**SUPPLEMENTARY MATERIAL**

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**Light penetration and topography shape juvenile tree species assemblies in the understory of the tropical Andean cloud forest**

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**Table S1** Sample description for evaluating juvenile trees (30- 150 cm tall). TDF (Tall Dense Forest); MMDF (Medium tall Medium Dense Forest); LDF (Low tall Dense Forest); LSF (Low tall Sparse Forest).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Forest Type** | **Covered area (ha)** | **Number of plots** | **Empty plots/lack HP\*** | **Sampled area (ha)** | **Sampling fraction** | **Sampling intensity (%)** | **Final**  **sample** | **Species number** | **Individuals** |
| TDF | 52.29 | 280 | 19 | 0.09 | 0.002 | 0.17 | 261 | 47 | 1840 |
| MMDF | 30.11 | 209 | 39 | 0.07 | 0.002 | 0.22 | 170 | 47 | 835 |
| LDF | 38.06 | 212 | 37 | 0.07 | 0.002 | 0.17 | 175 | 40 | 760 |
| LSF | 7.00 | 48 | 1 | 0.02 | 0.002 | 0.22 | 47 | 31 | 529 |
| **All Forests** | **124.36** | **749** | **96** | **0.24** | **0.002** | **0.19** | **653** | **53** | **3964** |

\*HP: hemispherical photographs

**Table S2** Sample description for evaluating trees > 5 cm dbh. TDF (Tall Dense Forest); MMDF (Medium tall Medium Dense Forest); LDF (Low tall Dense Forest); LSF (Low tall Sparse Forest).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Forest Type** | **Covered area (ha)** | **Number of plots** | **Sampled area (ha)** | **Sampling fraction** | **Sampling intensity (%)** | **Species number** | **Individuals** |
| TDF | 52.29 | 32 | 0.64 | 0.012 | 1.22 | **47** | 1220 |
| MMDF | 30.11 | 31 | 0.62 | 0.021 | 2.06 | **47** | 962 |
| LDF | 38.06 | 30 | 0.60 | 0.016 | 1.58 | **45** | 1123 |
| LSF | 7.00 | 12 | 0.24 | 0.062 | 6.15 | **16** | 331 |
| **All Forests** | **124.36** | **105** | **2.10** | **0.017** | **1.69** | **53** | **3636** |

**Figure S1** Hemispherical Photographs (overexposed) and photos (below) showing the overall structure of the various forests: a) Tall Dense Forest; b) Medium tall Medium Dense Forest; c) Low Dense Forest; and d) Low Sparse Forest.

**Figure S2** Height distribution by forest type. The Y axis is represented in a log10 scale to accommodate the large number of seedlings and saplings.

**Figure S3** Comparison of the coverage-based rarefaction (solid lines) and extrapolation (dashed lines), up to the base coverage 100% for the diversity of trees (dbh ≥ 5cm) per forest type using Hill numbers of order q0 (richness, left panel), q1 (evenness, middle panel), and q2 (diversity, right panel). Lines are the rarefaction-extrapolation curves. Symbols above the curves show the observed species diversity as a function of the number of sampled individuals. Legend: TDF (Tall Dense Forest); MMDF (Medium tall Medium Dense Forest); LDF (Low tall Dense Forest); LSF (Low tall Sparse Forest).

**Figure S4** Comparison of the coverage-based rarefaction (solid lines) and extrapolation (dashed lines), up to the base coverage 100% for the diversity of juvenile trees (30-150 cm tall) per forest type using Hill numbers of order q0 (richness, left panel), q1 (evenness, middle panel), and q2 (diversity, right panel). Lines are the rarefaction-extrapolation curves. Symbols above the curves show the observed diversity as a function of the sampling effort. TDF (Tall Dense Forest); MMDF (Medium tall Medium Dense Forest); LDF (Low tall Dense Forest); LSF (Low tall Sparse Forest).

**Figure S5** Comparison of the coverage-based rarefaction (solid lines) and extrapolation (dashed lines), up to the base coverage 100% for the diversity of trees (dbh ≥ 5cm) per forest type using Hill numbers of order q0 (richness, left panel), q1 (evenness, middle panel), and q2 (diversity, right panel). Lines are the rarefaction-extrapolation curves. Symbols above the curves show the observed diversity as a function of the sampling effort. TDF (Tall Dense Forest); MMDF (Medium tall Medium Dense Forest); LDF (Low tall Dense Forest); LSF (Low tall Sparse Forest).

**Table S3** Importance Value Index (IVI) and Relative Natural Regeneration (RNR) per species and forest type. Values are presented for the 35 most important species.

| N° | TDF | | | MMDF | | | LDF | | | LSF | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scientific name | IVI | RNR | Scientific name | IVI | RNR | Scientific name | IVI | RNR | Scientific name | IVI | RNR |
| 1 | *Myrcia fallax* | 15,9 | 6,8 | *Myrcia fallax* | 13,6 | 9,2 | *Myrcia acuminata* | 12,1 | 18,6 | *Hyeronima moritziana* | 15,5 | 3,6 |
| 2 | *Retrophyllum rospigliosii* | 7,8 | 10,6 | *Escheweilera monosperma* | 9,2 | 2,6 | *Escheweilera monosperma* | 11,0 | 2,1 | *Miconia resimoides* | 14,2 | 2,4 |
| 3 | *Myrcia acuminata* | 7,8 | 7,3 | *Myrcia acuminata* | 7,8 | 15,5 | *Myrcia fallax* | 9,9 | 7,0 | *Alchornea grandiflora* | 12,5 | 7,4 |
| 4 | *Ruagea pubescens* | 5,7 | 2,0 | *Alchornea grandiflora* | 7,7 | 2,5 | *Miconia resimoides* | 9,1 | 3,2 | *Clusia minor* | 12,2 | 2,2 |
| 5 | *Hyeronima moritziana* | 5,6 | 1,6 | *Ladenbergia undata* | 6,2 | 6,3 | *Hyeronima moritziana* | 6,5 | 2,5 | *Hedyosmum brasilensis* | 7,2 | 4,8 |
| 6 | *Oreopanax capitatus* | 5,5 | 2,0 | *Ruagea pubescens* | 5,4 | 3,0 | *Ruagea pubescens* | 5,8 | 3,2 | *Weinmmania jahnii* | 6,6 | 2,9 |
| 7 | *Miconia meridensis* | 5,5 | 4,3 | *Retrophyllum rospigliosii* | 5,0 | 1,6 | *Alchornea grandiflora* | 4,0 | 1,9 | *Billia colombiana* | 5,9 | 1,8 |
| 8 | *Eugenia tamaensis* | 5,4 | 4,5 | *Miconia resimoides* | 4,4 | 2,8 | *Zanthoxylum quinduense* | 3,7 | 2,5 | *Zanthoxylum quinduense* | 4,8 | 16,2 |
| 9 | *Clusia multiflora* | 4,5 | 0,7 | *Eugenia tamaensis* | 4,0 | 6,3 | *Ladenbergia undata* | 3,5 | 3,6 | *Clusia multiflora* | 4,3 | 5,8 |
| 10 | *Billia colombiana* | 4,5 | 1,3 | *Hyeronima moritziana* | 3,4 | 2,8 | *Eugenia tamaensis* | 2,9 | 6,6 | *Ternstroemia acrodantha* | 4,0 | 3,4 |
| 11 | *Tetrorchidium rubrivenium* | 4,2 | 0,8 | *Beilshmiedia sulcata* | 2,7 | 2,5 | *Cinchona pubescens* | 2,8 | 0,5 | *Eugenia tamaensis* | 3,7 | 10,4 |
| 12 | *Casearia tachirensis* | 4,1 | 3,5 | *Zanthoxylum quinduense* | 2,6 | 1,2 | *Clusia multiflora* | 2,6 | 1,4 | *Aegiphila ternifolia* | 2,7 | 0,3 |
| 13 | *Beilshmiedia sulcata* | 3,0 | 1,7 | *Billia colombiana* | 2,1 | 2,0 | *Podocarpus oleifolius* | 2,5 | 1,0 | *Ruagea pubescens* | 2,2 | 2,2 |
| 14 | *Myrsine ferruginea* | 2,3 | 3,2 | *Aiouea guianensis* | 2,1 | 2,5 | *Retrophyllum rospigliosii* | 2,4 | 1,5 | *Beilshmiedia sulcata* | 2,1 | 1,0 |
| 15 | *Ocotea macropoda* | 2,2 | 2,4 | *Tetrorchidium rubrivenium* | 2,1 | 0,6 | *Vochysia meridensis* | 2,4 | 1,6 | *Podocarpus oleifolius* | 1,3 | 1,9 |
| 16 | *Alchornea grandiflora* | 1,8 | 0,5 | *Clusia multiflora* | 2,0 | 1,3 | *Billia colombiana* | 2,2 | 2,0 | *Escheweilera monosperma* | 0,8 | 0,7 |
| 17 | *Ormosia tovarensis* | 1,5 | 0,1 | *Vochysia meridensis* | 1,8 | 1,4 | *Hedyosmum brasilensis* | 2,1 | 1,0 | *Prunus moritziana* | 0,0 | 10,4 |
| 18 | *Laplacea fruticosa* | 1,3 | 0,3 | *Prunus moritziana* | 1,7 | 5,3 | *Aiouea guianensis* | 1,7 | 1,7 | *Solanum tovarense* | 0,0 | 8,3 |
| 19 | *Viburno tinoides* | 1,2 | 0,9 | *Cinchona pubescens* | 1,5 | 0,7 | *Hyeronima oblonga* | 1,3 | 0,3 | *Cyathea caracasana* | 0,0 | 5,5 |
| 20 | *Aiouea guianensis* | 1,1 | 2,9 | *Miconia meridensis* | 1,5 | 3,8 | *Prunus moritziana* | 1,3 | 5,8 | *Ocotea macropoda* | 0,0 | 2,6 |
| 21 | *Hyeronima oblonga* | 1,0 | 0,6 | *Nectandra rigida* | 1,3 | 1,3 | *Miconia meridensis* | 1,2 | 2,3 | *Aiouea guianensis* | 0,0 | 1,3 |
| 22 | *Aegiphila ternifolia* | 1,0 | 12,2 | *Ficus Velutina* | 1,0 | 0,0 | *Cinnamomum triplinerve* | 0,9 | 1,2 | *Myrcia fallax* | 0,0 | 1,3 |
| 23 | *Prunus moritziana* | 0,9 | 3,8 | *Hyeronima oblonga* | 0,9 | 0,1 | *Clethra fagifolia* | 0,8 | 0,4 | *Euterpe acuminata* | 0,0 | 1,0 |
| 24 | *Ficus Velutina* | 0,8 | 0,1 | *Ocotea* sp. | 0,9 | 0,9 | *Aegiphila ternifolia* | 0,7 | 1,8 | *Tetrorchidium rubrivenium* | 0,0 | 0,6 |
| 25 | *Myrcianthes karsteniana* | 0,7 | 3,1 | *Oreopanax capitatus* | 0,7 | 0,9 | *Ternstroemia acrodantha* | 0,7 | 1,1 | *Ocotea karsteniana* | 0,0 | 0,3 |
| 26 | *Ladenbergia undata* | 0,7 | 0,4 | *Oreopanax reticulatus* | 0,6 | 2,6 | *Nectandra laurel* | 0,6 | 1,7 | *Nectandra laurel* | 0,0 | 0,3 |
| 27 | *Cinnamomum triplinerve* | 0,6 | 1,5 | *Nectandra laurel* | 0,6 | 1,8 | *Nectandra rigida* | 0,6 | 0,7 | *Ardisia* sp*.* | 0,0 | 0,3 |
| 28 | *Escheweilera monosperma* | 0,5 | 0,1 | *Havetia laurifolia* | 0,5 | 0,1 | *Beilshmiedia sulcata* | 0,6 | 2,3 | *Miconia meridensis* | 0,0 | 0,3 |
| 29 | *Ocotea karsteniana* | 0,5 | 0,3 | *Weinmmania jahnii* | 0,5 | 1,0 | *Oreopanax capitatus* | 0,5 | 0,7 | *Laplacea fruticosa* | 0,0 | 0,3 |
| 30 | *Solanum nudum* | 0,4 | 1,9 | *Myrsine ferruginea* | 0,4 | 3,3 | *Ocotea macropoda* | 0,5 | 4,2 | *Sapium stylare* | 0,0 | 0,3 |
| 31 | *Passiflora lindeniana* | 0,4 | 0,5 | *Ocotea macropoda* | 0,4 | 3,2 | *Ocotea* sp. | 0,5 | 1,1 | *Myrsine ferruginea* | 0,0 | 0,3 |
| 32 | *Solanum tovarense* | 0,2 | 7,5 | *Cyathea caracasana* | 0,3 | 3,4 | *Myrsine ferruginea* | 0,5 | 3,5 |  |  |  |
| 33 | *Hedyosmum brasilensis* | 0,4 | 0,1 | *Aegiphila ternifolia* | 0,3 | 2,3 | *Myrcianthes karsteniana* | 0,5 | 0,1 |  |  |  |
| 34 | *Cyathea caracasana* | 0,3 | 3,2 | *Myrcianthes karsteniana* | 0,4 | 0,1 | *Havetia laurifolia* | 0,4 | 1,1 |  |  |  |
| 35 | *Meliosma pittierana* | 0,3 | 0,6 | *Sapium stylare* | 0,4 | 0,1 | *Viburno tinoides* | 0,4 | 0,3 |  |  |  |
| 36 | 18 spp | 0,5 | 7,0 | 16 spp | 3,9 | 5,0 | 15spp | 0,9 | 9,5 | 0 spp | 0,0 | 0,0 |
|  |  | **100** | **100** |  | **100** | **100** |  | **100** | **100** |  | **100** | **100** |

**Table S4.** Species Indicator Value (SIV) for the 40 most abundant species (saplings) for each TWINSPAN group. A Monte Carlo test with 1000 permutations was used to test the significance of each species as an indicator for its respective group.

| **Scientific name** | **Abbreviation** | **Group** | **Indicator Value** | **p-value** |
| --- | --- | --- | --- | --- |
| *Aegiphila ternifolia* | **Aete** | 1 | 62.6 | 0.001 |
| *Myrcianthes karsteniana* | **Myka** | 1 | 27.6 | 0.001 |
| *Casearia tachirensis* | **Cata** | 1 | 21.7 | 0.001 |
| *Miconia meridensis* | **Mime** | 1 | 15.9 | 0.001 |
| *Solanum tovarense* | **Soto** | 1 | 14.6 | 0.001 |
| *Aiouea guianensis* | **Aigu** | 1 | 5.7 | 0.076 |
| *Nectandra laurel* | **Nela** | 1 | 4.0 | 0.073 |
| *Retrophyllum rospigliosii* | **Rero** | 1 | 2.6 | 0.106 |
| *Tetrorchidium rubrivenium* | **Teru** | 1 | 1.2 | 0.219 |
| *Myrcia fallax* | **Myfa** | 2 | 64.9 | 0.001 |
| *Roupala obovata* | **Roob** | 2 | 9.4 | 0.001 |
| *Myrcia* sp. | **Mysp** | 2 | 4.3 | 0.008 |
| *Oreopanax capitatus* | **Orca** | 2 | 3.4 | 0.057 |
| *Myrcia acuminata* | **Myac** | 3 | 42.7 | 0.001 |
| *Ladenbergia undata* | **Laun** | 3 | 15.2 | 0.001 |
| *Ocotea macropoda* | **Ocma** | 3 | 11.6 | 0.002 |
| *Escheweilera monosperma* | **Esmo** | 3 | 10.5 | 0.001 |
| *Myrsine ferruginea* | **Myfe** | 3 | 9.9 | 0.009 |
| *Oreopanax reticulatus* | **Orre** | 3 | 5.4 | 0.009 |
| *Vochysia meridensis* | **Vome** | 3 | 2.7 | 0.034 |
| *Cinnamomum triplinerve* | **Citr** | 3 | 1.4 | 0.155 |
| *Nectandra rigida* | **Neri** | 3 | 1.3 | 0.281 |
| *Cinchona pubescens* | **Cipu** | 3 | 1.3 | 0.326 |
| *Zanthoxylum quinduense* | **Zaqu** | 4 | 40.1 | 0.001 |
| *Eugenia tamaensis* | **Euta** | 4 | 39.6 | 0.001 |
| *Prunus moritziana* | **Prmo** | 4 | 29.5 | 0.001 |
| *Clusia multiflora* | **Clmu** | 4 | 25.0 | 0.001 |
| *Weinmmania jahnii* | **Weja** | 4 | 24.3 | 0.001 |
| *Alchornea grandiflora* | **Algr** | 4 | 22.0 | 0.001 |
| *Hyeronima moritziana* | **Hymo** | 4 | 17.0 | 0.001 |
| *Billia colombiana* | **Bico** | 4 | 13.0 | 0.001 |
| *Cyathea caracasana* | **Cyca** | 4 | 12.0 | 0.001 |
| *Ternstroemia acrodantha* | **Teac** | 4 | 11.1 | 0.001 |
| *Ruagea pubescens* | **Rupu** | 4 | 10.2 | 0.001 |
| *Podocarpus oleifolius* | **Pool** | 4 | 9.7 | 0.001 |
| *Miconia resimoides* | **Mire** | 4 | 8.5 | 0.001 |
| *Hedyosmum brasiliense* | **Hebr** | 4 | 8.3 | 0.001 |
| *Clusia minor* | **Clmi** | 4 | 5.6 | 0.001 |
| *Beilshmiedia sulcata* | **Besu** | 4 | 2.8 | 0.298 |
| *Havetia laurofolia* | **Hala** | 4 | 2.2 | 0.021 |

**Table S5.** Estimates of the environmental optima for each species

| **Species** | **%CO** | **Elevation (m)** | **LAI** | **Slope (º)** | **%TDIF** | **%TDIR** |
| --- | --- | --- | --- | --- | --- | --- |
| Aete | 3.00 | 2400.73 | 4.80 | 7.91 | 4.83 | 5.60 |
| Aigu | 3.03 | 2395.51 | 4.90 | 9.04 | 4.47 | 5.89 |
| Algr | 9.90 | 2347.97 | 3.02 | 6.42 | 14.22 | 20.86 |
| Besu | 3.98 | 2394.87 | 4.19 | 12.41 | 6.27 | 7.70 |
| Bico | 4.95 | 2381.28 | 4.06 | 9.28 | 7.25 | 11.26 |
| Cata | 2.79 | 2381.25 | 4.97 | 9.11 | 4.10 | 5.25 |
| Cipu | 3.62 | 2388.10 | 4.27 | 13.20 | 4.39 | 5.93 |
| Citr | 5.41 | 2400.40 | 3.54 | 11.60 | 7.69 | 3.59 |
| Clmi | 9.55 | 2340.60 | 3.55 | 4.40 | 8.05 | 4.87 |
| Clmu | 9.03 | 2349.93 | 3.25 | 5.00 | 11.85 | 17.52 |
| Cyca | 5.32 | 2377.19 | 4.47 | 6.85 | 8.15 | 10.60 |
| Esmo | 4.85 | 2360.35 | 3.76 | 12.59 | 7.14 | 9.69 |
| Euta | 6.21 | 2371.13 | 3.64 | 9.46 | 8.87 | 12.13 |
| Hala | 4.35 | 2427.75 | 4.24 | 15.50 | 3.40 | 3.74 |
| Hebr | 11.50 | 2342.33 | 2.79 | 4.83 | 14.42 | 15.29 |
| Hymo | 7.04 | 2366.27 | 3.61 | 9.77 | 9.78 | 12.08 |
| Laun | 3.45 | 2382.88 | 3.89 | 15.97 | 6.41 | 8.37 |
| Mime | 4.21 | 2404.91 | 4.33 | 9.42 | 6.74 | 8.67 |
| Mire | 6.87 | 2348.11 | 3.46 | 7.37 | 10.52 | 14.33 |
| Myac | 4.10 | 2384.78 | 4.10 | 12.54 | 6.41 | 9.12 |
| Myfa | 3.36 | 2389.57 | 4.54 | 9.79 | 5.16 | 6.74 |
| Myfe | 3.76 | 2384.53 | 4.33 | 12.25 | 5.31 | 7.73 |
| Myka | 3.11 | 2400.52 | 4.88 | 8.35 | 5.03 | 5.25 |
| Mysp | 3.58 | 2393.39 | 3.84 | 14.62 | 5.95 | 9.09 |
| Nela | 3.68 | 2388.16 | 4.41 | 11.30 | 5.65 | 7.22 |
| Neri | 3.14 | 2351.11 | 4.12 | 12.56 | 5.10 | 4.37 |
| Ocma | 5.42 | 2384.13 | 3.72 | 11.24 | 8.14 | 11.18 |
| Orca | 4.02 | 2381.27 | 4.62 | 9.63 | 5.04 | 6.74 |
| Orre | 5.20 | 2389.83 | 3.85 | 12.57 | 7.25 | 8.74 |
| Pool | 7.91 | 2342.50 | 3.00 | 5.00 | 14.09 | 15.80 |
| Prmo | 5.29 | 2371.47 | 3.95 | 9.68 | 8.37 | 11.39 |
| Rero | 3.30 | 2393.75 | 4.23 | 9.05 | 5.50 | 7.10 |
| Roob | 2.93 | 2394.78 | 4.62 | 11.06 | 5.32 | 6.50 |
| Rupu | 6.14 | 2368.73 | 3.22 | 9.41 | 10.48 | 15.32 |
| Soto | 4.86 | 2381.26 | 4.37 | 8.12 | 6.86 | 8.41 |
| Teac | 8.03 | 2342.20 | 2.96 | 5.27 | 14.83 | 18.64 |
| Teru | 5.81 | 2384.83 | 4.38 | 6.50 | 9.10 | 9.42 |
| Vome | 2.42 | 2359.10 | 4.45 | 18.00 | 2.74 | 6.83 |
| Weja | 7.80 | 2359.64 | 3.40 | 7.98 | 10.00 | 12.08 |
| Zaqu | 9.23 | 2347.27 | 3.14 | 6.74 | 13.36 | 20.29 |