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La Planada Forest Dynamics Plot, Colombia

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Site Location, Administration, and Scientific Infrastructure

La Planada Nature Reserve is located within cloud forests on the western slope of the Andes in the Department of Nariño (1°17'N, 78°15'W), near the Colombian border with Ecuador (fig. 30.1). The 3200-ha reserve was established in 1982 through a collaborative agreement between Fundación para la Educación Superior and the World Wildlife Fund.

La Planada is easily accessible along the road that connects Pasto, the capital of the Department of Nariño, and Tumaco, an important port on the Pacific Ocean. La Planada is located halfway between these towns, just 5 km from the small town of San Isidro. An administrative area inside the reserve contains an administrative center, laboratory for students and researchers, dormitories, tourist center, restaurant, small library, and reference collection of local plant and animals. La Planada also has telephone connections and electricity from a generator.

The 25-ha La Planada Forest Dynamics Plot is located within the reserve, approximately a 1-hour walk from the administrative center. The plot was established by the Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, a recently created national biodiversity research institute set up by public and private organizations in Colombia. While the 25-ha Forest Dynamics Plot is the only tree census plot in the reserve at present, scientists are exploring the possibility of establishing another permanent plot for comparative purposes.

Climate

La Planada Forest Dynamics Plot receives moisture-laden winds from the Pacific coast. A dominant feature of montane climates on the Pacific slopes of the Andes is the occurrence of periods of low cloud cover (Grubb and Whitmore 1966). The dense fog causes a marked decrease in temperature, which greatly reduces the evaporation rates, so that high levels of humidity are maintained. Studies over a 17-year period (1986–2002) indicate that the average annual rainfall is 4087 mm, ranging from 3191 mm to 5315 mm. Rainfall is high throughout the year; however, a marked drier period occurs from the end of June to at the beginning of
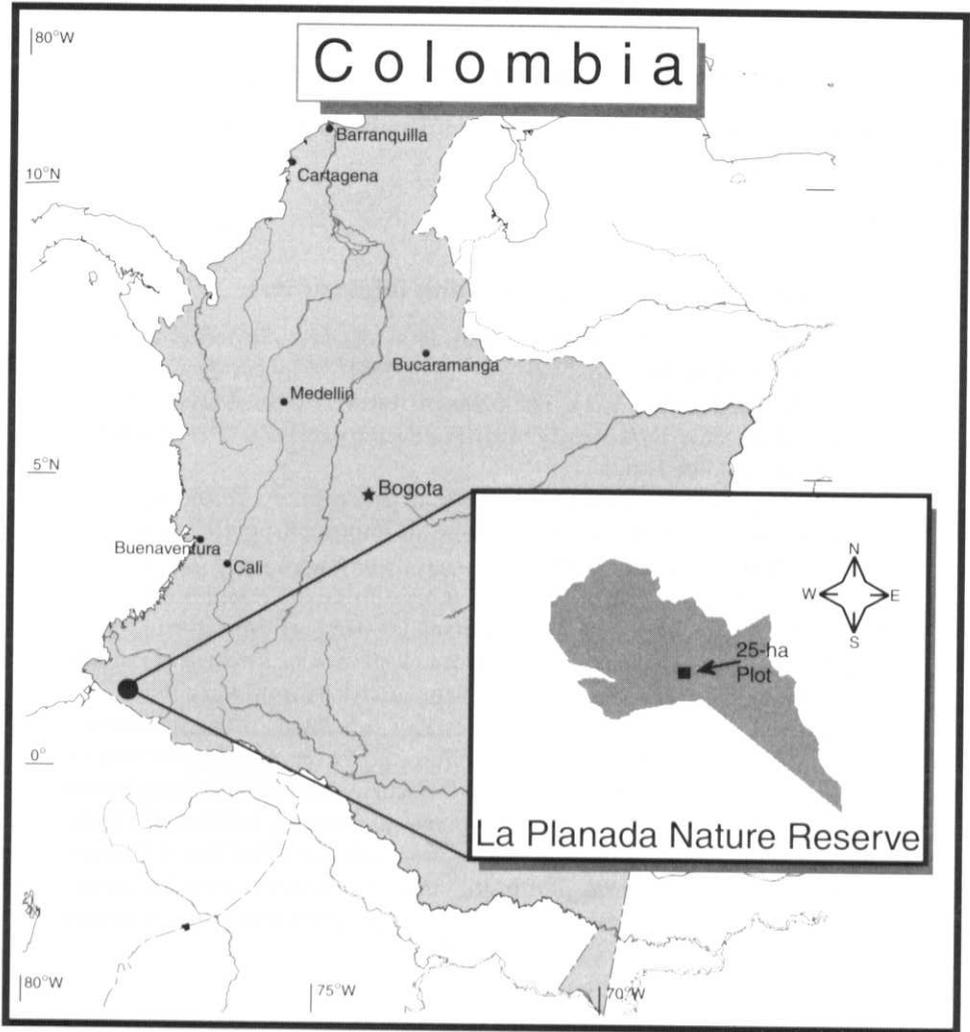
Fig. 30.1. Location of the 25-ha La Planada Forest Dynamics Plot.

September, though never less than 100 mm in a month. At 1800 m elevation, the average temperature is 19°C and the maximum 24.5°C. See table 30.1.

Topography and Soil

The reserve covers an altitudinal range of 1300–2100 m above sea level. La Planada Forest Dynamics Plot was established in a relatively flat area, though the terrain

Table 30.1. La Planada Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total/Averages
Rain (mm)	493	388	431	479	411	268	150	160	278	455	447	455	4415
ADTMx (°C)	22.8	23.2	24.1	23.8	24.1	23.8	24.4	25.0	24.2	24.2	23.8	22.8	23.8
ADTMn (°C)	13.6	13.3	13.3	13.4	13.2	12.8	11.5	11.6	12.5	13	13	13.3	12.9

Notes: Mean monthly rainfall and average daily temperature are based on data measured at the La Planada Biological Station during 1986–2002.
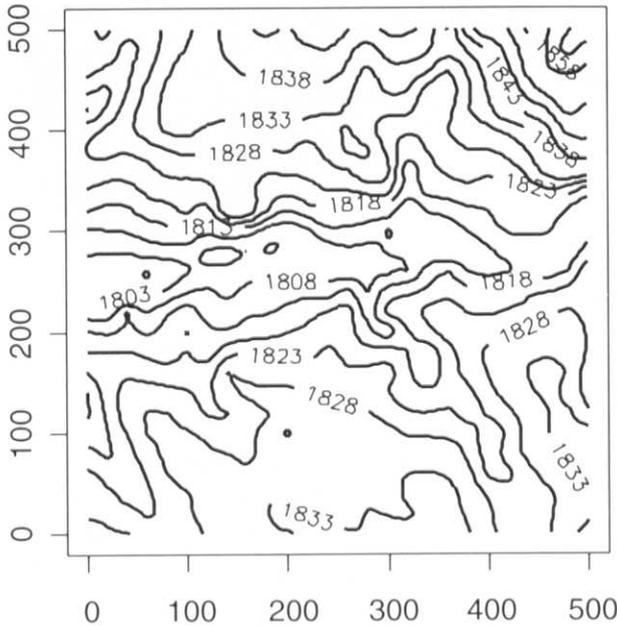

Fig. 30.2. Topographic map of the 25-ha La Planada Forest Dynamics Plot with 5-m contour intervals.

becomes steep near the El Oso and La Calladita streams. The plot's elevation ranges from 1796 to 1891 m above sea level, although the majority lies on a large plateau at 1800 m (figs. 30.2 and 30.3). The plot is crossed from east to west by the El Tejón stream, which receives the waters of four other minor streams (El Oso, La Calladita, Quebrada Juntas, and El Mar). These streams are permanent throughout the year, but there are also several ephemeral underground drainages dependent on factors such as rainfall, erosion, and treefalls.

The predominant soils on the plot are Andisols; these soils were developed from different ranges of volcanic ash in the Pleistocene. The parental material
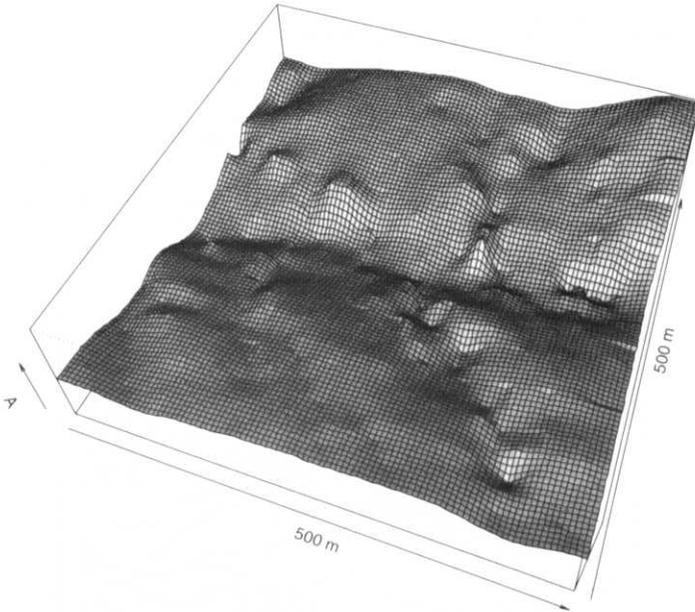
Fig. 30.3. Perspective map of the 25-ha La Planada Forest Dynamics Plot.

of Andisols is piroclastic (geological material of volcanic origin formed by frag-
ments of different rocks), which is variable in composition, grain structure, and
thickness, and strongly influenced by environmental conditions. These soils are
frequently found in the Andean region and are characterized by slow decompo-
sition of organic matter.

Physically, soil texture is mainly sandy, which affects soil aeration, drainage,
dampness retention, fertility, erosion susceptibility, and permeability (Salas and
Ballesteros *unpublished data*, Jaramillo 2002). In the plot, there is a clear rela-
tionship between the sand content of the superficial horizon and the suffusion
phenomenon in some areas. Micro- and macroorganisms contribute to the porous
nature of the soil in some well-drained areas.

Forest Type and Characteristics

La Planada Nature Reserve contains more than 890 species of vascular plants,
580 dicots, 192 monocots, and nearly 120 ferns (Mendoza and Ramirez 2001;
Ramirez and Mendoza 2002). Whereas Lauraceae is the most prevalent and

characteristic family in most neotropical montane forests, Rubiaceae and Melas-
tomataceae dominate the La Planada forest between 1300 and 1800 m asl (Gentry
1995).

Located above the cloud line, the La Planada Forest Dynamics Plot is classified
as pluvial premontane forest (Holdridge 1979). Nearly 75% of the woody plant
species of the La Planada Nature Reserve occur in the 25-ha plot (Humberto
Mendoza personal communication). The forest structure in the plot includes
five layers defined by the predominant vegetation type: emergent trees (20–25 m
high), canopy trees (12–15 m), saplings (5–8 m), shrubs and bushes (2–4 m),
and low understory plants (0–2 m). The average height of the canopy is 15 m.
The emergent trees can exceed 25 m in height and 1.5 meters in dbh. Stranglers
and vines colonize almost all of the emergent trees. The very dense understory is
dominated by species of the Rubiaceae family (*Faramea* and *Palicourea*). Hemiepi-
phyte species of the Guttiferae and Moraceae families are also very abundant in
the plot. One of the most important structural characteristics of the La Planada
forest is the dominant presence of epiphytes, especially from the families Orchi-
daceae, Araceae, and Gesneriaceae (Gentry 1991). Consequently, the frequency
of epiphytes in La Planada is considered to be among the highest in the Andes
(Gentry 1991). For census data and rankings see tables 30.2–30.6.

Table 30.2. La Planada Plot Census History

Census	Dates	Number of Trees ($\geq$1 cm dbh)	Number of Species ($\geq$1 cm dbh)	Number of Trees ($\geq$10 cm dbh)	Number of Species ($\geq$10 cm dbh)
First	February 1997–November 1997	115,129	228	14,650	179

Notes: One census has been completed. The second census was initiated in November 2002 and completed in July 2003.

Table 30.3. La Planada Summary Tally

Size Class (cm dbh)	Average per Hectare						50-ha Plot				
	BA	N	S	G	F	H'	α	S	G	F	H'	α
$\geq$1	29.8	4605	154	89	44	1.72	30.6	228	121	54	1.78	27.3
$\geq$10	23.8	586	88	58	34	1.66	28.6	179	102	49	1.76	28.7
$\geq$30	12.9	83	28	24	17	1.23	15.3	92	58	29	1.43	19.7
$>$60	2.9	7	5	5	5	0.62	8.1*	29	26	19	1.18	9.9

* Fisher's alpha is based on 19 hectares.

Notes: BA represents basal area in m^2, N is the total number of individual trees, S is the total number of species, G is the number of genera, F is the total number of families, H' is the Shannon–Wiener diversity index using $\log_{10}$, and α is Fisher's α. Basal area includes all multiple stems for each individual. 1444 individuals were not identified to species or morphospeices. Data are from the first census.

Table 30.4. La Planada Rankings by Family

Rank	Family	Basal Area (m²)	% BA	% Trees	Family	Trees	% Trees	Family	Species
1	Euphorbiaceae	109.2	14.9	4.4	Rubiaceae	40,161	35.3	Rubiaceae	28
2	Rubiaceae	103.2	14.1	35.3	Melastomataceae	9,789	8.6	Melastomataceae	26
3	Myristicaceae	83.3	11.4	1.8	Palmae	9,707	8.5	Lauraceae	21
4	Leguminosae (sensus lato)	46.1	6.3	5.8	Cyatheaceae	6,861	6.0	Solanaceae	11
5	Lauraceae	41.3	5.6	5.5	Leguminosae	6,540	5.8	Leguminosae	10
6	Melastomataceae	40.9	5.6	8.6	Lauraceae	6,235	5.5	Moraceae	10
7	Palmae	33.3	4.5	8.5	Euphorbiaceae	5,051	4.4	Cyatheaceae	9
8	Bombacaceae	29.8	4.1	1.7	Myrtaceae	3,426	3.0	Euphorbiaceae	9
9	Myrtaceae	29.6	4.0	3.0	Myristicaceae	2,046	1.8	Myrtaceae	9
10	Cyatheaceae	28.7	3.9	6.0	Bombacaceae	1,890	1.7	Araliaceae	6

Notes: The top 10 families for trees ≥1 cm dbh. Data are from the first census.

Table 30.5. La Planada Rankings by Genus

Rank	Genus	Basal Area (m²)	% BA	% Trees	Genus	Trees	% Trees	Genus	Species
1	Otoba (Myristicaceae)	83.3	11.5	1.8	Faramea (Rubiaceae)	22,999	20.8	Miconia (Melastomataceae)	9
2	Hyeronima (Euphorbiaceae)	64.6	8.9	2.2	Palicourea (Rubiaceae)	9,707	8.8	Palicourea (Rubiaceae)	9
3	Faramea (Rubiaceae)	51.7	7.2	20.8	Cyathea (Cyatheaceae)	6,673	6.0	Cyathea (Cyatheaceae)	8
4	Alchornea (Euphorbiaceae)	43.1	6.0	2.3	Inga (Leguminosae)	4,439	4.0	Ficus (Moraceae)	8
5	Elaeagia (Rubiaceae)	38.8	5.4	3.9	Prestoea (Palmae)	4,432	4.0	Inga (Leguminosae)	6
6	Inga (Leguminosae)	29.5	4.1	4.0	Elaeagia (Rubiaceae)	4,310	3.9	Piper (Piperaceae)	6
7	Matisia (Bombacaceae)	25.2	3.5	1.6	Miconia (Melastomataceae)	3,899	3.5	Psychotria (Rubiaceae)	6
8	Cyathea (Cyatheaceae)	25.0	3.5	6.0	Aiphanes (Palmae)	3,366	3.0	Faramea (Rubiaceae)	5
9	Prestoea (Palmae)	24.7	3.4	4.0	Ocotea (Lauraceae)	3,126	2.8	Meriania (Melastomataceae)	4
10	Miconia (Melastomataceae)	24.6	3.4	3.5	Alchornea (Euphorbiaceae)	2,514	2.3	Myrcia (Myrtaceae)	4

Notes: Top 10 tree genera for trees ≥1 cm dbh. Data are from the first census.

Fauna

La Planada has 243 species of birds, of which 189 are resident, 24 migratory, 24 endemic, and 6 occasional. The mountain toucan (*Andigena laminirostris*), the reserve's flagship bird, is endemic to the Andean region. The toucan barbet (*Semnornis ramphastinus*) is also common in the reserve. Eighty species of mammals—half

Table 30.6. La Planada Rankings by Species

Rank	Species	Number Trees	% Trees	Species	Basal Area (m²)	% BA	% Trees
1	Faramea calyptrata (Rubiaceae)	17,416	15.1	Otoba lehmanii (Myristicaceae)	83.3	11.4	1.8
2	Palicourea pyramidalis (Rubiaceae)	7,131	6.2	Hyeronima oblonga (Euphorbiaceae)	64.6	8.8	2.1
3	Cyathea planadae (Cyatheaceae)	4,995	4.3	Faramea calyptrata (Rubiaceae)	39.1	5.3	15.1
4	Prestoea acuminata (Palmae)	4,432	3.9	Elaeagia utilis (Rubiaceae)	38.8	5.3	3.7
5	Elaeagia utilis (Rubiaceae)	4,310	3.7	Alchornea triplinervia (Euphorbiaceae)	34.2	4.7	1.8
6	Aiphanes erinaceae (Palmae)	3,366	2.9	Matisia boliviarii (Bombacaceae)	25.2	3.4	1.5
7	Faramea sp. (Rubiaceae)	2,488	2.2	Prestoea acuminata (Palmae)	24.7	3.4	3.9
8	Hyeronima oblonga (Euphorbiaceae)	2,421	2.1	Billia colombiana (Hippocastanaceae)	18.8	2.6	1.5
9	Ocotea sp. (Lauraceae)	2,283	2.0	Sloanea aff. gracilis. (Elaeocarpaceae)	16.4	2.2	0.1
10	Otoba lehmanii (Myristicaceae)	2,046	1.8	Inga sp. (Leguminosae)	15.8	2.2	1.7

Notes: Top 10 tree species for trees ≥1 cm dbh. Data are from the first census.

of which are bats—have been identified in the reserve. The mammal most notably associated with the region is the Andean bear (*Tremarctos ornatus*). Since the creation of the reserve, five captive-bred bears have been reintroduced there. Other animals found in the reserve include carnivores such as the ocelot (*Felis pardalis*), tiger cat (*Felis tigrina*), and kinkajou (*Potos flavus*); large herbivores such as collared peccaries (*Tayassu tajacu*); primates such as the mantled howler (*Alouatta palliata*), the Colombian black spider monkey (*Ateles fusciceps*), and the white-faced capuchin (*Cebus capuchinus*); and three species of deer (*Mazama americana*, *Mazama rufina*, and *Pudu mephistophiles*). Preliminary inventories have recorded approximately 50 species of reptiles and 30 species of amphibians.

Because no good approximations of insect biodiversity exist, the Humboldt Institute in cooperation with the University of Kentucky and Los Angeles County Museum of Natural History has recently launched an inventory of insects in La Planada and 12 other areas inside of Colombian national parks. Findings are not yet available.

Natural Disturbance

Windthrows are the most important natural disturbance within the La Planada Forest Dynamics Plot. During the approximately 8 months of the first plot census,

three large forest gaps were created by windthrows. Two windthrows flattened almost 0.16 ha of the 25-ha plot.

Human Disturbance

An estimated 150 ha of the forest in the plateau near the reserve headquarters were cleared for cattle grazing pastures several decades ago. When the reserve was created in 1982, these pastures were abandoned and the process of natural regeneration initiated. At first, the old pastures were thickly covered by *Tibouchina lepidota and T. gleasoniana* (Melastomataceae) shrubs and dense masses of *Disterigma sterophyllum* (Ericaceae), a plant that grows as an epiphyte in the forest. After years of succession, pioneer trees including *Clethra fagifolia* (Clethraceae), *Vismia spp, Clusia cruciata, C. weberbauerii*, and *C. longistyla* (Guttiferae) began to dominate the forest. Several species that grow as epiphytes in the forest are found at ground level in these secondary areas, such as *Stenospermatium robustum* (Araceae), *Schefflera sphaerocoma* (Araliaceae), *Macleania bullata* (Ericaceae), and *M. stricta* (Samper 1992).

The forest surrounding the plot is relatively undisturbed. While there is moderate poaching and agricultural encroachment near the border of the reserve, these activities do not occur within or around the plot. One activity that does affect the La Planada forest is the harvest of palmito (*Prestoea acuminata* [Palmae]), the edible heart of palm extracted by humans in July and December. The exploitation of this palm results in decreased species regeneration due to seedling trampling, physiological changes in the subcanopy, and the creation of poorly drained areas due to the removal of the species. In addition, heart of palm collection also affects the wildlife by altering pollination and dispersal activities and limiting the food source for birds such as cotingas (*Lipaugus criptolophus, Rupicola peruviana*) and mountain toucans (*Andigena laminirostris, Aulacorhynchus haematophygus*), rodents such as *Orizomys albigularis*, and guan (*Chamaepetes goudotii*) (Guzmán 2000). During harvest season, the project supervisor and reserve forester vigilantly patrol the plot and the limits of the reserve to prevent poaching.

The Forest Dynamics Plot can be classified into an area with flat slopes and areas with steep slopes. In the region of flat slopes, selective logging activities occurred about 20 years ago and the forest is currently regenerating. The other region of the plot is characterized by greater slope with minimal human disturbance.

Plot Size and Location

The 25-ha plot is 500 × 500 m. Its northwest corner (00, 25) is located at 1°09′31.6″N, 77°59′44.8″W. The northeast corner (25, 25) of the plot is located at 1°09′31.6″N, 77°59′28.6″W. The southwest corner (00, 00) of the plot is located

at 1°09′05.3″N, 77°59′44.8″W. The southeast corner (25, 00) of the plot is located at 1°09′15.3″N, 77°59′28.6″W.

Funding Sources

Acknowledgments

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