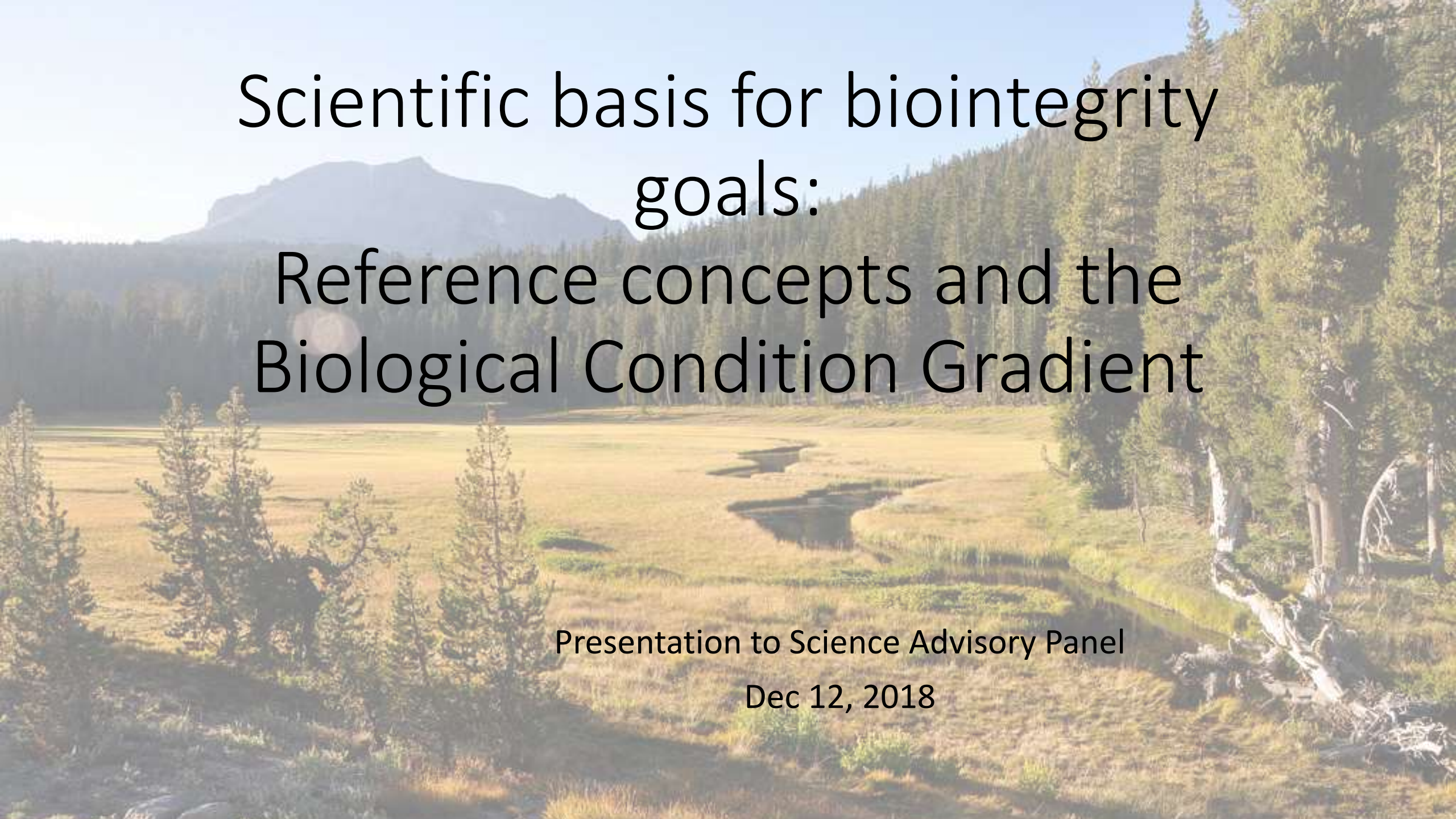


Scientific basis for biointegrity goals: Reference concepts and the Biological Condition Gradient

Presentation to Science Advisory Panel

Dec 12, 2018

What is a “biointegrity goal”?

- A “goal” is an ecological state of a stream that corresponds to an intended management outcome. Examples:
  - Largely natural
  - Similar to reference
  - No more than a minor loss of diversity
- We can derive numbers and thresholds for biointegrity indices that correspond to these goals
- Depending on needs and context, managers can set different goals for different streams

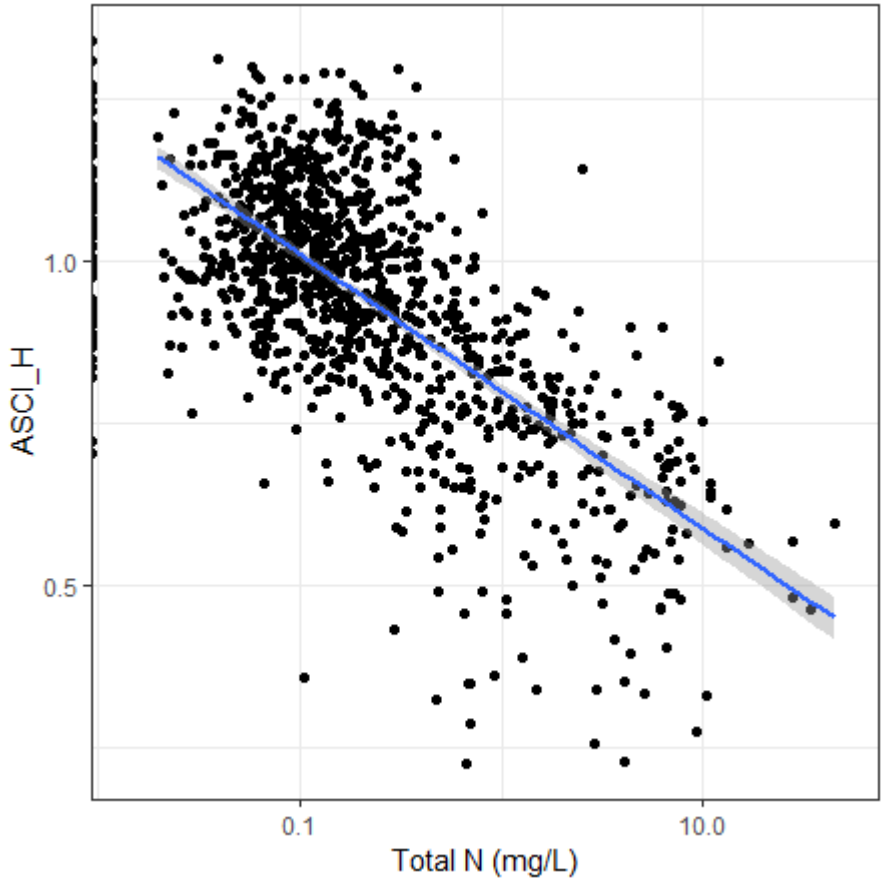
Principles and assumptions

- Bioassessment indices are a direct way to measure support for aquatic life
- Multiple measures provide more comprehensive evidence of AL support
- CSCI and ASCIs are a standard way to measure biointegrity in most California wadeable streams
  - Additional and alternative measures (e.g., fish) may be appropriate in certain circumstances

Goals for biointegrity policy… and beyond

- Biointegrity goals are used for biological objectives, assessing management effectiveness, and other activities

- But also needed as an assessment endpoint for biostimulatory stress response models!
  - E.g., what maximum level of stress still has a high likelihood of achieving goals?

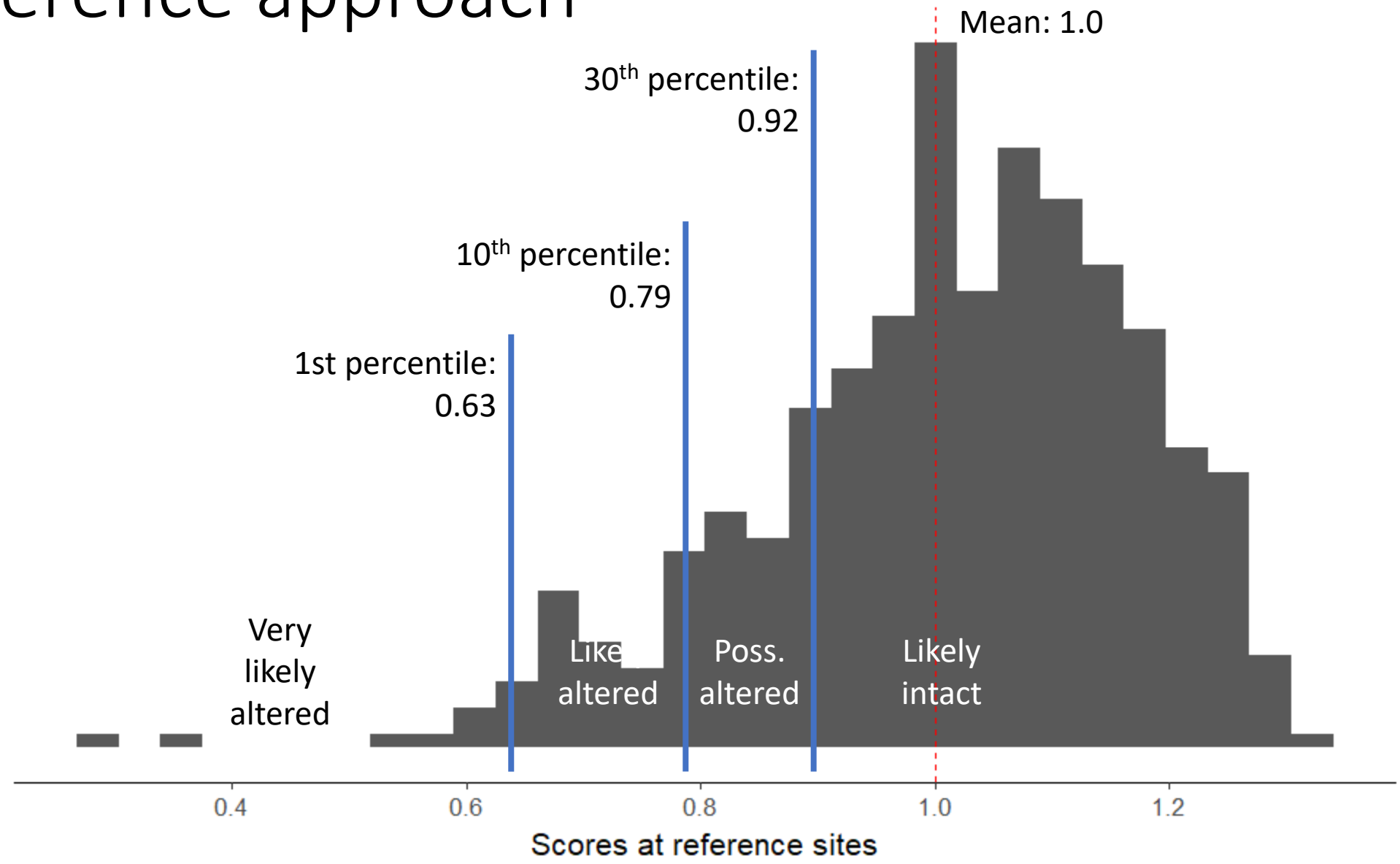


Two approaches to setting goals for biointegrity

1. Reference variability (percentile of reference)

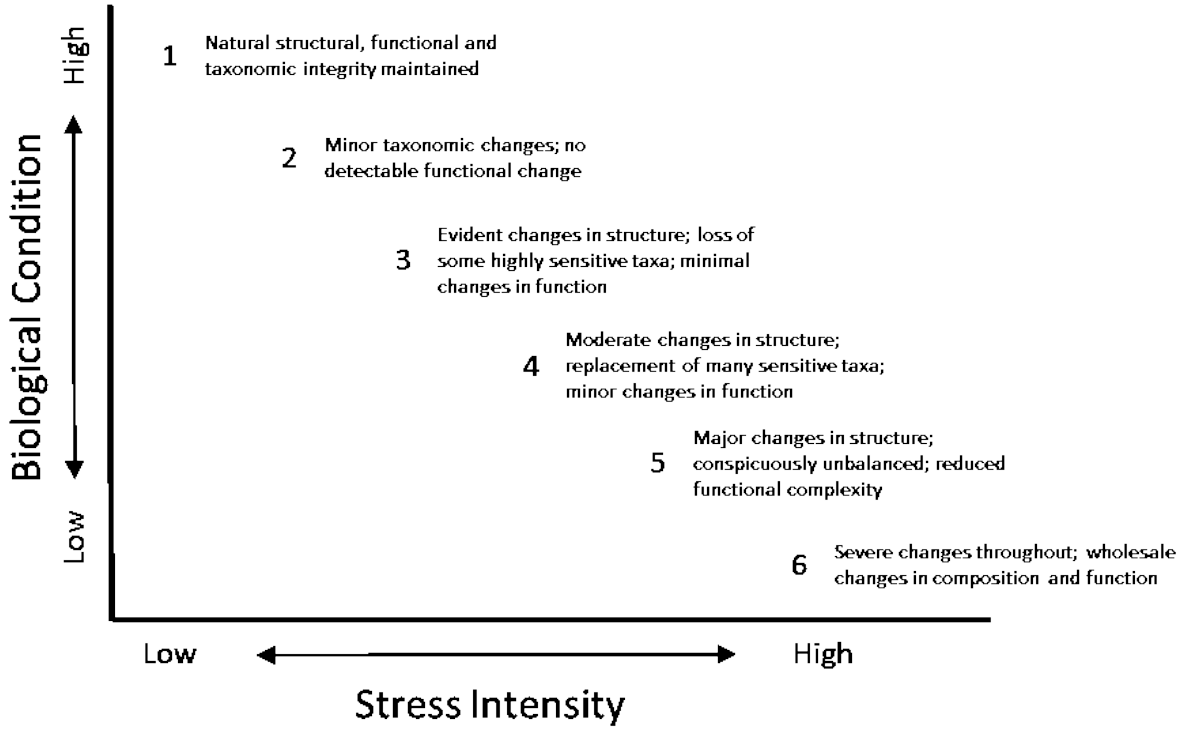
2. Expert opinion (Biological Condition Gradient, BCG)

Reference approach



BCG approach

Standard narratives of condition-classes, adapted to California by panel of experts



Still reference based, but relies on expert opinion rather than statistical calculation of deviation from reference

BCG approach

Standard narratives of condition-classes, adapted to California by panel of experts

Bin	Description
1	Natural or native condition
2	Minimal alteration in structure or function
3	Evident changes in structure, minimal loss of function
4	Moderate changes in structure, minor loss of function
5	Moderate changes in structure and function
6	Severe changes in structure and major loss of function

Still reference based, but relies on expert opinion rather than statistical calculation of deviation from reference

Process for developing a BCG model

- Assemble panels of expert ecologists (2 panels for bugs, algae)
- Ask panels to adapt national definitions to California
  - Describe biological characteristics of each “bin”
  - Ascribe tolerance values to taxa
- Create a dataset of 250 sites across the state, representing different ecoregions and exposures to stress
- Panels assign sites to bins
- Crosswalk bins to observed index scores (probability-odds models)
- Identify scores associated with high likelihood of bin membership

Who were the experts?

Benthic Invertebrates

Larry Brown

James Carter

David Herbst

Jeanette Howard

Bill Isham

Jason May

Patina Mendez

John Olson

Alison O'Dowd

Andy Rehn

Algae

Don Charles

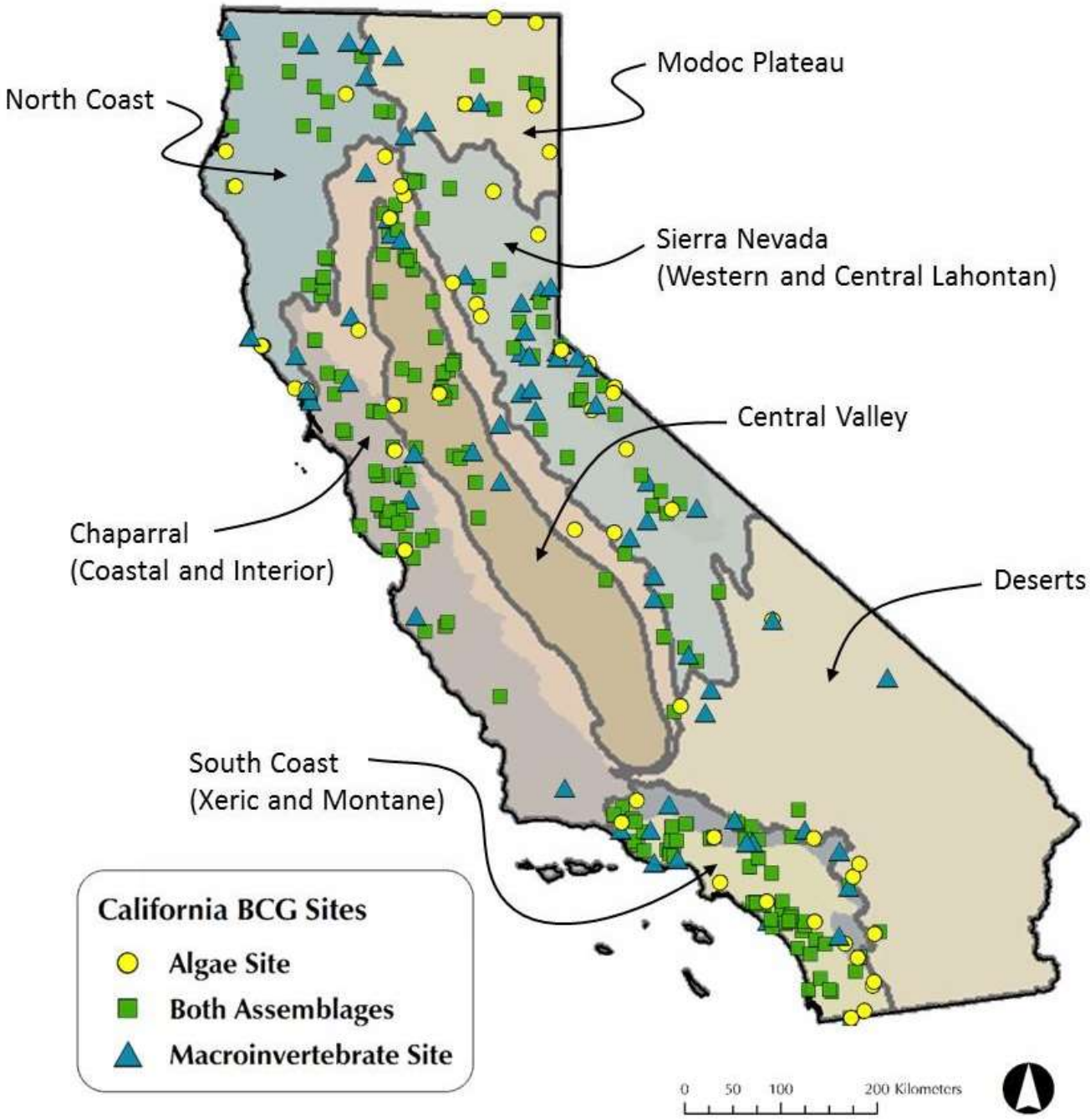
Rex Lowe

Yangdong Pan

Robert Sheath

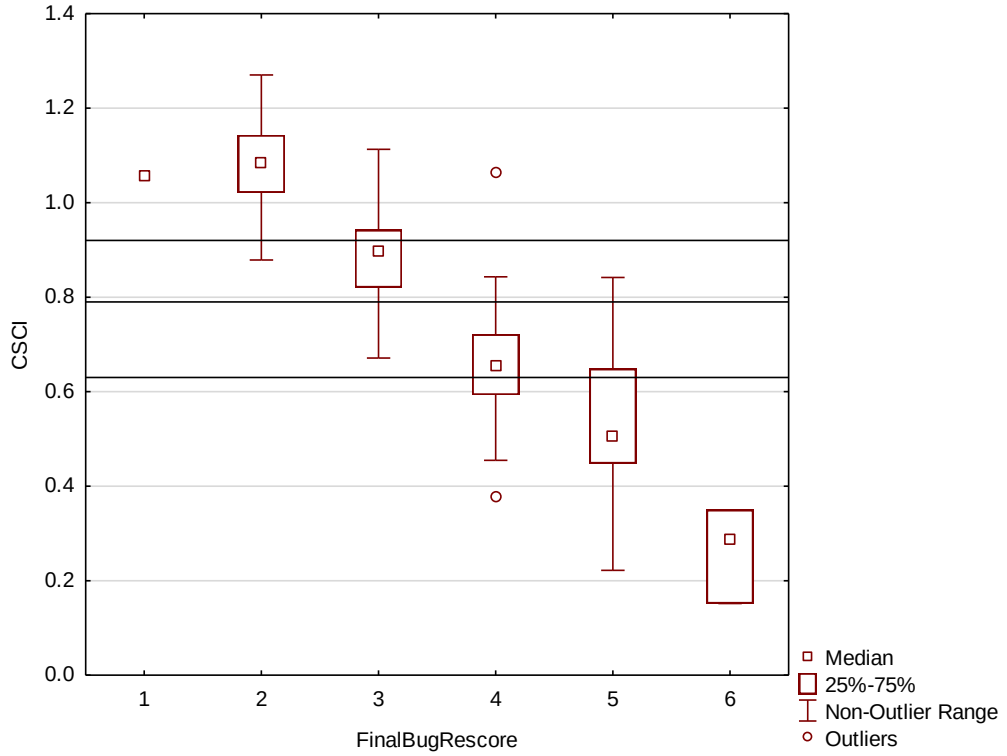
Sarah Spaulding

Rosalina Stancheva

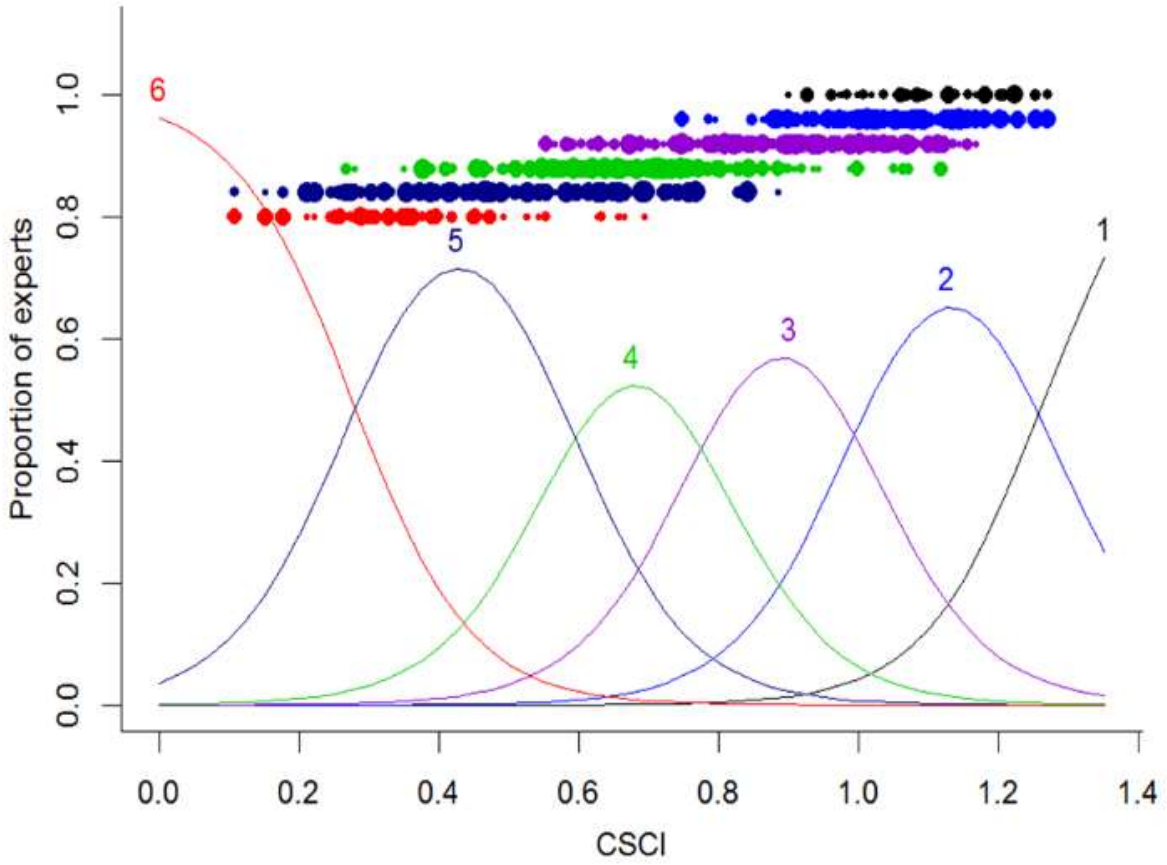


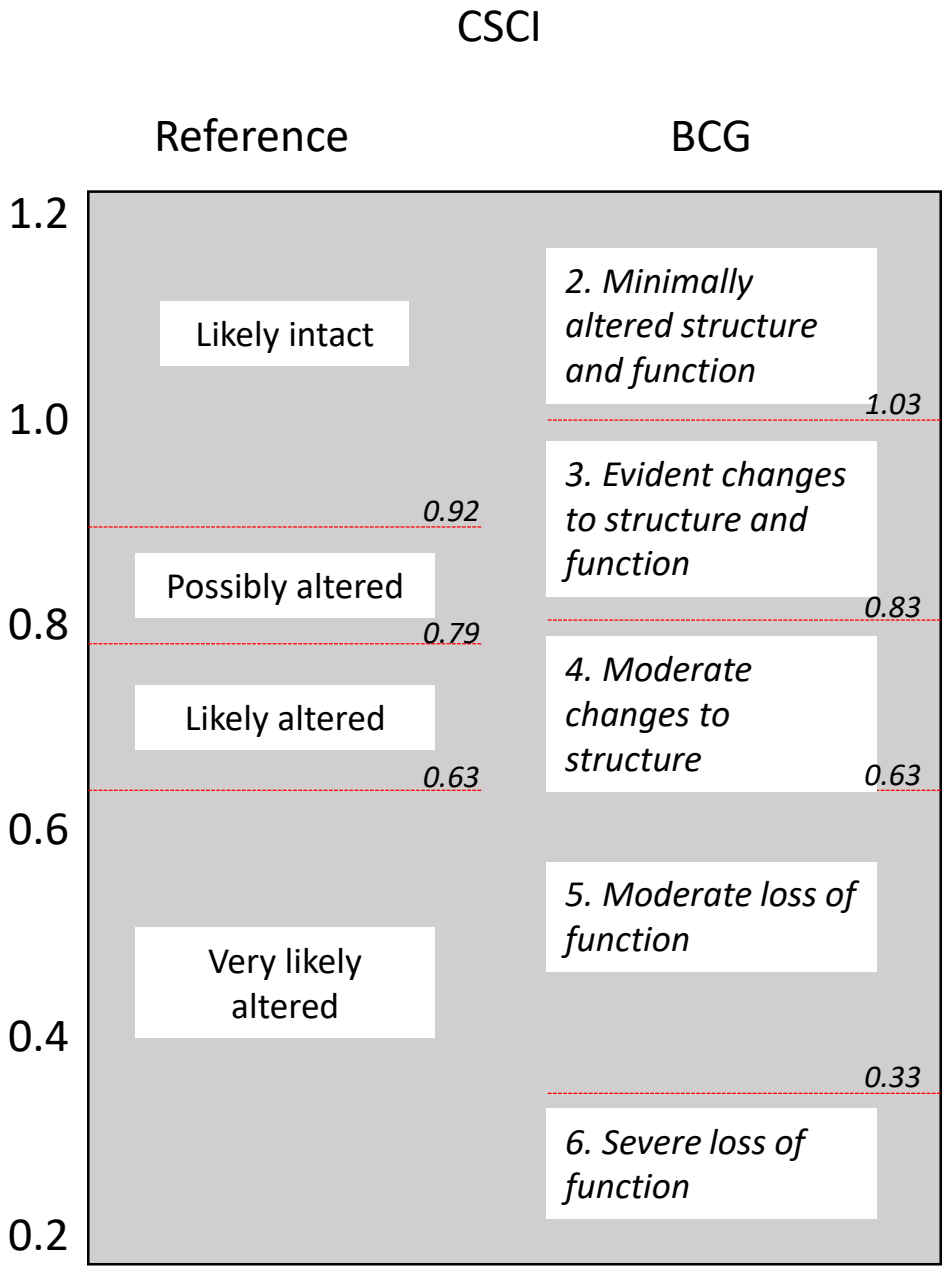
Large statewide development data set

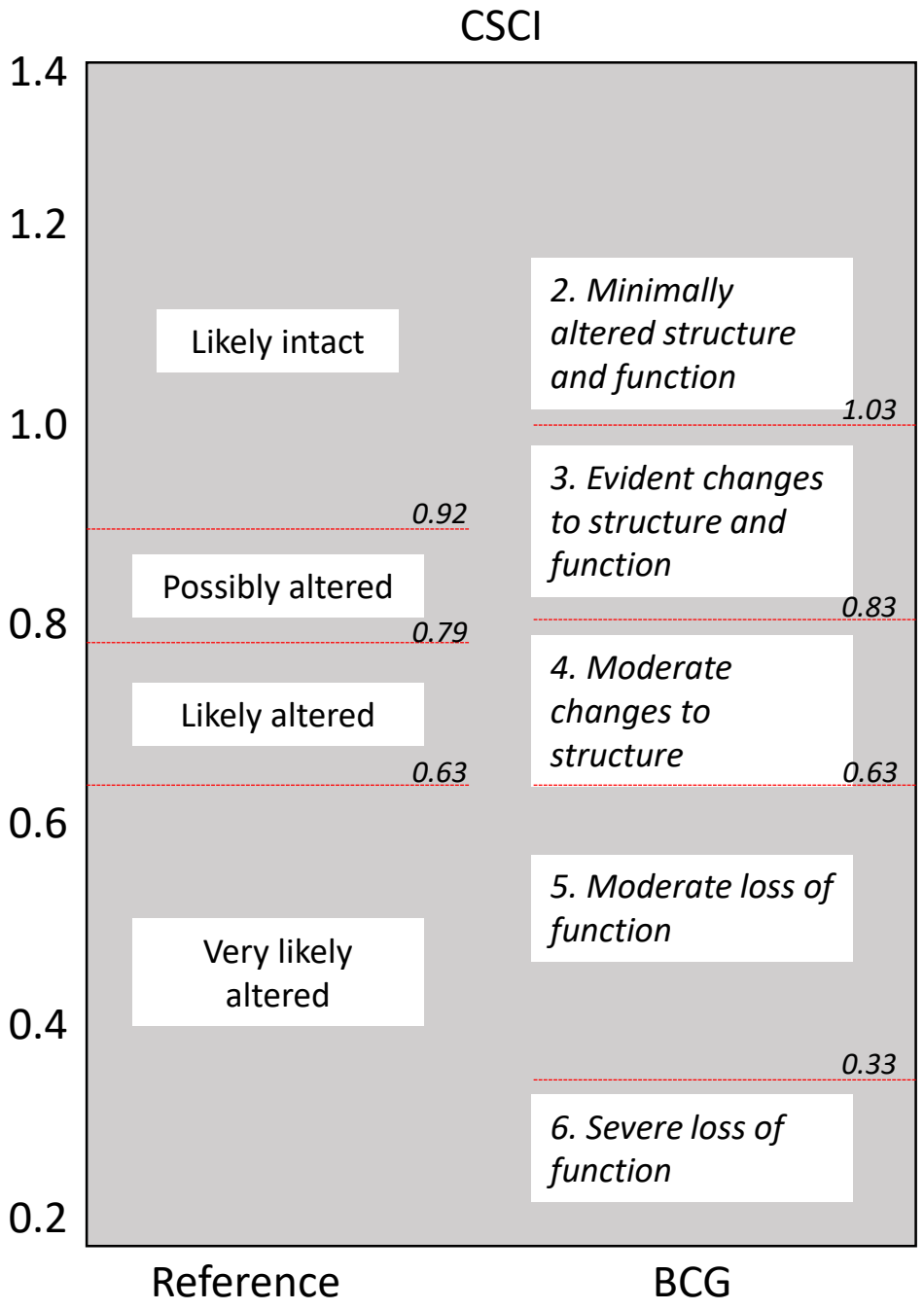
Panels reviewed mostly the same sites (80%)

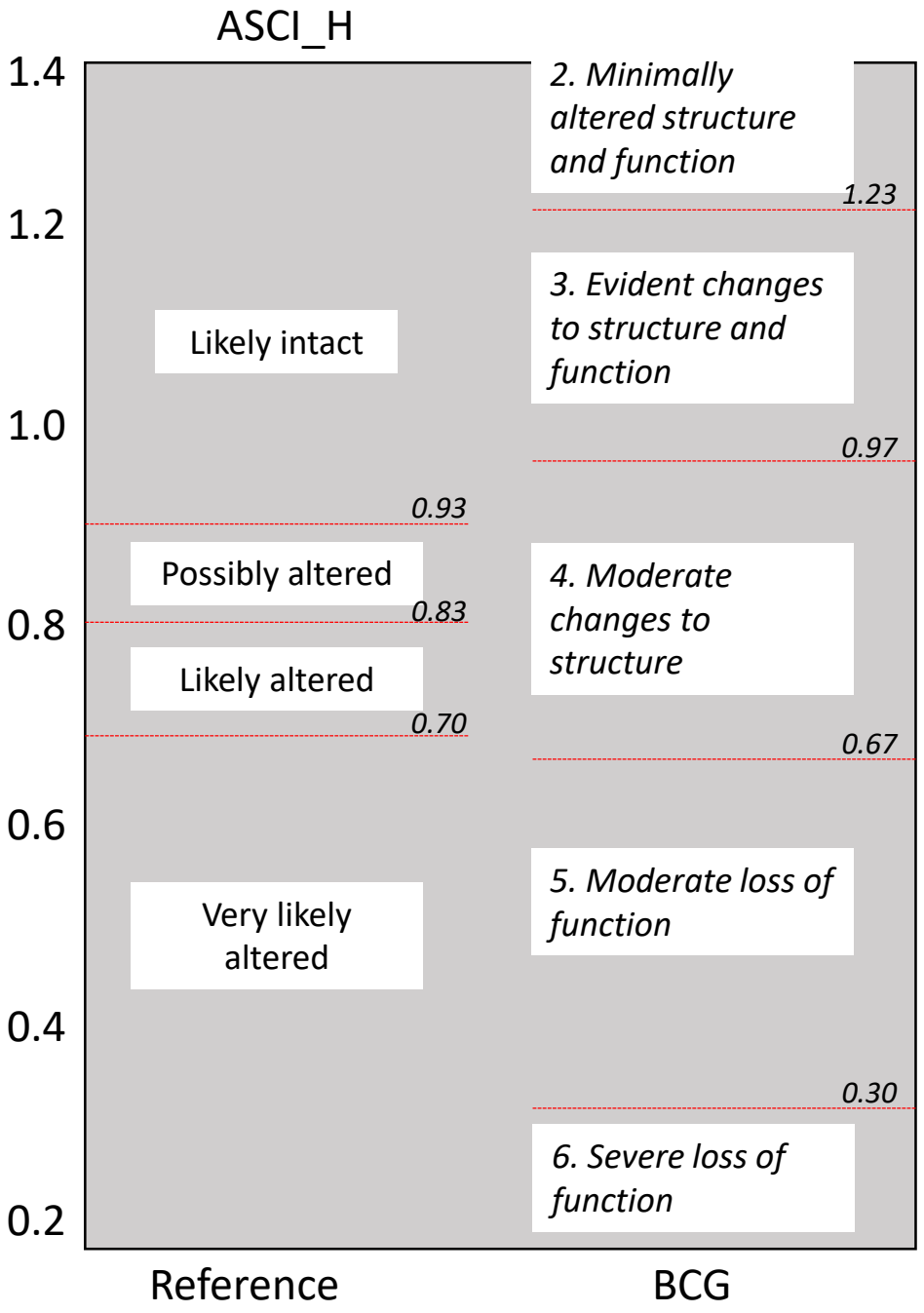


BCG: Models crosswalk to ranges of index scores






CSCI
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Likely intact
Possibly altered
Likely altered
Very likely altered
2. Minimally altered structure and function
3. Evident changes to structure and function
4. Moderate changes to structure
5. Moderate loss of function
6. Severe loss of function
1.03
0.92
0.83
0.79
0.63
0.63
0.33
Reference
BCG


ASCI_H
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Likely intact
Possibly altered
Likely altered
Very likely altered
2. Minimally altered structure and function
3. Evident changes to structure and function
4. Moderate changes to structure
5. Moderate loss of function
6. Severe loss of function
1.23
0.97
0.93
0.83
0.70
0.67
0.30
Reference
BCG

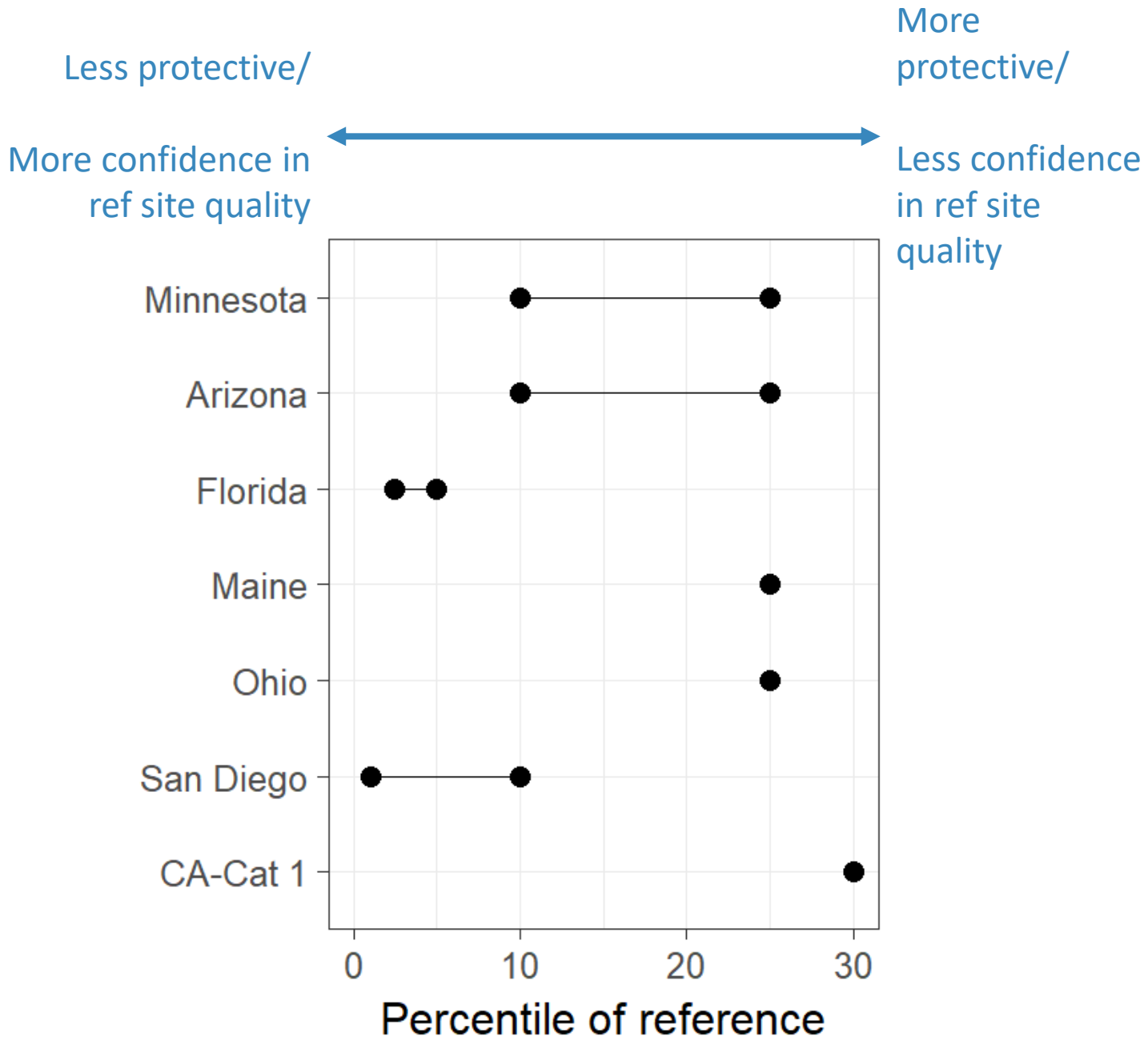
Size of data sets to determine numeric values of BI goals

Index	Reference calibration sites	BCG calibration sites
CSCI	473	250
ASCI-D	369	250
ASCI-S	414	250
ASCI-H	418	250

Both approaches have been used (or evaluated) for bio/nutrient criteria in other states

- Ref proposed for San Diego Regional Board's bio-objectives, statewide Category 1 listings

- MN, FL use BCG3 or 4 for most streams, BCG4 or BCG5 for modified uses.



Current status

- Manuscript ready for submission to journal, pending Science Panel and advisory group feedback

- Water Board staff is considering options, pending same feedback technical products

Water Board Charge Questions

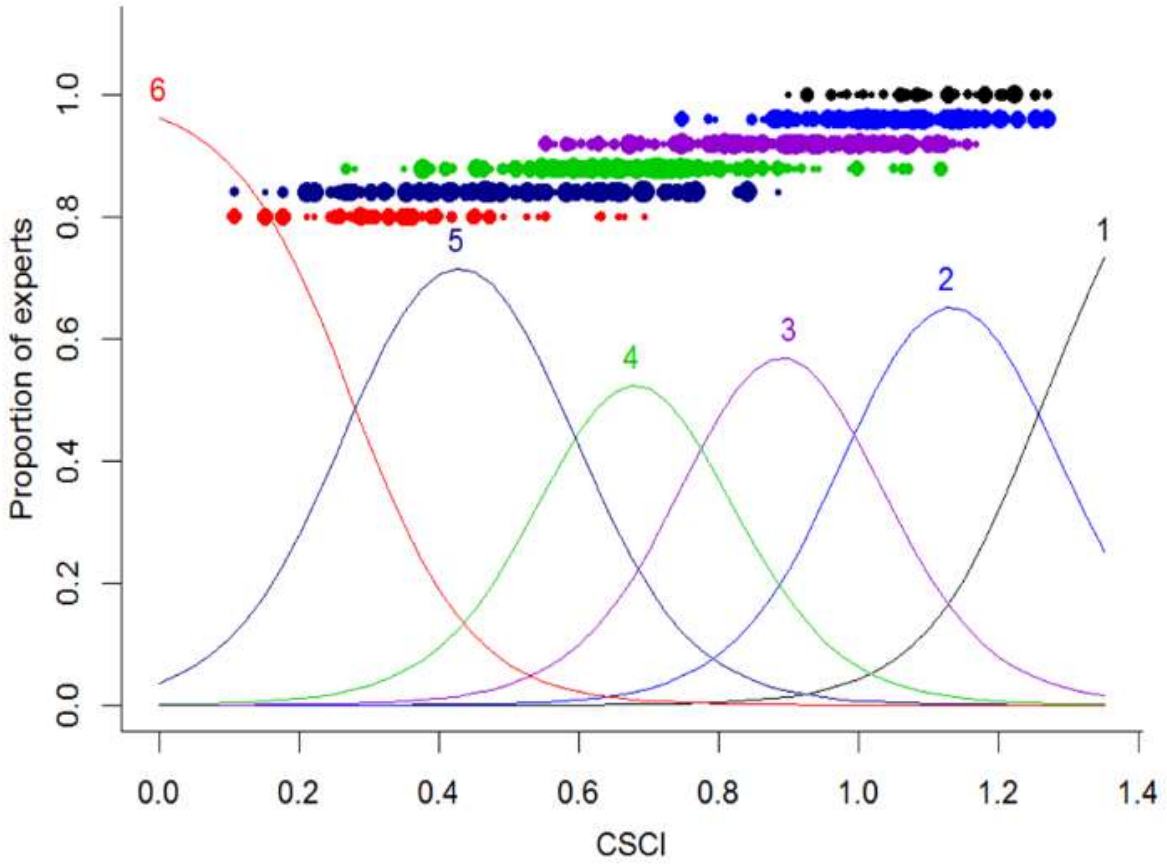
- Comment on the adequacy of the data set and the analytical approaches to evaluate the range of natural variability. Comment on the adequacy of data set, the analytical approaches and findings of the development of a BCG model.

- Are there technical ways to address stakeholder concerns?

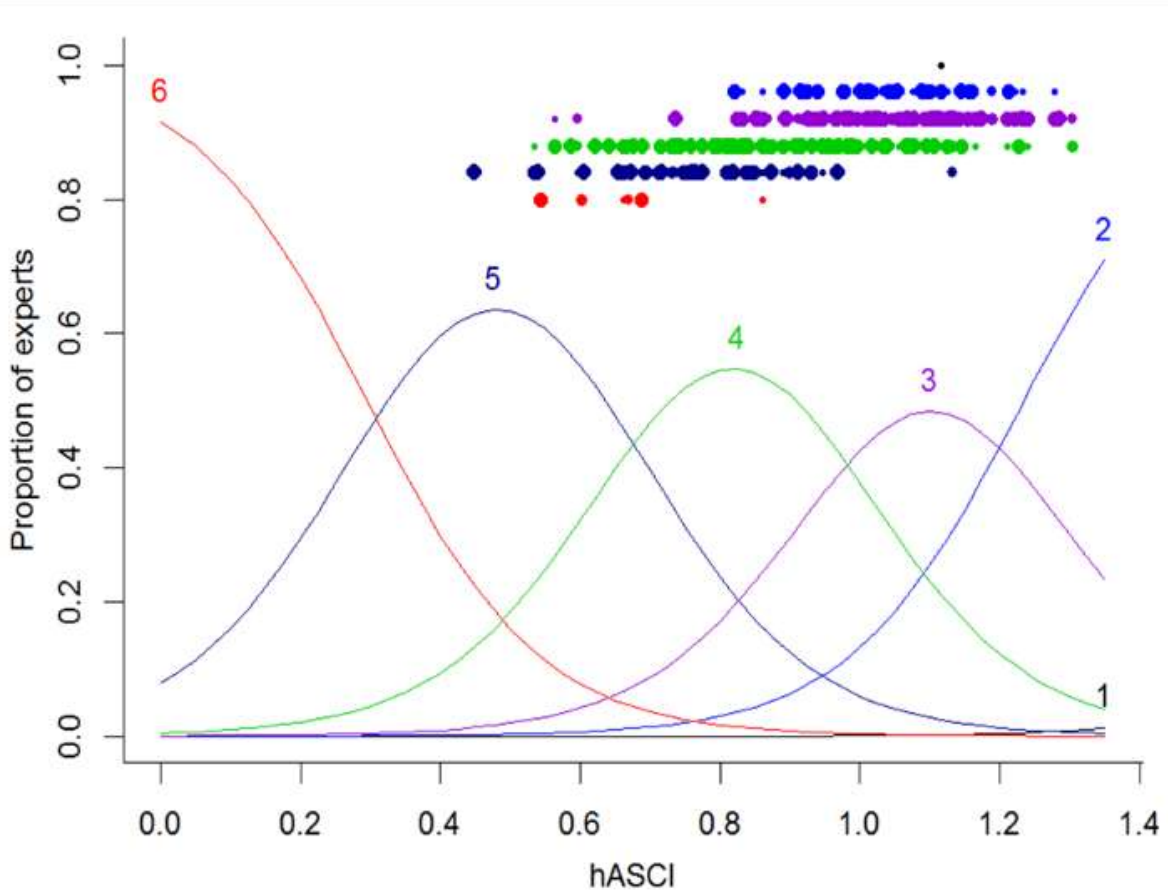
Questions?

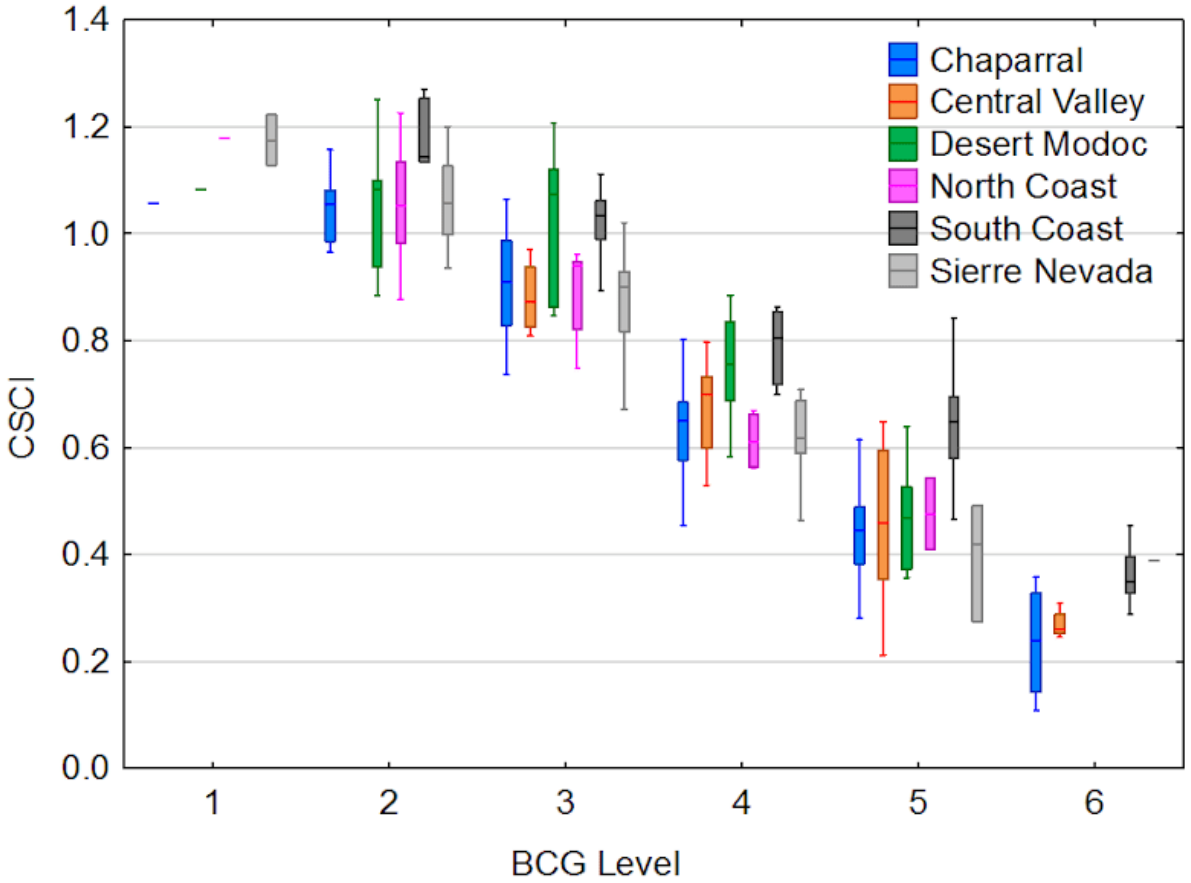
Probability-odds model

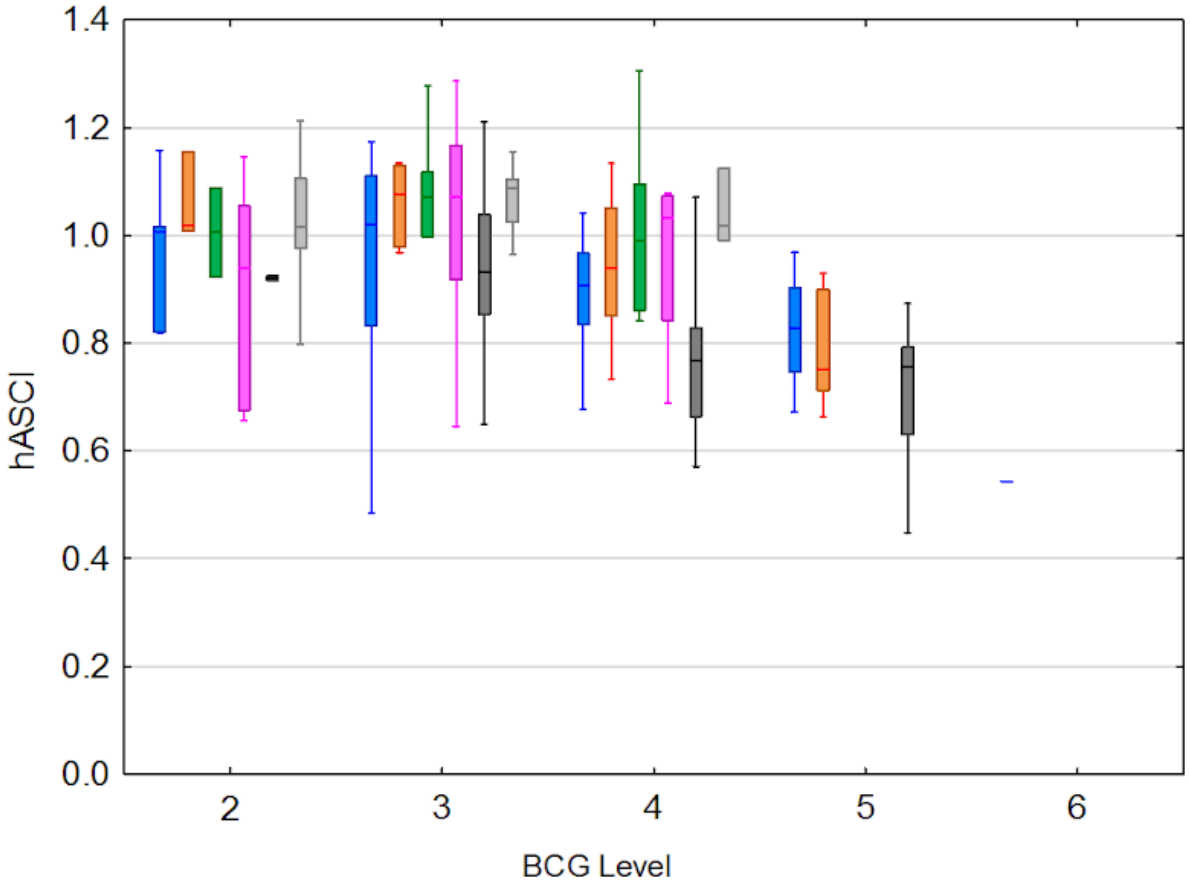
CSCI



Hybrid ASCI



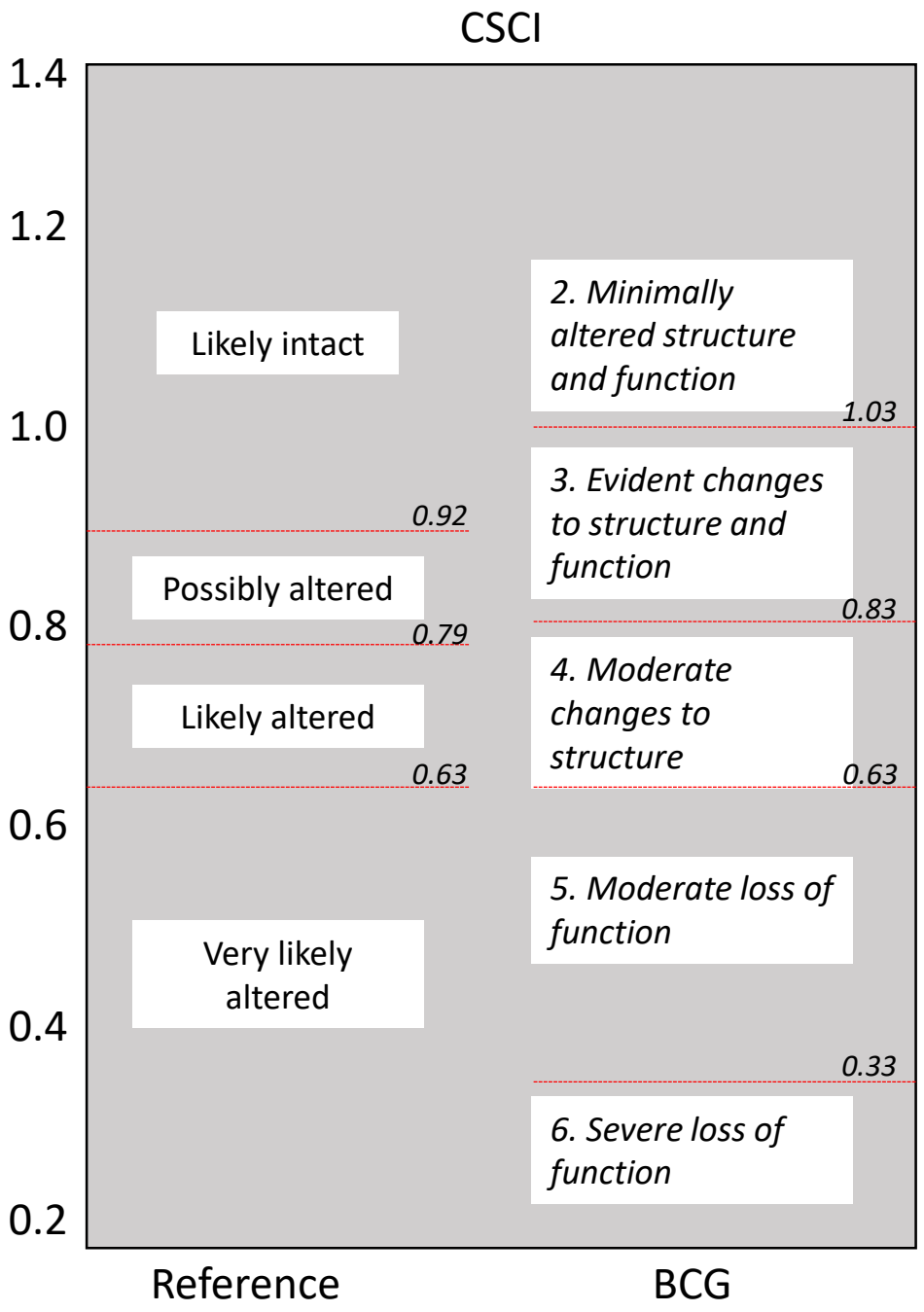

Chaparral
Central Valley
Desert Modoc
North Coast
South Coast
Sierre Nevada
CSCI
BCG Level
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6

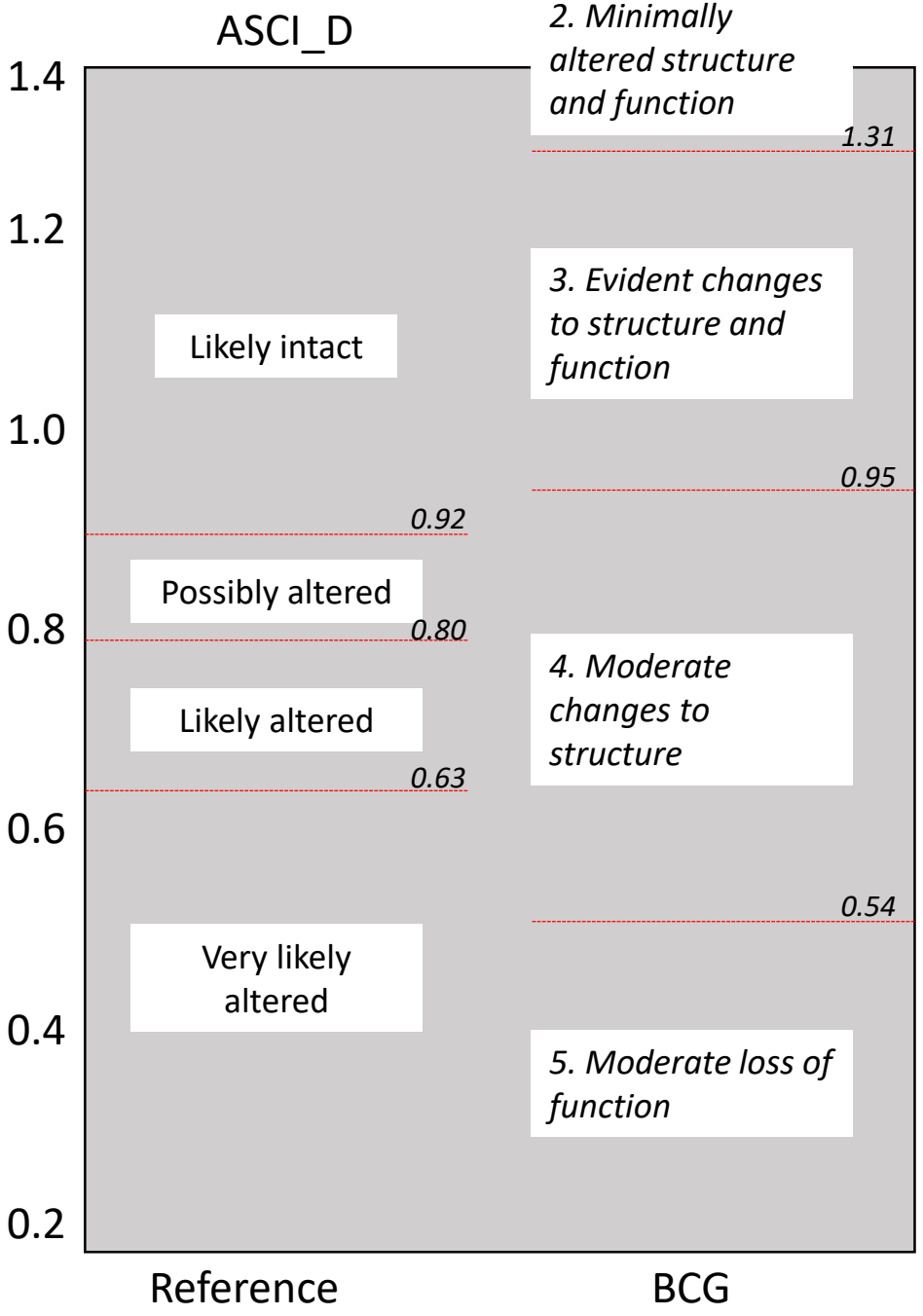

hASCI
BCG Level
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2
3
4
5
6

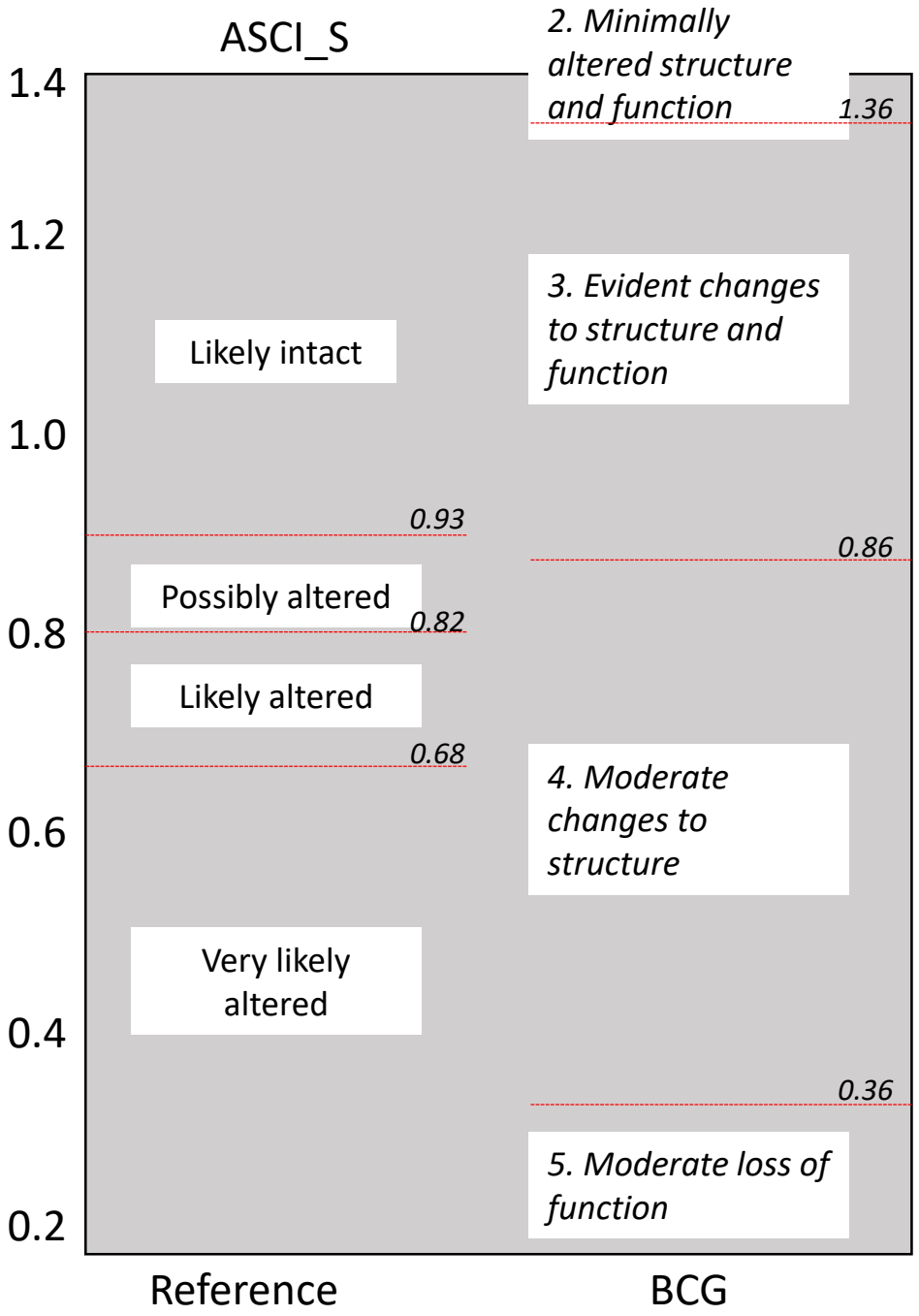
Scores associated with goals

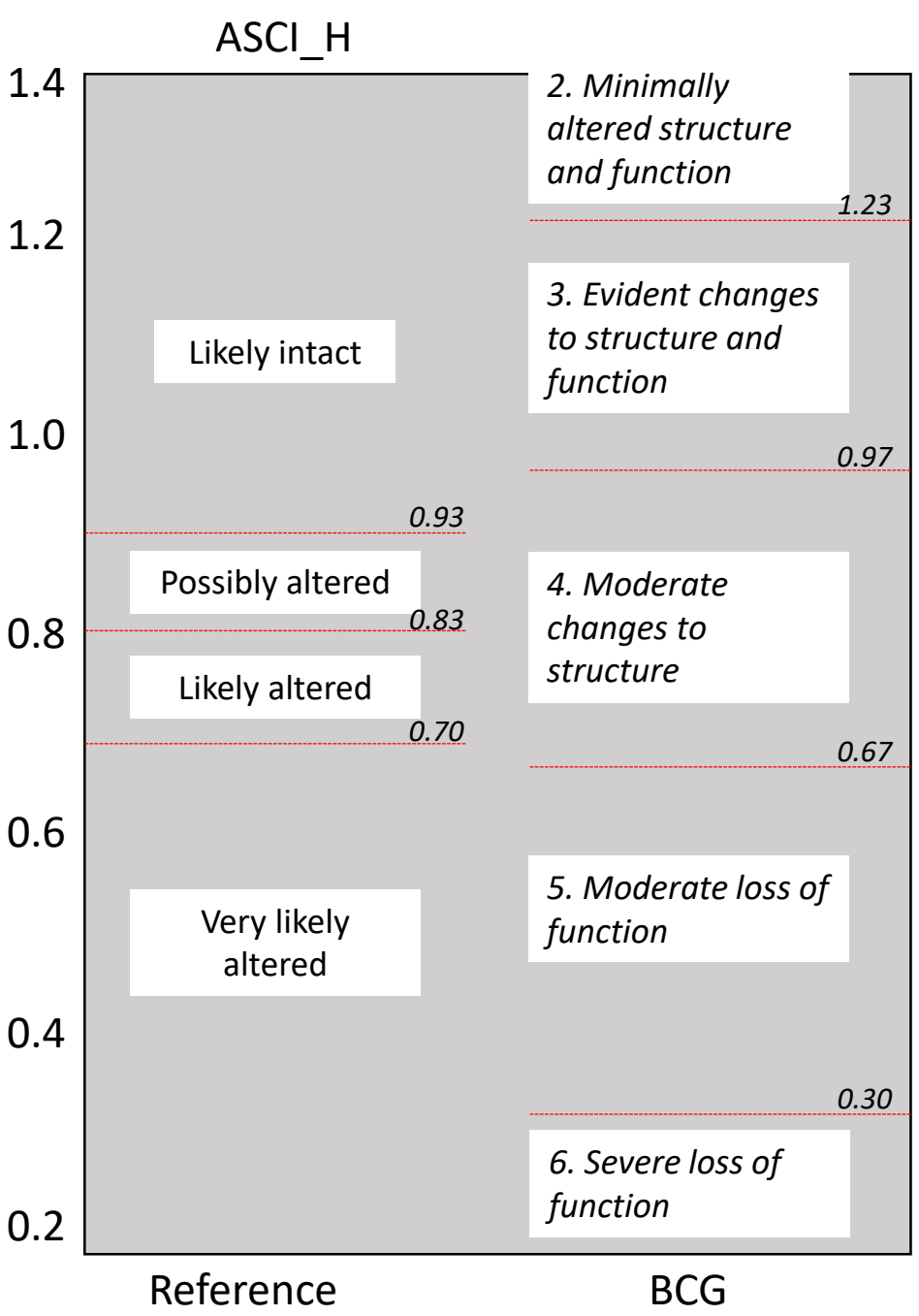
Goal	CSCI	ASCI-D	ASCI-S	ASCI-H
Ref-30	0.92	0.92	0.93	0.93
Ref-10	0.79	0.80	0.82	0.83
Ref-01	0.63	0.63	0.68	0.70
BCG2	1.025	1.310	1.360	1.230
BCG3	0.825	0.950	0.860	0.970
BCG4	0.625	0.540	0.360	0.670
BCG5	0.325	NA	NA	0.300

BCG2: Numbers are *really high*
BCG5: Couldn't model scores for ASCI-D, ASCI-S
BCG3 to BCG4: A very wide interval ASCI-D, ASCI-S (~0.4 to 0.5 points) vs. others (0.3 points)


CSCI
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Likely intact
Possibly altered
Likely altered
Very likely altered
2. Minimally altered structure and function
3. Evident changes to structure and function
4. Moderate changes to structure
5. Moderate loss of function
6. Severe loss of function
1.03
0.92
0.83
0.79
0.63
0.63
0.33
Reference
BCG


ASCI_D
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Likely intact
Possibly altered
Likely altered
Very likely altered
2. Minimally altered structure and function
3. Evident changes to structure and function
4. Moderate changes to structure
5. Moderate loss of function
1.31
0.95
0.92
0.80
0.63
0.54
Reference
BCG


ASCI_S
1.4
1.2
1.0
0.8
0.6
0.4
0.2
2. Minimally altered structure and function
1.36
3. Evident changes to structure and function
Likely intact
0.93
0.86
Possibly altered
0.82
Likely altered
0.68
4. Moderate changes to structure
Very likely altered
0.36
5. Moderate loss of function
Reference
BCG


ASCI_H
1.4
1.2
1.0
0.8
0.6
0.4
0.2
2. Minimally altered structure and function
1.23
3. Evident changes to structure and function
Likely intact
0.97
0.93
Possibly altered
0.83
4. Moderate changes to structure
Likely altered
0.70
0.67
5. Moderate loss of function
Very likely altered
0.30
6. Severe loss of function
Reference
BCG

Comparison of means (ANOVA) and variances (Levene's test) of Ref-Cal sites across 5 PSA regions

	Means		Variances	
Index	F	p	F	p
CSCI	1.36	0.245	1.97	0.098
ASCI-D	3.39	0.010	1.98	0.096
ASCI-S	1.35	0.252	2.36	0.053
ASCI-H	2.33	0.055	2.42	0.048