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Supplementary material

Spatial and seasonal variability of emergent aquatic insects and nearshore spiders in a subtropical estuary

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Extended results

Principal component analysis of ten physicochemical measures identified five axes with eigenvalues >1 (see Table S2). PC1 described 24% of the variance and was influenced by canopy cover (r^2 = 0.31), Chl-*a* (r^2 = 0.22), and ammonia (r^2 = 0.19). PC2 described 19.7% of the variance and was influenced by temperature (r^2 = 0.25), phosphate (r^2 = 0.20), and DO (r^2 = 0.18). PC3 captured 18.1% of the variance; important loadings were total P (r^2 = 0.43), DO (r^2 = 0.19), and pH (r^2 = 0.18). PC4 captured 14.5% of the variance and was driven by phosphate (r^2 = 0.33), temperature (r^2 = 0.26), and total N (r^2 = 0.20). Lastly, PC5 accounted for 10.9% of the variance and was influenced primarily by nitrate (r^2 = 0.58).

Table S1. Emergent-aquatic insect families observed along with trait characteristics including functional feeding group, dispersal distance, body size, and voltinism, as well as relative occurrence in all samples (*N* = 97)

Occurrence of taxa across all emergence samples collected at low-, mid- and high-salinity reaches are denoted as: –, absent; 1, rare (<3%); 2, uncommon (<10%); 3, fairly common (<50%); 4, common (<70%); 5, abundant (≥70%)

Order	Family	Voltinism	Dispersal distance	Size at maturity	Functional feeding group	Low	Mid	High
Diptera	Ceratopogonidae	univoltine	<1 km	small	predator	3	3	2
	Chaoroboridae	multivoltine	<1 km	small	predator	1	–	–
	Chironomidae	multivoltine	>1 km	small	collector–gatherer	5	5	4
	Culicidae	multivoltine	>1 km	small	collector–filterer	2	3	3
	Dolichopodidae	univoltine	<1 km	medium	predator	3	3	3
	Empididae	univoltine	>1 km	medium	predator	–	–	2
	Ephydridae	multivoltine	<1 km	small	predator–gatherer	1	1	2
	Phoridae	multivoltine	<1 km	small	collector–gatherer	1	1	1
	Sarcophagidae	multivoltine	>1 km	medium	collector–gatherer	3	–	–
	Simuliidae	multivoltine	<1 km	small	collector–filterer	1	–	2
	Syrphidae	multivoltine	>1 km	small	collector–gatherer	–	1	–
	Tabanidae	multivoltine	>1 km	medium	predator	2	–	–
Ephemeroptera	Baetidae	multivoltine	<1 km	small	collector–gatherer	2	–	–
	Ephemerellidae	univoltine	<1 km	small	collector–gatherer	1	–	–
Hymenoptera	Mymaridae	multivoltine	<1 km	small	parasite–carnivore	–	1	1
Lepidoptera		univoltine	<1 km	medium	shredder–herbivore	1	–	–
Trichoptera	Hydroptilidae	univoltine	>1 km	small	piercer–herbivore	2	2	–
	Hydropsychidae	univoltine	<1 km	small	filterer	–	–	1
Odonata	Coenagrionidae	univoltine	<1 km	large	predator	1	–	–
	Libellulidae	semivoltine	>1 km	large	predator	1	–	–

Table S2. Eigenvalues and the percentage variance captured by the principal components (eigenvalues > 1), along with each principal component's loadings and the proportion of the variance (r^2) each variable shared with the PCA axes

PC4 (highlighted in bold) was the only significant predictor of emergence rate in subsequent linear regressions

Parameter	PC1		PC2		PC3		**PC4**		PC5	
	Loading	r^2	Loading	r^2	Loading	r^2	**Loading**	**r^2**	Loading	r^2
Temperature	–0.09	0.01	0.5	0.25	–0.01	0	**0.51**	**0.26**	–0.06	0
pH	–0.3	0.09	–0.24	0.06	0.43	0.18	**0.27**	**0.07**	–0.28	0.08
DO	0.12	0.01	–0.42	0.18	–0.43	0.19	**0.02**	**0**	–0.23	0.05
Canopy	0.56	0.31	0.01	0	0.18	0.03	**0.14**	**0.02**	0.21	0.04
Chl-*a*	0.47	0.22	0.23	0.05	0.12	0.02	**0.3**	**0.09**	0.25	0.06
Total P	0.12	0.01	0.09	0.01	–0.65	0.43	**0.16**	**0.02**	–0.16	0.03
Total N	0.35	0.12	0.02	0	0.35	0.12	**–0.45**	**0.2**	–0.35	0.12
PO_4	0.01	0	–0.45	0.2	0.17	0.03	**0.57**	**0.33**	–0.13	0.02
NO_3	0.17	0.03	0.33	0.11	0.02	0	**0.06**	**0**	–0.76	0.58
NH_4	0.44	0.19	–0.38	0.14	–0.05	0	**0.05**	**0**	–0.06	0
Eigenvalue	2.4		1.969		1.81		**1.445**		1.091	
Percentage variance	24.01		19.69		18.09		**14.45**		10.9	

Table S3. SIMPER results for emergent–aquatic insect taxa contributing to dissimilarity (up to 97%) among low-, mid- and high-salinity assemblages and between summer and winter assemblages at high-salinity sites

Mean emergence rates (individuals m^{-2} day^{-1}) are also shown

Comparison	Family	Low	Mid	Percentage contribution to difference	Proportion of total variation explained
Low–Mid	Chironomidae	12.25	15.79	53.13	0.82
	Dolichopodidae	0.25	0.15	2.76	0.86
	Culicidae	0.05	0.16	1.99	0.89
	Hydroptilidae	0.05	0.17	1.88	0.92
	Ceratopogonidae	0.14	0.14	1.80	0.95
	Sarcophagidae	0.06	0.00	0.69	0.96
	Tabanidae	0.03	0.00	0.60	0.97
		Low	**High**		
Low–High	Chironomidae	12.25	1.03	54.93	0.65
	Dolichopodidae	0.25	1.48	12.00	0.80
	Culicidae	0.05	0.77	5.31	0.86
	Ceratopogonidae	0.14	0.42	4.70	0.92
	Sarcophagidae	0.06	0.00	1.43	0.93
	Tabanidae	0.03	0.00	1.40	0.95
	Ephydridae	0.01	0.07	0.78	0.96
	Simuliidae	0.01	0.02	0.74	0.97
		Mid	**High**		
Mid-High	Chironomidae	15.79	1.03	56.44	0.68
	Dolichopodidae	0.15	1.48	11.18	0.81
	Culicidae	0.16	0.77	6.59	0.89
	Ceratopogonidae	0.14	0.42	3.67	0.94
	Hydroptilidae	0.17	0.00	2.68	0.97
		S	**W**		
Summer–Winter (High)	Dolichopodidae	1.50	1.45	26.77	0.33
	Chironomidae	0.32	1.61	26.38	0.65
	Culicidae	1.48	0.19	13.78	0.81
	Ceratopogonidae	0.91	0.02	9.37	0.93
	Simuliidae	0.00	0.04	2.42	0.96
	Ephydridae	0.00	0.13	2.17	0.98

Table S4. Orb-weaving spiders and associated trait characteristics including body size and orb-web traits

Relative occurrence of taxa during species surveys at low-, mid-, and high-salinity sites are denoted as: –, absent, 1, rare (<3%), 2, uncommon (<20%), 3, fairly common (<50%), 4, common (<70%), 5, abundant (>70%)

Family	Subfamily	Species	Common name	Size at maturity	Orb type	Low	Mid	High
Araneidae	–	*Gasteracantha cancriformis*	Spiny-backed orbweaver	Small	V	1	–	1
	–	*Neoscona crucifera*	Spotted orbweaver	Medium	V	3	2	2
	Nephilinae	*Nephila clavipes*	Golden silk orbweaver	Large	V	–	2	2
Tetragnathidae	–	*Tetragnatha* spp.	Long-jawed orbweaver	Small	H	5	5	5
	–	*Leucage* spp. incl. *L. venusta* and *L. argyra*	Orchard orbweaver	Small	H	4	5	4

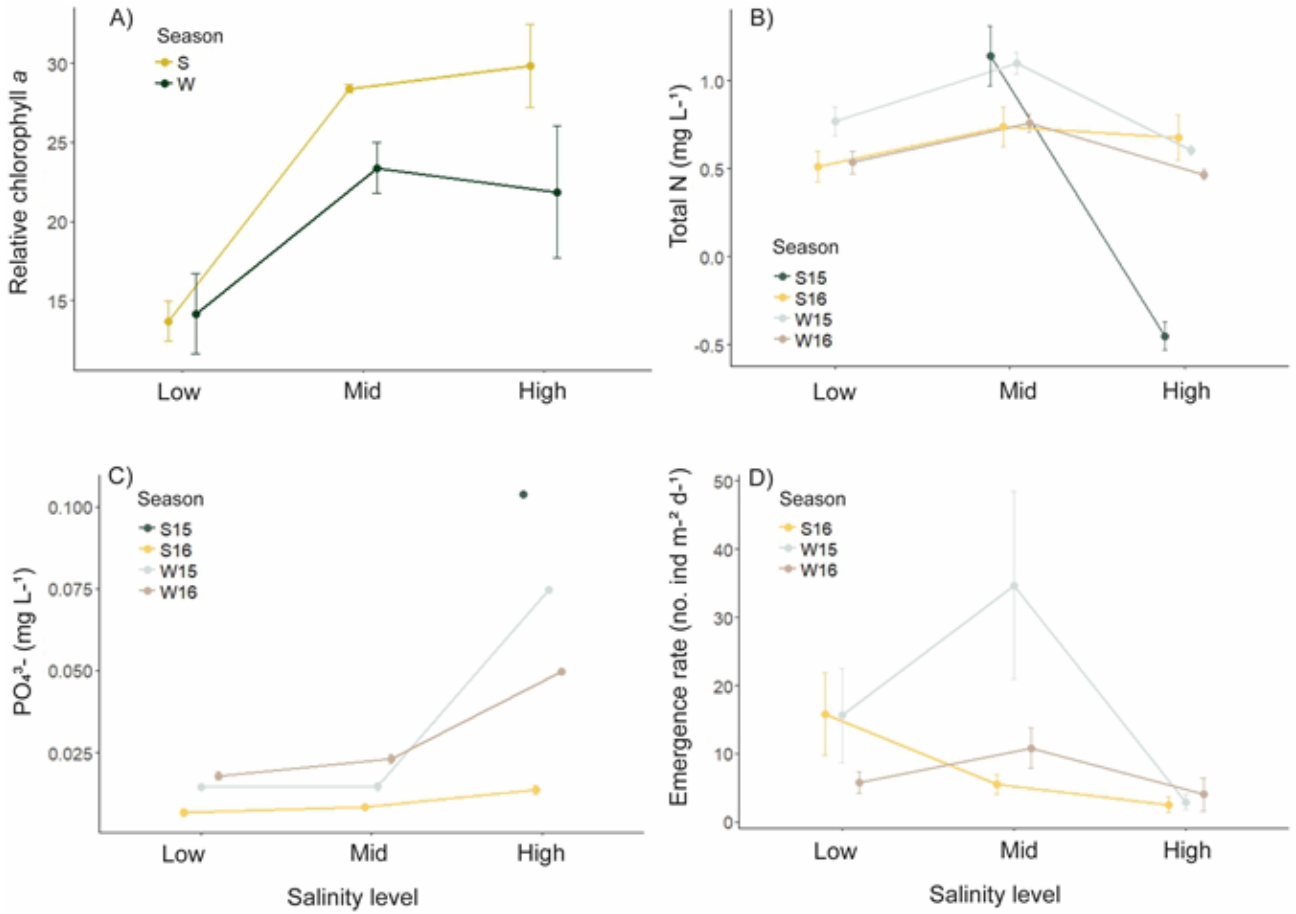

Figure S1. Spatial and seasonal patterns of (A) chlorophyll-*a*, (B) total nitrogen, and (C) phosphate in the Fakahatchee Strand and Ten Thousand Islands Estuary, plotted as raw data. Error bars are ±1 s.e.

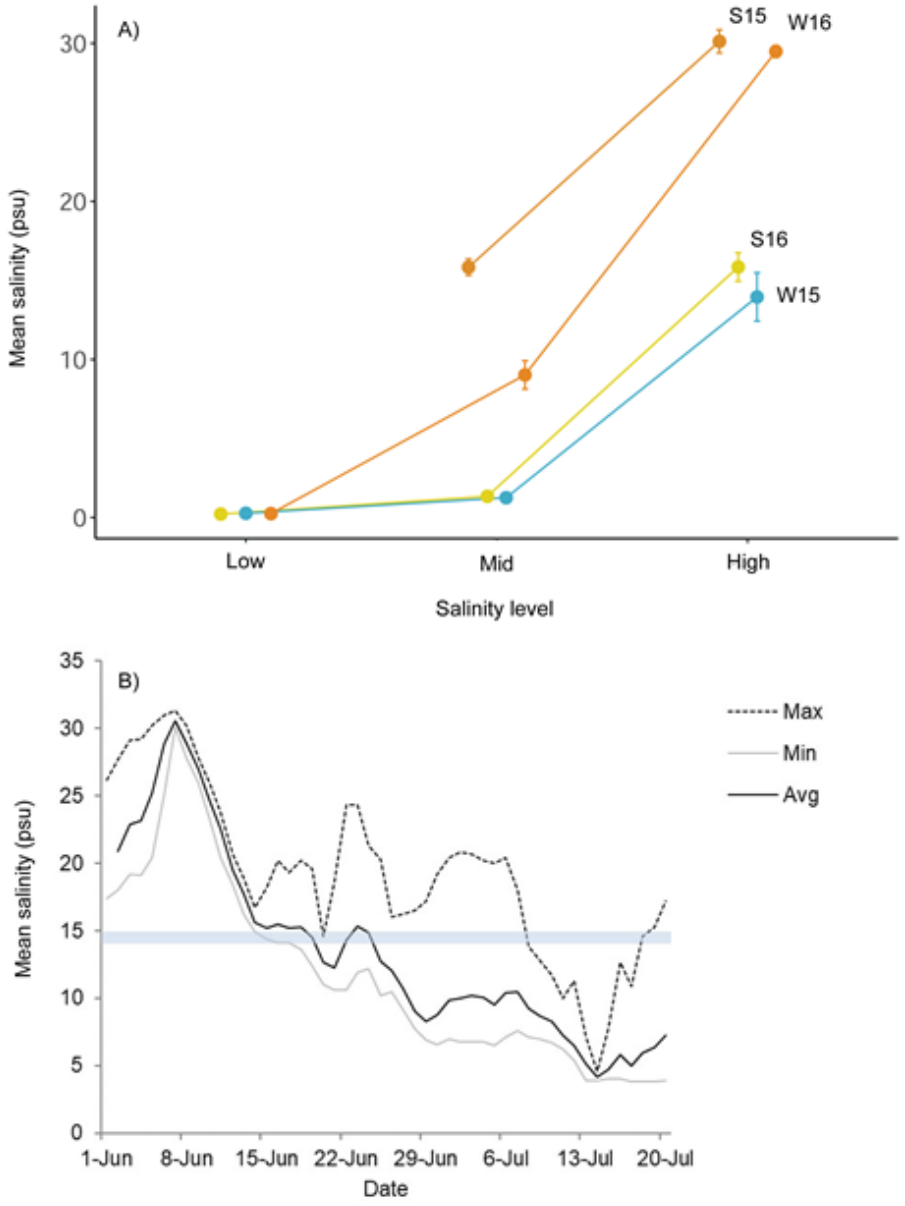

Figure S2. (A) Salinity trends over the course of this study at low-, mid- and high-salinity estuary reaches and (B) salinity levels observed at one of our high-salinity reaches during the summer 2016 (Source: USGS stream site 255327081275900).

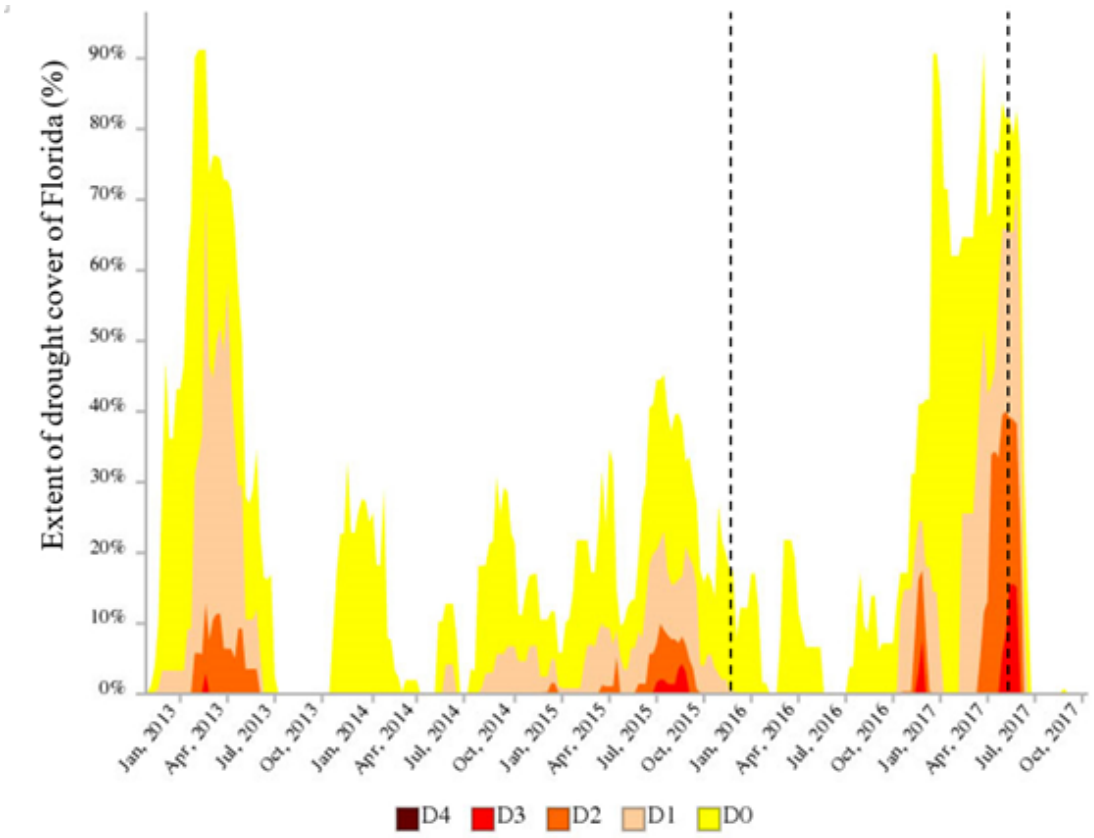

Figure S3. Recent trends of drought intensity in Florida (D0, abnormally dry; D1, moderate drought; D2, severe drought; D3, extreme drought; D4, exceptional drouht), including drought conditions experienced during the summer (Jun–Jul 2015) and winter (Dec 2016–Jan 2017) sampling periods of this study denoted by black dashed lines. (Source: NIDIS.)

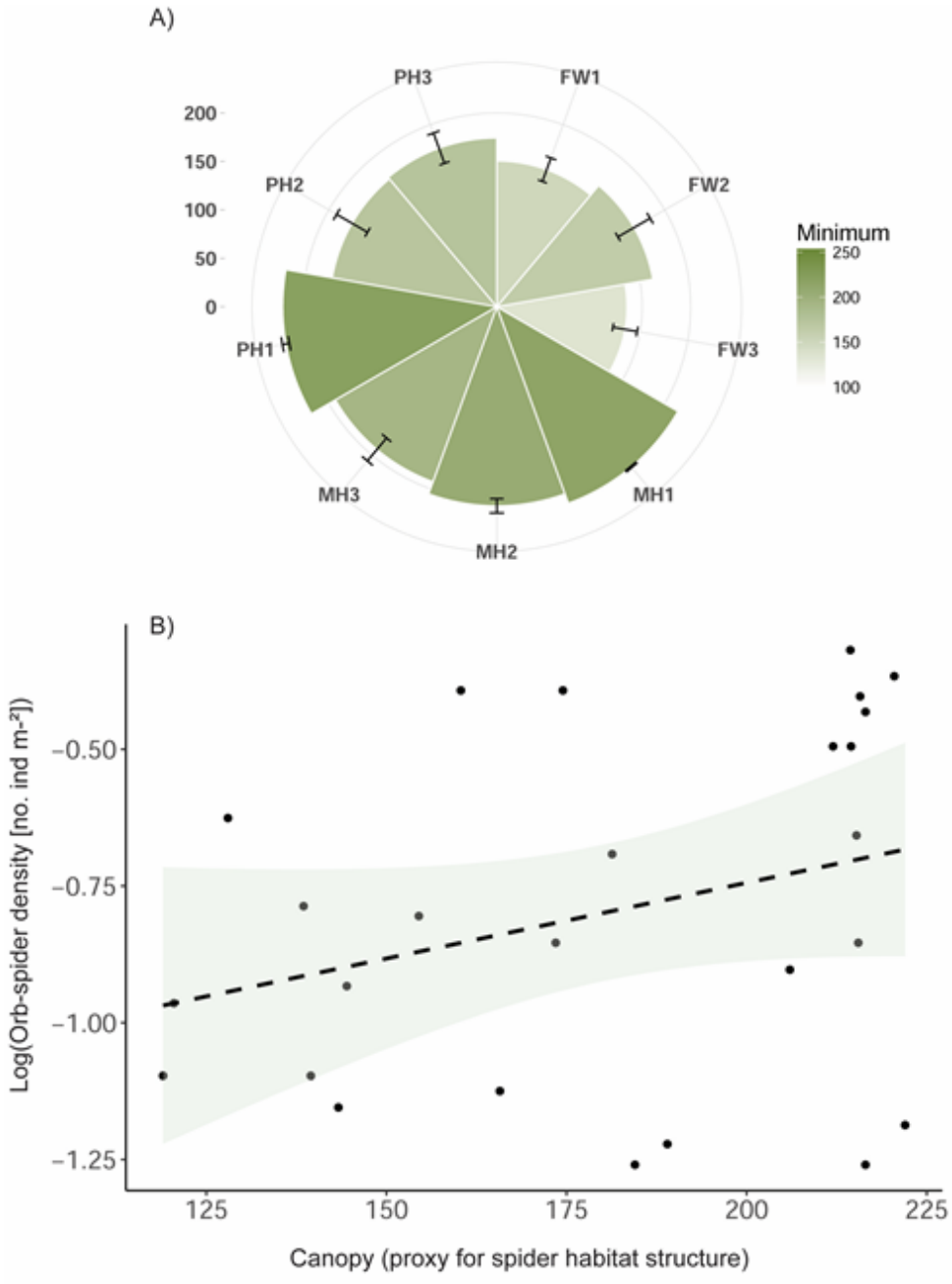

Figure S4. (A) Estimated overhanging vegetation (as proxy for orb-weaving spider habitat) at low- (FW, freshwater), mid- (MH, mesohaline), and high-salinity (PH, polyhaline) reaches and (B) the relationship between overhanging vegetation and spider emergence rate (i.e. density: $R^2 = 0.06$, $P = 0.125$; $y = 0.003x - 1.298$).

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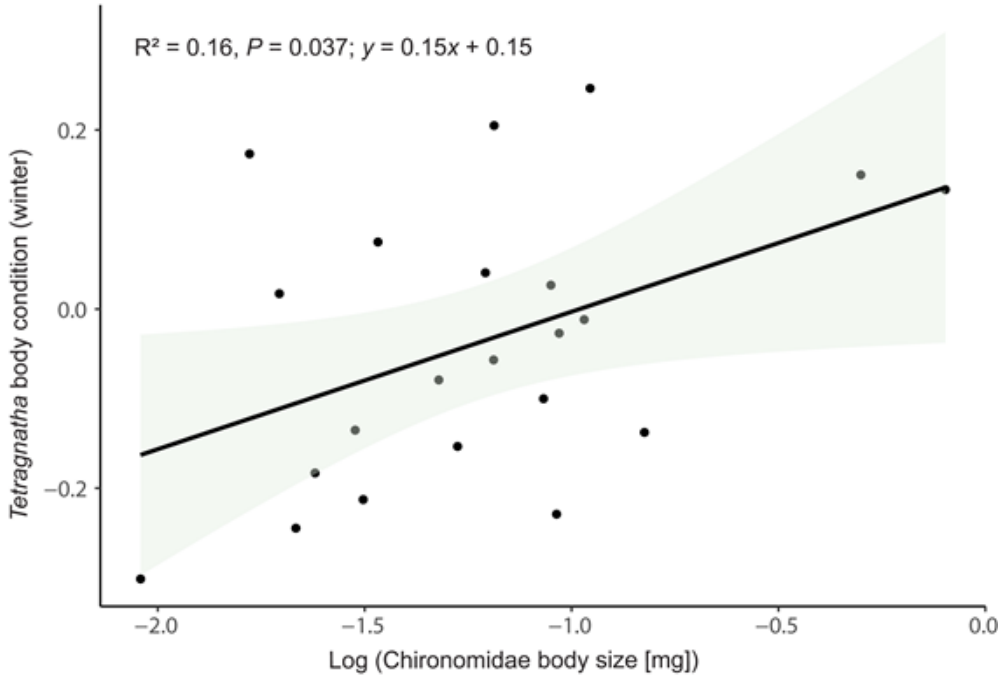

Figure S5. The relationship between body size of Chironomidae and body condition of *Tetragnatha* and: R^2 = 0.16, P = 0.037; y = 0.15x + 0.15.