Evaluating recovery of stream ecosystems from mining pollution: integrating biochemical, population, community and ecosystem-level indicators

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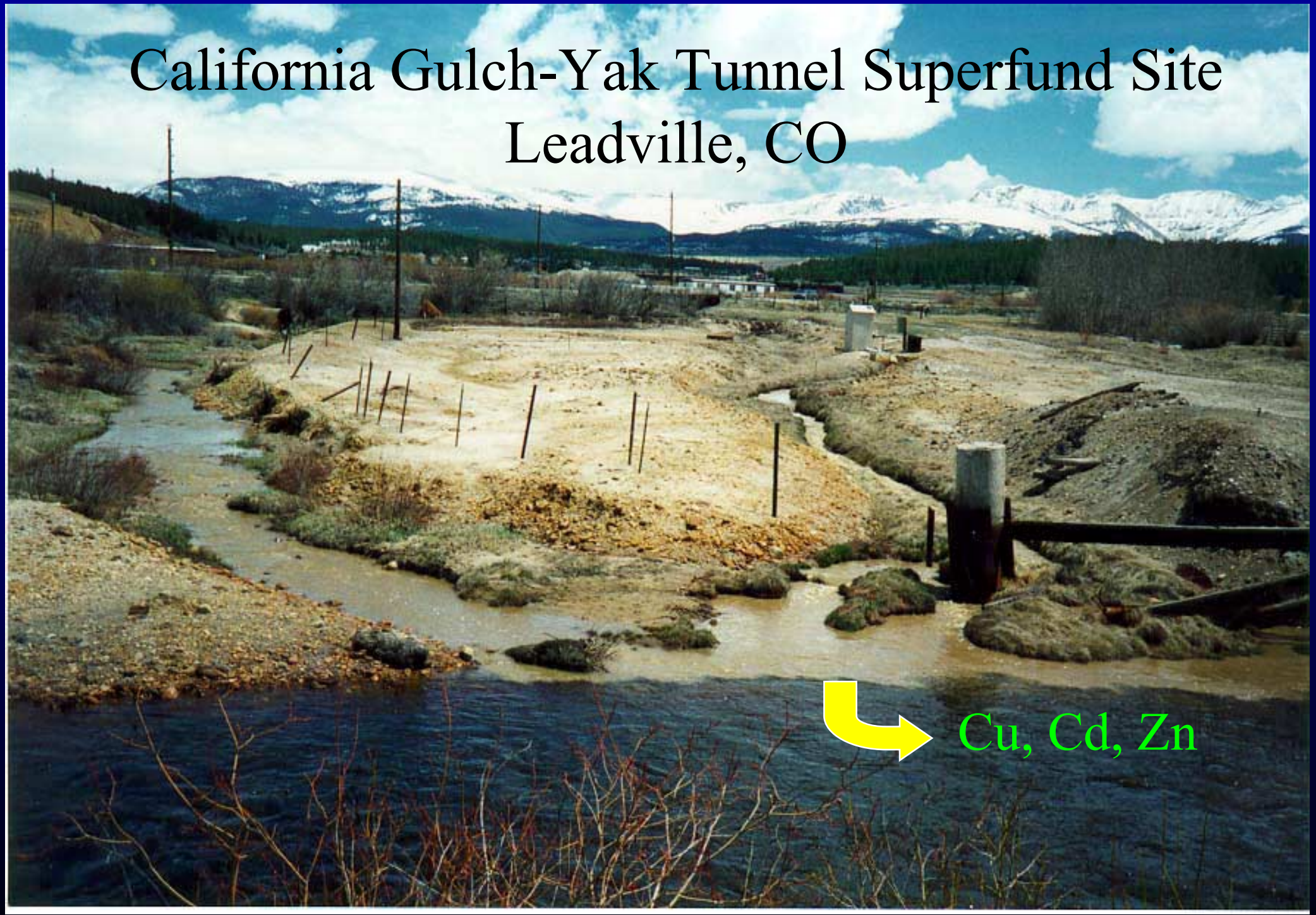
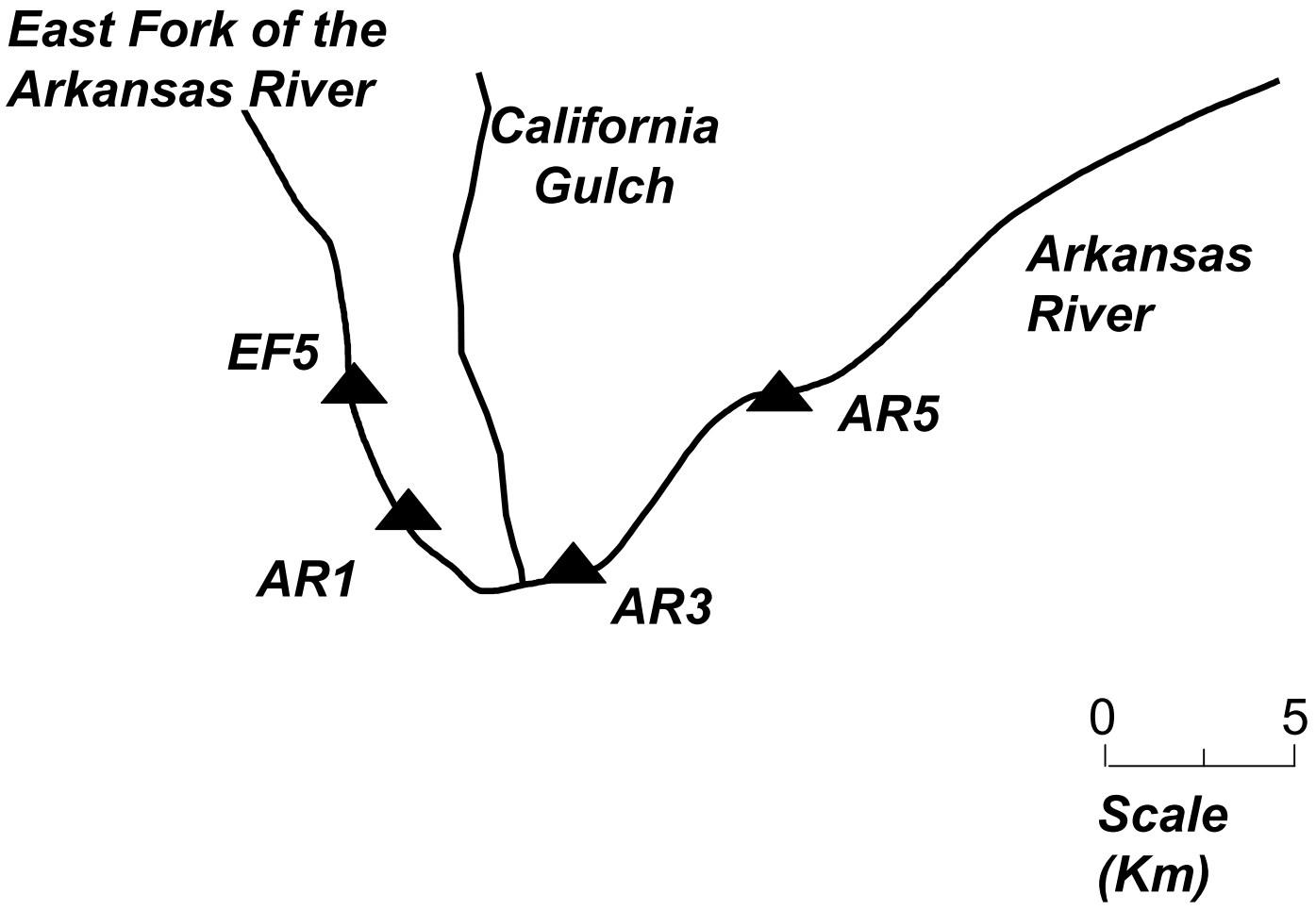
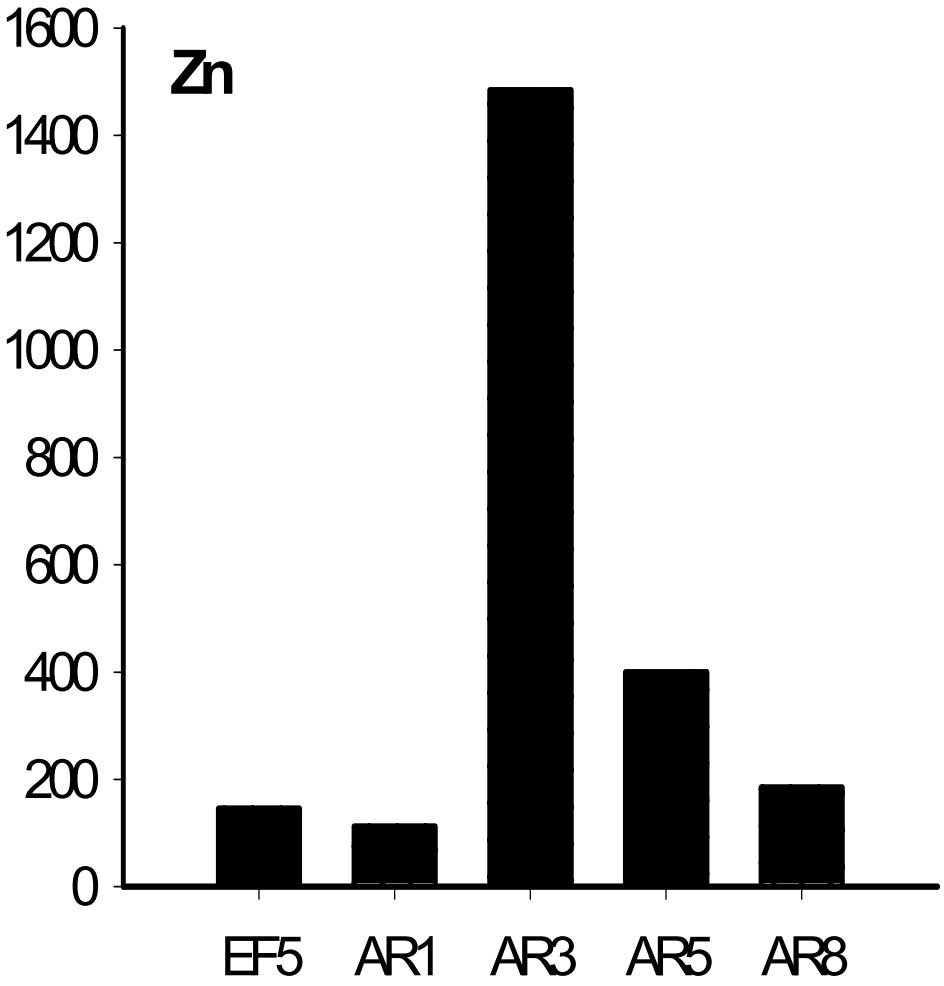
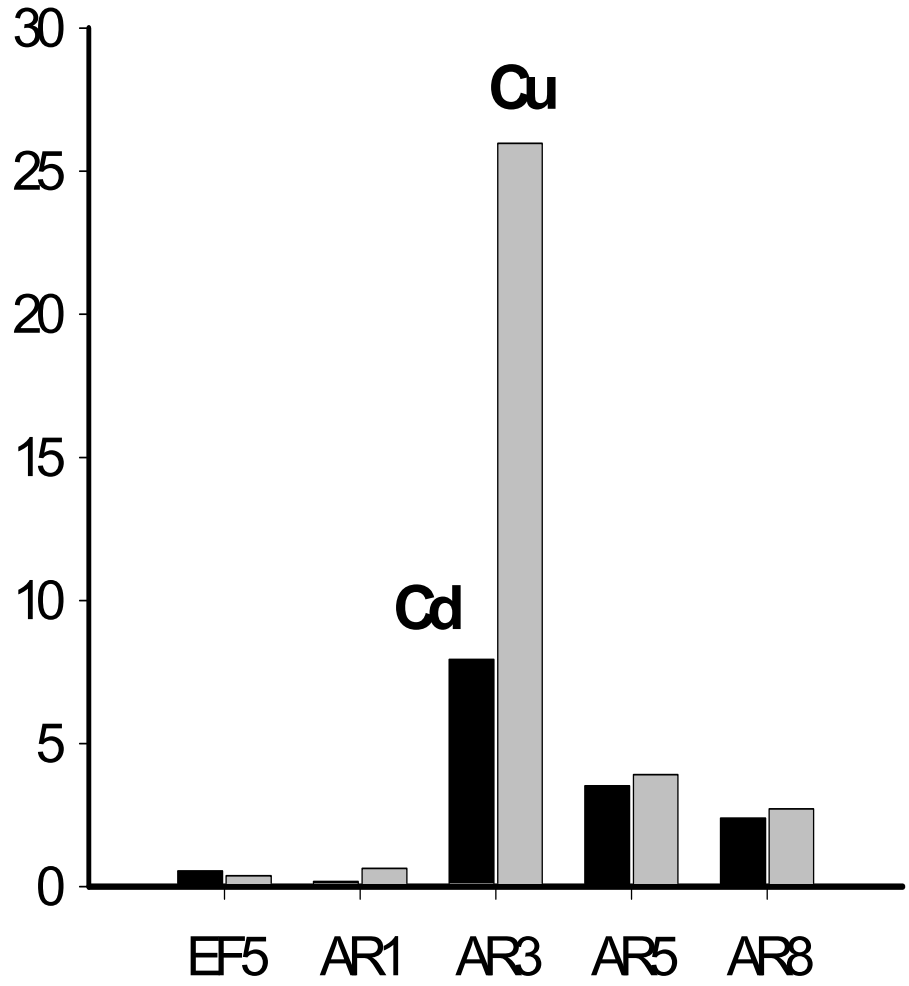

California Gulch-Yak Tunnel Superfund Site
Leadville, CO
Cu, Cd, Zn

Map of Sampling Stations
Upper Arkansas River Basin



Concentrations of metals in water (ug/L)





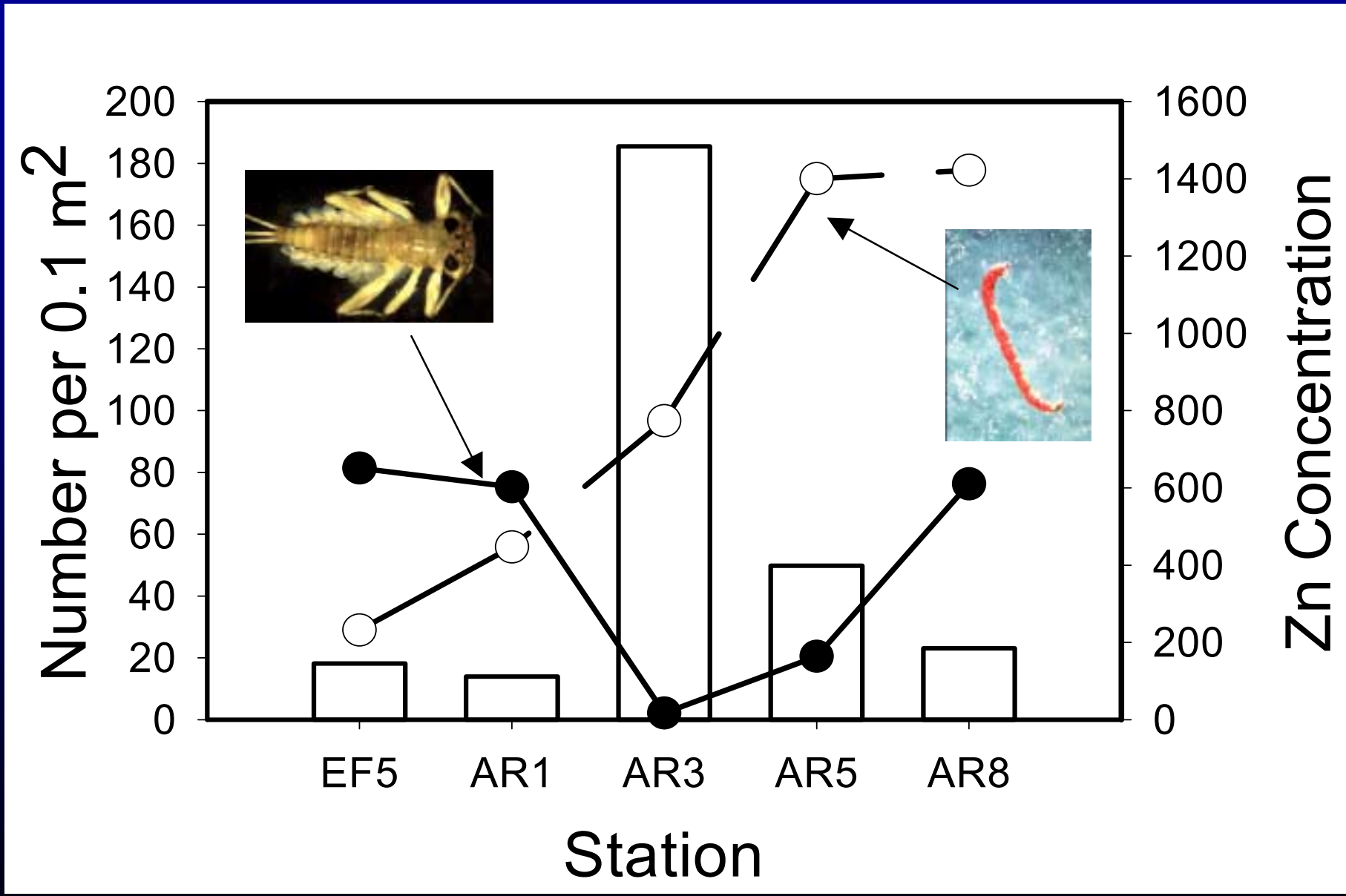
Critical Questions

- What level of cleanup is necessary to restore and protect aquatic communities?

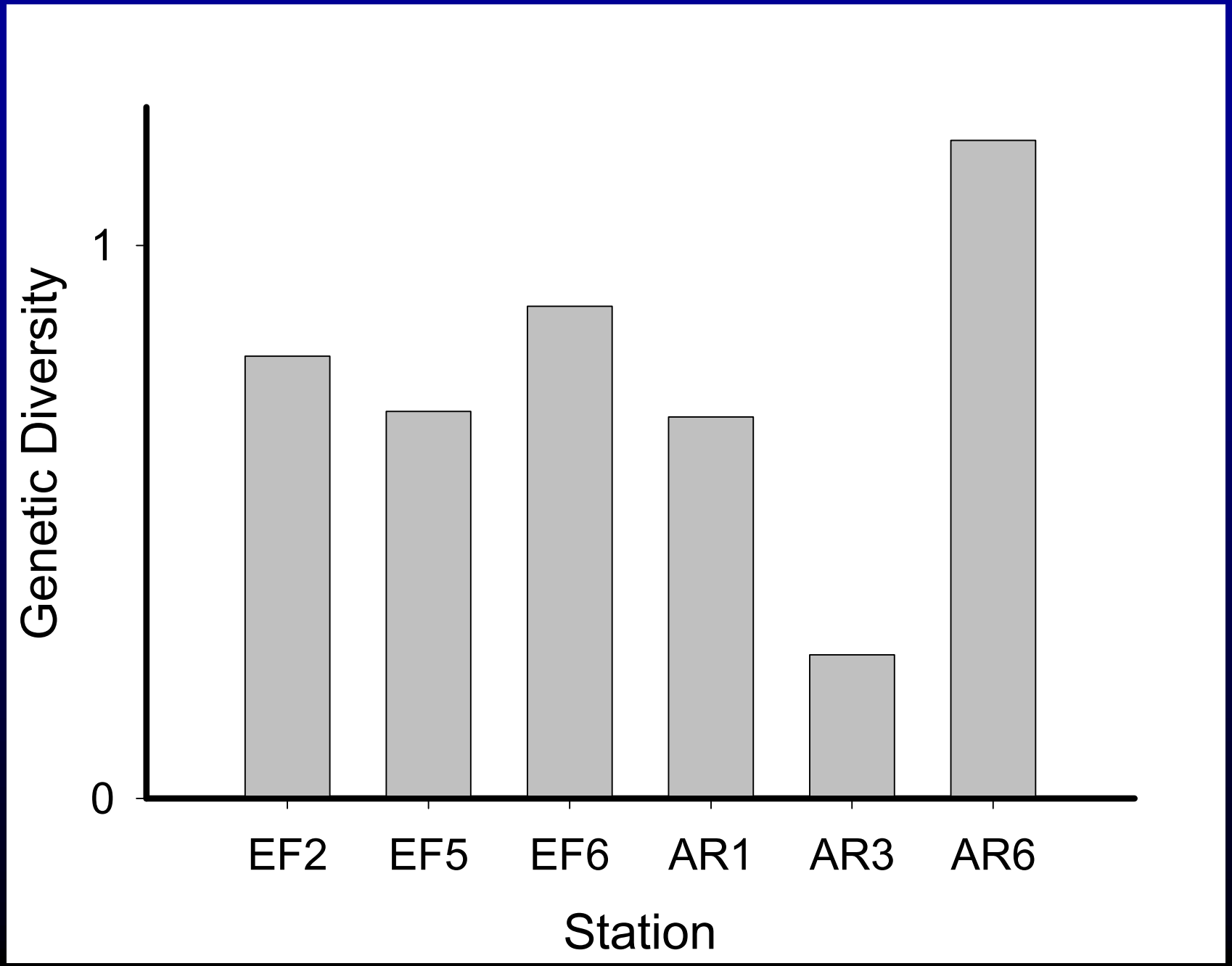
- What are the relevant indicators of recovery across levels of biological organization?
  - Biochemical → Populations → Communities → Ecosystems

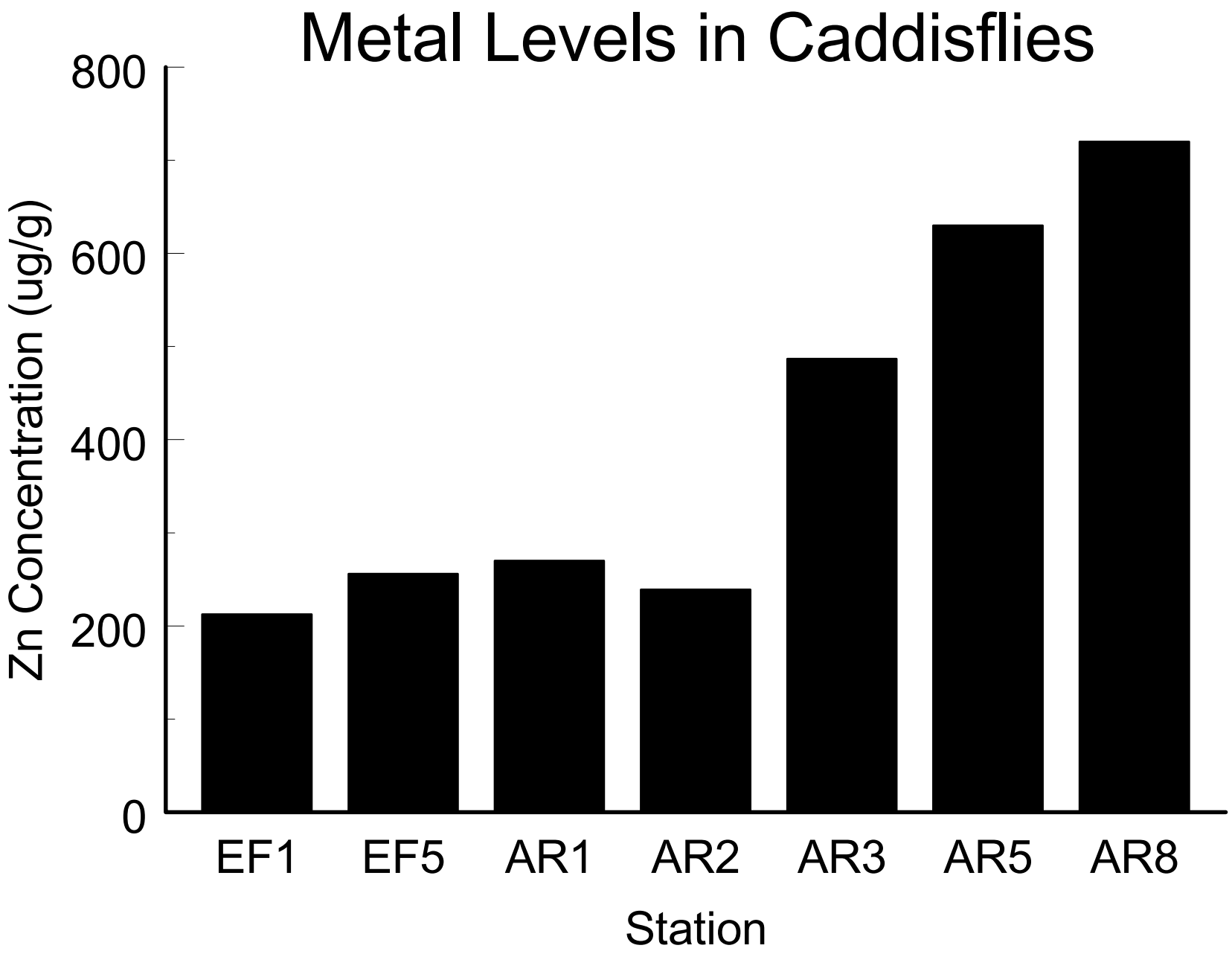
Examples of Benthic Macroinvertebrates

Responses of sensitive and tolerant taxa

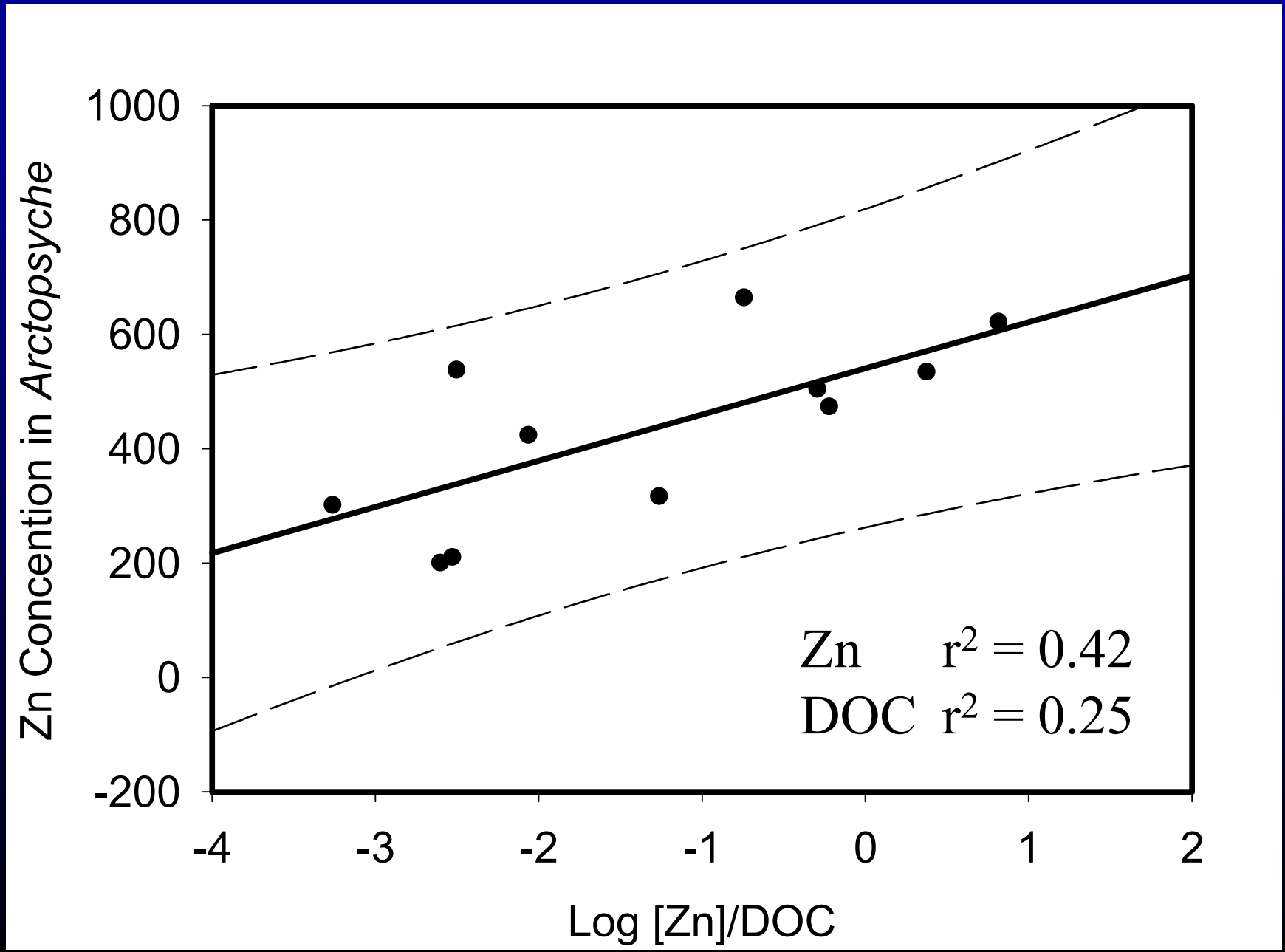


Genetic Diversity of Mayflies

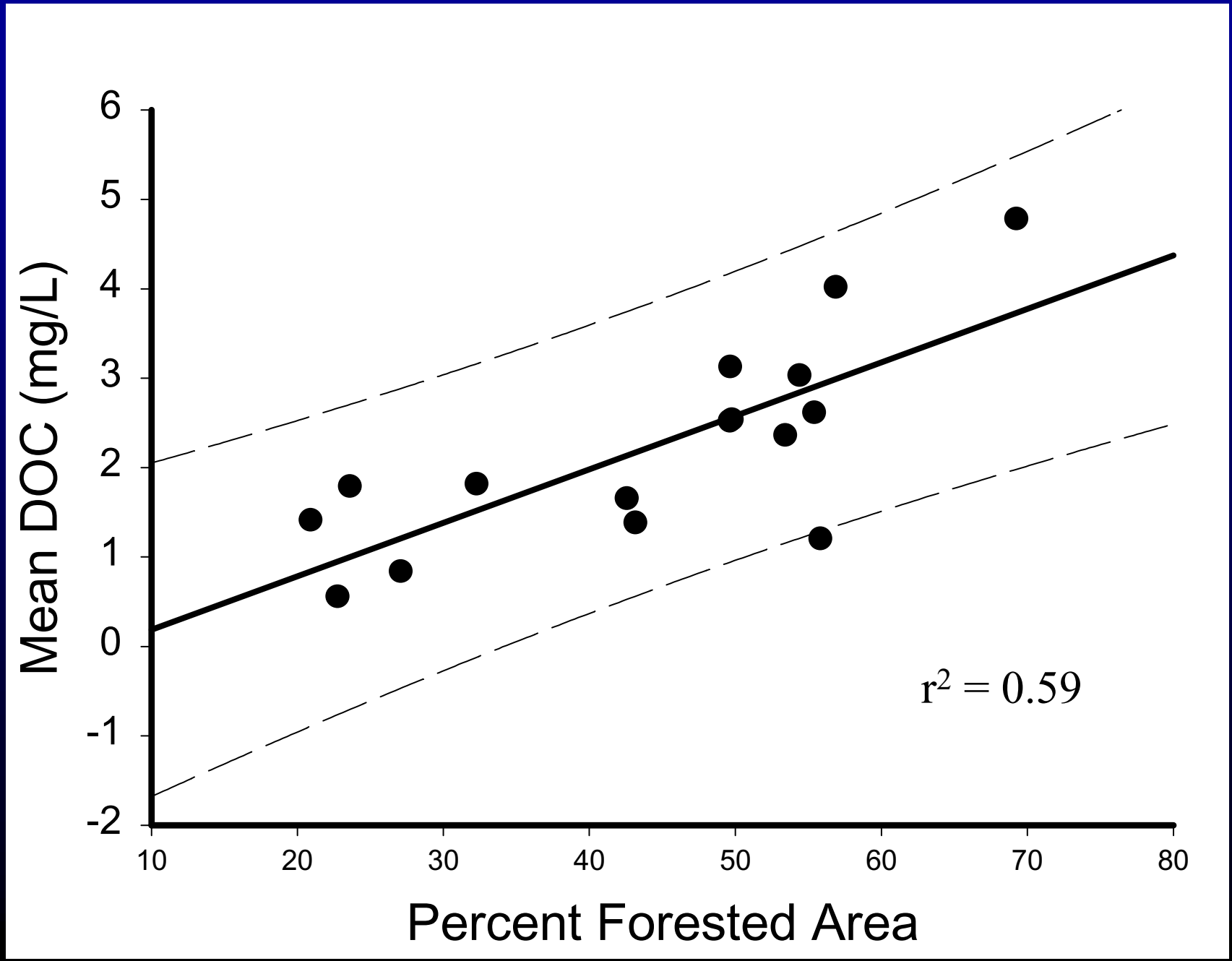



Metal Levels in Caddisflies
800
600
400
200
0
Zn Concentration (ug/g)
EF1
EF5
AR1
AR2
AR3
AR5
AR8
Station

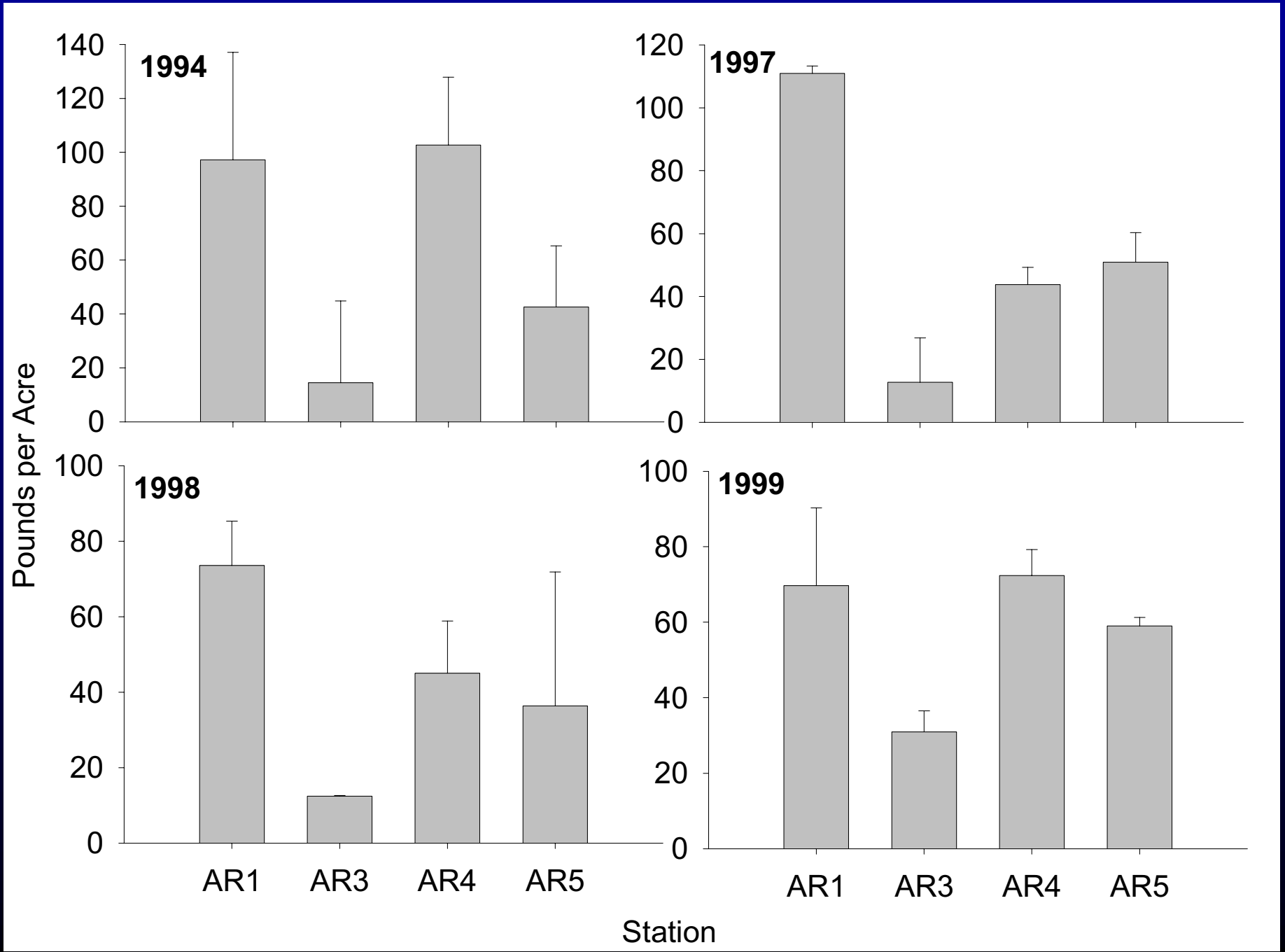
Metal Concentrations in Caddisflies: Influence of DOC



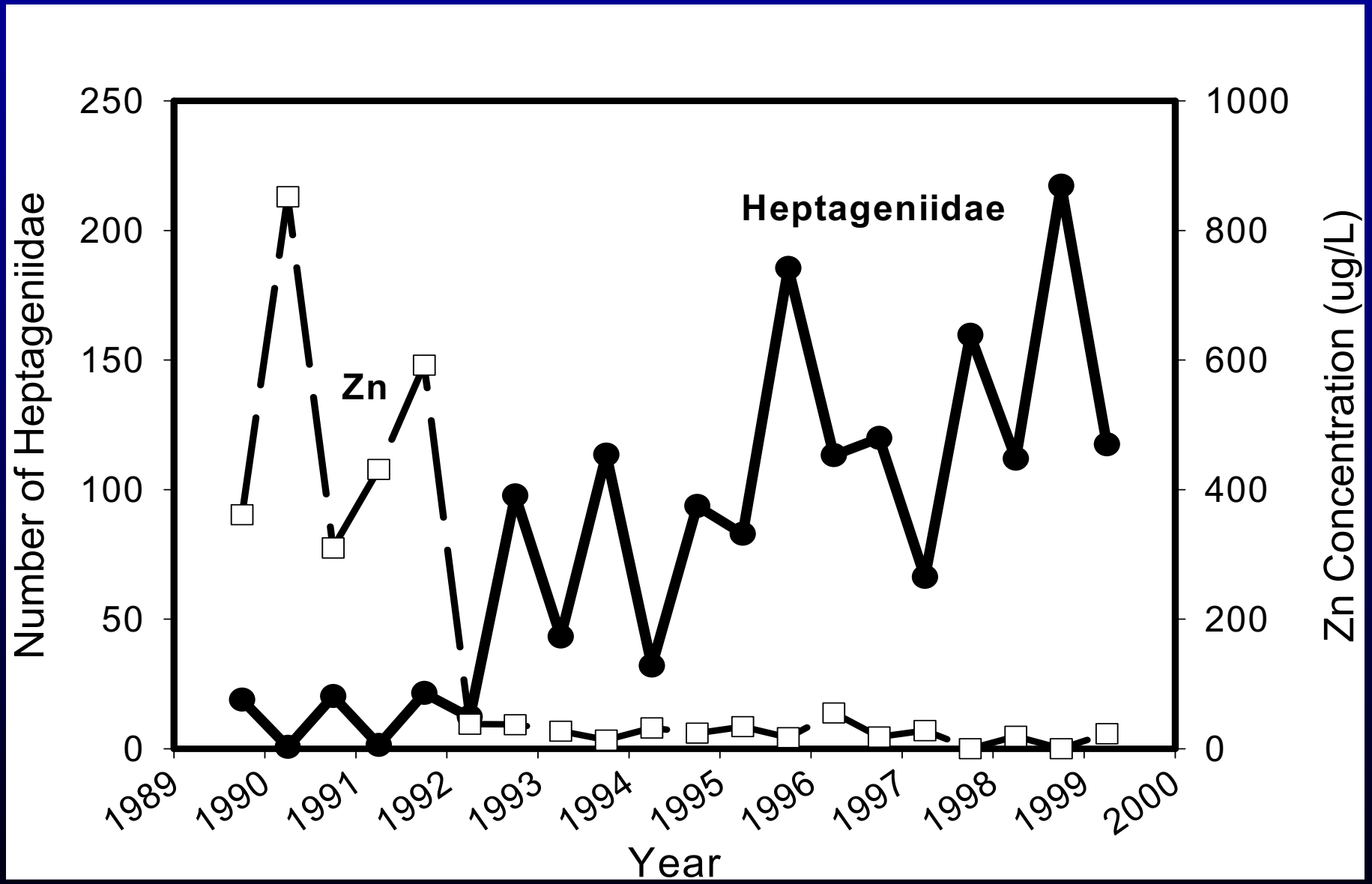
Influence of Landscape Features on DOC



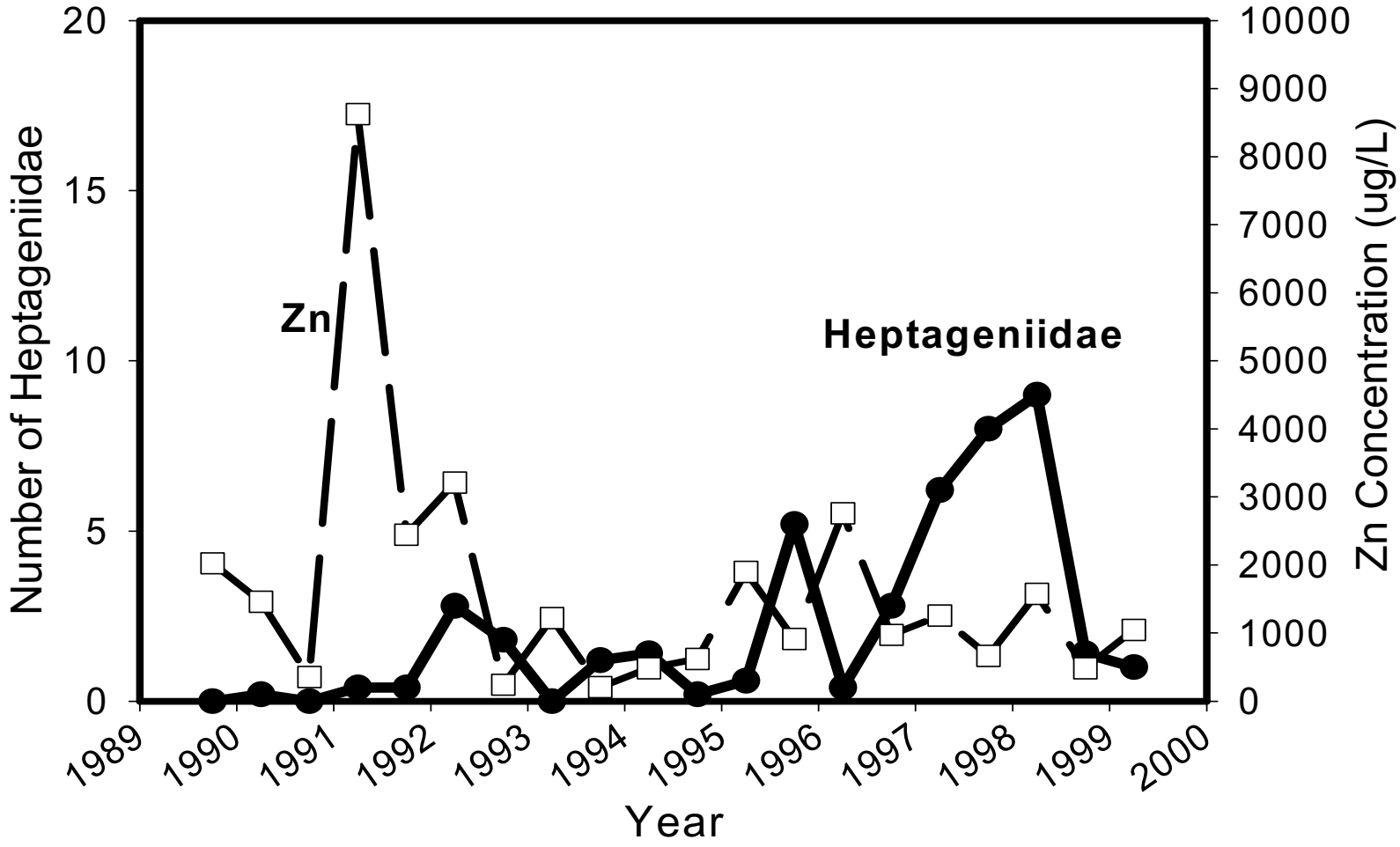
Biomass of Brown Trout

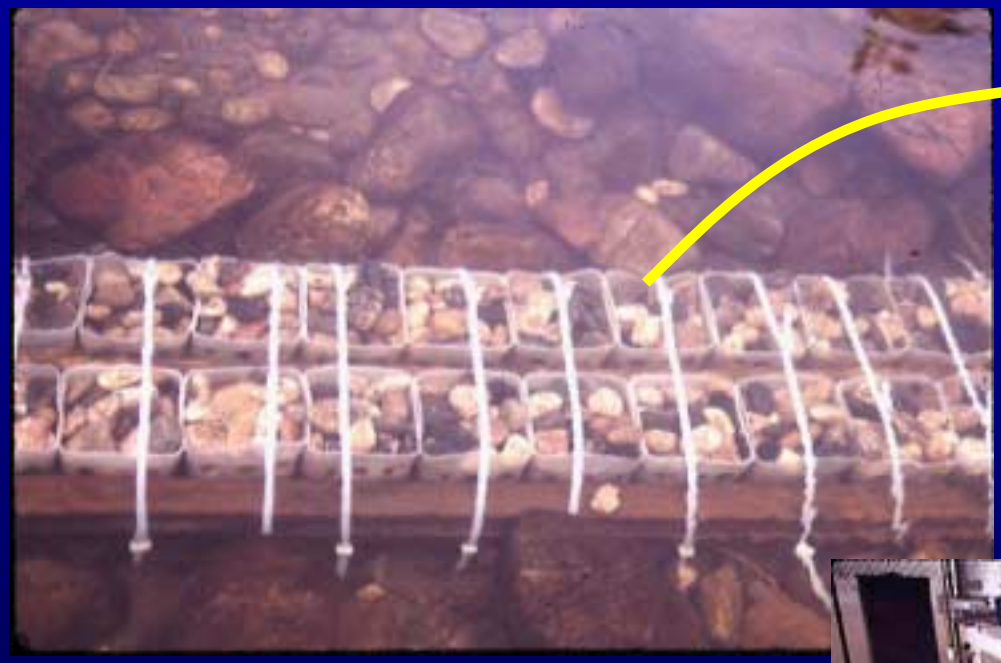


Recovery following remediation of LMDT (Station EF5)



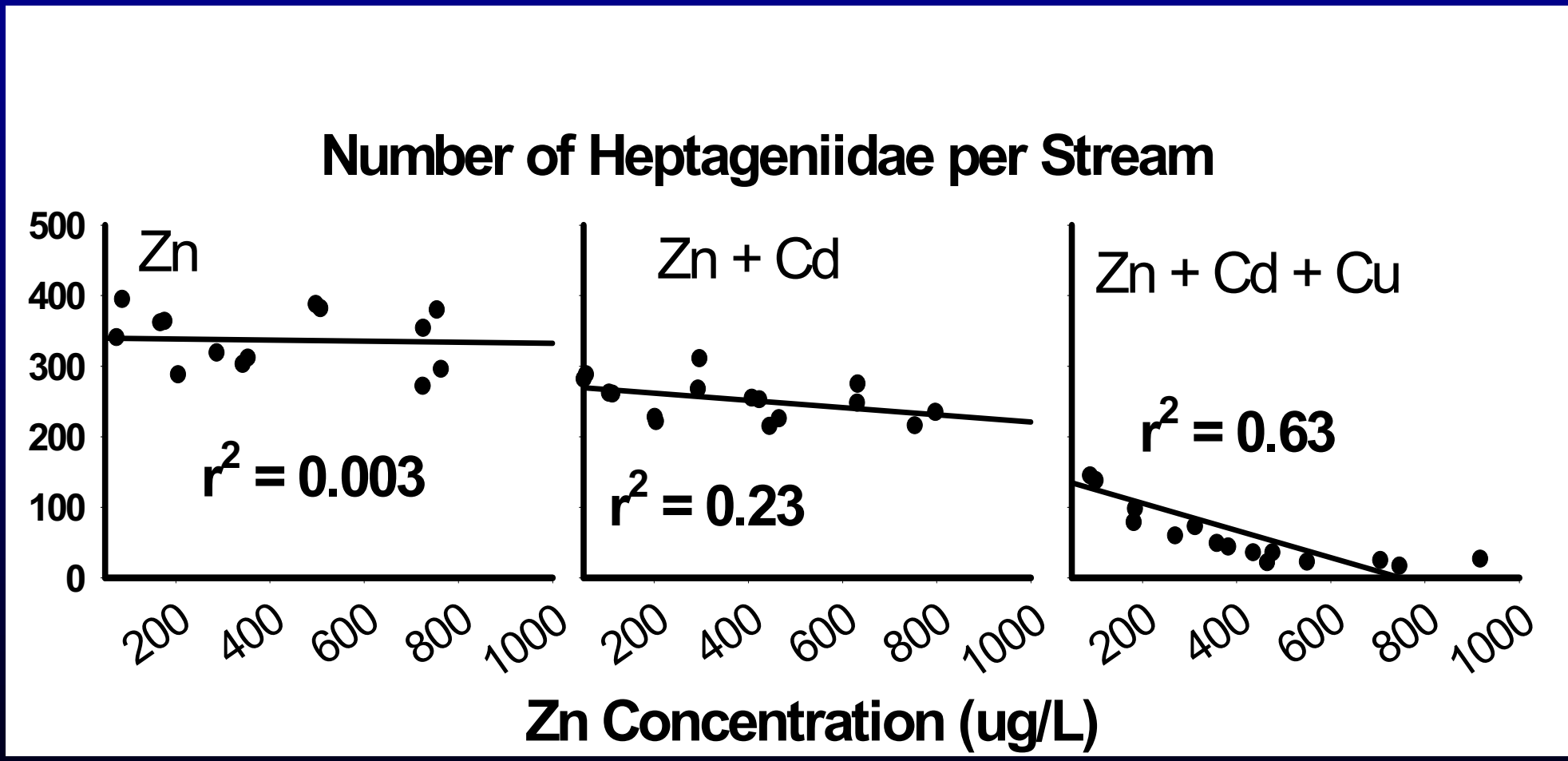
Little Evidence of Recovery below California Gulch (Station AR3)





Trays colonized for 40 d
Transferred to microcosms
Exposed to metals for 10 d

Community-level responses to metal mixtures in stream microcosms



Goals of the Current HSRC Research

- Examine recovery (or lack thereof) of aquatic communities in the Arkansas River
- Determine what biological indicators are most appropriate for assessing recovery
- Determine what level of cleanup is necessary to restore and protect aquatic communities in metal-polluted streams