National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
31 March – 4 April, 2003

Index 201

Confidence: Variability & Reliability

Presented by

Jeroen Gerritsen, Tetra Tech, Inc.

Problem

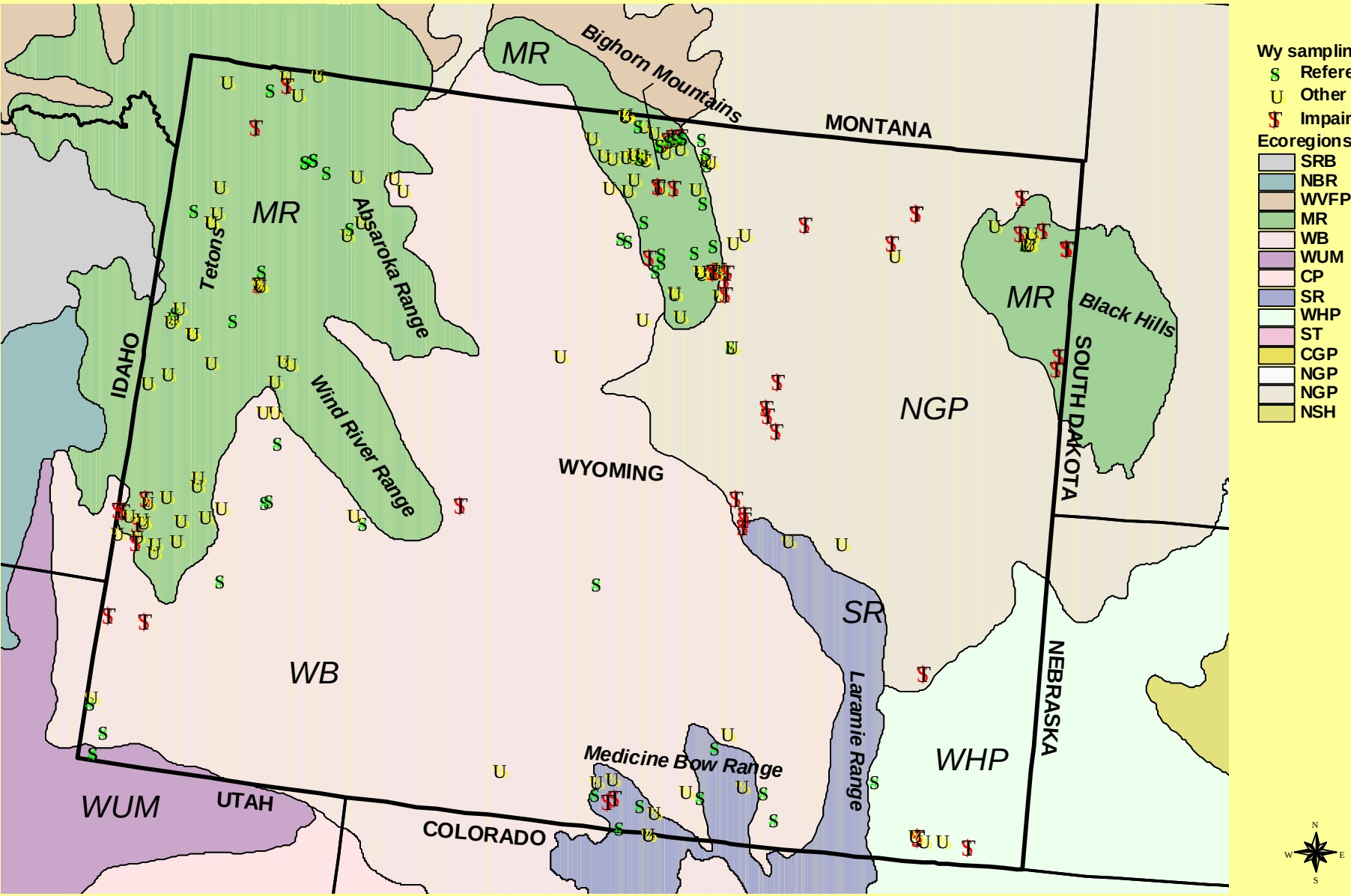
- Perceived variability of community-level bioassessment
  - Many species, taxonomic uncertainty
  - Here today, gone tomorrow
  - Plethora of sampling and analytical methods; no standardization

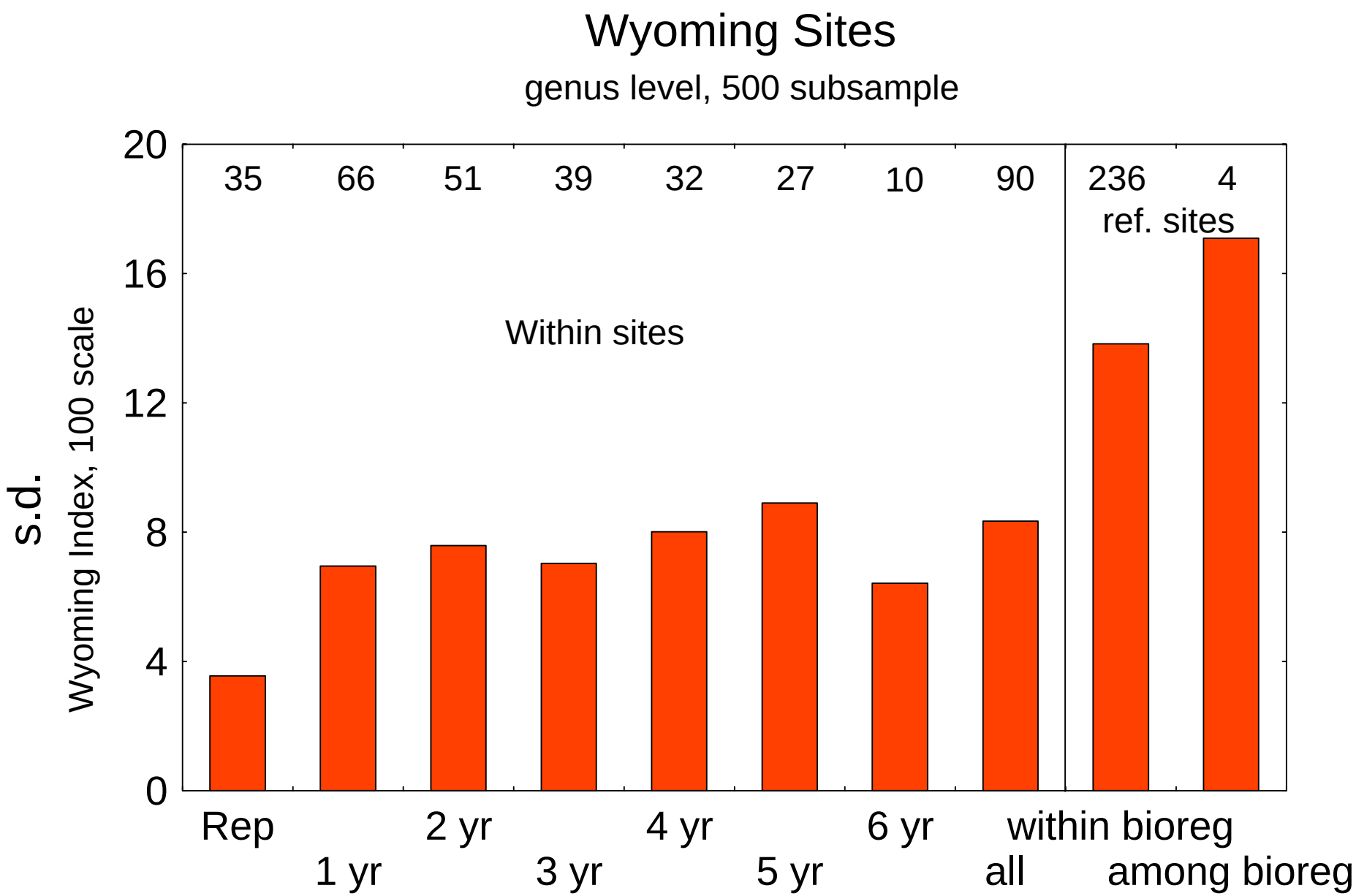
Solutions

- Standardized collection methods
- Stable metrics and indexes (no abundance, ratio metrics)
- Estimate variability!

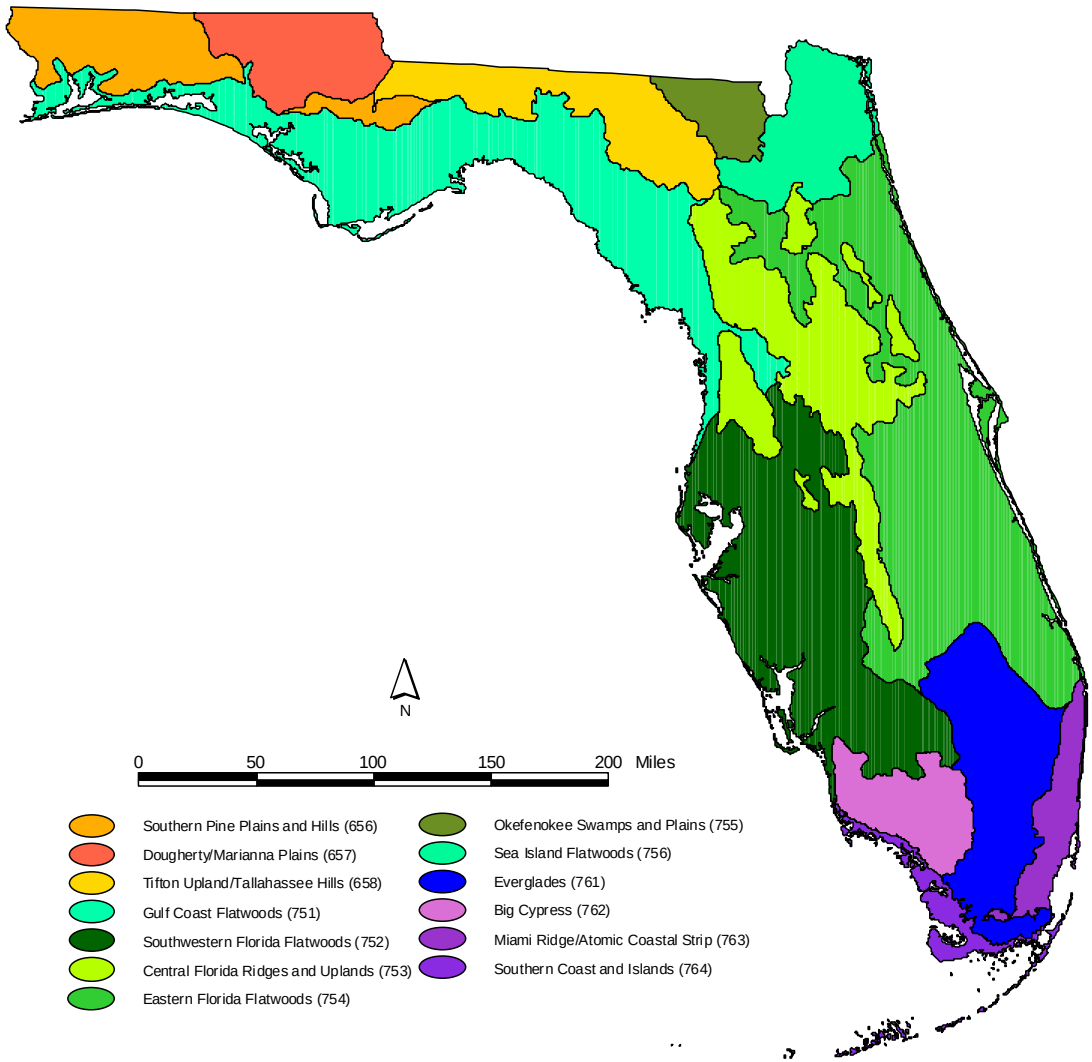
Estimating variability

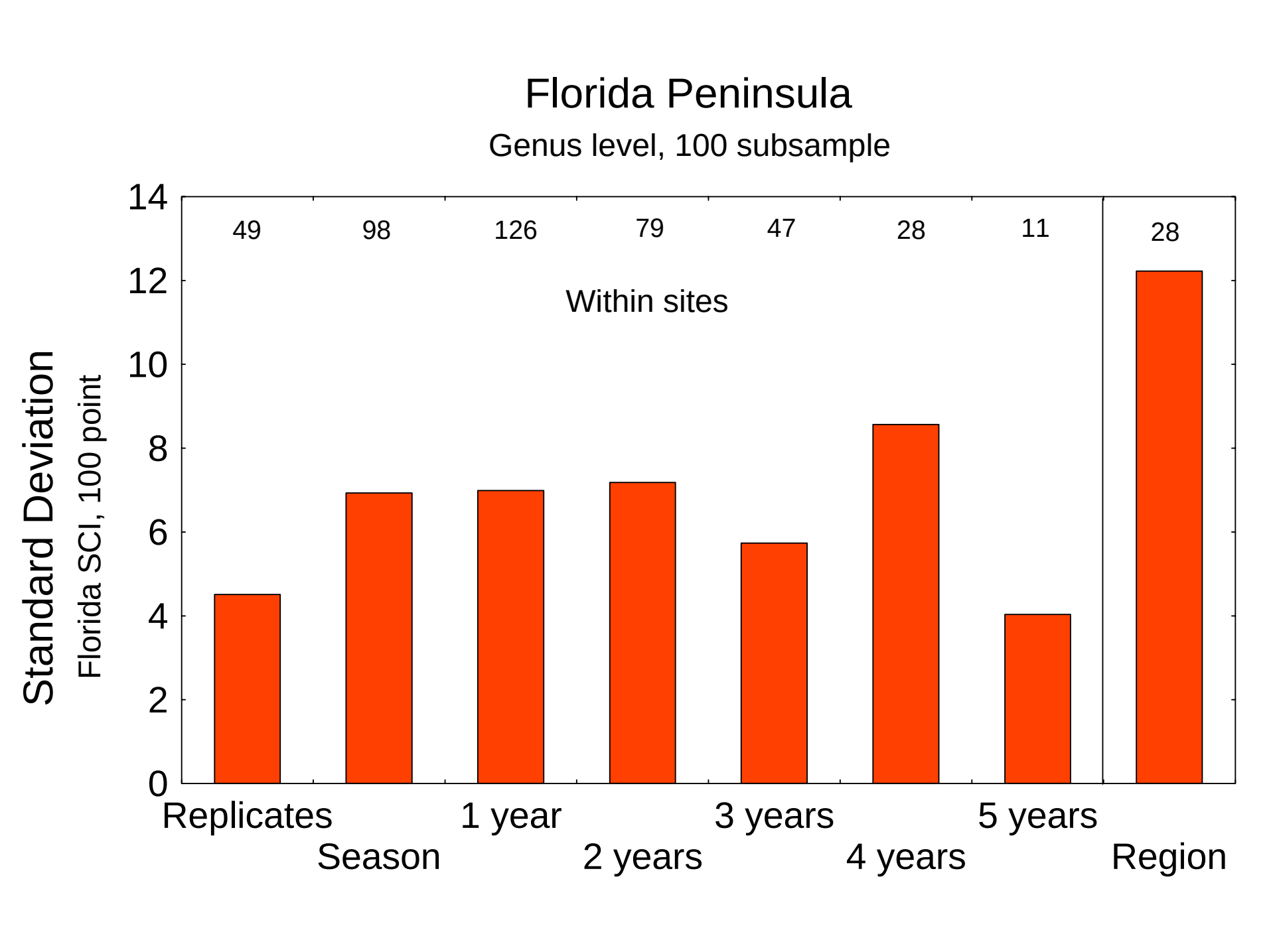
- Replicate samples: measurement error
- Seasonal: among index periods (spring, fall)
- Interannual: repeat site visits (2-6 yr)
- Among sites within regions
- Among regions


Wy sampling sites
Reference
Other
Impaired
Ecoregions
SRB
NBR
WVFP
MR
WB
WUM
CP
SR
WHP
ST
CGP
NGP
NGP
NSH
MR
Bighorn Mountains
MONTANA
MR
Tetons
Absaroka Range
IDAHO
Wind River Range
WYOMING
NGP
MR
Black Hills
SOUTH DAKOTA
SR
Laramie Range
NEBRASKA
WB
WHP
Medicine Bow Range
WUM
UTAH
COLORADO
N
W
E
S


Wyoming Sites
genus level, 500 subsample
s.d.
Wyoming Index, 100 scale
20
16
12
8
4
0
35
66
51
39
32
27
10
90
236
4
ref. sites
Within sites
Rep
1 yr
2 yr
3 yr
4 yr
5 yr
6 yr
all
within bioreg
among bioreg

Level IV Sub-Ecoregions for Streams




Florida Peninsula
Genus level, 100 subsample
Standard Deviation
Florida SCI, 100 point
14
12
10
8
6
4
2
0
49
98
126
79
47
28
11
28
Within sites
Replicates
Season
1 year
2 years
3 years
4 years
5 years
Region

Chemical and biological

- Biotic indexes (100 pt)
  - Multiyear s.d. = 7
  - Or, approximately 9-11% of reference site scores
- Conductivity (VA)
  - Log-transformed s.d = 0.145
  - 1 s.d. is –29% to +40% of measured conductivity
- Total P (Florida)
  - 1 s.d. is –50% to +100% of measured value

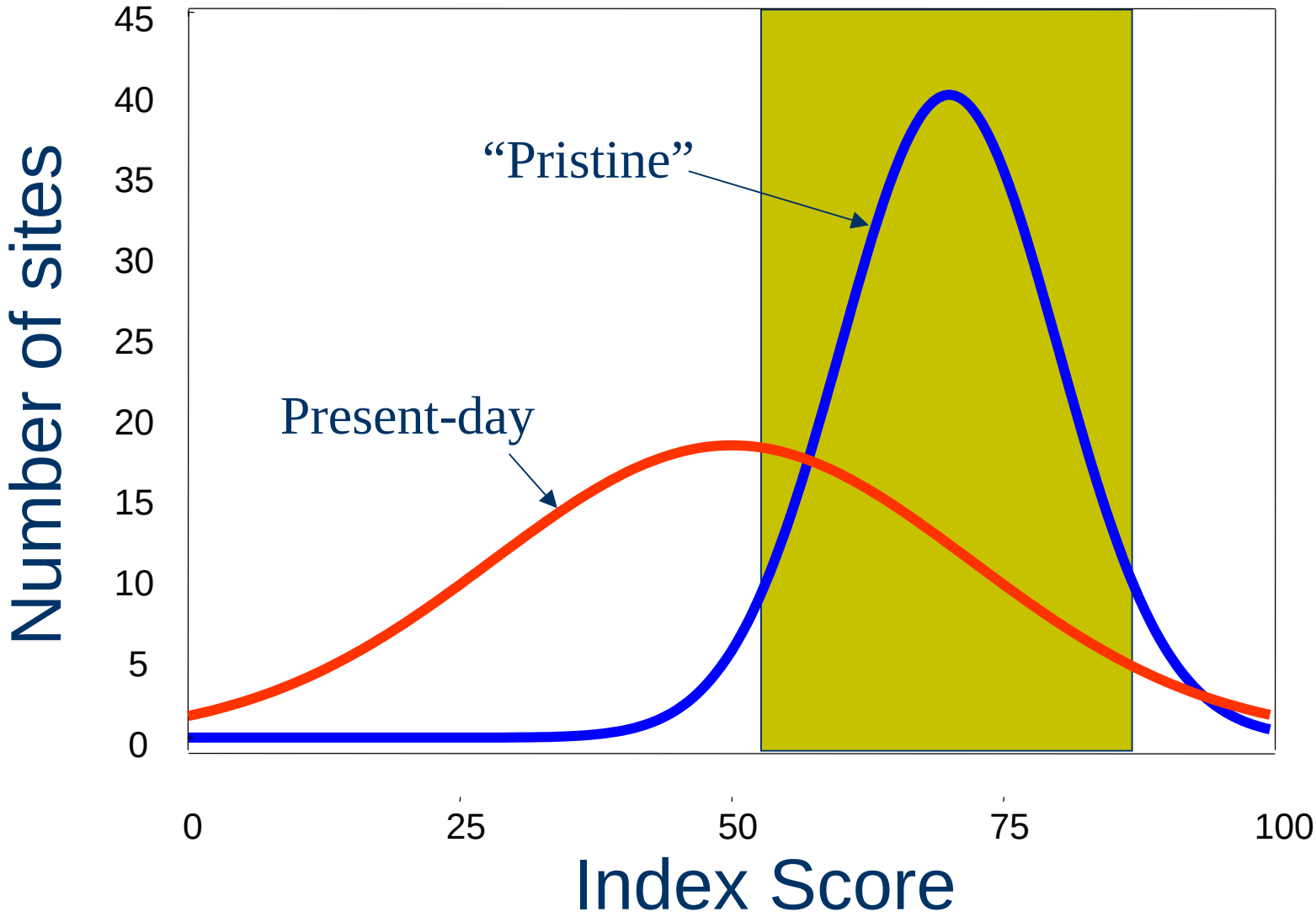
Conclusions

- High variability of biological measures is a myth!
- Equivalent power of detection for a **10%** decline in biotic index, and a **doubling** of nutrient concentrations

Biocriteria decision points

Where is the threshold?

Reference sites in an imperfect world



Decision Errors

- Type I - false positives, i.e., reject the null hypothesis when it is true
  - ***Unnecessary regulation***
- Type II - false negatives, i.e., accept the null hypothesis when it is false.
  - ***Continued degradation of the resource***

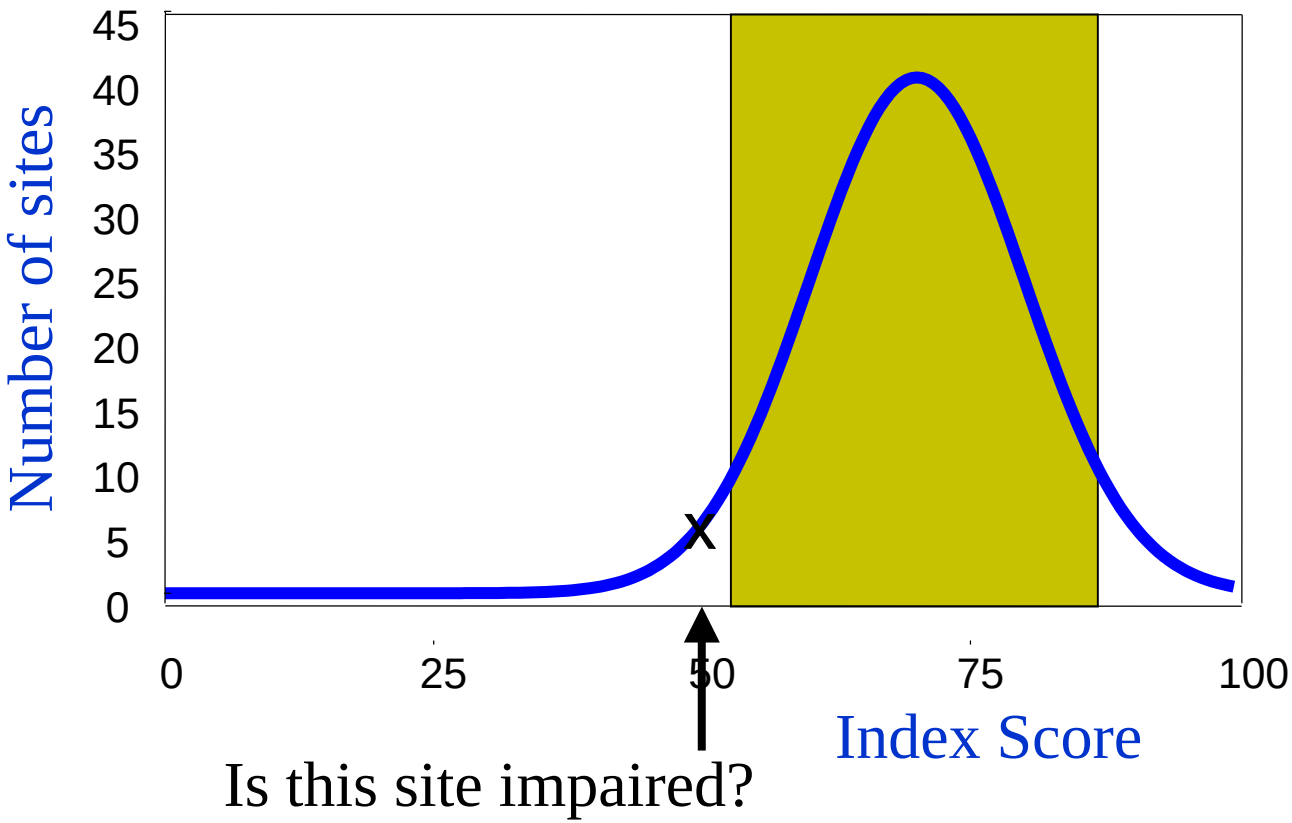
Decision Errors

State of the world	Decision: Accept null (Do not detect effect)	Decision: Reject null (Detect effect)
Null is true (no effect)	Correct p=1-α confidence	Type I error $p = \alpha$ significance (false positive)
Null is false (effect exists)	Type II error $p = \beta$ (false negative)	Correct p =1- β power

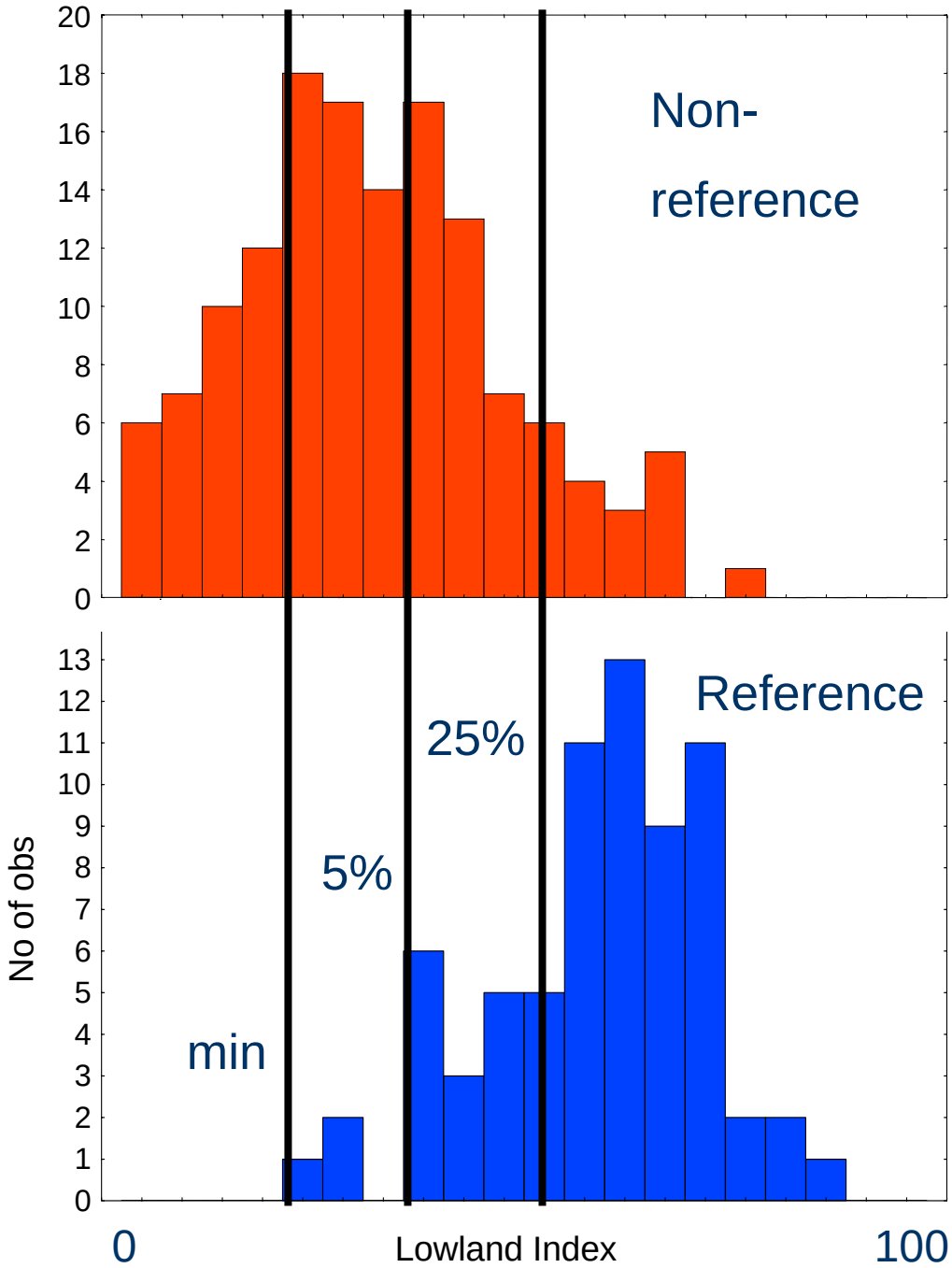
Issues in setting thresholds

- What is balance between Type 1 and Type 2 errors?
- Variability
- Confidence in reference site selection
- What is politically acceptable or desirable?

Where does impairment begin?



Null hypothesis: site is member of unimpaired population.
Test: Estimate the percentile.



Wyoming Plains Multimetric index

Reference sites
Mean = 59
Median = 61
s.d. = 13.5
25% = 51
5% = 36
Minimum = 21

Biocriteria

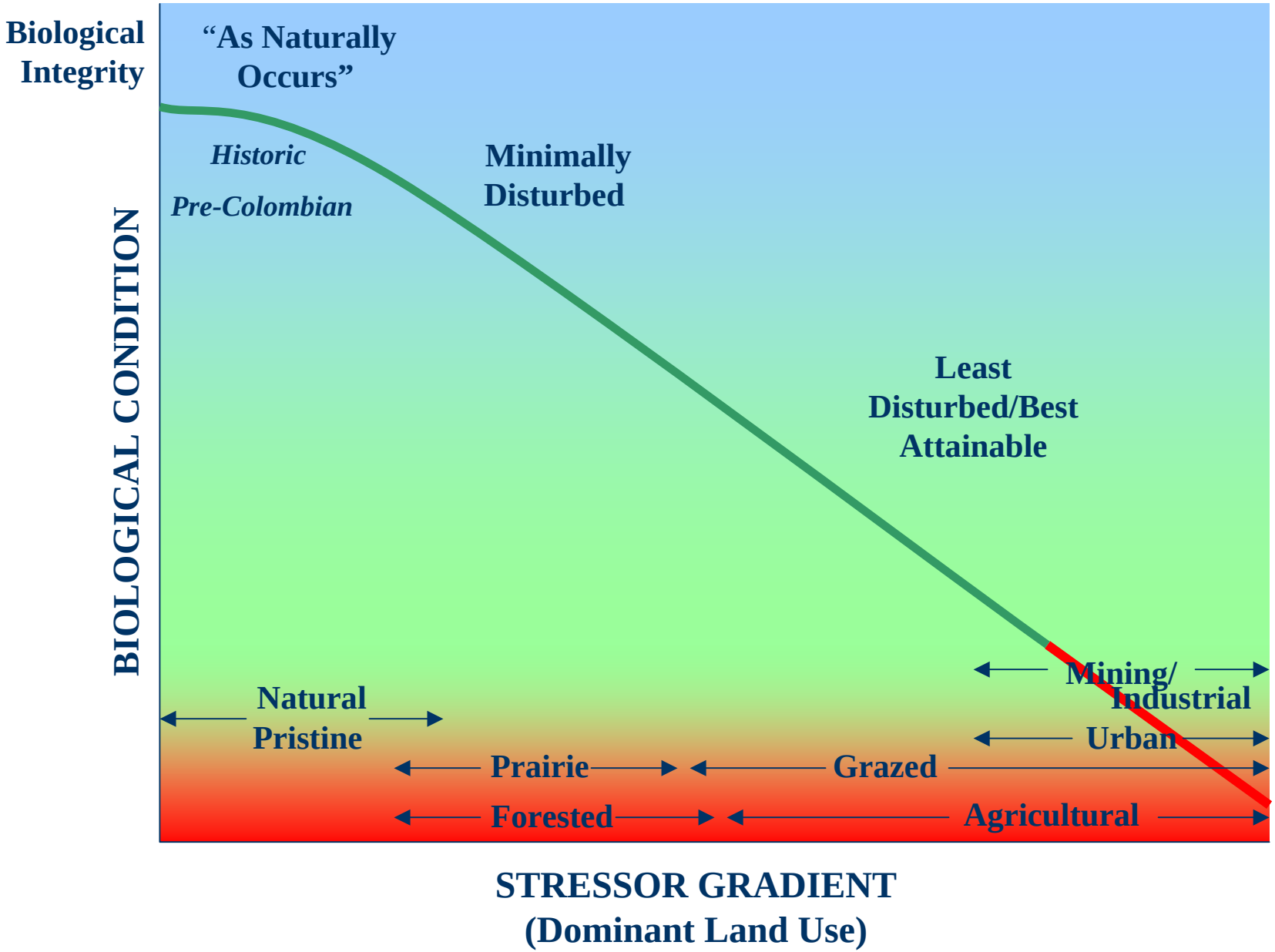
Indexes

And

Tiered Aquatic Life Use

Draft Tiered Aquatic Life Use

- Human disturbance gradient
- Biological condition gradient



*Protection & Propagation of Fish, Shellfish and Wildlife

Biological Condition Gradient

1. Native or natural condition
2. Minimal loss of taxa; some density changes
3. Some replacement of sensitive-low abundance taxa; functions fully maintained
4. Some sensitive taxa maintained; notable replacement by tolerant taxa; altered distributions; functions maintained
5. Tolerant taxa more dominant; sensitive taxa rare; functions altered
6. Severe alterations of structure and function

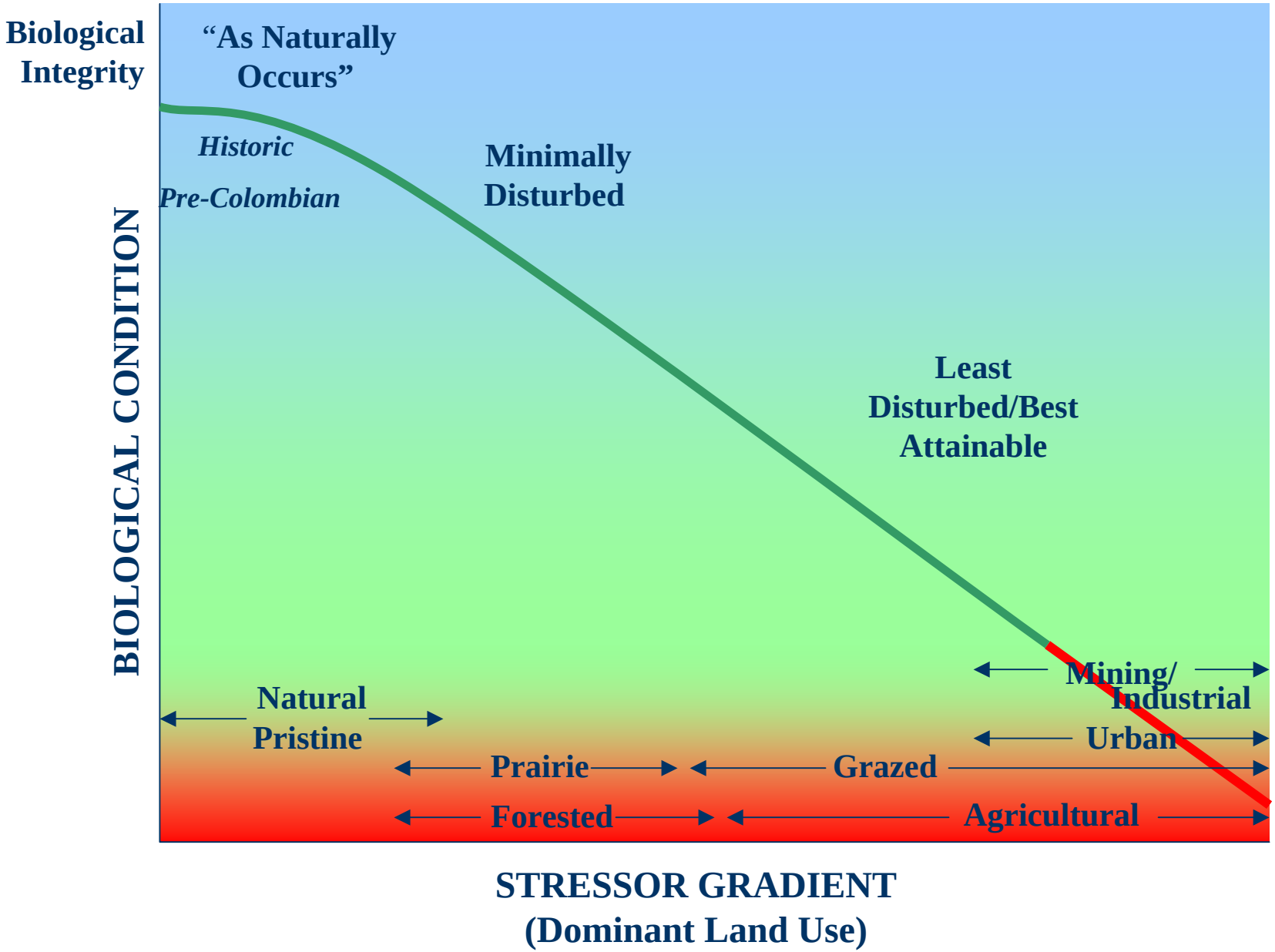
Tiers

1	Native or natural condition
2	Minimal loss of taxa; some density changes
3	Some replacement of sensitive-low abundance taxa; functions fully maintained
4	Some sensitive taxa maintained; notable replacement by tolerant taxa; altered distributions; functions maintained
5	Tolerant taxa more dominant; sensitive taxa rare; functions altered
6	Severe alterations of structure and function

CWA Goal: biological integrity

CWA Interim Goal: degraded, but fishable-swimmable

Unacceptable



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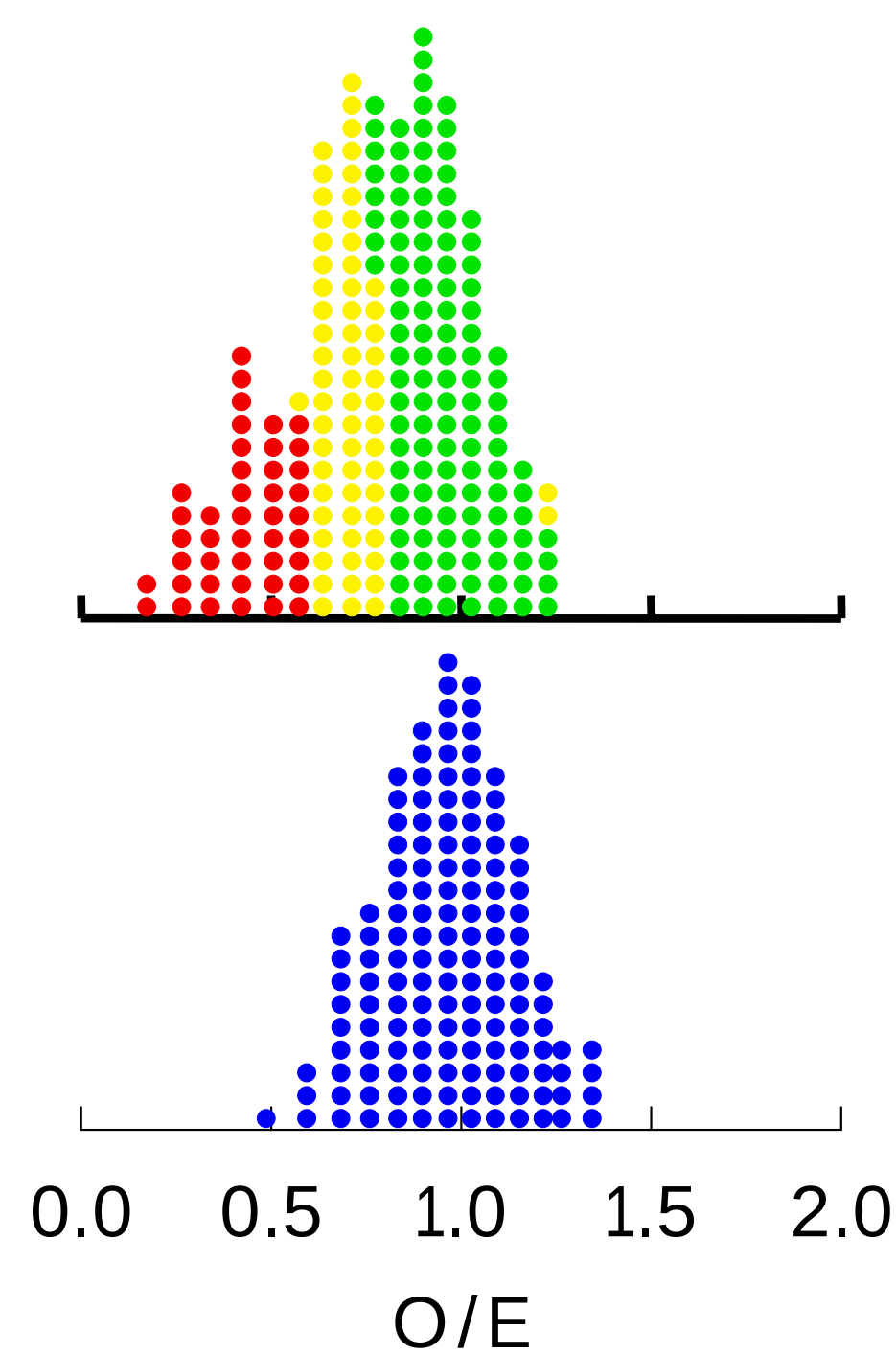
How many tiers can we detect?

- Depends on variability of our indicator
- What is range of index value for single category in biological condition gradient?
- Assessment “bands”



Wyoming O/E

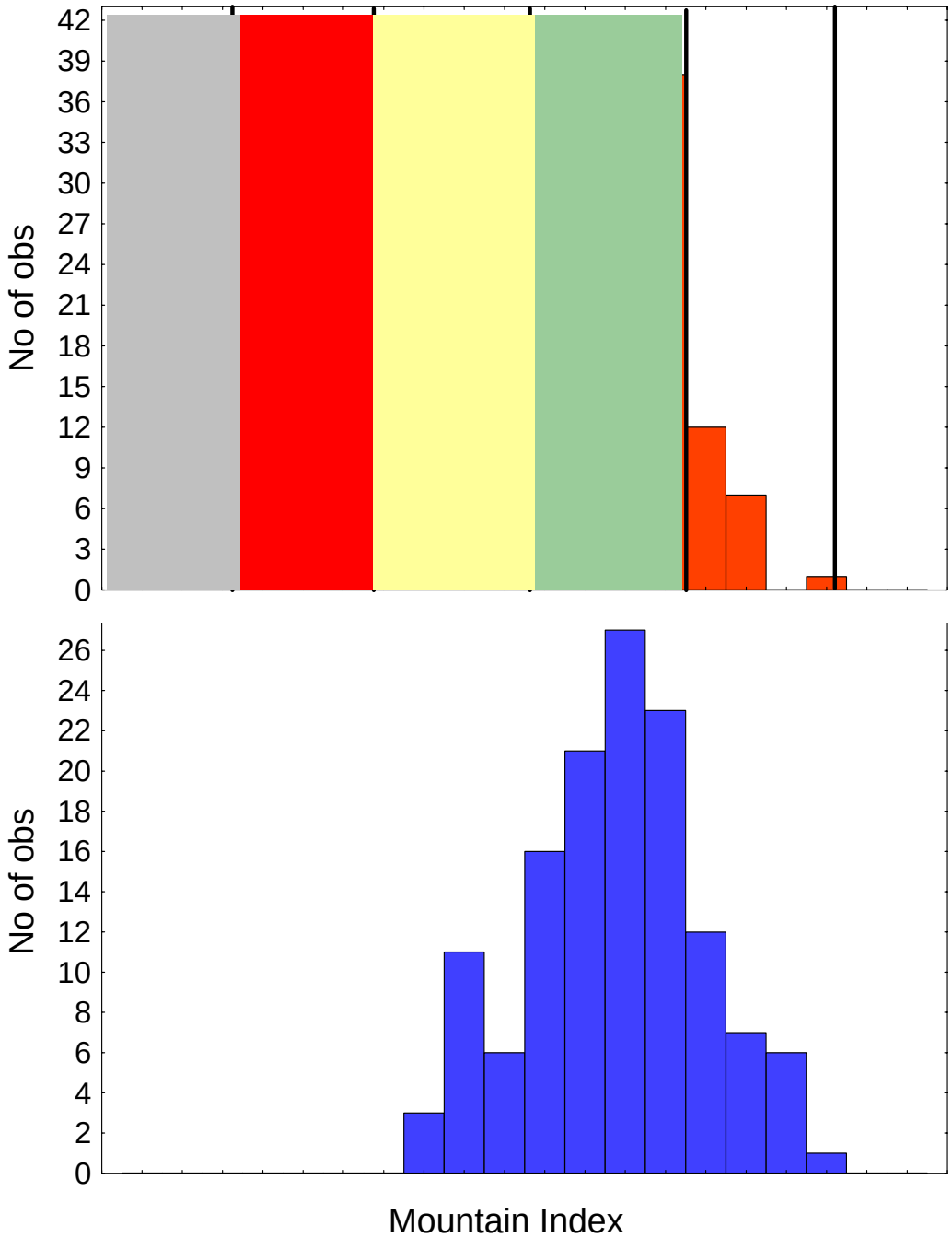
Non-reference sites.

Mean = 0.79

Green = 0.8 – 1.2	(53%)
Yellow = 0.6 – 0.8	(28%)
Red = < 0.6	(19%)

Reference site O/E values.

Mean = 0.98
S.D. = 0.16
10^{th} percentile = 0.73
90^{th} percentile = 1.19

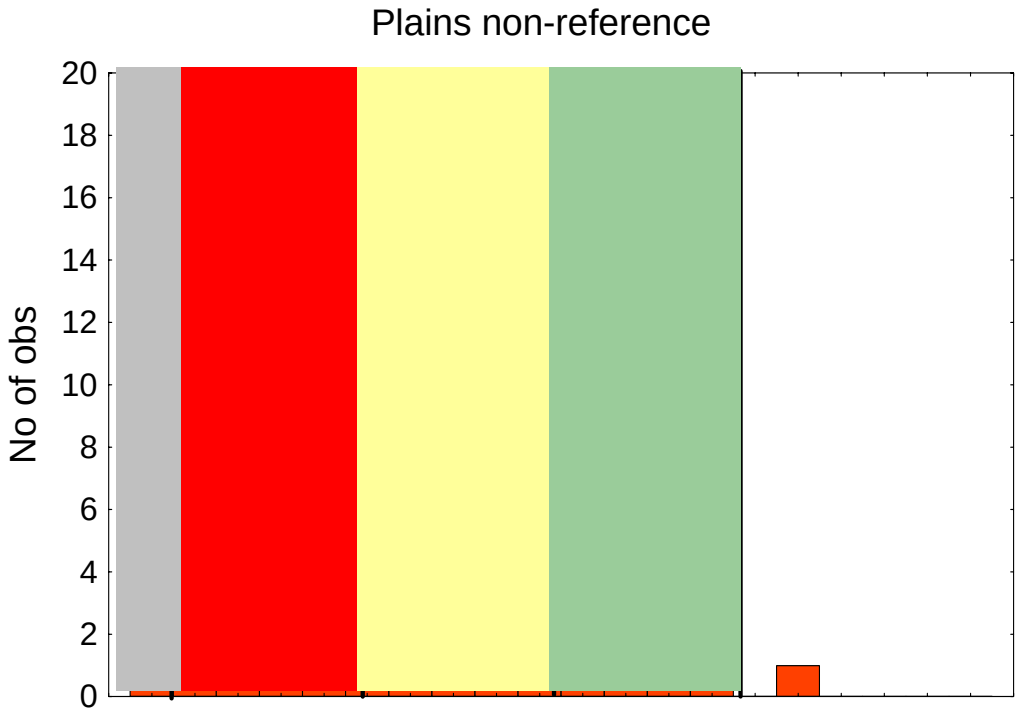


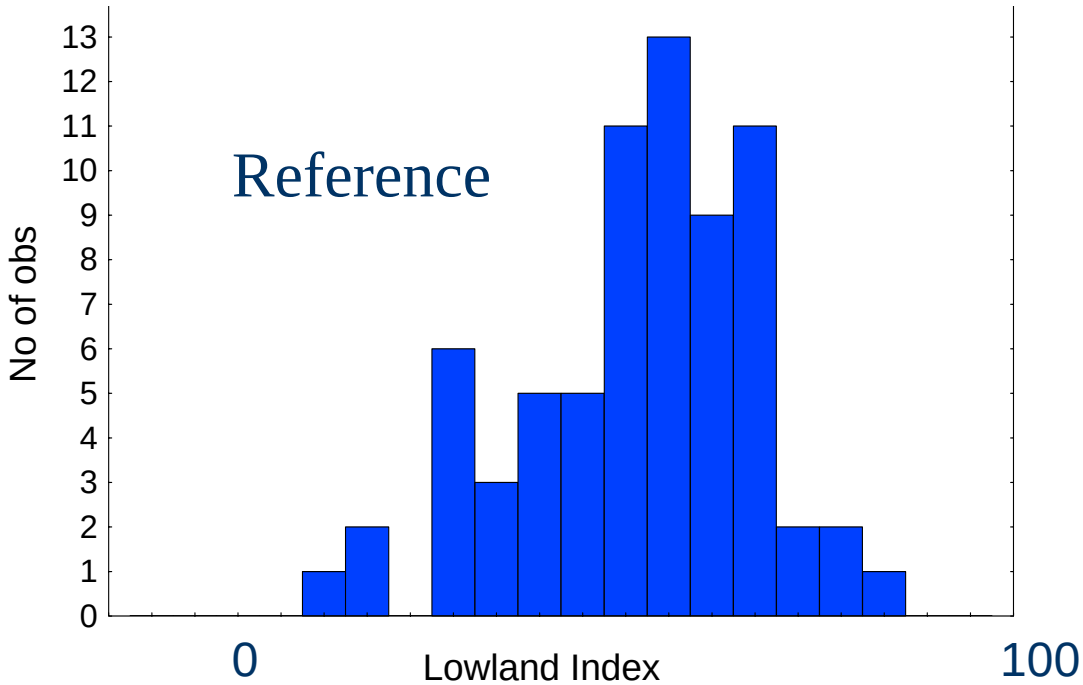
Wyoming Rocky Mts. Multimetric index

Non-Reference

Green, 51-70 = 48%
Yellow, 32-51 = 36%
Red, 14-32 = 6.6%
Gray, <14 = 2%

Reference
Mean = 61
Median = 61
s.d. = 11.0
20% = 51
80% = 70





Wyoming Plains Multimetric index

Non-Reference

Green, 49-71 = 14%
Yellow, 27-49 = 41%
Red, 5-27 = 40%
Gray, <5 = 4%

Reference

Mean = 59
Median = 61
s.d. = 13.5
20% = 49
80% = 71