Biological criteria for cold water streams based on a survey of the Oregon and Washington Coast Range

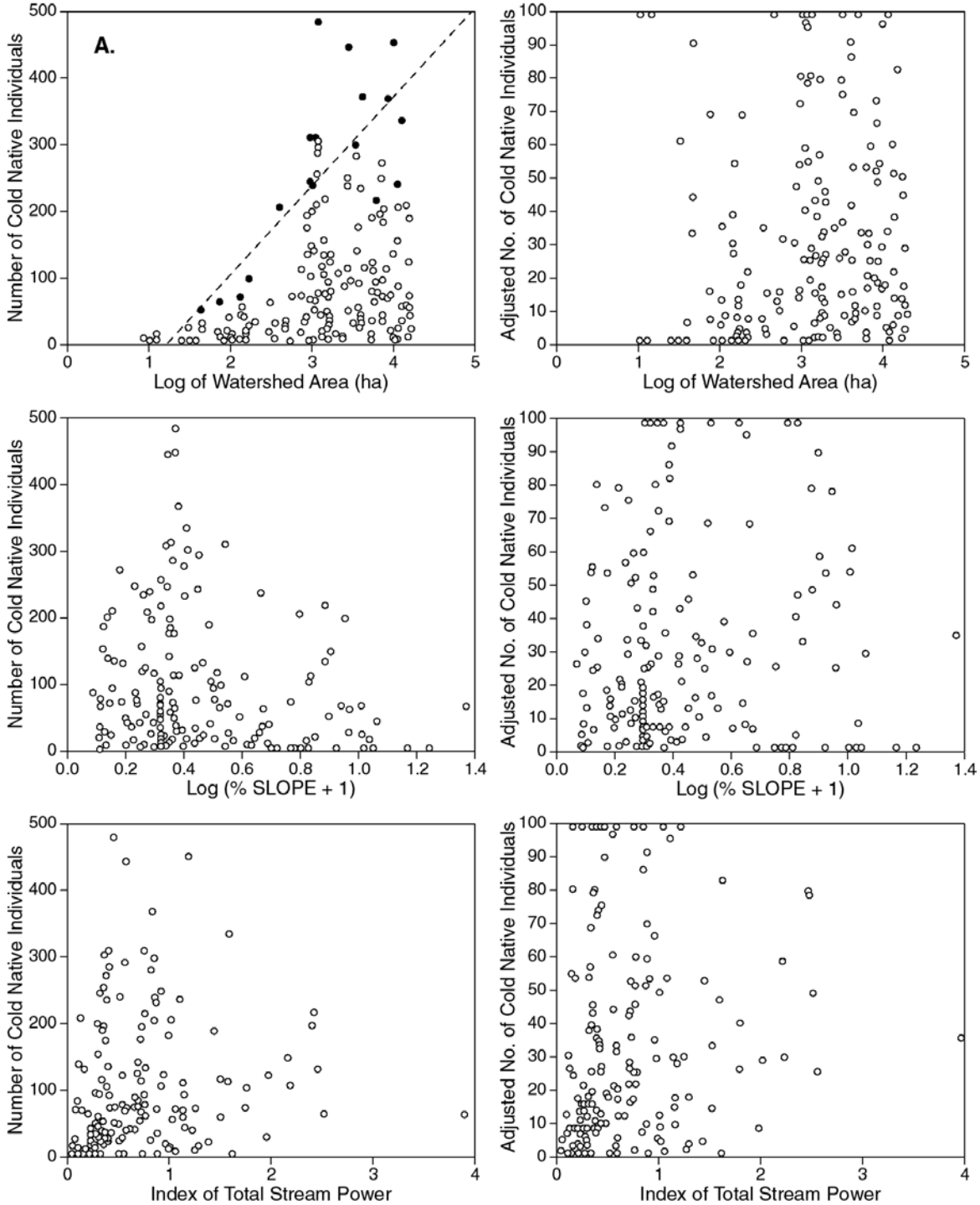
R. M. Hughes, Dynamac Corp.,
200 SW 35th St., Corvallis, OR
S. Howlin, West Inc.,
2003 Central Ave.,Cheyenne,WY
P. R. Kaufmann, USEPA,
200 SW 35th St., Corvallis, OR

Objective

- Develop and apply a biological criterion, based on aquatic vertebrate assemblages, for Coast Range OR & WA streams

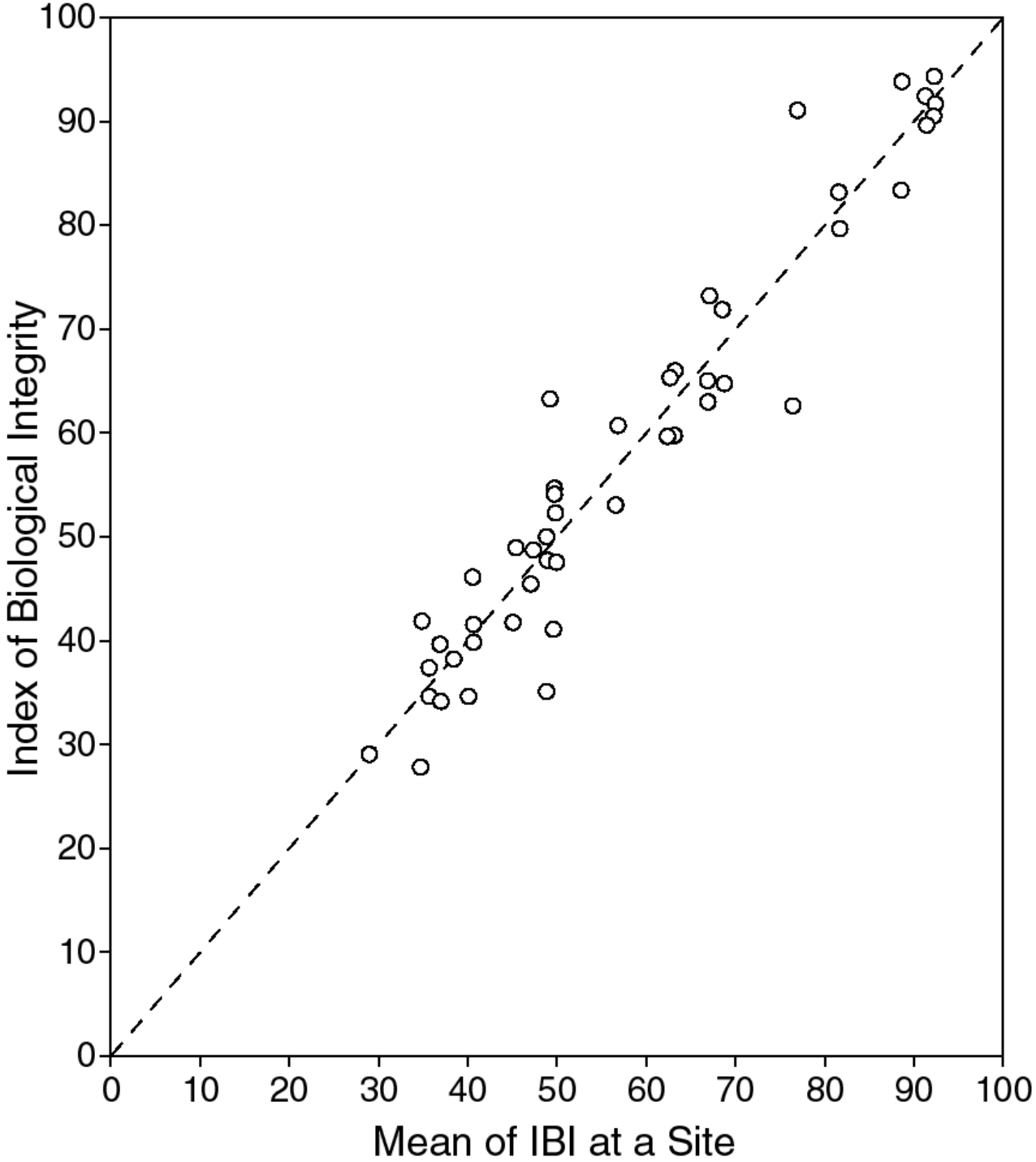
Methods

- Screen stressors correlated with natural gradients
- Adjust metrics for catchment area
- Select metrics responsive to varied stressors
- Select metrics with low among-site/index period variance
- Use minimally disturbed reference sites to set IBI impairment thresholds


A.
Number of Cold Native Individuals
Log of Watershed Area (ha)
Adjusted No. of Cold Native Individuals
Log of Watershed Area (ha)
Number of Cold Native Individuals
Log (% SLOPE + 1)
Adjusted No. of Cold Native Individuals
Log (% SLOPE + 1)
Number of Cold Native Individuals
Index of Total Stream Power
Adjusted No. of Cold Native Individuals
Index of Total Stream Power

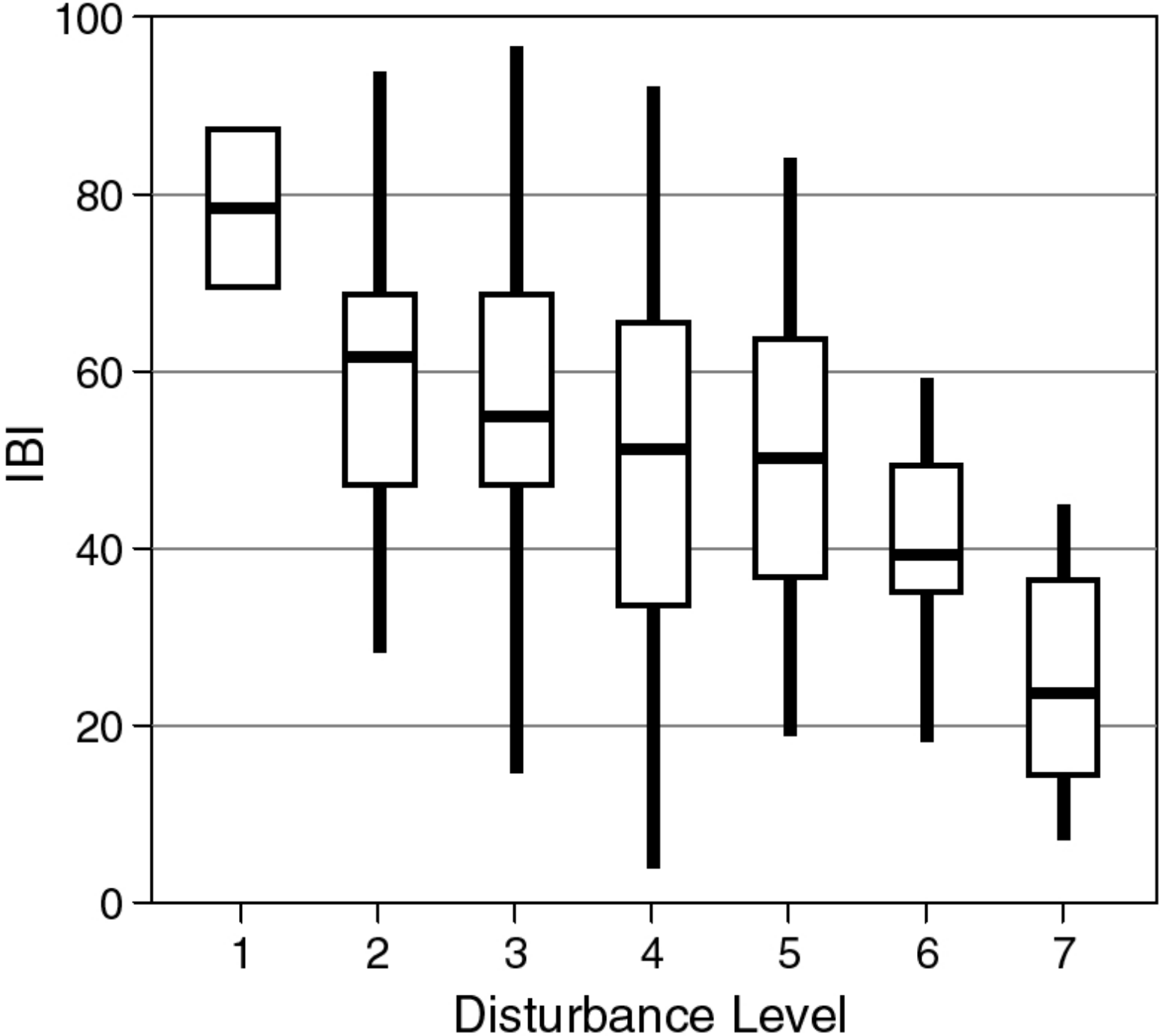
Fish IBI Metrics

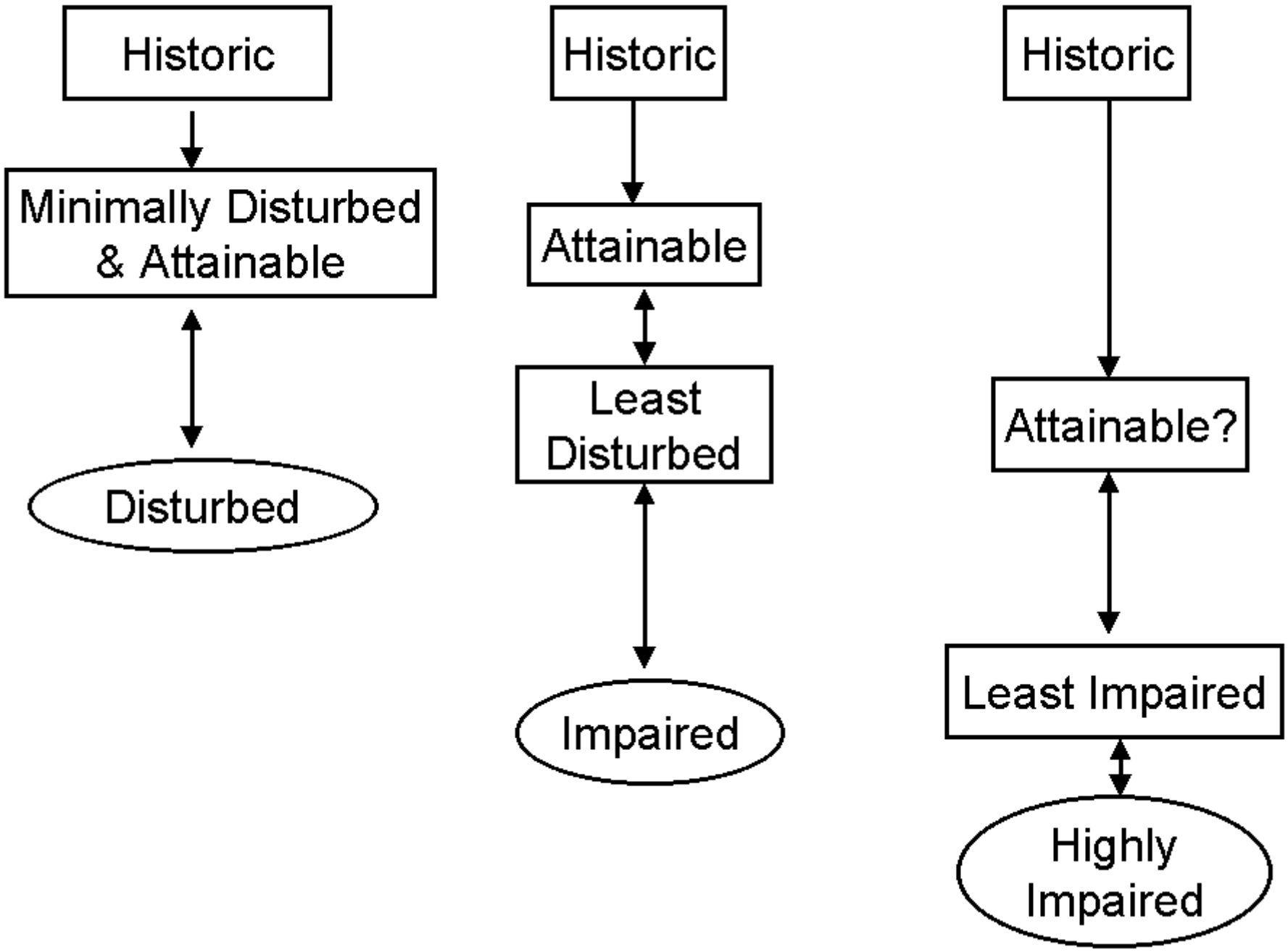
- % Alien species
- % Coolwater species
- % Anadromous species
- % Coldwater species
- No. tolerant individuals
- No. native coldwater species
- No. native coldwater individuals
- No. size classes

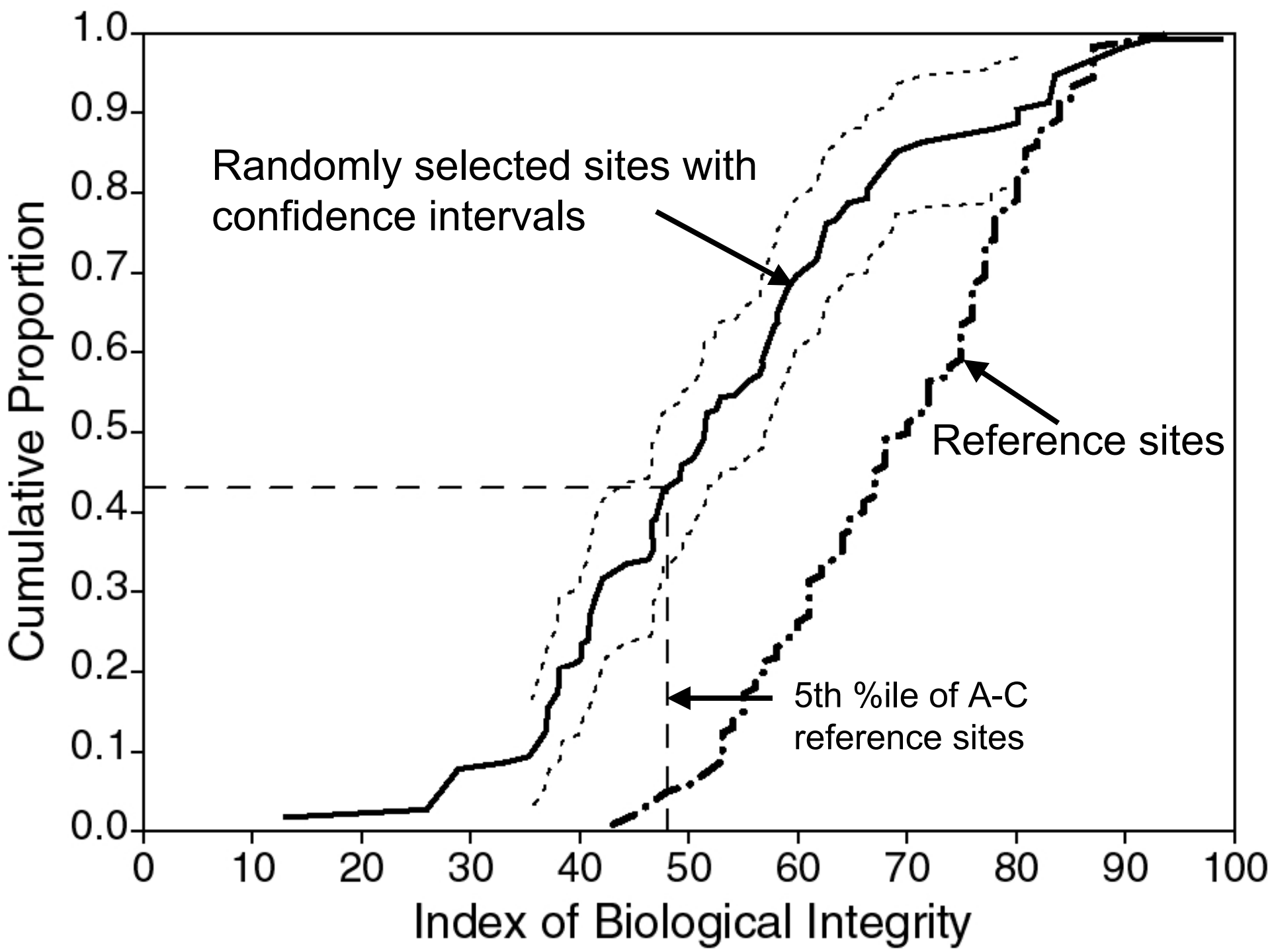

Index of Biological Integrity
Mean of IBI at a Site
0
10
20
30
40
50
60
70
80
90
100

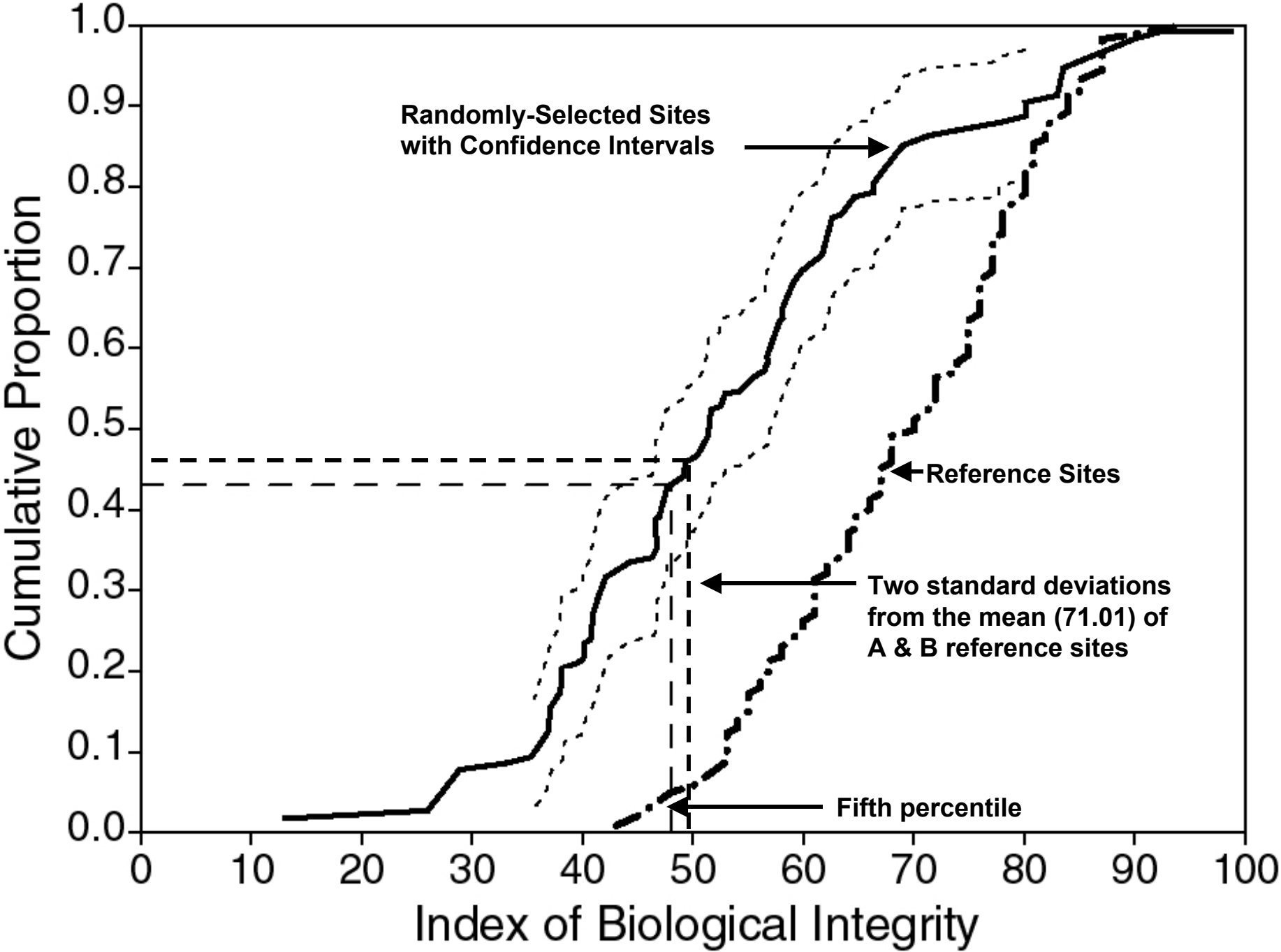
Significant IBI Correlations with Stressors

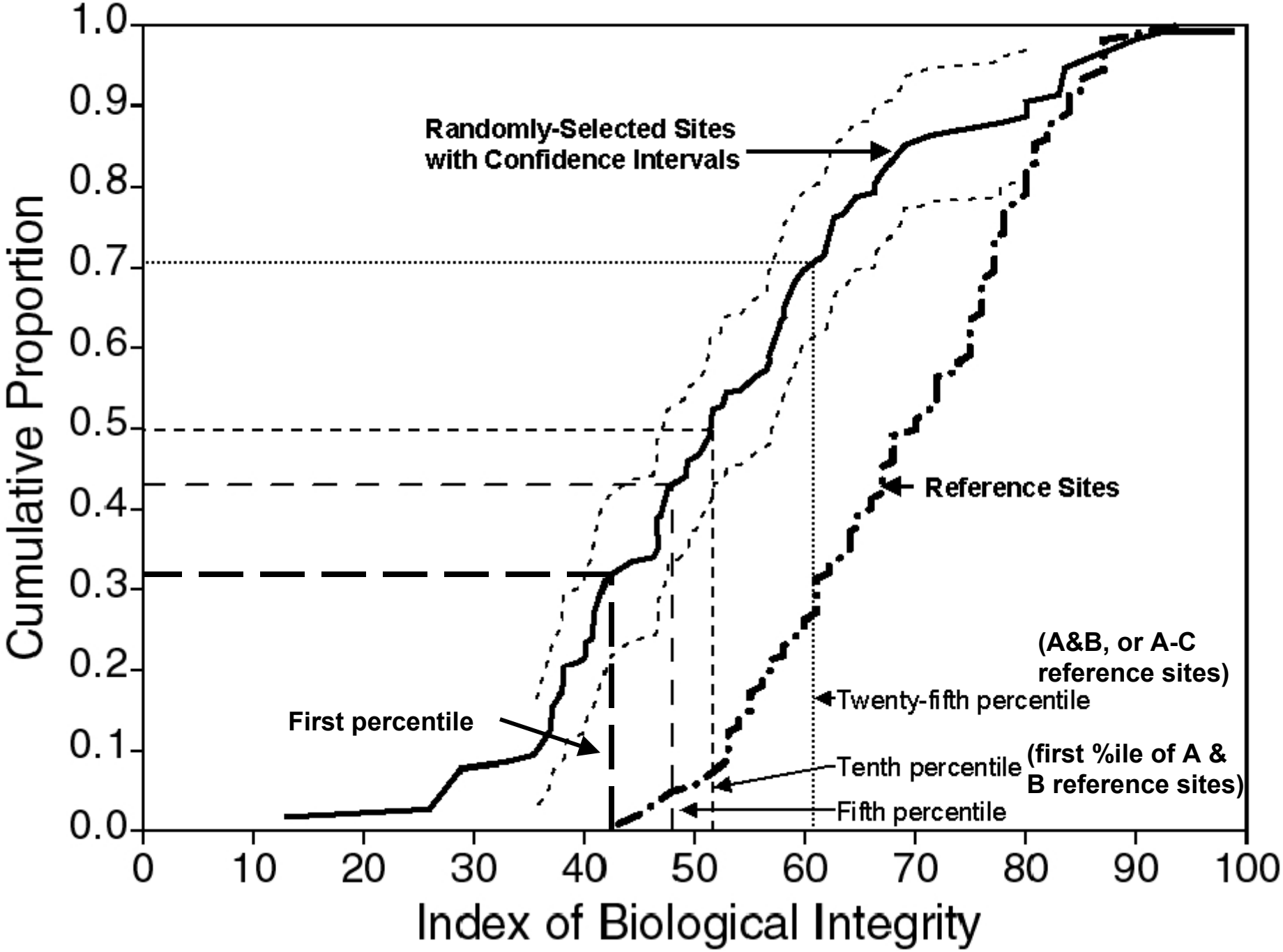
- Residual pools 0.21
- % Sand & fines -0.64
- Bed stability 0.58
- Log total N -0.34
- Log total P -0.47
- Riparian human disturbance -0.39
- Catchment road density -0.35

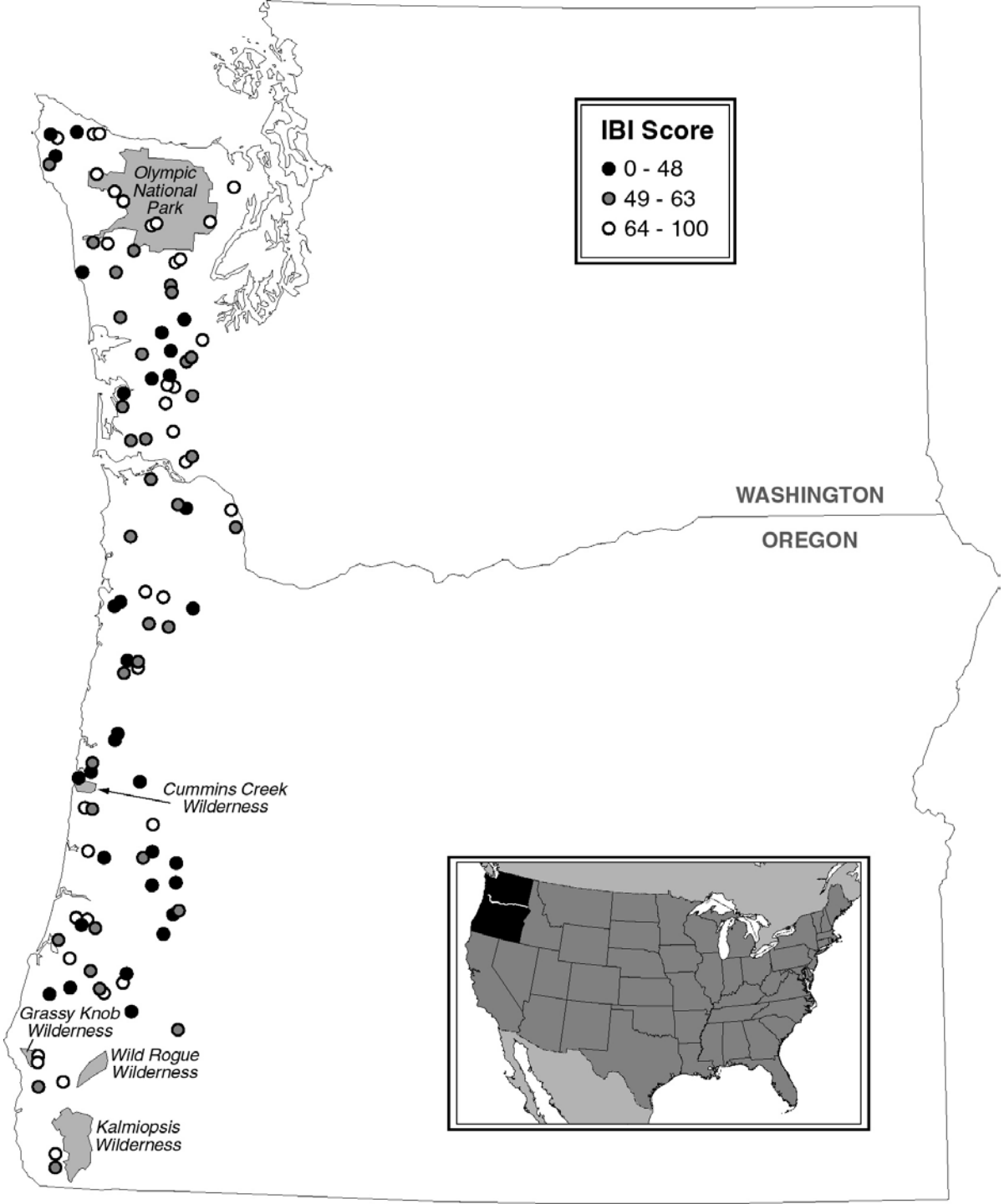

100
80
60
40
20
0
IBI
1
2
3
4
5
6
7
Disturbance Level

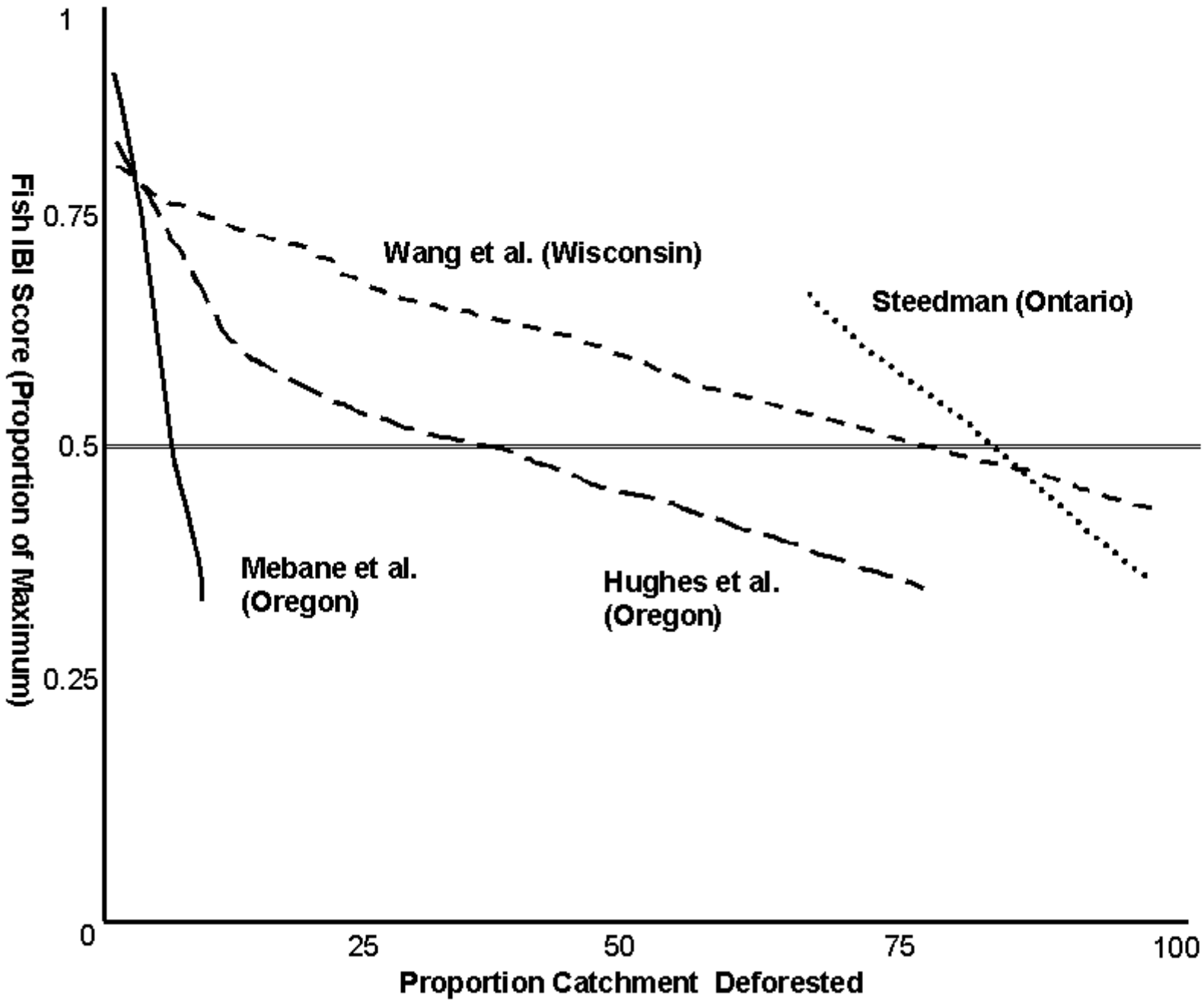

Historic
Minimally Disturbed & Attainable
Disturbed
Historic
Attainable
Least Disturbed
Impaired
Historic
Attainable?
Least Impaired
Highly Impaired


Randomly selected sites with confidence intervals
Reference sites
5th %ile of A-C reference sites
Cumulative Proportion
Index of Biological Integrity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100


Randomly-Selected Sites
with Confidence Intervals
Reference Sites
Two standard deviations
from the mean (71.01) of
A & B reference sites
Fifth percentile
Cumulative Proportion
Index of Biological Integrity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100


Cumulative Proportion
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
Index of Biological Integrity
Randomly-Selected Sites
with Confidence Intervals
Reference Sites
(A&B, or A-C
reference sites)
Twenty-fifth percentile
First percentile
Tenth percentile
(first %ile of A &
B reference sites)
Fifth percentile


IBI Score
0 - 48
49 - 63
64 - 100
Olympic National Park
WASHINGTON
OREGON
Cummins Creek Wilderness
Grassy Knob Wilderness
Wild Rogue Wilderness
Kalmiopsis Wilderness


1
0.75
0.5
0.25
0
Fish IBI Score (Proportion of Maximum)
Wang et al. (Wisconsin)
Steedman (Ontario)
Mebane et al.
(Oregon)
Hughes et al.
(Oregon)
25
50
75
100
Proportion Catchment Deforested

Conclusions

- IBI precise (signal/noise of 4.7)
- IBI correlated significantly with several stressors
- 43-46 % (10,173-10,883 km) of streams impaired if 5th %ile or 2SD from mean of reference sites used as biocriterion