Supplementary Materials: Can Rapid Assessments Predict the Biotic Condition of Restored Streams?

1. Watershed Principal Component Weights

Principal Component Analysis (PCA) was conducted on the scaled and centered full matrix of the six individual watershed variables (PRCOMP in R) for 65 streams. The resulting principal component weights are shown in Table S1.

Table S1. Principal component scores for six watershed variables for 65 streams.

	PC1	PC2	PC3	PC4	PC5	PC6
Basin Slope	0.37	0.06	−0.84	0.31	−0.18	−0.14
Time of Concentration	−0.34	−0.59	−0.01	−0.05	−0.64	−0.35
Watershed Size	−0.17	−0.70	−0.26	0.07	0.60	0.23
Curve Number	−0.48	0.19	0.11	0.84	0.07	−0.09
% Developed	−0.48	0.29	−0.31	−0.39	0.33	−0.57
% Impervious	−0.50	0.21	−0.34	−0.20	−0.28	0.68

2. Re-Weighted Indices and Factor Analyses Results for Five Habitat Assessment methods (EGA, SPA, RBP, RCE and SVAP)

Using the results of the PCA and PCR statistical analysis using EPT taxa, re-weighted indices were developed for all five of the habitat assessment methods in order to address the issue of multi-collinearity among the assessment variables and to eliminate the bias of subjective variable weights and the adding and/or averaging of the field measured variable ranks. Scaled weights were determined by multiplying the matrix of the principal component loadings (*i.e.*, a matrix whose columns contain the eigenvectors) from the PCA of habitat assessment variables by the betas for each principal component obtained from the linear regression or PCR analysis with EPT taxa. These weights are considered scaled since the PCA analysis is based on the centered and scaled matrix of habitat assessment variables. Therefore, un-scaled weights that can be multiplied by the raw variable ranks for each stream to determine the re-weighted index score is obtained by multiplying the scaled weights by the standard deviations of the values for each variable. Scaled weights provide insight into the relative importance of each variable for correlation to EPT taxa. While the un-scaled weights are simply multipliers that can be used with the original data as it was collected from the field to calculate new re-weighted "relative" ranks or index scores for each stream. Scaled and un-scaled index weights for the EGA, SPA, RCE and SVAP habitat assessments are provided in Table S2 through S5. Scaled and un-scaled index weights for the EGA, SPA, RCE and SVAP habitat assessments combined with the six watershed factors are provided in Table S6 through S9. The weights for the RBP method both with and without watershed are included in Chapter 2.

Table S2. Eco-geomorphological Assessment Method (EGA) index scaled and un-scaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.25) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier	Variable #	Variable Name	Scaled Weight	Multiplier
12	D84	0.59	0.48	8	Habitat quality	0.10	0.18
11	D50	0.54	0.51	2	Riffle habitat	0.09	0.14
13	>2 mm	0.51	−0.16	37	Invasive species	0.09	0.13
21	Structure Function	0.48	0.11	18	Surface protection	0.07	0.11
26	Pools > 2ft	0.41	0.30	16	Root density	0.06	0.26
20	Structure Condition	0.38	0.41	36	Natural tree regeneration	0.06	0.11
27	Root wads	0.31	0.28	19	Near bank stress	0.04	0.72
25	Root mats	0.28	0.39	31	Large woody debris	0.04	0.19
28	Boulders	0.27	0.19	23	Leaf packs	0.03	−0.07
29	Oxbows	0.25	0.04	30	Aquatic macrophytes	0.03	0.03
41	Floodplain habitat	0.23	−0.01	40	Veg buffer width	0.00	0.31
39	Floodplain connection	0.22	0.00	7	Habitat location	−0.01	0.13
32	Cover quality	0.20	0.07	44	Bare ground	−0.01	0.15
10	CGU habitat	0.17	0.51	42	Floodplain encroachment	−0.02	−0.38
17	Bank angle	0.16	0.13	15	Root depth ratio	−0.03	0.09
9	CGU location	0.15	0.16	24	Overhanging veg	−0.07	0.23
33	Cover quantity	0.14	−0.11	5	Pool location	−0.19	−0.32
4	Run glide habitat	0.14	−0.32	35	Planted vegetation	−0.21	0.06
3	Run glide location	0.13	0.23	14	Bank height ratio	−0.21	−0.26
22	Undercut banks	0.13	0.03	6	Pool habitat	−0.23	−0.01
38	Streambank root mass	0.12	0.19	34	Structural complexity	−0.29	−0.22
1	Riffle location	0.11	0.10	43	Soil characteristics	−0.33	−0.02

Table S3. Stream Performance Assessment (SPA) Index scaled and un-scaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.4) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier
4	**Riffles clean material**	**1.27**	1.32
13	**Boulder clusters**	**1.23**	1.43
15	**Streambank condition**	**0.77**	0.39
7	**Large woody debris**	**0.73**	0.71
9	**Undercut banks**	**0.68**	0.68
6	**Pattern**	**0.64**	0.27
3	**Riffles length slope**	**0.54**	0.68
14	**Sediment transport**	**0.48**	0.20
10	Root mats	0.23	0.25
5	Pools length depth	0.20	0.30
17	Floodplain function	0.17	0.06
12	Root wads	−0.08	−0.09
1	Riffles pools alternating	−0.12	−0.18
16	Streambank vegetation	−0.17	−0.07
8	Leaf packets	−0.35	−0.33
11	**Overhanging veg**	**−0.70**	−0.74
2	**Riffles pools located**	**−0.74**	−1.16

Table S4. Riparian Channel and Environmental Inventory (RCE) Index scaled and un-scaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.4) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier
17	**Fish**	**0.96**	0.21
13	**Stony substrate**	**0.92**	0.12
14	**Stream substrate**	**0.82**	0.08
16	**Aquatic vegetation**	**0.53**	0.12
1	**Land use**	**0.44**	0.06
15	**Riffles pools**	**0.42**	0.06
11	**Streambank stability**	**0.42**	0.07
4	Riparian continuity RB	0.22	0.11
5	Riparian continuity LB	0.21	0.12
12	Bank undercutting	0.20	0.06
8	Debris dams	0.18	0.04
18	Detritus	0.03	0.00
10	Channel bars	−0.11	−0.04
7	Vegetation RB	−0.14	−0.05
6	Vegetation LB	−0.15	−0.05
2	Riparian width LB	−0.32	−0.10
3	Riparian width RB	−0.34	−0.10
9	**Width/depth ratio**	**−0.41**	−0.15

Table S5. Stream Visual Assessment Protocol (SVAP) Index scaled and un-scaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.4) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier
10	**Invertebrate habitat**	**1.04**	0.43
8	**Instream fish cover**	**0.98**	0.46
2	**Hydrologic alteration**	**0.74**	0.57
6	**Nutrient enrichment**	**0.60**	0.31
5	**Water appearance**	**0.48**	0.28
9	Pools	0.30	0.14
7	Fish barriers	0.22	0.06
1	Channel condition	0.02	0.02
4	Bank stability	−0.03	−0.02
3	**Riparian Zone**	**−0.57**	−0.36
11	**Canopy cover**	**−1.54**	−0.41

Table S6. Eco-geomorphological Assessment Method (EGA) Index (including watershed factors) scaled and un-scaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.25) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier	Variable #	Variable Name	Scaled Weight	Multiplier
45	**Basin slope**	**0.55**	12.88	36	Natural tree regeneration	0.05	0.06
12	**D84**	**0.54**	0.50	16	Root density	0.03	0.06
11	**D50**	**0.47**	0.41	39	Floodplain connection	0.03	0.04
13	**> 2 mm**	**0.46**	0.35	19	Near bank stress	0.03	0.06
21	**Structure Function**	**0.46**	0.39	2	Riffle habitat	0.03	0.03
26	**Pools > 2ft**	**0.45**	0.44	44	Bare ground	0.02	0.04
20	**Structure Condition**	**0.30**	0.26	31	Large woody debris	0.01	0.01
28	Boulders	0.21	0.16	7	Habitat location	0.00	0.00
17	Bank angle	0.20	0.37	1	Riffle location	0.00	0.00
27	Root wads	0.19	0.20	23	Leaf packs	−0.03	−0.02
25	Root mats	0.18	0.16	15	Root depth ratio	−0.03	−0.05
41	Floodplain habitat	0.16	0.12	24	Overhanging veg	−0.04	−0.04
22	Undercut banks	0.14	0.13	40	Veg buffer width	−0.05	−0.06
10	CGU habitat	0.13	0.12	30	Aquatic macrophytes	−0.05	−0.04
32	Cover quality	0.11	0.06	46	Time of Concentration	−0.10	0.00
29	Oxbows	0.11	0.15	42	Floodplain encroachment	−0.10	−0.12
8	Habitat quality	0.10	0.12	34	Structural complexity	−0.11	−0.11
4	Run glide habitat	0.10	0.16	5	Pool location	−0.11	−0.16
47	Watershed Size	0.08	0.01	35	Planted vegetation	−0.12	−0.14
9	CGU location	0.08	0.08	14	Bank height ratio	−0.17	−1.39
3	Run glide location	0.07	0.12	6	Pool habitat	−0.18	−0.26
33	Cover quantity	0.07	0.03	43	**Soil characteristics**	**−0.28**	−0.37
37	Invasive species	0.06	0.07	48	**Curve Number**	**−0.33**	−0.04
18	Surface protection	0.06	0.16	50	**% Impervious**	**−0.38**	−0.03
38	Streambank root mass	0.05	0.05	49	**% Developed**	**−0.50**	−0.01

Table S7. Stream Performance Assessment (SPA) Index (including watershed factors) scaled and un-scaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.4) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier
18	**Basin Slope**	**1.13**	26.69
4	**Riffles clean material**	**0.80**	0.83
13	**Boulder clusters**	**0.78**	0.91
3	Riffles length slope	0.33	0.41
20	Watershed Size	0.33	0.03
9	Undercut banks	0.23	0.23
10	Root mats	0.18	0.20
6	Pattern	0.17	0.07
15	Streambank condition	0.15	0.08
5	Pools length depth	0.15	0.22
16	Streambank vegetation	−0.01	0.00
11	Overhanging veg	−0.05	−0.05
1	Riffles pools alternating	−0.06	−0.09
14	Sediment transport	−0.08	−0.03
7	Large woody debris	−0.08	−0.08
17	Floodplain function	−0.11	−0.04
19	Time of Concentration	−0.18	0.00
8	Leaf packets	−0.27	−0.25
2	Riffles pools located	−0.37	−0.58
12	Root wads	−0.39	−0.39
22	**% Developed**	**−0.58**	−0.02
23	**% Impervious**	**−0.59**	−0.04
21	**Curve Number**	**−0.77**	−0.09

Table S8. Riparian Channel and Environmental Inventory (RCE) Index (including watershed factors) scaled and un-scaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.4) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier
19	**Land use**	**0.78**	18.34
13	**Basin Slope**	**0.67**	0.09
14	**Time of Concentration**	**0.65**	0.07
17	**% Developed**	**0.63**	0.13
16	**Curve Number**	**0.41**	0.09
21	Riparian width RB	0.25	0.03
15	Watershed Size	0.21	0.03
8	Stream substrate	0.21	0.05
4	Channel bars	0.16	0.08
5	Streambank stability	0.15	0.08
1	Vegetation RB	0.14	0.02
12	Detritus	0.08	0.03
11	Fish	0.02	0.00
18	% Impervious	−0.03	0.00
7	Stony substrate	−0.15	−0.05
6	Bank undercutting	−0.15	−0.05
10	Aquatic vegetation	−0.15	−0.05
20	Riparian width LB	−0.16	0.00
9	Riffles pools	−0.34	−0.12
2	Debris dams	−0.37	−0.11
3	Width/depth ratio	−0.38	−0.11
24	**Vegetation LB**	**−0.54**	−0.04
23	**Riparian continuity LB**	**−0.56**	−0.02
22	**Riparian continuity RB**	**−0.68**	−0.08

Table S9. Stream Visual Assessment Protocol (SVAP) Index (including watershed factors) scaled and unscaled (multiplier) weights. Variables with larger scaled weights (absolute value ≥ 0.4) are highlighted.

Variable #	Variable Name	Scaled Weight	Multiplier
12	**Basin Slope**	**1.14**	26.83
9	**Pools**	**0.68**	0.33
2	**Hydrologic alteration**	**0.59**	0.45
4	**Bank stability**	**0.45**	0.29
10	Invertebrate habitat	0.39	0.16
5	Water appearance	0.38	0.22
14	Watershed Size	0.32	0.03
8	Instream fish cover	0.29	0.14
1	Channel condition	0.13	0.09
6	Nutrient enrichment	−0.02	−0.01
7	Fish barriers	−0.10	−0.03
13	Time of Concentration	−0.13	0.00
17	**% Impervious**	**−0.46**	−0.03
16	**% Developed**	**−0.62**	−0.02
3	**Riparian**	**−0.63**	−0.39
15	**Curve Number**	**−0.76**	−0.09
11	**Canopy cover**	**−0.87**	−0.23