

Code ▾

Supplementary information: Statistical Analysis and Methods

Script: Nutrient Limitation and Amazonian Spiders

Gaione-Costa et al. 2026

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Description

Supplementary information for the following paper: **Nitrogen and Phosphorus availability mediates the effects of bottom-up limitation on orb-weaver spider traits in an Amazonian rainforest**.

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Summary and highlights results of the analyses

Our results provide evidence that nutrient limitation in an Amazon terra firme rainforest has varying effects on the size, but not the fat content, of two common understory spider species. We found that individuals of *S. duodecimguttata* in N-only-fertilized (P not included) plots were smaller compared to those in environments with joint addition of N and P, which had a larger size. However, the fat content of remained unaffected by nutrient additions. In contrast, neither the size nor the fat content of *H. folisecens* was influenced by nutrient additions. To the best of our knowledge, this is the first evidence that nutrient limitation on soil can affect life-history traits of at least one predator in a naturally megadiverse nutrient-limited terrestrial environment.

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Linear mixed model approach

All analyzes in the article were based on the followed model:

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\[ lmer~(response ~ N*P*Cations + Expedition + (1|~Block), ~REML = FALSE) \]
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Simplifying the fixed effects of all models step-wise was carried out using the *step()* function from the '*lmerTest*' package.

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We used the standard type III *anova* to shows the results of each model. We compared final models to null models for completeness. Comparisons between the final model and null models were showed using the function *anova* from default package of R program.

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1. Pre-Analysis: Fat remove comparison and correlation between fat-free and fat removed mass

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1.1. LMM between steps of fat removal process of *Spilasma*

duodecimguttata (Table S1)

Supplementary Table S1 | Pairwise comparisons among sequential mass measurements during fat extraction of *S. duodecimguttata*. Dry body mass was measured procedure before extraction (Pi), after the first extraction step procedure (P1), and after the second extraction step procedure (P2). Estimates represent mean differences between steps (g) derived from linear mixed models (lmer(WEIGHT ~ STEP + EXPEDITION + (1 | ID)), with associated standard errors (SE), degrees of freedom (df), t-ratios, and p-values using contrasts by emmeans. Significant differences between Pi and both post-extraction measurements (P1 and P2) indicate effective fat removal, whereas the non-significant difference between P1 and P2 suggests minimal additional mass loss after the first extraction step.

contrast	estimate	SE	df	t.ratio	p.value
P1 - P2	0.0001101	5.91e-05	274	1.865043	0.1508855
P1 - Pi	-0.0006710	5.91e-05	274	-11.362040	0.0000000
P2 - Pi	-0.0007812	5.91e-05	274	-13.227083	0.0000000

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1.2. LMM between steps of fat removal process of *Hingstepeira folisecens* (Table S2)

Supplementary Table S2 | Pairwise comparisons among sequential mass measurements during fat extraction of *H. folisecens*. Dry body mass was measured procedure before extraction (Pi), after the first extraction step procedure (P1), and after the second extraction step procedure (P2). Estimates represent mean differences between steps (g) derived from linear mixed model 'lmer(log(WEIGHT) ~ STEP + EXPEDITION + (1 | ID))', with associated standard errors (SE), degrees of freedom (df), t-ratios, and p-values using contrasts by emmeans. Significant differences between Pi and both post-extraction measurements (P1 and P2) indicate effective fat removal, whereas the non-significant difference between P1 and P2 suggests minimal additional mass loss after the first extraction step.

contrast	ratio	SE	df	null	t.ratio	p.value
P1 / P2	1.0135314	0.0095744	280	1	1.422808	0.3305283
P1 / Pi	0.8621926	0.0081448	280	1	-15.696321	0.0000000
P2 / Pi	0.8506816	0.0080360	280	1	-17.119129	0.0000000

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2. Cephalothorax width of *S. duodecimguttata*

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2.1. Dataset of cephalothorax width of *S. duodecimguttata*

individuals by treatment (Table S3)

Supplementary Table S3 | Summary of cephalothorax width data for *S. duodecimguttata* across AFEX treatments. Mean, SD, and SE of cephalothorax width for adult females collected during two expeditions (2022–2023) in an old-growth forest in Central Amazonia.

Treatment	N	1 ^a expedition (n)	2 ^a expedition (n)	Mean cephalothorax width (mm)	SD	SE
Control	18	16	2	2.272	0.162	0.038
Phosphorus	38	27	11	2.222	0.200	0.032
Nitrogen	15	13	2	2.163	0.219	0.057
Cations	22	17	5	2.284	0.097	0.021
N+P	14	11	3	2.291	0.115	0.031
P+Cations	11	9	2	2.211	0.165	0.050
N+Cations	22	13	9	2.218	0.165	0.035
N+P+Cations	11	7	4	2.303	0.066	0.020

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2.2. Dataset of cephalothorax width of *S. duodecimguttata* individuals by main nutrient (Table S4)

Supplementary Table S4 | Summary of cephalothorax width data for *S. duodecimguttata* by primary nutrient. Mean, SD, and SE of cephalothorax width of individuals collected in AFEX plots according to the presence or absence of each nutrient. Data include specimens collected during two expeditions (2022–2023).

Treatment	N	Mean cephalothorax width (mm)	se
-P	77	2.239	0.019
+P	74	2.245	0.020
-N	89	2.246	0.018
+N	62	2.236	0.021
-Cations	85	2.233	0.020
+Cations	66	2.253	0.017

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2.3. Full model for cephalothorax width of *S. duodecimguttata* (Table

S5)

Supplementary Table S5 | Analysis of variance of the full mixed-effects model for cephalothorax width of *S. duodecimguttata*. Fixed effects include N, P, Cations, their interactions, and collection expedition, with block included as a random intercept. The model was fitted as:

`lmer(WIDTH_CEPHALOTHORAX ~ N * P * CATIONS + EXPEDITION + (1 | BLOCK), REML = FALSE)`

	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N	0.0001162	0.0001162	1	151	0.0046847	0.9455220
P	0.0204611	0.0204611	1	151	0.8252394	0.3651003
CATIONS	0.0180477	0.0180477	1	151	0.7279026	0.3949152
EXPEDITION	0.1088944	0.1088944	1	151	4.3919460	0.0377776
N:P	0.2199029	0.2199029	1	151	8.8691594	0.0033799
N:CATIONS	0.0166942	0.0166942	1	151	0.6733124	0.4131926
P:CATIONS	0.0157203	0.0157203	1	151	0.6340324	0.4271301
N:P:CATIONS	0.0004400	0.0004400	1	151	0.0177476	0.8941967

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2.4. Model simplification procedure for cephalothorax width of *S. duodecimguttata* (Table S6)

Supplementary Table S6 | Backward simplification of the full mixed-effects model for cephalothorax width of *S. duodecimguttata*. Fixed effects were sequentially removed using the `step` function (`lmerTest`). The table shows the eliminated fixed terms during the model simplification procedure.

	Eliminated	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N:P:CATIONS	1	0.0004400	0.0004400	1	151.0000	0.0177476	0.8941967
P:CATIONS	2	0.0153307	0.0153307	1	151.0000	0.6182470	0.4329317
N:CATIONS	3	0.0191605	0.0191605	1	150.9136	0.7706100	0.3814238
CATIONS	4	0.0178677	0.0178677	1	150.9982	0.7151824	0.3990668
EXPEDITION	0	0.0840973	0.0840973	1	150.9944	3.3590121	0.0688079
N:P	0	0.2095918	0.2095918	1	149.7561	8.3715121	0.0043807

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2.5. Simplified model for cephalothorax width of *S. duodecimguttata* (Table S7)

Supplementary Table S7 | Type III anova of the final mixed-effects model for cephalothorax width of *S. duodecimguttata*. The model includes the N × P interaction, expedition as a fixed effect, and block as a random intercept. The model was fitted as: `lmer(WIDTH_CEPHALOTHORAX ~ N * P + EXPEDITION + (1 | BLOCK), REML = FALSE)`

	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N	0.0000252	0.0000252	1	150.8882	0.0010069	0.9747276
P	0.0177827	0.0177827	1	144.7329	0.7102749	0.4007431
EXPEDITION	0.0840973	0.0840973	1	150.9944	3.3590121	0.0688079
N:P	0.2095918	0.2095918	1	149.7561	8.3715121	0.0043807

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2.6. Null model comparison (Table S8)

Supplementary Table S8 | Likelihood ratio test comparing the final and null mixed-effects models for cephalothorax width of *S. duodecimguttata*. The null model includes expedition as a fixed effect and block as a random intercept. We observed a significant difference between the final model and the null model ($\text{Chisq}(3) = 8.265$, $p = 0.041$), suggesting that the addition of N and P nutrients does indeed affect the size of the spiders.

	npar	AIC	BIC	logLik	-2*log(L)	Chisq	Df	Pr(>Chisq)
m1_size_spilasma_null	4	-111.3960	-99.32684	59.69798	-119.3960	NA	NA	NA
m1_size_spilasma_final	7	-113.6607	-92.53971	63.83033	-127.6607	8.264711	3	0.0408463

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2.7. Final dataset for cephalothorax width of *S. duodecimguttata* (N|P interaction) (Table S9)

Supplementary Table S9 | Summary of the marginal means of the final model:

lmer(WIDTH_CEPHALOTHORAX ~ N * P + EXPEDITION + (1 | BLOCK) for *S. duodecimguttata*. All data is associated with estimate marginal means from emmeans function of 'emmeans' package, representing the estimation of the real data by the model. Plots with +N-P showed spiders with a smaller relative size compared to environments without the addition of N and P (-N-P), while relatively larger spiders were observed in environments with the addition of +N+P. On these data, SE, df and CI is estimated based on model estimates.

Interactions between main nutrients	n	Estimated marginal mean (mm)	SE	df	lower.CL	upper.CL
-N-P	40	2.279339	0.0203334	22.19557	2.222905	2.335774
+N-P	37	2.195376	0.0308548	23.91892	2.137047	2.253705
-N+P	49	2.218938	0.0272972	17.99657	2.166879	2.270997
+N+P	25	2.296156	0.0190252	36.07900	2.227347	2.364965

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3. Cephalothorax width of *H. folisecens*

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3.1. Dataset of cephalothorax width of *H. folisecens* (Table S10)

Supplementary Table S10 | Summary of the data on the width of the cephalothorax of *H. folisecens* by AFEX treatments. Mean, SD, and SE of the width cephalothorax of individuals of *H. folisecens* in different fertilization treatments of AFEX in a mature forest in Central Amazonia. The data comprises data of spiders *H. folisecens* collected in three expeditions (2022, 2023 and 2024).

Treatment	N	1 ^a expedition (n)	2 ^a expedition (n)	3 ^a expedition (n)	Mean width cephalothorax (mm)	SD	SE
Control	20	5	2	13	1.68	0.107	0.024
Phosphorus	25	4	1	20	1.65	0.084	0.017
Nitrogen	24	5	1	18	1.68	0.083	0.017
Cations	20	6	2	12	1.69	0.112	0.025
N+P	21	3	1	17	1.72	0.053	0.012
P+Cations	17	2	3	12	1.70	0.099	0.024
N+Cations	20	1	1	18	1.68	0.064	0.014
N+P+Cations	8	1	1	6	1.67	0.061	0.022

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3.2. Dataset of cephalothorax width of *H. folisecens* individuals by main nutrient (Table S11)

Supplementary Table S11 | Cephalothorax width of *H. folisecens* by nutrient addition. Mean, SD, and SE of individuals collected in AFEX plots according to the presence or absence of each macronutrient.

Treatment	N	Mean	SD	SE
-P	84	1.680	0.091	0.010
+P	71	1.685	0.082	0.010
-N	82	1.678	0.100	0.011
+N	73	1.687	0.069	0.008
-Cations	90	1.680	0.086	0.009
+Cations	65	1.686	0.089	0.011

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3.3. Full model for cephalothorax width of *H. folisecens* (Table S12)

Supplementary Table S12 | Type III anova of the f mixed-effects model for cephalothorax width of *H. folisecens*. The model included macronutrient fertilization (N, P, and Cations), their interactions, expedition, and block as a random effect. The model was fitted as: lmer(WIDTH_CEPHALOTHORAX ~ N * P * CATIONS + EXPEDITION + (1 | BLOCK), REML = FALSE)

	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N	0.0001166	0.0001166	1	155	0.0167167	0.8972933
P	0.0006260	0.0006260	1	155	0.0897507	0.7648957
CATIONS	0.0004225	0.0004225	1	155	0.0605663	0.8059286
EXPEDITION	0.0185955	0.0092978	2	155	1.3329625	0.2667005
N:P	0.0077775	0.0077775	1	155	1.1150184	0.2926367
N:CATIONS	0.0280058	0.0280058	1	155	4.0150229	0.0468390
P:CATIONS	0.0001130	0.0001130	1	155	0.0161940	0.8989031
N:P:CATIONS	0.0132067	0.0132067	1	155	1.8933695	0.1708072

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3.4. Model simplification procedure for cephalothorax width of *H. folisecens* (Table S13)

Supplementary Table S13 | Model simplification for cephalothorax width of *H. folisecens*.

Simplification process of the full model of effects of macronutrient fertilization in the *H. folisecens*'s size. This table shows the selected terms after backward elimination. N and Cations were not removed from the model

	Eliminated	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N:P:CATIONS	1	0.0132067	0.0132067	1	155	1.8933695	0.1708072
P:CATIONS	2	0.0000298	0.0000298	1	155	0.0042216	0.9482784
N:P	3	0.0139100	0.0139100	1	155	1.9700772	0.1624399
P	4	0.0009696	0.0009696	1	155	0.1355997	0.7131977
EXPEDITION	0	0.0182971	0.0091486	2	155	1.2783287	0.2814219
N:CATIONS	0	0.0295439	0.0295439	1	155	4.1281734	0.0438828

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3.5. Null model comparison (Table S14)

Supplementary Table S14 | Output of an anova comparison between the final and null models.

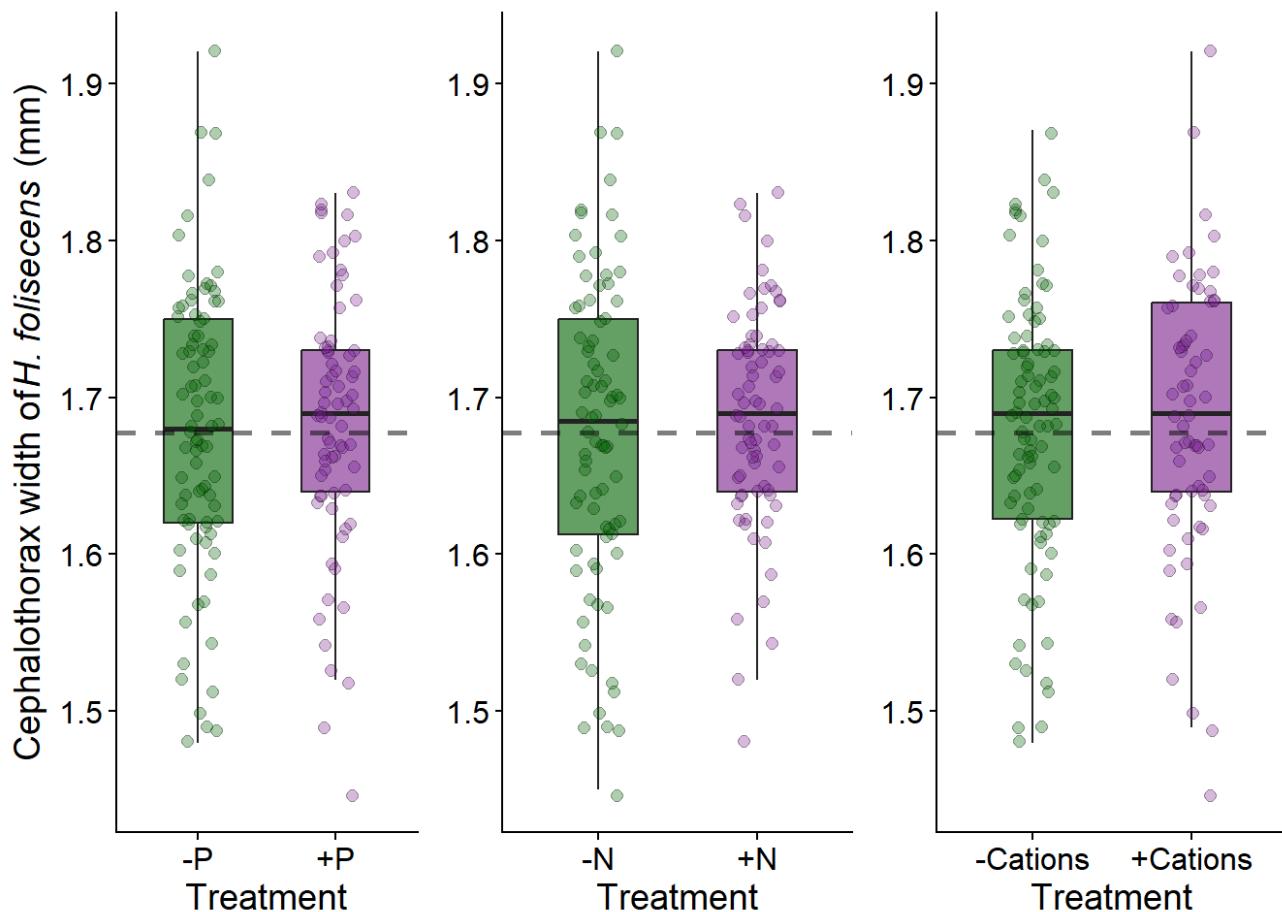
Although the addition of N and Cations was maintained in the final model, the comparison with the null model showed a nonsignificant difference between the models ($\text{Chisq}(3) = 4.597$, $p = 0.203$), indicating that these nutrients do not result in a significant effect on the nutritional status of *H. folisecens*.

	npar	AIC	BIC	logLik	-2*log(L)	Chisq	Df	Pr(>Chisq)
m2_null	5	-311.1869	-295.9697	160.5934	-321.1869	NA	NA	NA
m2_width_final	8	-309.7845	-285.4371	162.8922	-325.7845	4.597608	3	0.2037474

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3.6. Relationship between nutrient addition and body size of *H. folisecens*

(Figure S1)



Supplementary Figure S1 | Size of *H. foliaceus* individuals through the addition of macronutrients, represented by the width of the cephalothorax. We no observed any effect of nutrient addition on the size of the individuals of *H. foliaceus*. Each box represents the dispersion values of the data, where the full black line in the boxes represents the median of the data. The dots in each box represent the size of each individual. The dashed line represents the mean value of the cephalothorax width of individuals collected in the control plots ($n = 20$; mean = 1.677 ± 0.023 mm).

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4. Fat content of *S. duodecimguttata*

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4.1. Dataset of fat content of *S. duodecimguttata* (Table S15)

Supplementary Table S15 | Summary of the fat content of the individuals of *S. duodecimguttata* by AFEX treatments. Treatment (TRT), number of individuals, mean weight, mean residual fat removed, ratio fat representation, and mean patronized residuals of the body condition data of individuals of *S. duodecimguttata* in different fertilization treatments in a mature forest in Central Amazonia. The data analysis comprises data from spiders *S. duodecimguttata* collected in two expeditions (2022 and 2023).

Treatment	N	Mean weight total (g)	Mean residual fat removed (g)
Control	17	0.0081 (\pm 0.0007)	0.0006 (\pm 0.0001)
Phosphorus	34	0.0084 (\pm 0.0005)	0.001 (\pm 0.0002)
Nitrogen	12	0.0074 (\pm 0.001)	0.0006 (\pm 0.0001)
Cations	22	0.008 (\pm 0.0003)	0.0007 (\pm 0.0001)
N+P	13	0.0087 (\pm 0.0006)	0.0009 (\pm 0.0002)
P+Cations	10	0.0066 (\pm 0.0006)	0.0005 (\pm 0.0001)
N+Cations	20	0.0078 (\pm 0.0006)	0.0008 (\pm 0.0001)
N+P+Cations	10	0.0084 (\pm 0.0007)	0.0008 (\pm 0.0002)

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4.2. Dataset of cephalothorax width of *S. duodecimguttata* by main nutrient (Table S16)

Supplementary Table S16 | Summary of the fat content of the individuals of *S. duodecimguttata* per primary nutrient. Treatment (TRT), number of individuals, mean weight, mean residual fat removed, ratio fat representation, and mean patronized residuals of the body condition data of individuals of *S. duodecimguttata* in different fertilization treatments in a mature forest in Central Amazonia. The data analysis comprises data from spiders *S. duodecimguttata* collected in two expeditions (2022 and 2023).

Treatment	N	Mean weight total (g)	Fat content weight (g)	Mean padronized residuals
-P	71	0.0079 (\pm 0.0003)	0.0007 (\pm 0.0001)	-0.1395 (\pm 0.0783)
+P	67	0.0082 (\pm 0.0003)	0.0009 (\pm 0.0001)	0.1467 (\pm 0.1536)
-N	83	0.008 (\pm 0.0003)	0.0008 (\pm 0.0001)	-0.0258 (\pm 0.1212)
+N	55	0.008 (\pm 0.0004)	0.0008 (\pm 0.0001)	0.0375 (\pm 0.1124)
-Cations	76	0.0082 (\pm 0.0003)	0.0008 (\pm 0.0001)	0.0442 (\pm 0.1391)
+Cations	62	0.0078 (\pm 0.0003)	0.0007 (\pm 0.0001)	-0.0554 (\pm 0.0844)

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4.3. Full model for fat content of *S. duodecimguttata* (Table S17)

Supplementary Table S15 | Output of an anova of the full model: ‘lmer(y_transformed ~ N * P * CATIONS + EXPEDITION + (1 | BLOCK), REML = F’. This model was fitted with the the boxcox adjust of standard residuals of the ratio between total weight and residual fat content in the data of the individuals *S. duodecimguttata*.

	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N	0.2213461	0.2213461	1	138	1.6499789	0.2011139
P	0.1186476	0.1186476	1	138	0.8844338	0.3486334
CATIONS	0.0167874	0.0167874	1	138	0.1251379	0.7240674
EXPEDITION	0.0469259	0.0469259	1	138	0.3497993	0.5551943
N:P	0.1251281	0.1251281	1	138	0.9327415	0.3358410
N:CATIONS	0.0247442	0.0247442	1	138	0.1844504	0.6682460
P:CATIONS	0.2007888	0.2007888	1	138	1.4967385	0.2232588
N:P:CATIONS	0.0557492	0.0557492	1	138	0.4155706	0.5202257

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4.4. Model simplification procedure for fat content of *S. duodecimguttata* (Table S18)

Supplementary Table S18 | Model simplification for standard residuals of the ratio between total weight and residual fat content of *H. folisecens*. Simplification process of the full model of effects of the macronutrient fertilization in the *S. duodecimguttata*'s body condition. This table shows the selected terms after backward elimination. All treatments were removed through the simplification process.

	Eliminated	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N:P:CATIONS	1	0.0557492	0.0557492	1	138	0.4155706	0.5202257
N:CATIONS	2	0.0157879	0.0157879	1	138	0.1173346	0.7324647
N:P	3	0.1773889	0.1773889	1	138	1.3172187	0.2530776
N	4	0.2082537	0.2082537	1	138	1.5317870	0.2179461
P:CATIONS	5	0.2558697	0.2558697	1	138	1.8613609	0.1746886
CATIONS	6	0.0302669	0.0302669	1	138	0.2172505	0.6418778
P	7	0.2255433	0.2255433	1	138	1.6163664	0.2057378
EXPEDITION	0	0.0007830	0.0007830	1	138	0.0055464	0.9407408

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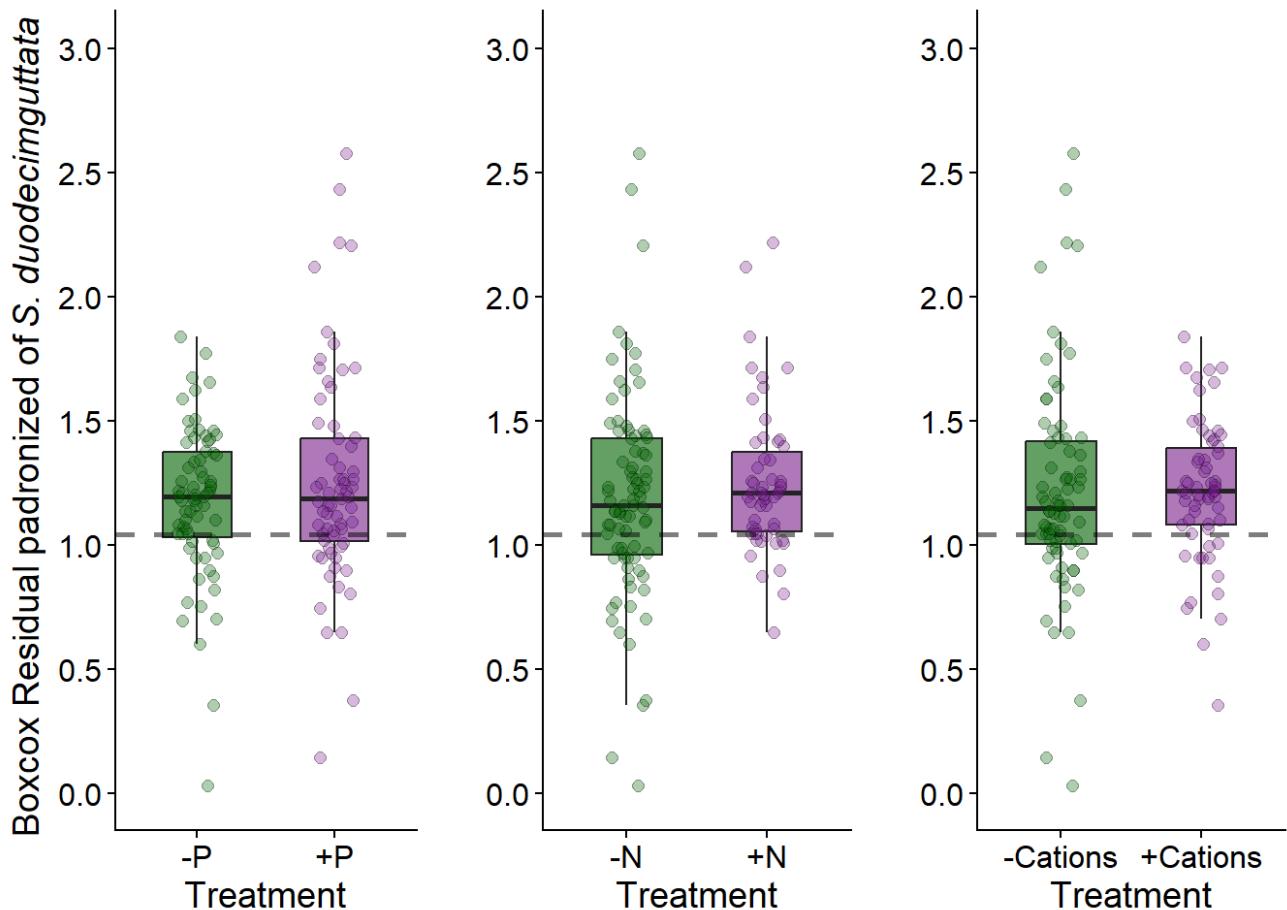
4.5. Null model comparison (Table S19)

Supplementary Table S19 | Output of anova comparison between the final and null models. The comparison showed a nonsignificant difference between the models ($\text{Chisq}(7) = 7.039$, $p = 0.424$).

	npar	AIC	BIC	logLik	-2*log(L)	Chisq	Df	Pr(>Chisq)
null_m3	4	129.4535	141.1625	-60.72677	121.4535	NA	NA	NA
m_boxcox_m3	11	136.4140	168.6138	-57.20700	114.4140	7.039524	7	0.4247763

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4.6. Relationship between nutrient addition and body fat content of *S.*

duodecimguttata (Figure S2)

Supplementary Figure S2 | Fat content of *S. duodecimguttata* individuals by adding macronutrients, represented by the patronized residuals of the ratio between fat extracted and the weight without fat. We no observed any effect of nutrient addiction on these spiders's body fat content. Each box represents the dispersion values of the data, where the full black line in the boxes represents the median of the data. The dots in each box represent the size of each individual. The dashed line represents the mean value of the cephalothorax width of individuals collected in the control plots ($n = 17$; Dashed line = 1.043 ± 0.093 mm (mean \pm se)).

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5. Fat content of *H. folisecens*

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5.1. Dataset of fat content of *H. folisecens* (Table S20)

Supplementary Table s20 | Summary of the fat content of the individuals of *H. folisecens* by AFEX treatments. Treatment (TRT), number of individuals, mean weight, mean residual fat removed, ratio fat representation, and mean patronized residuals of the body condition data of individuals of *H. folisecens* in different fertilization treatments in a mature forest in Central Amazonia. The data analysis comprises data from spiders *H. folisecens* collected in three expeditions (2022, 2023 and 2024).

Treatment	N	Mean weight total (g)	Mean residual fat removed (g)	Mean padronized residuals
Control	19	0.0047 (\pm 0.0006)	0.0007 (\pm 0.0002)	-0.132 (\pm 0.2366)
Phosphorus	24	0.0043 (\pm 0.0004)	0.0009 (\pm 0.0002)	0.3905 (\pm 0.226)
Nitrogen	22	0.0049 (\pm 0.0004)	0.0009 (\pm 0.0002)	0.1987 (\pm 0.2344)
Cations	18	0.0044 (\pm 0.0005)	0.0008 (\pm 0.0002)	0.1652 (\pm 0.2982)
N+P	21	0.0046 (\pm 0.0005)	0.0006 (\pm 0.0002)	-0.38 (\pm 0.1928)
P+Cations	13	0.0038 (\pm 0.0003)	0.0005 (\pm 0.0002)	-0.1584 (\pm 0.1977)
N+Cations	19	0.0042 (\pm 0.0003)	0.0006 (\pm 0.0001)	-0.0918 (\pm 0.1575)
N+P+Cations	5	0.0034 (\pm 0.0003)	0.0003 (\pm 0.0001)	-0.4793 (\pm 0.2225)

\(\sim\)

5.2. Dataset of cephalothorax width of *H. folisecens* individuals by main nutrient (Table S21)

Supplementary Table S21 | Summary of the fat content of the individuals of *H. folisecens* per primary nutrient. Treatment (TRT), number of individuals, mean weight, mean residual fat removed, ratio fat representation, and mean patronized residuals of the body condition data of individuals of *H. folisecens* in different fertilization treatments in a mature forest in Central Amazonia. The data analysis comprises data from spiders *H. folisecens* collected in three expeditions (2022, 2023 and 2024).

Treatment	N	Mean weight total (g)	Fat content weight (g)	Mean padronized residuals
-P	78	0.0045 (\pm 0.0002)	0.0008 (\pm 0.0001)	0.0397 (\pm 0.1168)
+P	63	0.0043 (\pm 0.0002)	0.0007 (\pm 0.0001)	-0.0487 (\pm 0.1228)
-N	74	0.0043 (\pm 0.0002)	0.0008 (\pm 0.0001)	0.1051 (\pm 0.1252)
+N	67	0.0045 (\pm 0.0002)	0.0007 (\pm 0.0001)	-0.1157 (\pm 0.1113)
-Cations	86	0.0046 (\pm 0.0002)	0.0008 (\pm 0.0001)	0.0378 (\pm 0.1147)
+Cations	55	0.0041 (\pm 0.0002)	0.0006 (\pm 0.0001)	-0.0587 (\pm 0.1227)

\(\sim\)

5.3. Full model for fat content of *H. folisecens* (Table S22)

Supplementary Table S22 | Output of an anova of the full model:

'lmer(Standard_residuals_hingstepeira ~ N * P * CATIONS + EXPEDITION + (1 | BLOCK), REML = F. This model was fitted with the standard residuals of the ratio between the total weight and residual fat content of the data of the individuals *H. folisecens*.

	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N	2.6521831	2.6521831	1	118.1175	3.0388922	0.0838935
P	1.0782092	1.0782092	1	126.4697	1.2354205	0.2684640
CATIONS	0.6680281	0.6680281	1	126.2067	0.7654318	0.3832959
EXPEDITION	6.2417278	3.1208639	2	135.6413	3.5759103	0.0306591
N:P	1.5942497	1.5942497	1	129.0844	1.8267038	0.1788811
N:CATIONS	0.0641037	0.0641037	1	139.4386	0.0734505	0.7867784
P:CATIONS	0.4760532	0.4760532	1	133.8928	0.5454655	0.4614691
N:P:CATIONS	2.1416148	2.1416148	1	133.9689	2.4538789	0.1195939

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5.4. Model simplification procedure for fat content of *H. folisecens* (Table S23)

Supplementary Table S23 | Model simplification for standard residuals of the ratio between total weight and residual fat content of *H. folisecens*. Simplification process of the full model of effects of the macronutrient fertilization in the *H. folisecens*'s body condition. This table shows the selected terms after backward elimination. All treatments were removed through the simplification process.

	Eliminated	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
N:P:CATIONS	1	2.1416148	2.1416148	1	133.9689	2.4538789	0.1195939
N:CATIONS	2	0.3610585	0.3610585	1	140.8684	0.4099932	0.5230131
P:CATIONS	3	0.7435686	0.7435686	1	137.0126	0.8458498	0.3593454
CATIONS	4	0.7948318	0.7948318	1	134.3328	0.8994746	0.3446257
N:P	5	2.5747599	2.5747599	1	135.9518	2.8993299	0.0909016
P	6	0.4435051	0.4435051	1	140.8815	0.4904595	0.4848774
N	7	3.1821943	3.1821943	1	136.7904	3.5128319	0.0630281
EXPEDITION	0	5.4729178	2.7364589	2	136.7072	2.9377005	0.0563415

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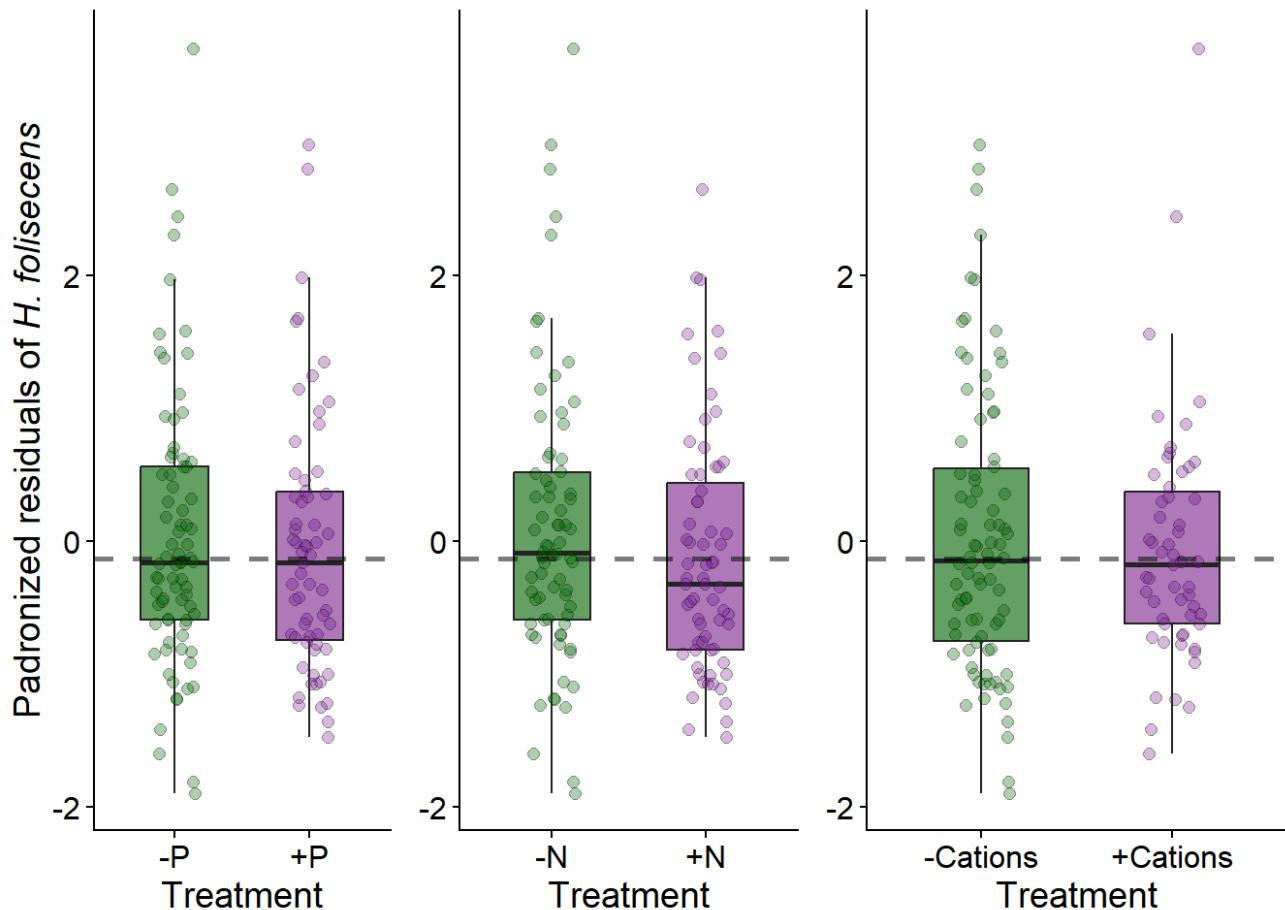
5.5. Null model comparison (Table S24)

Supplementary Table S24 | Output of anova comparison between the final and null models. The comparison showed a nonsignificant difference between the models ($\text{Chisq}(7) = 11.308$, $p = 0.125$).

	npar	AIC	BIC	logLik	-2*log(L)	Chisq	Df	Pr(>Chisq)
null_m4	5	404.3675	419.1113	-197.1838	394.3675	NA	NA	NA
m4_fat_hingstepeira	12	407.0597	442.4448	-191.5299	383.0597	11.30782	7	0.1257444

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5.6. Relationship between nutrient addition and body fat content of *H.*

folisecens (Figure S3)

Supplementary Figure S3 | Fat content of *H. folisecens* individuals by adding macronutrients, represented by the patronized residuals of the ratio between fat extracted and the weight without fat. We no observed any effect of nutrient addiction on these spiders's body fat content. Each box represents the dispersion values of the data, where the full black line in the boxes represents the median of the data. The dots in each box represent the size of each individual. The dashed line represents the mean value of the cephalothorax width of individuals collected in the control plots ($n = 17$; Dashed line = -0.132 ± 0.237 (mean \pm se)).