**Supplementary Information**

# Exploring plant α- and β-diversity patterns along tropical altitudinal gradients in the Southern Andes of Ecuador: a potential pathway to biodiversity conservation

Plant Biosystems

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**Table S1** Number of transects and sampling subplots corresponding to each altitudinal band analyzed in the study, along with the number of families, genera, species, and endemic species recorded

| | Altitudinal bands m a.s.l. | Number of samples | | Number of families | Number of genera | Number of species | | | | Number of endemic species |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Transects | Subplots | | | Total | Trees | Shrubs | Herbs | |
| Jubones | 1000 | 1 | 10 | 19 | 32 | 37 | 1 | 13 | 23 | 4 |
| | 1100 | 4 | 39 | 22 | 44 | 51 | 0 | 19 | 32 | 6 |
| | 1200 | 1 | 10 | 12 | 21 | 21 | 0 | 7 | 14 | 4 |
| | 1300 | 2 | 20 | 13 | 30 | 37 | 1 | 17 | 19 | 3 |
| | 1400 | 1 | 10 | 12 | 18 | 21 | 1 | 11 | 9 | 2 |
| | 1500 | 2 | 20 | 20 | 45 | 57 | 6 | 26 | 25 | 5 |
| | 1600 | 3 | 30 | 20 | 42 | 53 | 3 | 30 | 20 | 5 |
| | 1700 | 2 | 20 | 26 | 51 | 60 | 8 | 29 | 23 | 8 |
| | 1800 | 2 | 20 | 28 | 51 | 54 | 11 | 17 | 26 | 6 |
| | 1900 | 3 | 30 | 36 | 81 | 104 | 9 | 39 | 56 | 10 |
| | 2000 | 1 | 10 | 17 | 31 | 34 | 4 | 18 | 12 | 6 |
| | 2100 | 1 | 10 | 28 | 46 | 52 | 20 | 16 | 16 | 5 |
| | 2200 | 1 | 10 | 34 | 56 | 61 | 19 | 23 | 19 | 5 |
| | 2300 | 1 | 10 | 25 | 39 | 42 | 16 | 17 | 9 | 3 |
| | 2400 | 1 | 10 | 30 | 39 | 43 | 22 | 12 | 9 | 4 |
| | 2500 | 1 | 10 | 39 | 50 | 58 | 28 | 13 | 17 | 8 |
| | 2600 | 1 | 10 | 35 | 40 | 49 | 26 | 15 | 8 | 6 |
| | 2700 | 1 | 10 | 35 | 44 | 50 | 23 | 8 | 19 | 3 |
| | 2800 | 1 | 10 | 35 | 41 | 48 | 26 | 7 | 15 | 4 |
| | 2900 | 1 | 10 | 43 | 61 | 73 | 35 | 13 | 25 | 12 |
| | 3000 | 1 | 10 | 43 | 62 | 74 | 24 | 14 | 36 | 10 |
| CNP | 3300 | 2 | 20 | 39 | 76 | 96 | 17 | 29 | 50 | 11 |
| | 3400 | 4 | 40 | 57 | 111 | 168 | 27 | 45 | 96 | 23 |
| | 3500 | 14 | 140 | 71 | 173 | 315 | 47 | 91 | 177 | 42 |
| | 3600 | 14 | 140 | 54 | 140 | 247 | 24 | 66 | 157 | 34 |
| | 3700 | 22 | 157 | 57 | 138 | 267 | 12 | 54 | 201 | 31 |
| | 3800 | 31 | 130 | 50 | 129 | 266 | 8 | 56 | 202 | 42 |
| | 3900 | 12 | 30 | 39 | 94 | 160 | 7 | 38 | 115 | 26 |
| | 4000 | 8 | 44 | 33 | 80 | 134 | 6 | 25 | 103 | 22 |
| | 4100 | 5 | 5 | 29 | 58 | 75 | 0 | 21 | 54 | 14 |
| | 4200 | 2 | 2 | 19 | 31 | 39 | 0 | 12 | 27 | 9 |

**Table S2** Results of the fitted GAM models testing the effect of the altitudinal gradient (1000 to 4200 m a.s.l.) on trees, shrubs and herbs at small and large scale

| SMALL SCALE | | | | | | |
|---|---|---|---|---|---|---|
| | **α-diversity** | **Estimate** | **SE** | **t-value** | **$R^2$** | **Model** |
| **TREES** | R-richness | 2.210 | 0.045 | 48.91 | 0.763 | QPoisson-log |
| | Chao | 1.939 | 0.087 | 22.2 | 0.72 | QPoisson-log |
| | Shannon exp | 1.858 | 0.060 | 30.66 | 0.704 | QPoisson-log |
| **SHRUBS** | R-richness | 2.249 | 0.027 | 83.12 | 0.307 | Gaussian-log |
| | Chao | 2.492 | 0.042 | 59.22 | 0.157 | Gaussian-log |
| | Shannon exp | 1.938 | 0.038 | 50.2 | 0.254 | Gaussian-log |
| **HERBS** | R-richness | 2.530 | 0.027 | 93.7 | 0.086 | QPoisson-log |
| | Chao | 3.621 | 0.014 | 248.7 | 0.233 | Poisson-log |
| | Shannon exp | 2.050 | 0.047 | 43.62 | 0.088 | QPoisson-log |
| **LARGE SCALE** | | | | | | |
| | **α-diversity** | **Estimate** | **SE** | **t-value** | **$R^2$** | **Model** |
| **TREES** | R-richness | 2.474 | 0.059 | 41.62 | 0.673 | QPoisson-log |
| | Chao | 2.745 | 0.091 | 30.05 | 0.632 | QPoisson-log |
| | Shannon exp | 2.109 | 0.096 | 21.86 | 0.546 | QPoisson-log |
| **SHRUBS** | R-richness | 2.653 | 0.045 | 57.83 | 0.761 | QPoisson-log |
| | Chao | 3.101 | 0.060 | 50.88 | 0.81 | QPoisson-log |
| | Shannon exp | 2.310 | 0.076 | 30.22 | 0.755 | QPoisson-log |
| **HERBS** | R-richness | 3.060 | 0.048 | 62.91 | 0.6 | Gaussian-log |
| | Chao | 3.621 | 0.074 | 48.38 | 0.946 | QPoisson-log |
| | Shannon exp | 2.492 | 0.071 | 34.7 | 0.472 | QPoisson-log |

**Table S3** Results of the fitted GAM models testing the effect of the altitudinal gradient (1000 to 4200 m a.s.l.) on β-diversity (Bray-Curtis dissimilarity index), performed for trees, shrubs and herbs

| SMALL SCALE | | | | | | |
|---|---|---|---|---|---|---|
| | **β-diversity** | **Estimate** | **SE** | **t-value** | **$R^2$** | **Model** |
| **TREES** | Bray-Curtis | -0.091 | 0.003 | -24.95 | 0.442 | Gaussian-log |
| **SHRUBS** | Bray-Curtis | -0.064 | 0.001 | -32.89 | 0.556 | Gaussian-log |
| **HERBS** | Bray-Curtis | -0.182 | 0.009 | -19.91 | 0.509 | Gaussian-log |
| **LARGE SCALE** | | | | | | |
| | **β-diversity** | **Estimate** | **SE** | **t-value** | **$R^2$** | **Model** |
| **TREES** | Bray-Curtis | -0.107 | 0.005 | -20.82 | 0.607 | QPoisson-log |
| **SHRUBS** | Bray-Curtis | -0.073 | 0.002 | -26.36 | 0.68 | QPoisson-log |
| **HERBS** | Bray-Curtis | -0.079 | 0.002 | -35.45 | 0.927 | QPoisson-log |

**Table S4** Results of the fitted GAMs models testing the effect of the altitudinal gradient (1000 to 4200 m a.s.l.) on species richness and β-diversity (Sørensen dissimilarity index) performed for total vascular plant species

| | Estimate | SE | t-value | $R^2$ | Model |
|---|---|---|---|---|---|
| **Species richness** | 53.029 | 1.329 | 39.89 | 0.454 | Gaussian-log |
| **β-diversity** | 0.805 | 0.002 | 390.9 | 0.863 | Gaussian-log |

**Table S5** Results of the null β-diversity models performed for trees, shrubs and herbs at the two different scales using the fixed species abundance distribution model. The table presents the observed β-diversity values, and the standardized effect sizes (SES)

| | Growth forms | β-Observed | SES |
|---|---|---|---|
| **Small scale** | **TREES** | 0.913 | 23.139 |
| | **SHRUBS** | 0.937 | 37.873 |
| | **HERBS** | 0.836 | 41.623 |
| **Large scale** | **TREES** | 0.888 | 46.368 |
| | **SHRUBS** | 0.929 | 52.907 |
| | **HERBS** | 0.918 | 52.858 |

**Table S6** Result of the CCA analysis carried out for tree, shrub and herb species along the altitudinal gradient (1000 to 4200 m a.s.l.). The analysis is explained by the full set of environmental variables: temperature, precipitation, solar radiation, slope, and aspect

| **TREES** | | | | | |
|---|---|---|---|---|---|
| **Axes** | **1** | **2** | **3** | **4** | **Total inertia** |
| Eigenvalues | 0.821 | 0.604 | 0.331 | 0.234 | 10.413 |
| Species-environmental correlations: | 0.976 | 0.915 | 0.894 | 0.814 | |
| Cumulative % variance of species data | 7.9 | 13.7 | 16.9 | 19.1 | |
| Cumulative % variance of species-environment relation | 36.1 | 62.7 | 77.2 | 87.5 | |
| Sum of all eigenvalues | | | | | 10.413 |
| Sum of all canonical eigenvalues | | | | | 2.274 |
| **Variable** | **LambdaA** | **P** | **F** | | |
| Temperature | 0.82 | 0.000 | 5.61 | | |
| Precipitation | 0.51 | 0.000 | 3.71 | | |
| Solar radiation | 0.39 | 0.000 | 2.81 | | |

| | | | | | |
|---|---|---|---|---|---|
| Eastness | 0.23 | 0.001 | 1.75 | | |
| Slope | 0.18 | 0.045 | 1.37 | | |
| Northnes | 0.14 | 0.364 | 1.05 | | |

**SHRUBS**

| Axes | 1 | 2 | 3 | 4 | Total inertia |
|---|---|---|---|---|---|
| Eigenvalues | 0.935 | 0.530 | 0.338 | 0.210 | 17.834 |
| Species-environmental correlations: | 0.994 | 0.906 | 0.873 | 0.744 | |
| Cumulative % variance of species data | 5.2 | 8.2 | 10.1 | 11.3 | |
| Cumulative % variance of species-environment relation | 41.3 | 64.6 | 76.5 | 88.8 | |
| Sum of all eigenvalues | | | | | 17.834 |
| Sum of all canonical eigenvalues | | | | | 2.266 |
| **Variable** | **LambdaA** | **P** | **F** | | |
| Temperature | 0.92 | 0.000 | 7.65 | | |
| Precipitation | 0.47 | 0.000 | 3.94 | | |
| Solar radiation | 0.37 | 0.000 | 3.17 | | |
| Slope | 0.23 | 0.000 | 1.95 | | |
| Eastness | 0.17 | 0.002 | 1.48 | | |
| Northnes | 0.11 | 0.567 | 0.97 | | |

**HERBS**

| Axes | 1 | 2 | 3 | 4 | Total inertia |
|---|---|---|---|---|---|
| Eigenvalues | 0.929 | 0.595 | 0.388 | 0.268 | 23.334 |
| Species-environmental correlations: | 0.991 | 0.891 | 0.833 | 0.827 | |
| Cumulative % variance of species data | 4.0 | **6.5** | 8.2 | **9.3** | |
| Cumulative % variance of species-environment relation | 37.6 | 61.8 | 77.5 | 88.3 | |
| Sum of all eigenvalues | | | | | 23.334 |
| Sum of all canonical eigenvalues | | | | | 2.468 |
| **Variable** | **LambdaA** | **P** | **F** | | |
| Temperature | 0.92 | 0.000 | 5.9 | | |
| Precipitation | 0.52 | 0.000 | 3.39 | | |
| Slope | 0.37 | 0.000 | 2.48 | | |
| Solar radiation | 0.36 | 0.000 | 2.38 | | |
| Eastness | 0.15 | 0.447 | 1.01 | | |
| Northnes | 0.15 | 0.574 | 0.98 | | |

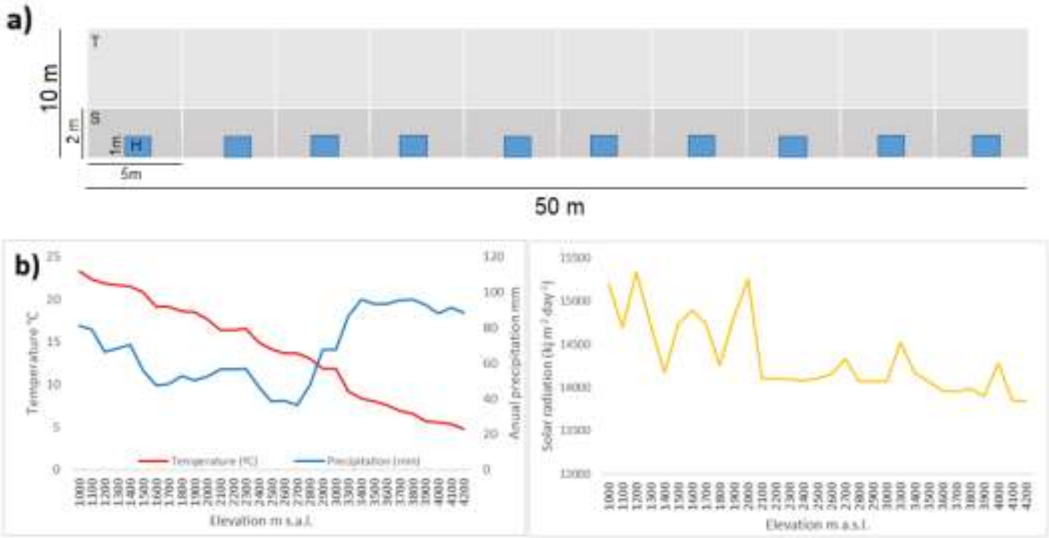


**Fig. S1** a) Illustration of the stratified transect used to record the different plant growth form: trees (T), shrubs (S), and herbs (H). b) Environmental variables along the altitudinal gradient, including temperature (°C) (red), precipitation (mm) (blue), and solar radiation (kj m-2 day-1) (yellow), obtained from Worldclim

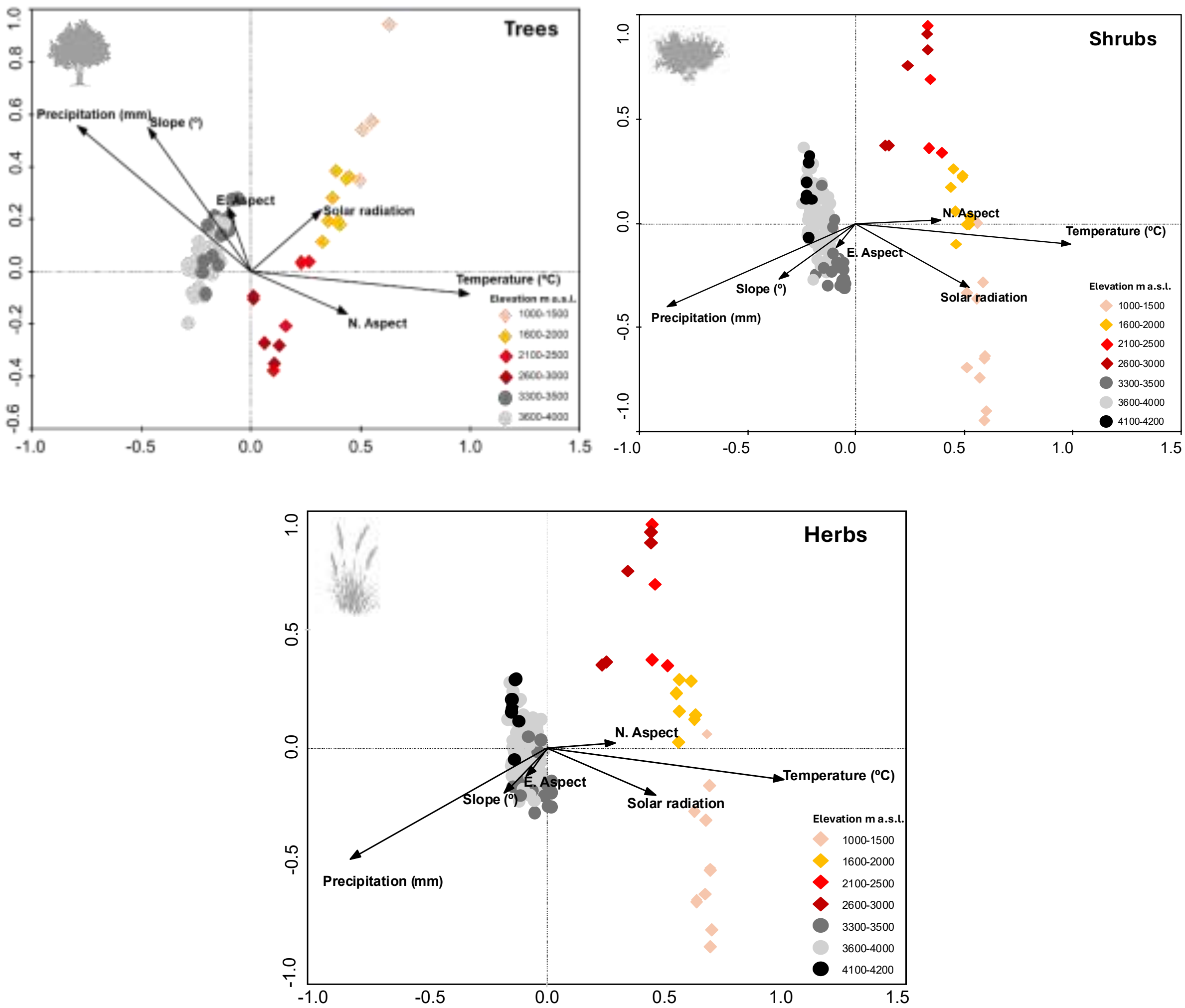


**Fig. S2** Ordination biplots showing the first two axes of the CCA for species assemblages across altitudinal bands for each growth form. Environmental variables are represented by arrows, while sample scores are indicated by circles (CNP) and diamonds (Jubones Valley) of different colors, corresponding to different elevation ranges