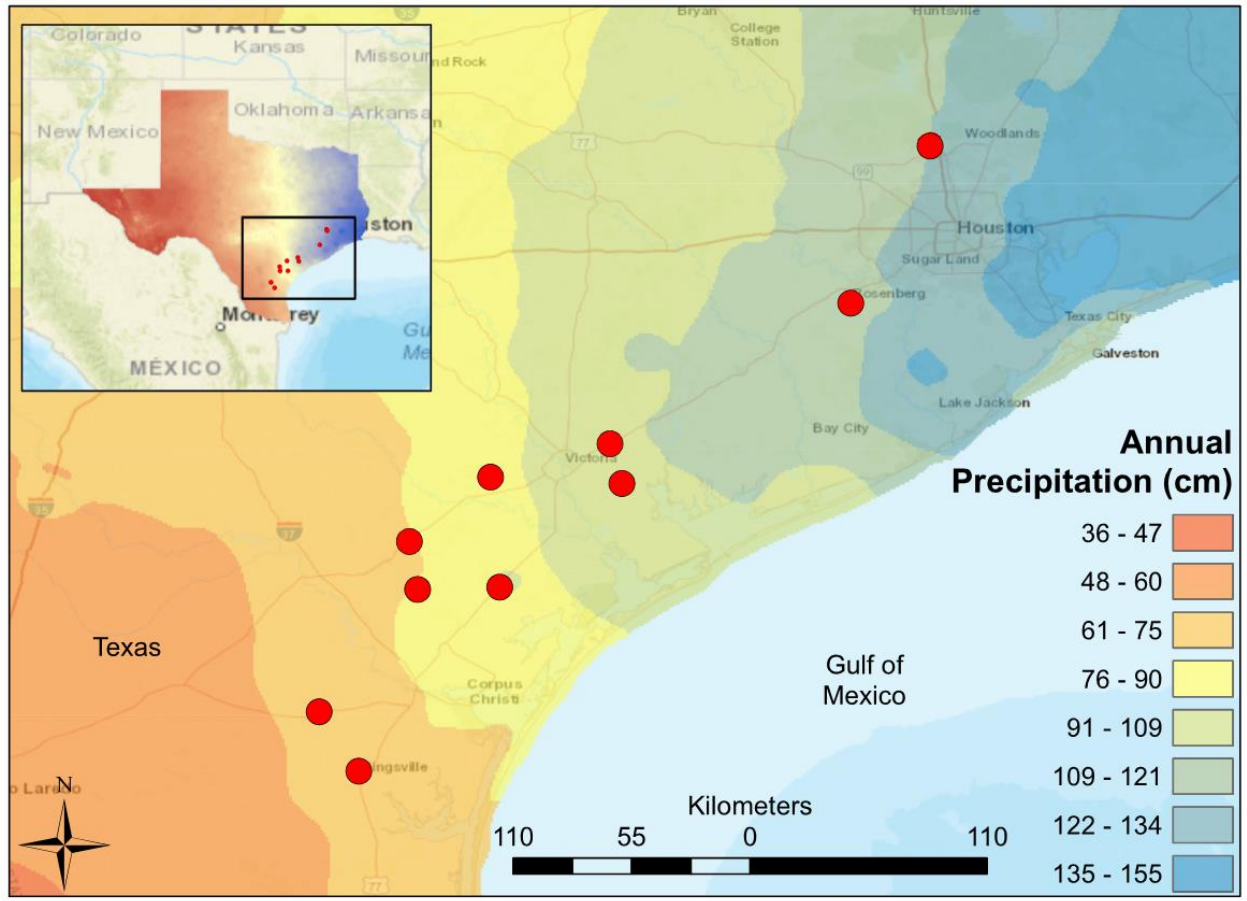
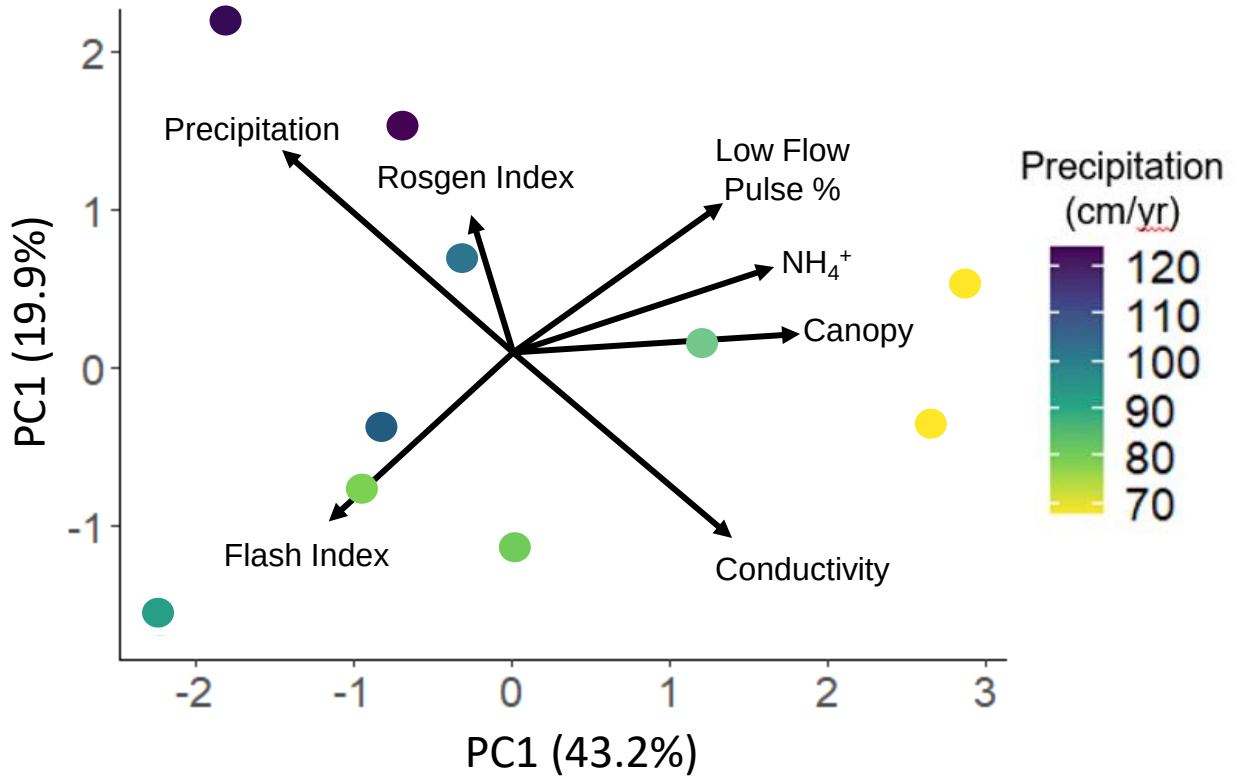
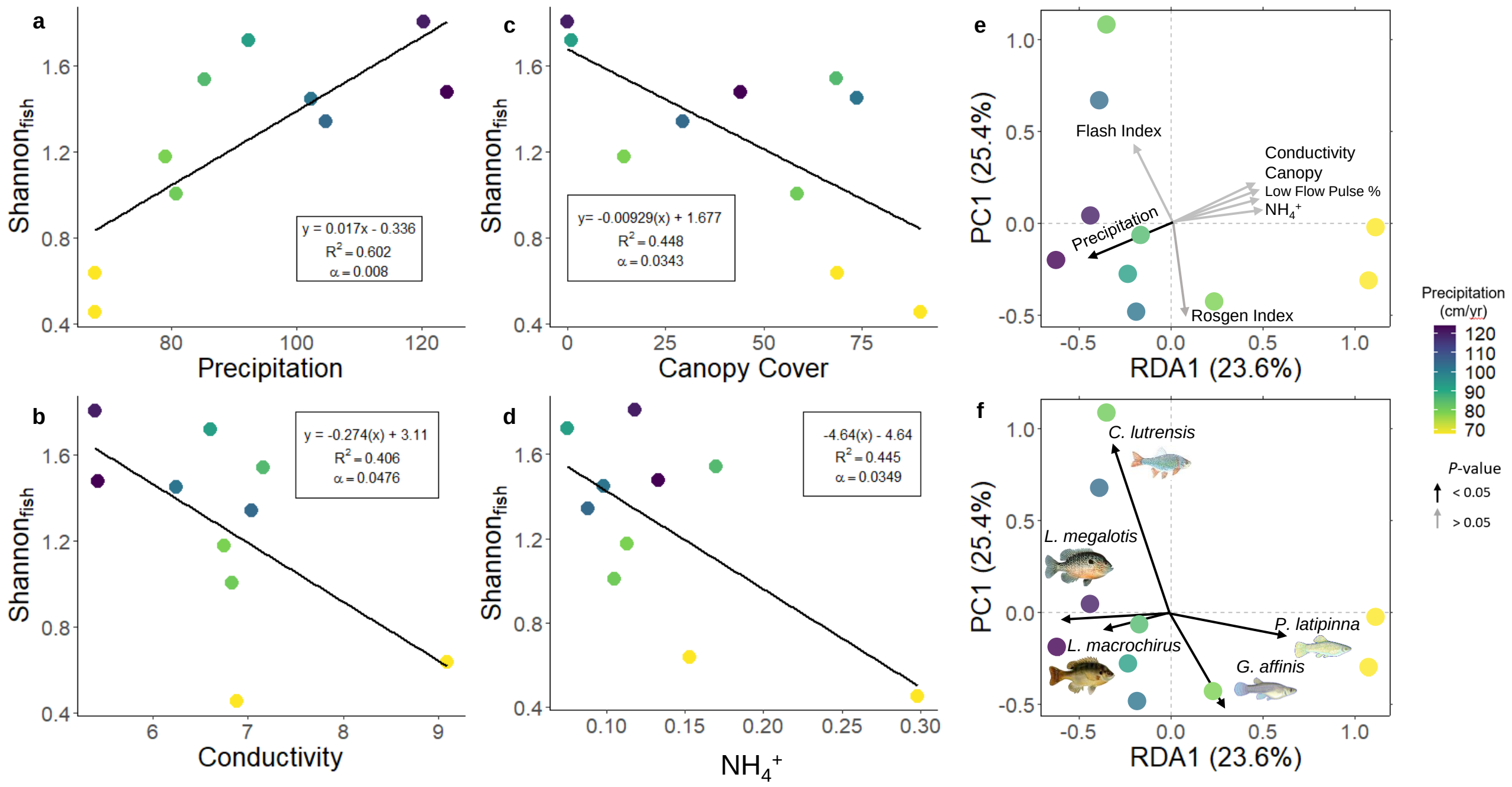
Revised Data Analysis
Texas Precipitation Gradient (2017)

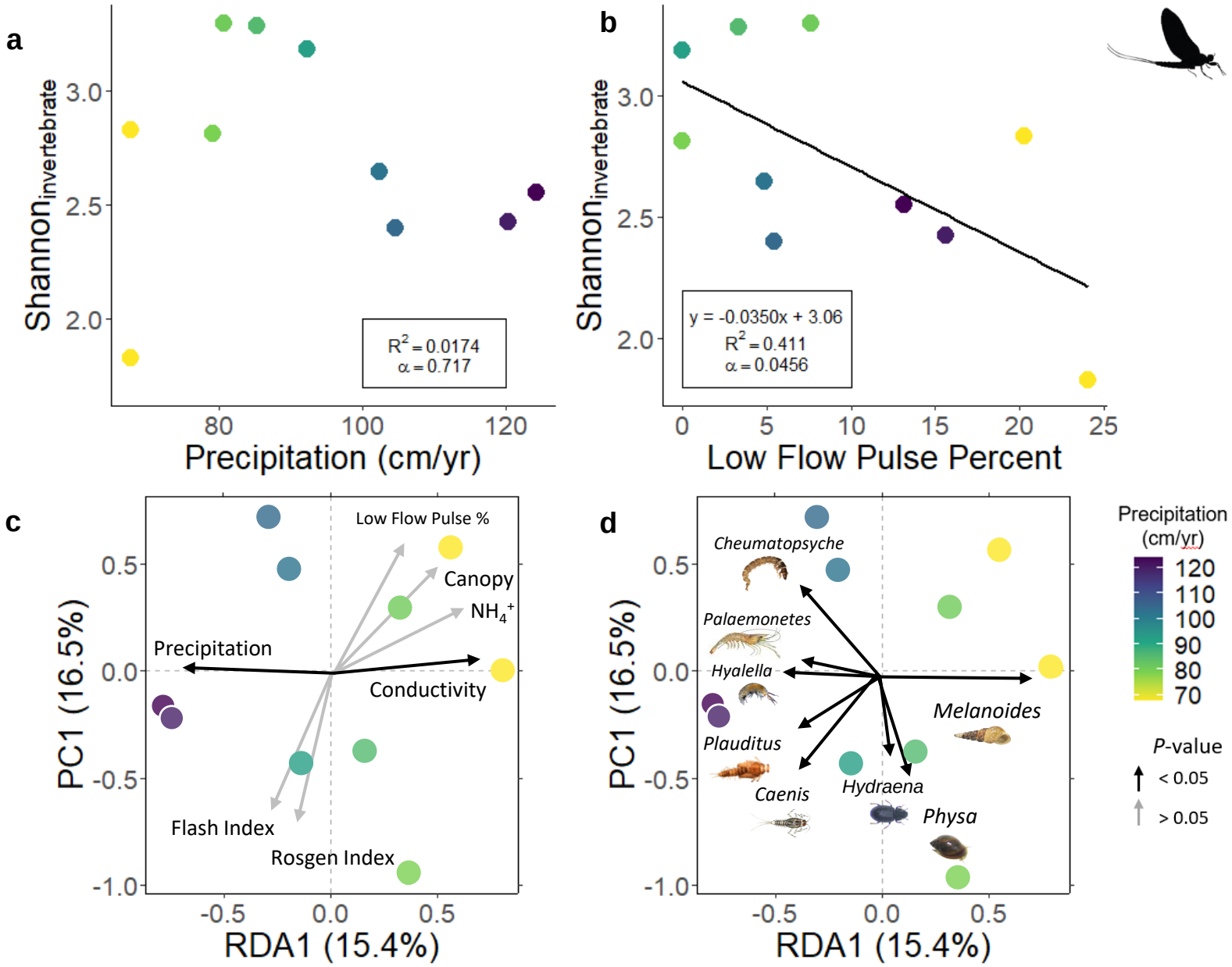
For PeerJ revision

By Sean Kinard


Colorado
Kansas
Missouri
Oklahoma
Arkansas
New Mexico
MÉXICO
Texas
Houston
Woodlands
Sugar Land
Rosenberg
Texas City
Galveston
Lake Jackson
Bay City
Victoria
College Station
Corpus Christi
Gulf of Mexico
N
Kilometers
110 55 0 110
Annual Precipitation (cm)
36 - 47
48 - 60
61 - 75
76 - 90
91 - 109
109 - 121
122 - 134
135 - 155


Precipitation
Rosgen Index
Low Flow
Pulse %
NH_4^+
Canopy
Flash Index
Conductivity
PC1 (19.9%)
PC1 (43.2%)
2
1
0
-1
-2
-1
0
1
2
3
Precipitation
(cm/yr)
120
110
100
90
80
70


a
Shannon_fish
Precipitation
y = 0.017x - 0.336
R² = 0.602
α = 0.008
b
Conductivity
y = -0.274(x) + 3.11
R² = 0.406
α = 0.0476
c
Canopy Cover
y= -0.00929(x) + 1.677
R² = 0.448
α = 0.0343
d
NH4+
-4.64(x) - 4.64
R² = 0.445
α = 0.0349
e
PC1 (25.4%)
RDA1 (23.6%)
Flash Index
Conductivity
Canopy
Low Flow Pulse %
NH4+
Precipitation
Rosgen Index
f
C. lutrensis
L. megalotis
P. latipinna
L. macrochirus
G. affinis
Precipitation (cm/yr)
120
110
100
90
80
70
P-value
< 0.05
> 0.05


a
Shannon$_{invertebrate}$
3.0
2.5
2.0
80
100
120
Precipitation (cm/yr)
$R^2 = 0.0174$
$\alpha = 0.717$
b
Shannon$_{invertebrate}$
3.0
2.5
2.0
0
5
10
15
20
25
Low Flow Pulse Percent
y = -0.0350x + 3.06
$R^2 = 0.411$
$\alpha = 0.0456$
c
PC1 (16.5%)
0.5
0.0
-0.5
-1.0
-0.5
0.0
0.5
RDA1 (15.4%)
Low Flow Pulse %
Canopy
NH_4^+
Precipitation
Conductivity
Flash Index
Rosgen Index
d
PC1 (16.5%)
0.5
0.0
-0.5
-1.0
-0.5
0.0
0.5
RDA1 (15.4%)
Cheumatopsyche
Palaemonetes
Hyalella
Melanoides
Plauditus
Caenis
Hydraena
Physa
Precipitation (cm/yr)
120
110
100
90
80
70
P-value
< 0.05
> 0.05

Environmental Feature	Mean	Interquartile Range
Precipitaiton (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

Site Name	USGS Station ID	Precipitation (cm/yr)	Flash Index	Low Flow Pulse %	Rosgen Index	Canopy (%)	NH_4^+ (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

Response	Input	Sign	Slope	R^2	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	0.060
Low Flow Pulse %	Canopy	+	0.420	0.176	1.712	2	0.227
NH_4^+	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	0.630
Low Flow Pulse %	Flash Index	-	0.309	0.096	0.847	2	0.384
NH4	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_4^+	Low Flow Pulse %	+	0.595	0.354	4.383	2	0.070
Rosgen Index	Low Flow Pulse %	+	0.217	0.047	0.395	2	0.547
Conductivity	NH_4^+	+	0.194	0.038	0.315	2	0.590
Rosgen Index	NH_4^+	+	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
NH4	Precipitation	-	0.480	0.230	2.395	2	0.160
Rosgen Index	Precipitation	+	0.073	0.005	0.042	2	0.842
Canopy	Rosgen.Index	-	0.301	0.091	0.798	2	0.398

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_4^+	0.792	0.265
Flash Index	-0.553	-0.508
Low Flow Pulse %	0.633	0.456

Response	Input	Sign	Slope	R^2	F-stat	df	p-value
$Shannon_{Fish}$	Canopy	-	0.009	0.448	6.490	1	0.034 *
$Shannon_{Fish}$	Conductivity	-	0.274	0.406	5.464	1	0.048 *
$Shannon_{Fish}$	Flash Index	+	0.339	0.024	0.193	1	0.672
$Shannon_{Fish}$	Low Flow Pulse %	-	0.031	0.339	4.102	1	0.077
$Shannon_{Fish}$	NH_4^+	-	4.647	0.446	6.431	1	0.035 *
$Shannon_{Fish}$	Precipitation	+	0.017	0.602	12.101	1	0.008 *
$Shannon_{Fish}$	Rosgen Index	+	0.021	0.027	0.224	1	0.649
$Shannon_{Invert}$	Canopy	-	0.000	0.000	0.002	2	0.966
$Shannon_{Invert}$	Conductivity	-	0.134	0.802	0.091	2	0.397
$Shannon_{Invert}$	Flash Index	+	0.623	0.650	0.075	2	0.443
$Shannon_{Invert}$	Low Flow Pulse %	-	0.035	5.591	0.411	2	0.046 *
$Shannon_{Invert}$	NH_4^+	-	0.065	0.001	0.000	2	0.98
$Shannon_{Invert}$	Precipitation	-	0.003	0.141	0.017	2	0.717
$Shannon_{Invert}$	Rosgen Index	-	0.054	1.612	0.168	2	0.24

Candidate Model Predicting $Shannon_{fish}$	df	Log-Likelihood	AIC_c	ΔAIC_c	Weight
+ 0.313*Precipitation - 0.210*Low Flow Pulse %	4	2.912	10.2	0.00	0.429
+ 0.346*Precipitation	3	-0.985	12.0	1.79	0.175
+ 0.263*Precipitation - 0.172*Canopy	4	+0.690	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	16.0	5.80	0.024
+ 0.301*Precipitation - 0.234*Low Flow Pulse % + 0.103*Rosgen Index	5	+4.501	16.0	5.82	0.023
random effects	2	-5.592	16.9	6.72	0.015
- 0.26*Low Flow Pulse %	3	-3.523	17.0	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	7.70	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	8.70	0.006
- 0.230*Canopy - 0.163*Low Flow Pulse %	4	-1.510	19.0	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

Candidate Model Predicting $Shannon_{invert}$	df	Log-Likelihood	AIC_c	ΔAIC_c	Weight
-0.035*Low Flow Pulse %	3	-3.236	16.5	0.00	0.299
Random Effects	2	-5.886	17.5	1.01	0.180
-0.054*Low Flow Pulse % + 4.133*NH_4^+	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	21.0	4.52	0.031
+ 0.004*Canopy -0.04203*Low Flow Pulse %	4	-2.524	21.0	4.58	0.030
-0.032*Low Flow Pulse % -0.038*Rosgen Index	4	-2.538	21.1	4.60	0.030
-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	5.30	0.021
-0.065*NH_4^+	3	-5.886	21.8	5.30	0.021
-0.022*Precipitation -0.468*Conductivity	4	-2.945	21.9	5.42	0.020
-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	25.0	8.50	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_4^+ -0.028*Rosgen Index	5	-0.370	25.7	9.27	0.003
+ 0.494*Flash Index -0.052*Low Flow Pulse % + 4.588*NH_4^+	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_4^+ -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_4^+	5	-0.700	26.4	9.93	0.002

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_4^+	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					
	C.lutrensis	-0.217	0.627	0.880	0.007 *
	L.megalotis	-0.407	-0.021	0.720	0.013 *
	P.latipinna	0.415	-0.090	0.837	0.016 *
	L.macrochirus	-0.240	-0.061	0.756	0.018 *
	G.affinis	0.188	-0.340	0.618	0.041 *

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_4^+	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					
	Hyalella	-0.168	0.005	0.780	0.007 *
	Cheumatopsyche	-0.140	0.158	0.741	0.009 *
	Melanoides	0.266	-0.002	0.691	0.017 *
	Plauditus	-0.138	-0.091	0.661	0.027 *
	Physa	0.047	-0.158	0.639	0.033 *
	Caenis	-0.135	-0.162	0.642	0.037 *
	Palaemonetes	-0.135	0.024	0.575	0.045 *