

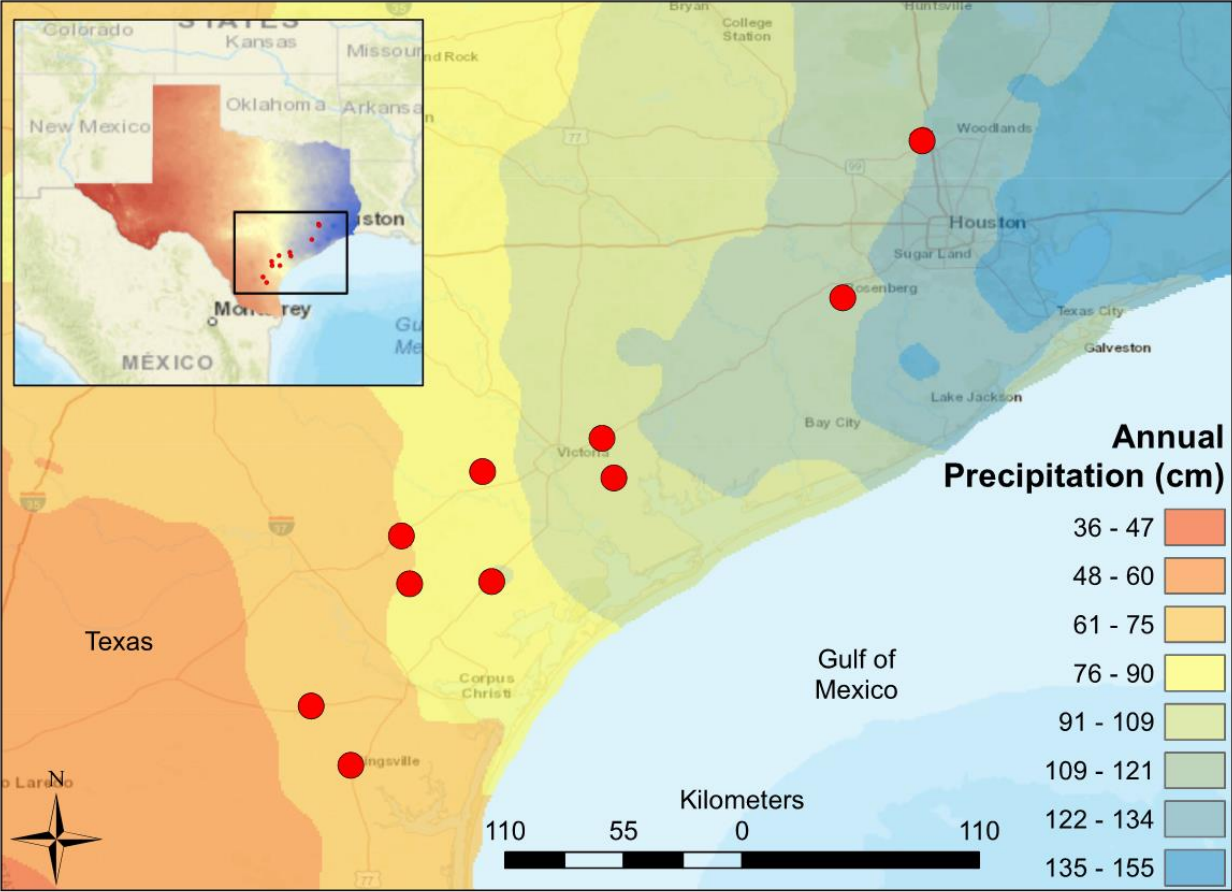
# Revised Data Analysis Texas Precipitation Gradient (2017)

For PeerJ revision

By Sean Kinard

Environmental Feature	Interquartile	
	Mean	Range
Precipitation (cm/yr)	92.5	24.6
Mean Air Temperature (°C)	21.1	0.3
Minimum Air Temperature (°C)	15.1	0.4
Maximum Air Temperature (°C)	27.5	0.8
Elevation (m)	29.9	32.0
Average Basin Slope (%)	0.7	0.8
Human Development (%)	13.3	5.8
Planted Cropland (%)	41.8	23.9
Average Clay Content (%)	30.5	4.6
Average Silt Content (%)	31.0	2.1
Average Sand Content (%)	38.5	3.9

**Table 1:** Mean and interquartile range values for environmental gradient features of 10 samples sites spanning the Texas Coastal Prairie. The source data was collected from from US Geologic Surveyors Geospatial Attributes of Gages for Evaluating Streamflow, version II dataset (Falcone 2011).

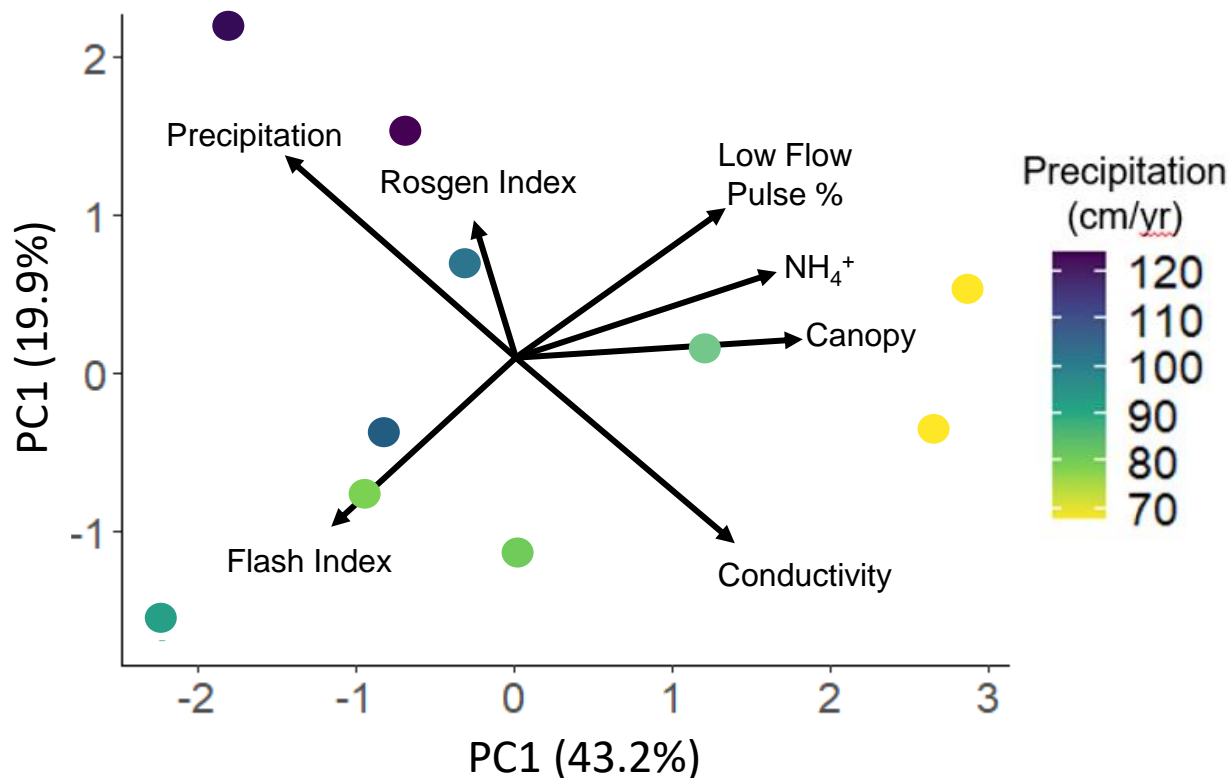


**Figure 1:** Map of South-Central Texas, where 10 USGS gaged Streams were sampled in the Spring of 2017. An annual precipitation overlay indicate that the sample sites span a gradient from 61 cm/yr in the Southwest to 134 cm/yr in the Northeast.



Site Name	USGS Station ID	Precipitation (cm/yr)	Flash Index	Low Flow Pulse %	Rosgen Index	Canopy (%)	NH <sub>4</sub> <sup>+</sup> (mg/L)	Conductivity ln(μS/cm)
Aransas	8189700	80.770	1.053	7.664	11.781	58.559	0.105	6.835
Bear Branch	8068390	124.190	0.777	13.146	12.011	44.144	0.133	5.426
Big Creek	8115000	120.310	0.961	15.631	23.150	0.000	0.118	5.390
Garcitas	8164600	102.410	0.806	4.867	18.161	73.649	0.098	6.249
Medio	8189300	79.130	0.993	0.000	18.405	14.414	0.113	6.748
Mission	8189500	85.360	0.580	3.357	14.701	68.468	0.170	7.163
Perdido	8177300	92.370	1.339	0.000	15.152	0.901	0.075	6.602
Placedo	8164800	104.650	0.921	5.482	13.380	29.279	0.088	7.035
San Fernando	8211900	67.750	0.907	20.306	15.762	89.865	0.298	6.887
Tranquitas	8212300	67.750	0.781	24.060	17.988	68.769	0.153	9.096

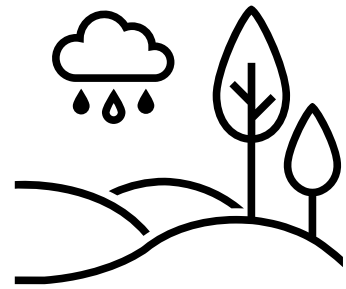
**Table 2:** Environmental Predictors for the 10 sample sites. Annual precipitation, Flash Index, and Low Flow Pulse % are calculated using 30-year records provided by USGS stream gauges. Rosgen Index (stream width / stream depth), Canopy %, NH<sub>4</sub><sup>+</sup>, and Conductivity were measured in-situ in during Spring 2017 sampling.



Variation	PC1	PC2
Proportion of Variance	0.432	0.199
Cumulative Proportion	0.432	0.631
Standard deviation	1.739	1.179
Correlation (R)	PC1	PC2
Precipitation	-0.698	0.615
Conductivity	0.663	-0.550
Rosgen Index	-0.111	0.411
Canopy	0.867	0.069
NH <sub>4</sub> <sup>+</sup>	0.792	0.265
Flash Index	-0.553	-0.508
Low Flow Pulse %	0.633	0.456

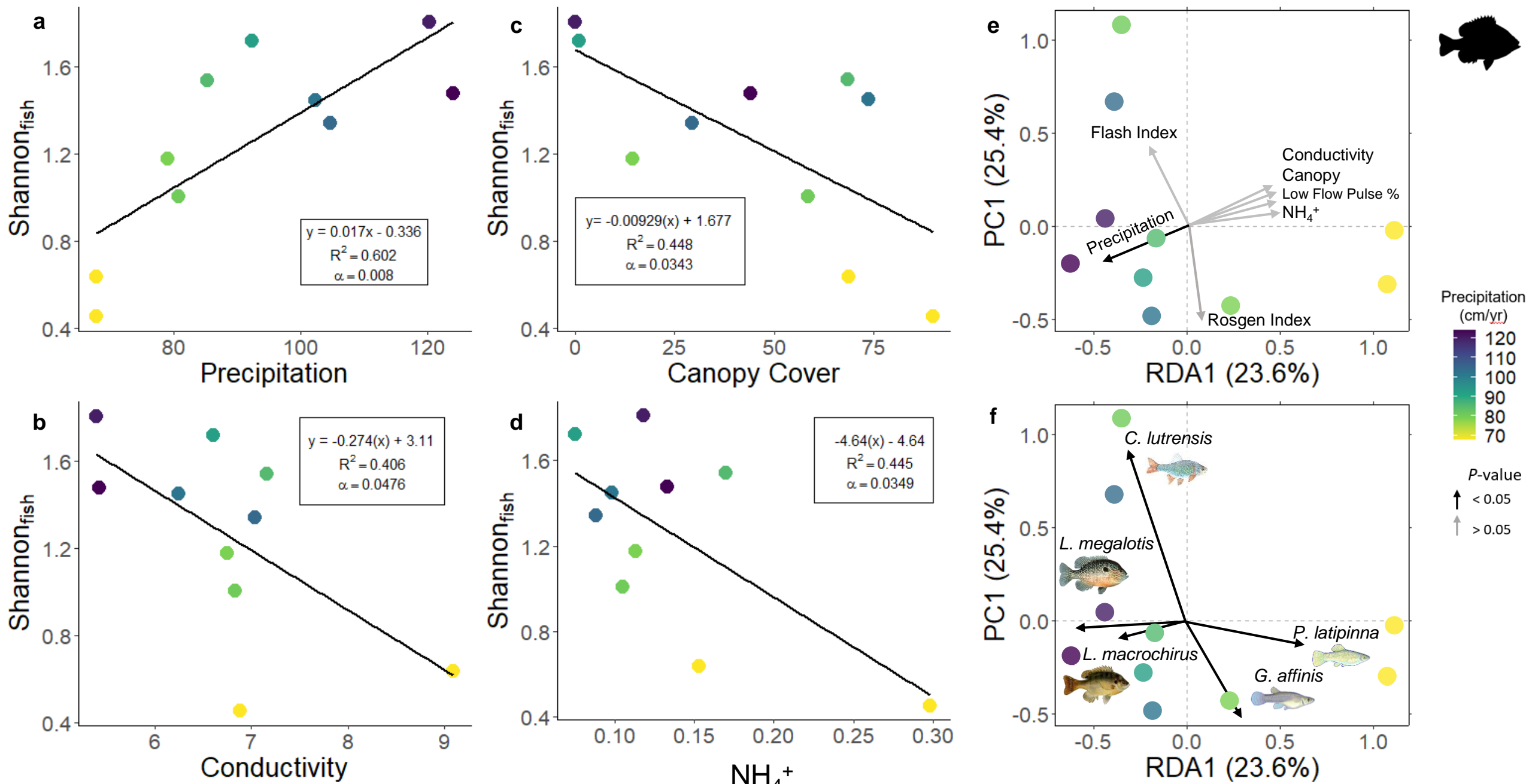
**Figure 2:** Principal Component Analysis of environmental predictors at 10 sites spanning a precipitation gradient along the Texas Coastal Prairie. Circles representing sample sites are colored based on their annual precipitation. Axes labels include the percentage of variance explained by PC1 (horizontal axis) and PC2 (vertical axis).

**Table 3:** Above: Proportion of total variation captured in principle component axes 1 or 2 of environmental predictors at 10 sites spanning a precipitation gradient along the Texas Coastal Prairie. Below: Correlation coefficients for environmental predictors versus principal component axes 1 or 2.



Response	Input	Sign	Slope	R <sup>2</sup>	F-stat	df	p-value
Conductivity	Canopy	+	0.410	0.168	1.617	2	0.239
Flash Index	Canopy	-	0.612	0.375	4.796	2	0.06
Low Flow Pulse %	Canopy	+	0.420	0.176	1.712	2	0.227
NH <sub>4</sub> <sup>+</sup>	Canopy	+	0.643	0.414	5.649	2	0.045 *
Rosgen Index	Conductivity	-	0.074	0.006	0.044	2	0.838
Conductivity	Flash Index	-	0.174	0.030	0.251	2	0.63
Low Flow Pulse %	Flash Index	-	0.309	0.096	0.847	2	0.384
NH <sub>4</sub>	Flash Index	-	0.373	0.139	1.291	2	0.289
Rosgen Index	Flash Index	+	0.007	0.000	0.000	2	0.984
Conductivity	Low Flow Pulse %	+	0.285	0.081	0.706	2	0.425
NH <sub>4</sub> <sup>+</sup>	Low Flow Pulse %	+	0.595	0.354	4.383	2	0.07
Rosgen Index	Low Flow Pulse %	+	0.217	0.047	0.395	2	0.547
Conductivity	NH <sub>4</sub> <sup>+</sup>	+	0.194	0.038	0.315	2	0.59
Rosgen Index	NH <sub>4</sub> <sup>+</sup>	+	0.003	0.000	0.000	2	0.994
Canopy	Precipitation	-	0.483	0.233	2.429	2	0.158
Conductivity	Precipitation	-	0.785	0.616	12.817	2	0.007 *
Flash Index	Precipitation	-	0.025	0.001	0.005	2	0.945
Low Flow Pulse %	Precipitation	-	0.160	0.026	0.210	2	0.659
NH <sub>4</sub>	Precipitation	-	0.480	0.230	2.395	2	0.16
Rosgen Index	Precipitation	+	0.073	0.005	0.042	2	0.842
Canopy	Rosgen.Index	-	0.301	0.091	0.798	2	0.398

**Table 4:** Summary statistics for linear autocorrelations among environmental predictors. \* denotes a statistically significant correlation ( $p$ -value < 0.05).



**Figure 4:** Fish diversity plotted against (a) annual precipitation (cm/yr), (b) log-transformed conductivity ( $\mu\text{S}/\text{cm}$ ), (c) canopy cover (%), (d)  $\text{NH}_4^+$  (mg/L). (E & F) Fish community ordinations using Hellinger transformation and redundancy analysis. Axes labels display the proportion of the variance explained as a percentage. Colored circles represent sites with color determined by annual precipitation. Arrows depict fitted vectors for (e) species and (f) environmental predictors which can be visually interpreted based on their direction. Black arrows indicate statistically significant ( $p$ -value  $< 0.05$ ) correlations. Only significant species vectors were plotted to improve figure clarity.



Response	Input	Sign	Slope	R <sup>2</sup>	F-stat	df	p-value
Shannon <sub>Fish</sub>	Canopy	-	0.009	0.448	6.490	1	0.034 *
Shannon <sub>Fish</sub>	Conductivity	-	0.274	0.406	5.464	1	0.048 *
Shannon <sub>Fish</sub>	Flash Index	+	0.339	0.024	0.193	1	0.672
Shannon <sub>Fish</sub>	Low Flow Pulse %	-	0.031	0.339	4.102	1	0.077
Shannon <sub>Fish</sub>	NH <sub>4</sub> <sup>+</sup>	-	4.647	0.446	6.431	1	0.035 *
Shannon <sub>Fish</sub>	Precipitation	+	0.017	0.602	12.101	1	0.008 *
Shannon <sub>Fish</sub>	Rosgen Index	+	0.021	0.027	0.224	1	0.649

**Table 5:** Summary statistics for linear regressions of fish Shannon Index values versus environmental predictors. \* denotes a statistically significant correlation ( $p$ -value < 0.05).



Candidate Model Formula	df	Log-Likelihood	AIC <sub>c</sub>	Δ AIC <sub>c</sub>	Weight
+ 0.313*Precipitation - 0.210*Low Flow Pulse %	4	2.912	10.2	0	0.429
+ 0.346*Precipitation	3	-0.985	12	1.79	0.175
+ 0.263*Precipitation - 0.172*Canopy	4	0.69	14.6	4.44	0.046
+ 0.264*Precipitation -0.171*NH4+	4	0.688	14.6	4.45	0.046
-0.235*Conductivity - 0.252*NH4+	4	0.649	14.7	4.52	0.045
-0.299*Canopy	3	-2.622	15.2	5.07	0.034
-0.298*NH4+	3	-2.642	15.3	5.11	0.033
- 0.284*Conductivity	3	-2.989	16	5.8	0.024
+ 0.301*Precipitation - 0.234*Low Flow Pulse % + 0.103*Rosgen Index	5	4.501	16	5.82	0.023
random effects	2	-5.592	16.9	6.72	0.015
- 0.26*Low Flow Pulse %	3	-3.523	17	6.87	0.014
+ 0.348*Precipitation + 0.077*Flash Index	4	-0.594	17.2	7.01	0.013
+ 0.273*Precipitation - 0.092*Canopy - 0.177*Low Flow Pulse %	5	3.732	17.5	7.36	0.011
+ 0.343*Precipitation + 0.049*Rosgen Index	4	-0.834	17.7	7.49	0.010
- 0.219*Canopy - 0.195*Conductivity	4	-0.936	17.9	7.7	0.009
+ 0.321*Precipitation - 0.033*Conductivity	4	-0.959	17.9	7.74	0.009
- 0.195*Low Flow Pulse % - 0.229*Conductivity	4	-1.248	18.5	8.32	0.007
+ 0.357*Precipitation - 0.219*Low Flow Pulse % + 0.058*Conductivity	5	3.082	18.8	8.66	0.006
+ 0.294*Precipitation - 0.185*Low Flow Pulse % - 0.047*NH4+	5	3.061	18.9	8.7	0.006
- 0.230*Canopy - 0.163*Low Flow Pulse %	4	-1.51	19	8.84	0.005
+ 0.314*Precipitation + 0.013*Flash Index - 0.206*Low Flow Pulse %	5	2.932	19.1	8.96	0.005
- 0.411*Canopy - 0.183*Flash Index	4	-1.568	19.1	8.96	0.005
- 0.183*Canopy - 0.180*NH4+	4	-1.669	19.3	9.16	0.004

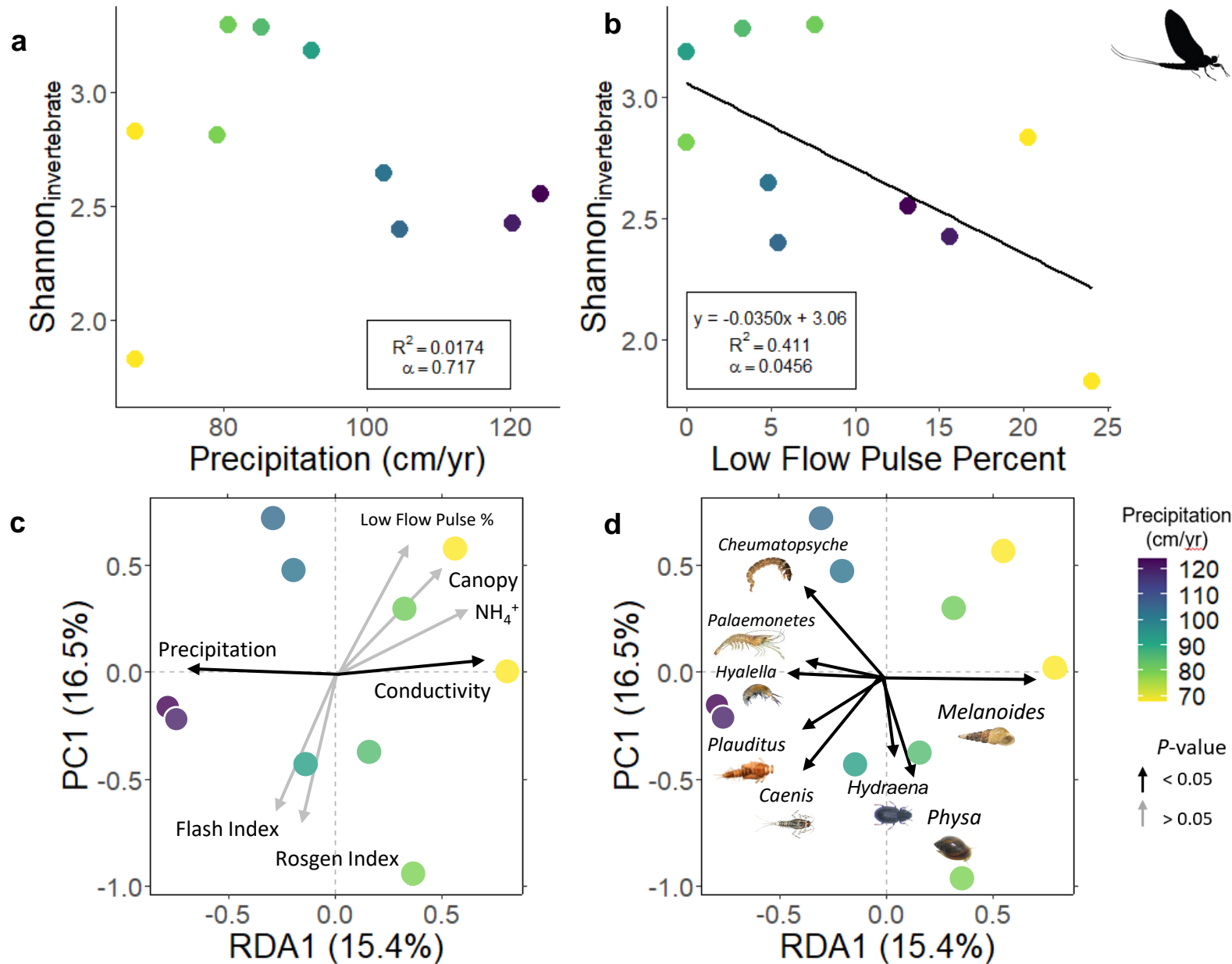
**Table 6.** Predictor variables and coefficients (formula), degrees of freedom (df) , log-likelihood, Akaike's Information Criterion with the small-sample bias adjustment (AIC<sub>c</sub> ), difference from the best-ranked model's AIC<sub>c</sub> (Δ AIC<sub>c</sub> ), and Akaike's weight (w<sub>i</sub>) for each formula. The model with the lowest AIC<sub>c</sub> is the best model.





Fitted Vector		axis1	axis2	R	p-value
Environment					
	Canopy	0.924	0.383	0.292	0.302
	Conductivity	0.938	0.345	0.539	0.051
	Flash Index	-0.434	0.901	0.033	0.877
	Low Flow Pulse %	0.949	0.315	0.357	0.214
	NH <sub>4</sub> <sup>+</sup>	0.986	0.167	0.494	0.104
	Precipitation	-0.941	-0.340	0.726	0.013 *
	Rosgen Index	0.149	-0.989	0.241	0.363
Species					
	<i>C.lutrensis</i>	-0.217	0.627	0.880	0.007 *
	<i>L.megalotis</i>	-0.407	-0.021	0.720	0.013 *
	<i>P.latipinna</i>	0.415	-0.090	0.837	0.016 *
	<i>L.macrochirus</i>	-0.240	-0.061	0.756	0.018 *
	<i>G.affinis</i>	0.188	-0.340	0.618	0.041 *

**Table 7:** Radial coordinates and summary statistics for fitted vectors of species and environmental predictors within the fish RDA ordination. \* denotes a statistically significant correlation ( $p$ -value < 0.05).



**Figure 5:** Macroinvertebrate Shannon diversity plotted against (A) annual precipitation (cm/yr) and (B) Low Flow Pulse Percent. (C & D) Fish community ordinations using Hellinger transformation and redundancy analysis. Axes labels contain proportion of the variance explained as a percentage. Dots represent sites with color determined by annual precipitation. Arrows represent fitted vectors for (C) environmental predictors and (D) species which can be visually interpreted based on their direction. Black arrows indicate statistically significant ( $p$ -value < 0.05) correlations. Only significant species vectors were plotted to improve figure clarity.



Response	Input	Sign	estimate	df	R <sup>2</sup>	F-stat	p-value
Shannon <sub>Invert</sub>	Precipitation	-	0.003	2	0.017	0.141	0.717
Shannon <sub>Invert</sub>	Conductivity	-	0.134	2	0.091	0.802	0.397
Shannon <sub>Invert</sub>	Rosgen Index	-	0.054	2	0.168	1.612	0.240
Shannon <sub>Invert</sub>	Canopy	-	0.000	2	0.000	0.002	0.966
Shannon <sub>Invert</sub>	NH <sub>4</sub> <sup>+</sup>	-	0.065	2	0.000	0.001	0.980
Shannon <sub>Invert</sub>	Flash Index	+	0.623	2	0.075	0.650	0.443
Shannon <sub>Invert</sub>	Low Flow Pulse %	-	0.035	2	0.411	5.591	0.046 *

**Table 8:** Summary statistics for linear regressions of invertebrate Shannon Index values versus environmental predictors. \* denotes a statistically significant correlation ( $p$ -value < 0.05).



Candidate Model Formula	df	Log-Likelihood	AIC <sub>c</sub>	Δ AIC <sub>c</sub>	Weight
-0.035*Low Flow Pulse %	3	-3.236	16.5	0	0.299
Random Effects	2	-5.886	17.5	1.01	0.18
-0.054*Low Flow Pulse % + 4.133*NH <sub>4</sub> <sup>+</sup>	4	-0.967	17.9	1.46	0.144
-0.054*Rosgen Index	3	-4.968	19.9	3.46	0.053
-0.134*Conductivity	3	-5.409	20.8	4.34	0.034
+ 0.623*Flash Index	3	-5.495	21	4.52	0.031
+ 0.004*Canopy -0.04203*Low Flow Pulse %	4	-2.524	21	4.58	0.03
-0.032*Low Flow Pulse % -0.038*Rosgen Index	4	-2.538	21.1	4.6	0.03
-0.005*Precipitation -0.037*Low Flow Pulse %	4	-2.733	21.5	4.99	0.025
-0.003*Precipitation	3	-5.799	21.6	5.12	0.023
-0.000*Canopy	3	-5.885	21.8	5.3	0.021
-0.065*NH <sub>4</sub> <sup>+</sup>	3	-5.886	21.8	5.3	0.021
-0.022*Precipitation -0.468*Conductivity	4	-2.945	21.9	5.42	0.02
-0.033*Low Flow Pulse % -0.058*Conductivity	4	-3.103	22.2	5.73	0.017
+ 0.190*Flash Index -0.034*Low Flow Pulse %	4	-3.182	22.4	5.89	0.016
-0.020*Precipitation -0.030*Low Flow Pulse % -0.368*Conductivity	5	0.367	24.3	7.79	0.006
-0.148*Conductivity -0.0575*Rosgen Index	4	-4.252	24.5	8.03	0.005
+ 0.630*Flash Index -0.054*Rosgen Index	4	-4.484	25	8.5	0.004
-0.002*Canopy -0.060*Rosgen Index	4	-4.839	25.7	9.21	0.003
-0.050*Low Flow Pulse % + 3.835*NH <sub>4</sub> <sup>+</sup> -0.028*Rosgen Index	5	-0.37	25.7	9.27	0.003
+ 0.494*Flash Index -0.052*Low Flow Pulse % + 4.588*NH <sub>4</sub> <sup>+</sup>	5	-0.399	25.8	9.33	0.003
-0.002*Precipitation -0.053*Rosgen Index	4	-4.905	25.8	9.34	0.003
-0.057*NH <sub>4</sub> <sup>+</sup> -0.054*Rosgen Index	4	-4.968	25.9	9.46	0.003
+ 0.520*Flash Index -0.116*Conductivity	4	-5.122	26.2	9.77	0.002
-0.052*Low Flow Pulse % -0.065*Conductivity + 4.174*NH <sub>4</sub> <sup>+</sup>	5	-0.7	26.4	9.93	0.002

**Table 9.** Predictor variables and coefficients (formula), degrees of freedom (df) , log-likelihood, Akaike’s Information Criterion with the small-sample bias adjustment (AIC<sub>c</sub> ), difference from the best-ranked model’s AIC<sub>c</sub> (Δ AIC<sub>c</sub> ), and Akaike weights (w) for set of nonlinear, multivariate regressions predicting invertebrate Shannon diversity.



Vector Input	axis1	axis2	R	p-value
Environment				
Precipitation	0.976	0.001	-1.000	0.022 *
Conductivity	0.711	0.008	0.995	0.103
Rosgen Index	0.074	0.759	-0.222	-0.975 *
Canopy	0.550	0.082	0.697	0.717
NH <sub>4</sub> <sup>+</sup>	0.250	0.372	0.888	0.460
Flash Index	0.022	0.935	-0.389	-0.921 *
Low Flow Pulse %	0.171	0.502	0.494	0.869
Genus				
<i>Hyalella</i>	-0.168	0.005	0.780	0.007 *
<i>Cheumatopsyche</i>	-0.140	0.158	0.741	0.009 *
<i>Melanoides</i>	0.266	-0.002	0.691	0.017 *
<i>Plauditus</i>	-0.138	-0.091	0.661	0.027 *
<i>Physa</i>	0.047	-0.158	0.639	0.033 *
<i>Caenis</i>	-0.135	-0.162	0.642	0.037 *
<i>Palaemonetes</i>	-0.135	0.024	0.575	0.045 *

**Table 10.** Radial coordinates and summary statistics for fitted vectors of species and environmental predictors within the invertebrate RDA ordination. \* denotes a statistically significant correlation ( $p$ -value < 0.05).