

Palanan Forest Dynamics Plot, Philippines

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Site Location, Administration, and Scientific Infrastructure

The 250,000-ha Palanan Wilderness Area was created in 1979. It lies in the Province of Isabela on the Island of Luzon, and was recently redefined as the Northern Sierra Madre Natural Park (NSMNP). It is a totally protected area under the administration of the Philippine Department of Environment and Natural Resources. Although described as a wilderness area, it includes the historic seaside town of Palanan with several thousand permanent residents. Palanan is one of the last spots in the Philippines where one can traverse pristine habitats from seashore and mangrove, through lowland forests to montane and mossy forests. All terrestrial habitats found in the Philippines are represented here, except peat swamps and semideciduous rainforest.

The 16-ha Forest Dynamics Plot is located about 4 km from Palanan town, near Villa Robles (fig. 35.1). The plot was established in 1994 through a scientific consortium that included Conservation International, the College of Forestry at Isabela State University (based in the nearby town of Cabagan, Isabela), and the Center for Tropical Forest Science in concert with the Arnold Arboretum of Harvard University.

Access to the site is via small commercial propeller airplanes to the town of Palanan, and from there by foot to the plot itself. The consortium has built some modest wooden facilities, powered at night for lighting by a small electric generator, for researchers and staff to sleep and eat adjacent to the plot. A permanent stream runs next to the buildings providing fresh water year round. Food and supplies can be obtained in Palanan town but must be carried to the site.

Climate

No long-term weather data are available for the immediate vicinity of Palanan. The most comparable data have been collected at a station of the Philippine Meteorological Service in Casiguran, about 80 km south of the plot. In Casiguran, the 30-year mean annual rainfall is 3379 mm, with a minimum of 1347 mm and a

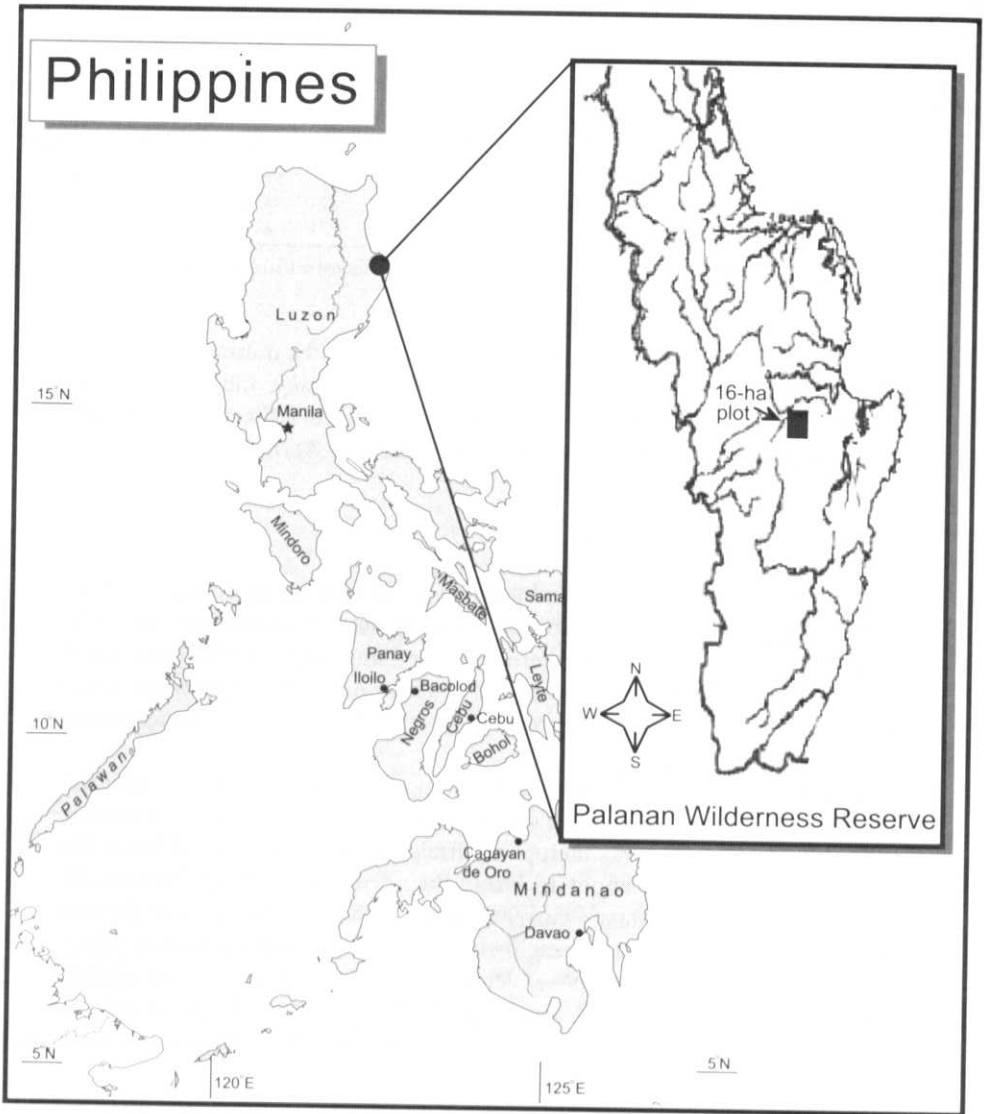


Fig. 35.1. Location of the 16-ha Palanan Forest Dynamics Plot.

maximum of 6841 mm. The rainfall in Palanan is thought to be somewhat higher, perhaps a 30-year mean of 5000 mm. The very wet year of 2000 had a measured rainfall at Palanan town center of more than 8000 mm (exact data are not available). The 4 months from January to April are relatively dry, though no month averages less than 100 mm. The mean annual temperature in Casiguran is

Table 35.1. Palanan Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total/ Averages
Rain (mm)	220	152	166	129	229	218	274	217	287	510	525	453	3379
ADTMx	26.9	28.5	30.2	32.1	33.4	33.6	33.0	33.0	32.0	31.1	28.6	27.7	30.8
ADTMn	18.7	19.2	20.1	21.5	22.6	23.2	23.0	23.0	22.9	22.0	20.8	19.9	21.4

Notes: Mean monthly rainfall and average daily temperature are based on data measured at Casiguran, 1966 to 1995.

26.1°C, with an average diurnal maximum of 30.8°C and a minimum of 21.4°C (table 35.1). Typhoons hit Palanan both from the southwest and the northeast, generally from August to November, and the prevailing wind direction is southerly from May to September and northerly from October to April.

Topography and Soil

The Northern Sierra Madre Natural Park is located near the northern end of the Sierra Madre mountain range, which runs along most of Luzon's eastern shore, from Cagayan Province at the northern tip of the island to Quezon Province, south of Manila. The range is a highly complex structure of volcanic, limestone, ultrabasic, and uplifted granites, all interdigitated with tongues of limestone appearing amid the ultrabasic outcrops.

In the vicinity of the Palanan Forest Dynamics Plot, clays, limestone, and ultrabasics are patchily distributed and support forests of markedly different composition and stature. Extensive outcrops of ultrabasics support a stunted heath-like lowland forest, especially about 15 km to the north and south of Palanan. Although no soil profile data are currently available for the plot, soils in the area mostly appear to be clay loams ranging from yellowish to reddish-brown, generally overlain with partly decomposed detrital materials 0.3–1 cm thick. Along deep gully bottoms, dark soil rich in humus is occasionally found. Exposed bedrock seen within the plot is mostly shale, although boulders of certain igneous rocks occur, especially along the eastern fork of Ditalad Creek.

The Palanan Forest Dynamics Plot straddles a low broad ridge, with an elevation range of 85–140 m above sea level (figs. 35.2 and 35.3). Trending diagonally along a northwest to southeast direction, the ridge lies roughly perpendicular to the general direction of typhoons originating from the Pacific. As a result, the plot has marked windward and leeward sides, which are reflected in the structure of the plot's forest cover. Flanking the plot are two branches of Ditalad Creek, a tributary of the Palanan River, one of the major river systems within the park. Gullies carved by this creek provide sheltered spots with higher diversity and taller trees than on the more exposed broad ridge summits.

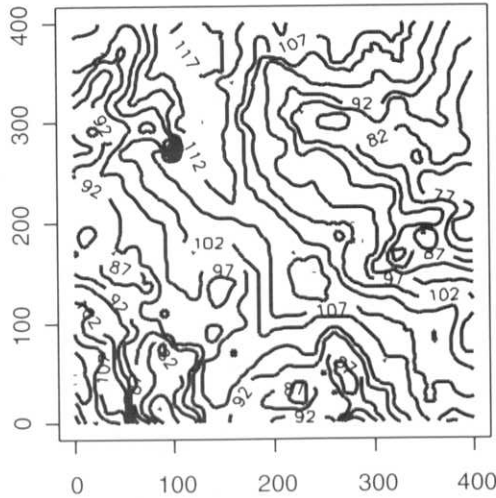


Fig. 35.2. Topographic map of the 16-ha Palanan Forest Dynamics Plot with 5-m contour intervals.

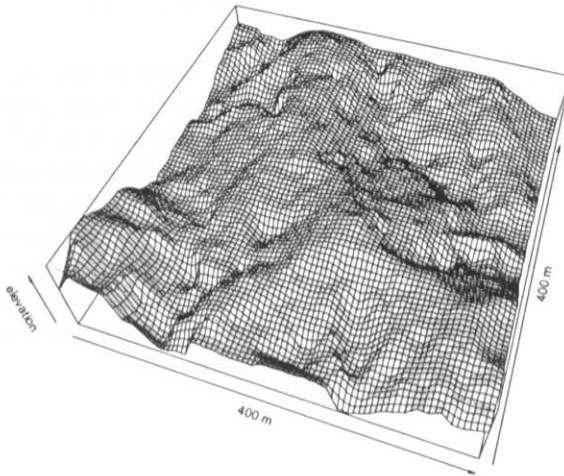


Fig. 35.3. Perspective map of the 16-ha Palanan Forest Dynamics Plot.

Forest Type and Characteristics

Palanan includes a rich mosaic of forest types largely influenced by the diverse underlying soils. The Palanan Forest Dynamics Plot itself encompasses ever-green dipterocarp forest dominated in basal area by species of *Shorea* (Dipterocarpaceae), *Dipterocarpus* (Dipterocarpaceae), and *Hopea* (Dipterocarpaceae).

Table 35.2. Palanan Plot Census History

Census	Dates	Number of Trees (≥1 cm dbh)	Number of Species (≥1 cm dbh)	Number of Trees (≥10 cm dbh)	Number of Species (≥10 cm dbh)
First	1994–1999	65,986	335	8593	262

Notes: An initial census was completed of the 8-ha Palanan Forest Dynamics Plot. A second census of the first 8 ha and a first census of a supplemental 8 ha was completed in 1999. Data from the second census of the first 8 ha are not yet available.

Table 35.3. Palanan Summary Tally

Size Class (cm dbh)	Average per Hectare							16-ha Plot				
	BA	N	S	G	F	H'	α	S	G	F	H'	α
≥1	39.8	4124	197	111	48	1.92	43.4	335	155	60	2.00	46.1
≥10	36.1	537	100	63	35	1.63	36.5	262	137	55	1.79	51.1
≥30	26.0	110	32	24	18	1.21	16.0	130	78	39	1.44	32.4
≥60	15.6	28	8	4	4	0.69	4.0	36	27	20	0.89	9.2

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 total 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. Individuals are counted using their largest stem. 3370 individuals were not identified to species or morphospecies. Data are from 16 ha of the first census.

Trees from the Dipterocarpaceae represent over half of all trees over 30 cm dbh. The next closest families (Tiliaceae and Meliaceae) are represented by 126 and 90 trees respectively. The Meliaceae is expected to be among the 10 most abundant and species-rich families in any Asian forest. In Palanan it is especially rich: ranking third in species number and first in total abundance. Also notable is the rich abundance of the genus *Leea* [Leeaceae]. While *Leea* is found in all Asian forests (and is listed among all of the Asian plots), it is only in the Palanan plot that it becomes a major component of the forest understory, represented by seven species and over 3400 trees, or nearly 5% of the total census. For census data and rankings, see tables 35.2–35.6.

Fauna

The Northern Sierra Madre Natural Park contains a rich diversity of faunal life. Of 291 species of birds thus far documented in the park, 83 are endemic to the Philippines. The park is also host to 44 species of terrestrial mammals, of which 21 are endemic to the country (NSMNP Management Plan 2001). Notable large mammal species are few, consisting of a macaque, *Macaca fascicularis*, two species of civets, *Paradoxurus hermaphroditus* and *Viverra zangalunga*, a pig, *Sus philippinensis*, and a deer, *Cervus mariannus* (Danielsen et al. 1994). A distinctive feature of the mammalian fauna of Luzon Island is the absence of squirrels, which

Table 35.4. Palaman Rankings by Family

Rank	Family	Basal Area (m ²)	% BA	% Trees	Family	Trees	% Trees	Family	Species
1	Dipterocarpaceae	323.4	52.8	11.7	Meliaceae	7561	12.1	Euphorbiaceae	37
2	Euphorbiaceae	37.1	6.1	9.9	Dipterocarpaceae	7310	11.7	Myrtaceae	23
3	Tiliaceae	35.9	5.9	3.5	Euphorbiaceae	6200	9.9	Meliaceae	20
4	Meliaceae	33.2	5.4	12.1	Sapindaceae	5742	9.2	Lauraceae	18
5	Sapindaceae	28.4	4.6	9.2	Lauraceae	5154	8.2	Moraceae	16
6	Oleaceae	16.1	2.6	2.6	Annonaceae	3171	5.1	Rubiaceae	16
7	Lauraceae	15.4	2.5	8.2	Leeaceae	2941	4.7	Annonaceae	14
8	Myrtaceae	15.1	2.5	4.5	Myrtaceae	2823	4.5	Guttiferae	13
9	Leguminosae	14.1	2.3	1.7	Rubiaceae	2222	3.5	Sapindaceae	13
10	Moraceae	7.5	1.2	1.6	Tiliaceae	2177	3.5	Dipterocarpaceae	12
								Myristicaceae	12
								Sapotaceae	12

Notes: The top 10 families for trees ≥ 1 cm dbh ranked in terms of basal area, number of individual trees, and number of species, with the percentage of trees in the plot. Data are from 16 ha of the first census.

Table 35.5. Palanan Rankings by Genus

Rank	Genus	Basal Area (m ²)	% BA	% Trees	Genus	Trees	% Trees	Genus	Species
1	<i>Shorea</i> (Dipterocarpaceae)	311.6	50.9	9.8	<i>Shorea</i> (Dipterocarpaceae)	6144	9.8	<i>Eugenia</i> (Myrtaceae)	23
2	<i>Diplodiscus</i> (Tiliaceae)	29.8	4.9	2.1	<i>Litsea</i> (Lauraceae)	3809	6.1	<i>Ficus</i> (Moraceae)	14
3	<i>Drypetes</i> (Euphorbiaceae)	29.3	4.8	4.9	<i>Nephelium</i> (Sapindaceae)	3525	5.6	<i>Palaquium</i> (Sapotaceae)	12
4	<i>Nephelium</i> (Sapindaceae)	23.5	3.8	5.6	<i>Drypetes</i> (Euphorbiaceae)	3038	4.9	<i>Dysoxylum</i> (Meliaceae)	8
5	<i>Srombhosia</i> (Olacaceae)	16.1	2.6	2.6	<i>Leea</i> (Leeaceae)	2941	4.7	<i>Garcinia</i> (Guttiferae)	7
6	<i>Eugenia</i> (Myrtaceae)	15.1	2.5	4.5	<i>Eugenia</i> (Myrtaceae)	2823	4.5	<i>Glochidion</i> (Euphorbiaceae)	7
7	<i>Dysoxylum</i> (Meliaceae)	14.8	2.4	3.9	<i>Chisocheton</i> (Meliaceae)	2610	4.2	<i>Leea</i> (Leeaceae)	7
8	<i>Chisocheton</i> (Meliaceae)	12.5	2.0	4.2	<i>Dysoxylum</i> (Meliaceae)	2450	3.9	<i>Litsea</i> (Lauraceae)	7
9	<i>Dipterocarpus</i> (Dipterocarpaceae)	11.3	1.8	1.7	<i>Aglaiia</i> (Meliaceae)	2263	3.6	<i>Aglaiia</i> (Meliaceae)	6
10	<i>Litsea</i> (Lauraceae)	8.1	1.3	6.1	<i>Haplostichanthus</i> (Annonaceae)	2198	3.5	<i>Shorea</i> (Dipterocarpaceae)	6

Notes: The top 10 tree genera for trees ≥ 1 cm dbh ranked by basal area, number of individual trees, and number of species with the percentage of trees in the plot. Data are from 16 ha of the first census.

Table 35.6. Palanan Rankings by Species

Rank	Species	Number Trees	% Trees	Species	Basal Area (m ²)	% BA	% Trees
1	<i>Nephelium lappaceum</i> (Sapindaceae)	3525	5.6	<i>Shorea palosapis</i> (Dipterocarpaceae)	117.4	19.2	3.6
2	<i>Shorea palosapis</i> (Dipterocarpaceae)	2237	3.6	<i>Shorea negrosensis</i> (Dipterocarpaceae)	101.3	16.6	2.2
3	<i>Drypetes megacarpa</i> (Euphorbiaceae)	2179	3.5	<i>Shorea polysperma</i> (Dipterocarpaceae)	37.0	6.0	0.5
4	<i>Haplostichanthus sp.</i> (Annonaceae)	2020	3.2	<i>Shorea contorta</i> (Dipterocarpaceae)	30.5	5.0	2.8
5	<i>Shorea contorta</i> (Dipterocarpaceae)	1719	2.8	<i>Diplodiscus paniculatus</i> (Tiliaceae)	29.8	4.9	2.1
6	<i>Dysoxylum oppositifolium</i> (Meliaceae)	1667	2.7	<i>Drypetes megacarpa</i> (Euphorbiaceae)	25.2	4.1	3.5
7	<i>Praravinia sp.</i> (Rubiaceae)	1638	2.6	<i>Nephelium lappaceum</i> (Sapindaceae)	23.5	3.8	5.6
8	<i>Strombosia philippinensis</i> (Olacaceae)	1622	2.6	<i>Shorea assamica</i> ssp. <i>philippinensis</i> (Dipterocarpaceae)	18.0	3.0	0.5
9	<i>Leea congesta</i> (Lecaceae)	1482	2.4	<i>Strombosia philippinensis</i> (Olacaceae)	16.1	2.6	2.6
10	<i>Shorea negrosensis</i> (Dipterocarpaceae)	1363	2.2	<i>Dysoxylum oppositifolium</i> (Meliaceae)	9.2	1.5	2.7

Notes: The top 10 tree species for trees ≥ 1 cm dbh are ranked by number and percentage of trees and basal area. Data are from 16 ha of the first census.

are perhaps replaced ecologically by various forest rats. The largest colony of flying foxes in Luzon Island is also found in the park, most noteworthy of which are the golden crowned flying fox (*Acerodon jubatus*) and the mottled-winged flying fox (*Pteropus leucopterus*). Although no systematic survey has been conducted on amphibians or reptiles in the park, preliminary data indicate high levels of species endemism. Of about 18 species of amphibians thus far known to occur in the park, 13 are endemics.

In 1997, a rapid survey of the terrestrial vertebrate fauna of the 16-ha Palanan Forest Dynamics Plot and immediate 3-km radius recorded 95 species including 7 amphibians, 5 reptiles, 67 birds, and 16 mammals. Rufous hornbill (*Buceros hydrocorax*), Gray's monitor lizard (*Varanus olivaceus*), Luzon pygmy fruit bat (*Otopteropus cartilagonodus*), and wild pigs (*Sus philippinensis*) are some of the more prominent endemic wildlife species that frequent the 16-ha plot (Duya et al. unpublished data).

Natural Disturbances

Palanan Forest Dynamics Plot is subjected to periodic severe typhoons that are strong enough to either knock over exposed trees or strip their canopy bare of

leaves. The area is buffeted by three to eight typhoons per year, mostly of modest strength (class one). Powerful typhoons (class three and above) strike every few years. The exact frequency of these typhoons is not clear, but the living memory of Palanan residents suggests that typhoons destructive to the forest occur every 3 years or so.

From November to June, northeast winds off the Pacific dominate the weather of northern Luzon. These steady winds bring daily clouds and rain to east-facing slopes of the Sierra Madre, while leaving the western side dry. Thus, during the driest months of the year (January to May) when 4 months of rainless days are expected in the Cagayan Valley and Northwest Luzon, Palanan may be receiving daily storms.

From June to November, Philippine weather is dominated by the great cyclonic storms that rise up in the Pacific. They begin their life 1000 km away to the southeast and sweep north and west, typically either crossing the central Philippine islands and southern Luzon, or moving northward up the Luzon coast westward across the strait between Luzon and Taiwan. These latter storms are an annual feature of Palanan weather. Relatively mild storms occur every year, while highly destructive storms (wind gusts over 100 km/hr) occur at least every decade. Effects on the forest include a direct impact on the crown, branches, and form, producing a short, even stature, and an indirect impact through litter deposition and the subsequent greater chance of fires. There is no known impact of El Niño events.

Human Disturbance

Although Palanan is completely cut off via road network from the economically more developed western side of the Sierra Madre, it suffers from a variety of human disturbances. Individual trees of valued species, particularly narra, *Pterocarpus indicus* (Leguminosae), and ebonies, *Diospyros* spp. (Ebenaceae), have been routinely extracted over the past decades. Typically trees are cut and squared in the forest and the log is drawn out using the native buffalo. The logs are taken to the ocean side and picked up by large outrigger boats bound elsewhere in Luzon. Deep logging trails can be found in the plot itself, although the number of trees extracted from the plot appears to be low.

Some hunting of deer and pig continues as does the extraction of rattan. The greatest danger to the residual lowland forest is the continuing loss of forest land to small-scale, low-income farming, especially for corn, pineapple, and banana. No figures are available for the recent loss of forest cover.

Much of the high diversity of faunal life in the Northern Sierra Madre Natural Park is threatened because of past and current human activity throughout the region. Fifty-one endemic bird species and 12 of the endemic terrestrial mammal species are categorized as threatened or near-threatened species by the International Union for Conservation of Nature and Natural Resources (IUCN)

Red List of Threatened Species (IUCN 2002; NSMNP Management Plan 2001). The golden crowned flying fox and mottled-winged flying fox are categorized as endangered in the IUCN list, while two forest tree frogs, *Platymantis pygmaeus* and *P. sierramadrensis*, are categorized as vulnerable in the list. Among the threatened herpetofauna, Gray's monitor lizard, *Varanus olivaceus*, and the Philippine crocodile, *Crocodylus mindorensis* (both Philippine endemics), are respectively categorized as vulnerable and critically endangered (NORDECO-DENR 1998; NSMNP Conservation Project unpublished data; Duya personal communication).

The 16-ha plot is located within a multiple-use zone within the park, which allows limited and regulated extraction of timber and nontimber products and game hunting for domestic, noncommercial consumption. However, local communities around the plot do not engage in any open extractive activities within the plot or its associated field station. There is currently a move within the NSMNP Protected Area Management Board to declare the plot's perimeter as a special-use zone for scientific research and ecotourism.

Plot Size and Location

The initial census was 8 ha, 200 × 400 m; the long axis lies north and south. The second 8 ha, 200 × 400 m, is located to the east of the first 8 ha and also has a north-south orientation. The plot is located at approximately 17°02'36" N, 122°22'58" E.

Funding Sources

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