FISH ASSEMBLAGE INDICATORS OF BIOLOGICAL INTEGRITY IN NORTHWESTERN RIVERS, MOUNTAIN STREAMS, AND DESERT STREAMS

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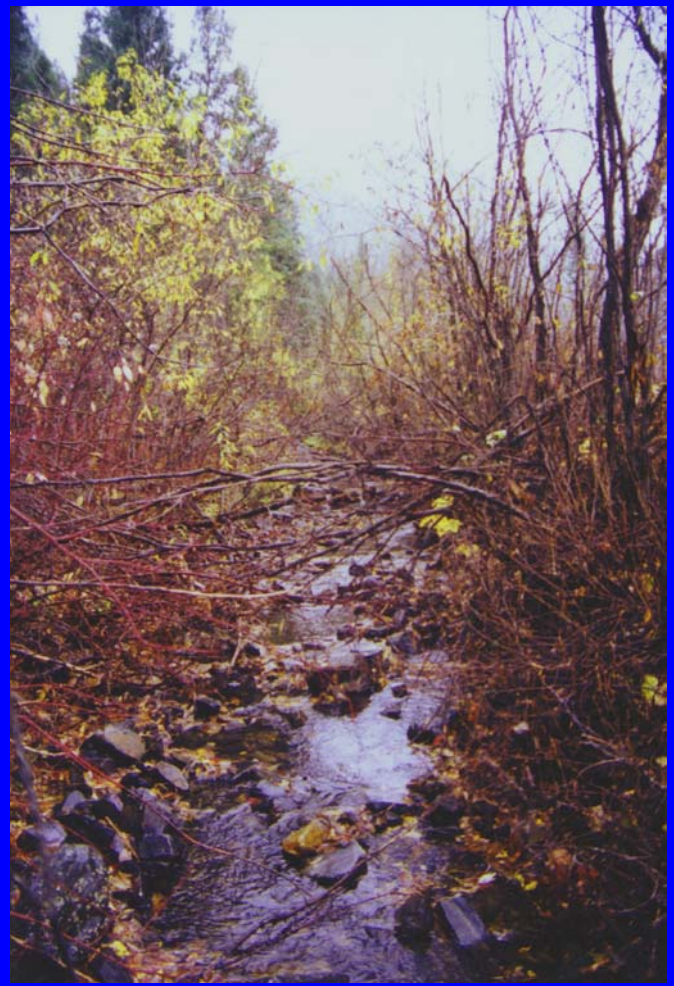
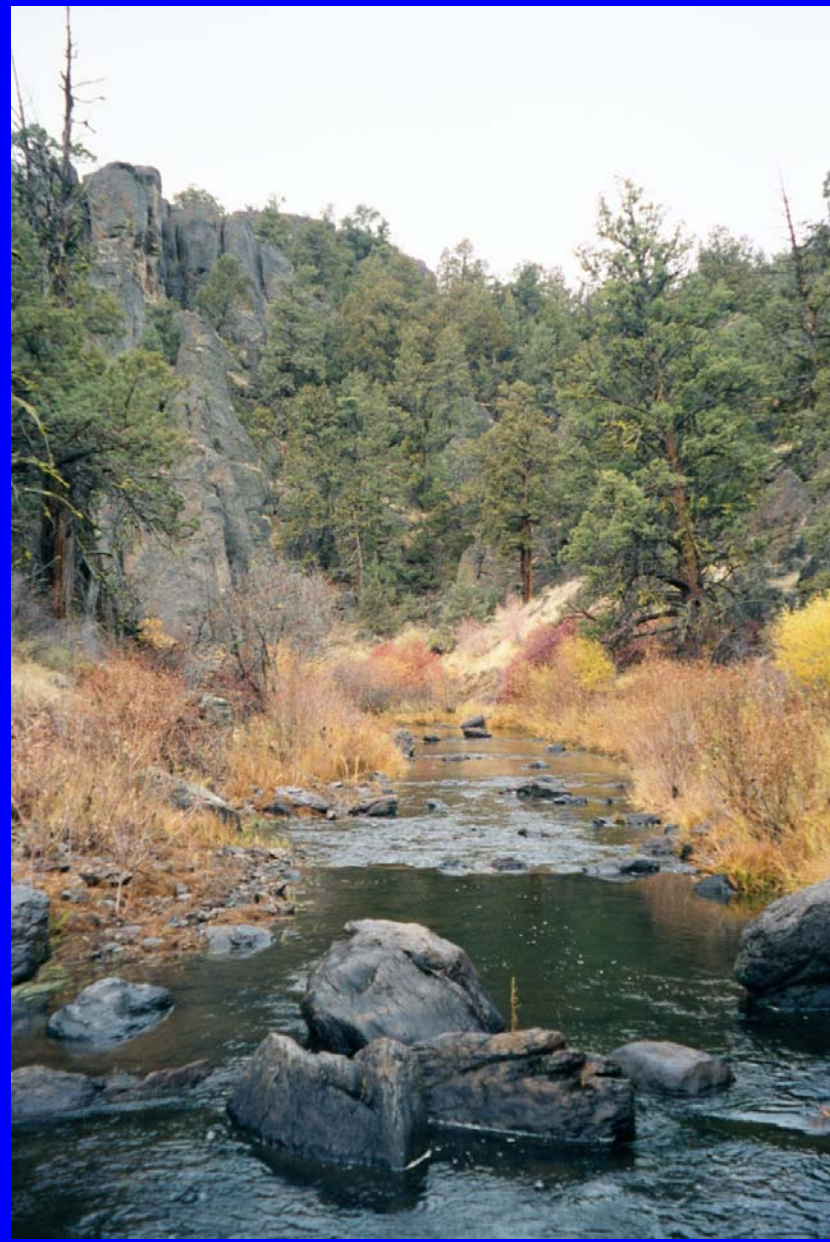
- Fish assemblages probably less used in bioassessment in western U.S. than Midwest or East
- Issues using fish assemblages as ecological indicators in the western U.S. include:
  - Naturally low species richness
  - Species richness may increase in response to disturbance
  - Extensive stocking of salmonids blurs assemblages
  - Human disturbance patterns overlay natural longitudinal river continuum patterns

- ***Mountain streams***

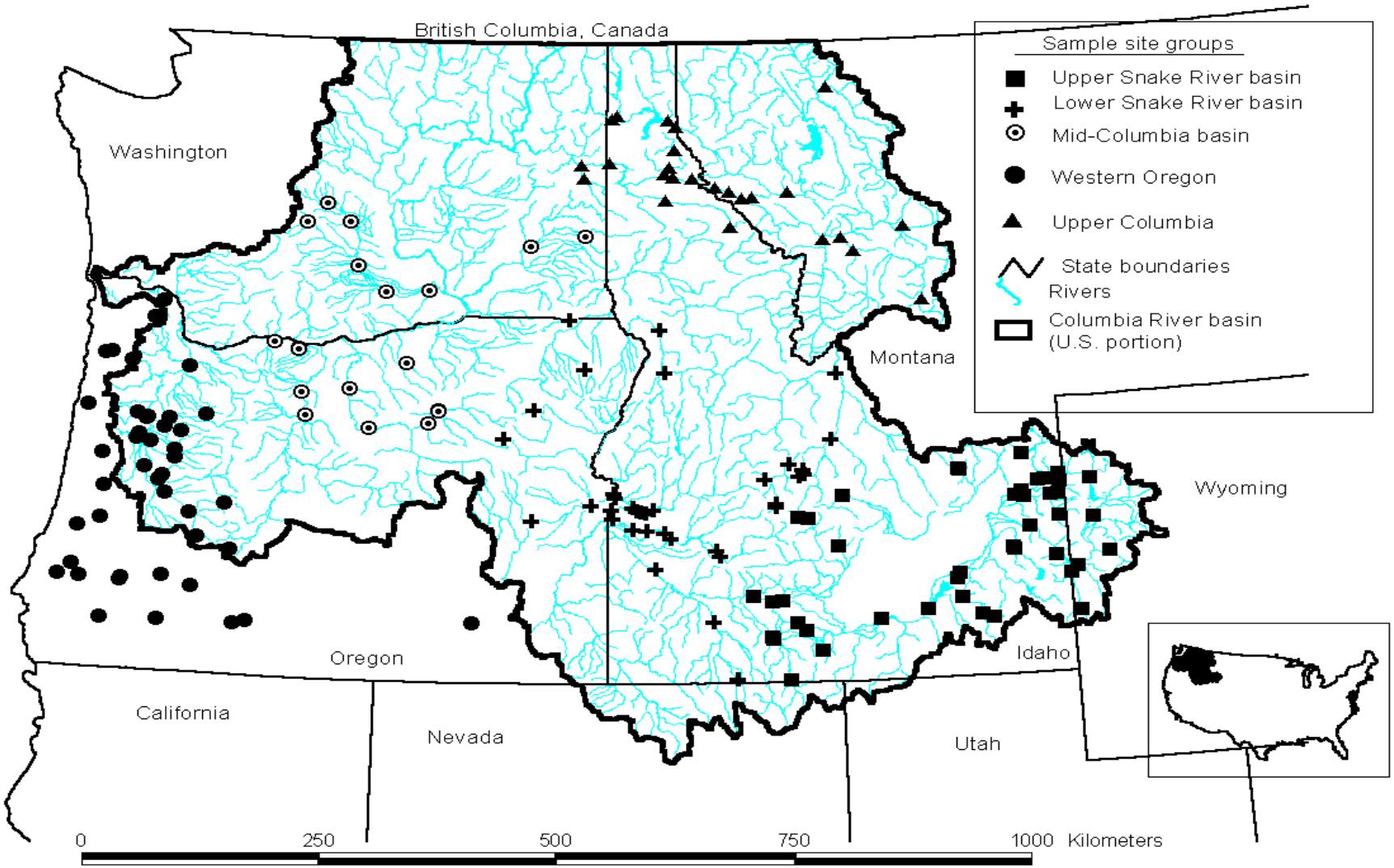


- ***Desert streams***



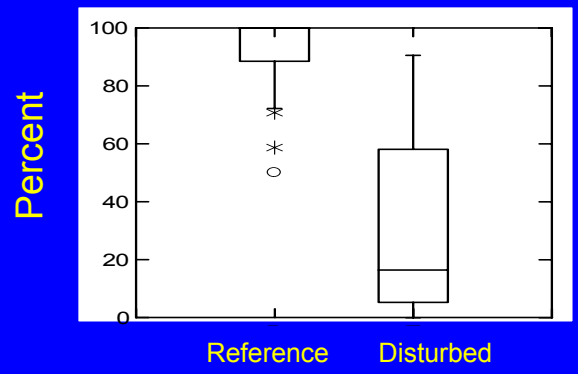
- ***Rivers***

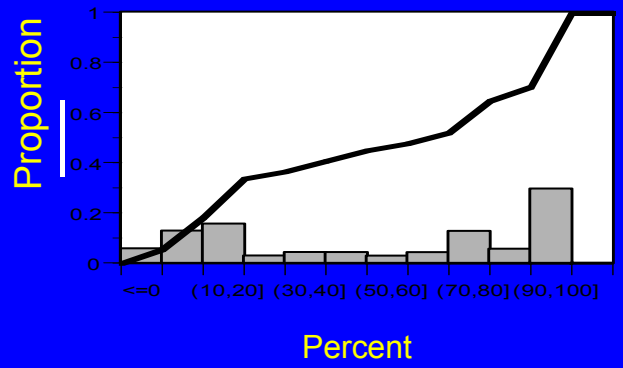
River IBI development: – compiled data

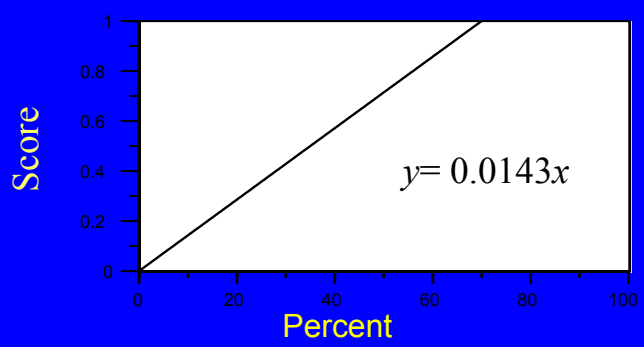


Tested potential indicators and constructed metrics

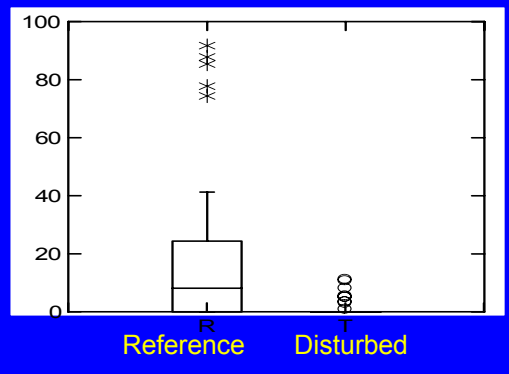
Percent coldwater individuals

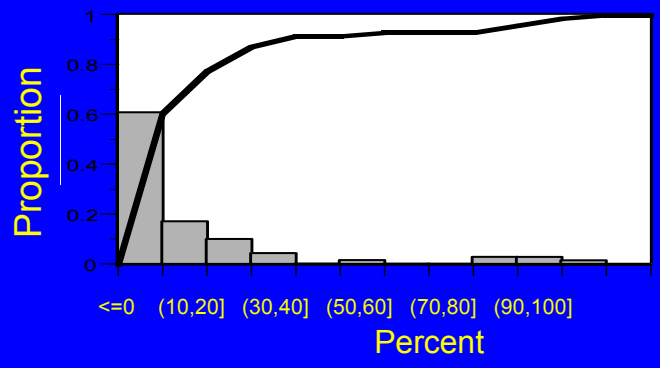


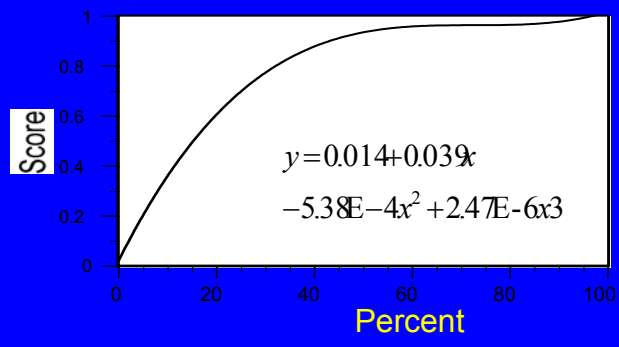


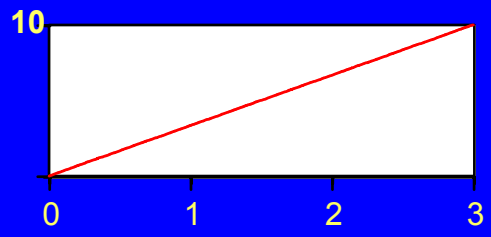


Percent sensitive native individuals

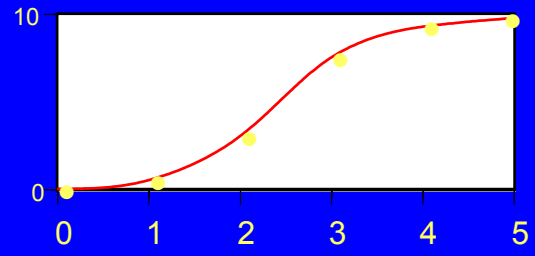




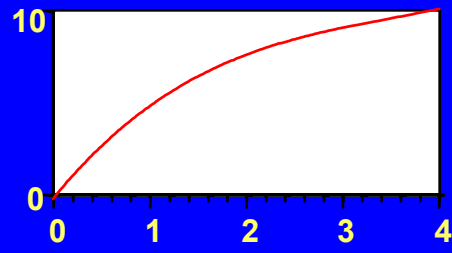




Coldwater native species

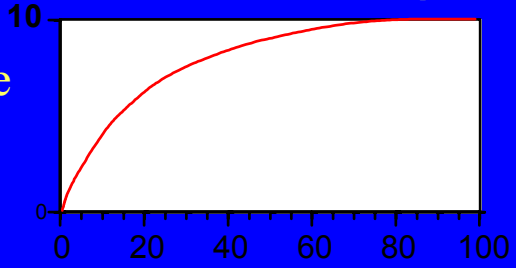


Sculpin Age Classes

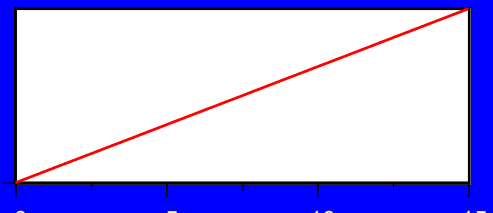


Cold/ min. E-fish

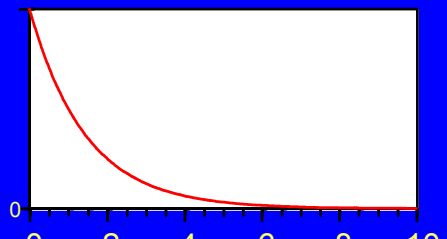
Score



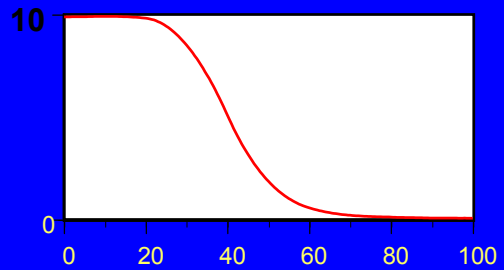
% Sensitive native individuals



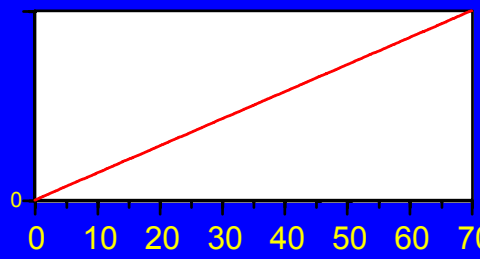
% Sculpin (alternate)



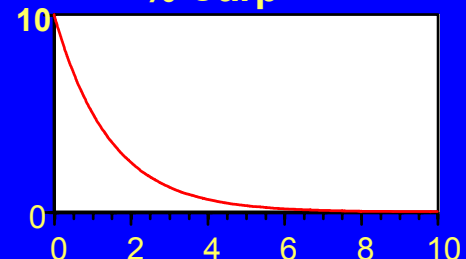
% Carp



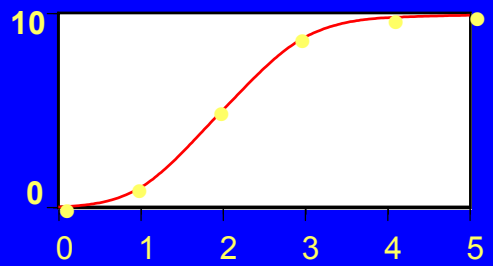
% Tolerant individuals



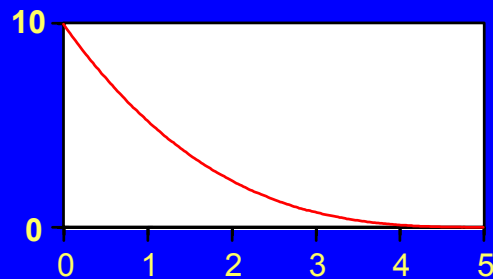
% Coldwater individuals



% DELT Anomalies



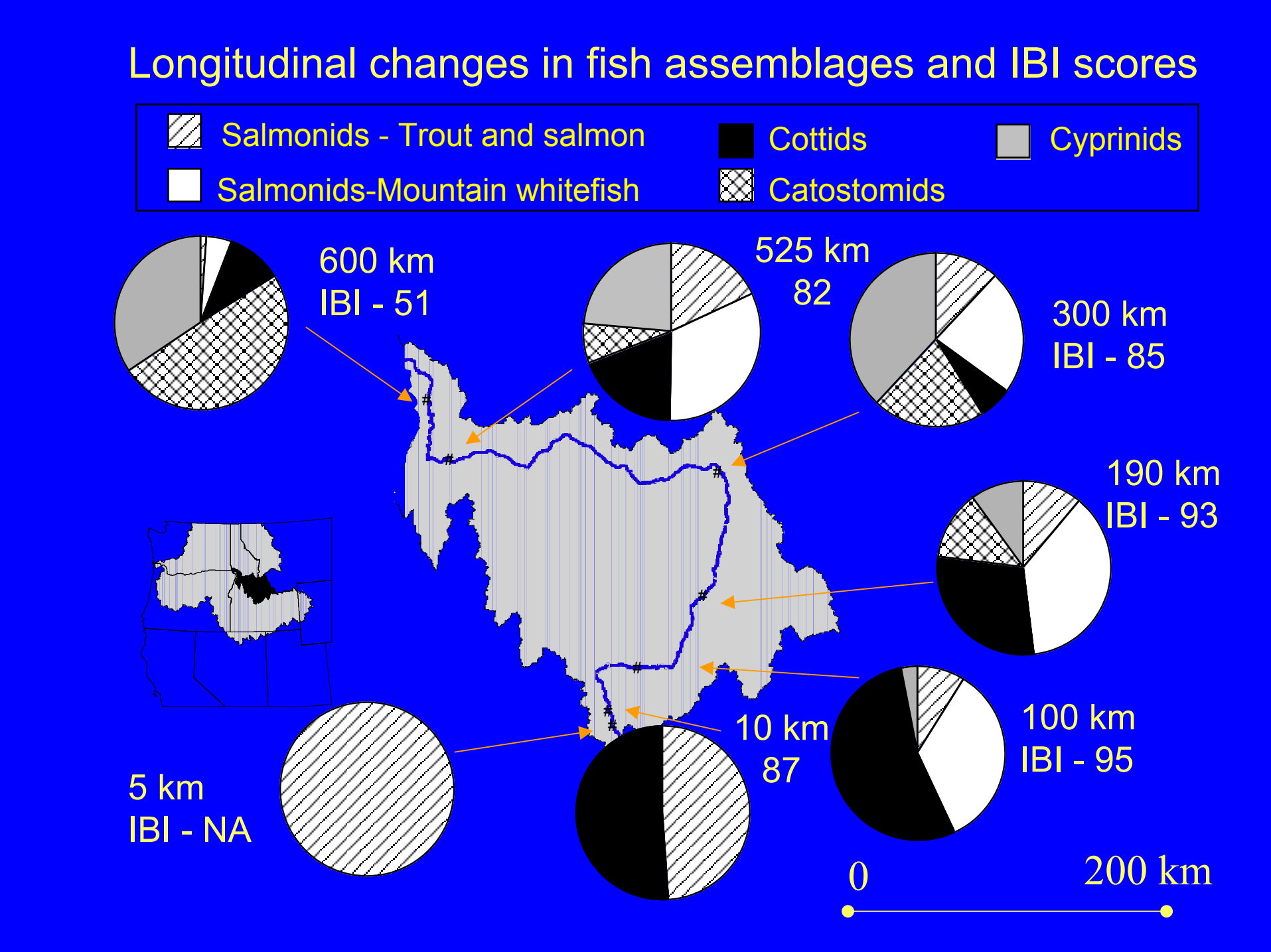
Salmonid age classes



Non-indigenous species

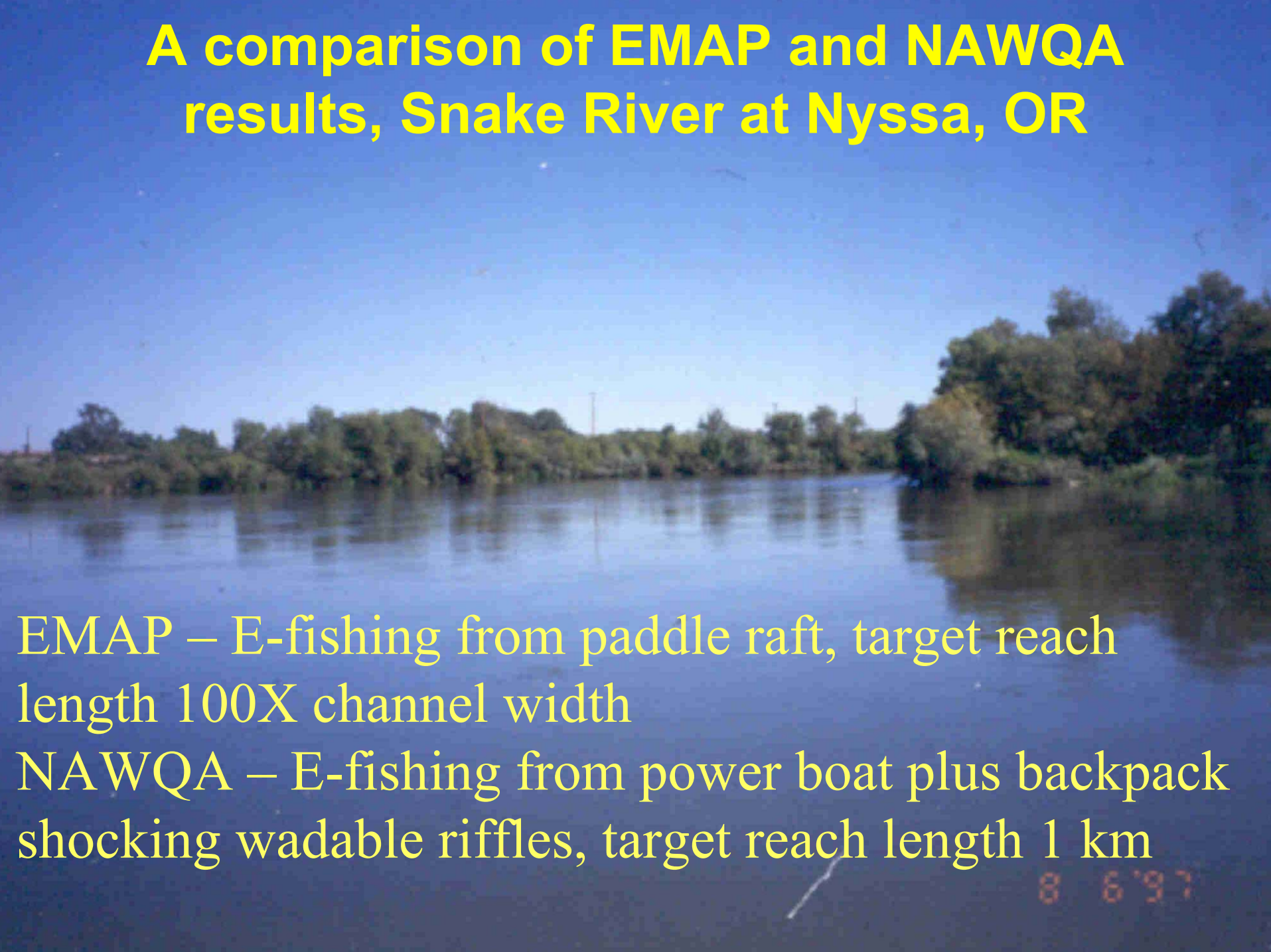
Metrics for the River IBI

Longitudinal changes in fish assemblages and IBI scores



Sampling considerations – what's a representative sample of the assemblage?

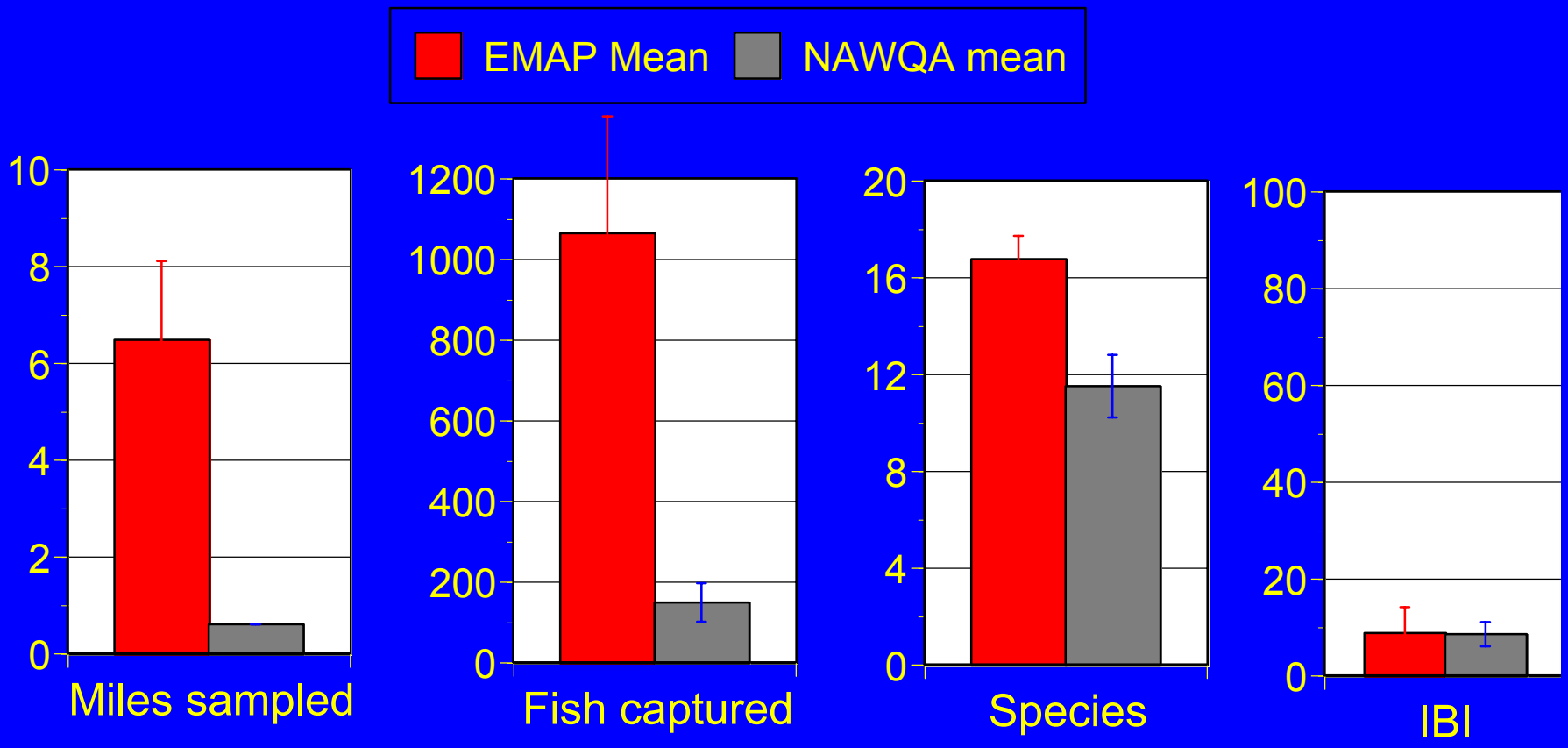
A comparison of EMAP and NAWQA results, Snake River at Nyssa, OR



EMAP – E-fishing from paddle raft, target reach length 100X channel width

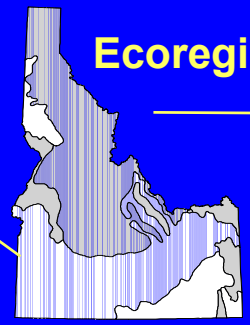
NAWQA – E-fishing from power boat plus backpack shocking wadable riffles, target reach length 1 km

EMAP and USGS results, Snake River at Nyssa, OR



n = 4

Stream IBI - Mountain and desert streams



Semi-arid Basin Ecoregions

SRB & WB | NBR | CB

Elevation

<1600m | <1750m | <1200m

Yes

Desert Index

- Percent Coldwater Individuals
- Percent cyprinids as longnose dace
- Percent Omnivores & Herbivores
- Percent DELT anomalies
- Jaccard genus similarity
- Relative abundance of coldwater fishes (CPUE, # coldwater individuals/minute electrofishing)
- *Plus secondary metric*
  Presence of native amphibians

No

Mountain Ecoregions

NR, MR, BM, WUM

Forest Index

In steep gradient streams (≥ 4% slope), does assemblage consist solely of salmonids?

Yes

Mountain Index (5 metrics)

- Number Coldwater Native species
- Percent sensitive native individuals
- Percent Coldwater Individuals
- Number of Salmonid Age Classes
- Relative abundance of coldwater fishes (CPUE, # coldwater individuals/minute electrofishing)
- *Plus secondary metrics*
  Presence of tailed frogs, or
  Presence of other native amphibians

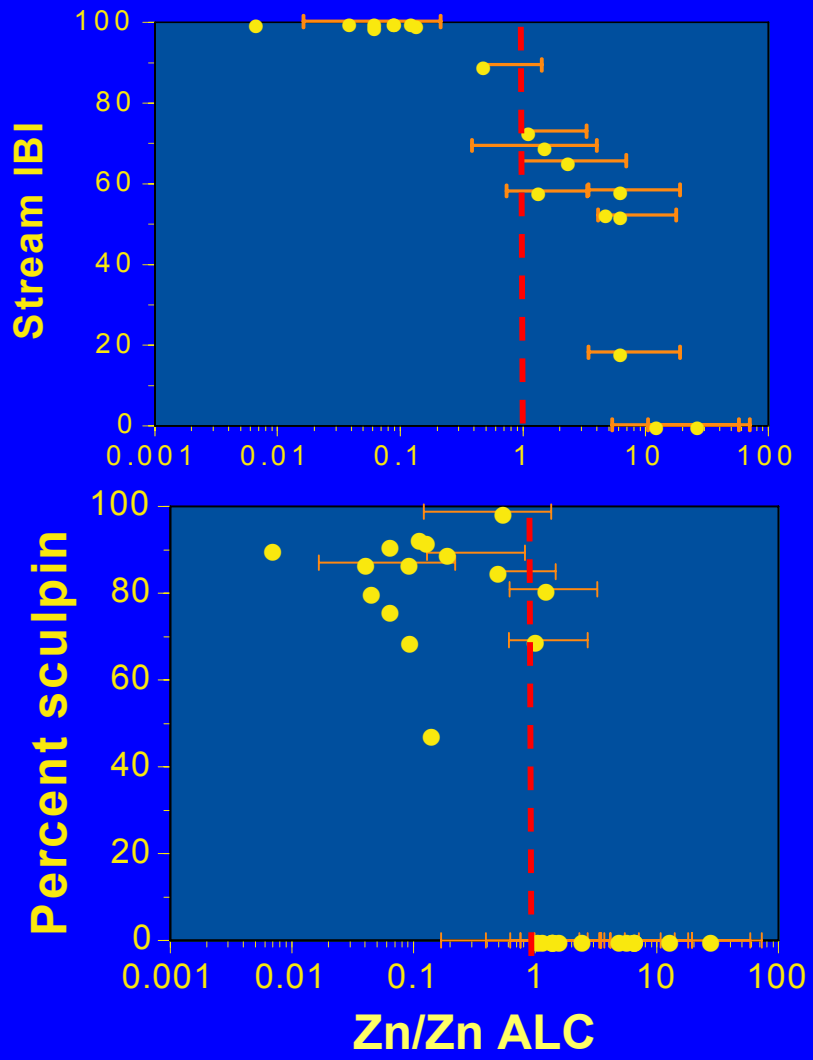
No

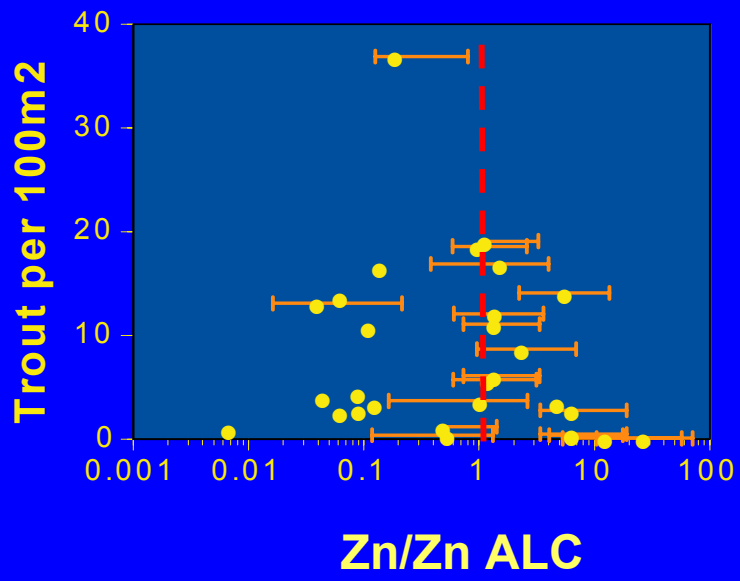
Mountain Index (6 metrics)

- Number Coldwater Native species
- Number of Sculpin Age Classes
- Percent sensitive native individuals
- Percent Coldwater Individuals
- Number of Salmonid Age Classes
- Relative abundance of coldwater fishes (CPUE, # coldwater individuals/minute electrofishing)

Plus secondary metrics
Presence of tailed frogs, or
Presence of other native amphibians

Stream IBI, trout density, and sculpin presence compared with zinc aquatic life criteria exceedence factors





- IBI provided a graded response to criteria exceedences, trout had little response, whereas the sculpin were abruptly extirpated

Stream IBI - Temporal Variability

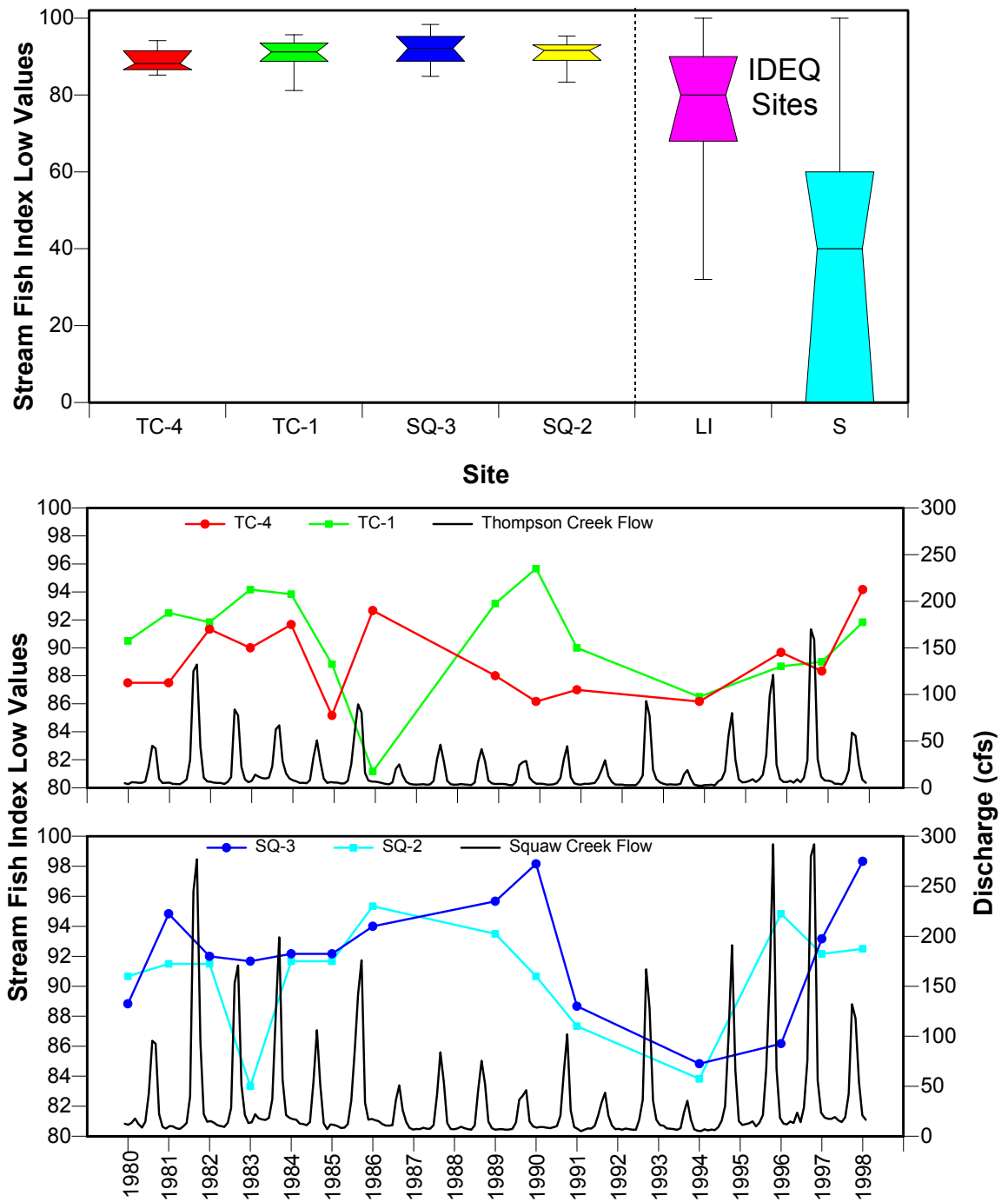


Figure provided courtesy of Steve Canton, Chadwick Ecological Services, Littleton, CO

Conclusions

- Fish assemblages can be useful indicators of biological condition in depauperate NW streams and rivers
- IBI approach provides a functional model
- Several apparently confounding problems may be resolved through careful stratification, and metric construction and testing

- The IBI and the mountain-stream IBI appear useful over broad areas.
- Speculate that these or similar indexes could be more broadly applicable than tested so far.
  - Wherever a trout-sculpin-sucker-minnow natural assemblage occurs.

What is the study question? Is it:

- Broadscale indication of how similar or different streams and rivers are from a regional, best attainable, reference condition?
  - ***IBIs appropriate***
- Setting measurable biological benchmarks or to evaluate maintenance or restoration of biological integrity? ***IBIs appropriate***

- Impact assessment – BACI monitoring for biological effects from waste outfalls, remedial or BMP effectiveness (e.g. monitoring for effects following timber harvest, ecological risk assessment, EIS, NRDA, NPDES monitoring, …)
  - More specific test questions and measurements endpoints probably needed, but IBIs probably complementary

Familiarity with study area and data inspection necessary!

- We need to take care in dumbing-down bioassessment (I.e. over-standardizing and over-simplifying).
- Over-reliance on IBI scores could have missed the Mystery of the Missing Sculpin
  - There is a role for judgment

Ascertain Biological Condition

Done