Chesapeake Bay Benthic Index of Biotic Integrity

Tidal Monitoring and Analysis Workgroup

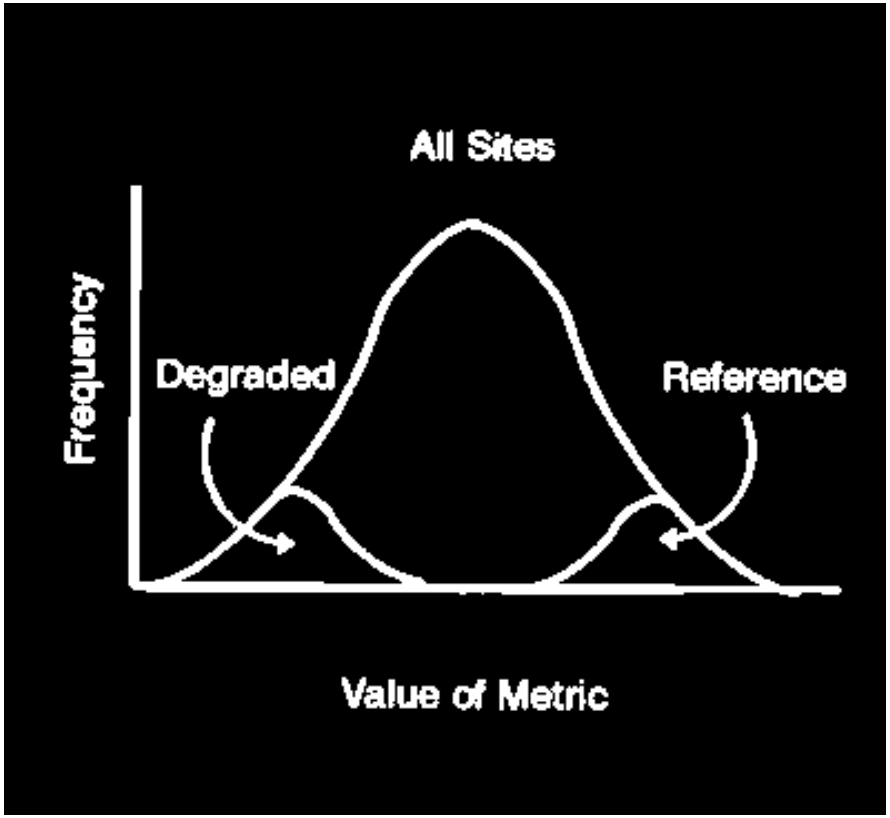
June 12, 2012

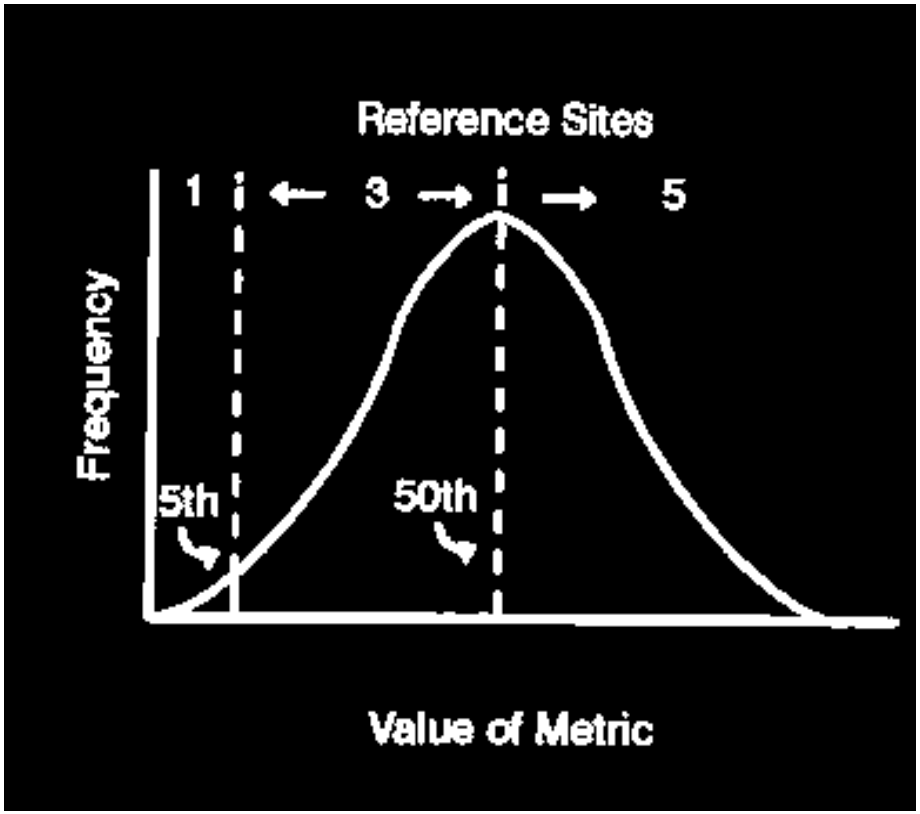
B-IBI Background

- Based on quantitative benchmarks that describe the characteristics of benthic assemblages expected in non-degraded habitats of Chesapeake Bay
- Multimetric, habitat-specific index of benthic community condition
- Metric selection and values for scoring metrics developed separately for each of seven benthic habitat types
- Described in:

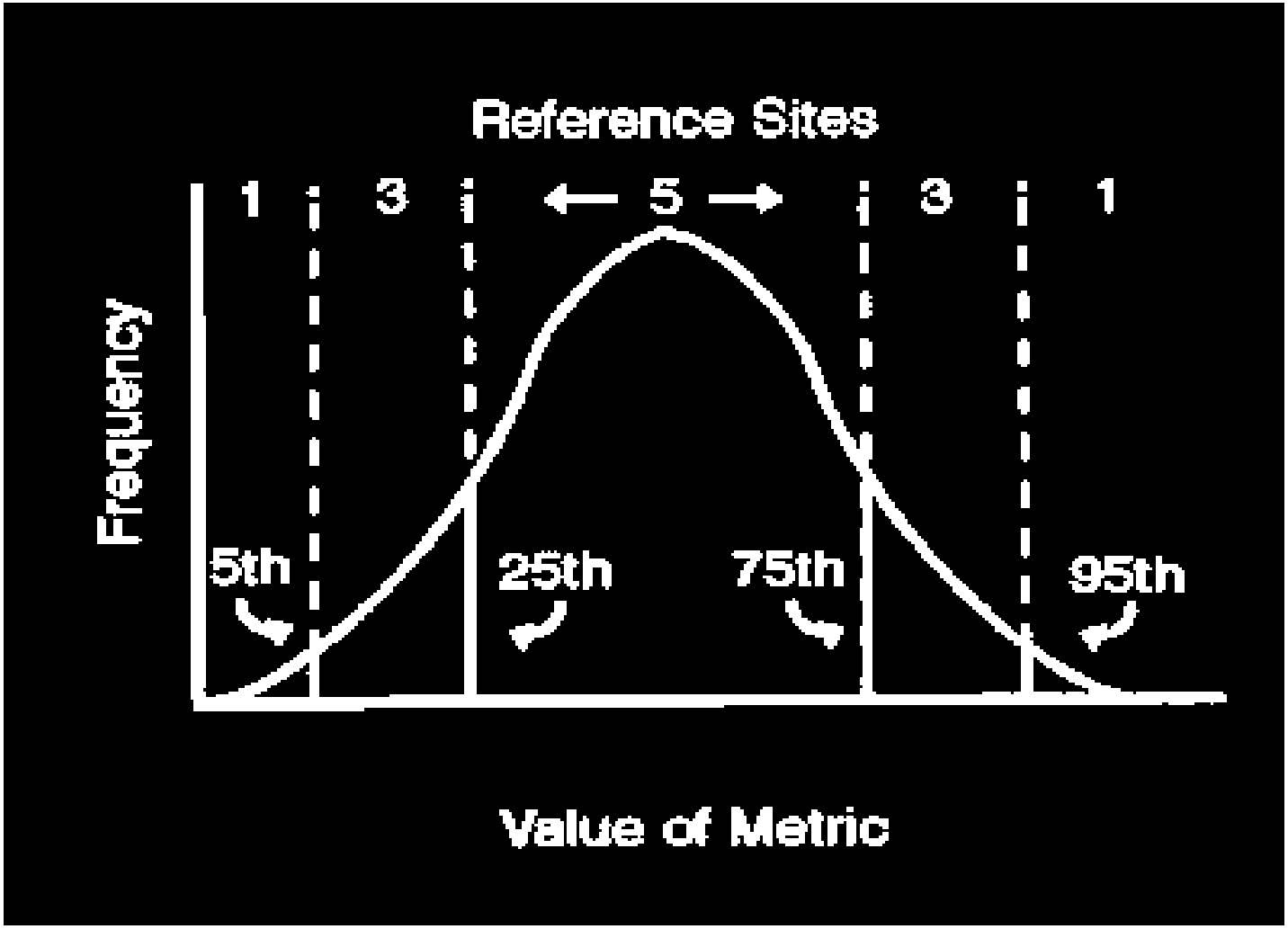
  - Weisberg et al. (1997), *Estuaries* 20:149-158.
  - Alden et al. (2002), *Environmetrics* 13:473-498.
  - Llanso et al. (2002), *Estuaries* 25:1219-1230, and 25:1231-1242.
  - Llanso et al. (2003), *Environmental Monitoring and Assessment* 81:163-174.
  - Dauer and Llanso (2003), *Environmental Monitoring and Assessment* 81:175-186.
  - Llanso et al. (2009), *Environmental Monitoring and Assessment* 150:119-127.

Benthic Index of Biotic Integrity Metric Scoring System





Excess Abundance or Excess Biomass Indicative of Stress



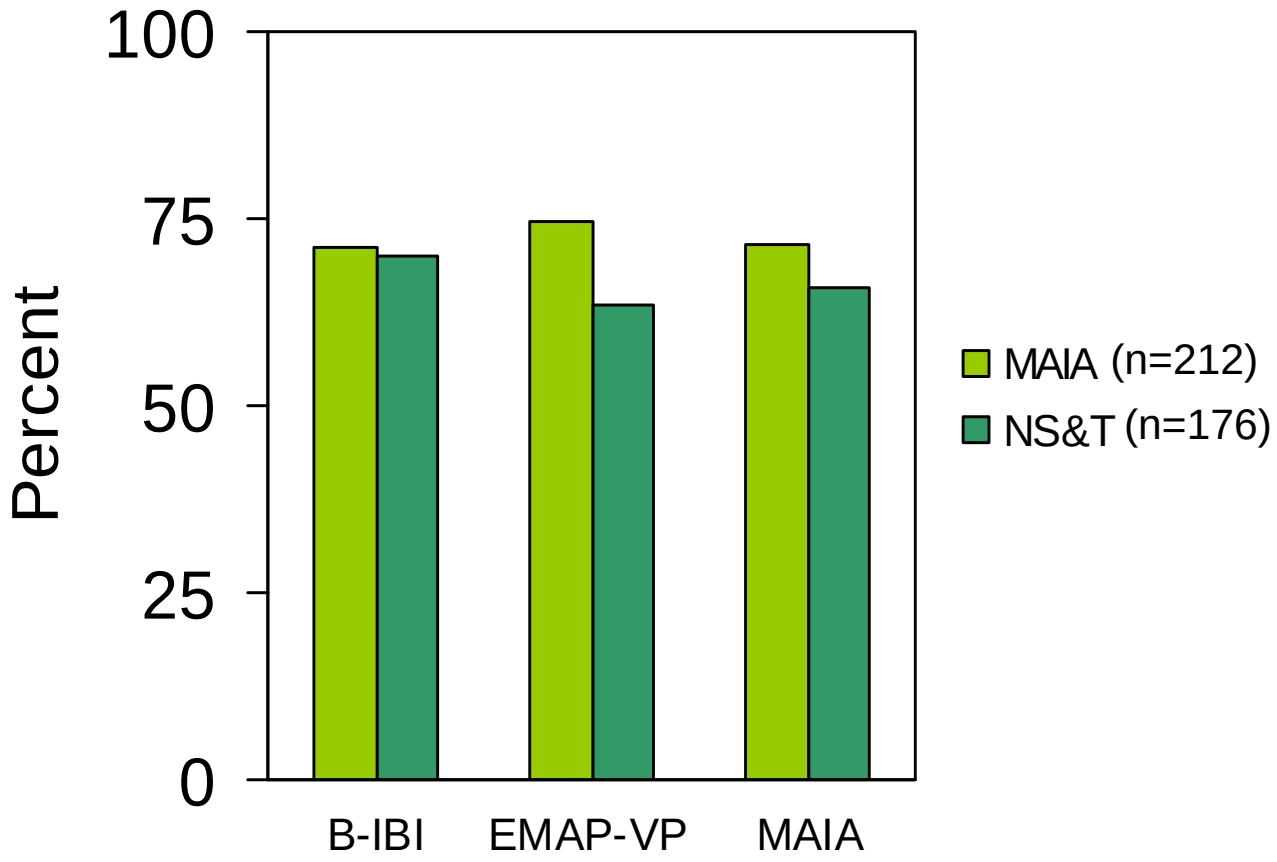
Metrics

Metric	Habitat Class						
	TF	OL	LM	HM sand	HM mud	PO sand	PO mud
Shannon-Wiener species diversity index			X	X	X	X	X
Total species abundance	X	X	X	X	X	X	X
Total species biomass			X	X	X	X	X
Percent abundance of pollution-indicative taxa	X	X	X	X			
Percent abundance of pollution-sensitive taxa		X		X		X	
Percent biomass of pollution-indicative taxa					X	X	X
Percent biomass of pollution-sensitive taxa			X		X		X
Percent abundance of carnivore & omnivores		X		X	X		X
Percent abundance of deep-deposit feeders	X					X	
Tolerance Score	X	X					
Tanypodinae to Chironomidae percent abundance ratio		X					
Percent biomass >5 cm below the sediment-water interface			X		X		
Percent number of taxa >5 cm below the sediment-water interface							X

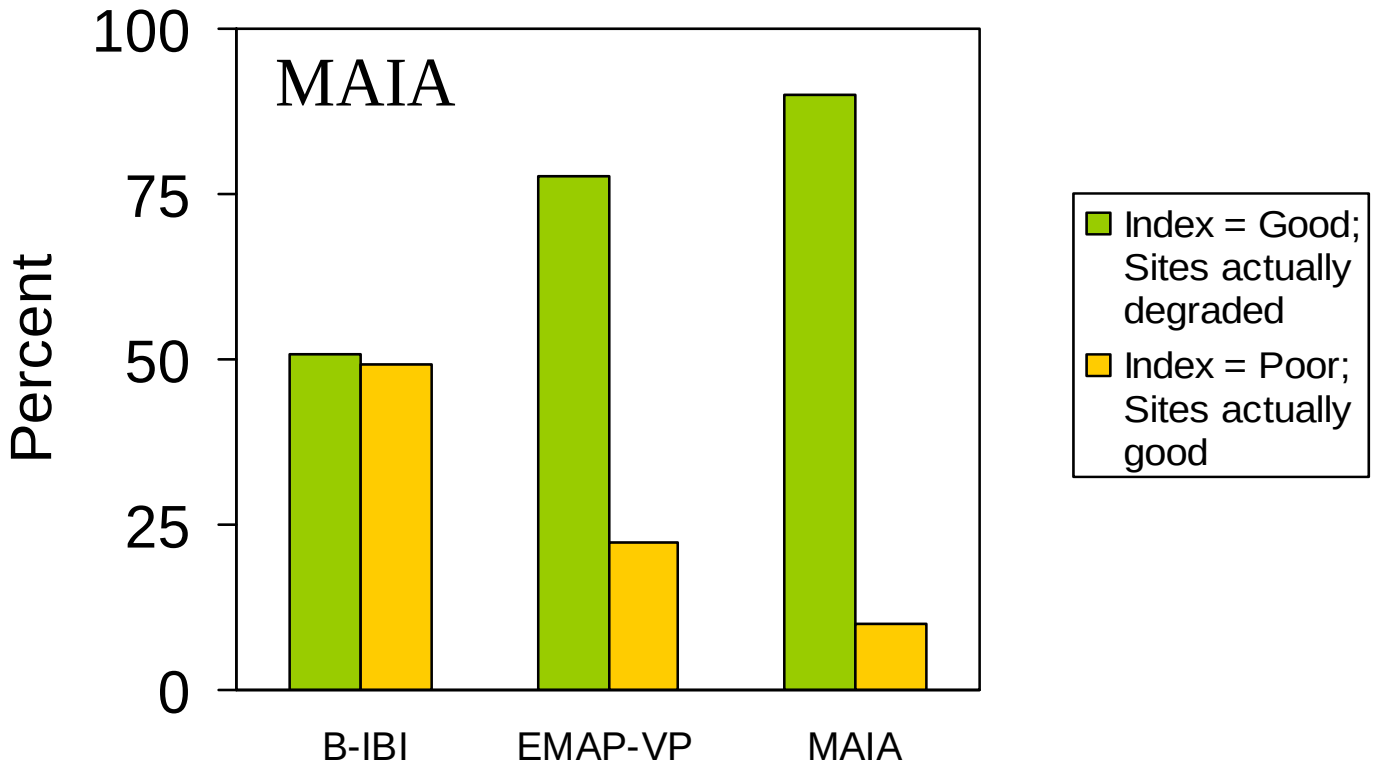
Classification Efficiency

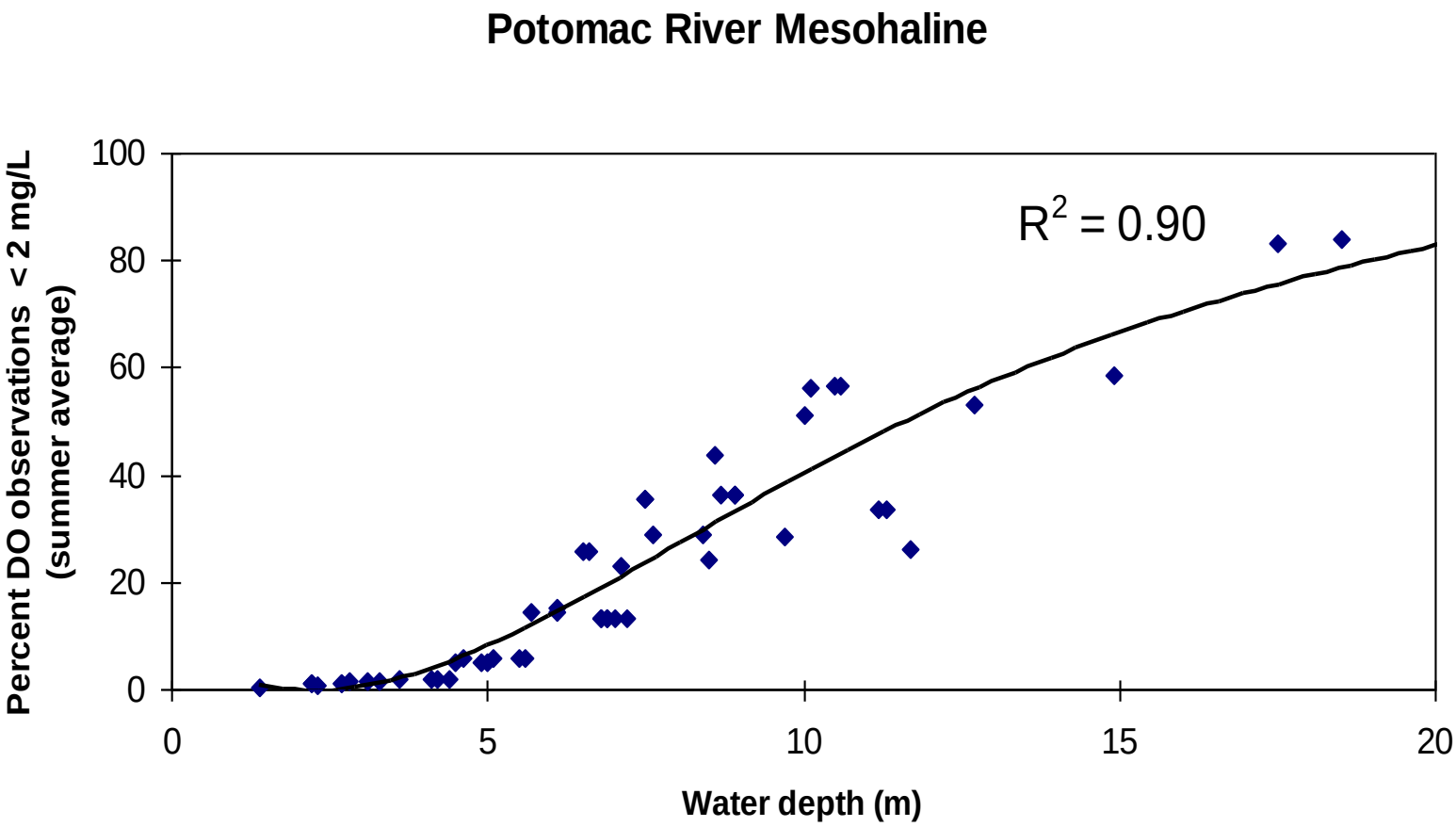
Habitat Type	Number of Samples	Percent Correctly Classified
Tidal fresh	211	66
Oligohaline	124	73
Low Mesohaline	29	82
High Mesohaline Sand	2	50
High Mesohaline Mud	50	96
Polyhaline Sand	11	100
Polyhaline Mud	52	100

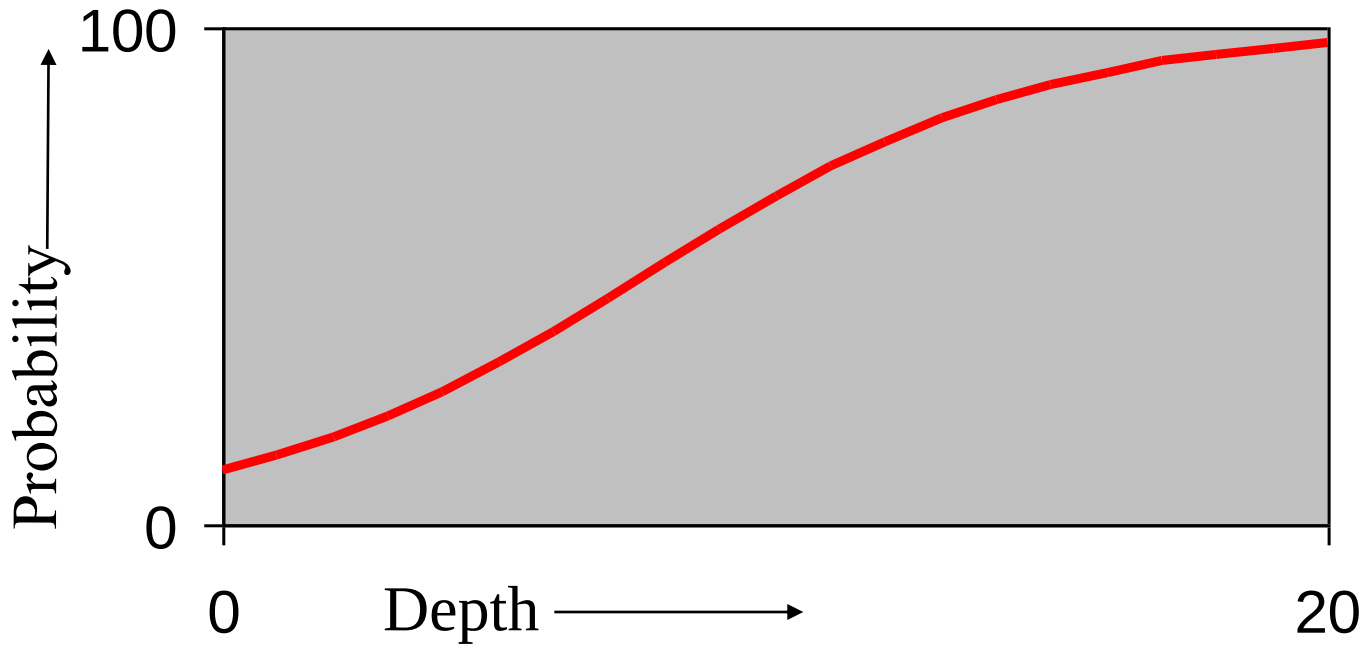
Correct Classifications Based on DO, Contaminant, and Toxicity Criteria

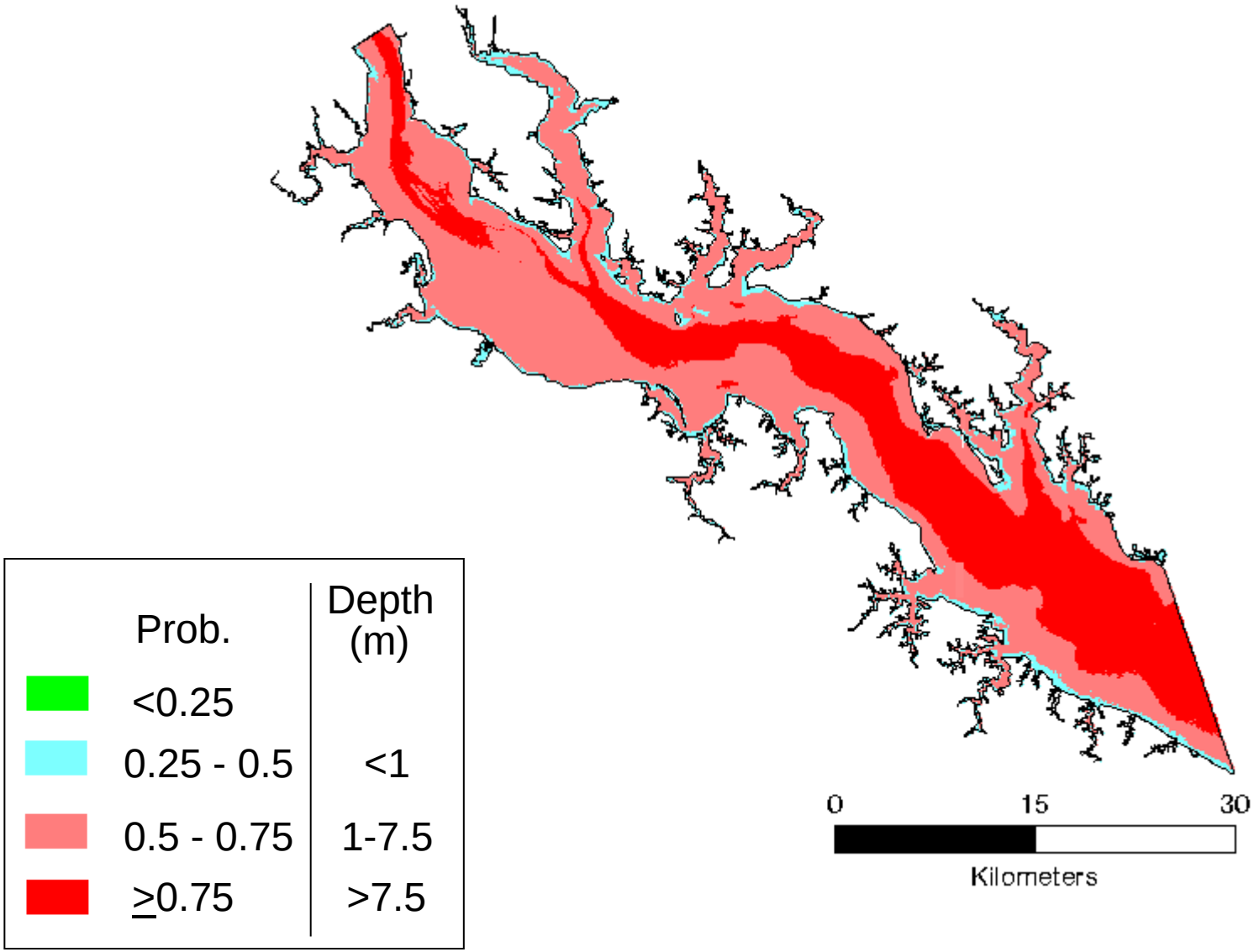


Misclassifications



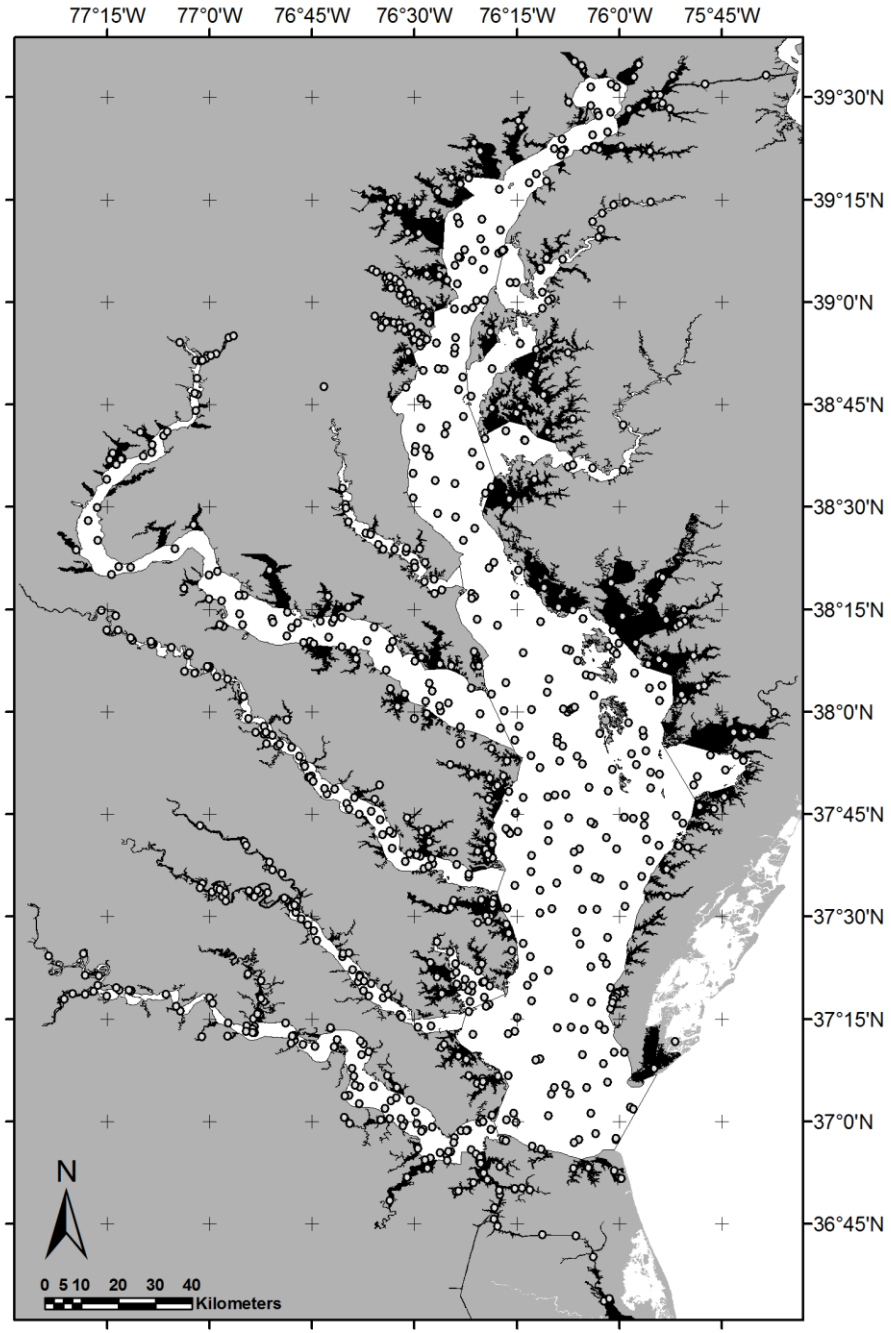

Potomac River Mesohaline
Percent DO observations < 2 mg/L (summer average)
100
80
60
40
20
0
0
5
10
15
20
Water depth (m)
R2 = 0.90

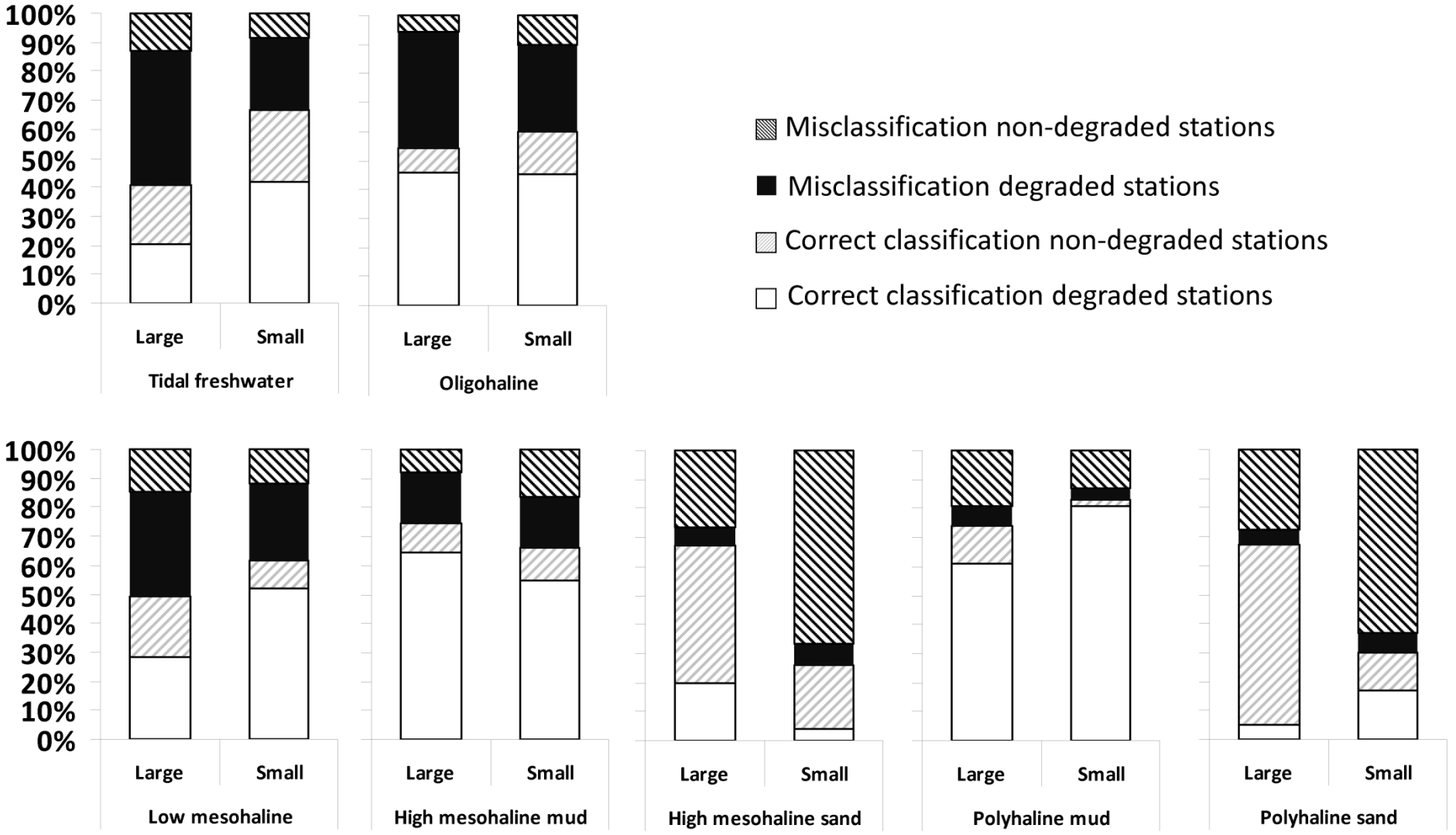

100
Probability
0
0
Depth
20


Prob.
Depth (m)
<0.25
0.25 - 0.5
<1
0.5 - 0.75
1-7.5
≥0.75
>7.5
0
15
30
Kilometers

Performance Issues

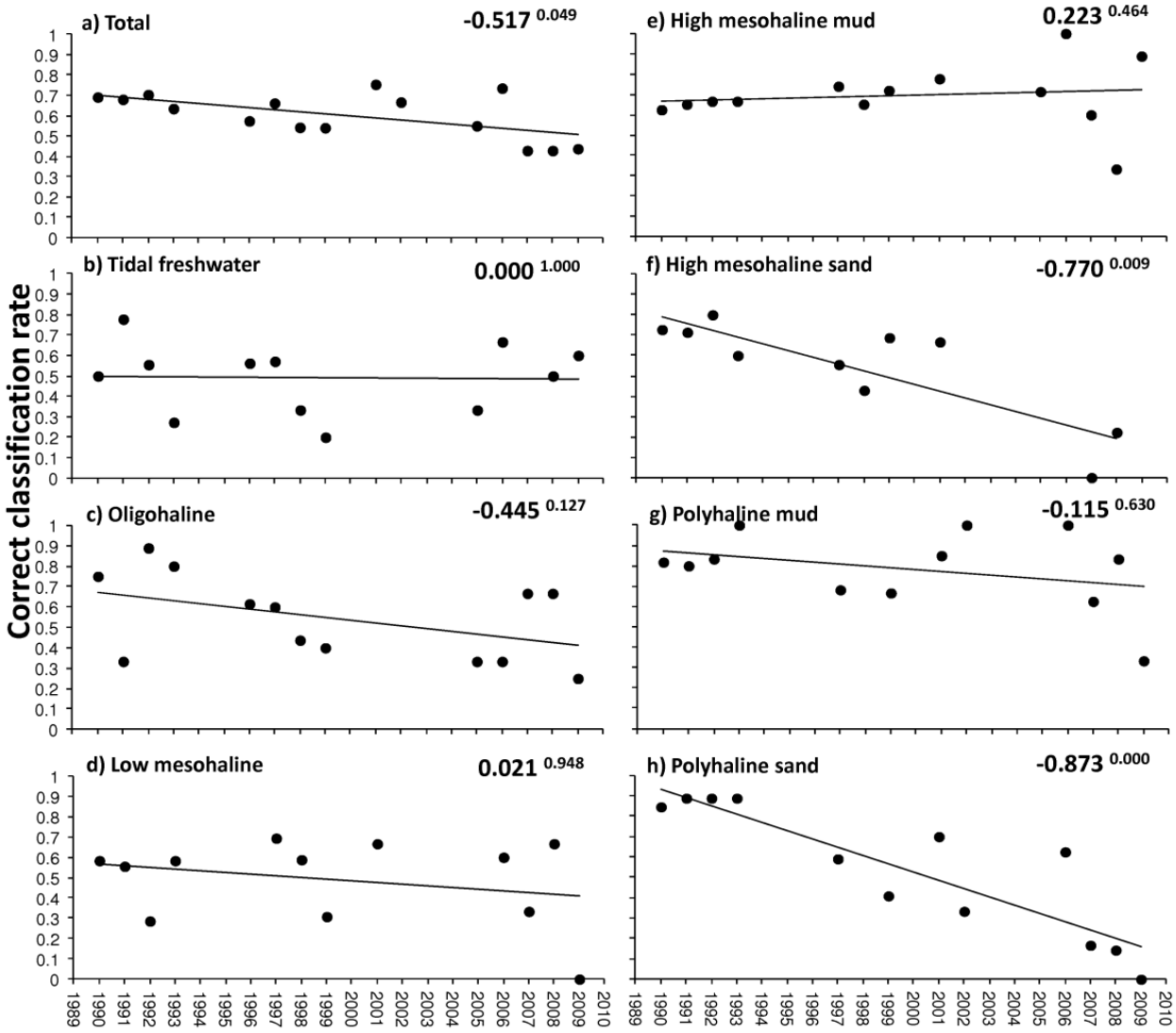
- Differences in classification efficiency by estuary size


77°15'W
77°0'W
76°45'W
76°30'W
76°15'W
76°0'W
75°45'W
39°30'N
39°15'N
39°0'N
38°45'N
38°30'N
38°15'N
38°0'N
37°45'N
37°30'N
37°15'N
37°0'N
36°45'N
N
0 5 10 20 30 40
Kilometers


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Misclassification non-degraded stations
Misclassification degraded stations
Correct classification non-degraded stations
Correct classification degraded stations
Large
Small
Tidal freshwater
Oligohaline
Low mesohaline
High mesohaline mud
High mesohaline sand
Polyhaline mud
Polyhaline sand

Performance Issues

- Differences in classification efficiency by estuary size
- Better correct classification levels in small bays than in open waters in low salinity habitats (TF-Low Mesohaline), but lower correct classification levels (below those of the initial calibration effort) in small bays in high salinity habitats (mesohaline and polyhaline sands).
- Long-term changes in classification efficiency


Correct classification rate
a) Total
-0.517 0.049
b) Tidal freshwater
0.000 1.000
c) Oligohaline
-0.445 0.127
d) Low mesohaline
0.021 0.948
e) High mesohaline mud
0.223 0.464
f) High mesohaline sand
-0.770 0.009
g) Polyhaline mud
-0.115 0.630
h) Polyhaline sand
-0.873 0.000
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

Performance Issues

- Differences in classification efficiency by estuary size
- Better correct classification levels in small bays than in open waters in low salinity habitats (TF-Low Mesohaline), but lower correct classification levels (below those of the initial calibration effort) in small bays in high salinity habitats (mesohaline and polyhaline sands).
- Long-term changes in classification efficiency
- Spatial stratification and salinity issues
- Differences in pollution indicative and pollution sensitive species lists among the different salinity habitats
- Low mesohaline regions with productive clam beds for which the B-IBI biomass metric receives a "1" for excess biomass
- Diagnostic approaches have been developed to determine sources of anthropogenic stress; however large data sets that were unavailable to Weisberg et al. can be used today to calibrate the B-IBI