Fortier et al. Annals of Forest Science (2024) 81:24
https://doi.org/10.1186/s13595-024-01239-6

INRAE
Annals of Forest Science

DATA PAPER Open Access

Diversity, composition, and structure of a 1-hectare tree plot in the cloud forest of the Sierra Nevada de Santa Marta, Colombia

Riley P. Fortier[1*], Manuel Bernal-Escobar[1], Alyssa T. Kullberg[1], Juan Camilo Osorio Ospina[2], Yeison Herrera Medina[2], Lina Aragón[1], Camilo Palacios Hurtado[1] and Maria Paula Contreras[2]

Abstract

Key Message We present data from a new delimited 1-ha forest plot on the Sierra Nevada de Santa Marta in Colombia and describe its tree diversity, composition, and structure. This data can be used in regional analyses and help to refine remote sensing models. Future censuses will provide data on the demographics of rare, endangered, and endemic trees that can be used for their conservation. Dataset access is at https://doi.org/10.15472/ftwol2. Associated metadata are available at https://metadata-afs.nancy.inra.fr/geonetwork/srv/fre/catalog.search#/metadata/a4a7855f-4cb2-459b-a1a2-287bd1e6d587.

Keywords Biomass, Cloud forest, Permanent plot, Tree composition, Sierra Nevada de Santa Marta

1 Background

The Sierra Nevada de Santa Marta (SNSM) is an isolated mountain on Colombia's Caribbean coast. Rising to 5775 m asl, this immense massif is the tallest peak in Colombia and the tallest coastal mountain in the world. The SNSM is separated from the Andes mountains by hot and dry lowland Caribbean savannas to the southeast and by a large wetland, the Ciénaga Grande de Santa Marta, to the southwest. Owing to its unique location, isolation, and complex topography, the mountain is home to a mosaic of distinct ecosystems with high levels of endemism (Adams 1973; Carbono and Lozano-Contreras 1997; Cardona and Ojeda 2010).

Unfortunately, our understanding of the mountain's flora is incomplete. Although there have been important botanical expeditions to the SNSM (Van der Hammen and Ruiz 1984; Ayers and Boufford 1998), no study has implemented a standardized tree plot with which to compare the cloud forests of SNSM to others in the region (ForestPlots.net et al. 2021). Therefore, our knowledge of the diversity, composition, and structure of tree communities on the SNSM remains severely limited. To address this problem, we installed a permanent 1-ha forest plot on the SNSM, and we here present baseline data from the plot. Our work represents the first standardized tree plot above 600 m asl on the SNSM and will contribute to our understanding of both local and regional cloud forest diversity and composition.

2 Methods

2.1 Study site

The 1-ha plot is located on Cerro Kennedy, a high point reaching 2830 m asl on the northwest side of the SNSM. On the southern face of Cerro Kennedy, in Reserva El Dorado, is a strip of relict old-growth forest totaling just

Handling editor: Véronique Lesage.

*Correspondence:
Riley P. Fortier
Fortier.riley@gmail.com
[1] Department of Biology, University of Miami, Coral Gables, FL 33146, USA
[2] Jardín Botánico de Cartagena "Guillermo Piñeres", Turbaco, Bolívar 131007, Colombia

over 250 ha. The plot is located in this remnant forest at 2200-m elevation (11° 6′4.37″ N, 74° 2′22.20″ W, Fig. 1). Mean annual temperature is ~ 15 °C, and mean annual precipitation is ~ 1900 mm.

2.2 Plot demarcation

The specific location of the plot was chosen pseudo-randomly, avoiding difficult terrain and steep topography, in a location easy to access from the trail, and ensuring that each plot edge was at least 100 m from a forest edge to avoid as many edge effects as possible (Laurance et al. 2002). We demarcated the plot boundaries with PVC tubes every 10 m following cardinal directions with a compass. We then installed 100 10 × 10 m subplots following the same methods. The shape of the plot is irregular due to a cliff we encountered in the southwest corner and is steep, with an ENE to WSW slope exceeding 30°. Because each 10-m interval was demarcated using a

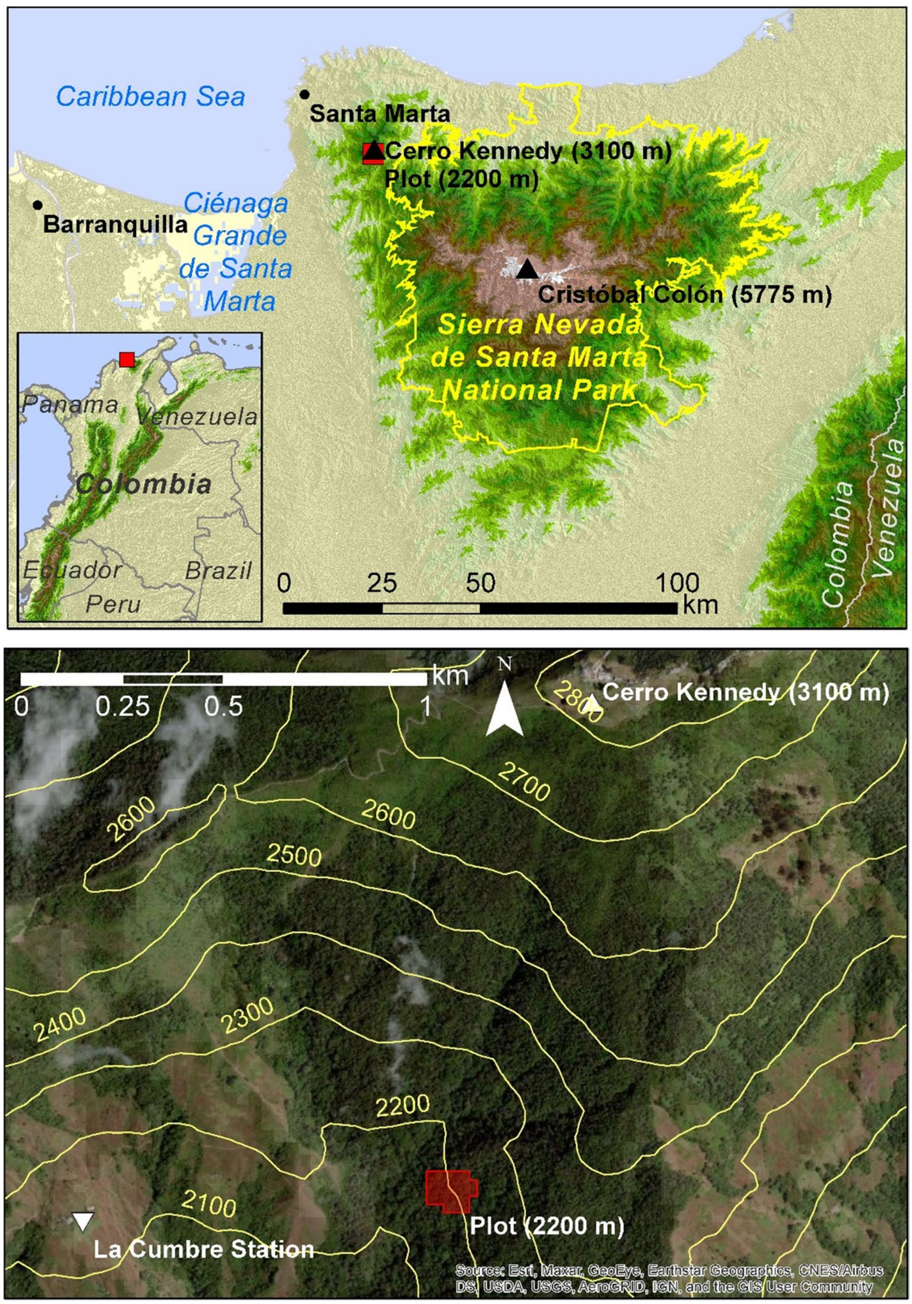

Fig. 1 Map showing the location of the 1-ha plot in Colombia and on the Sierra Nevada de Santa Marta

planar projection and the ground distance was corrected with a digital clinometer, the total ground area of the plot is approximately 1.21 ha.

2.3 Tree measurements

We tagged, measured, mapped, and identified every stem ≥ 10-cm DBH following standard protocols (Lopez-Gonzalez et al. 2011; Phillips et al. 2018). For trees with buttressed trunks or other irregularities, diameter was measured above the irregularities, and measurement height was noted. We collected voucher specimens for species identifications and stored them in the herbarium at the Cartagena Botanical Garden "Guillermo Piñeres" (JBGP).

We also scored each tree for liana infestation, sun exposure, and canopy damage. Liana infestation scores

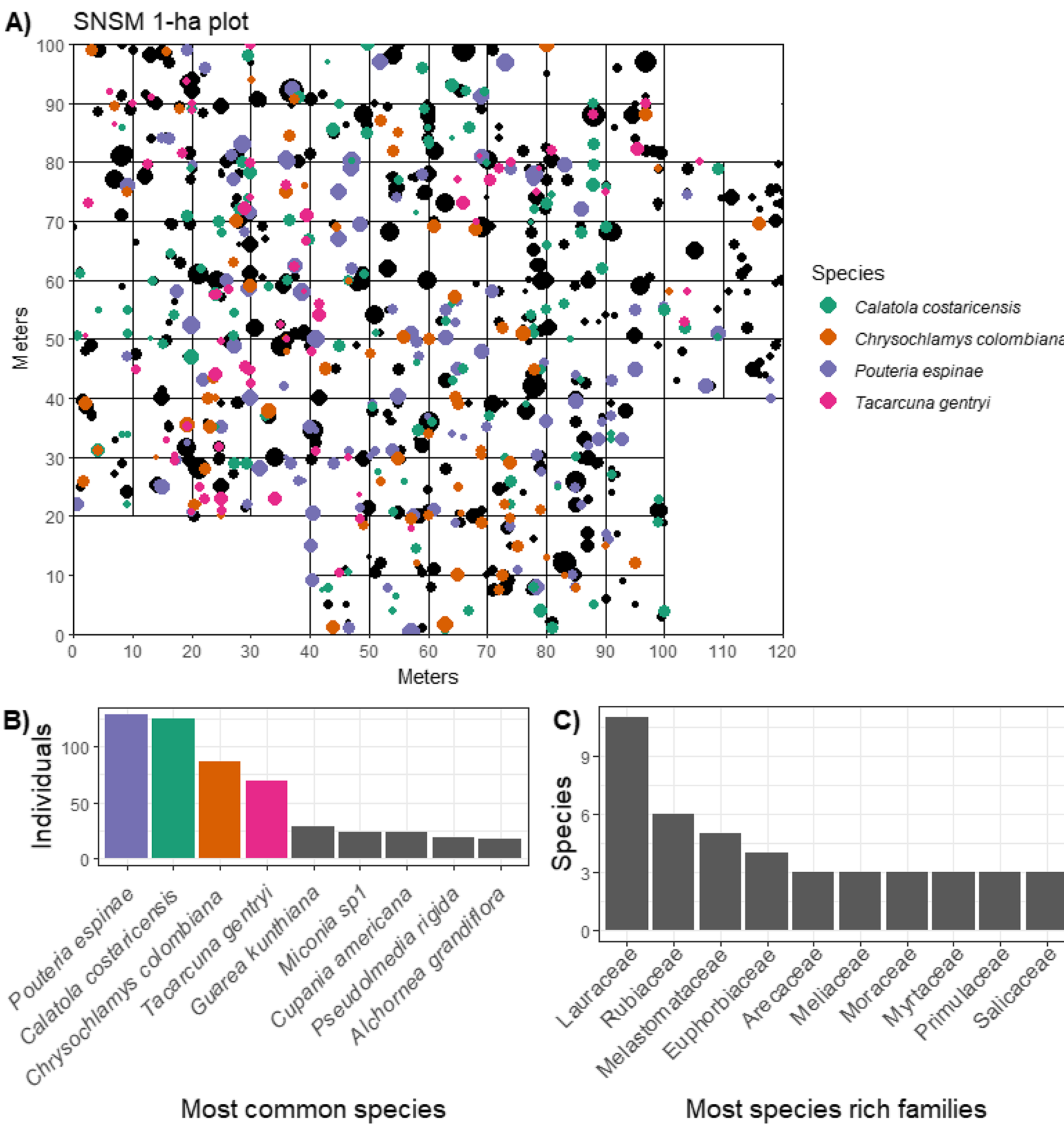

Fig. 2 **A** Stem map of the 1-ha plot. Each dot is a stem, with the size of the dot corresponding to its diameter. The four most common species are color coded. **B** Bar graph of the most common species, ranked by number of individuals. The four most common species are color coded as in **A**. **C** Bar graph of the 10 most species-rich families, ranked by number of species

were 0 for trees without lianas and 1, 2, 3, or 4 for trees with 1–25%, 26–50%, 51–75%, or 76–100% of their canopy covered by lianas, respectively (Clark & Clark 1990). Sun exposure scores were from 1 to 5, with 1 for plants lacking direct sunlight except during sun flecks and 5 for canopy emergents (Dawkins 1978). Crown damage scores were 0 for trees with intact crowns and 1, 2, 3, or 4 for trees with 1–25%, 26–50%, 51–75%, or 76–100% of the crown broken, respectively. Finally, we estimated tree height.

2.4 Access to the data and metadata description

The datasets generated during the present study are available in the SiB Colombia (Contreras et al. 2024), URL: https://ipt.biodiversidad.co/sib/resource?r=parcelasnsm#anchor-downloads, DOI: https://doi.org/10.15472/ftwol2. Metadata files are included with this dataset and also accessible at https://metadata-afs.nancy.inra.fr/geonetwork/srv/fre/catalog.search#/metadata/a4a7855f-4cb2-459b-a1a2-287bd1e6d587.

2.5 Technical validation

All variables were examined for inconsistencies. Any outliers, impossible tree scores, and mapping errors were revised by checking with field sheets and confirming with the field team. We made figures to summarize and visualize the data to ease error identification (Figs. 2–3). Species identifications that were made in the field were confirmed or refined by comparing our collections to physical material in the Jardín Botánico de Cartagena "Guillermo Piñeres" herbarium (JBPG). When physical material was not available, we reviewed digital herbarium specimens in the online repositories of the New York Botanical Garden (NY), Missouri Botanical Garden (MO), Field Museum Herbarium (F), the Royal Botanic Gardens Kew (K), and the Herbario Forestal de la Universidad Distrital "Francisco José de Caldas" (UDBC).

In total, we measured, tagged, mapped, and identified a total of 924 stems representing 846 individual trees and 85 species in 41 families. Four species represent nearly half of total stems, and four families account for 32% of all species (Table 1**,** Fig. 2). We calculated three diversity metrics including Shannon, Simpson, and inverse Simpson indices, which were 3.36, 0.93, and 14.3, respectively. Even though each metric is calculated differently, they all illustrate relatively high diversity within the plot.

Using measured tree diameters (D), we calculated the basal area of each stem as (D/2)^2*π. We then assigned wood density for each species from a wood density database (Zanne et al. 2009). When a species-level wood density was not available, we assigned a species the genus- or family-level wood density average instead. We then estimated biomass for the entire stand using an allometric model via the R package BIOMASS (Chave et al.

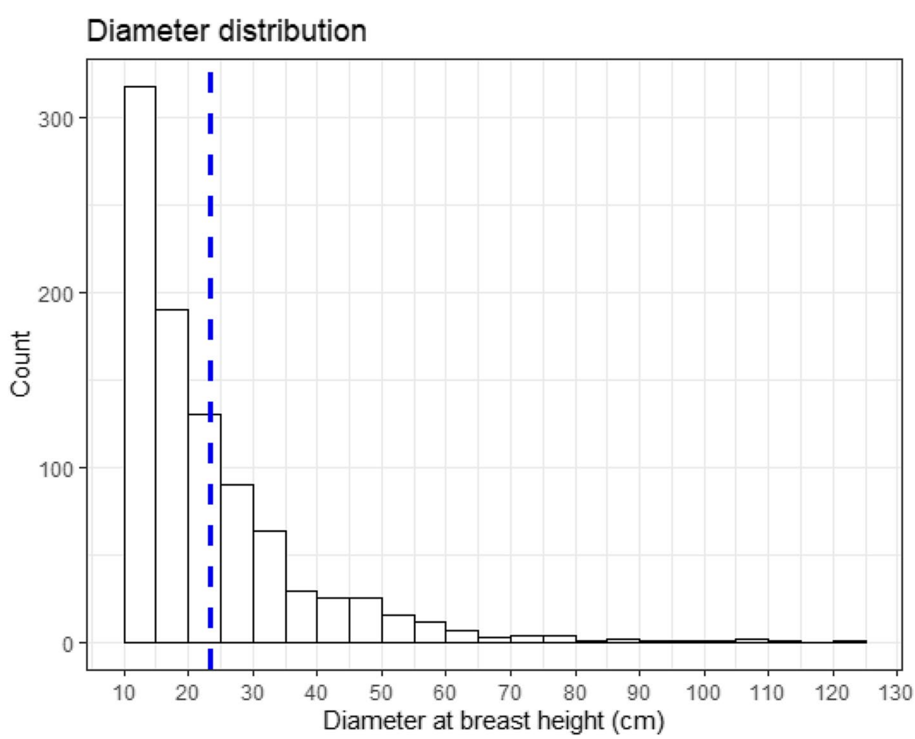

Fig. 3 Histogram of stem diameters in the 1-ha plot. The blue dashed line indicates the mean diameter (23.3 cm) at breast height

Table 1 Table summarizing the number of stems, number of individuals, maximum diameter at breast height in cm (max DBH), wood density in g/cm^3 (WD), basal area in cm^2, and the percent of total plot basal area for each species (or morphospecies)

Family	Species	Number of stems	Number of individuals	Max DBH	WD	Basal area	% of plot basal area
Actinidiaceae	*Saurauia excelsa* Willd	1	1	10.9	0.603	93.31	0.02
Anacardiaceae	*Tapirira guianensis* Aubl	14	14	50.7	0.457	5204.12	0.93
Anacardiaceae	*Toxicodendron striatum* (Ruiz & Pav.) Kuntze	1	1	22.6	0.565	401.15	0.07
Araliaceae	*Dendropanax* sp1	1	1	23.5	0.423	433.74	0.08
Araliaceae	*Oreopanax schultzei* Harms	4	4	46	0.480	2458.90	0.44
Arecaceae	*Geonoma* sp1	2	2	10.4	0.441	163.49	0.03
Arecaceae	*Geonoma* sp2	1	1	11.2	0.441	98.52	0.02
Arecaceae	*Prestoea acuminata* (Willd.) H.E.Moore	9	9	11.7	0.441	811.06	0.14
Bignoniaceae	*Handroanthus chrysanthus* (Jacq.) S.O.Grose	3	3	42.6	0.570	2752.95	0.49
Brunelliaceae	*Brunellia integrifolia* Szyszyl	3	3	45	0.603	1898.62	0.34
Cannabaceae	*Lozanella enantiophylla* (Donn.Sm.) Killip & C.V.Morton	2	2	11.9	0.446	199.47	0.04
Cannabaceae	*Trema micranthum* (L.) Blume	1	1	13	0.250	132.73	0.02
Celastraceae	*Maytenus* sp1	5	5	57.6	0.745	5257.99	0.94
Celastraceae	*Maytenus woodsonii* Lundell	10	10	24.7	0.745	1958.96	0.35
Clusiaceae	*Arawakia weddelliana* (Planch. & Triana) L. Marinho	16	14	58.8	0.651	17,784.63	3.18
Clusiaceae	*Chrysochlamys colombiana* (Cuatrec.) Cuatrec	123	87	45.8	0.430	45,991.31	8.22
Cunoniaceae	*Weinmannia pinnata* L	1	1	26.4	0.520	547.39	0.10
Cyatheaceae	*Cyathea* sp1	4	4	13.4	0.603	412.70	0.07
Cyatheaceae	*Cyathea* sp2	1	1	10	0.603	78.54	0.01
Dipentodontaceae	*Perrottetia multiflora* Lundell	9	6	32	0.603	2517.62	0.45
Euphorbiaceae	*Alchornea grandiflora* Müll.Arg	23	17	88.3	0.401	30,206.71	5.40
Euphorbiaceae	*Sapium* sp1	1	1	33	0.431	855.30	0.15
Euphorbiaceae	*Sapium stylare* Müll.Arg	5	5	62.4	0.470	7563.93	1.35
Euphorbiaceae	*Tetrorchidium rubrivenium* Poepp	15	13	22.6	0.520	2542.29	0.45
Fabaceae	*Inga sierrae* Britton & Killip	12	12	63	0.581	13,089.83	2.34
Lamiaceae	*Aegiphila grandis* Moldenke	7	7	47.4	0.645	6154.52	1.10
Lauraceae	*Cinnamomum triplinerve* (Ruiz & Pav.) Kosterm	2	2	42.1	0.470	1485.36	0.27
Lauraceae	*Nectandra* sp1	1	1	12.6	0.521	124.69	0.02
Lauraceae	*Nectandra* sp2	1	1	12.7	0.521	126.68	0.02
Lauraceae	*Nectandra* sp3	4	4	71.7	0.521	9067.50	1.62
Lauraceae	*Nectandra* sp4	1	1	10.9	0.521	93.31	0.02
Lauraceae	*Nectandra* sp5	2	2	34.5	0.521	1445.53	0.26
Lauraceae	*Ocotea santamartae* van der Werff	1	1	19.9	0.519	311.03	0.06
Lauraceae	*Ocotea terciopelo* C.K.Allen	12	12	47.4	0.519	6596.87	1.18
Lauraceae	*Persea americana* Mill	11	11	77.6	0.451	10,595.99	1.89
Lauraceae	*Persea* sp1	2	2	27.8	0.451	937.05	0.17
Lauraceae	*Pleurothyrium* sp1	3	2	22.7	0.470	875.11	0.16
Lecythidaceae	*Eschweilera* sp1	2	2	30.4	0.825	1413.97	0.25
Malvaceae	*Malvaviscus concinnus* Kunth	2	2	12.6	0.437	223.21	0.04
Melastomataceae	*Blakea* sp1	2	2	16.8	0.710	329.18	0.06
Melastomataceae	*Meriania macrophylla* (Benth.) Triana	12	12	64.3	0.490	10,177.86	1.82
Melastomataceae	*Miconia floribunda* (Bonpl.) DC	12	10	26.7	0.623	2909.57	0.52
Melastomataceae	*Miconia* sp1	24	24	31	0.623	6399.31	1.14
Melastomataceae	*Miconia* sp4	3	3	47.2	0.623	2278.20	0.41
Meliaceae	*Cedrela montana* Moritz ex Turcz	1	1	26.5	0.340	551.55	0.10
Meliaceae	*Guarea kunthiana* A.Juss	28	28	85.7	0.575	34,210.62	6.11
Meliaceae	*Ruagea pubescens* H.Karst	1	1	40.8	0.470	1307.41	0.23

Table 1 (continued)

Family	Species	Number of stems	Number of individuals	Max DBH	WD	Basal area	% of plot basal area
Metteniusaceae	*Calatola costaricensis* Standl	125	125	40.7	0.600	38,048.69	6.80
Moraceae	*Ficus brevibracteata* W.C.Burger	1	1	10.5	0.396	86.59	0.02
Moraceae	*Ficus insipida* Willd	11	9	123.5	0.381	61,385.76	10.97
Moraceae	*Pseudolmedia rigida* (Klotzsch & H.Karst.) Cuatrec	19	19	64.2	0.640	8648.62	1.55
Myrtaceae	*Myrtac* sp1	15	14	44	0.748	7051.23	1.26
Myrtaceae	*Myrtac* sp2	12	12	41.9	0.748	8168.99	1.46
Myrtaceae	*Myrtac* sp3	10	10	46.3	0.748	6456.79	1.15
Nyctaginaceae	*Neea* sp1	1	1	18.2	0.694	260.16	0.05
Papaveraceae	*Bocconia frutescens* L	4	4	15.2	0.603	568.01	0.10
Pentaphylacaceae	*Ternstroemia meridionalis* Mutis ex L.f	1	1	18.3	0.690	263.02	0.05
Phyllanthaceae	*Hieronyma oblonga* (Tul.) Müll.Arg	2	2	13	0.616	233.02	0.04
Phyllanthaceae	*Tacarcuna gentry* Huft	73	70	34.7	0.805	18,903.38	3.38
Piperaceae	*Piper obliquum* Ruiz & Pav	14	8	30	0.330	2944.07	0.53
Piperaceae	*Piper scutilimbum* C.DC	3	3	10.6	0.330	256.52	0.05
Primulaceae	*Cybianthus* sp1	2	2	40.3	0.593	2199.57	0.39
Primulaceae	*Geissanthus fragrans* Mez	4	4	16.9	0.589	637.31	0.11
Primulaceae	*Parathesis adenanthera* (Miq.) Hook.f. ex B.D.Jacks	1	1	13.1	0.620	134.78	0.02
Rosaceae	*Prunus urotaenia* Koehne	1	1	52.4	0.741	2156.51	0.39
Rubiaceae	*Arachnothryx colombiana* (Rusby) Steyerm	4	4	13.6	0.620	459.98	0.08
Rubiaceae	*Coussarea* sp1	2	2	23	0.550	576.08	0.10
Rubiaceae	*Faramea coerulescens* K.Schum. & K.Krause	1	1	13.7	0.620	147.41	0.03
Rubiaceae	*Guettarda crispiflora* Vahl	14	13	97.4	0.707	17,224.95	3.08
Rubiaceae	*Ladenbergia oblongifolia* (Humb. ex Mutis) L.Andersson	1	1	48.7	0.490	1862.72	0.33
Rubiaceae	*Randia armata* (Sw.) DC	6	6	12.4	0.690	636.19	0.11
Sabiaceae	*Meliosma martana* Idrobo & Cuatrec	3	2	12.3	0.410	283.95	0.05
Salicaceae	*Casearia* sp1	4	4	24	0.678	1260.71	0.23
Salicaceae	*Hasseltia lateriflora* Rusby	2	2	12.3	0.520	207.07	0.04
Salicaceae	*Xylosma paucinervosa* (Steyerm.) Sleumer	1	1	34.8	0.606	951.15	0.17
Sapindaceae	*Cupania americana* L	23	23	67.6	0.730	13,489.12	2.41
Sapotaceae	*Pouteria arguacoensium* (H.Karst.) Baehni	3	3	37.7	0.758	1538.82	0.27
Sapotaceae	*Pouteria espinae* (Standl.) Baehni	141	130	60.3	0.758	98,806.50	17.66
Siparunaceae	*Siparuna calantha* (Perkins) S.S.Renner & Hausner	1	1	18.3	0.662	263.02	0.05
Solanaceae	*Cestrum petiolare* Kunth	1	1	23.4	0.457	430.05	0.08
Solanaceae	*Solanum aphyodendron* S.Knapp	8	8	19	0.280	1293.61	0.23
Styracaceae	*Styrax schultzei* Perkins	2	2	26.8	0.340	720.25	0.13
Thymelaeaceae	*Daphnopsis crispotomentosa* Cuatrec	1	1	48.8	0.603	1870.38	0.33
Vochysiaceae	*Vochysia gigantea* Stafleu	5	5	91.4	0.444	17,939.88	3.21

2014; Réjou-Méchain et al. 2017). Tree diameters range from 10 to 123.5 cm, with a mean diameter of 23.3 cm (Fig. 3). The total basal area for the entire plot is 55.96 m^2. The four species with the largest basal area are *Pouteria espinae* (18% of total basal area, Table 1), *Ficus insipida* (Moraceae, 11%), *Chrysochlamys colombiana* (8%), and *Calatola costaricensis* (7%). Total plot biomass is ~ 451 t.

2.6 Reuse and potential limits

Plot data is essential for analyses of species composition across space and through time. Our plot data will be uploaded into ForestPlots.net (Lopez-Gonzalez et al. 2011), a pantropical network of tree plots which facilitates studies that investigate patterns of tree species composition and diversity. Data on tree-level liana infestation, sun exposure, and crown damage in 1-ha plots is scarce in tropical montane cloud forests, so our plot will be useful when doing cross-site examinations of these variables. We plan to do a full recensus of the plot in 2028 and every 5 years thereafter in order to characterize compositional changes and calculate growth and mortality rates through time.

Data on the structure and composition of trees such as those presented here are important components of earth systems modeling. Indeed, forest plots help to inform and calibrate remote sensing estimations of aboveground biomass and carbon sequestration (Chave et al. 2019). Thus, our ground-based data can be used in future studies that estimate biomass on large spatial scales using remote sensing techniques.

Some species in our dataset are rare, endangered, and/or endemic (e.g., *Pouteria espinae*, the most common species in the plot) to the SNSM. Therefore, the occurrence data (and future growth, mortality, and recruitment data) of these species can be useful for their management, for protection, and for future assessments for the Red List of the International Union for the Conservation of Nature (IUCN).

Acknowledgements
We thank Fundación ProAves for the use of their forest and their support during the field campaign. We also thank Marcela Yacomelo, Rubén Sanguino Arciniegas, Christian Vasquez, Erandi Garcia, Olivia Lockyear, and Luis Gabriel Mosquera for their assistance in the field.

Code availability
Not applicable.

Authors' contributions
RPF, MBE, and ATK conceptualized the study. RPF, MBE, ATK, MPC, JCOO, YHM, LA, and CP conducted field work. MPC and RPF curated, organized, and uploaded data to the repository. RPF led the production of the manuscript, and all the authors read and approved the final manuscript.

Funding
Funding was provided by a Botany in Action Fellowship from the Phipps Conservatory and Botanical Gardens, a Tinker Field Research Grant from the University of Miami Institute of the Americas, the Savage, Evoy, and Kushlan funds from the University of Miami Department of Biology, and by the Colombian Bank of the Republic Foundation "Fundación para la promoción de la investigación y la tecnología" agreement 202316.

Availability of data and materials
The datasets generated during the current study are available as a Darwin Core Archive in the SiB Colombia, DOI: https://doi.org/10.15472/ftwol2, URL: https://ipt.biodiversidad.co/sib/resource?r=parcelasnsm#anchor-downloads. The data can also be accessed through the Global Biodiversity Information Facility (GBIF) at https://www.gbif.org/dataset/caf76652-9bb6-4d47-8a67-4c473cf56130.

Declarations

Ethics approval and consent to participate
Some species in the dataset are rare, endangered, and/or endemic to the Sierra Nevada de Santa Marta. The authors declare that they obtained the approval of Fundación ProAves for conducting the study in their private reserve, Reserva El Dorado.
Plants were collected under the joint permit endorsed by the Colombian National Environmental Authority by resolution 00571 of May 18, 2017, to the Jardín Botánico de Cartagena "Guillermo Piñeres," "Permiso Marco de Recolección de Especímenes de Especies Silvestres de la Diversidad Biológica con Fines de Investigación Científica No Comercial." All specimens are stored in the herbarium at the Jardín Botánico de Cartagena "Guillermo Piñeres" (JBGP).

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 15 December 2023 Accepted: 16 May 2024
Published online: 26 June 2024

References
Adams M (1973) Ecological zonation and the butterflies of the Sierra Nevada de Santa Marta, Colombia. J Nat Hist 7:699–718
Ayers TJ, Boufford DE (1998) Index to the vascular plant types collected by H. H. Smith near Santa Marta Colombia. Brittonia 40:400–432
Carbono E, Lozano-Contreras G (1997) Endemismos y otras singularidades de la Sierra Nevada de Santa Marta, Colombia. Posibles causas de origen y necesidad de conservarlos. Rev Acad Colombiana Ciencias 21:409–419
Cardona A, Ojeda GY (2010) Special volume: geological evolution of the Sierra Nevada de Santa Marta and adjacent basins, Colombian Caribbean region
Chave J, Réjou-Méchain M, Búrquez A, Chidumayo E, Colgan MS, Delitti WBC, Duque A, Eid T, Fearnside PM, Goodman RC, Henry M, Martínez-Yrízar A, Mugasha WA, Muller-Landau HC, Mencuccini M, Nelson BW, Ngomanda A, Nogueira EM, Ortiz-Malavassi E, Pélissier R, Ploton P, Ryan CM, Saldarriaga JG, Vieilledent G (2014) Improved allometric models to estimate the aboveground biomass of tropical trees. Glob Change Biol 20:3177–3190
Chave J, Davies SJ, Phillips OL, Lewis SL, Sist P, Schepaschenko D, Armston J, Baker TR, Coomes D, Disney M, Duncanson L, Hérault B, Labrière N, Meyer V, Réjou-Méchain M, Scipal K, Saatchi S (2019) Ground data are essential for biomass remote sensing missions. Surv Geophys 40:863–880
Clark DB, Clark DA (1990) Distribution and Effects on Tree Growth of Lianas and Woody Hemiepiphytes in a Costa Rican Tropical Wet Forest. J Trop Ecol 6:321–331
Contreras MP, Bernal-Escobar M, Kullberg A, Osorio-Ospina JC, Herrera Y, Aragón L, Palacios C, Fortier RP (2024) Composición y estructura de una parcela permanente en la Sierra Nevada de Santa Marta. Jardín Botánico de Cartagena "Guillermo Piñeres". [dataset]. V1.1. https://doi.org/10.15472/ftwol2
Dawkins HC, Field DRB (1978) A long-term surveillance system for British woodland vegetation. Commenwealth Forestry Institute, University of Oxford, Oxford
ForestPlots.net, Blundo C, Carilla J, Grau R, Malizia A, Malizia L, et al (2021) Taking the pulse of Earth's tropical forests using networks of highly distributed plots. Biol Conserv 260:1–27
Laurance WF, Lovejoy TE, Vasconcelos HL, Bruna EM, Didham RK, Stouffer PC, Gascon C, Bierregaard RO, Laurance SG, Sampaio E (2002) Ecosystem decay of Amazonian forest fragments: A 22-year investigation. Conserv Biol 16:605–618
Lopez-Gonzalez G, Lewis SL, Burkitt M, Phillips OL (2011) ForestPlots.net: a web application and research tool to manage and analyse tropical forest plot data. J Veg Sci 22:610–613
Phillips O, Baker T, Feldpausch T, Brienen R (2018) RAINFOR field manual for plot establishment and remeasurement
Réjou-Méchain M, Tanguy A, Piponiot C, Chave J, Hérault B (2017) Biomass: an R package for estimating above-ground biomass and its uncertainty in tropical forests. Methods Ecol Evol 8:1163–1167
Van der Hammen T, Ruiz PM (eds) (1984) La Sierra Nevada de Santa Marta (Colombia) Transecto Buritaca-La Cumbre. J. Cramer, Berlin-Stuttgart
Zanne AE, Lopez-Gonzalez G, Coomes DA, Ilic J, Jansen S, Lewis SL, Miller RB, Swenson NG, Wiemann MC, Chave J (2009) Data from: towards a worldwide wood economics spectrum. Dryad, Dataset

Publisher's Note