

Development of stressor-specific tolerance values for western benthic macroinvertebrates

Andrew Rehn

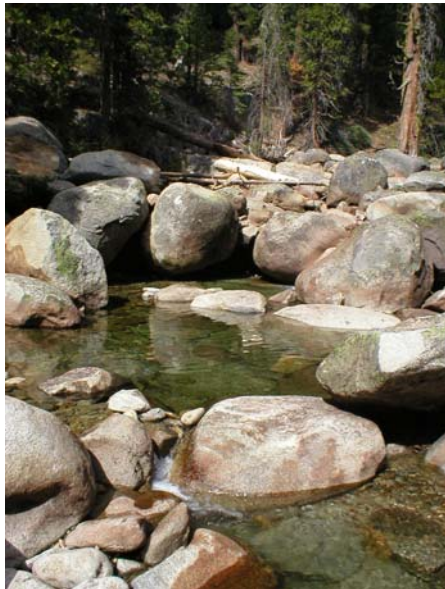
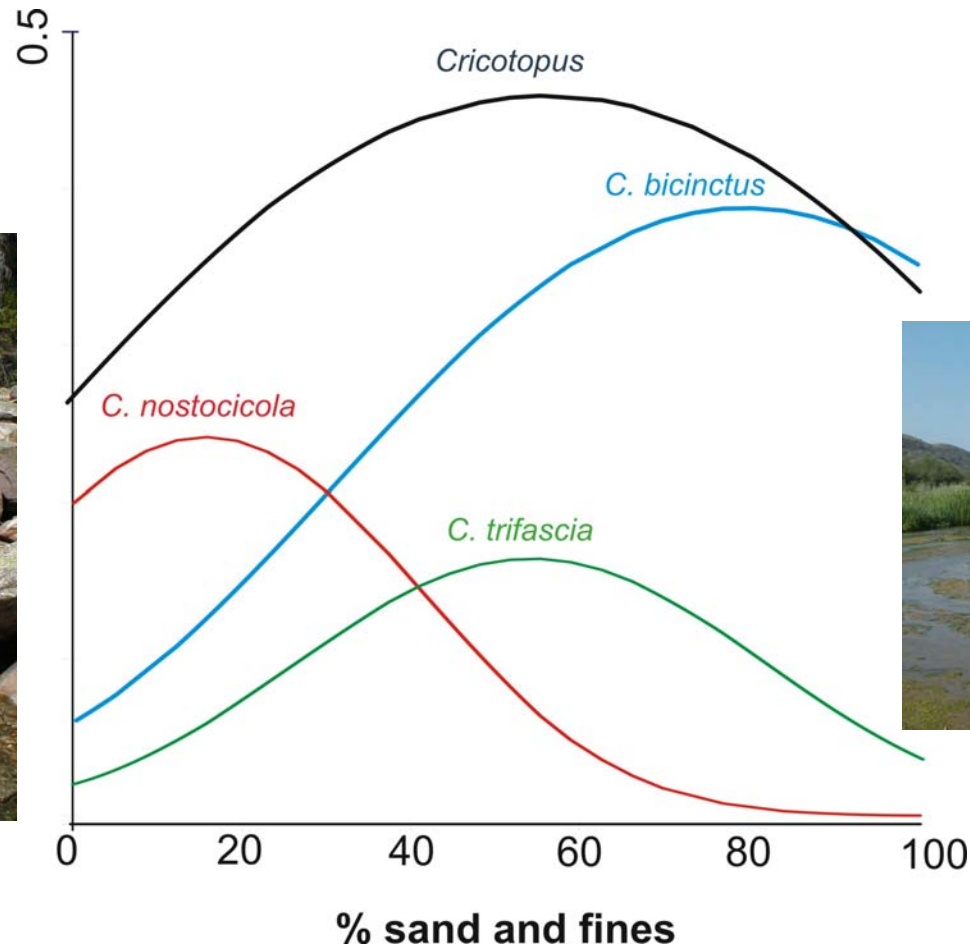
California Aquatic Bioassessment Lab

Rancho Cordova, CA

Theory: Benthic macroinvertebrates (BMIs) are integrators of environmental conditions in streams. Therefore, BMI assemblages *should* be good predictors of environmental conditions and *should* be useful for stressor diagnosis.

In bioassessment, tolerance values (TVs) are a numerical rating assigned to individual taxa that indicate each taxon's tendency to survive under conditions where there's a lot of human influence.

Based in ecological niche theory:

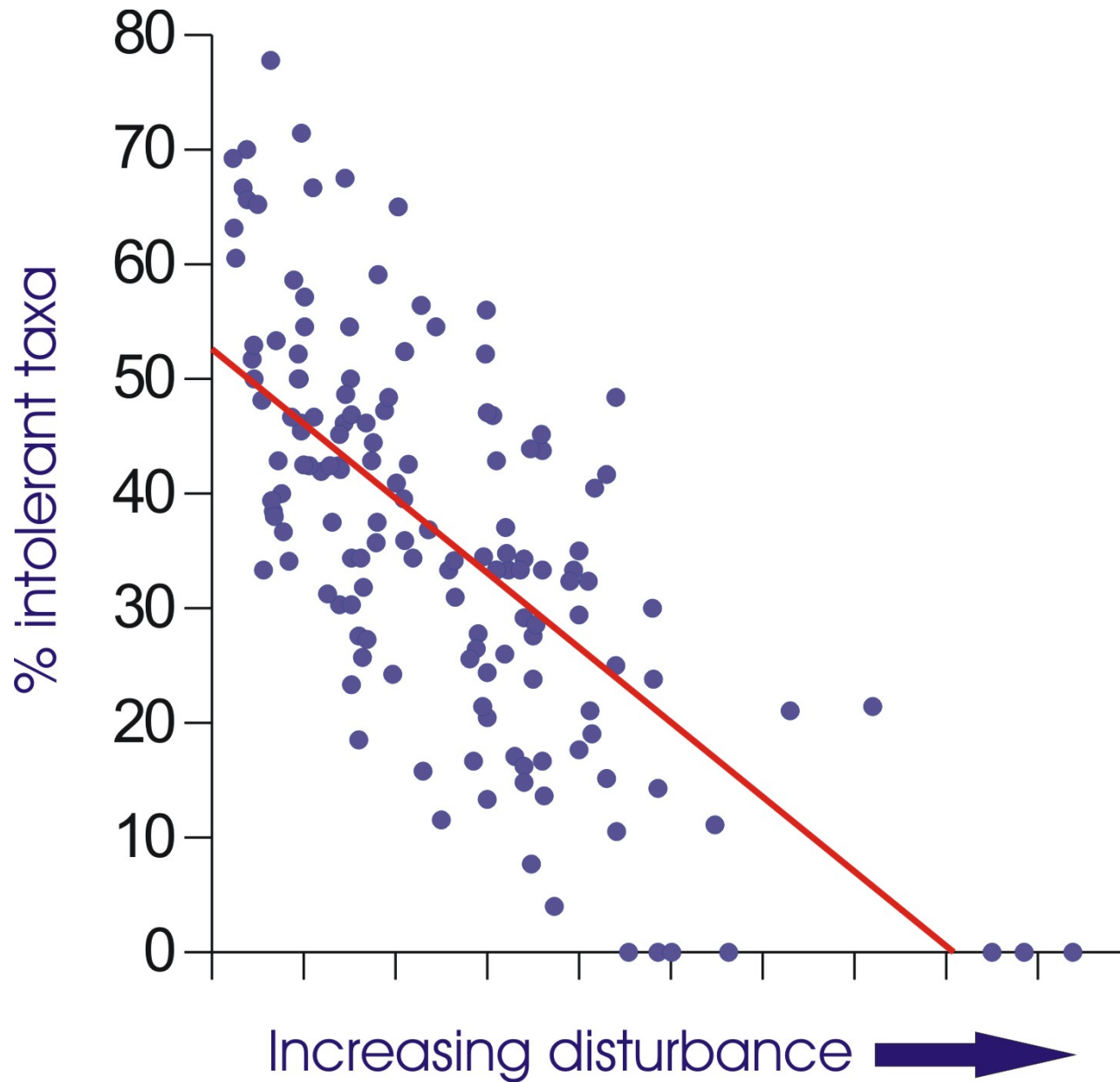


Intolerant Taxa (0-2)



Tolerant Taxa (8-10)





TVs are usually assigned on the basis of BPJ

- reflect general tolerance to cumulative human disturbance.

Recent interest in TV development:

- development based on explicit and objective methods
- tolerance to specific stressors, not a general or cumulative gradient of disturbance.
- predict stressor levels at sites that are biologically impaired, i.e. for **stressor diagnosis**

RECENT EFFORTS:

Blinn & Ruiter. 2006. TVs for caddisflies in the lower Colorado River basin

Blocksom & Winters. 2006. Evaluation of methods for creating TVs

Bressler et al. 2006. TVs for benthic macroinvertebrates in Mississippi

Carlisle et al. In press. TVs for common BMI genera and families of the U.S.

Meador & Carlisle. In press. TVs for common U.S. stream fish

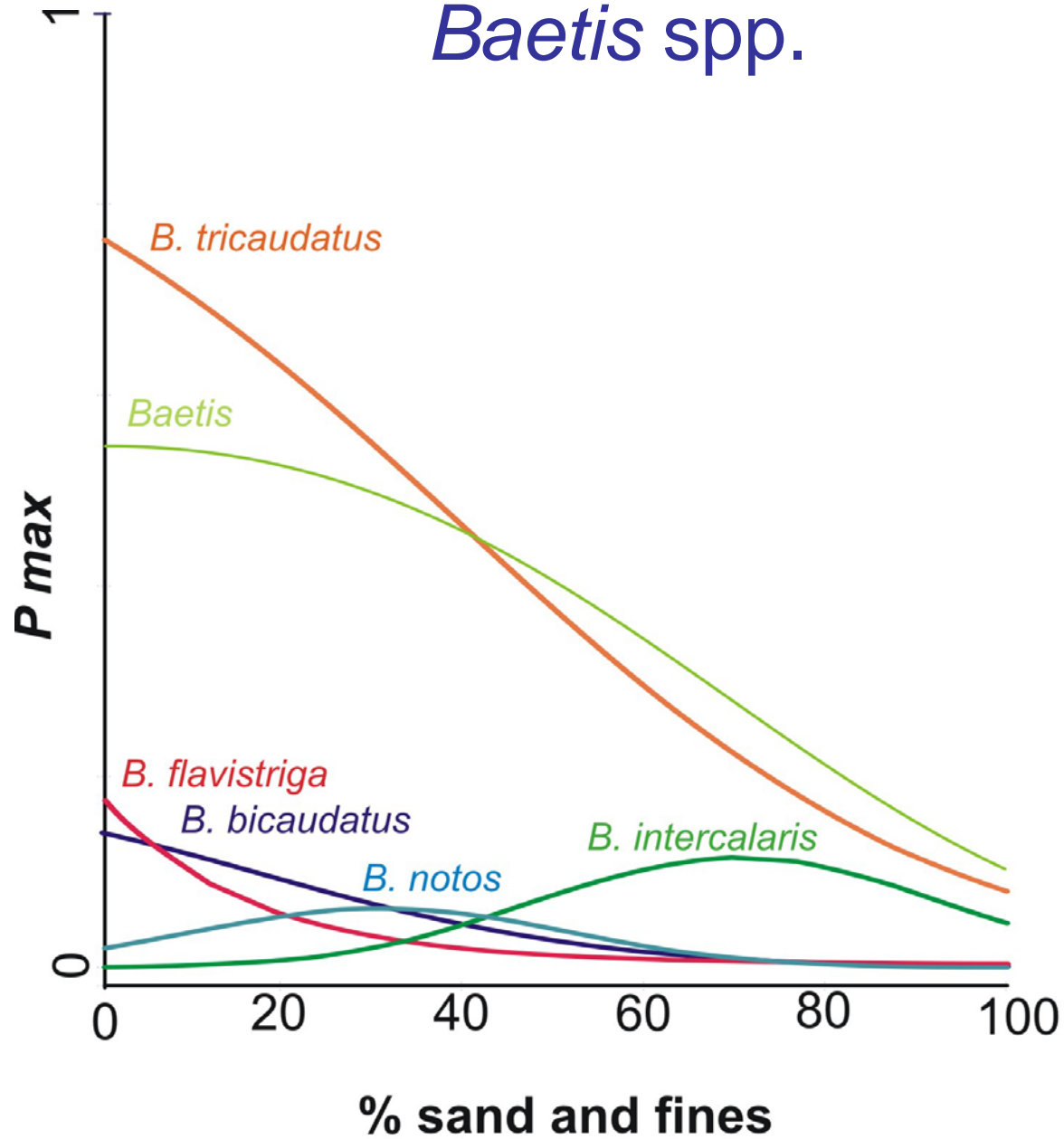
Smith et al. In press. Nutrient biotic index for BMIs

Yuan, L.L. 2006. Sediment and temperature TVs for western BMIs

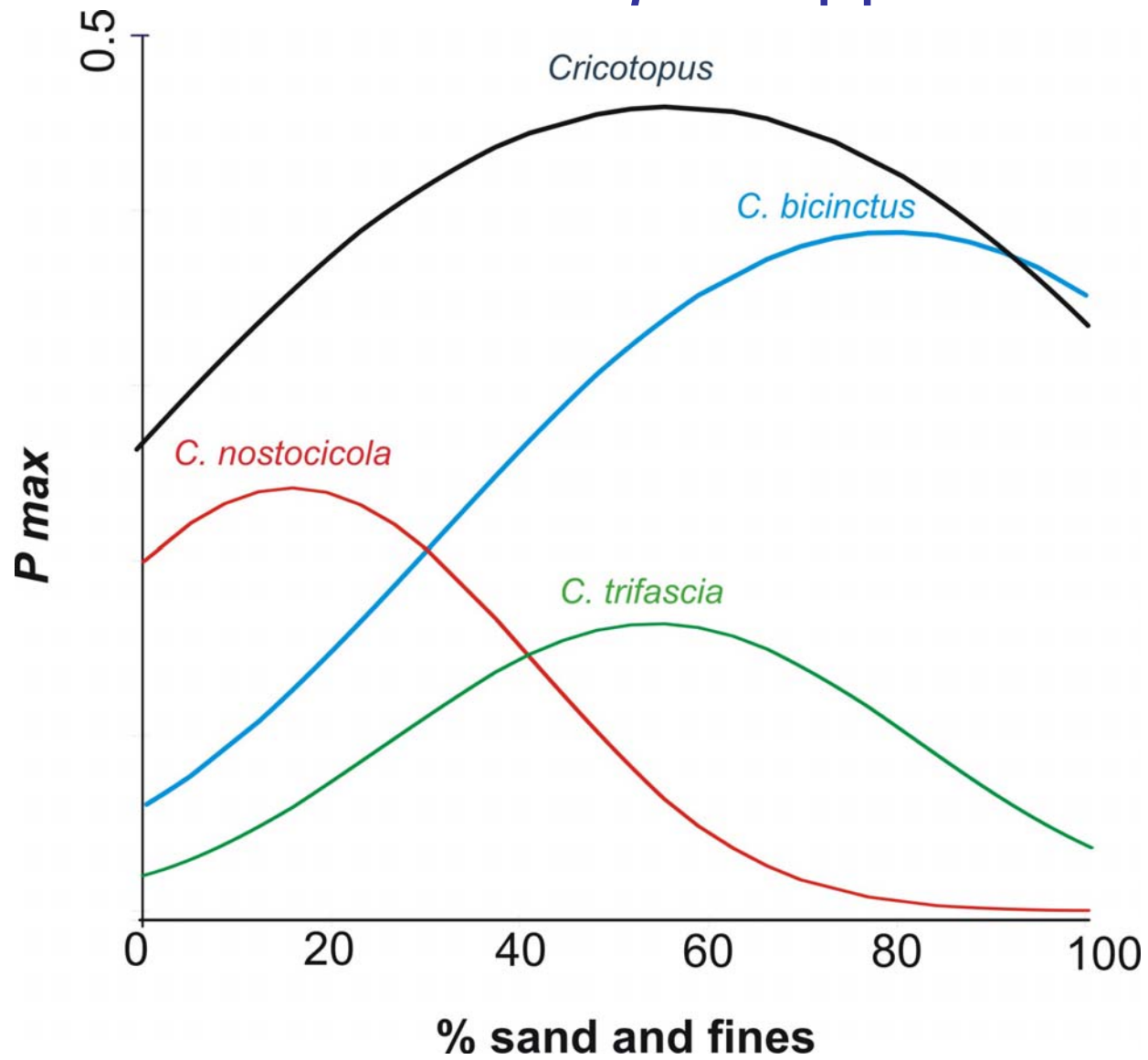
Yuan, L.L. 2006. Estimation and application of macroinvertebrate tolerance values. EPA/600/P-04/116F. Office of Research and Development, US EPA.

- Used first two years of WEMAP as development set
- Independent test set from western Oregon
- Compared different methods to develop TVs
- Genus as taxonomic level of effort

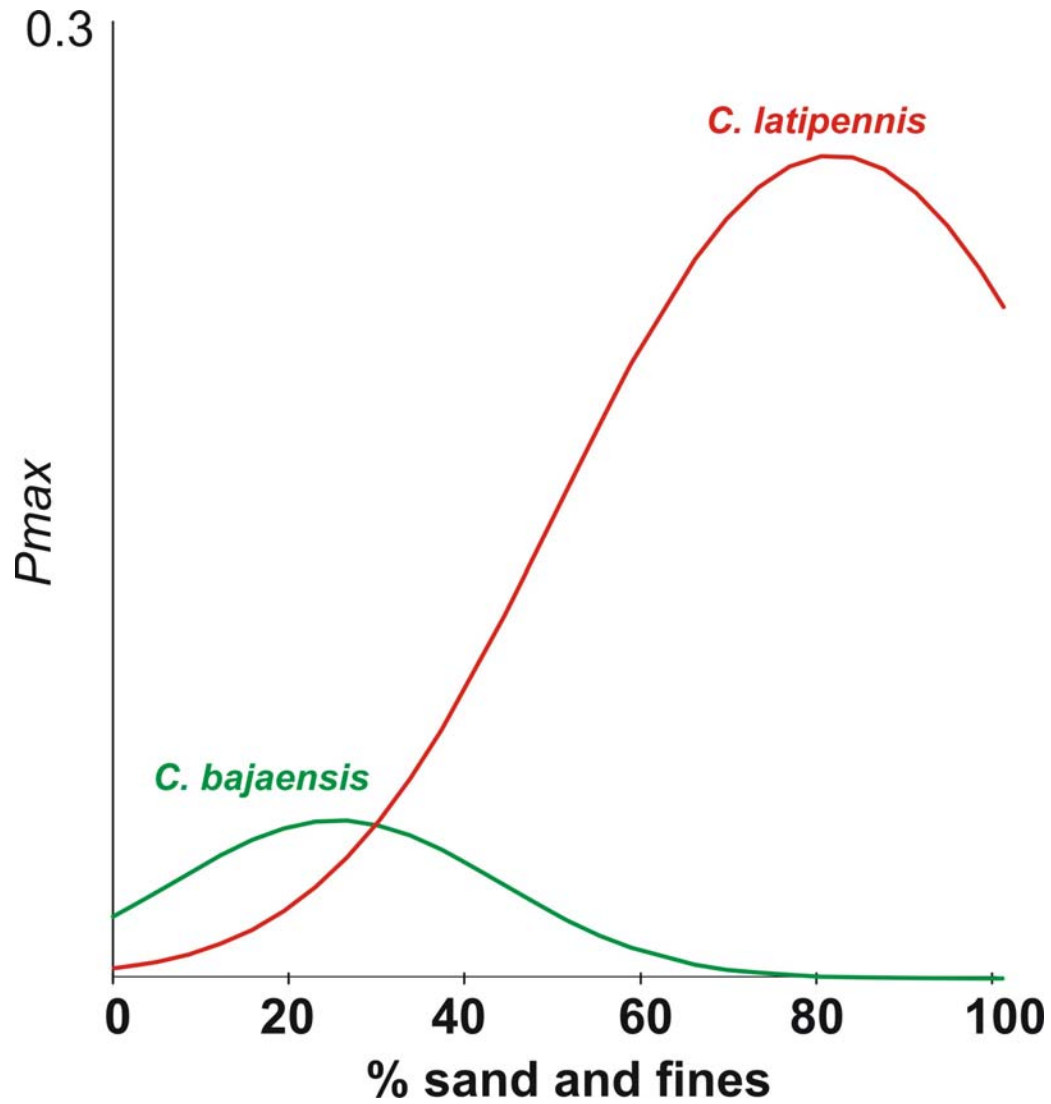
Baetis spp.



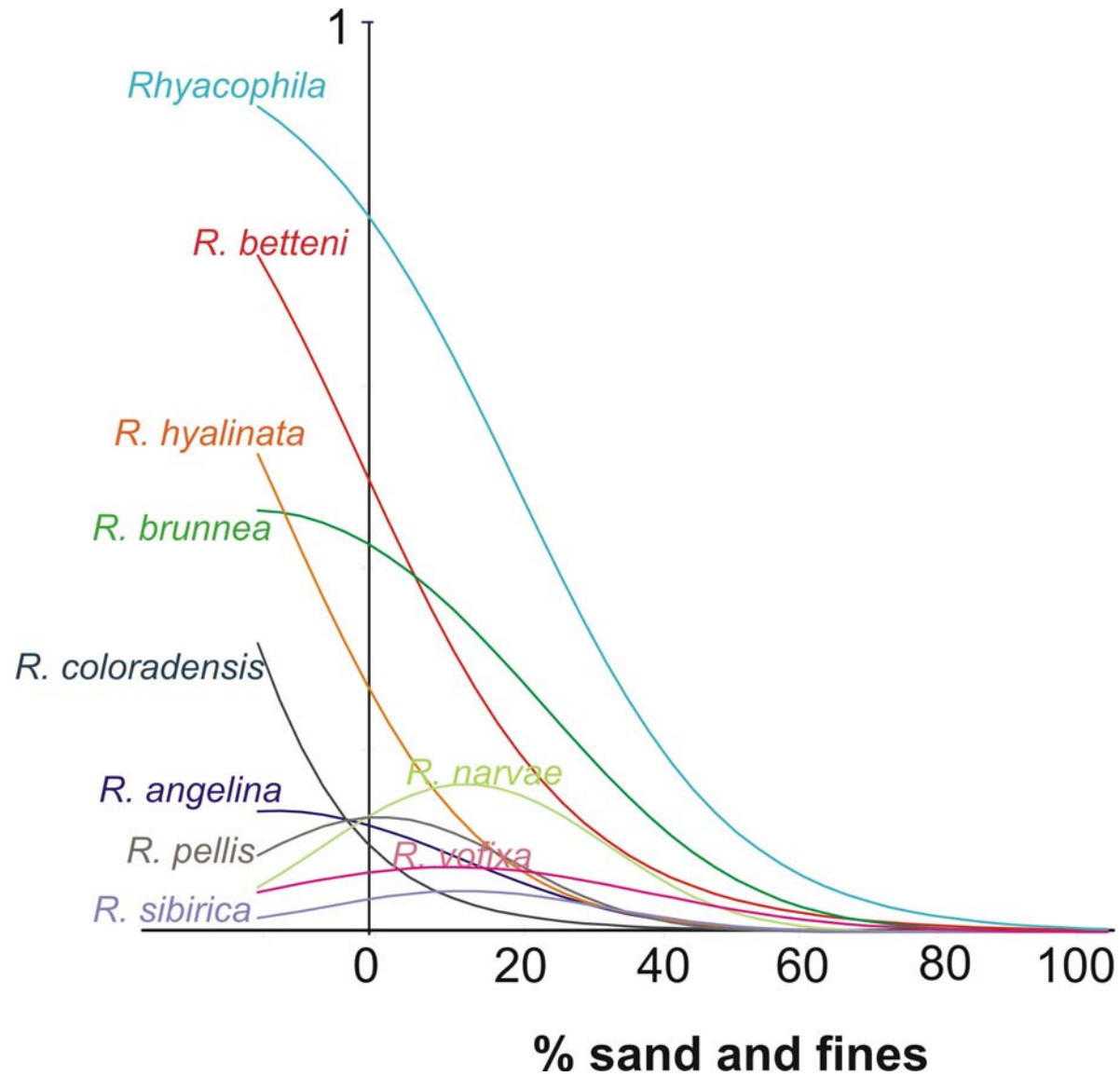
Cricotopus spp.



Caenis spp.

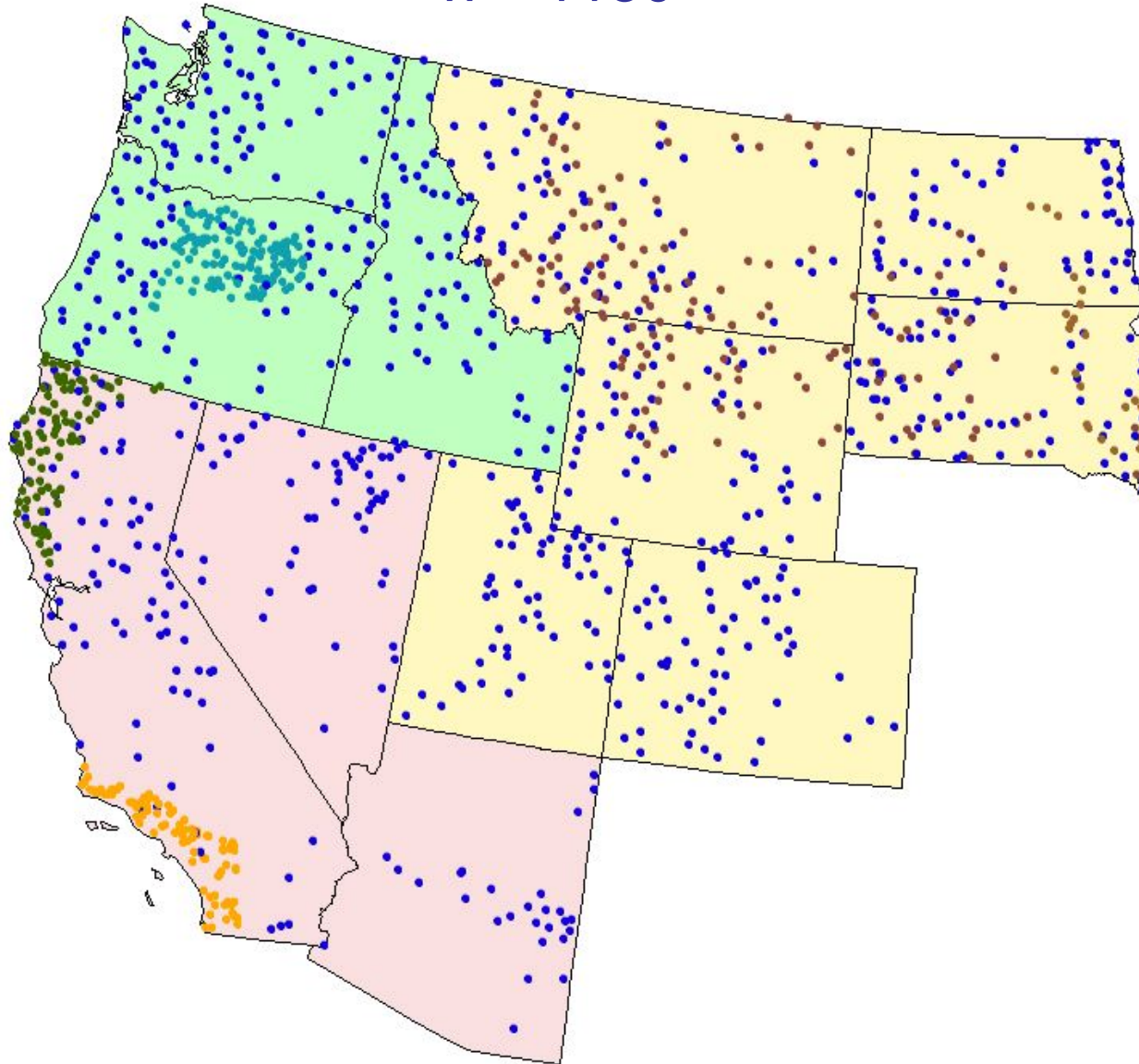


Rhyacophila spp.



Western EMAP Development Set: 2000-2003

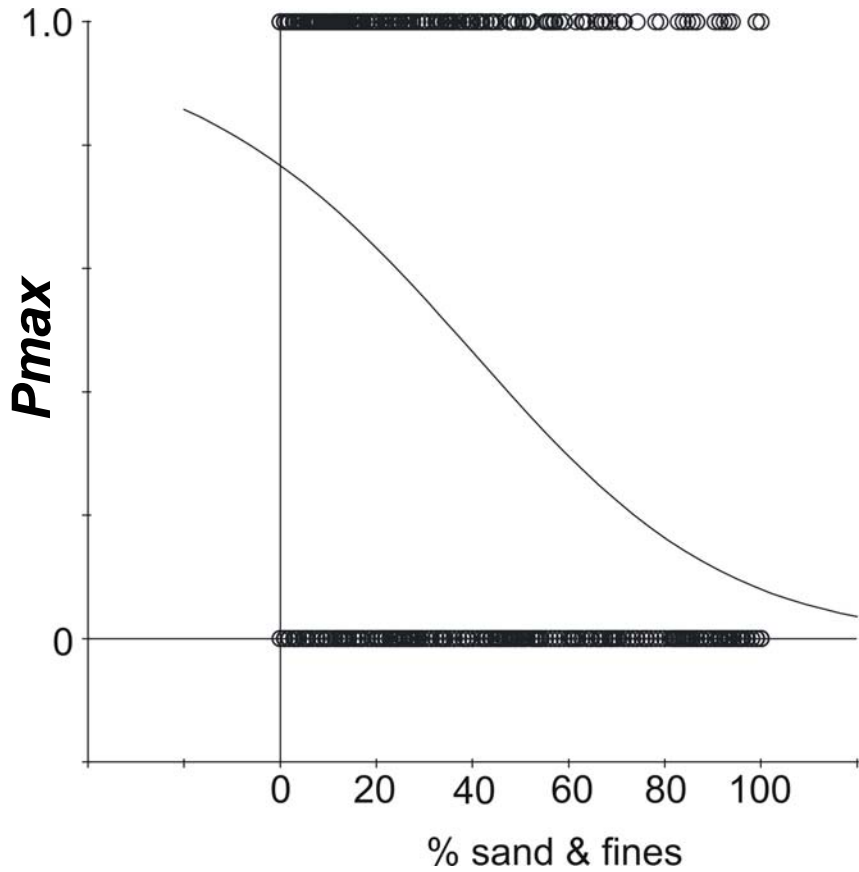
$n \sim 1150$



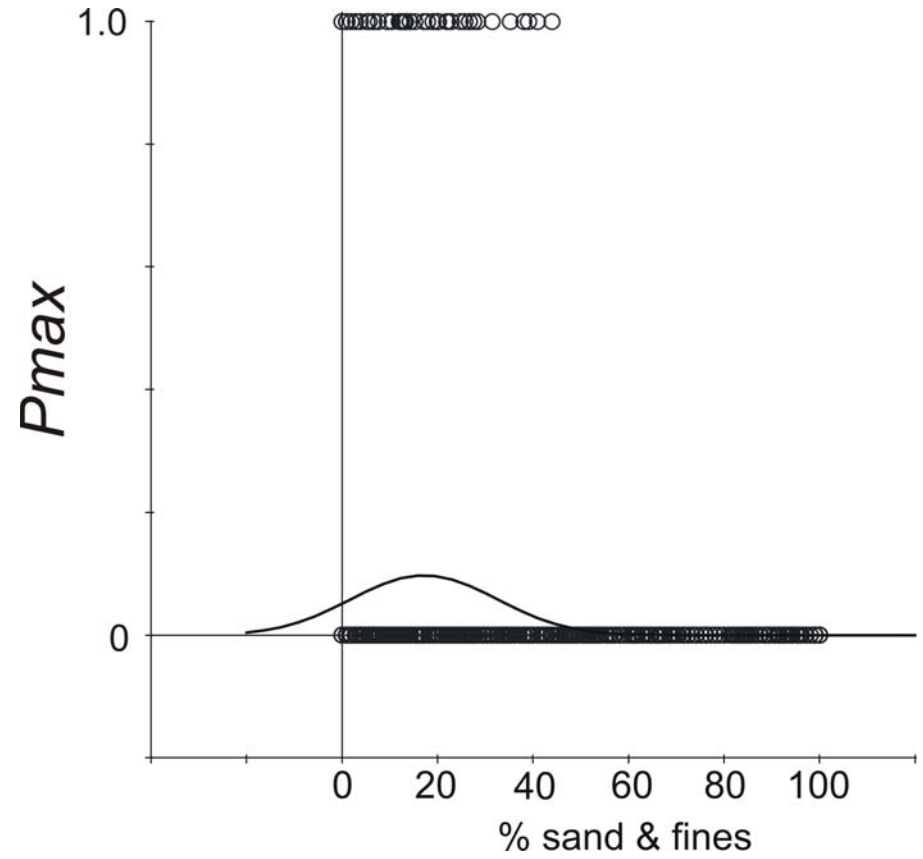
Three methods to estimate temperature and sediment optima and rate taxa as either intolerant, moderate or tolerant:

Weighted averaging: simple, but can imply central tendency when there is not one

Baetis tricaudatus



Neophylax rickeri



% Sand and fines

176 intolerant

83 moderately tolerant

41 tolerant

40 non-significant

TOTAL = 340 taxa

Temperature

119 intolerant

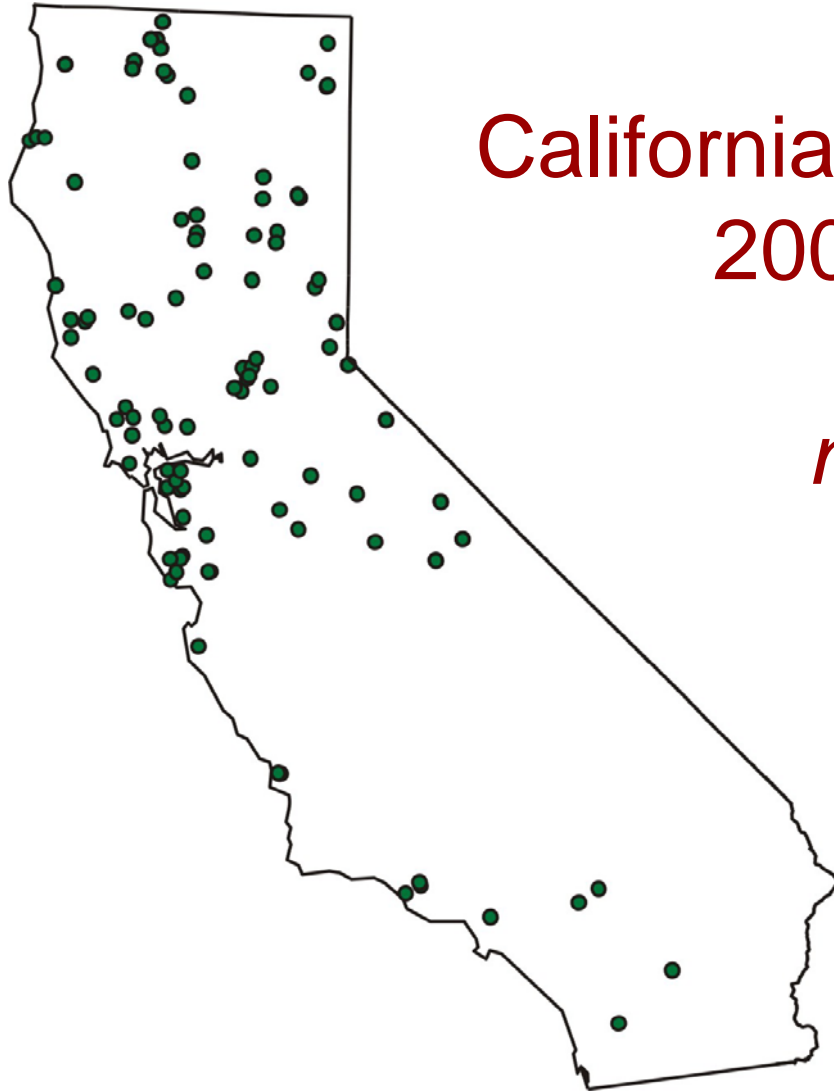
127 moderately tolerant

65 tolerant

36 non-significant

TOTAL = 347 taxa

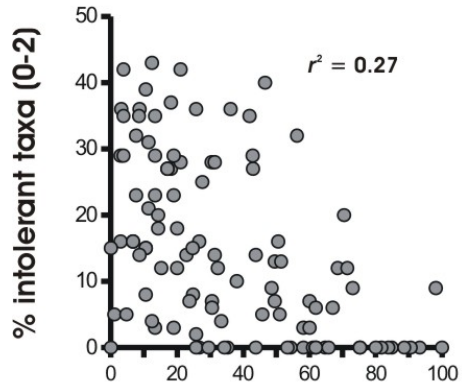
Independent Test Set



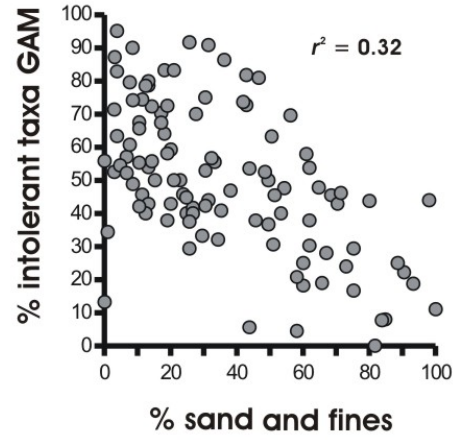
California probability sites
2004-2005

$n = 112$

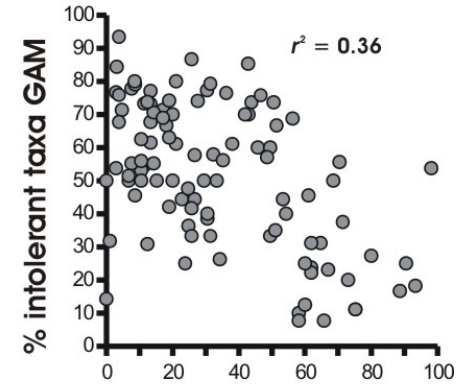
BPJ



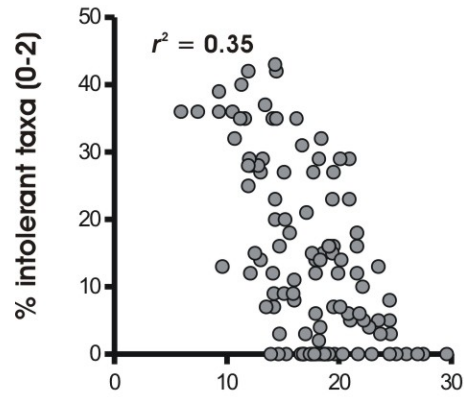
ABL



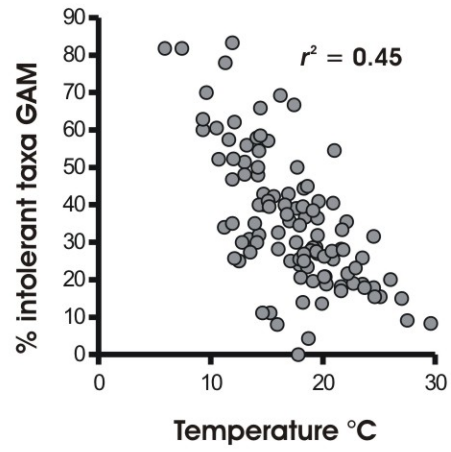
EPA



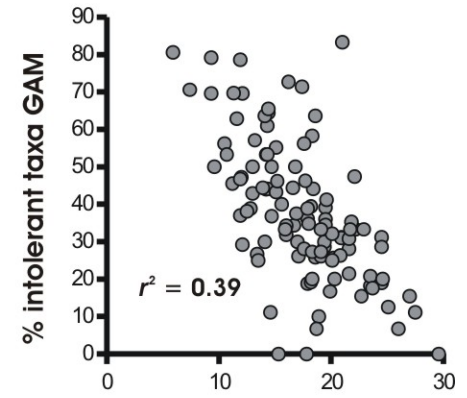
BPJ



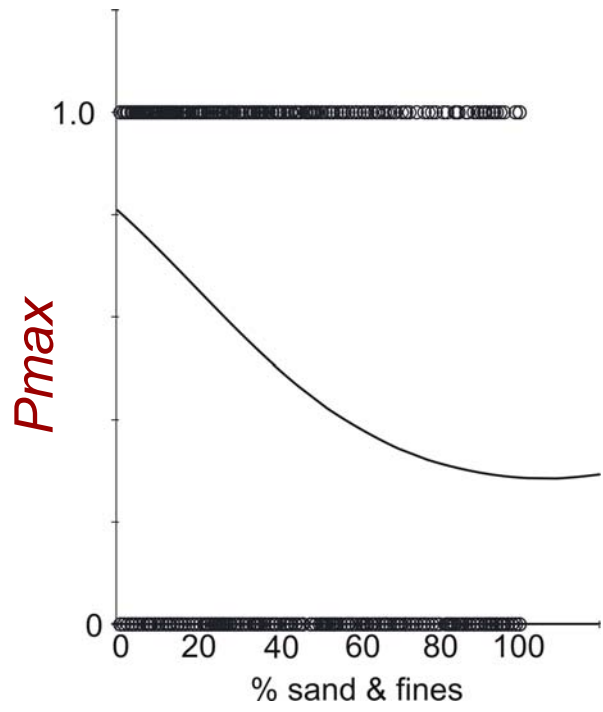
ABL



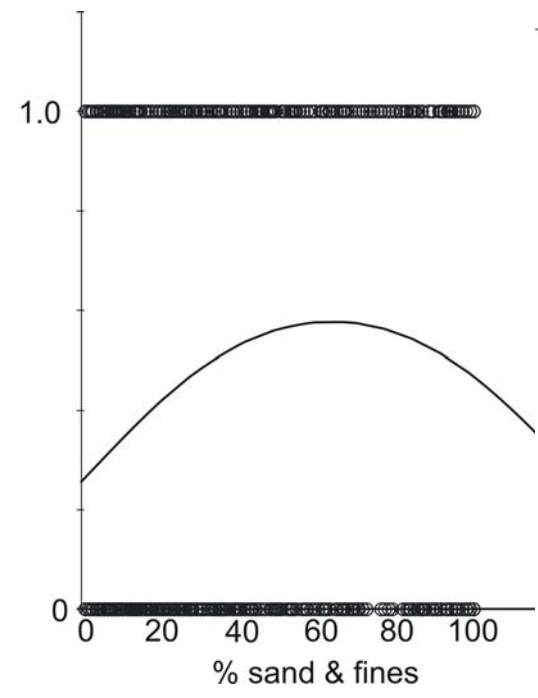
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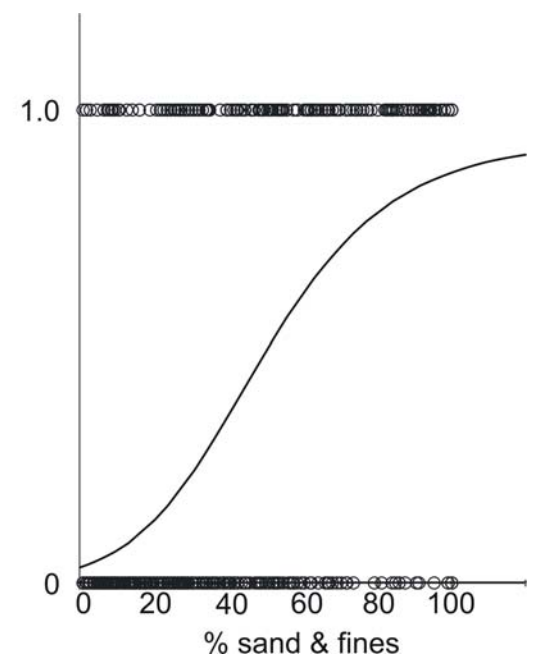
Micropsectra



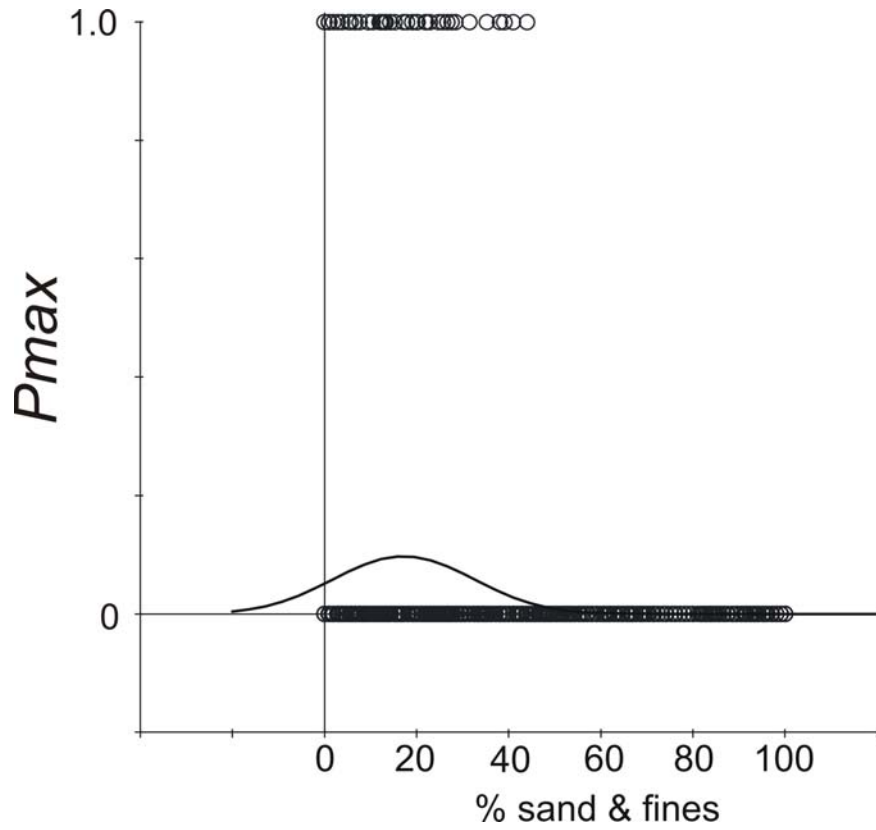
Tanytarsus



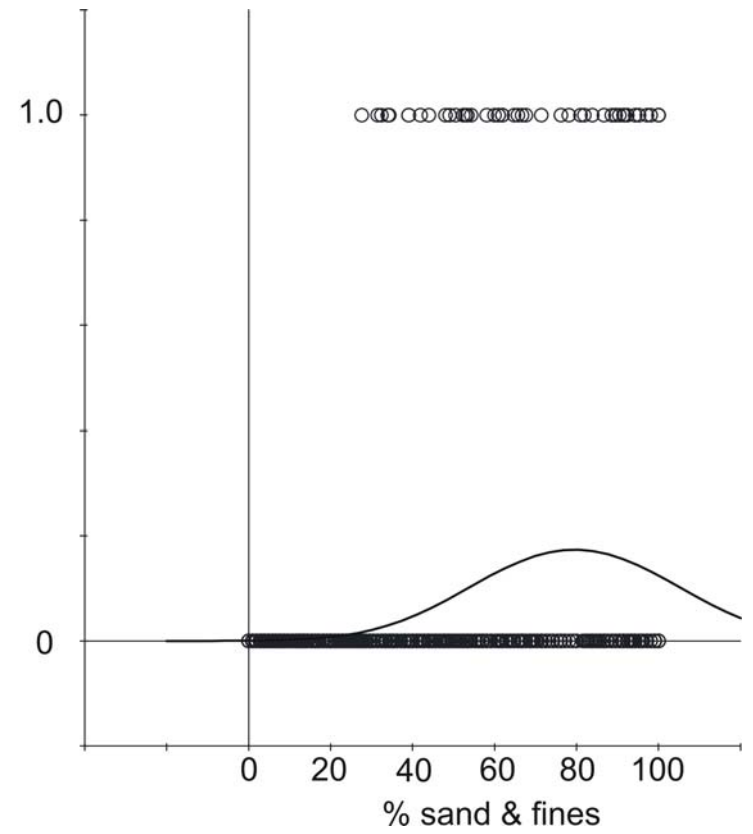
Cryptotendipes



Neophylax rickeri



Stenelmis



Conclusions???

- Maybe BMI assemblages don't have that much potential for stressor diagnosis
- Maybe we don't collect data at the scale at which bugs respond
- Maybe single stressor diagnosis isn't really feasible, since stressors rarely occur in isolation
- The dichotomy between widespread and rare taxa is a problem
- Species-level tolerance values don't seem to add predictive power over genus-level tolerance values, and don't really yield more responsive metrics