US EPA ARCHIVE DOCUMENT

Reference Condition Approach and Site Selection: An approach for biological criteria and watershed assessment

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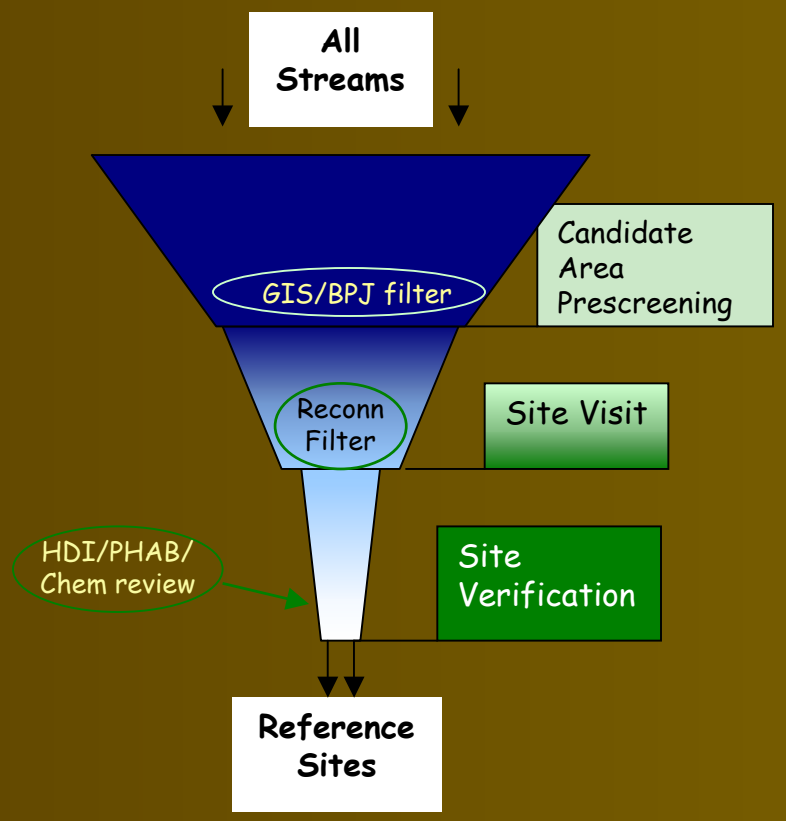
Overview

- 1992 to present - Identified more than 200 reference sites
- Wadeable streams (1st- 4th order) representing 84-92% of total streams miles
- Use in Biocriteria, 303d, TMDL, Permitting support, stressor identification

Site Selection Process

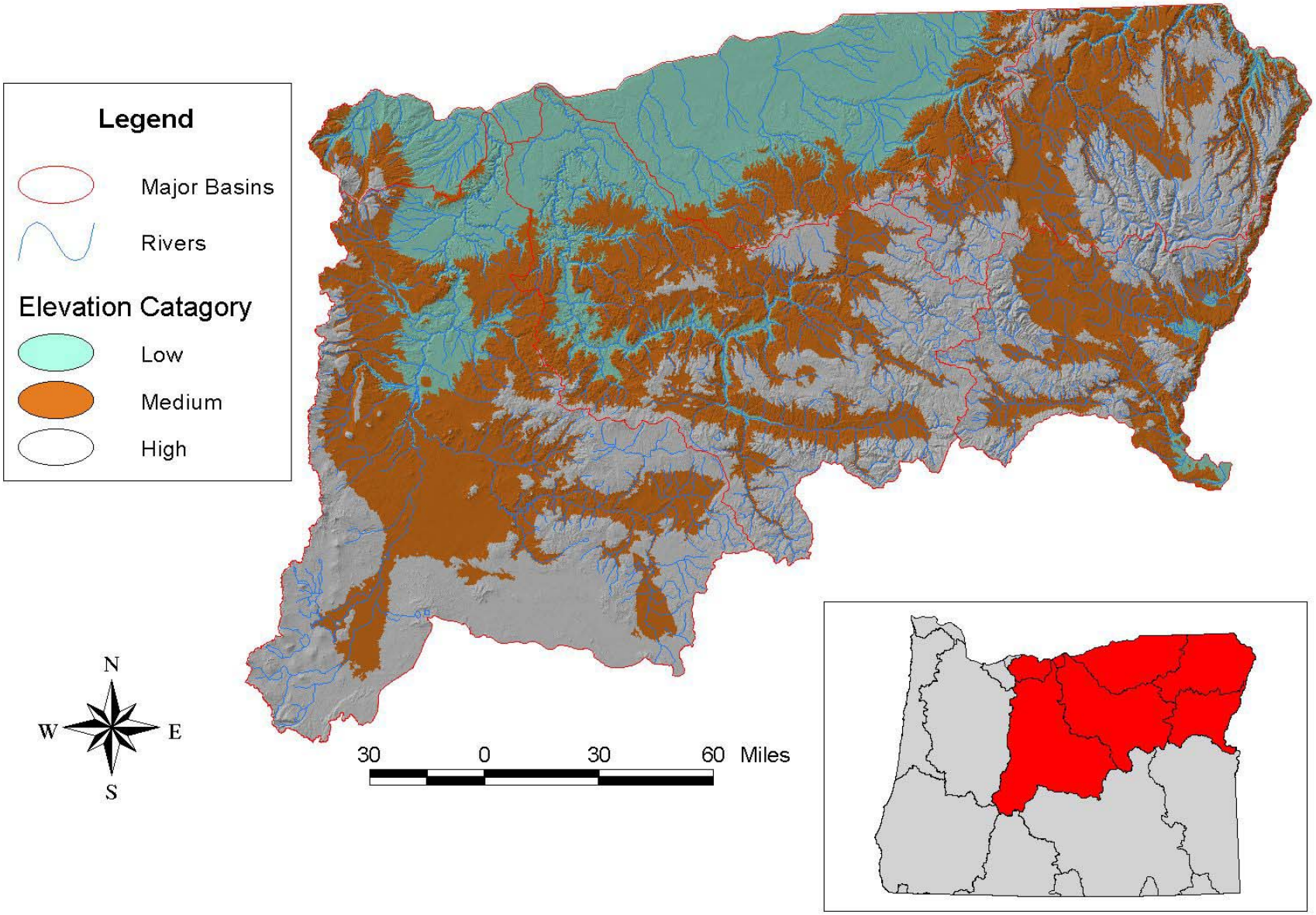


- **Candidate area prescreening**
  - Select region/natural gradients, use GIS and BPJ to map candidate areas
- **Site visit (Field reconnaissance & Sampling)**
  - Site reach assessment of human disturbance ranks candidates (for sampling)
- **Site verification**
  - Use site specific landscape, reach & sample data to verify and grade sites

Prescreening
NE Example

- Blue Mt. ecoregion broken into 5th field watersheds, Strata: 2-4 order, 3 elevation classes
- Five GIS coverages used
- BPJ survey of resource managers

Reference Site Study Area



Prescreening Coverages

- Ag and urban land use
- Road Coverage (density)
- Forest Fragmentation

Other coverages used

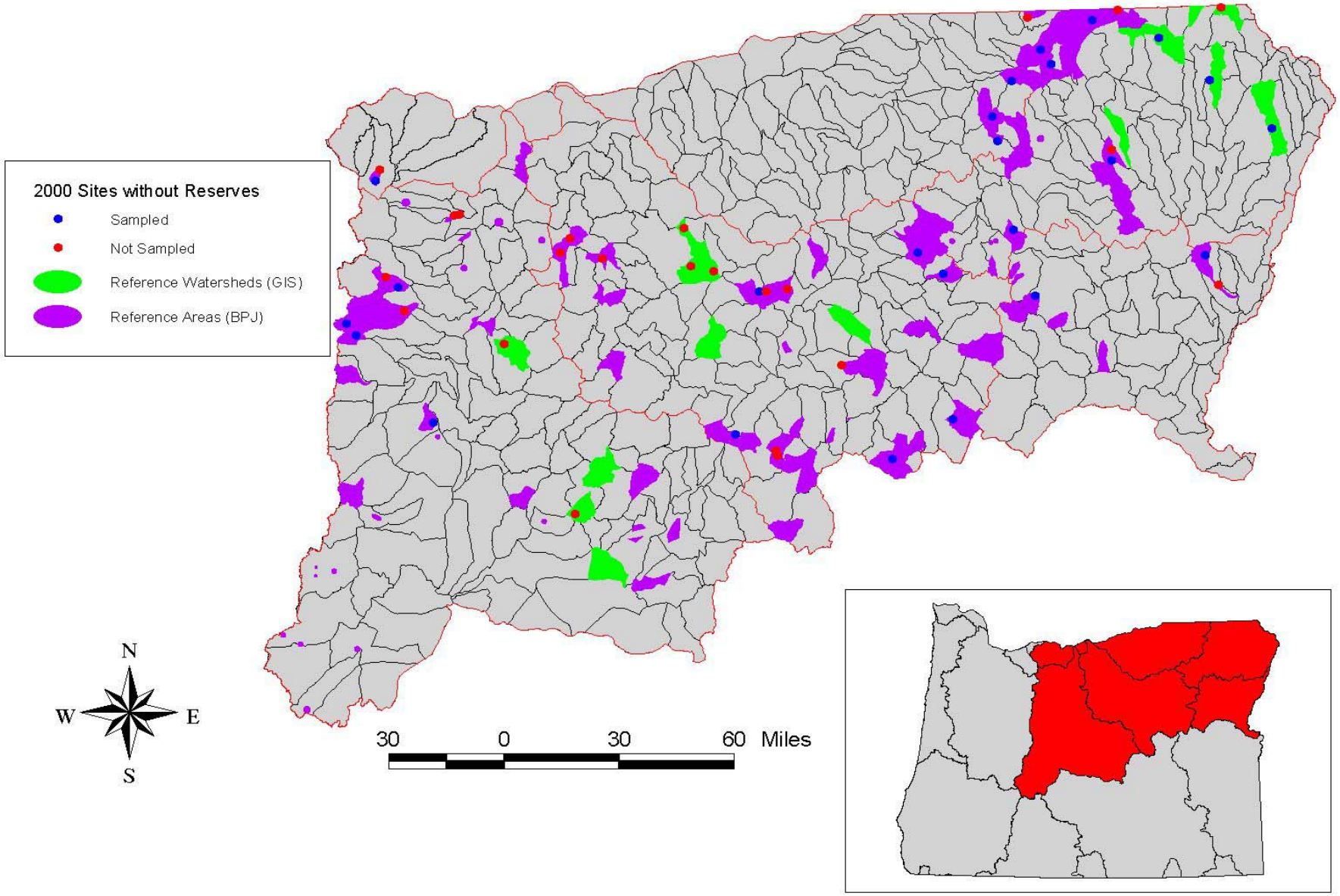
- Grazing (where available)
- Population Density
- WQ Impairment

Prescreening Survey

State & Federal resource management professionals

- How do GIS candidate watersheds look?
- Does it agree with where you find least-impaired watersheds?
- Did we miss any watersheds in reference condition?

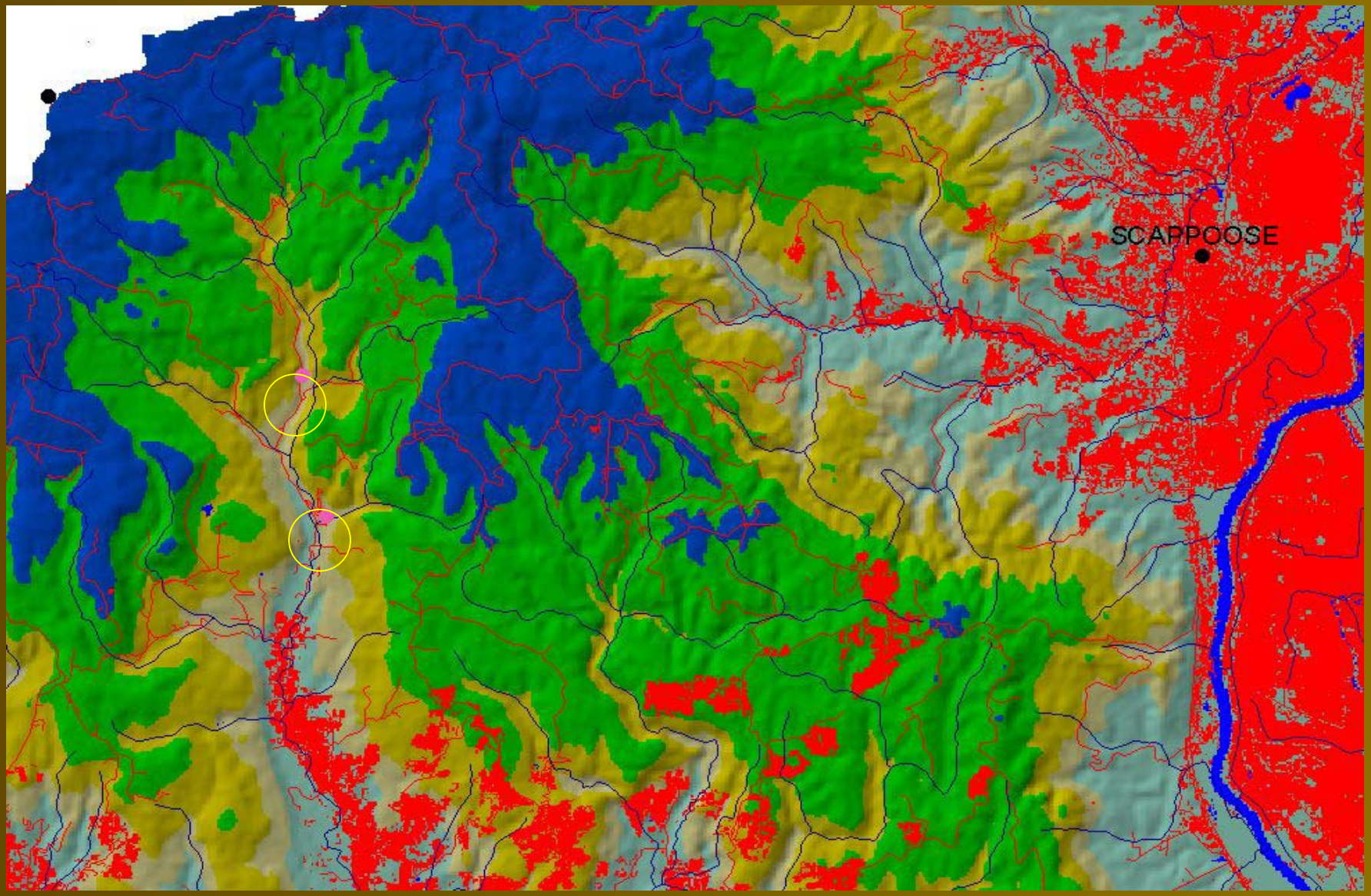
Fifth Field Basins in the Study Area



Prescreening/Reconn

- GIS and reconnaissance primarily used
- Natural gradient is elevation (3-4 classes)
- Used previous GIS (Roads, Ag, Grazing, Pop. & WQ) added MRLC and forest fragmentation.
- Used candidate areas to perform intense reconnaissance.

Prescreening



Site Visits

Reconnaissance Checklist

- Human Disturbance reach-level activity checklist (modified from Kaufmann et al, 1999)
- Uses simple set of metrics to produce a reach-level Human Disturbance Score to rank sites
- Allows for objective ranking of candidate sites for sampling

Site Visit

Reconnaissance or Sampling

Reach data – 5 metrics scored* based on proximity of these disturbances:

- Roads,
- Logging,
- Agricultural and/or Urban land use,
- Rangeland,
- Miscellaneous (includes mining, recreational activity, other).

*absent=0, present=1, within 10 m=3, on the bank=5

Site Verification

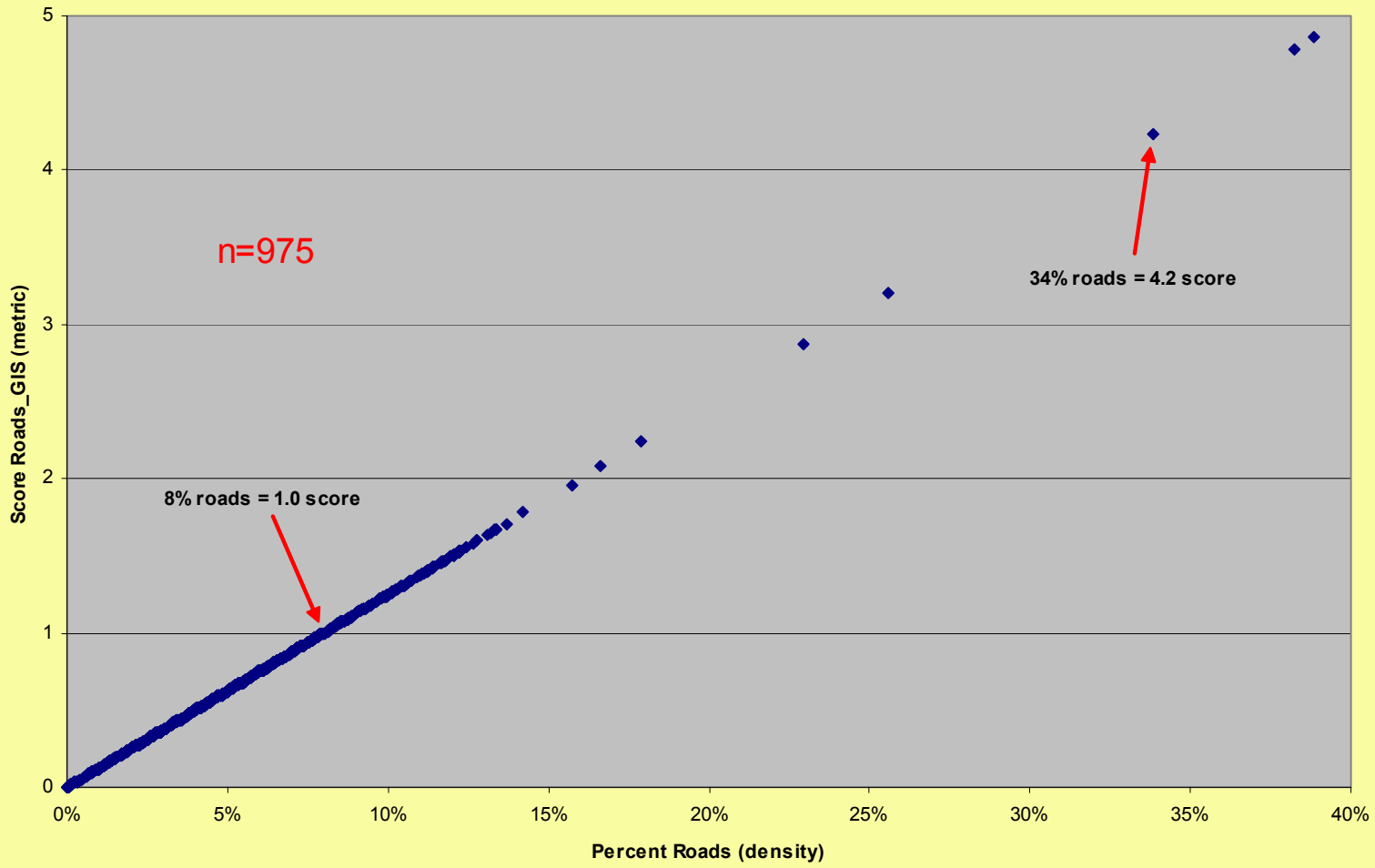
Watershed specific assessment

GIS data – 3 Metrics scored* based on watershed extent of :

- Percent Ag-Urban land use
- Forest fragmentation
- Percent roads (density)

*metric score uses the range of values to set score (maximum = 5, Lowest = 0)

Road density (scoring example)



Site Verification

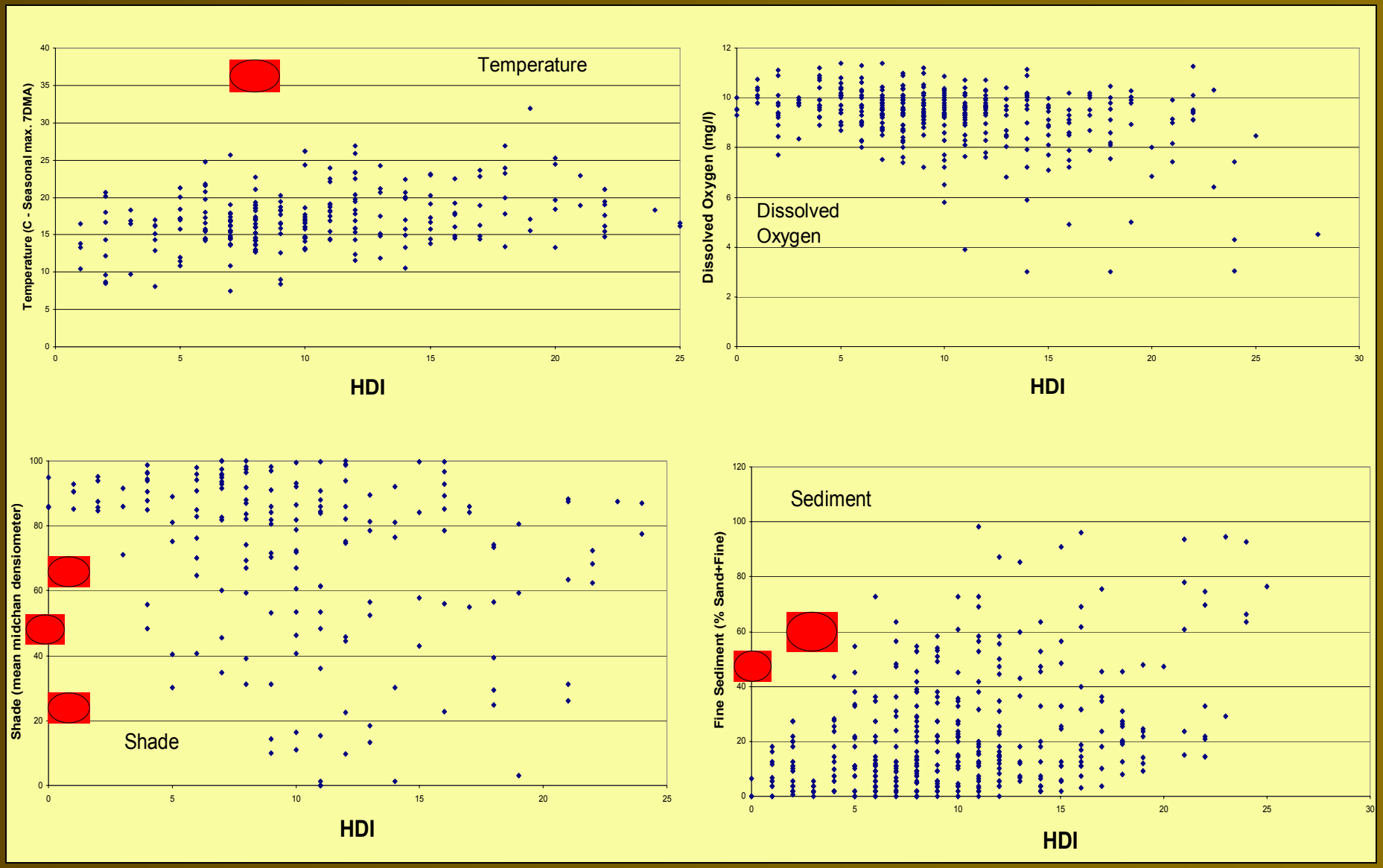
- **HDI (Human Disturbance Index)**
  Reach and watershed scores are averaged and summed to give relative index score
- **Review sample data**

  Anomalous sites for non-biological variables are flagged and reviewed before assigning final grade

HDI Score examples

Activity (scale)	**Cultus Creek**	**Testament Creek**	**Tillamook River**
Ag/Urban (reach)	Not present = 0	Present = 1	Within 10 m = 3
Logging (reach)	Not present = 0	Present = 1	Within 10 m = 3
Range (reach)	Not present = 0	Not present = 0	Within 10 m = 3
Roads (reach)	Not present = 0	Present = 1	On the bank = 5
Misc (reach)	Not present = 0	Trail on bank = 5	Trash on bank = 5
Ag/Urban (watershed)	0.07% = 0.003	3% = 0.15	6% = 0.32
Forest Frag (watershed)	0 = 0	84% = 4.2	62% = 3.1
Road (watershed density)	0 = 0	13% = 1.7	5.4% = 0.68
HDI Score	0.001	3.6	5.2

Flagged Site examples



Site Verification
Flagged sites examples

High sediment – Flynn (low slope/geology)

Cultus (meadow)

High Temp – Canyon (ran dry)

Low Shade – Battle (above average width)

Cultus (meadow)

Goose (dry)

Site Grading

A - Ideal watershed and stream condition, a watershed with virtually no human disturbance.

B - Good watershed and stream condition, some limited human disturbance and/or BMPs are well implemented.

C - Marginal watershed and stream condition. Considerable human disturbance. Best available. Replace if better quality reference sites are located.

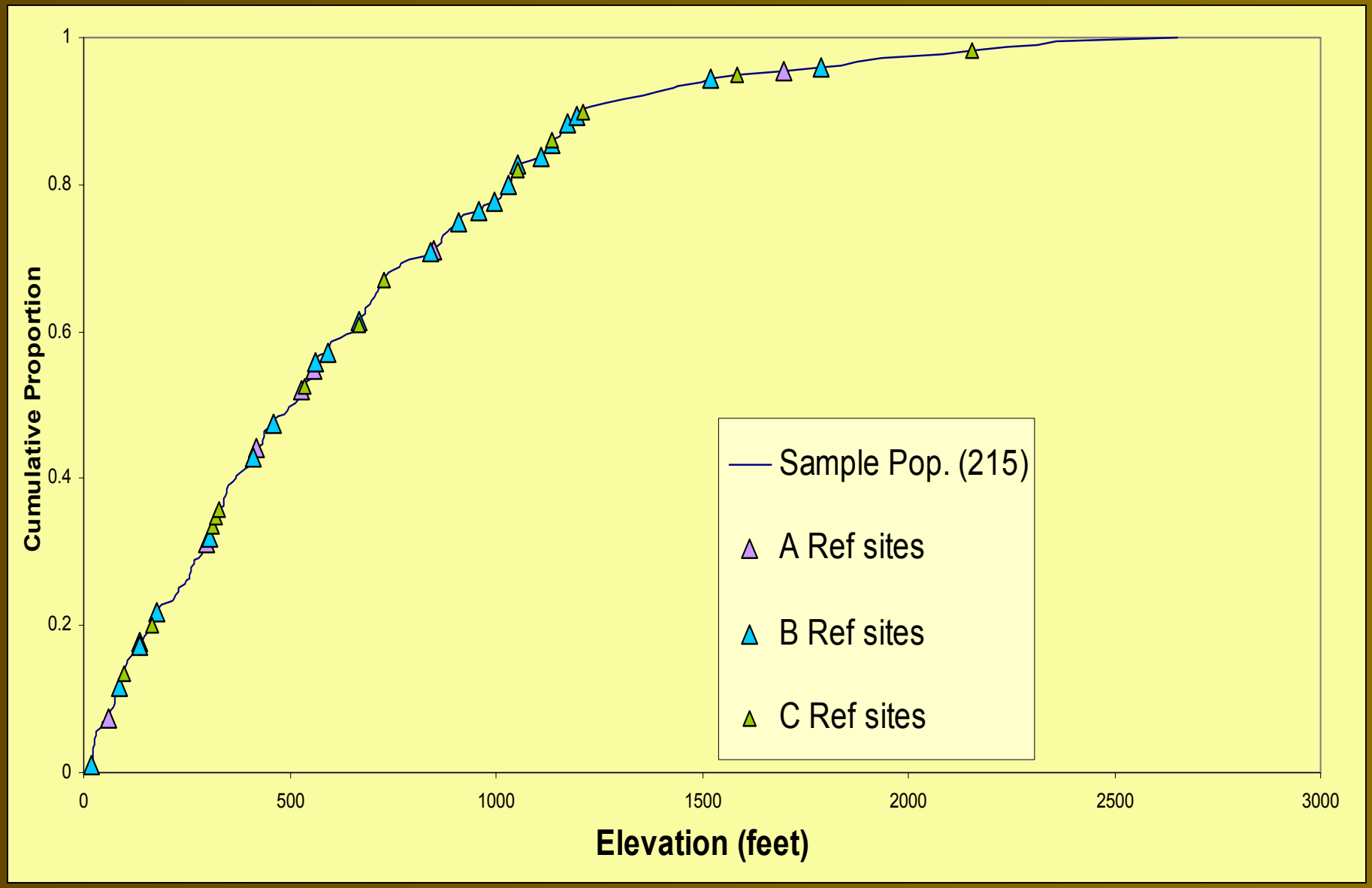
Site Grading continued

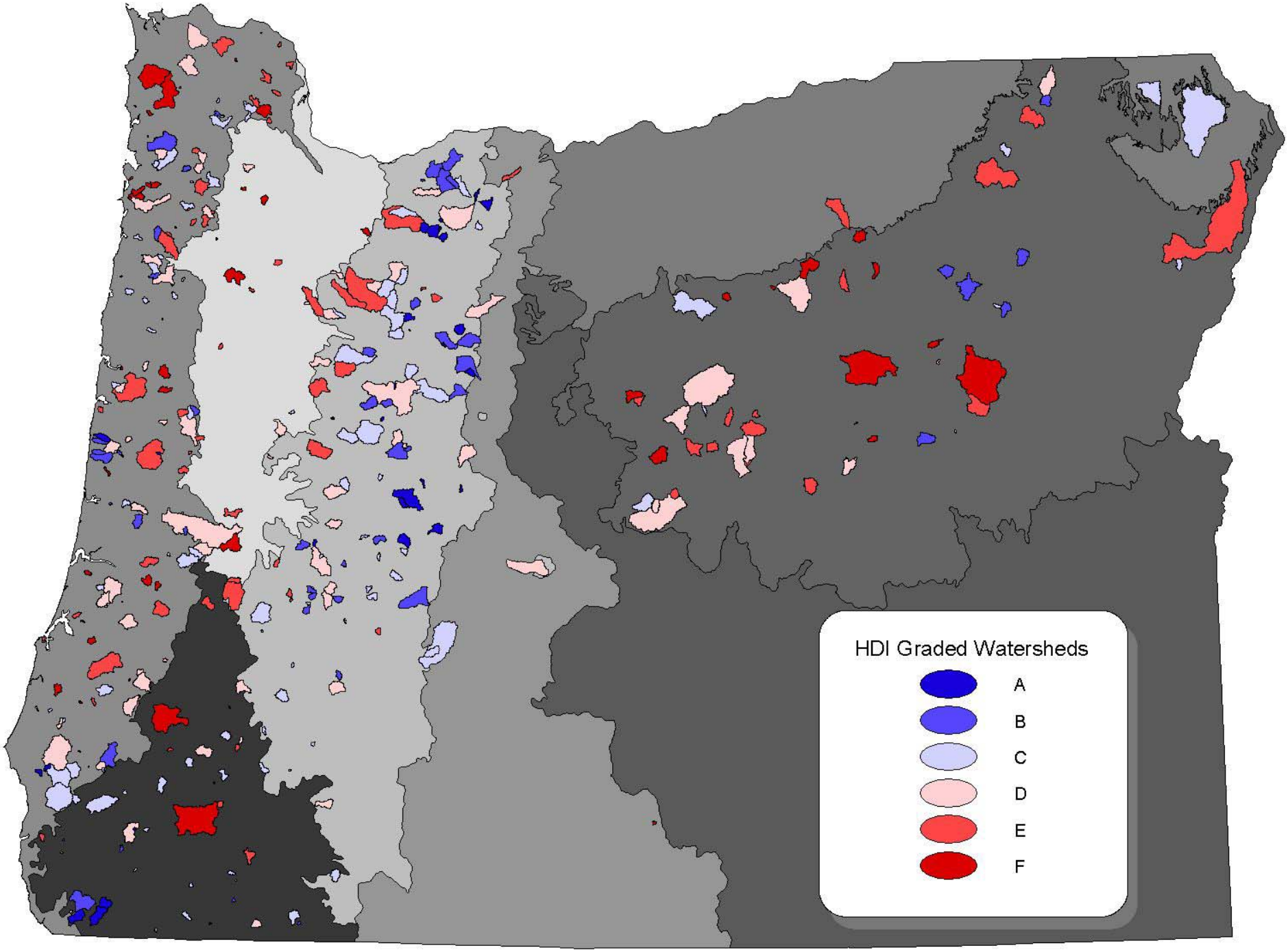
D - Site represents sub-marginal stream and watershed conditions, considerable human disturbance is present at reach or watershed.

E - Site represents poor stream and watershed conditions, considerable human disturbance is present at reach and watershed.

F - Site represents very poor stream and watershed conditions, human disturbance is extensive throughout reach and watershed.

Coast Range (HDI graded Sites)



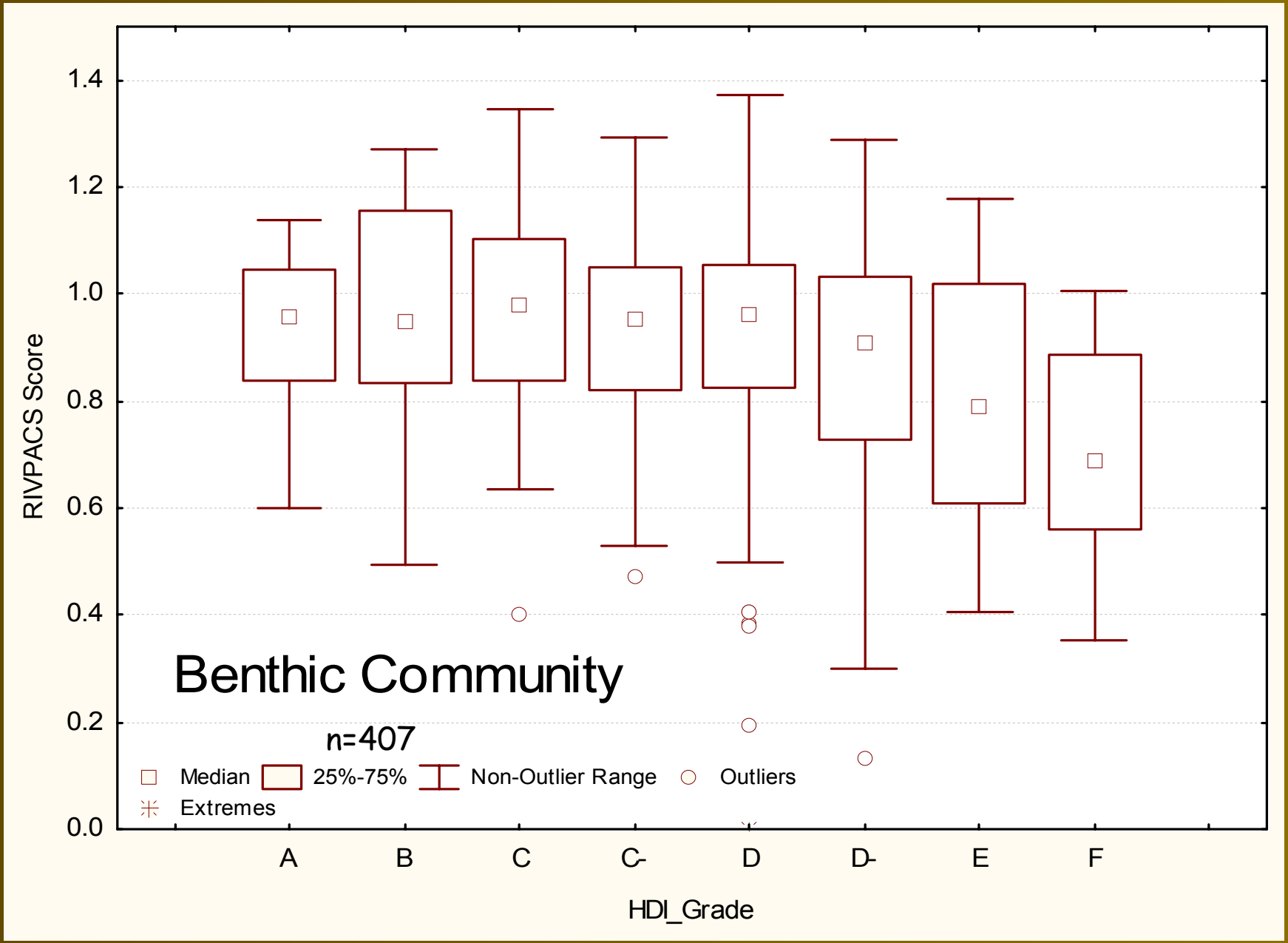

HDI Graded Watersheds
A
B
C
D
E
F

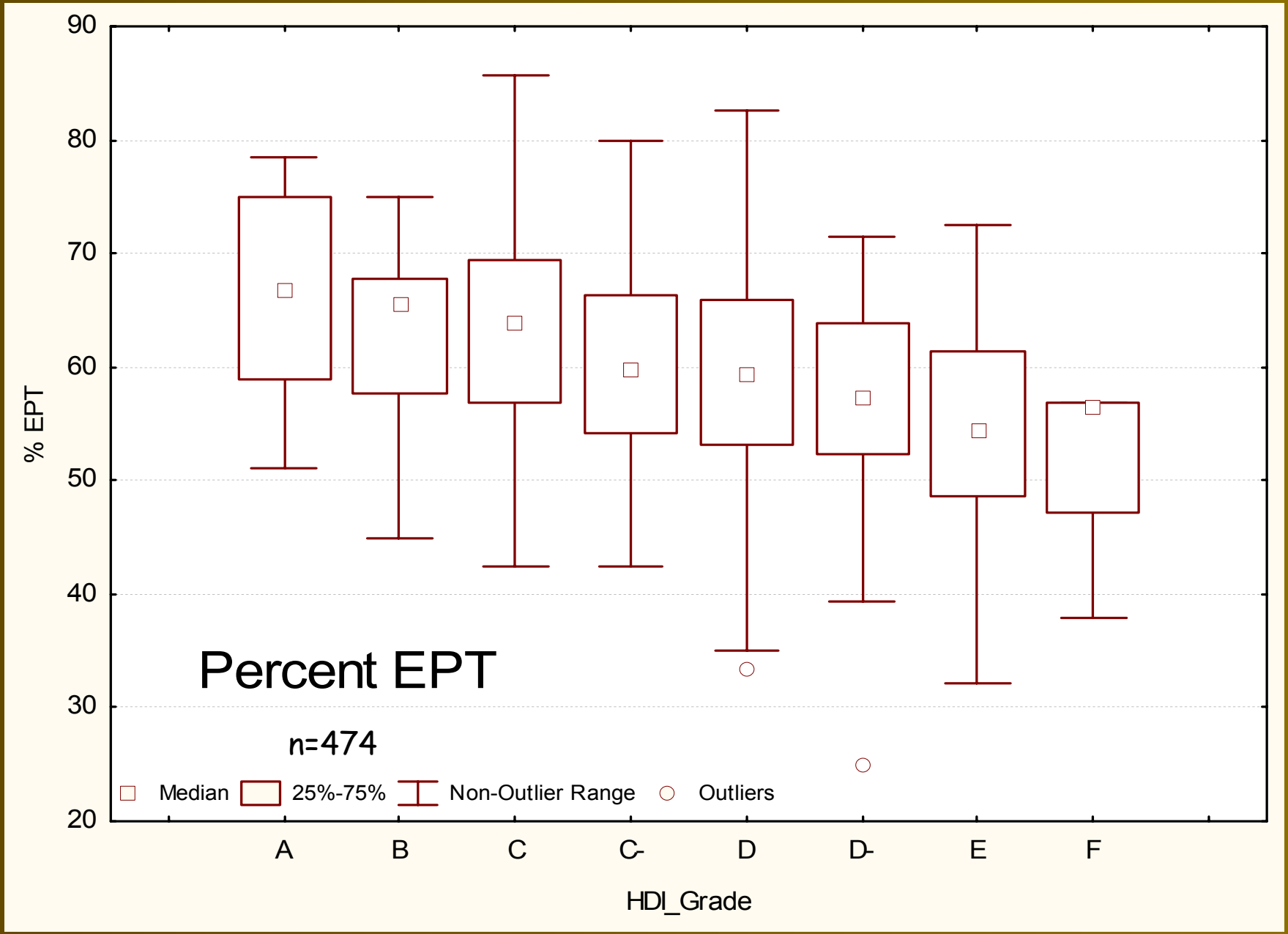
Lessons Learned

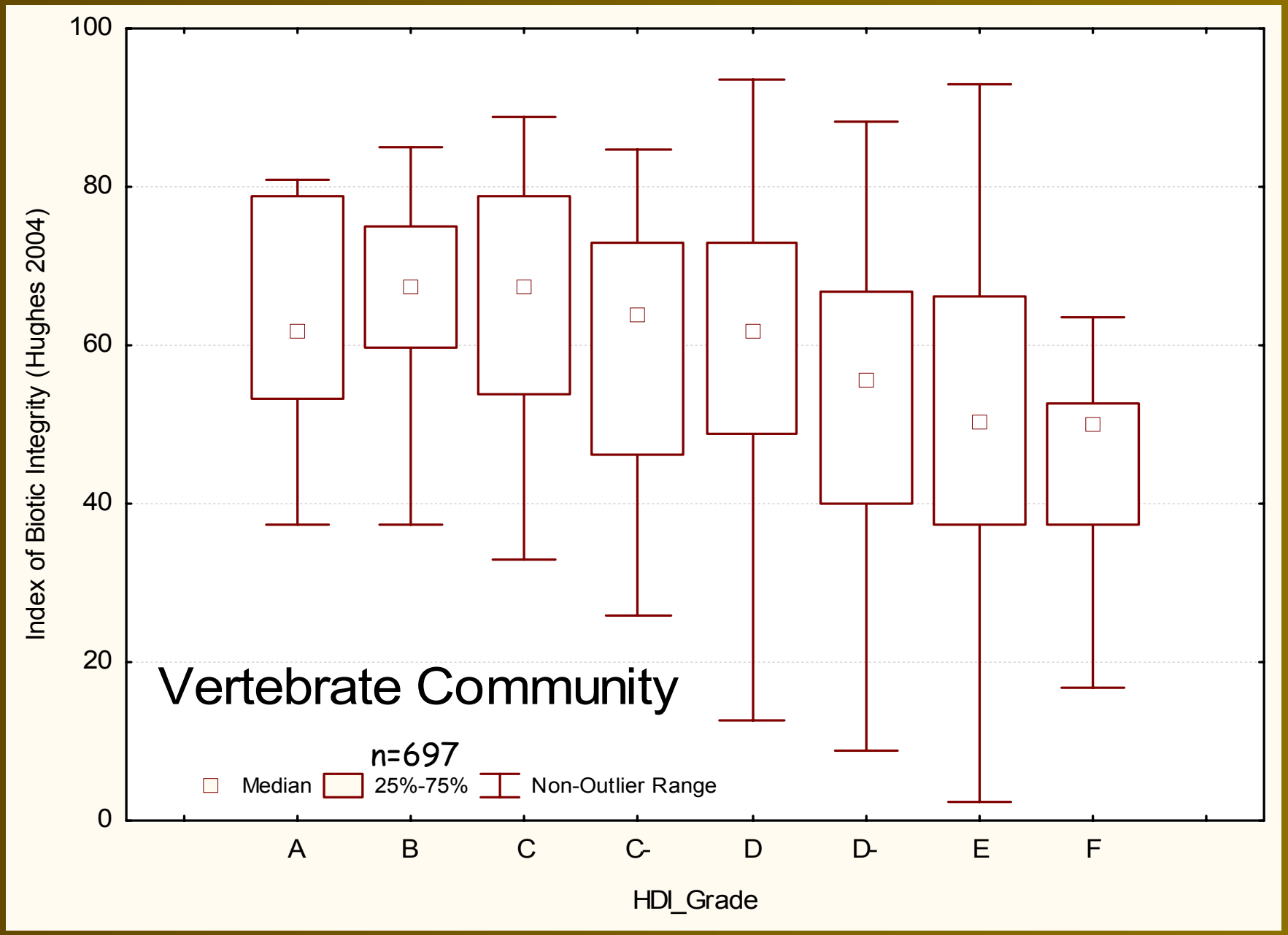
- BPJ surveys – are helpful but need to verify quality of candidates
- GIS information – Use what you have, but incorporate latest coverages
- Reconnaissance – Can't do too much
- Verification – Anomalous data may be highlighting unique sites

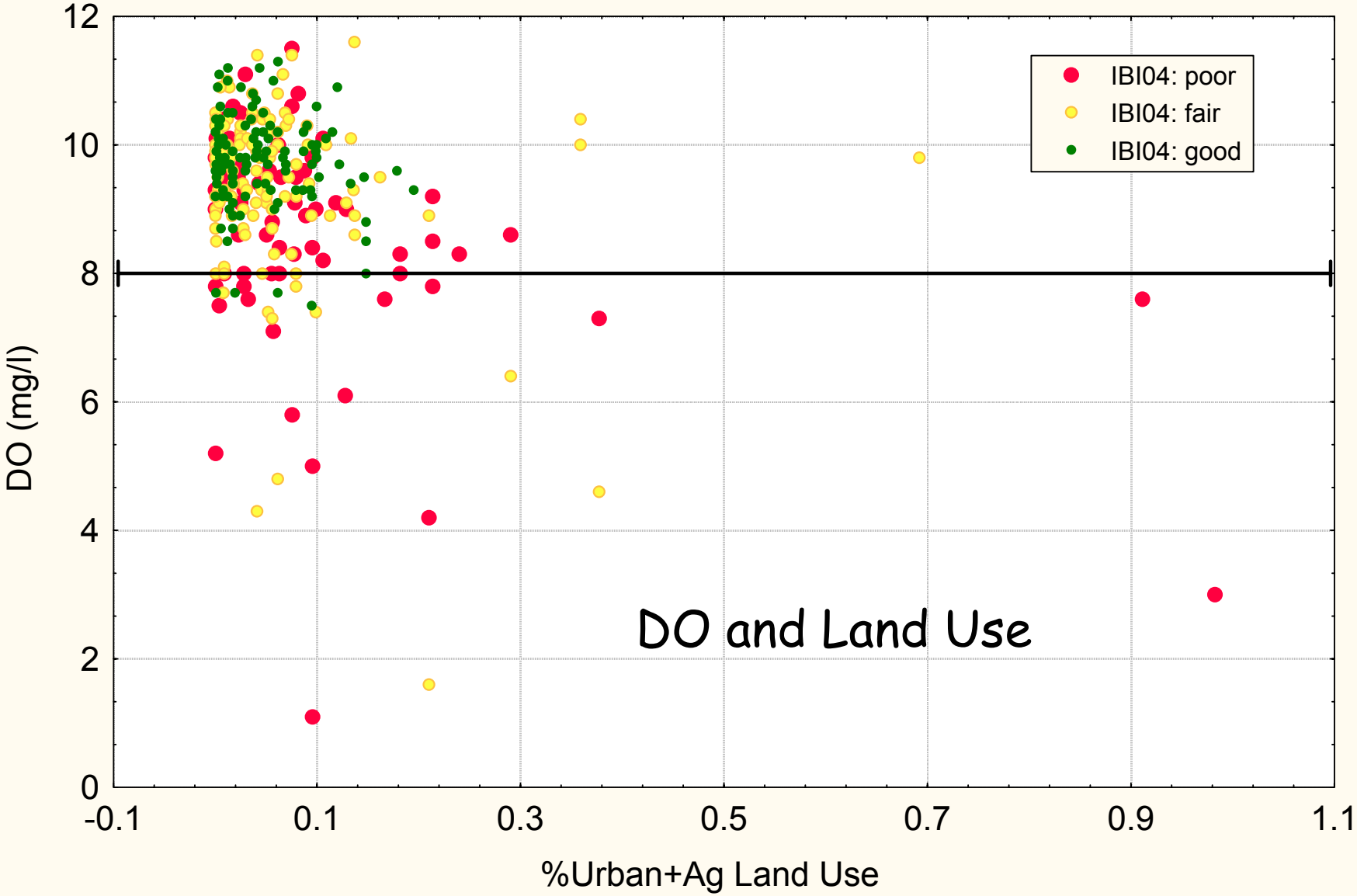
What about biological criteria and watershed assessment?

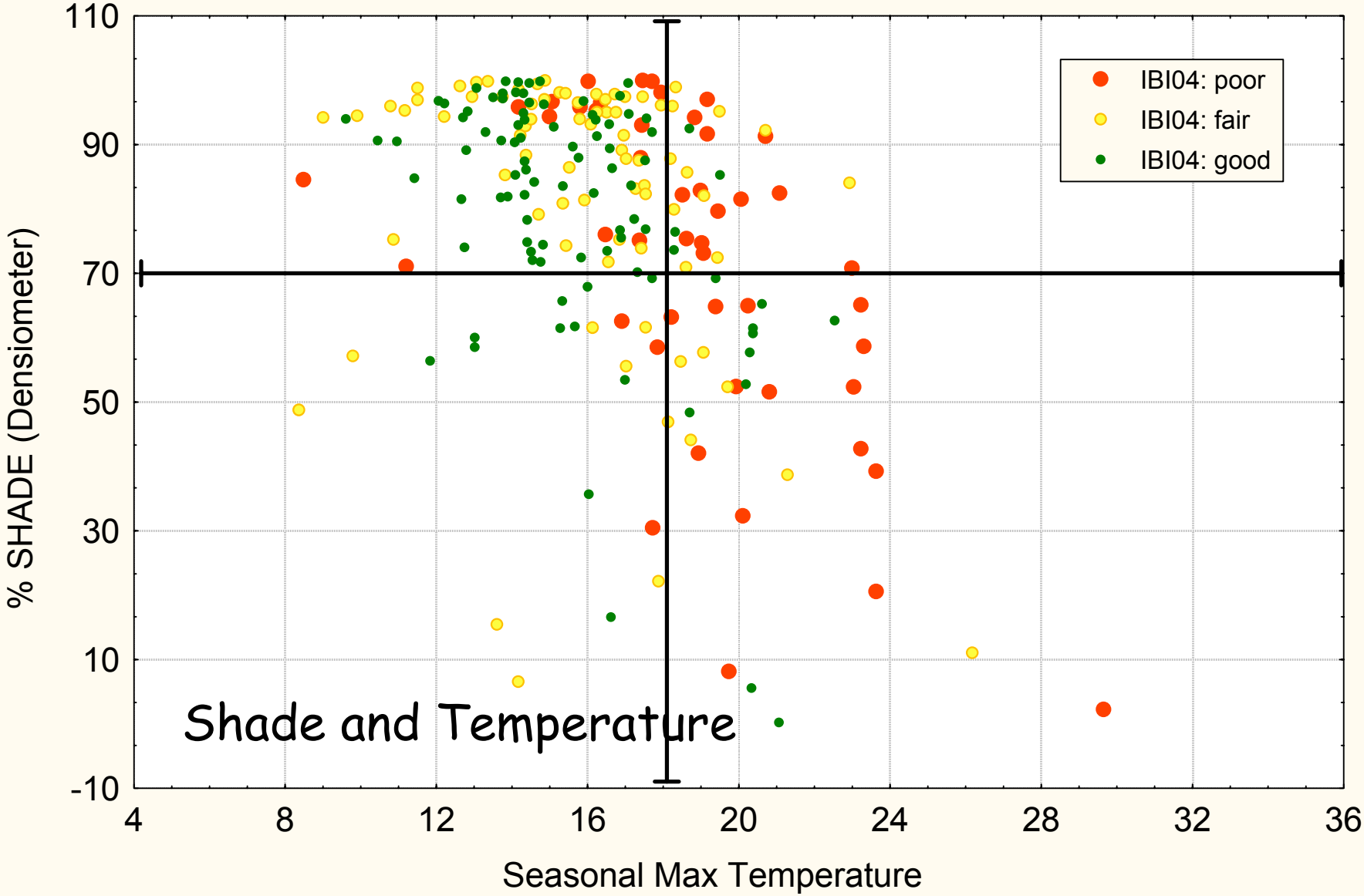
- Benthic Community
- Vertebrate Community
- Temperature
- Dissolved Oxygen
- Fine Sediment and Relative Bed Stability
- Land Use

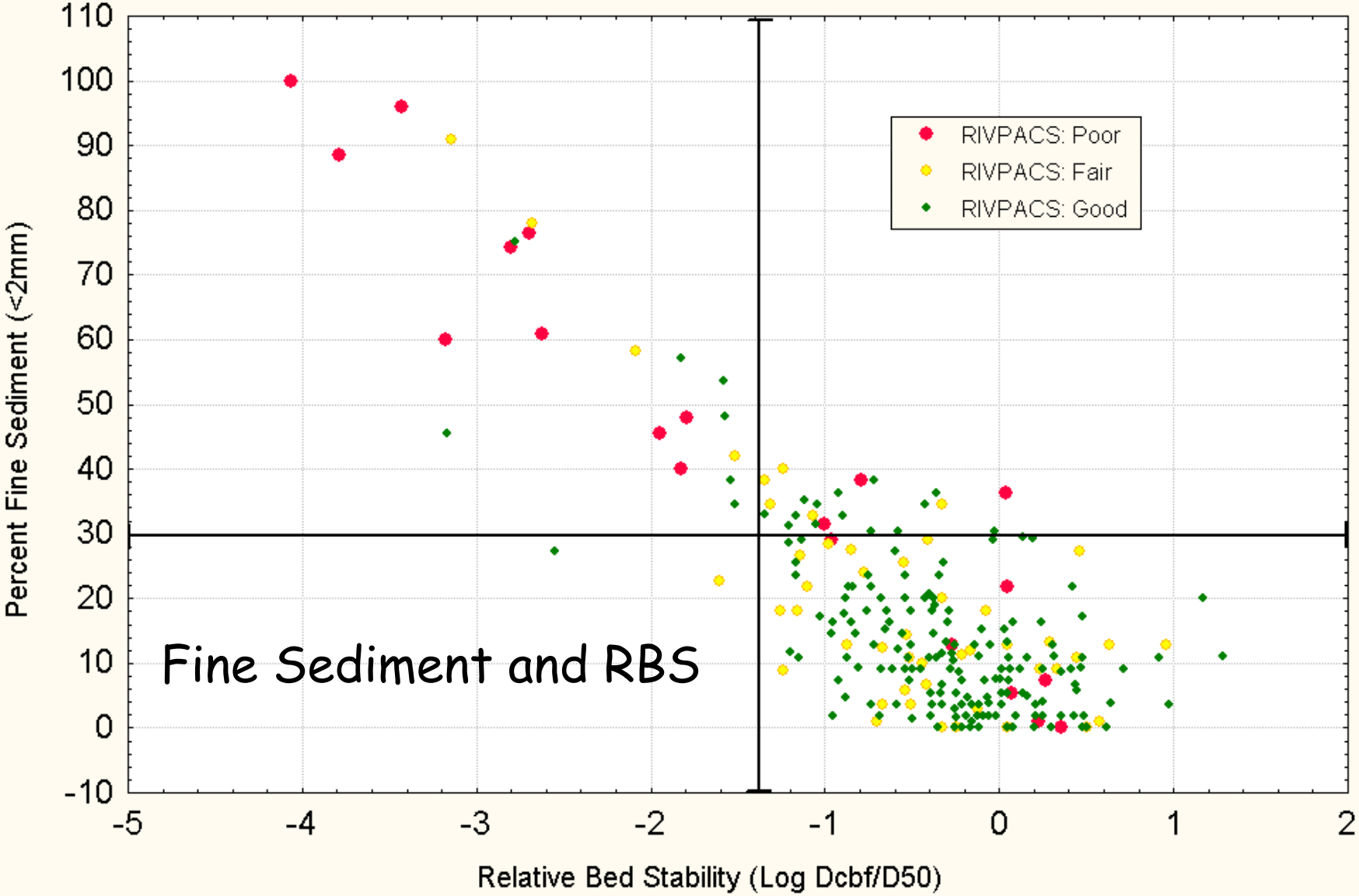

Benthic Community
n=407
Median
25%-75%
Non-Outlier Range
Outliers
Extremes
RIVPACS Score
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
A
B
C
C-
D
D-
E
F
HDI_Grade


Percent EPT
n=474
% EPT
90
80
70
60
50
40
30
20
A
B
C
C-
D
D-
E
F
HDI_Grade
Median
25%-75%
Non-Outlier Range
Outliers


Vertebrate Community
n=697
Median
25%-75%
Non-Outlier Range
Index of Biotic Integrity (Hughes 2004)
100
80
60
40
20
0
A
B
C
C-
D
D-
E
F
HDI_Grade


DO and Land Use
IBI04: poor
IBI04: fair
IBI04: good
DO (mg/l)
%Urban+Ag Land Use
12
10
8
6
4
2
0
-0.1
0.1
0.3
0.5
0.7
0.9
1.1


Shade and Temperature
IBI04: poor
IBI04: fair
IBI04: good
% SHADE (Densiometer)
Seasonal Max Temperature
110
90
70
50
30
10
-10
4
8
12
16
20
24
28
32
36


Fine Sediment and RBS
RIVPACS: Poor
RIVPACS: Fair
RIVPACS: Good
Percent Fine Sediment (<2mm)
Relative Bed Stability (Log Dcbf/D50)
110
100
90
80
70
60
50
40
30
20
10
0
-10
-5
-4
-3
-2
-1
0
1
2

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