Methods for Stressor Identification

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Why do a stressor ID?

- TMDLs required for any stream that is listed as biologically impaired

- Identify areas of impairment so the TMDL process can determine appropriate management actions

What samples need a stressor ID?

- Pre-TMDL Monitoring Stations

- Targeted Monitoring

- Probabilistic Monitoring

- Long Term Monitoring Stations

- Benthic IBIs Dictate
  - WVSCI
    - Impairment threshold <72
  - ALCAT
    - Impairment threshold <100 % of Threshold
- Impairments applied to stream segments
  - AUIDs

Data Used

- WQSAS Monitoring Unit Database (WABbase)
  - WQ samples
  - Habitat surveys
  - Benthic macroinvertebrate surveys
  - Fish surveys
  - Pollutant source tracking information
  - Photos
  - O/E Model

- GIS Data
  - Aerial imagery
  - NPDES permit layer
  - WVDEP Abandoned Mine Land (AML) layers
  - WVDEP Div. of Mining and Reclamation (DMR) layers
  - WVDEP Office of Oil and Gas (OOG) layers
  - Geologic formations

O/E Model and Stressor Modules

- Ratio of observed taxonomic richness to the expected taxonomic richness in the absence of disturbance

- Modules
  - O/E Sensitive
  - O/E Opportunistic
  - Discriminant Analysis
  - Percent Model Affinity
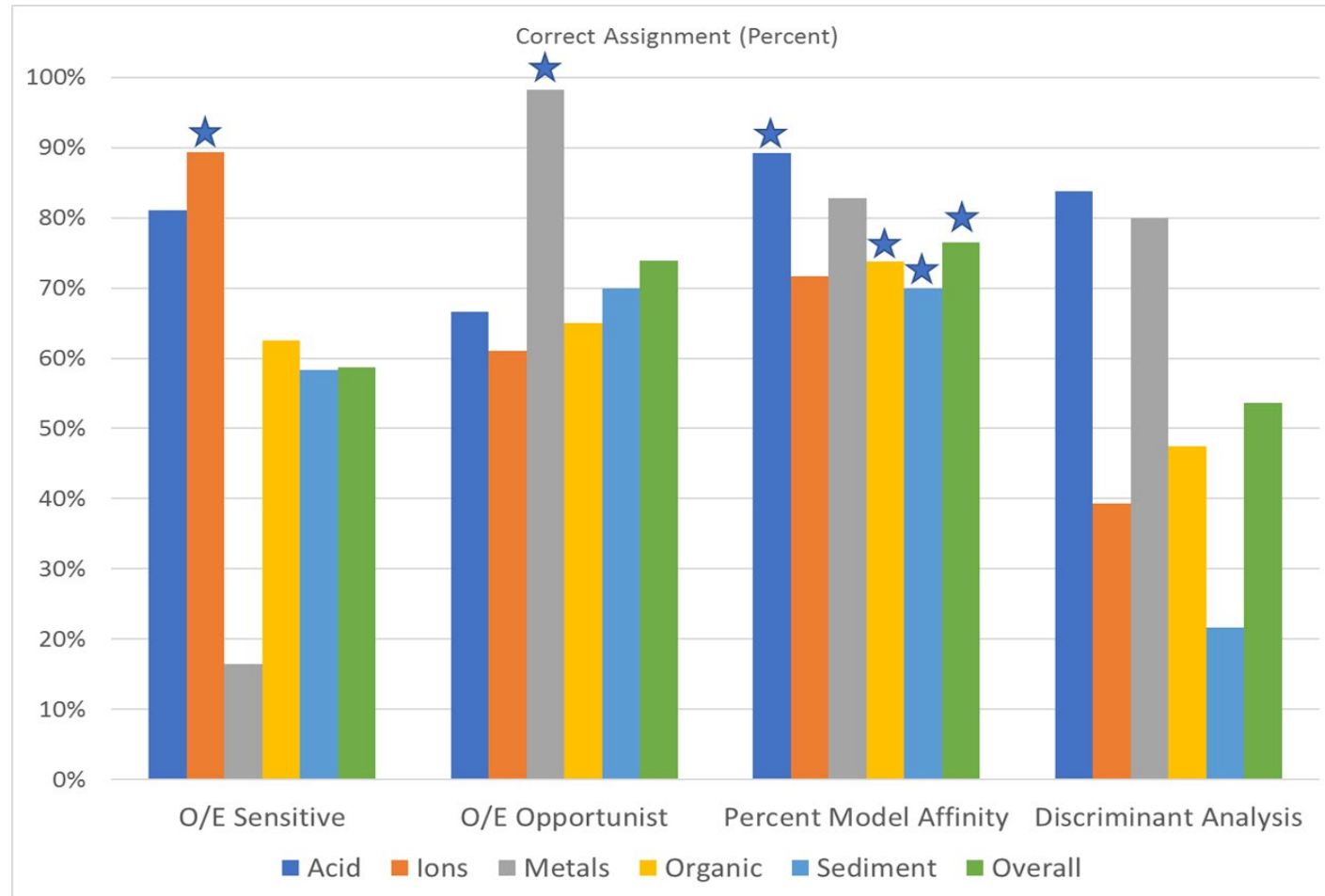
O/E Model and Stressor Modules

Figure 7 – Percent of correct stressor sample assignments by each method for each stressor type.

Determining Comparability

- Are samples comparable?
  - Sample methods/protocol deviations
  - Depth
  - Velocity
  - Scour
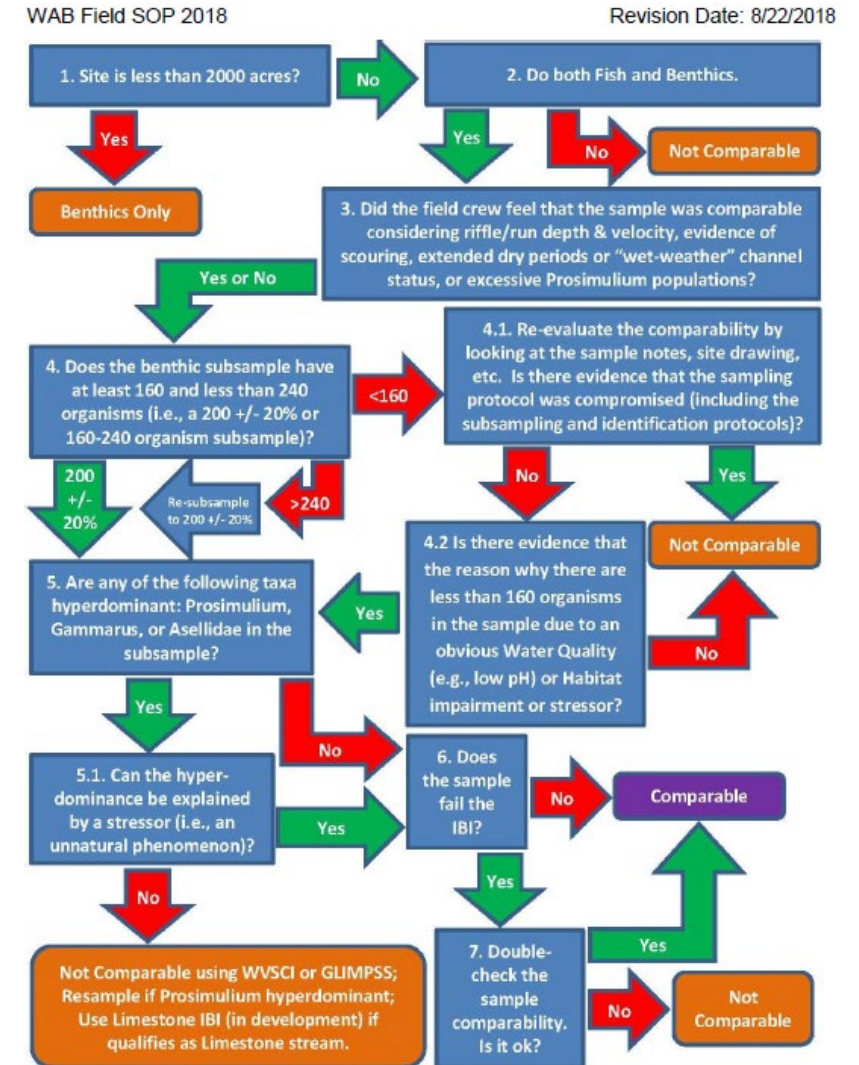 - Extended dryness
  - Wet-weather
  - Hyperdominance

Figure 5-17. Benthic Comparability Flow Chart

Stressor Categories

- Metals Toxicity/AMD
- Acid Deposition
- High pH
- Ionic Strength
- Sediment
- Metals Flocculation
- Organic Enrichment
- Temperature

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Inferring Causes of Biological Impairment in the Clear Fork Watershed, West Virginia

Sediment

%Fines (SA+ST+CL)	RBP Embed	RBP Sed Dep	RBP Bank Stab	Silt Rating	Sand Rating
> 25	< 9 (8)	< 8 (7)	< 12 (11)	> 2	> 2

O/E Sensitive	O/E Opportunistic	O/E PMA
<0.5	>2.0	>0.3

Benthic Macroinvertebrate Taxa Review: review taxa lists and metrics to find indicators of excess sediment. For example, *Caenis* is a common opportunistic taxon in streams with excess sediment, and the metric % Elmidae is often increased.

Qualitative Habitat Evaluation: professional judgment applied to combination of station observations including RBP embeddedness, sediment deposition, bank stability, bank vegetation, riparian vegetation, and total scores; supplemented with watershed erosion rating, reach substrate particle characterization, sediment layer profile, and field rating of sediment stress. Station photography, GIS imagery evaluation and land use, and field notes/source tracking observations.

Sediment

The threshold for identifying stress using % Fines (sand+silt+clay in benthic kick), RBP Embeddedness, RBP Sediment, and RBP bank Stability was taken from *Inferring Causes of Biological Impairment in the Clear Fork Watershed, WV*.

		TABLE 1 cont.				
		Weakening Evidence from Reference Sites or Other Data		**Supporting Evidence from Stressor-Response**		
Candidate Cause	Stressor Indicator Measures	Reference Threshold	Data Source	Plausible S-R Threshold (LOWESS line declines)	Substantial Effects Threshold	Comments
5. Sedimentation	TSS	max < 7 mg/L	95%ile reference	No S-R impairment	No S-R impairment	See Appendix A and Figure A-17b
	% Fines (sand + silt + clay)	max $\leq$ 30%	95%ile reference	>30%	>30%	LOWESS suggested threshold around 20% (see Figure A-15a); change point of raw data suggested substantial effects above 24%
	RBP: Embedded-ness	min $\geq$ 13	5%ile reference	<13	<9	Change Point Analysis; (see Appendix A and Figure A-13b,f; Table A-1)
5. cont.	RBP: Sediment	min $\geq$ 11	5%ile reference	<11	<8	Change Point Analysis; (see Appendix A and Figure A-13c,g; Table A-1)
	RBP: Total (adjusted to post-1998 RBP)	min $\geq$ 147	5%ile reference	<140	<130	Change Point Analysis; (see Appendix A and Figure A-13a,e; Table A-1)
	RBP: bank stability	min $\geq$ 13	5%ile reference	<13	<12	Change Point Analysis; (see Appendix A and Figure A-13d,h); Table A-1

Sediment

Sample ID 51232 | Benthic Col ID 7438 — **Benthic OE Stressor ID Models**

Benthic Sample ID 51232.1
OE/PMA Stressor ID 4843

	Observed	Expected	O/E	BC
O/E Model	10	10.62	0.94	0.3545
Null Model	8	8.82	0.91	0.4232

O/E Model: >=0.7 = Unimpaired; <0.7 = Impaired

Sensitive
Acid Deposition	10	8.7668
Metal Toxicity	16	20.0077
Ionic Strength	4	9.4641
Organic Enrichment	2	11.321
Sedimentation	2	11.8148

Opportunistic
Acid Deposition	1	1.2466
Metal Toxicity	2	0.726
Ionic Strength	7	3.4728
Organic Enrichment	12	2.3668
Sedimentation	13	2.5396

Probability: Group 1 0.021; Group 3 0.069; Group 7 0.186; Group 8 0.055; Group 15 0.248; Group 16 0.047; Group 17 0.062; Group 18 0; Group 24 0.016; Group 35 0.007; Group 39 0; Group 42 0.001; Group 52 0.001; Group 95 0.033; Group 97 0.017; Group 102 0.022; Group 126 0.215

Group Prediction: Group 15

Stressor	PMA Model	O/E Sens Model	O/E Opp Model	DFA Model	Primary Model	Secondary Model	Tertiary Model
Acid Deposition	0.28	1.14	0.80	0.14	No	No	No
Metal Toxicity	0.20	0.80	2.75	0.24	Yes	No	No
Ionic Strength	0.29	0.42	2.02	0.13	Yes	No	Yes
Organic Enrichment	0.35	0.18	5.07	0.20	Yes	Yes	Yes
Sedimentation	0.37	0.17	5.12	0.29	Yes	Yes	Yes
Model Call	SED	SED	SED	SED			

DFA Model Experience

Stressor Model Result Interpretation:
PMA (Percent Model Affinity): >0.3 = STRONG INDICATION OF STRESSOR
O/E Sensitive: <0.5 = STRONG INDICATION OF STRESSOR
O/E Opportunist: >2 = STRONG INDICATION OF STRESSOR
DFA (Discriminant Function Analysis/Ordination: >0.5 = STRONG INDICATION OF STRESSOR

Preferred Stressor Model:
Acid Deposition: 1st-PMA, 2nd-DFA, 3rd-O/E Sensitive
Metal Toxicity: 1st-O/E Opportunist, 2nd-PMA, 3rd-DFA
Ionic Strength: 1st-O/E Sensitive, 2nd-PMA, 3rd-O/E Opportunist
Organic Enrichment: 1st-PMA, 2nd-O/E Opportunist, 3rd-O/E Sensitive
Sedimentation: 1st-PMA, 2nd-O/E Opportunist, 3rd-O/E Sensitive

Stressor ID Call
Sample ID 51232 — Modified: 20181024
Stressor ID | Stressor ID By | Stressor ID Date | Stressor ID Reasoning

Stressor Reference Group Data Partitions:
Acid Deposition: pH <5.5 and DO >6; Sp. Cond <100; Fecal <800; Benthic Substrate >10; Periphyton Ab. <=2 or NR; Filamentous Algae Ab. <=2 or NR
Metal Toxicity: pH <6; DO >6; Sp. Cond >300; Fecal <800; Diss. Al >0.4
Ionic Strength: pH >=6 and <8.5; DO >6; Sp. Cond >500; Fecal <800; Benthic Substrate >11; Periphyton Ab. <=2 or NR; Filamentous Algae Ab. <=2 or NR
Organic Enrichment: pH >=6 and <8.5; DO >6; Sp. Cond <300; Fecal >800; Benthic Substrate >=11 OR Periphyton Ab. <=2 or NR OR Filamentous Algae Ab. <=2 or NR
Sedimentation: pH >=6 and <8.5; DO >6; Sp. Cond <300; Fecal <800; Benthic Substrate <10; Periphyton Ab. <=2 or NR; Filamentous Algae Ab. <=2 or NR

Benthic OE Stressor Model Taxa Data — Modified: 20210208

OE Stressor ID Taxa	Count	Total Ind	Rel Ab	Pc	Acid	Ion
Psephenus	1	195	0.005128	0.260629	Sens	
Sphaerium	1	195	0.005128	0.000042		
Hyalella	1	195	0.005128	0.004043		
Plauditus	1	195	0.005128	0.189876	Sens	Sens
Paraleptophlebia	1	195	0.005128	0.589109	Sens	Sens
Ephemerella	1	195	0.005128	0.692392	Sens	Sens
Timpanoga	1	195	0.005128	0.018142		
Caenis	18	195	0.092308	0.030016		
Amphinemura	44	195	0.225641	0.694933		
Leuctridae	6	195	0.030769	0.937347		
Perlesta	17	195	0.087179	0.065103		
Isoperla	9	195	0.046154	0.52476		
Dubiraphia	2	195	0.010256	0.020012	Opp	
Pisidium	1	195	0.005128	0.009925		Opp
Stenelmis	12	195	0.061538	0.241108	Sens	
Tanytarsus	2	195	0.010256	0.571588		
Cheumatopsyche	3	195	0.015385	0.463963	Sens	Opp
Hexatoma	2	195	0.010256	0.527567		Sens
Simulium	2	195	0.010256	0.472652		
Bezzia/Palpomyia	2	195	0.010256	0.255926		
Larsia	1	195	0.005128	0.016448		
Thienemannimyia	7	195	0.035897	0.64758		
Cricotopus/Orthocladius	26	195	0.133333	0.41493		Opp
Parametriocnemus	17	195	0.087179	0.704738	Sens	
Tvetenia	3	195	0.015385	0.384713		
Dicrotendipes	2	195	0.010256	0.001726		Opp
Polypedilum	7	195	0.035897	0.76329	Sens	
Paratanytarsus	2	195	0.010256	0.030755		Opp
Rheotanytarsus	2	195	0.010256	0.201817	Sens	Opp
Optioservus	1	195	0.005128	0.39001	Sens	Opp

Record: 1 of 30 — No Filter — Search

Comparable Benthic IBI Method? Yes | Comparable Benthic IBI Season? Yes
Special Considerations
Final Benthic IBI Comparable? WVSCI/GLIMPSS | 303d/ADB Benthic IBI Comparable? WVSCI/GLIMPSS
Reason Why Not Benthic IBI Comparable
Benthic IBI Comparable Checked By

Sediment