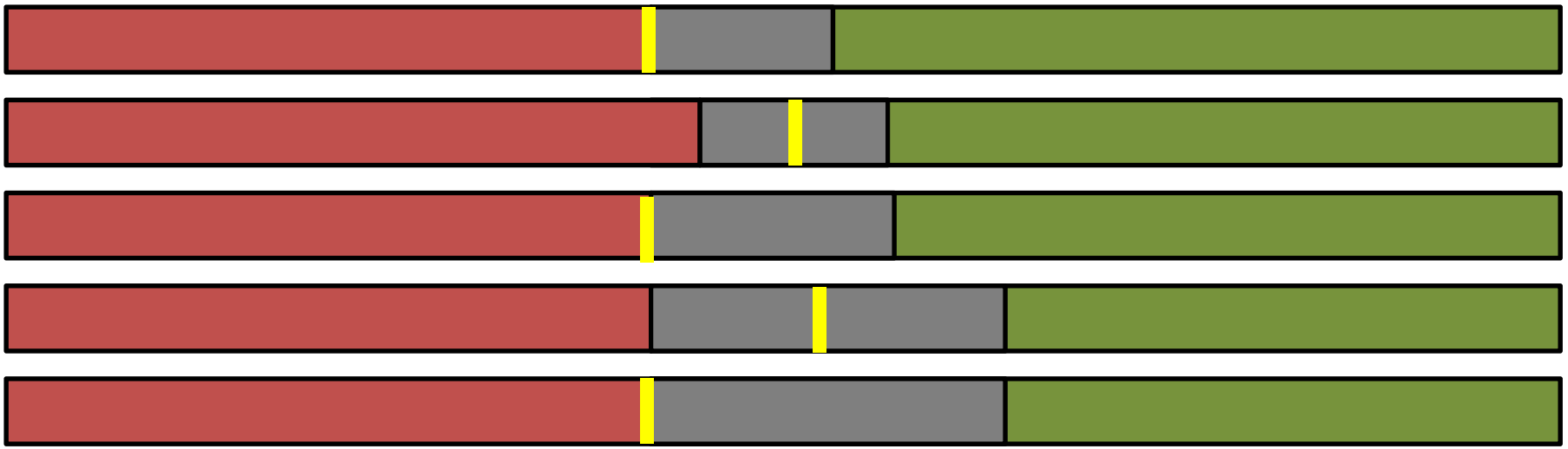
- Specifically concerned about Type I and Type II errors
  - Type I: Declared Impaired, but Not Impaired
  - Type II: Declared Not Impaired, but Impaired

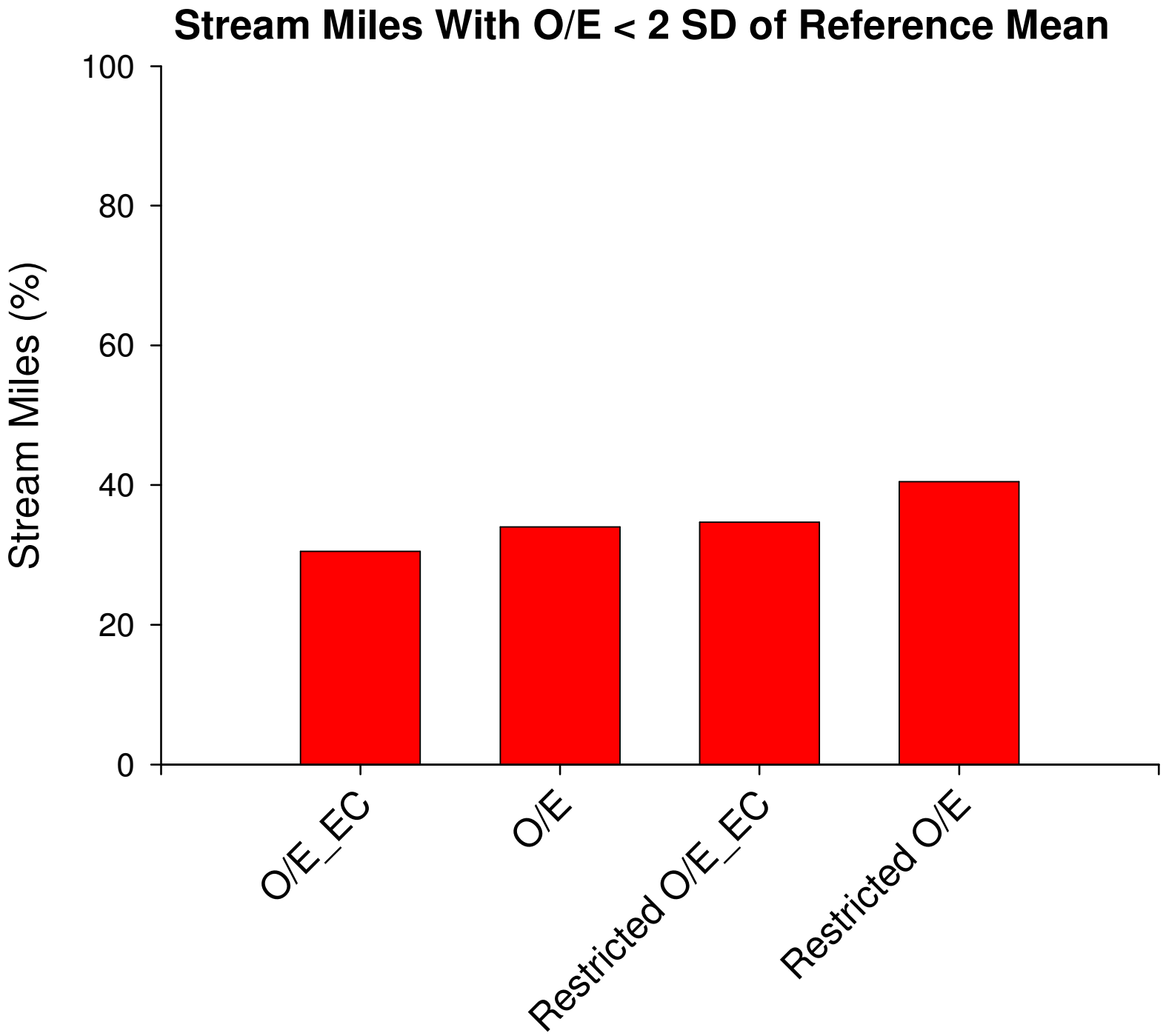
- Utilize a three-step process
  - Step 1: set threshold that balance types of error
  - Step 2: add uncertainty bounds to define zones of clearly impaired, clearly unimpaired, and grey zone
  - Step 3: Follow up with additional study in grey zone (re-sample, streamlined causal assessment) to make determination of impairment/non-impairment

O/E Reference Site Distribution




2 sd
1 sd
0.5
0.6
0.7
0.8
0.9
1.0

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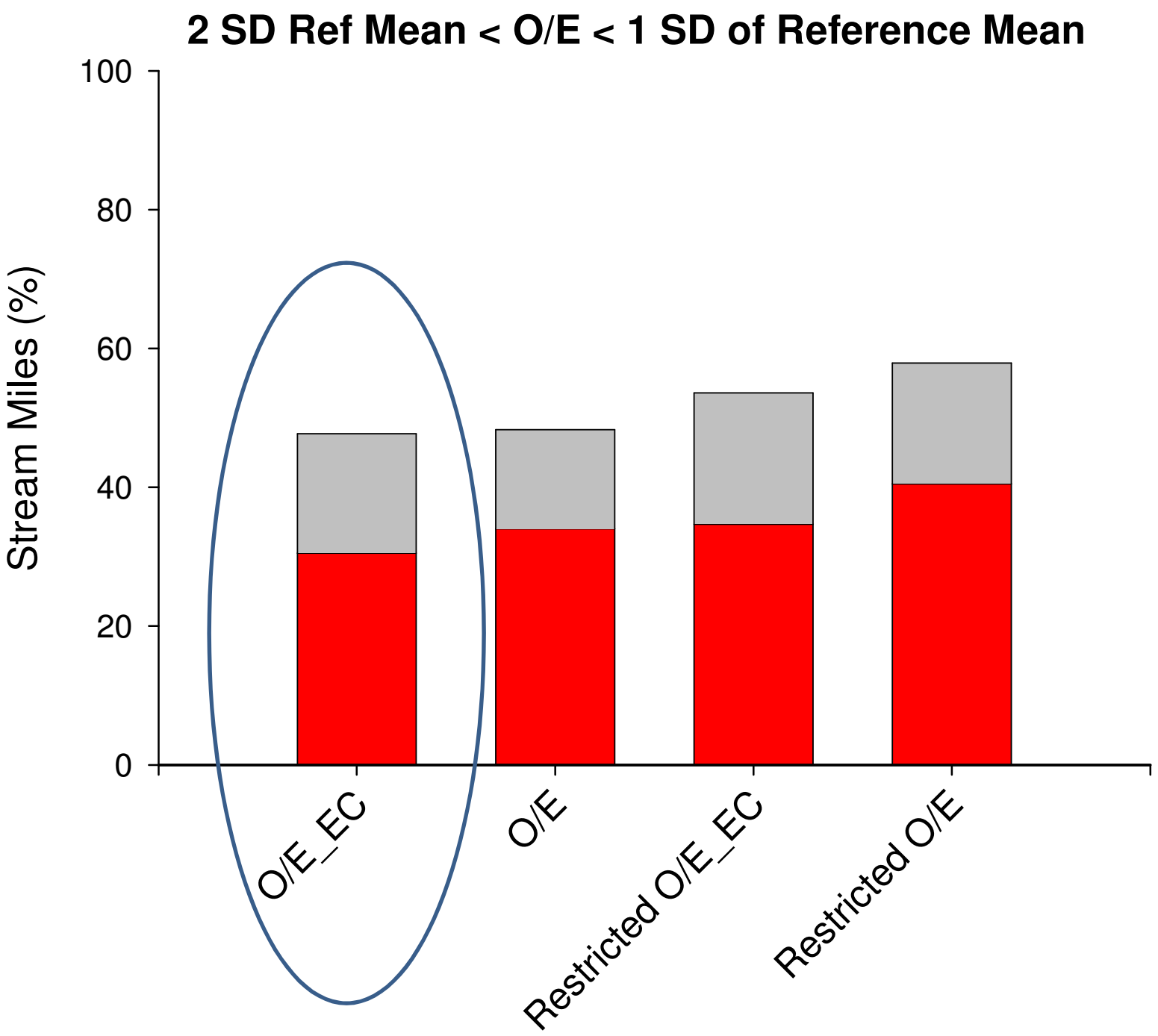
2 SD Ref Mean < O/E < 1 SD of Reference Mean
Stream Miles (%)
100
80
60
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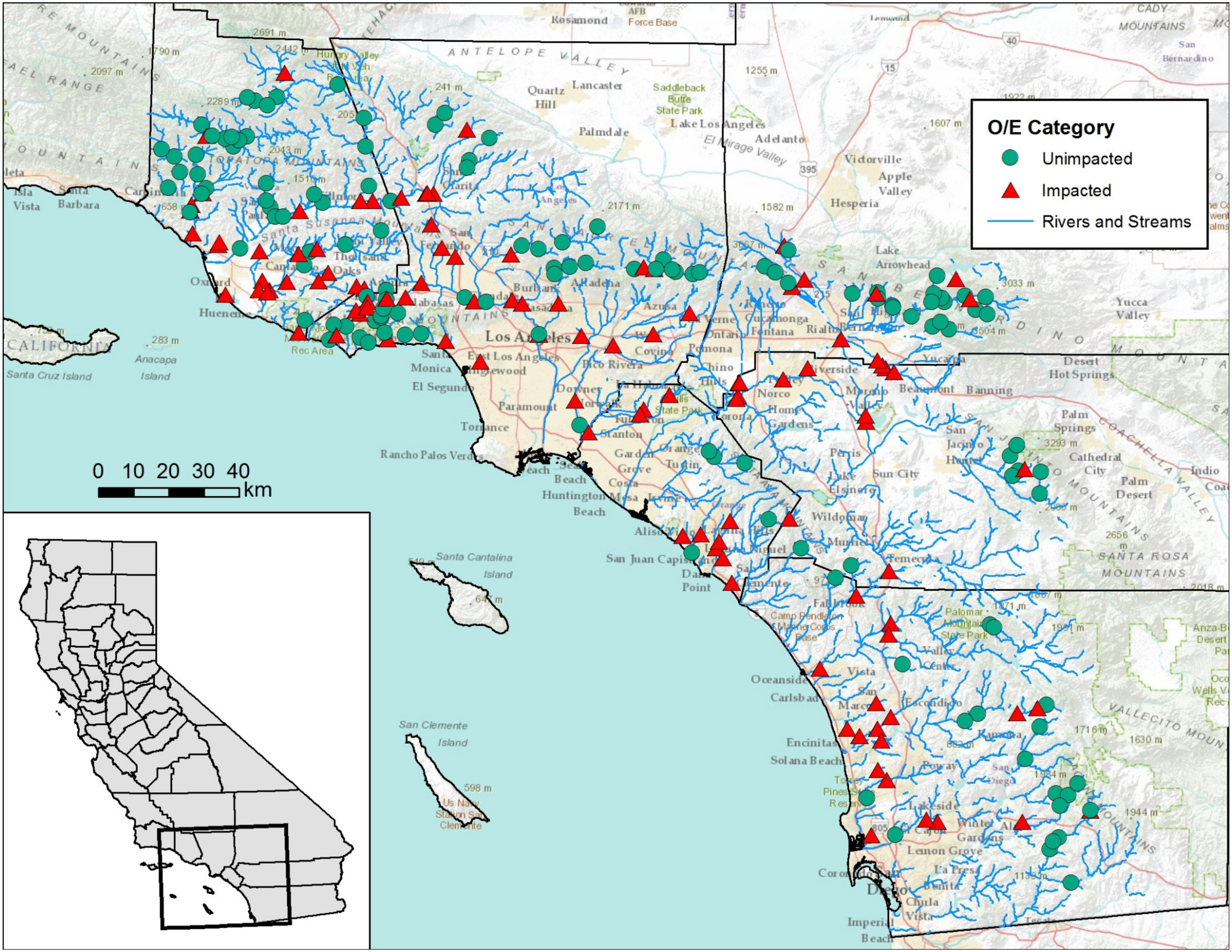
O/E_EC
O/E
Restricted O/E_EC
Restricted O/E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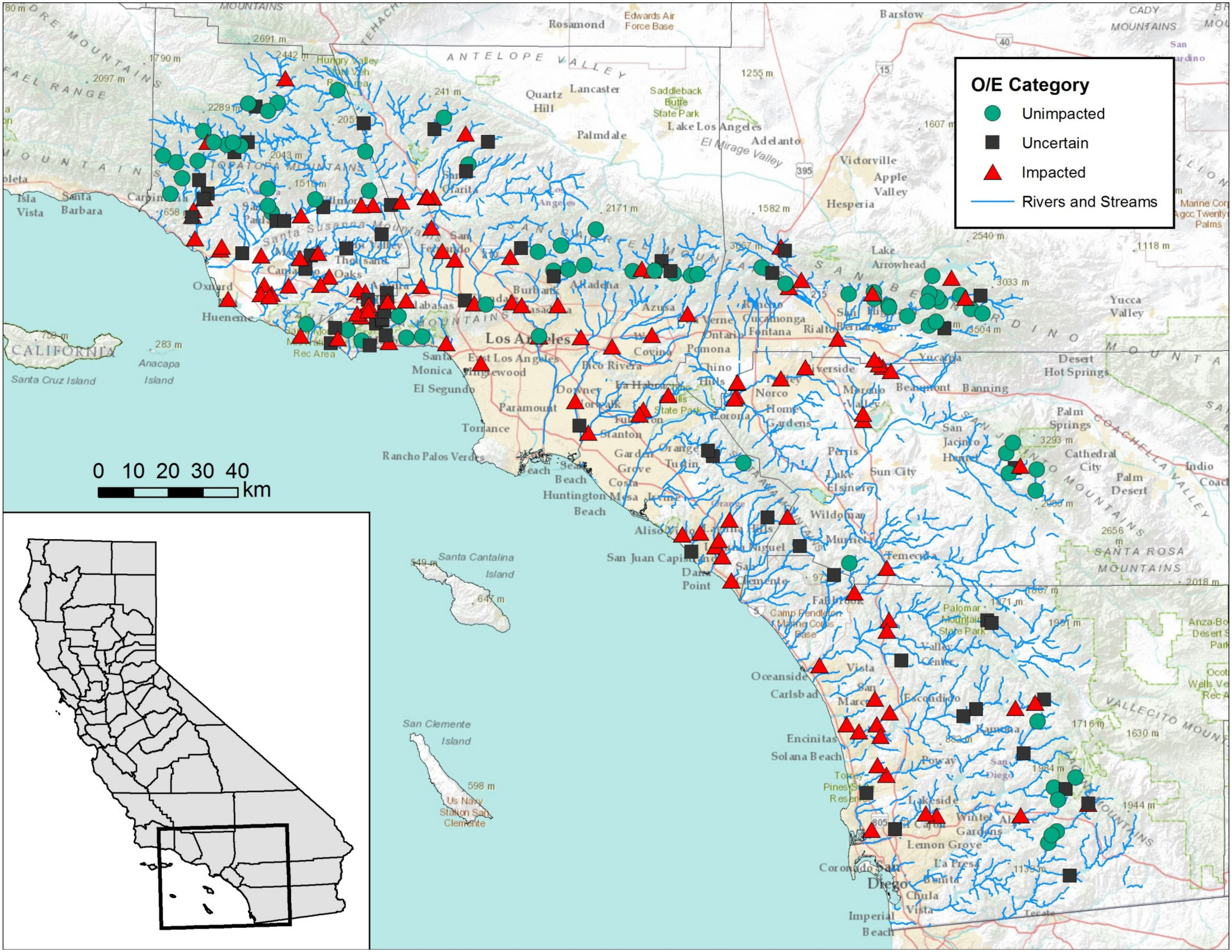
Anacapa Island
Palm Springs
Yucca Valley


O/E Category
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Uncertain
Impacted
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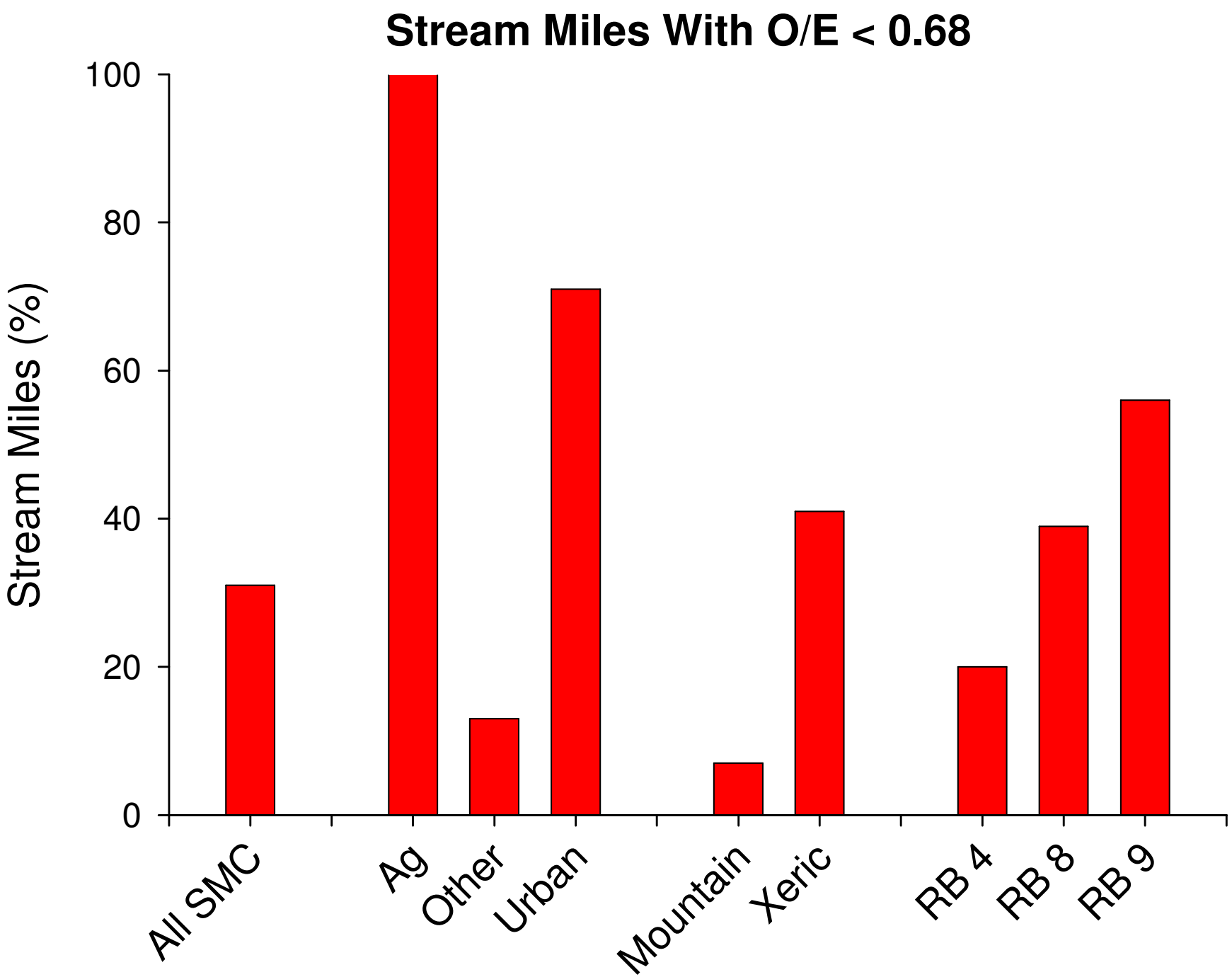
km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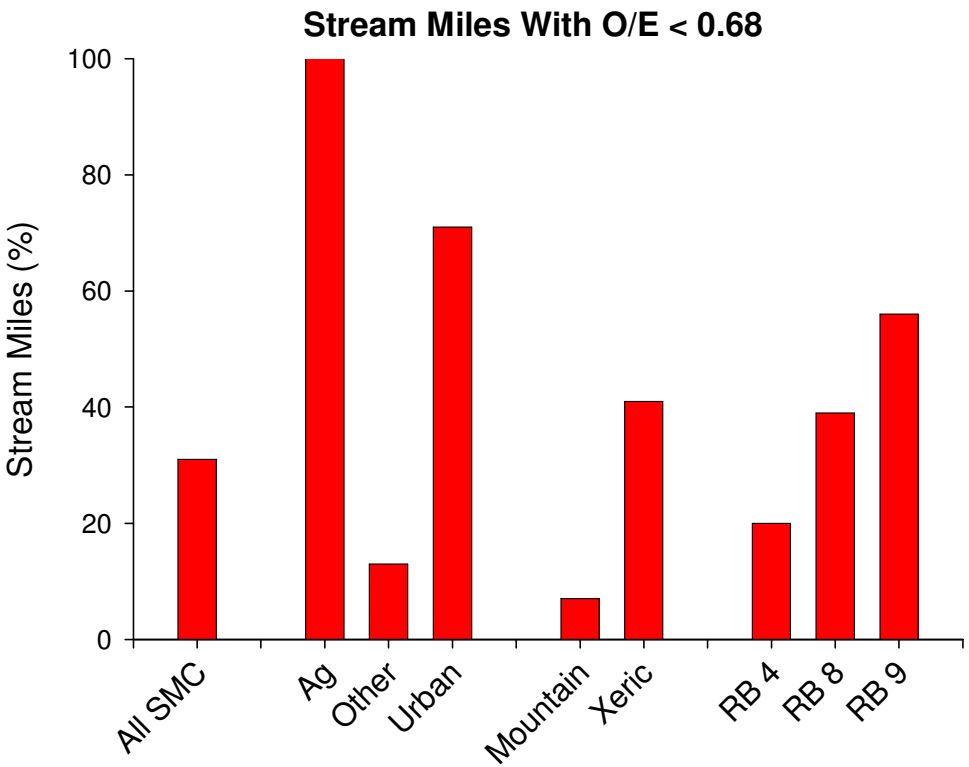
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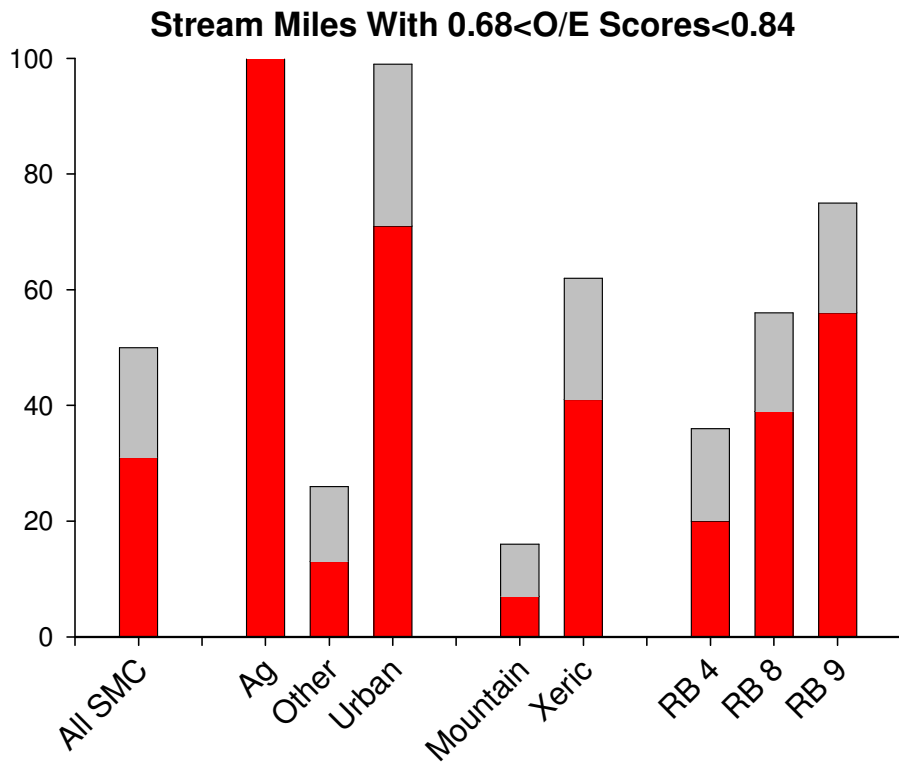
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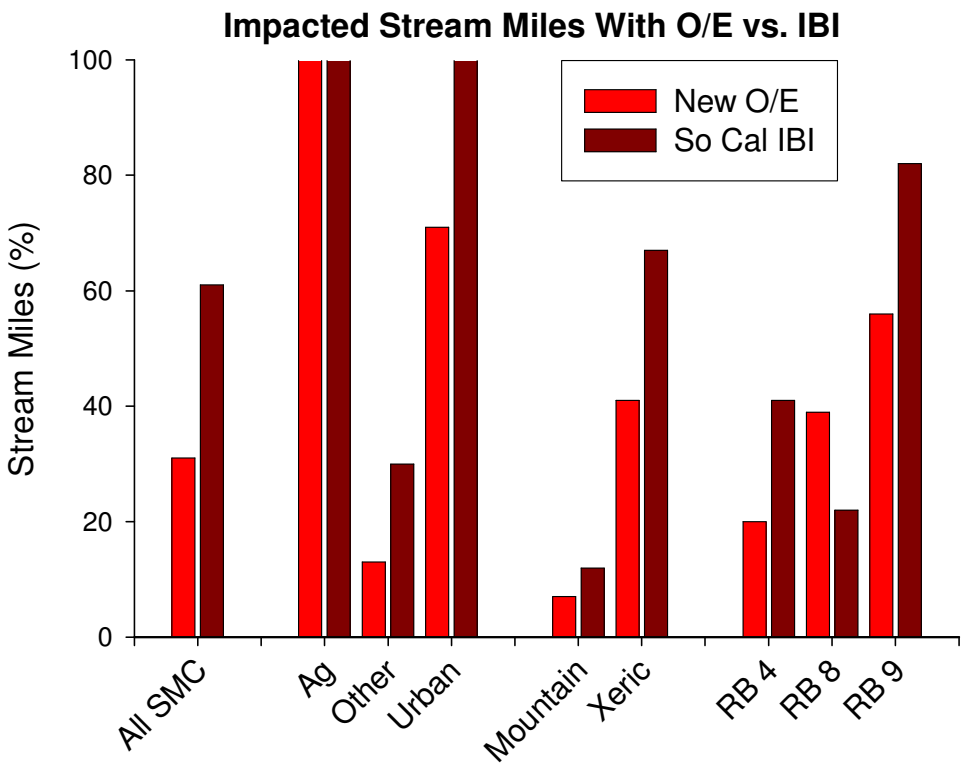
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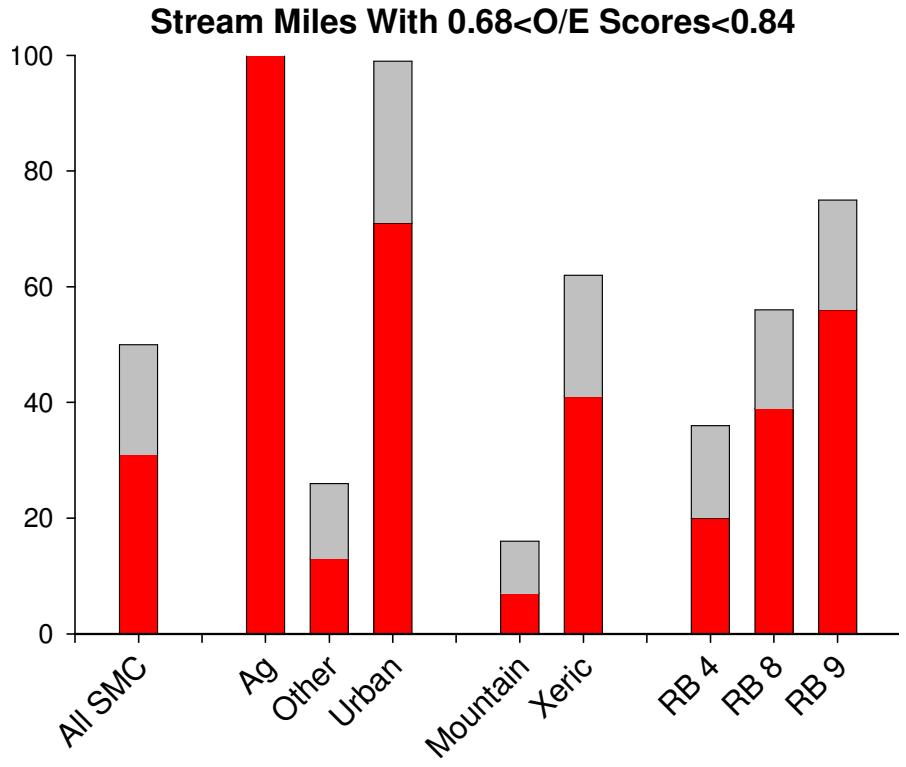
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Setting Biological Expectations for Modified Channels

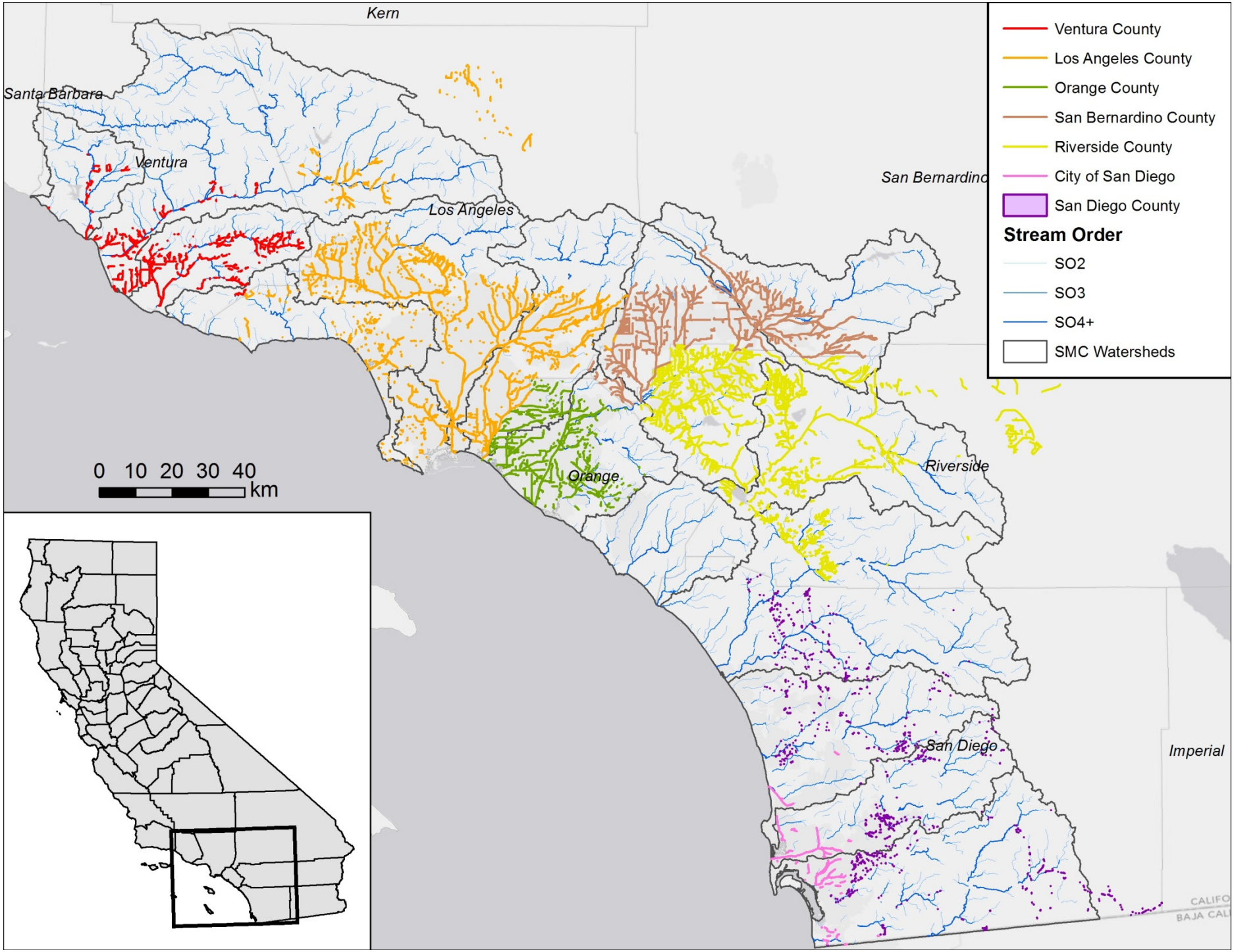
- What to do with sites that we think cannot attain reference condition?

- We've discussed several options previously
  - Avoid them
  - Use reference threshold and a long compliance timeline
  - Set a different [lower] expectation

- Came down to an assessment of extent
  - Makes a difference how widespread the exception class would be

Options Stakeholders Selected For Identifying Exception Stream Classes

- Constructed Channel
- Maintained Channel
- Physical Habitat Score
- Landscape Development Score
- Invasive Species
- Effluent Dominated


Kern
Santa Barbara
Ventura
Los Angeles
San Bernardino
Orange
Riverside
San Diego
Imperial
Ventura County
Los Angeles County
Orange County
San Bernardino County
Riverside County
City of San Diego
San Diego County
Stream Order
SO2
SO3
SO4+
SMC Watersheds
0 10 20 30 40
km

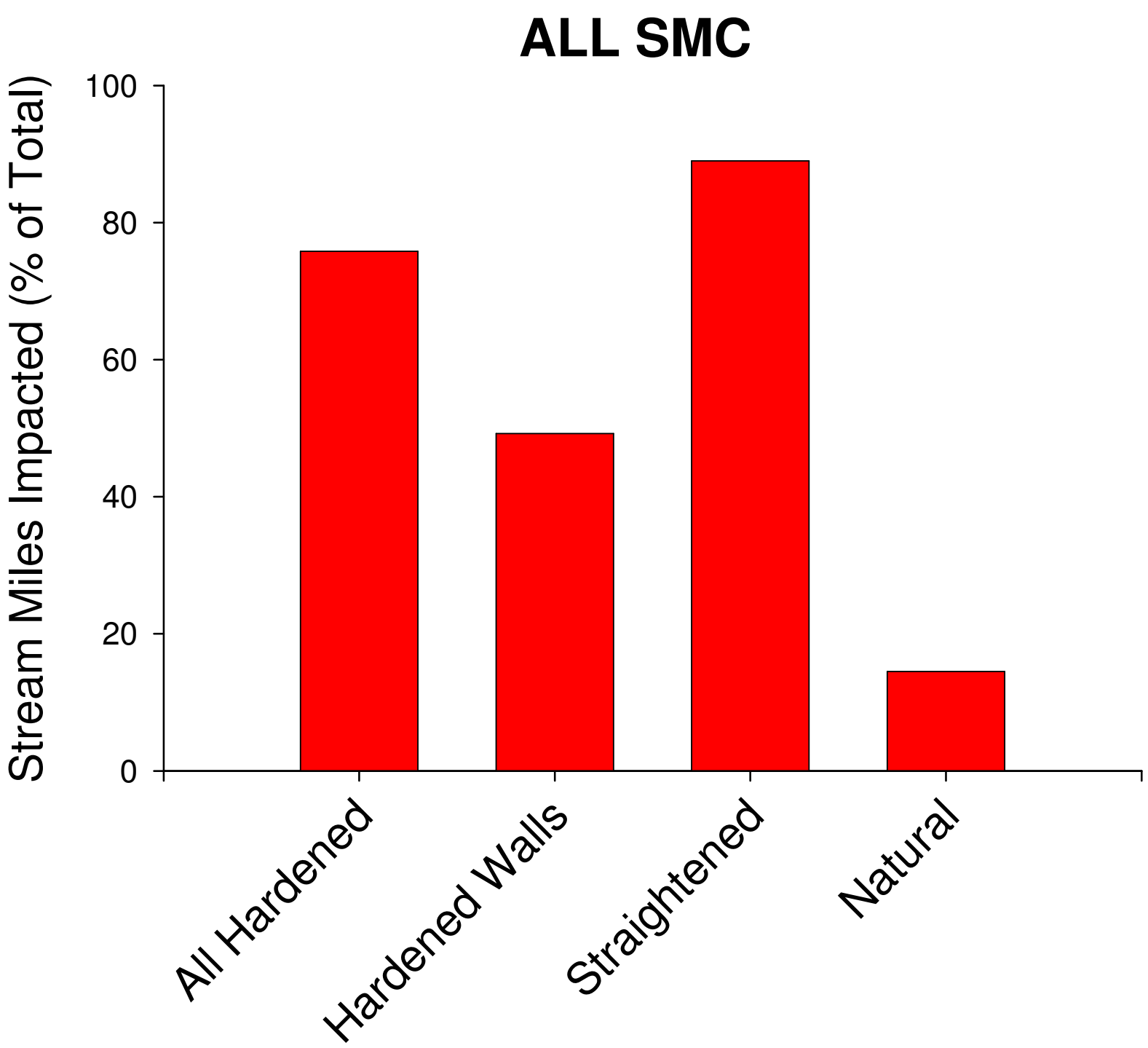
County Flood Control Data Inventories

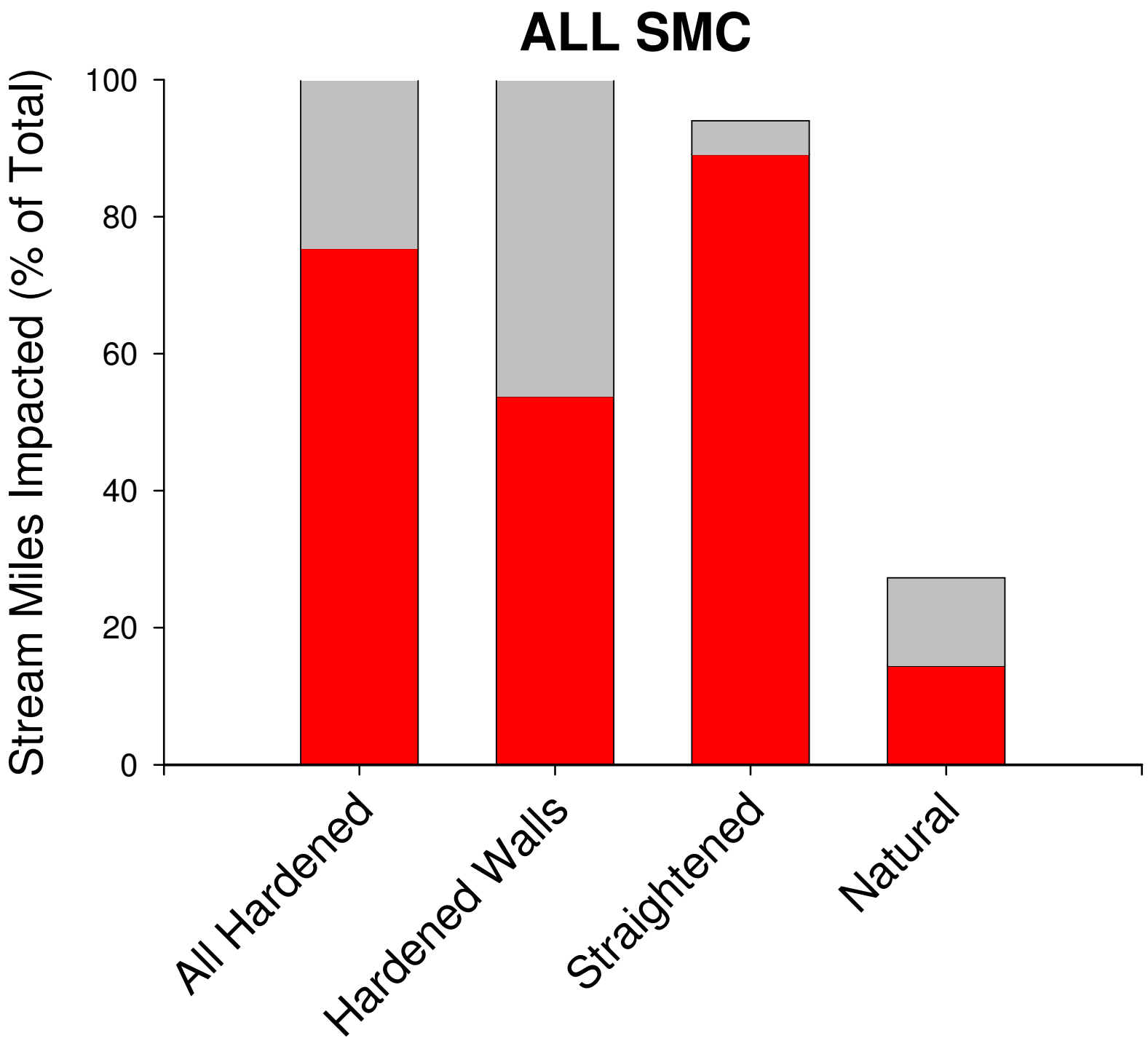
	Channel Name	Material Of Construction	Shape	Dimensions	Maintenance
Ventura County	X				
Los Angeles County	X	X	X	X	
Orange County	X	X	X		
San Bernardino County	X	X			
Riverside County	X	X			
San Diego County	X	X	X	X	X
City of San Diego					

Hardened Channel Extent Estimates

(% Stream-Miles Based on Probability Sites)

Hardscape Classification	All So Cal Streams	So Cal Mountain Streams	So Cal Xeric Streams
Concrete Walls and Bottom	5%	0%	7%
Concrete Walls, Soft Bottom	5%	0%	7%
Unlined, But Straightened	14%	1%	20%
Natural Watercourse	77%	99%	66%


ALL SMC
Stream Miles Impacted (% of Total)
100
80
60
40
20
0
All Hardened
Hardened Walls
Straightened
Natural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Straightened
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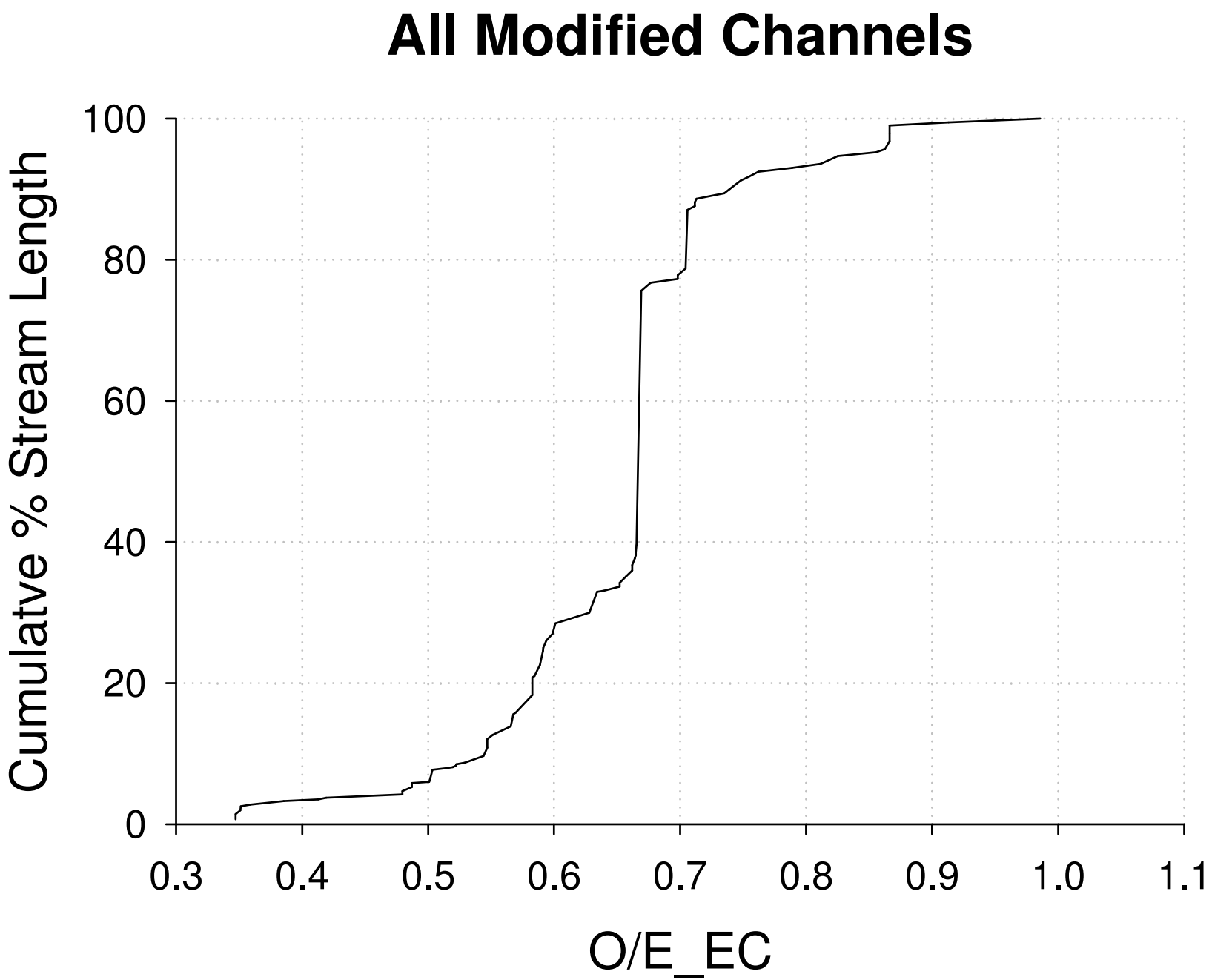
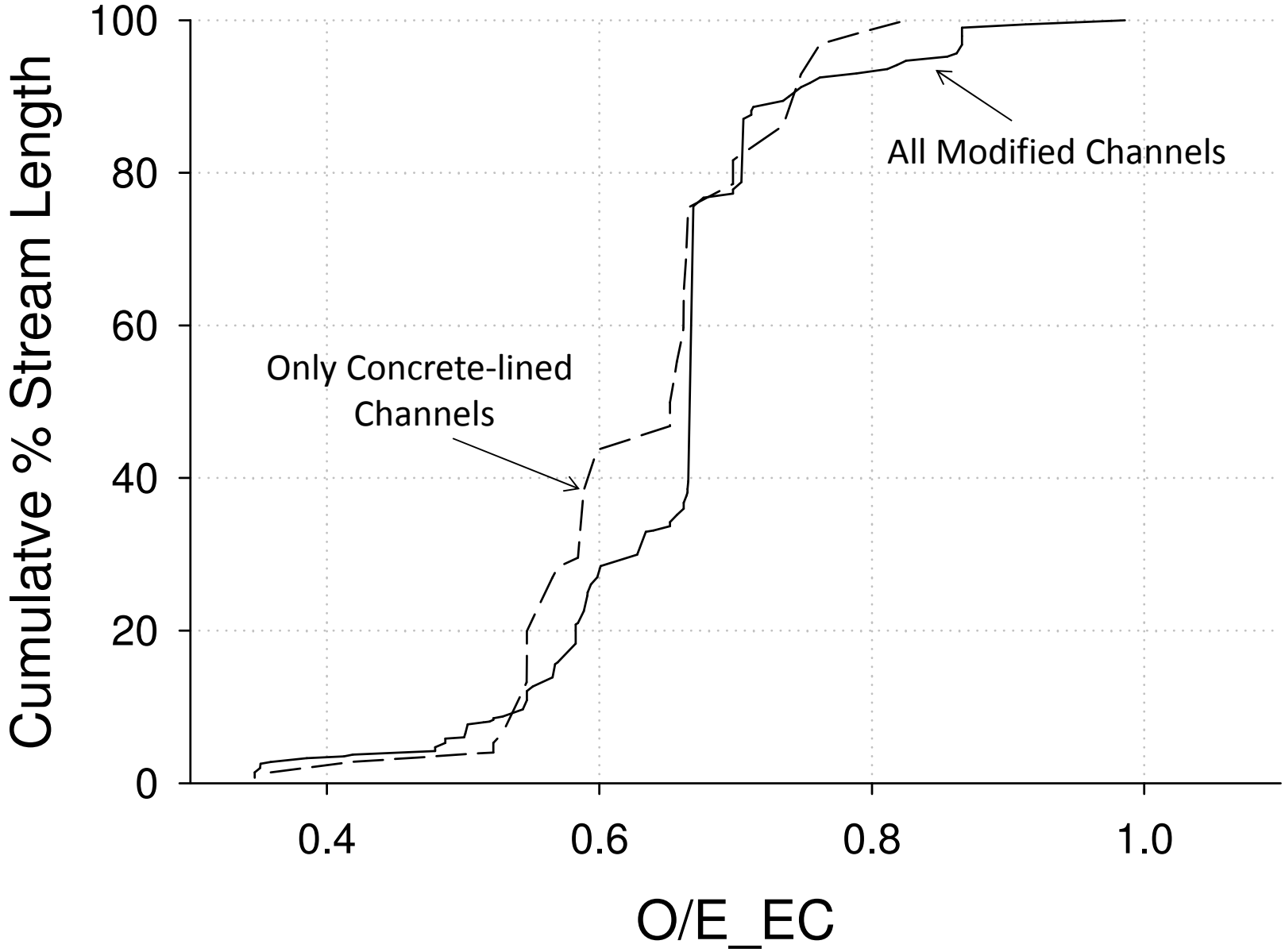

All Modified Channels
Cumulatve % Stream Length
100
80
60
40
20
0
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
O/E_EC

Concrete-Lined vs. All Modified Channels



What We Learned About Exception Classes

- It's a small list of channel types
  - They are difficult to define
- Even if you can define well, they are currently difficult to locate *a priori*
  - Likely require some type of local evidence
- Once located, setting expectations is not straightforward

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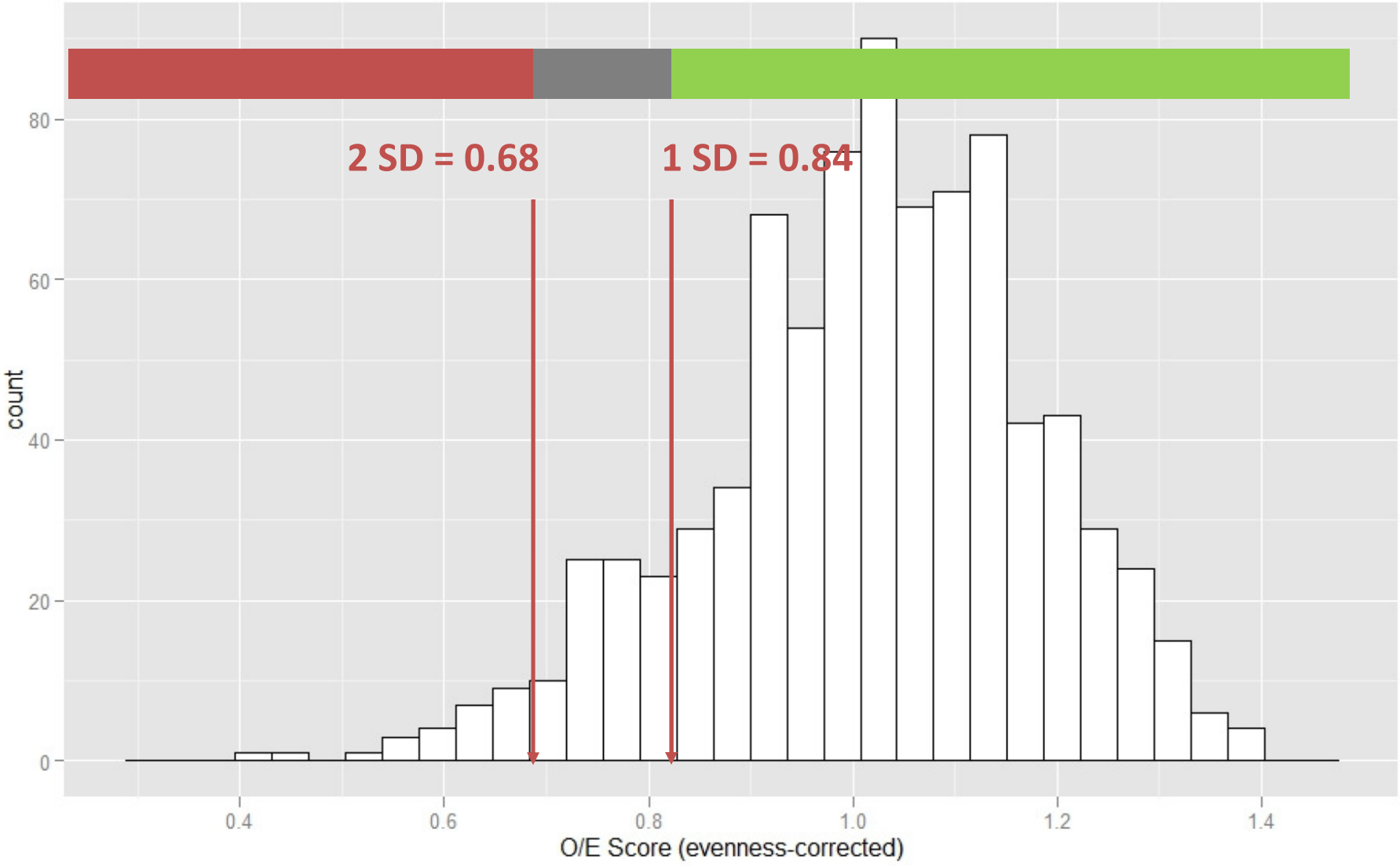
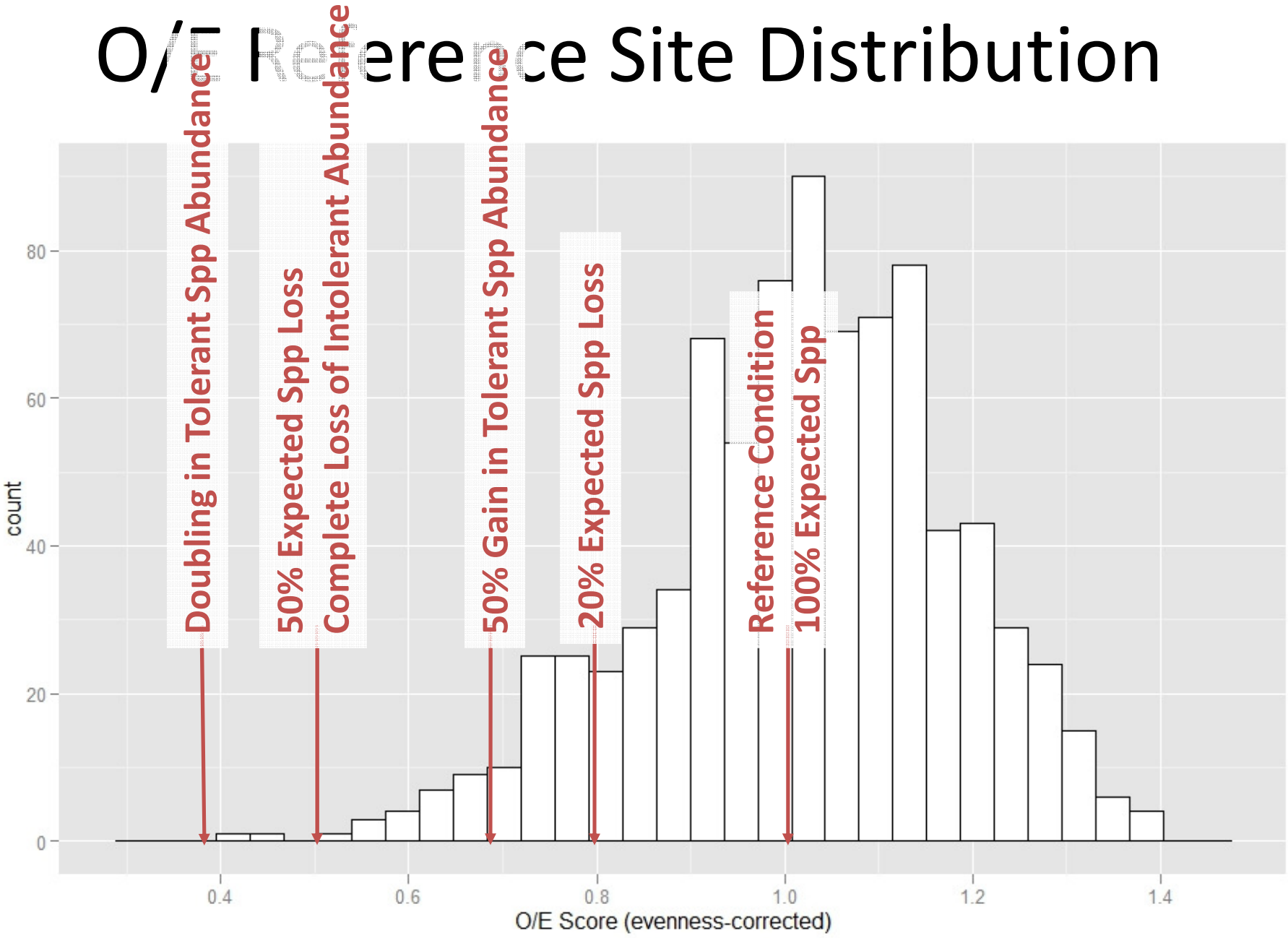
Antidegradation Technical Approaches

- Two basic approaches available
- Use multiple thresholds to create zones
- Some estimate of variability
  - Method variability
  - Intra-annual variability
  - Inter-annual variability
  - Combination

O/E Reference Site Distribution

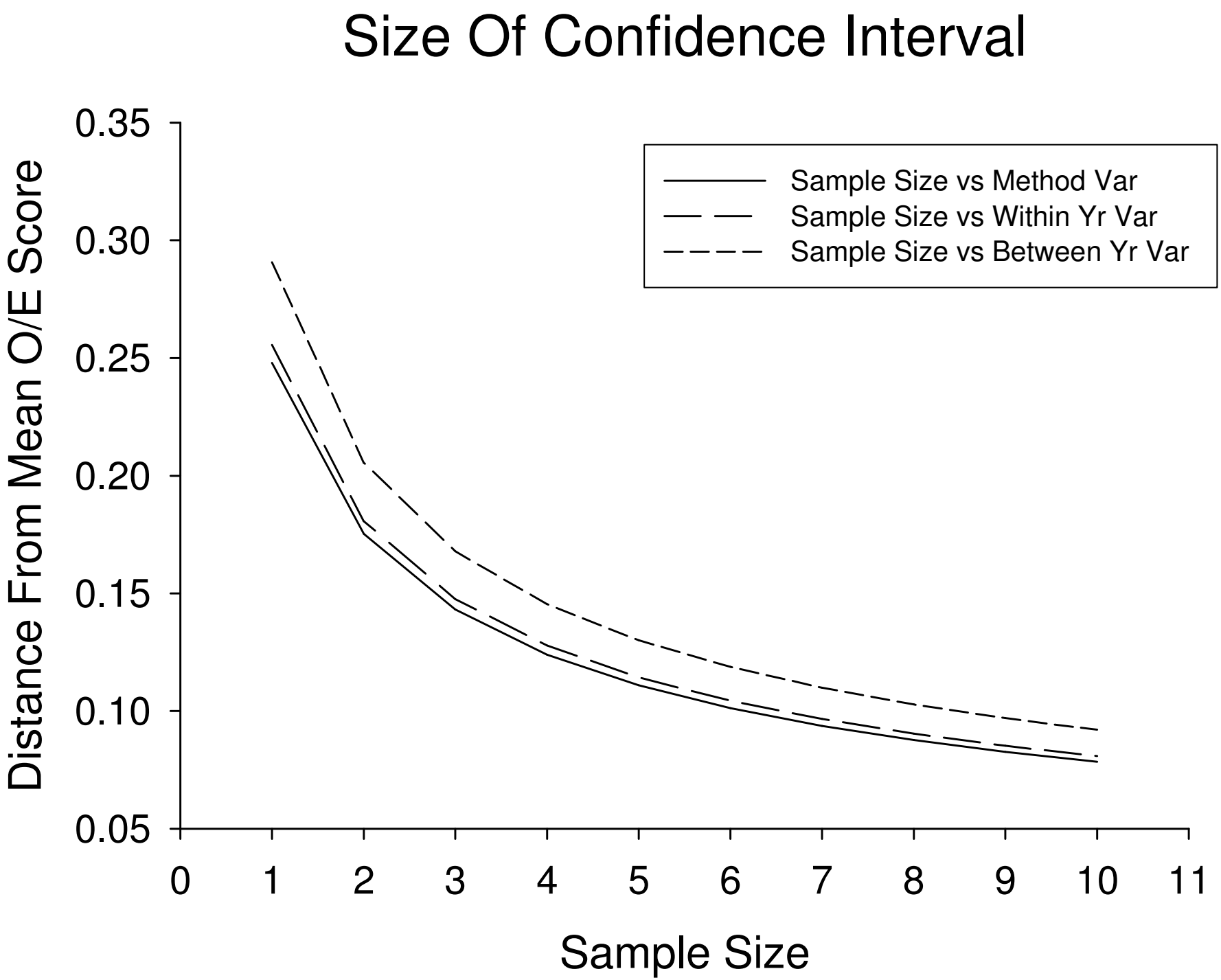


O/E Reference Site Distribution



Setting Bounds Based on Variability

Type of Variance	Description	Supporting Data	Pooled Variance Estimate (O/E Units)	Coefficient of Variation (% CV)
Sampling Method	Samples collected on the same day at same site	16 sites, 32 samples	0.016	14
Intra-annual	Samples collected at same site, but on different days of same season and year	6 sites, 24 samples	0.017	12
Inter-Annual	Samples collected at same site, but in same season of different years	18 sites, 69 samples	0.021	13

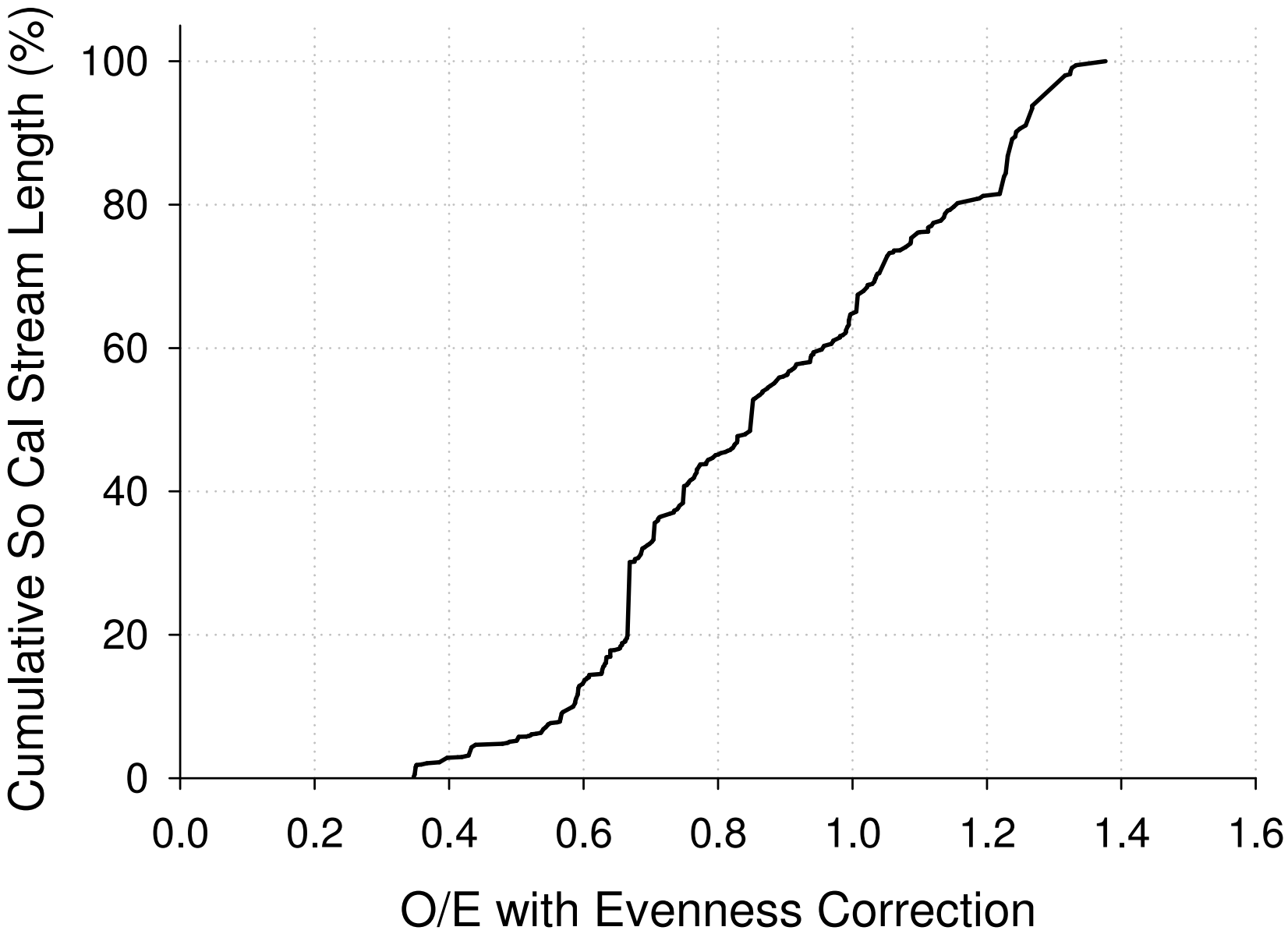

Size Of Confidence Interval
Distance From Mean O/E Score
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
1
2
3
4
5
6
7
8
9
10
11
Sample Size
Sample Size vs Method Var
Sample Size vs Within Yr Var
Sample Size vs Between Yr Var

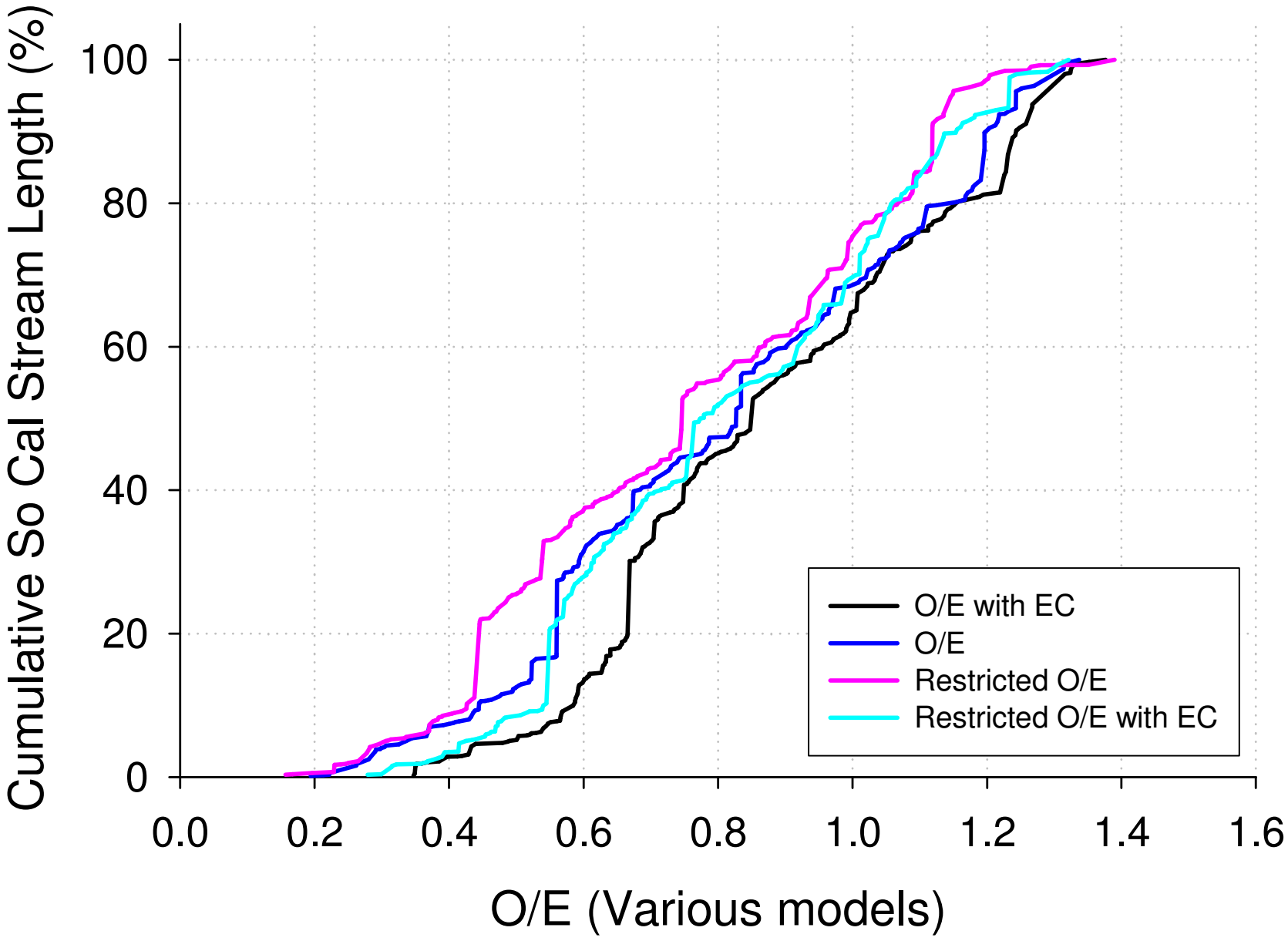
What You've Seen Today

- Description of expanded study area
- New assessment tool threshold application
  - Empirical *vs* ecosystem function/biological metrics
- Dealing with uncertainty
  - Drawing the bright line remains a challenge
- Regulatory applications
  - Exception classes are likely limited, but options remain for how to deal with them
  - Antidegradation concepts will be an important component of the regulatory package

Questions for the Science Panel

- How can we improve the balance between Type I and Type II error?
  - What is the preferred approach for threshold selection?
- What is your recommended approach for uncertainty?
  - How would your preferred thresholds differ relative to the Expanded Pilot example?
- What advice can you offer the state on exception classes?
  - How have other states dealt with exception classes, especially thresholds for exception classes?
- What options are most technically sound for the State to consider for anti-degradation?
- Do you have any recommendations when we move statewide?
  - Are there concerns about exporting So Cal approaches to rest of state?
  - Are there additional areas we should explore for new regions?


Cumulative So Cal Stream Length (%)
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
O/E with Evenness Correction


Cumulative So Cal Stream Length (%)
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
O/E (Various models)
O/E with EC
O/E
Restricted O/E
Restricted O/E with EC

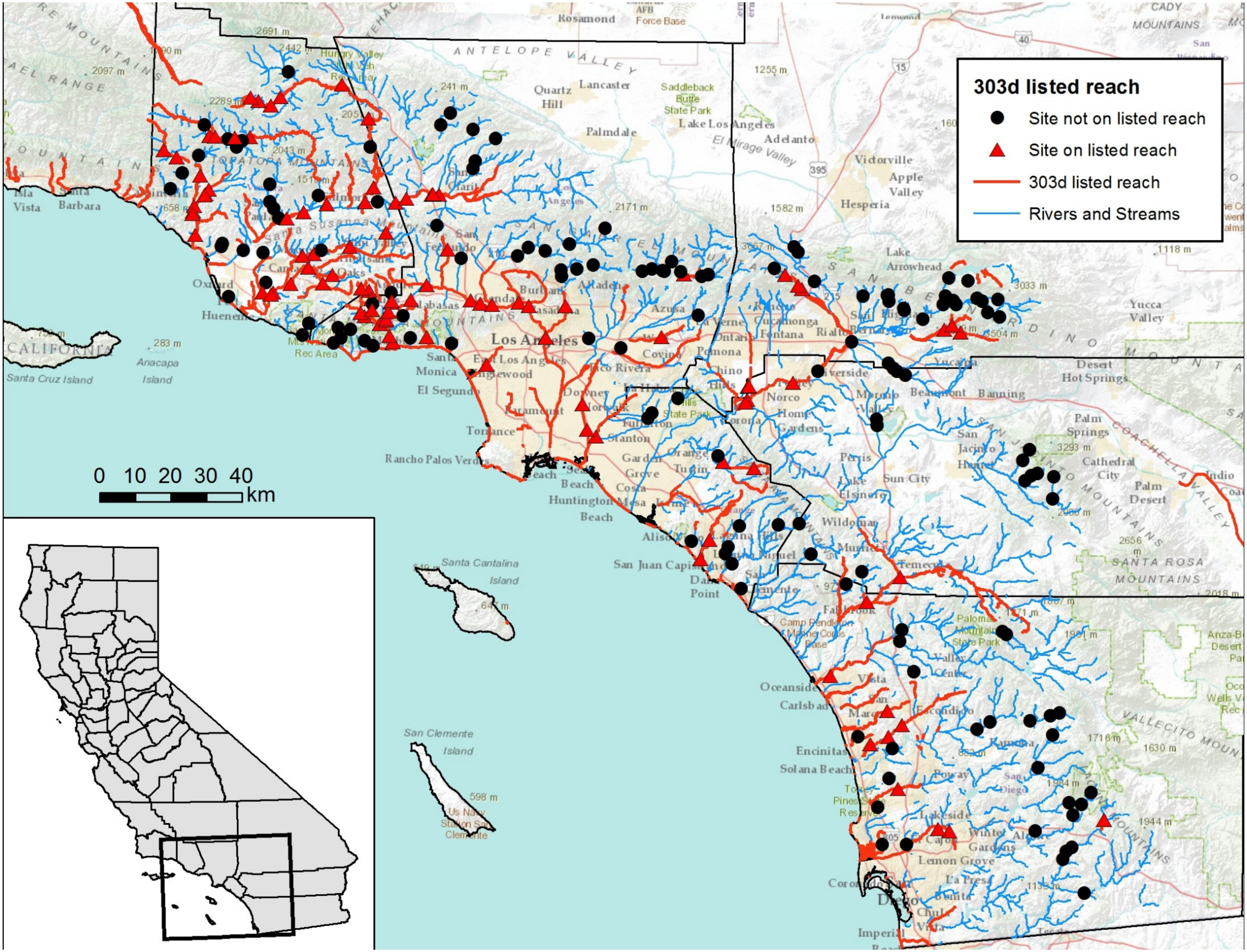
What You'll See Today

- Description of expanded study area
  - Data inventory
- New assessment tool threshold application
- Dealing with uncertainty
- Regulatory applications
  - Exception classes
  - Comparison with 303d listing
  - Antidegradation concepts

303d Listings in Southern California

- Approximately 32% of stream miles in So Cal are on the 303d list (2006)
- 316 pollutant-waterbody combinations
  - Over a dozen pollutant categories
- Current policy will not list on benthic community effects alone
  - Requires a chemical pollutant co-listing

POLLUTANT	NUMBER OF STREAMS	ESTIMATED SIZE (stream miles)
Hydromodification	6	70
Metals/Metalloids	37	358
Miscellaneous	12	256
Nuisance*	4	47
Nutrients	50	613
Other Inorganics	13	133
Other Organics	10	70
Pathogens*	40	399
Pesticides	59	505
Salinity	43	698
Sediment	15	124
Toxicity	14	174
Trash*	13	108
Any Pollutant	**57**	**759**


303d listed reach
Site not on listed reach
Site on listed reach
303d listed reach
Rivers and Streams
0 10 20 30 40
km

Comparing 303d Listings To Biology

- Relationship between existing listings and our assessments of biology on the same reaches?

- Does the relationship improve with specific pollutants?

Percent of So Cal Stream Miles
Contingency Table: Biology vs. Any 303d Listing

	Listed	Not Listed
Biology Does Not Score Well	16	38
Biology Score Well	16	30

Percent of So Cal Stream Miles
Contingency Table: Biology vs. Nutrient Listings

	Listed	Not Listed
Biology Does Not Score Well	7	24
Biology Score Well	10	59

Biology vs. Various Listings (% So Cal Stream Miles)

LISTING	% AGREEMENT	% DISAGREEMENT
Hydromodification	67	33
Metals	65	35
Nutrients	66	34
Pesticides	64	36
Salinity	61	39
Sediment	64	36
Toxicity	70	30
Any	46	54