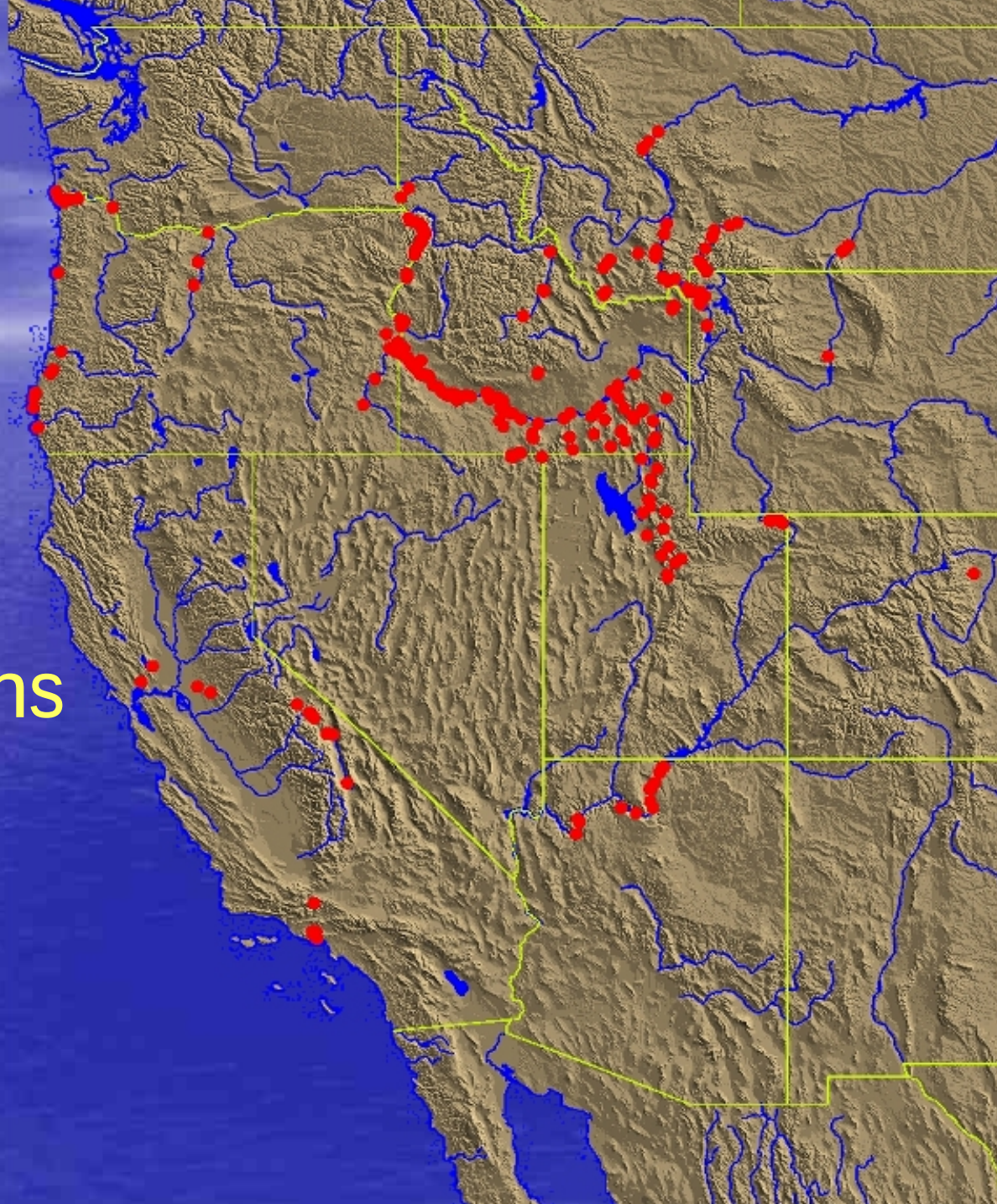
Effects of NZMS on Bioassessment Metrics (plus a bonus round)

Richards, D. C., C. Smith, and B. Marshall

EcoAnalysts, Inc.
Center for Aquatic Studies
Bozeman, MT


It came from across the sea

Reported locations of NZMS as of October 2006



coAnalysts, Inc.

The Problem

EcoAnalysts, Inc.

Snake River, Idaho

NZMS impacts (i.e. biological pollution) are:

- Competition with and displacement of native macroinvertebrates
- Poor food source for trout and other fishes
- Drastic alteration of ecosystem functioning
- As much impact on water quality as single point or non-point sources

EcoAnalysts, Inc.

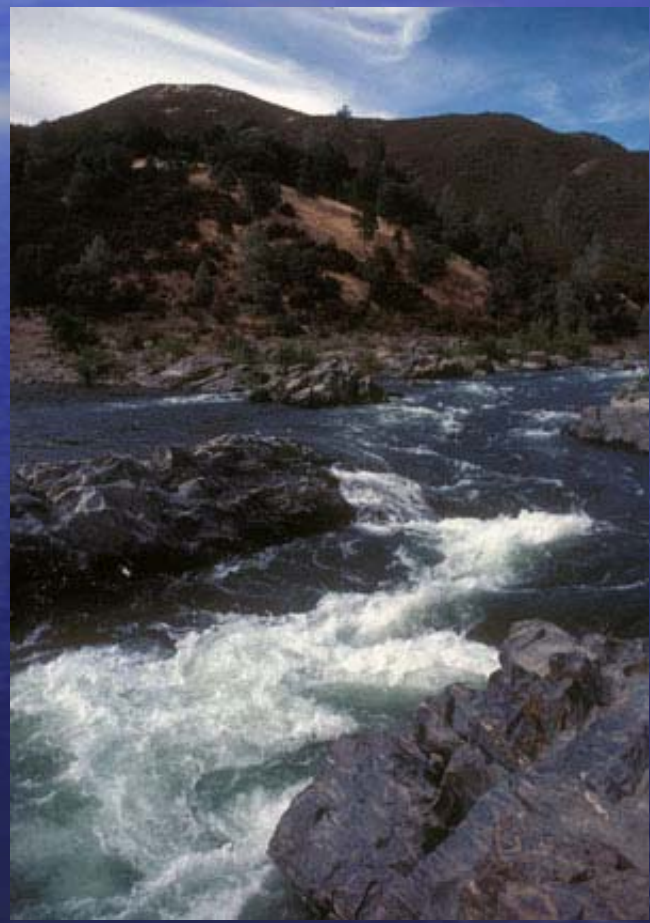
Goal and Hypothesis

- Goal: Examine effects of increasing abundances of NZMS on bioassessment metrics from two different types of rivers in CA

- Hypothesis: Increased abundance of NZMS in bioassessment samples would negatively affect metrics and assessment

EcoAnalysts, Inc.

S. F. American River, CA



Cold water, heterogeneous, high invertebrate diversity and evenness

EcoAnalysts, Inc.

Russian River, CA

Warmer water, homogeneous, less invertebrate diversity and dominated by a midge

Methods

- Used two slightly different methods for S. F. American River and Russian River macroinvertebrate samples

EcoAnalysts, Inc.

S. F. American River, CA

- Rounded to nearest integer the mean abundance of taxa from 27 sub-samples of 300 organisms
- Added 10% (30), 20% (60), 30% (90), and 50% (150) NZMS to above hypothetical sample
- Randomly sampled 300 organisms from the above 4 NZMS scenarios, 10 X each
- Calculated mean and 95% CIs on some commonly used metrics

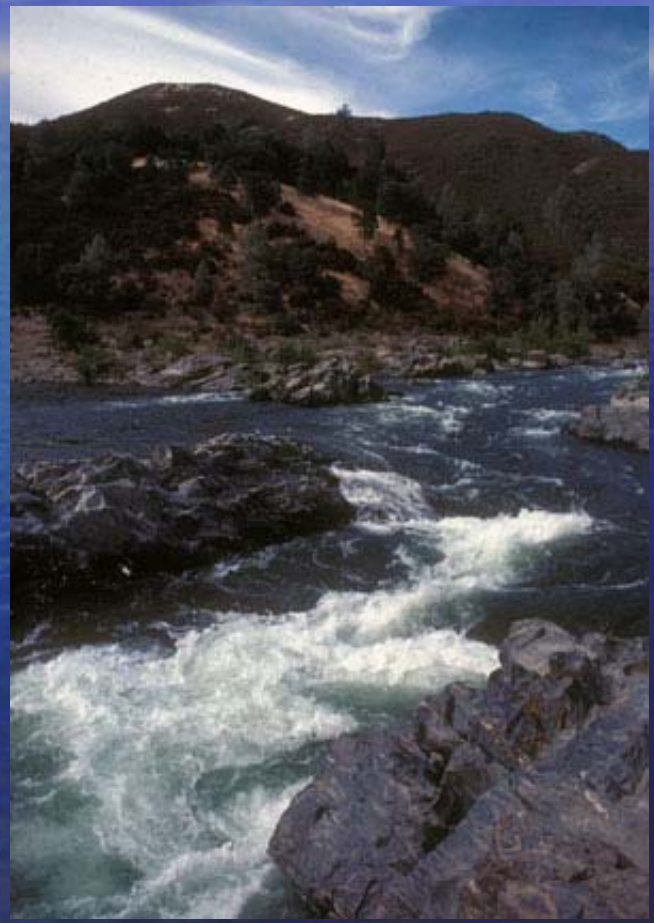
EcoAnalysts, Inc.

Russian River, CA

- Randomly selected one 300-organism sample from our database
- Added 10% (30), 20% (60), and 30% (90) NZMS to above sample
- Randomly sampled 300 organisms from the above 3 NZMS scenarios, 10 X each
- Calculated mean and 95% CI values for some commonly used metrics

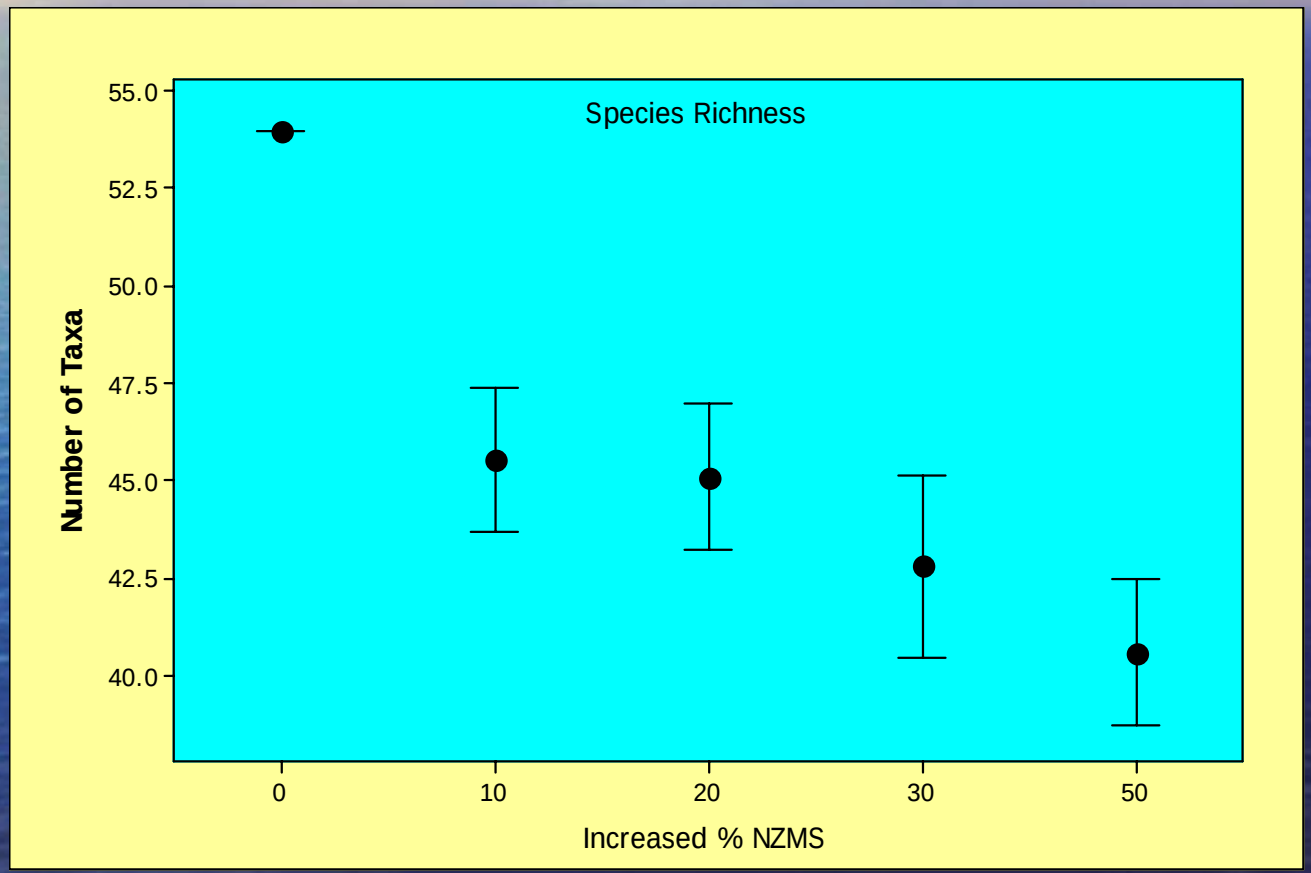
EcoAnalysts, Inc.

S. F. American River Results



EcoAnalysts, Inc.

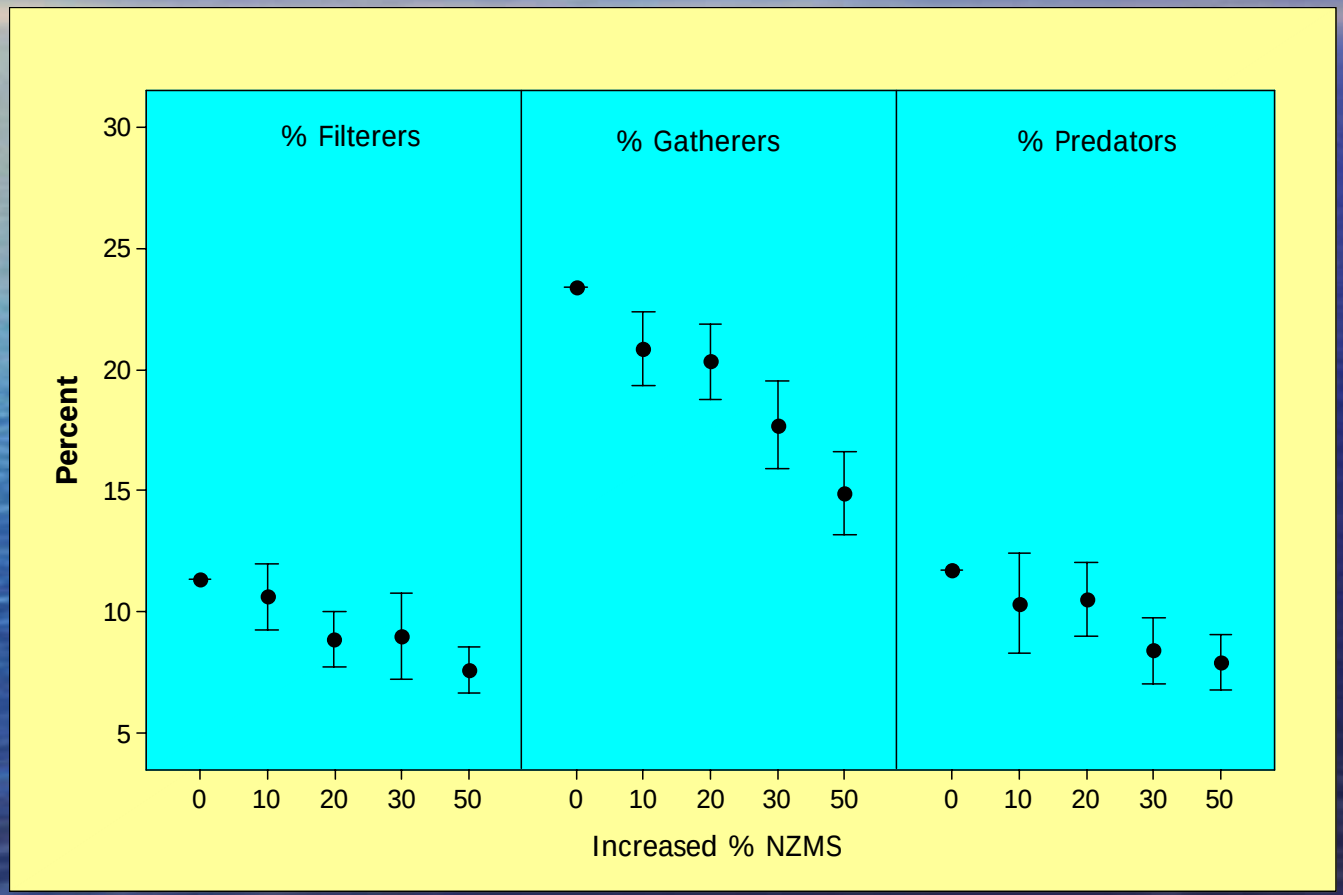
Richness Measure



EcoAnalysts, Inc.

S. F. American River

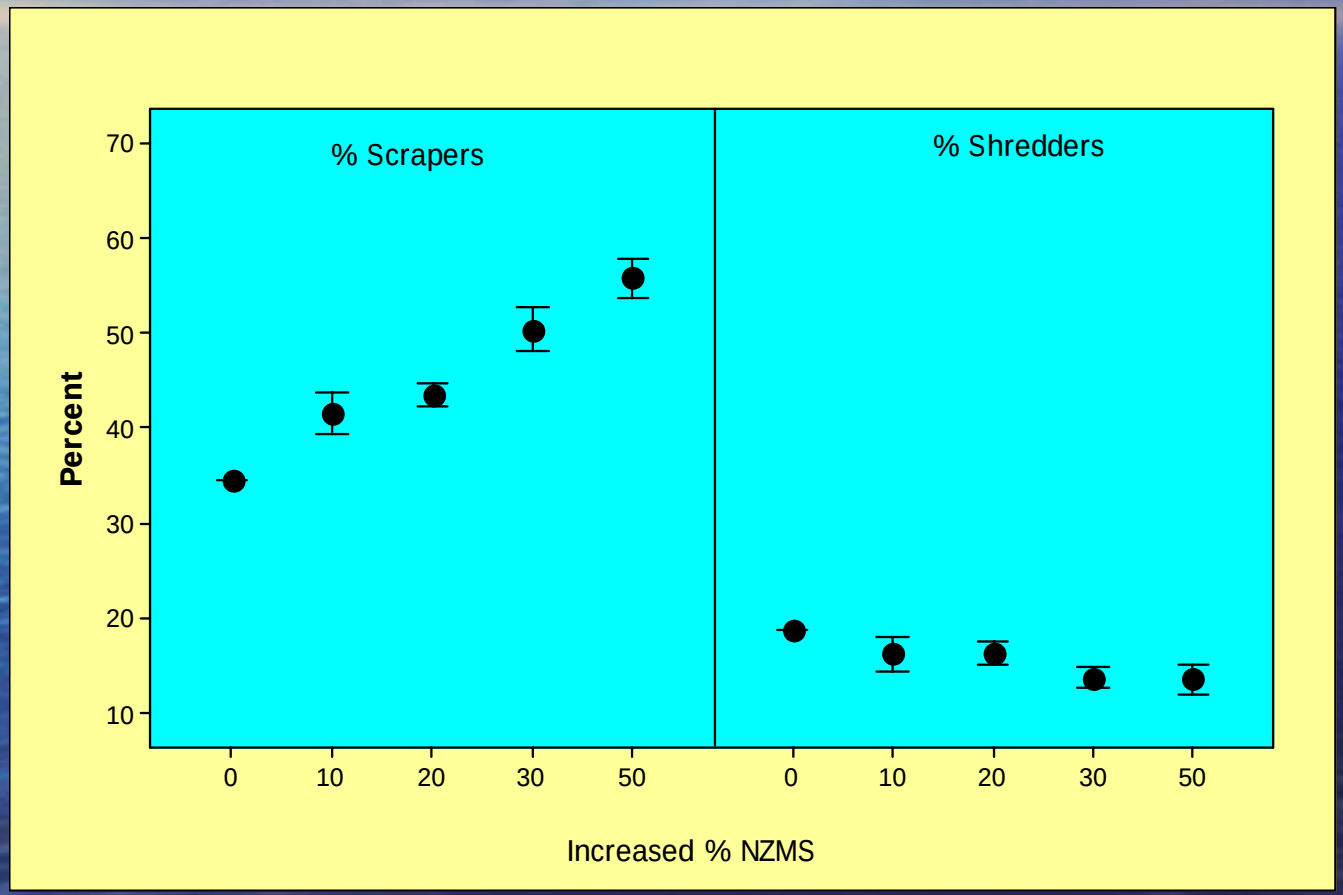
Functional Feeding Groups



EcoAnalysts, Inc.

S. F. American River

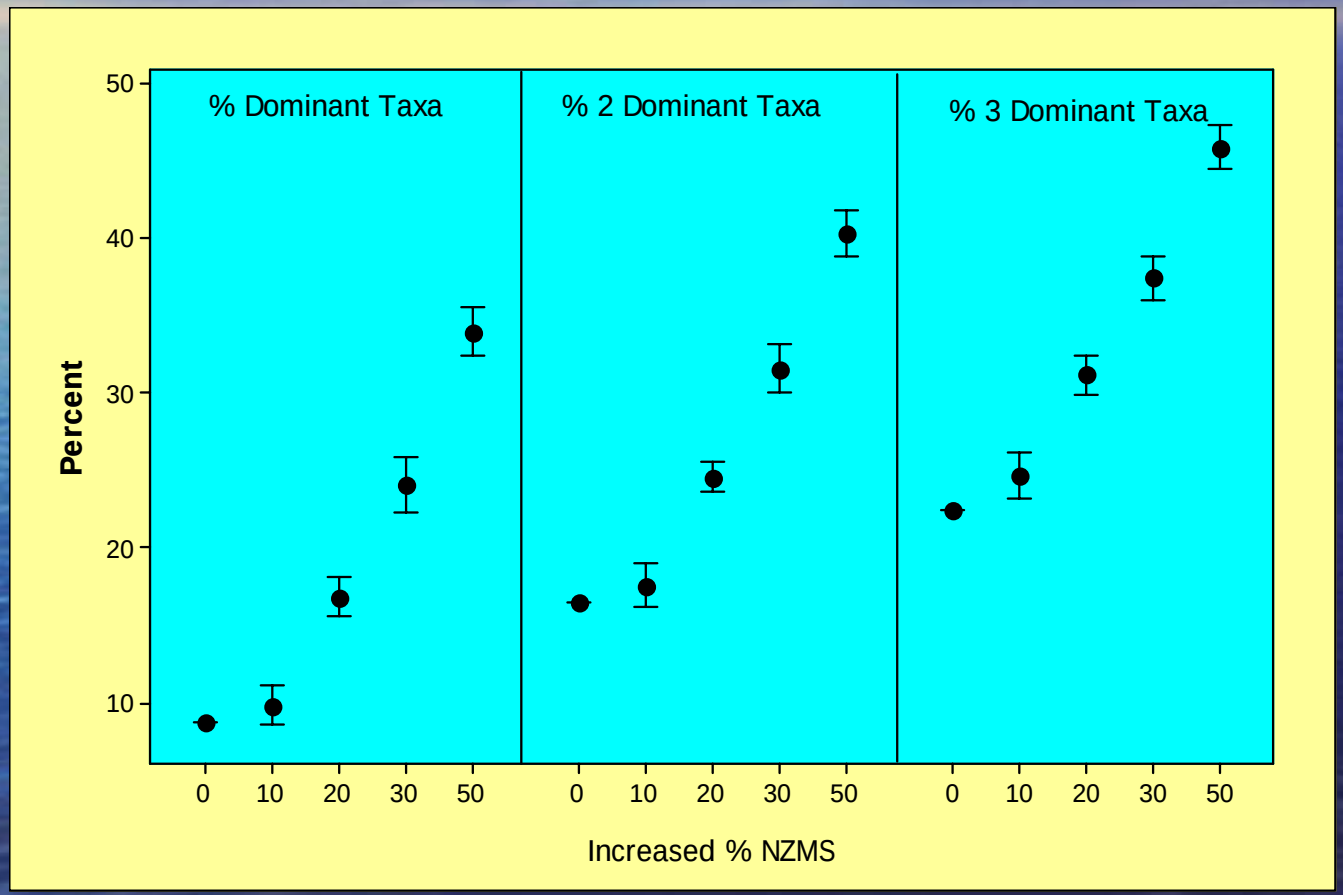
Functional Feeding Groups



EcoAnalysts, Inc.

S. F. American River

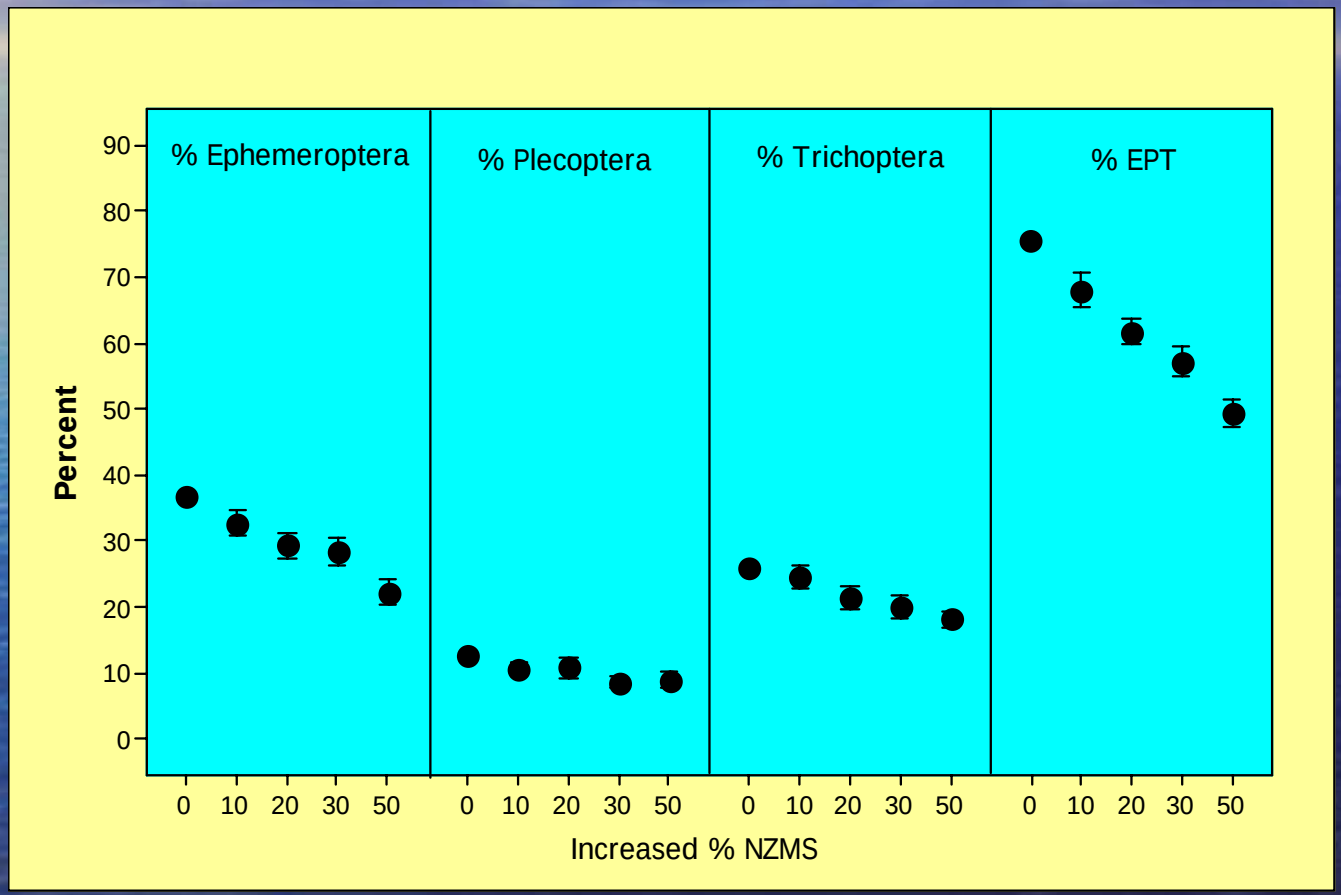
Dominance Measures



EcoAnalysts, Inc.

S. F. American River

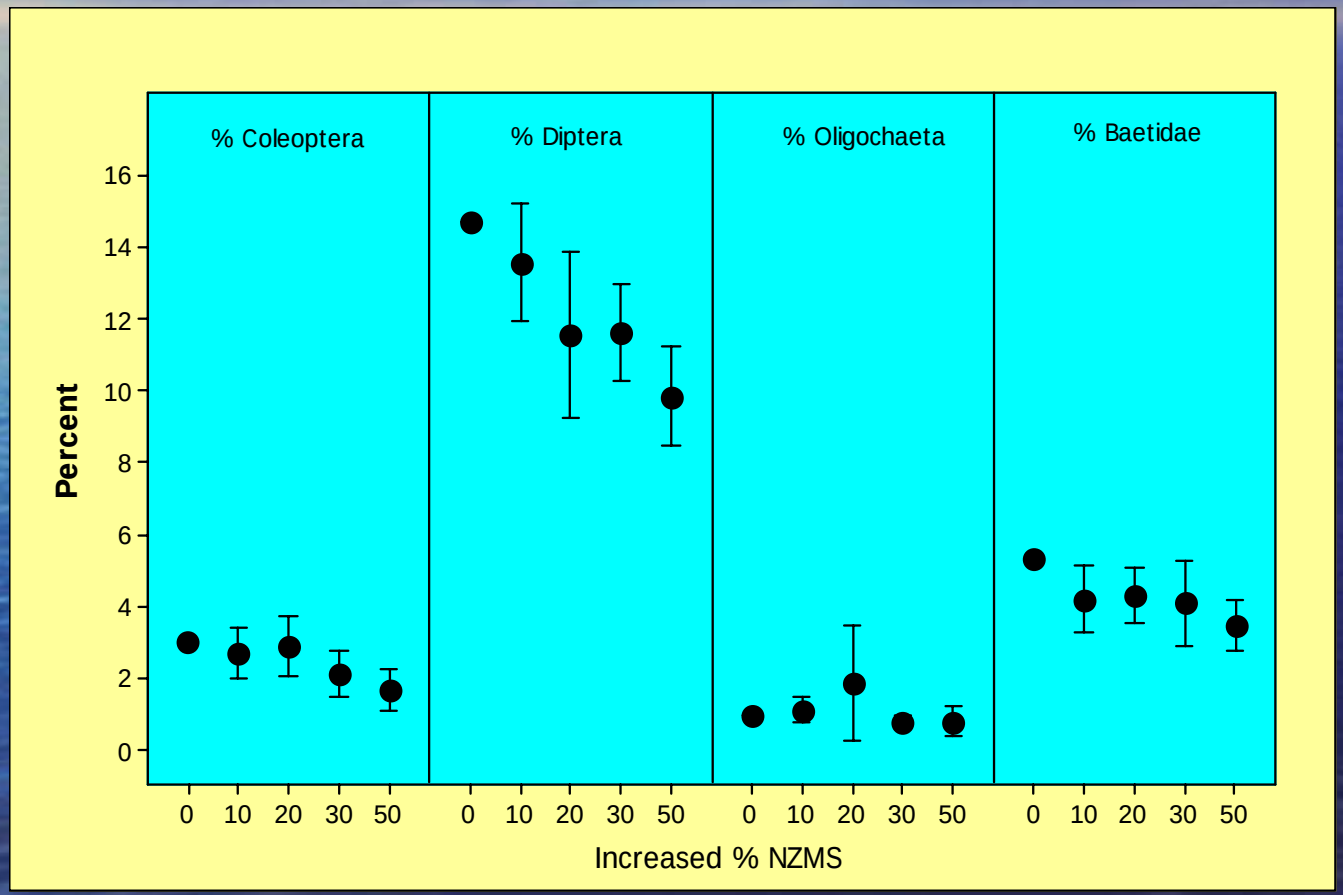
Community Composition



EcoAnalysts, Inc.

S. F. American River

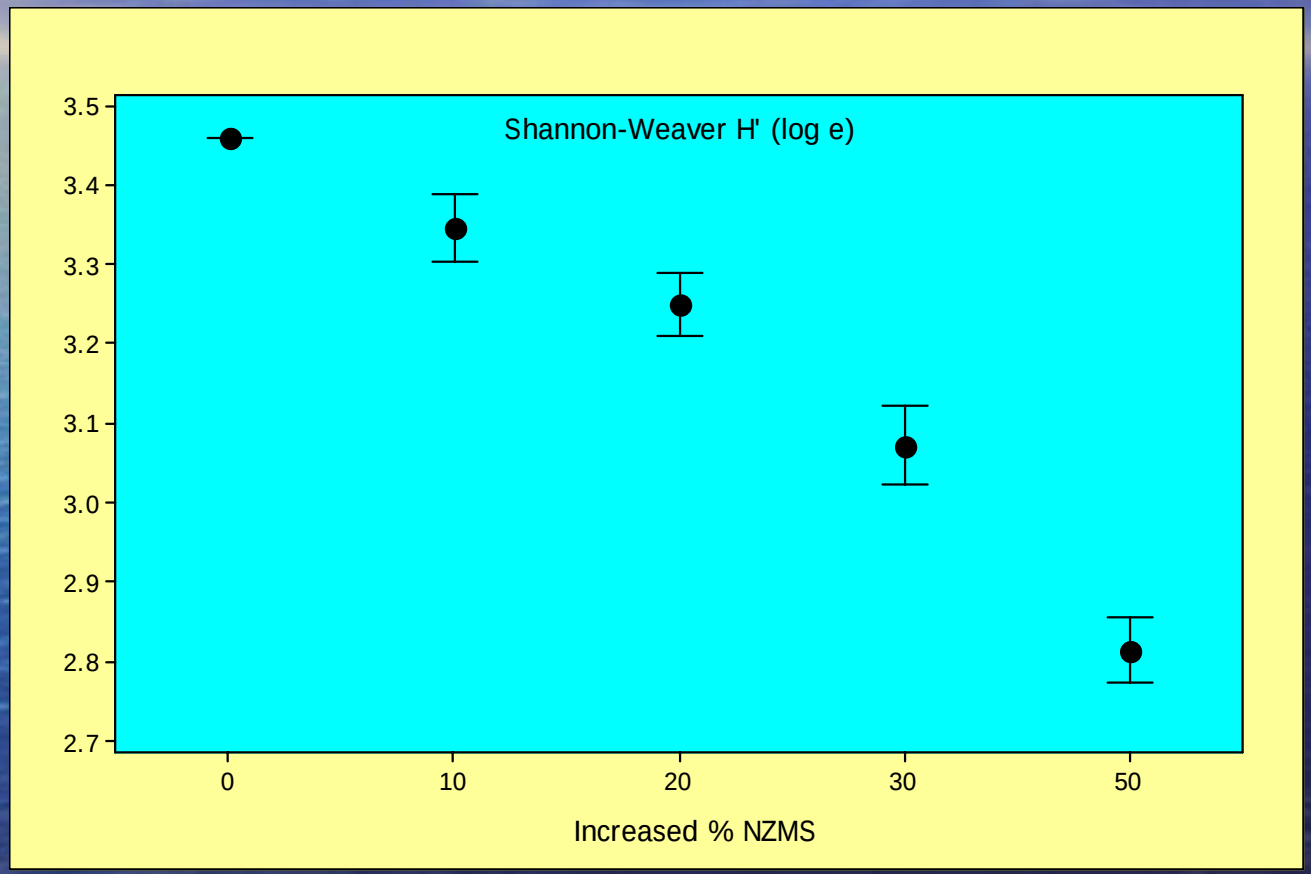
Community Composition



EcoAnalysts, Inc.

S. F. American River

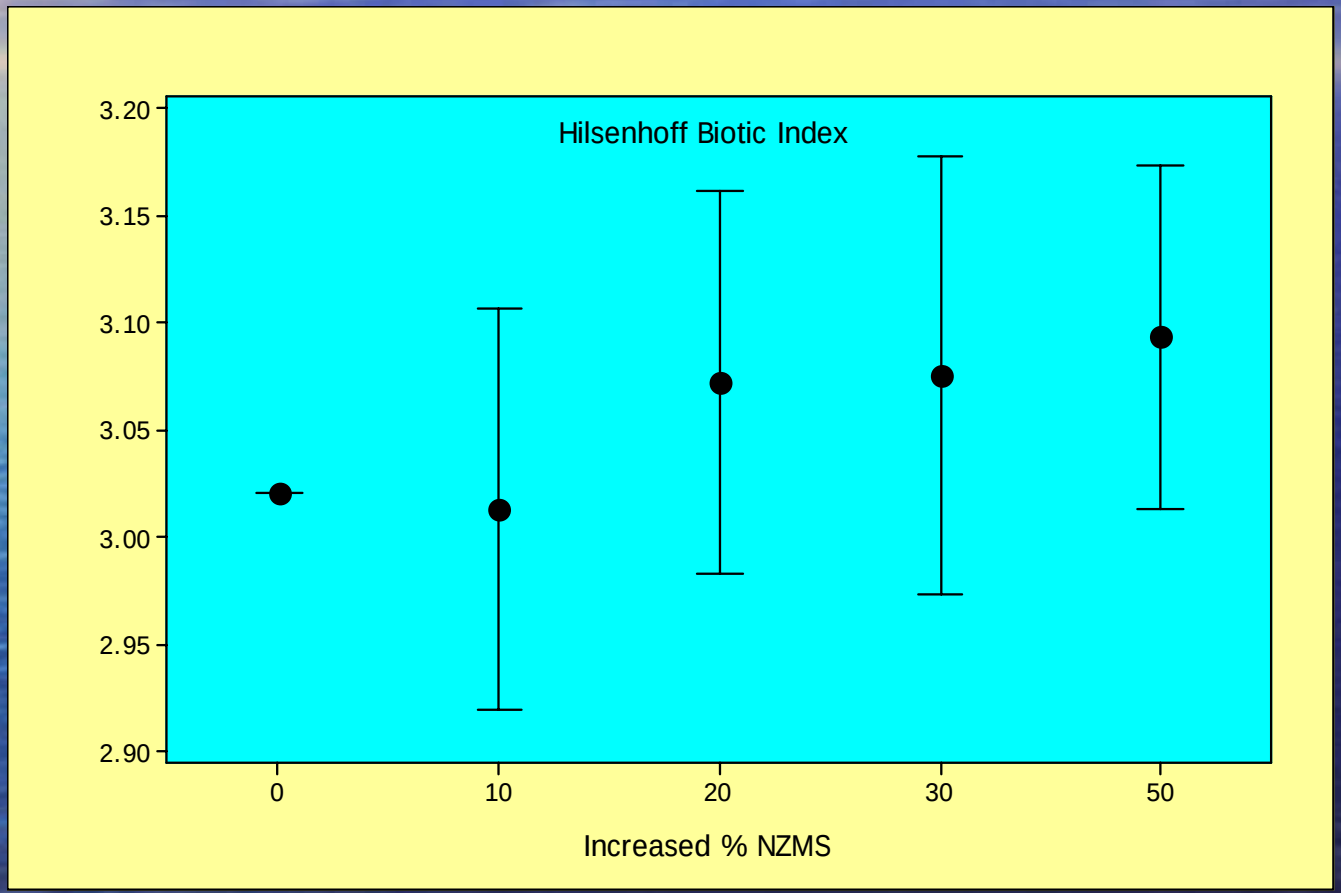
Diversity/Evenness Measure



EcoAnalysts, Inc.

S. F. American River

Biotic Index



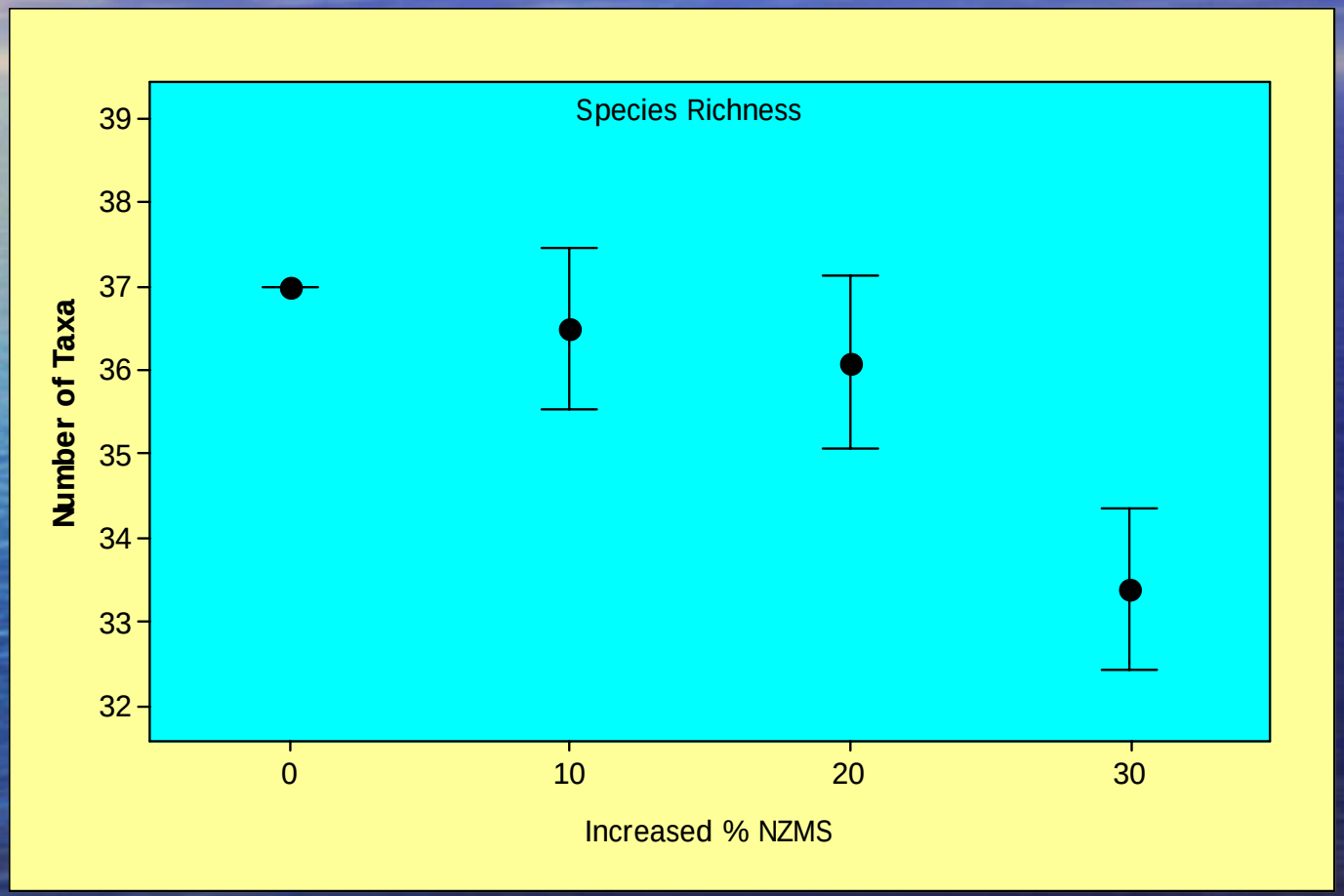
S. F. American River

EcoAnalysts, Inc.

Russian River Results

EcoAnalysts, Inc.

Richness Measure

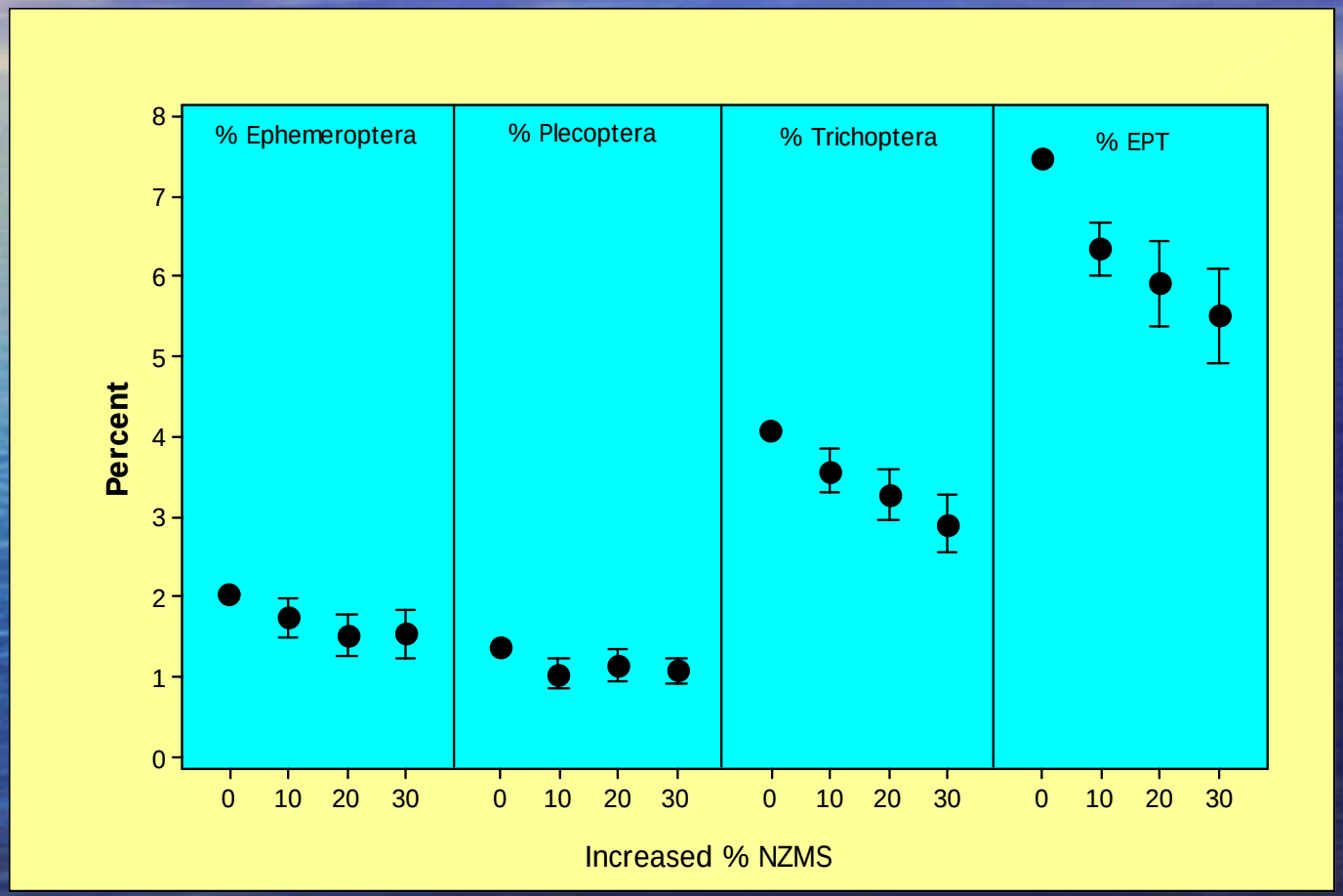


Dominated by *Brillia* sp.

Russian River

EcoAnalysts, Inc.

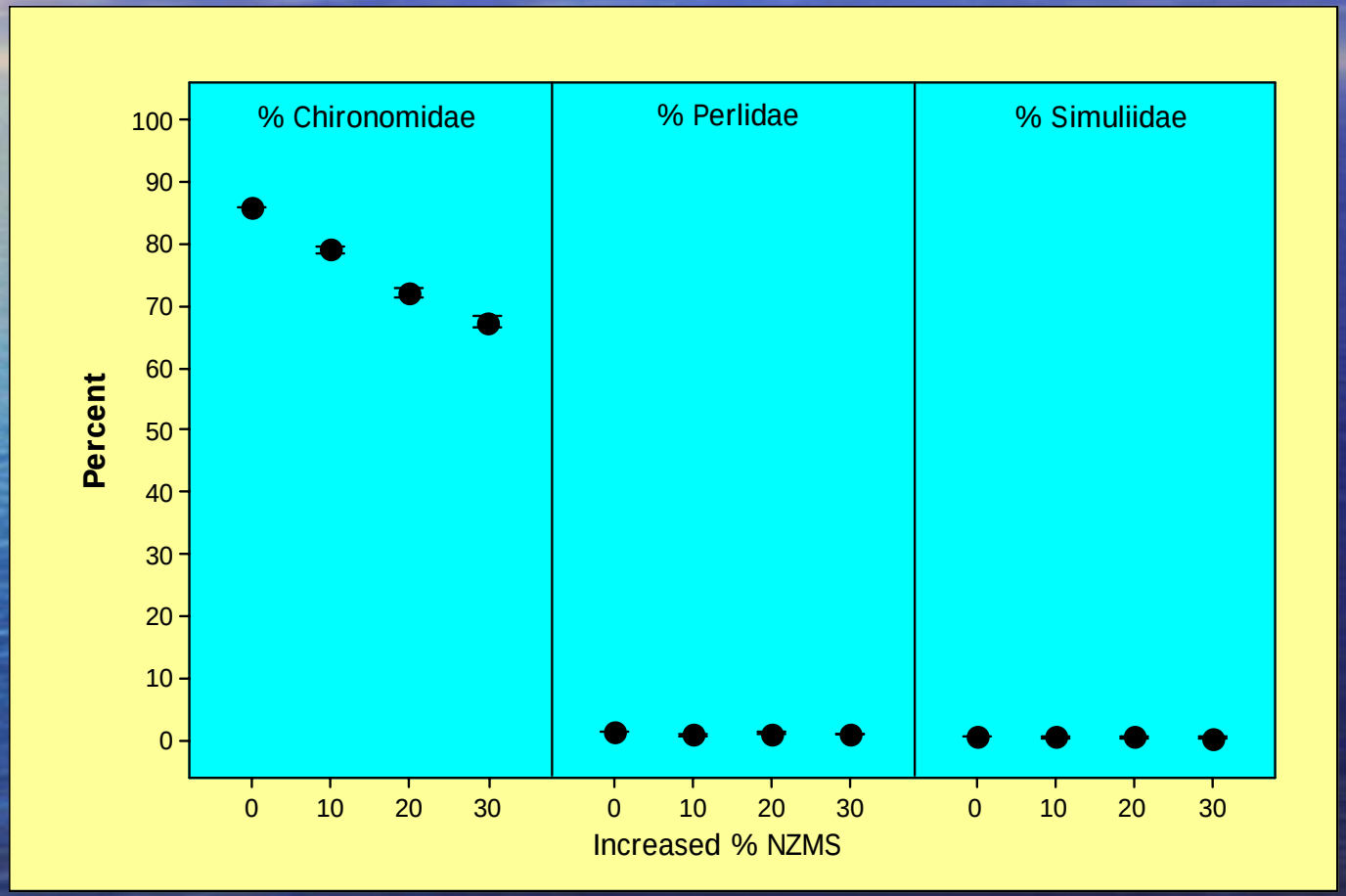
Community Composition



EcoAnalysts, Inc.

Russian River

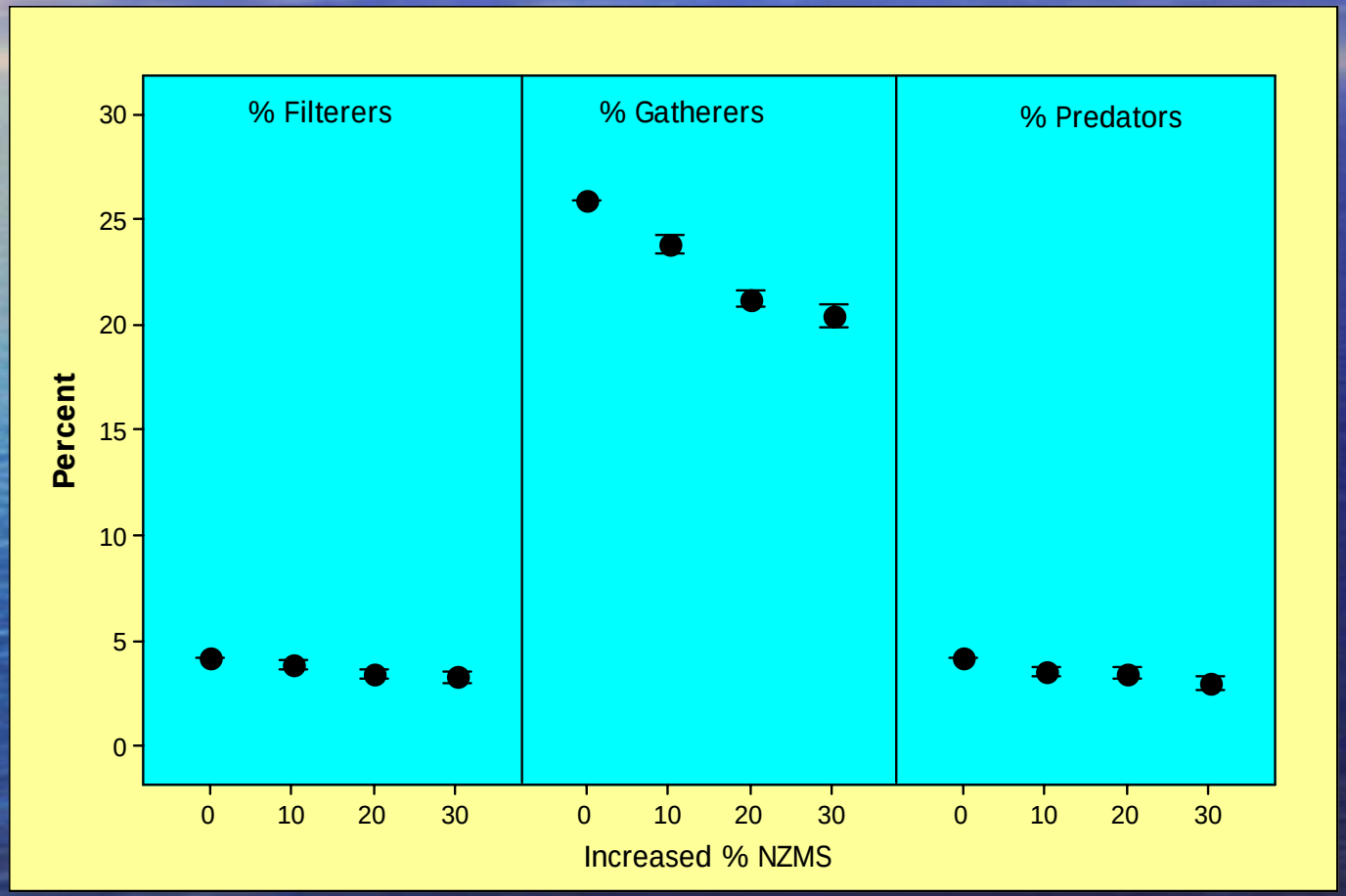
Community Composition



EcoAnalysts, Inc.

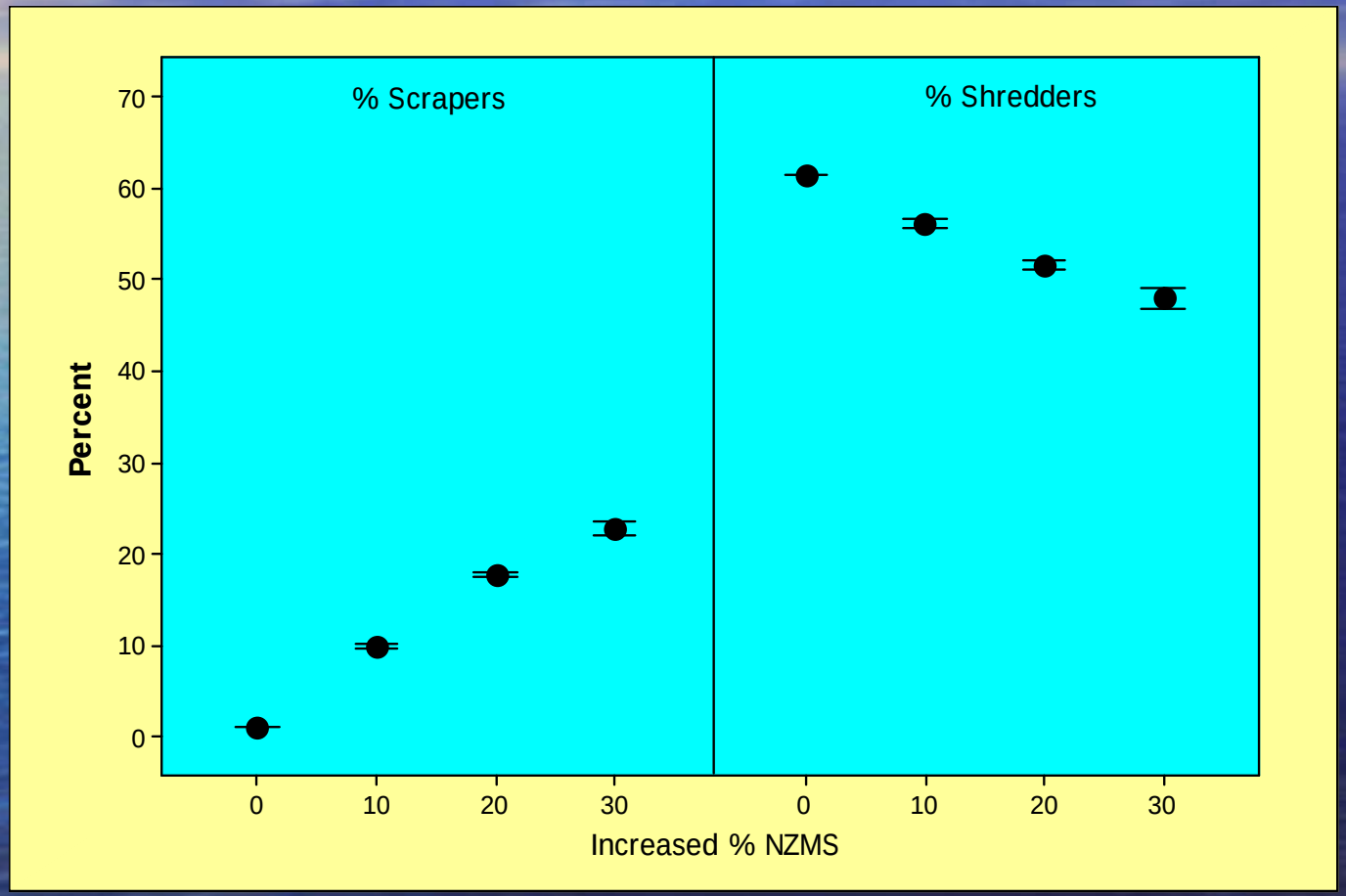
Russian River

Functional Feeding Groups



Russian River

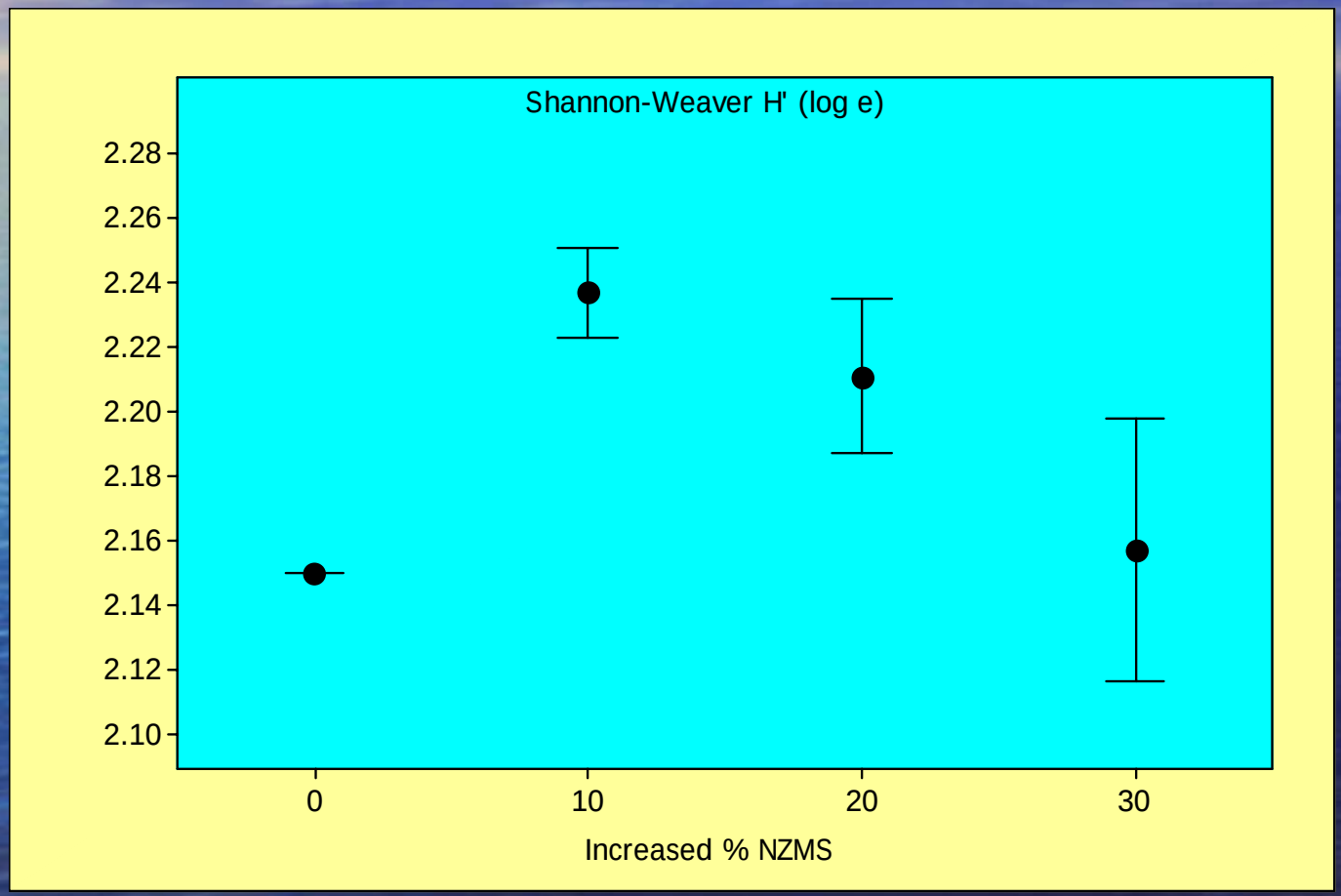
Functional Feeding Groups



EcoAnalysts, Inc.

Russian River

Diversity/Evenness Measures



EcoAnalysts, Inc.

Russian River

Discussion

- In this exercise, NZMS randomly replaced other invertebrate taxa
- NZMS doesn’t randomly replace taxa in the real world
- NZMS most likely replaces more similar taxa such as scrapers or other taxa via interference or exploitative competition (direct affects)

EcoAnalysts, Inc.

Indirect affects of NZMS

- NZMS can alter ecosystem function and therefore can indirectly affect abundances of other taxa
  - Ex. NZMS can alter primary production
  - Nutrient availability
    - Feces
    - Dislodged periphyton

EcoAnalysts, Inc.

NZMS metrics

- No HBI value for NZMS
- No invasive species metric

EcoAnalysts, Inc.

Conclusion

- NZMS can affect bioassessment metrics even at the superficial level of random replacement
- Values (HBI, etc.) need to be determined for NZMS and other invasive species
- An invasive taxa metric needs to be incorporated into bioassessment criteria

EcoAnalysts, Inc.

Bonus Round
NZMS New Findings:

Top Secret and Highly Classified

- Evolution of NZMS in western USA
- Population dynamics of NZMS in some rivers in western USA

Evolution of NZMS in Snake River

Shell morphology

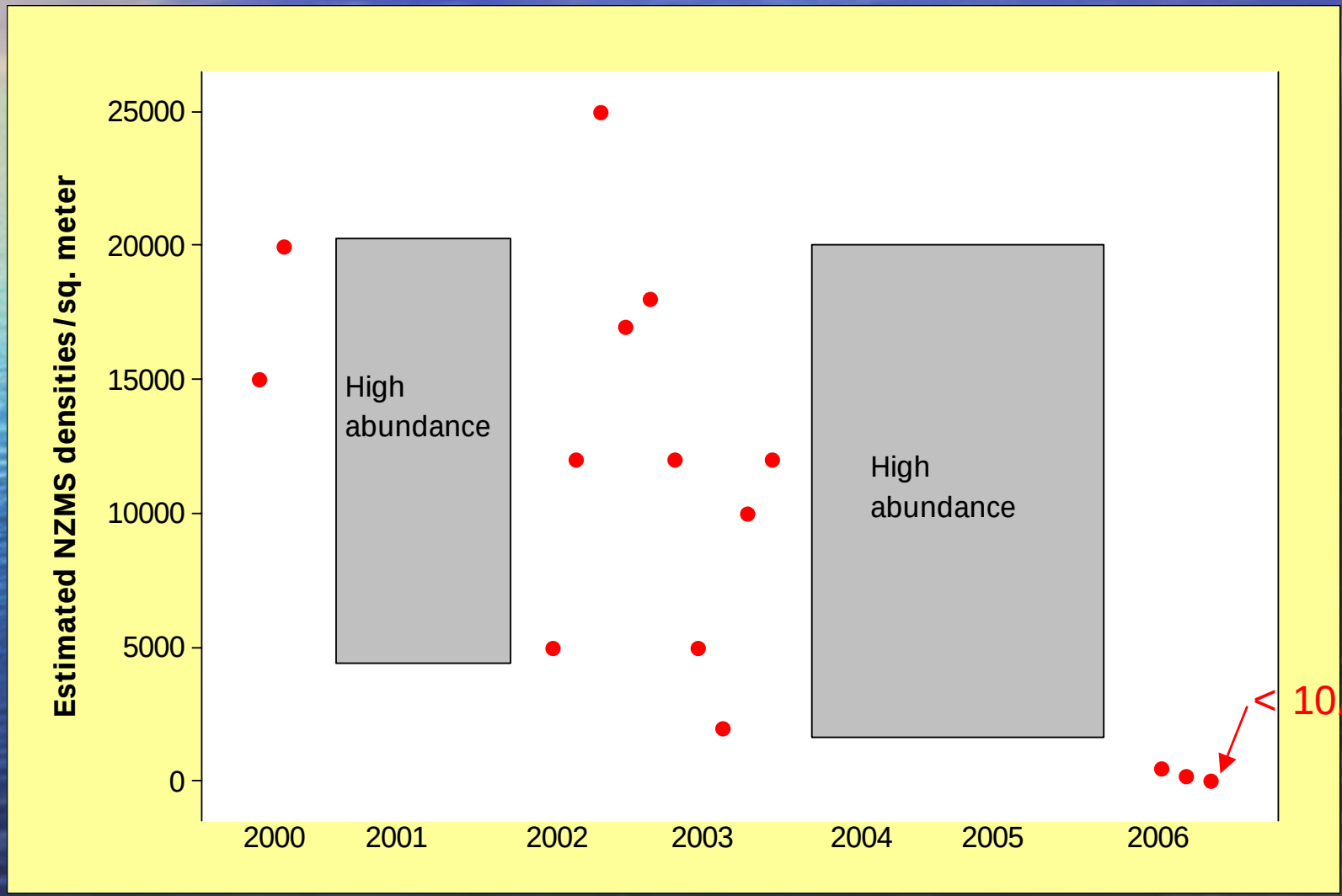
Sex	100 % ♀♀	??	??	50% ♂♂
Year	1985-1998	1999-2000	2002-03	2004-06

Are NZMS leaving us? (we should be so lucky)

- Several biologists suggest NZMS populations have crashed in the last year or so in the following rivers*:
  - Boise River, Idaho (BSU/IDEQ)
  - Snake River near Weiser (IPC)
  - Firehole, Gibbon, and Madison Rivers, YNP (NPS biologists, D. C. Richards)
  - Darlinton Ditch Spring Creek (DDSC), MT (D. C. Richards)

*NZMS in system > 10 yrs

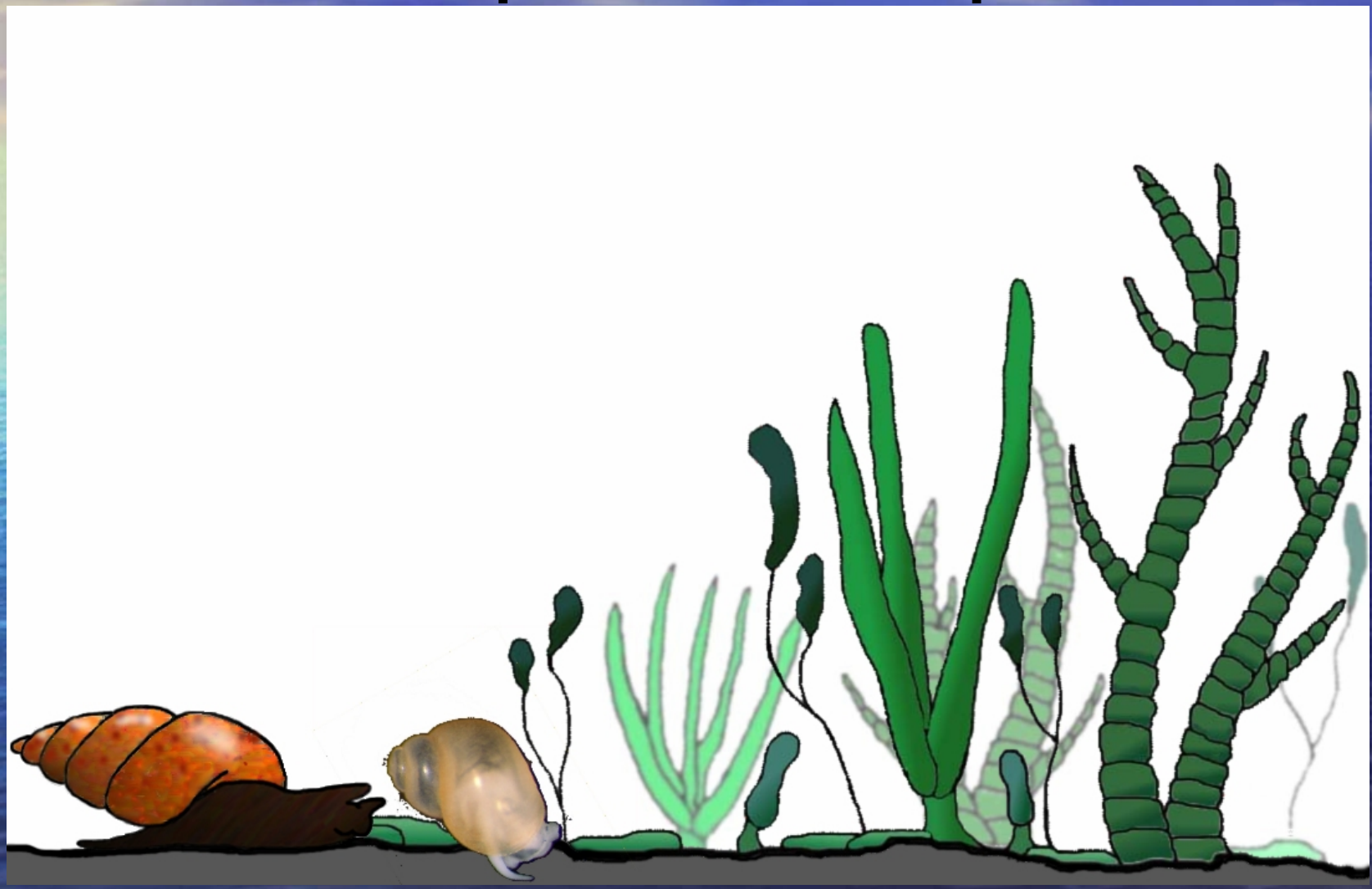
Darlinton Ditch Spring Creek, MT



Reasons for NZMS decline

- Could be due to several population regulators:
  - Scramble intraspecific competition and reduced food resources
  - Predators/parasites/disease
  - Environmental stochasticity (catastrophes, water quality, floods etc.)

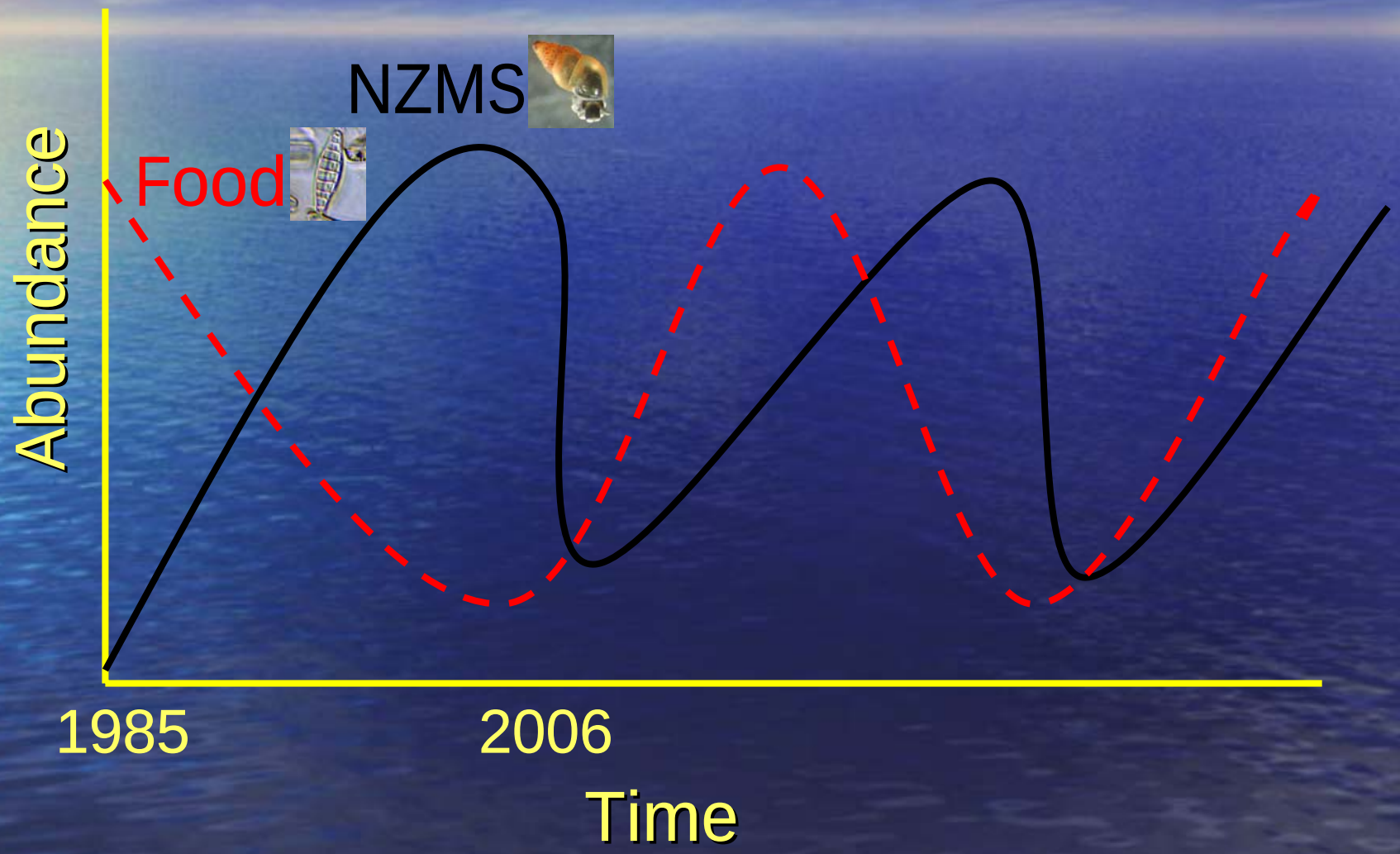
Intra/interspecific competition*



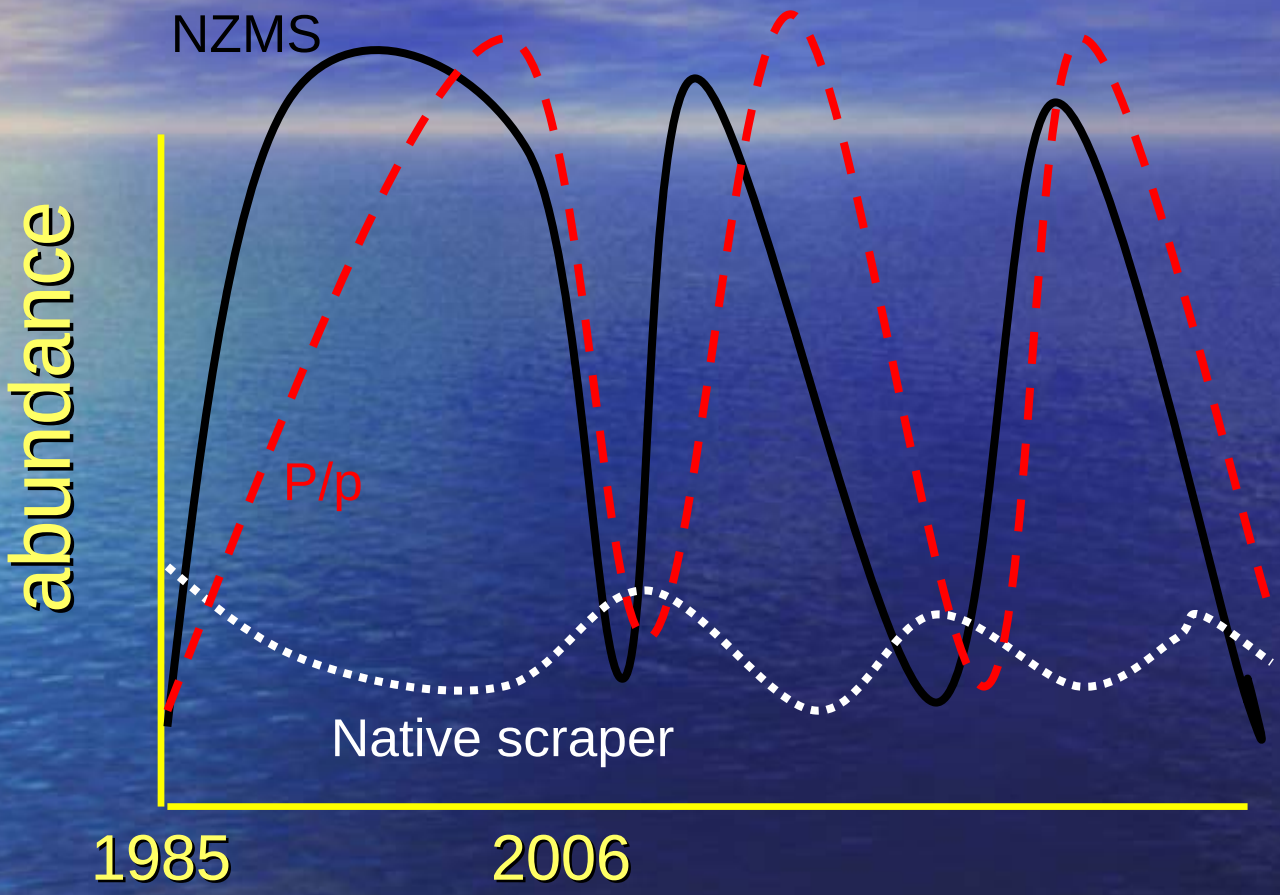
Drawing by Carolyn Smith

*my speculative interpretation

Scramble competition



Predator/parasite

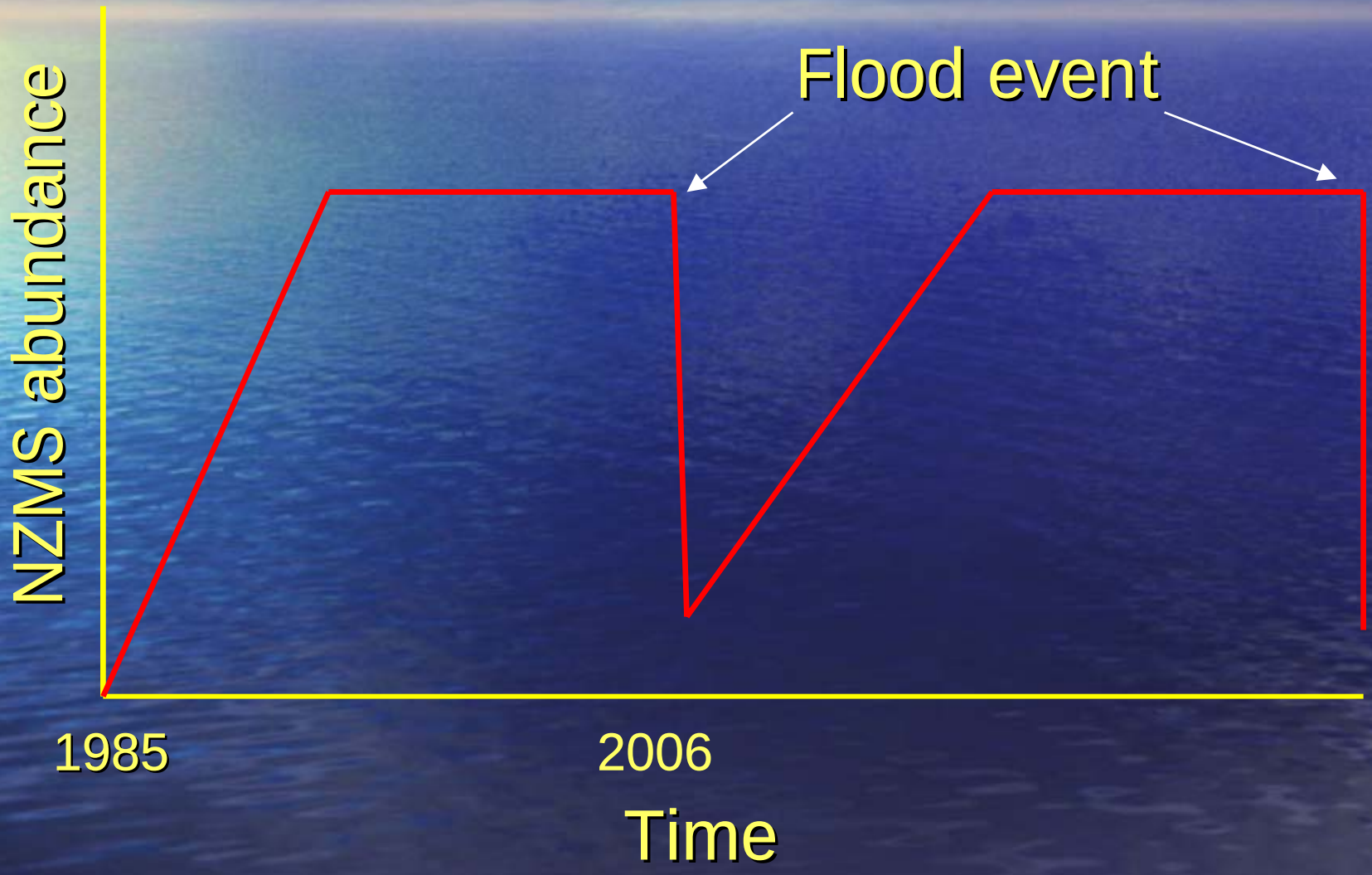


Δ Environmental Conditions ?

2006 was a “high” water year in MT, ID, and YNP

However, this shouldn’t have affected DDSC

Flood effect on NZMS abundance



This doesn’t help much either

Darlinton Ditch Spring Creek, November 2006


Fin