AMBI and M-AMBI for use in National Coastal Condition Surveys

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Existing Coastal Indices

Region/ Province	Data Source	Statistical Method	Component Metrics	Index Condition Scale		
				Good	Fair	Poor
Northeast/ Acadian	NCA 2000-2001	Logistic Regression Analysis	Diversity (Shannon *H'*) Pollution Tolerant Taxa Proportion Capitellids	> 5	4 – 5	< 4
Northeast/ Virginian	EMAP 1990-1993	Discriminant Analysis	Diversity (Gleason *D*) Abundance Tubificids Abundance Spionids	> 0	n/a	≤ 0
Southeast/ Carolinian	EMAP 1993-1994	Cluster Analysis	Abundance Species Richness Dominance Pollution Sensitive Taxa	> 2.5	2 – 2.5	< 2
Gulf/ Louisianan	EMAP 1991-1992	Discriminant Analysis	Diversity (Shannon *H'*) Abundance Tubificids Proportion Capitellids Proportion Bivalves Proportion Amphipods	> 5	3 – 5	< 3

West Coast Salinity-adjusted expected number of species

Region	Good	Fair	Poor
West	Observed species richness is more than 90% of the lower 95% confidence interval of expected species richness for a specific salinity.	Observed species richness is between 75% and 90% of the lower 95% confidence interval of expected species richness for a specific salinity.	Observed species richness is less than 75% of the lower 95% confidence interval of expected species richness for a specific salinity.

Existing Coastal Indices

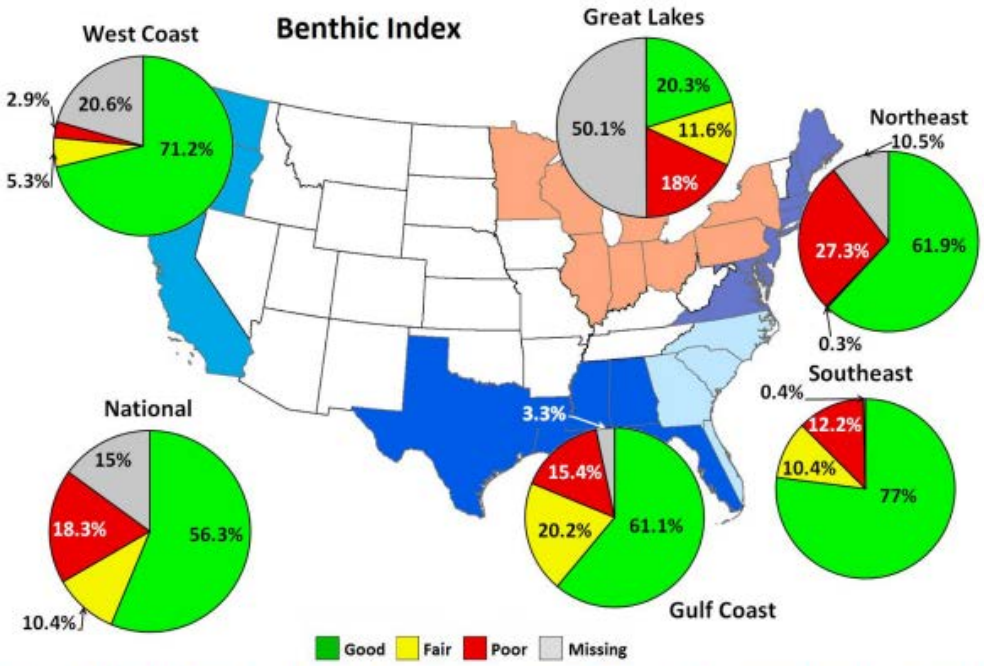

Figure 4-1. Biological quality of the nation's coastal waters, by region, based on the benthic index (NCCA 2010).

- Benthic Indices developed and calibrated separately for each Region
- Concerns about cross-region comparability

AMBI – Initial Development

Pergamon

Marine Pollution Bulletin Vol. 40, No. 12, pp. 1100–1114, 2000

Printed in Great Britain
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0025-326X/00 $ - see front matter

A Marine Biotic Index to Establish the Ecological Quality of Soft-Bottom Benthos Within European Estuarine and Coastal Environments

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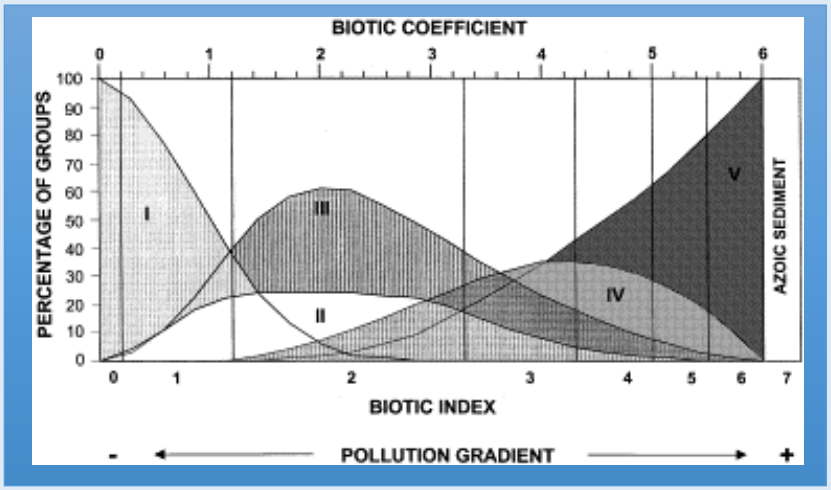

$$BI = 0 * \%EG\ I + 1.5 * \%EG\ II + 3 * \%EG\ III + 4.5 * EG\ IV + 6 * EG\ V$$

Range =

0 (unimpacted) to 6 (heavily impacted) or 7 (azoic)

- Previous Case Studies in FL, SoCal, Chesapeake Bay, Northwest

AMBI – Adaptation to US estuaries

- 3 Day workshop (Sept 2011)
- NCCA species categorized by EG group
- Workshop EG list augmented with existing European EG list
- 3 regional Datasets assembled – compared local index to AMBI
- Published results in 2015

Ecological Indicators 50 (2015) 99–107

Contents lists available at ScienceDirect

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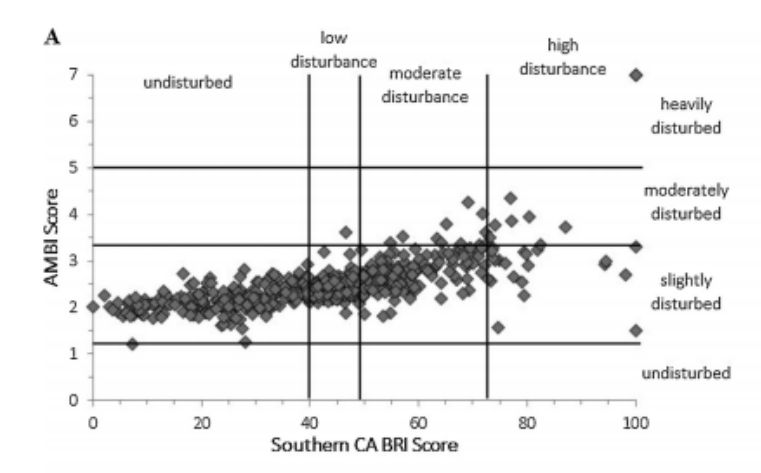
journal homepage: www.elsevier.com/locate/ecolind

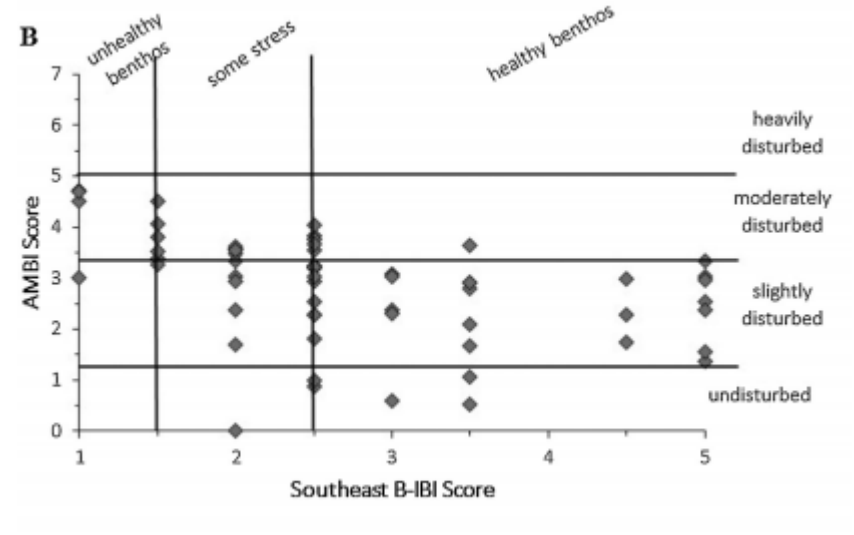
Effect of ecological group classification schemes on performance of the AMBI benthic index in US coastal waters

David J. Gillett [a,*], Stephan B. Weisberg [a], Treda Grayson [b], Anna Hamilton [c], Virginia Hansen [d], Erik W. Leppo [c], Marguerite C. Pelletier [e], Angel Borja [f], Donald Cadien [g], Daniel Dauer [h], Robert Diaz [i], Margaret Dutch [j], Jeffrey L. Hyland [k], Michael Kellogg [l], Peter F. Larsen [m], Jeffrey S. Levinton [n], Roberto Llansó [o], Lawrence L. Lovell [g], Paul A. Montagna [p], Dean Pasko [q], Charles A. Phillips [r], Chet Rakocinski [s], J. Ananda Ranasinghe [a], Denise M. Sanger [t], Heliana Teixeira [u], Robert F. Van Dolah [t], Ronald G. Velarde [v], Kathy I. Welch [j]

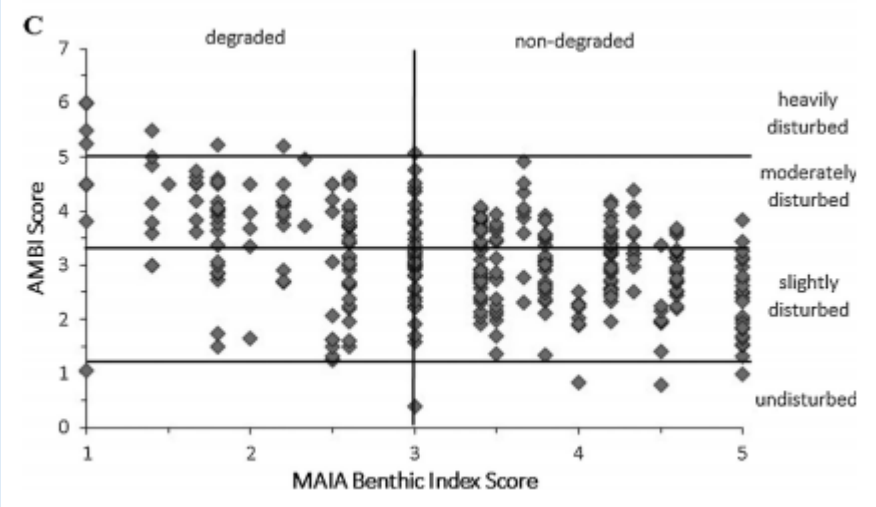
AMBI – Adaptation to US estuaries



R = 0.736, p<0.0001

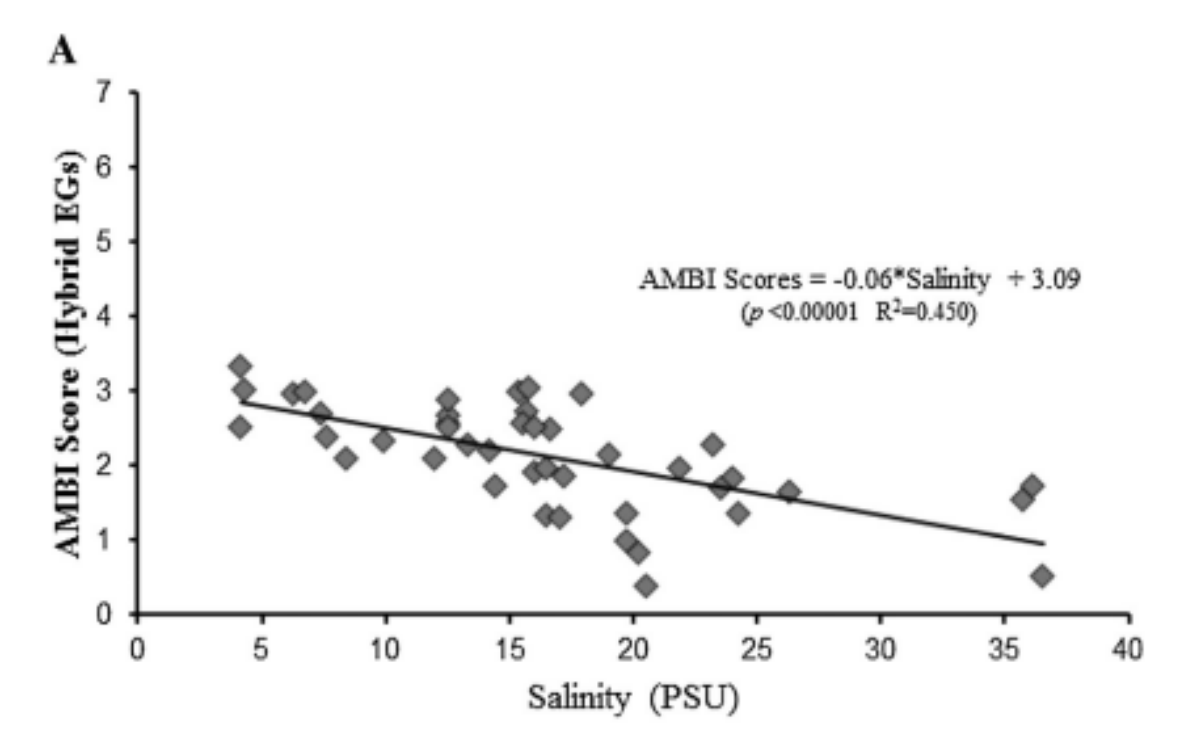


R = 0.525, p<0.0001



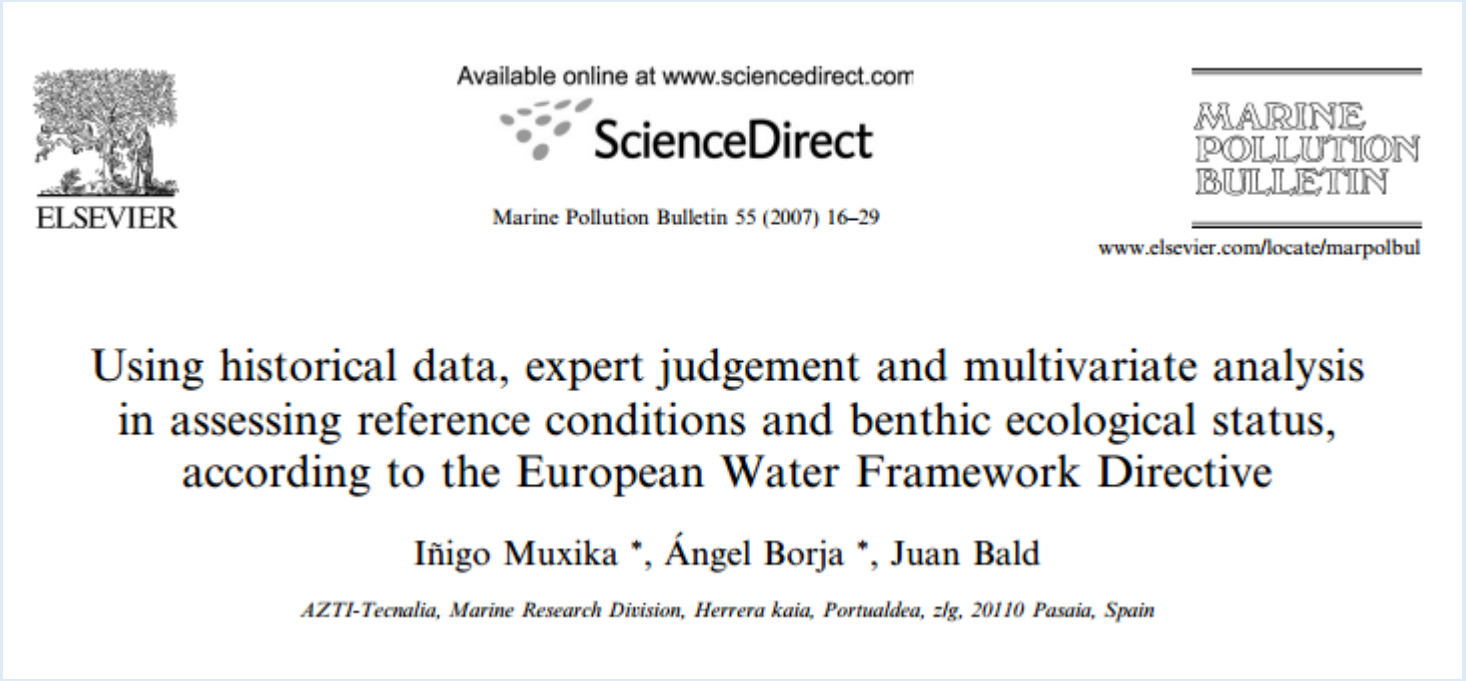
R = 0.437, p<0.0001

AMBI – Adaptation to US estuaries



- Strong salinity bias seen in unimpacted station in the southeast and mid-Atlantic (SoCal is primarily high salinity sites so a salinity bias would not be expected)

M-AMBI – Initial Development



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Using historical data, expert judgement and multivariate analysis in assessing reference conditions and benthic ecological status, according to the European Water Framework Directive

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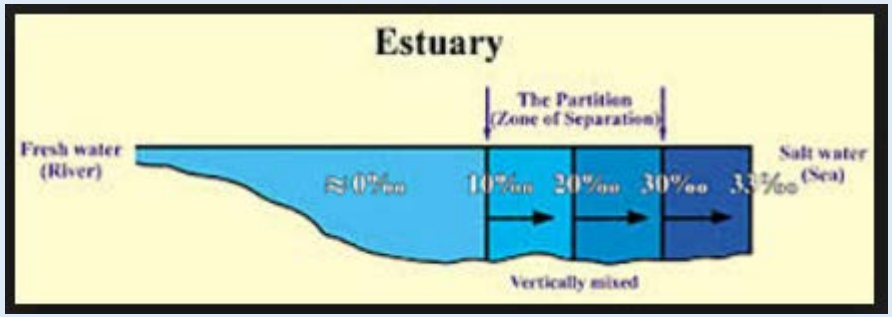
- Used Factor Analysis to combine AMBI, diversity (H') and species richness into a new index
- Classified by habitat (salinity and location (coastal)
- Good and Bad endpoints derived for each metric
- Range = 0 (Bad) to 1 (High)

Stretches
Oligo/mesohaline
Polyhaline
Euhaline (estuarine)
Euhaline (coastal)

M-AMBI – Adaptation to US estuaries

- Venice salinity classification to identify habitats

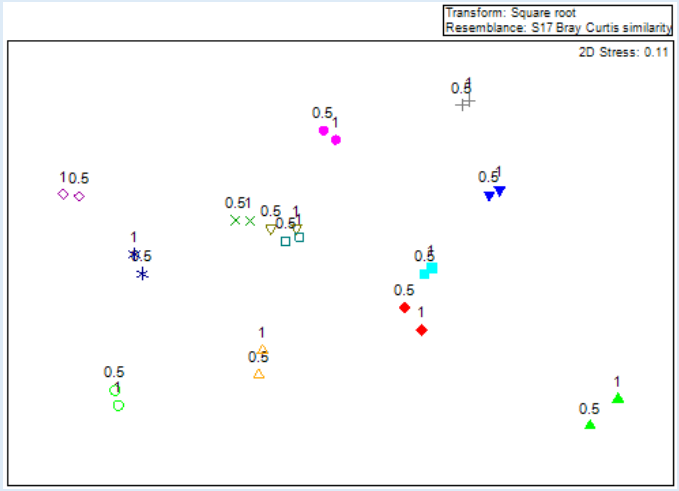


Habitat	Salinity (psu)		
Tidal Freshwater	<0.5		
Oligohaline	0.5	to	<5
Mesohaline	5	to	<18
Polyhaline	18	to	<30
Euhaline	30	to	<40
Hyperhaline	>=40		

- Examined West Coast data – used larger grab (0.1 m^2 grab vs 0.04 m^2 grab or equivalent) and sieve (1.0 mm vs. 0.5 mm)

M-AMBI – Adaptation to US estuaries

- West Coast gear differences
  - Sieve size differences did not appear to be significant based on subset of stations using both sieves



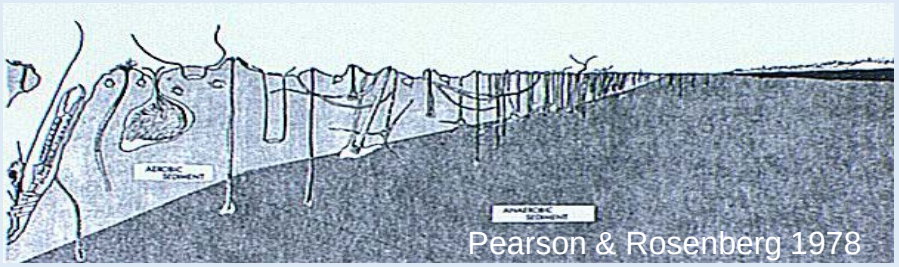
  - Grab size impacted the total number of species

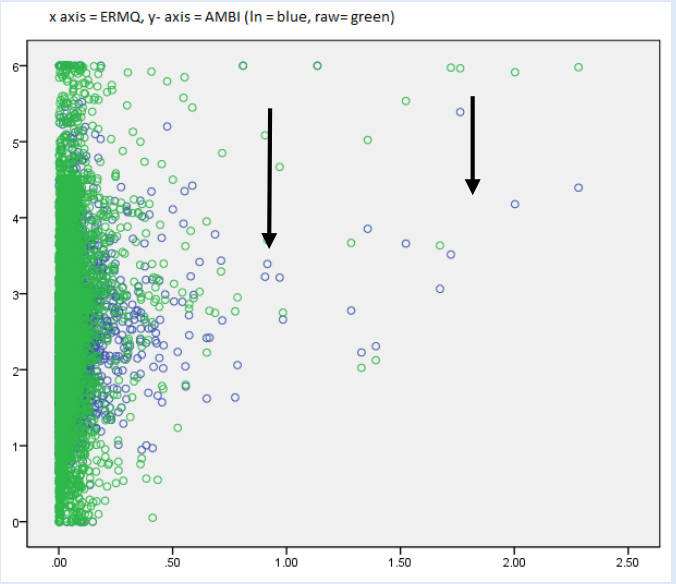
95th percentile (S, H') 5th percentile (AMBI)	Rest of US			WEST		
	S	H'	AMBI	S	H'	AMBI
Polyhaline mud	31	2.74	1.07	67	3.03	1.31
Polyhaline sand	50	3.06	0.60	80	3.33	0.00
Euhaline mud	49	3.07	0.94	78	3.40	1.58
Euhaline sand	62	3.34	0.57	104	3.73	0.38

M-AMBI – Adaptation to US estuaries

- Derived Bad/High endpoints for factor analysis calculation based on habitat
  - Tidal freshwater, Oligohaline, Mesohaline, Hyperhaline – few of these sites on West coast, so calculated for entire US
  - Polyhaline and Euhaline – calculated thresholds separately for West only and Rest of US

- Used raw abundance (rather than ln(abundance) as in Gillett paper) due to dampening of benthic response to chemical contamination

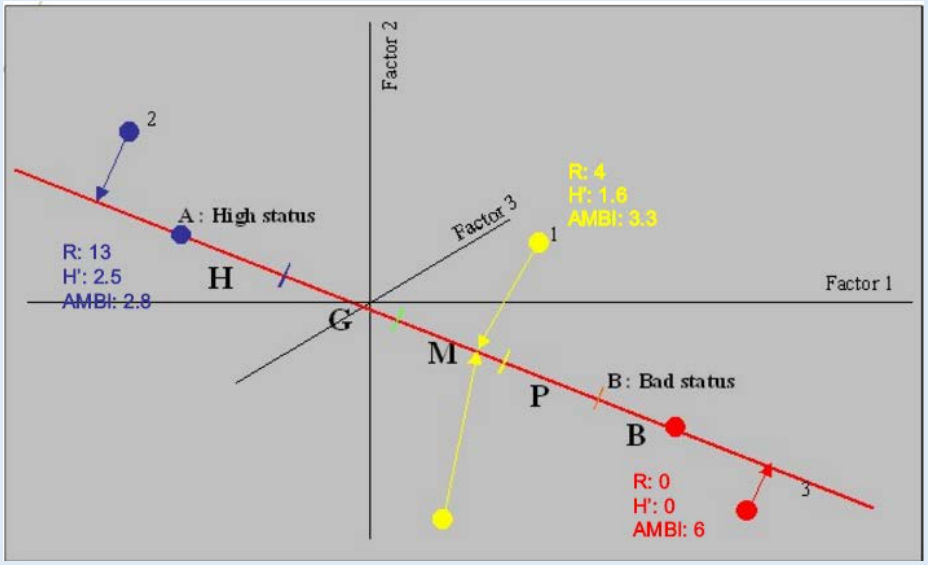




M-AMBI – Adaptation to US estuaries

- Using 2000-2006 NCA data, explored use of metrics other than S and H' (e.g., dominance % oligochaetes)

- Calculating M-AMBI for 3 validation datasets
  - Compare to local indices
  - Look at calibration accuracy vs. apriori Good/Bad sites
  - Look to see if salinity correlation has been reduced or eliminated



Summary

- AMBI is an abundance-weighted tolerance index analogous to the Hilsenhoff Index (conceptually)

- M-AMBI is multivariate AMBI
  - Accounts for naturally structuring parameters (e.g., salinity)
  - Improves index performance by adding additional metrics

- For the Great Lakes we would like to have an index that is conceptually compatible with the estuarine approach, if possible