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Doi Inthanon Forest Dynamics Plot, Thailand

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Site Location, Administration, and Scientific Infrastructure

The Doi Inthanon Forest Dynamics Plot is located in the well-protected and well-developed montane forest of Doi Inthanon National Park, Chiang Mai province, northern Thailand (fig. 26.1). The park, established in 1972 and located 50 km to the southwest of the city of Chiang Mai, comprises 48,240 ha and ranges from 400 m up to 2565 m above sea level.

The 15-ha plot was initiated in 1996 and is maintained by a collaborative project involving scientists from Kasetsart University (Thailand), the Royal Forest Department (Thailand), Maejo University (Thailand), Osaka City University (Japan), Kyoto University (Japan), Utsunomiya University (Japan), and Chiba Natural History Museum, and Institute (Japan). The park and the plot are easily reached by car. A park-operated guesthouse and food shop are available in the park headquarters as well as a simple laboratory, supported by Japanese funding. Scientists from Kasetsart University have also established 45 small plots, 40 × 40 m in size, to investigate changes in vegetation along the park's altitudinal gradient (Teejuntuk et al. 2003).

Climate

Doi Inthanon has an average annual rainfall of 1908 mm, ranging from 1229 to 2561 mm over a 7-yr period (measured in 1993–99 at the Royal Project Office of Doi Inthanon Natonal Park, 1300 m above sea level). This montane forest has a typical tropical monsoonal climate with a 5- to 6-month dry season. Rainfall increases with altitude (Santisuk 1988), and clouds frequently cover the mountains above 1500 m, even in the dry season. See table 26.1.

Topography and Soil

The 15-ha Doi Inthanon Forest Dynamics Plot is located on the middle slope (about 1700 m above sea level) of Doi Inthanon mountain. Within the 15-ha plot,

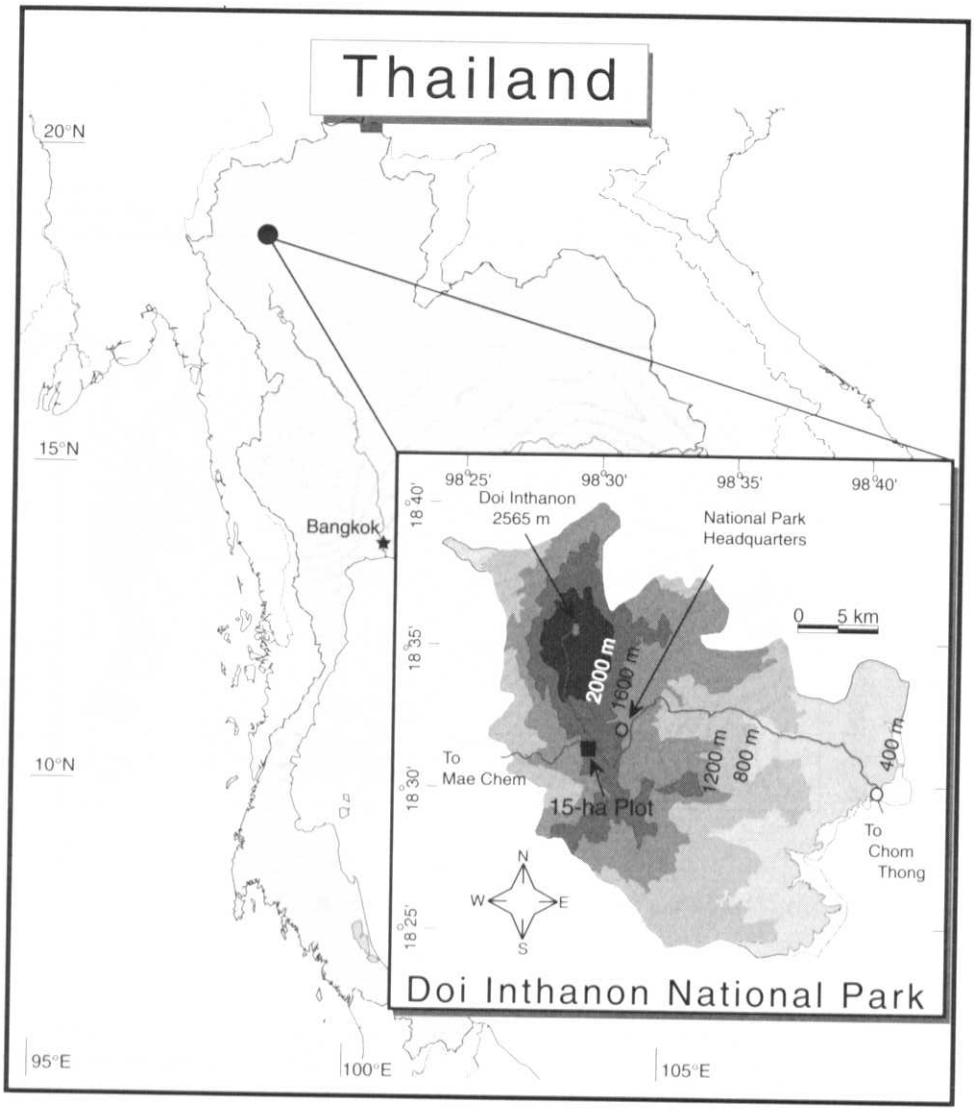

Fig. 26.1. Location of the 15-ha Doi Inthanon Forest Dynamics Plot.

slope inclination varies from 0° to 45.6° and elevation differs by 78 m (figs. 26.2 and 26.3). Moderately inclined slopes cover most of the plot.

Bedrock within the plot is comprised of post-Silurian and post-Permian granite and pre-Cambrian gneiss. The substratum rocks in Doi Inthanon have produced a coarse sandy loamy soil (Pendleton 1962). Soil in the plot is coarse, sandy, and

Table 26.1. Doi Inthanon Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total/ Averages
Rain (mm)	3	14	31	92	247	228	271	355	371	212	74	9	1908
ADTMx (°C)	23.8	25.9	28.5	28.9	27.7	25.9	25.2	25.2	25.7	25.7	23.4	22.7	25.7
ADTMn (°C)	11.5	13.4	16.9	18.3	18.6	18.2	18.1	18.0	17.8	16.3	14.2	11.8	16.1

Note: Average daily maximum and minimum temperatures (ADTMx and ADTMn) and mean monthly rainfall were determined from 1993–99 climate data obtained from the nearest weather station located at 1300 m above sea level and operated by the Royal Project Office of Doi Inthanon National Park.

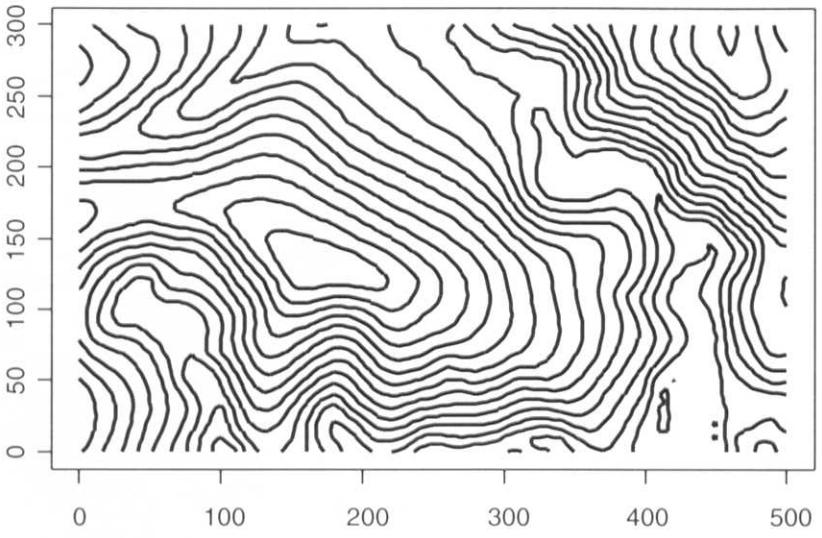

Fig. 26.2. Topographic map of the 15-ha Doi Inthanon Forest Dynamics Plot with 5-m contour intervals.

well drained, except along streams where drainage is poor. The Forest Dynamics Plot contains various geographical features including ridges, permanent streams, rectilinear slopes, and flat terrain along streams.

Forest Type and Characteristics

According to Santisuk (1988), altitudinal zonation of vegetation in the mountains of northern Thailand consists of two zones: the lowland zone (0 to 1000 m),

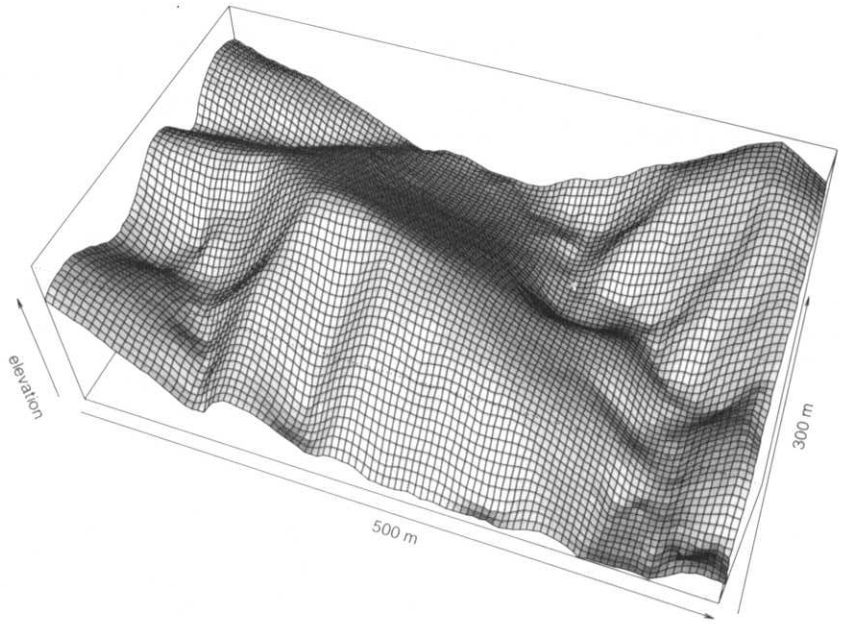

Fig. 26.3. Perspective map of the 15-ha Doi Inthanon Forest Dynamics Plot.

dominated by deciduous forest, and the montane zone (above 1000 m), dominated by evergreen forest. At approximately 1800 m, the montane zone is further divided into lower montane forest (LMF) and upper montane forest (UMF). The UMF is distinguished from the LMF by shorter canopy height and lower species richness, but tree species tend to be similar between the two forest types. The vegetation of the park accurately represents the altitudinal zonation. The Doi Inthanon Forest Dynamics Plot (1700 m altitude) is located near the transition zone from LMF to UMF. The structure of the forest varies in relation to the topography of the plot. The forest canopy is dense and reaches from 15 to 30 m in height with the tallest trees of the plot reaching more than 50 m and the maximum tree size reaching more than 175 cm dbh. Saplings and pole size trees are abundant. Many small gaps (<1000 m^2) are scattered throughout the plot. Aboveground biomass in the plot is estimated to be 570 tons/ha, roughly equivalent to those in lowland tropical rain forests (Yamakura et al. 1986, 1996). The huge emergent trees contribute to the high biomass of the site.

In terms of basal area, the Fagaceae and Lauraceae are the dominant families within the plot. The dominant species is *Mastixia euonymoides* (Cornaceae), with individual trees growing to a maximum height of over 50 m. This emergent species overtops the crowns of Fagaceae and Lauraceae trees. The other characteristic species in the forest are *Nyssa javanica* (Nyssaceae) and *Manglietia garretii*

Table 26.2. Doi Inthanon 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	February 1997–March 2000	73655	162	7785	112

Notes: The first census of the 15-ha Forest Dynamics Plot was completed in March 2000 and identification was completed in March 2001. The next census began in 2003.

Table 26.3. Doi Inthanon Summary Tally

Size Class (cm dbh)	Average per Hectare							15-ha Plot				
	BA	*N*	*S*	*G*	*F*	*H'*	α	*S*	*G*	*F*	*H'*	α
≥1	39.8	4910	104.9	73.1	41.9	1.62	19.0	162	105	57	1.75	19.9
≥10	36.1	519	66.6	50.4	31.1	1.59	20.5	106	76	43	1.74	18.6
≥30	26.3	128	38.2	30.2	22.2	1.40	18.9	90	61	39	1.62	19.7
≥60	11.3	20.8	9.9	9.0	7.9	0.88	8.3	37	28	23	1.18	11.0

Notes: *BA* represents basal area in m^2, *N* is the number of individual trees, *S* is number of species, *G* is number of genera, *F* is number of families, *H'* is 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 stems. Data are from the first census. 981 trees were excluded from the calculation of species diversity indices because they were not identified to species or morphospecies.

Table 26.4. Doi Inthanon Rankings by Family

Rank	Family	Basal Area (m^2)	% BA	% Trees	Family	Trees	% Trees	Family	Species
1	Fagaceae	122.7	20.1	13.1	Lauraceae	10,797	14.7	Lauraceae	25
2	Lauraceae	92.2	15.1	14.7	Fagaceae	9,683	13.1	Rubiaceae	13
3	Cornaceae	87.4	14.3	1.3	Euphorbiaceae	8,785	11.9	Myrsinaceae	11
4	Euphorbiaceae	51.3	8.4	11.9	Rubiaceae	7,340	10.0	Fagaceae	8
5	Magnoliaceae	35.8	5.9	0.9	Guttiferae	5,995	8.1	Euphorbiaceae	8
6	Guttiferae	32.4	5.3	8.1	Myrtaceae	3,689	5.0	Rosaceae	6
7	Myrtaceae	25.7	4.2	5.0	Theaceae	3,428	4.7	Theaceae	5
8	Rubiaceae	17.0	2.8	10.0	Meliaceae	3,043	4.1	Moraceae	5
9	Oleaceae	11.5	1.9	1.5	Myrsinaceae	2,729	3.7	Meliaceae	4
10	Aceraceae	11.4	1.9	1.7	Rutaceae	2,681	3.6	Rutaceae	4

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

Table 26.5. Doi Inthanon Rankings by Genus

Rank	Genus	Basal Area (m^2)	% BA	% Trees	Genus	Trees	% Trees	Genus	Species
1	*Quercus* (Fagaceae)	74.6	12.2	2.8	*Calophyllum* (Guttiferae)	5995	8.1	*Litsea* (Lauraceae)	9
2	*Mastixia* (Cornaceae)	72.8	12.9	0.9	*Castanopsis* (Fagaceae)	5481	7.4	*Prunus* (Rosaceae)	5
3	*Manglietia* (Magnoliaceae)	35.7	5.9	0.9	*Mallotus* (Euphorbiaceae)	4939	6.7	*Lasianthus* (Rubiaceae)	4
4	*Calophyllum* (Guttiferae)	32.4	5.3	8.1	*Litsea* (Lauraceae)	4688	6.4	*Ardisia* (Myrsinaceae)	4
5	*Litsea* (Lauraceae)	28.5	4.7	6.4	*Syzygium* (Myrtaceae)	3689	5.0	*Castanopsis* (Fagaceae)	3
6	*Cryptocarya* (Lauraceae)	27.2	4.5	3.1	*Psychotria* (Rubiaceae)	3055	4.1	*Psychotria* (Rubiaceae)	3
7	*Syzygium* (Myrtaceae)	25.7	4.2	5.0	*Melicope* (Rutaceae)	2647	3.6	*Symplocos* (Symplocaceae)	3
8	*Drypetes* (Euphorbiaceae)	25.7	4.2	2.6	*Symplocos* (Symplocaceae)	2441	3.3	*Lithocarpus* (Fagaceae)	3
9	*Castanopsis* (Fagaceae)	25.4	4.2	7.4	*Heynea* (Meliaceae)	2407	3.3	*Elaeocarpus* (Elaeocarpaceae)	3
10	*Lithocarpus* (Fagaceae)	22.8	3.7	2.9	*Cryptocarya* (Lauraceae)	2320	3.1	*Cinnamomum* (Lauraceae)	3

Notes: The top 10 tree genera for trees ≥1 cm dbh are ranked by basal area, number of individual trees, and number of species with the percentage of trees in the plot. Data are from 15 ha of the first census.

(Magnoliaceae), both long-lived, deciduous pioneers. A gymnosperm, *Podocarpus neriifolius* (Podocarpaceae), a small bamboo (*Melocanna* sp. [Gramineae]), a small palm (*Pinanga* sp. [Palmae]), a rattan (*Calamus viminalis* var. *cochinchinensis* [Palmae]), and temperate species such as *Prunus* spp. (Rosaceae) and *Betula alnoides* (Betulaceae) also occur in the plot (Hara et al. 2002). One new species of *Ophiopogon* (Convallariaceae) was found in the plot and named *O. siamensis* (Tamura, 1998). For census data and rankings, see tables 26.2–26.6.

Fauna

Doi Inthanon National Park is home to at least 65 mammal species, including primates, the Indian civet (*Viverra zibetha*), barking deer (*Muntiacus muntijak*), the Asiatic bear (*Ursus thibetanus*), native cats, bats, and squirrels (Gray et al. 1991). The park is also famous for its rich bird fauna, with 383 bird species reported (Gray et al. 1991). In the 15-ha Forest Dynamics Plot, rodents, a wild boar, and many birds have been observed but no scientific census has been conducted.

Table 26.6. Doi Inthanon Rankings by Species

Rank	Species	Number Trees	% Trees	Species	Basal Area (m^2)	% BA	% Trees
1	*Calophyllum polyanthum* (Guttiferae)	5995	8.1	*Mastixia euonymoides* (Cornaceae)	72.8	11.9	0.9
2	*Mallotus khasianus* (Euphorbiaceae)	4939	6.7	*Quercus eumorpha* (Fagaceae)	51.5	8.4	1.6
3	*Castanopsis calathiformis* (Fagaceae)	3993	5.4	*Manglietia garretii* (Magnoliaceae)	35.7	5.9	0.9
4	*Syzygium angkae* ssp. *angkae* (Myrtaceae)	2647	3.6	*Calophyllum polyanthum* (Guttiferae)	32.4	5.3	8.1
5	*Melicope pteleifolia* (Rutaceae)	2407	3.3	*Quercus brevicalyx* (Fagaceae)	23.0	3.8	1.2
6	*Heynea trijuga* (Meliaceae)	1968	2.7	*Cryptocarya densiflora* (Lauraceae)	20.9	3.4	1.8
7	*Psychotria symplocifolia* (Rubiaceae)	2682	3.6	*Syzygium angkae* ssp. *angkae* (Myrtaceae)	15.4	2.5	3.6
8	*Eurya nitida* var. *nitida* (Theaceae)	1795	2.4	*Drypetes* sp. (Euphorbiaceae)	15.1	2.5	1.4
9	*Symplocos macrophylla* ssp. *sulcata* var. *sulcata* (Symplocaceae)	1733	2.4	*Nyssa javanica* (Cornaceae)	14.5	2.4	0.4
10	*Lindera metcalfiana* (Lauraceae)	1588	2.2	*Mallotus khasianus* (Euphorbiaceae)	13.9	2.3	6.7

Notes: The top 10 tree species for trees ≥1 cm dbh are ranked by number of trees and basal area. The percentage of the total population is also shown. Data are from 15 ha of the first census.

Natural Disturbance

There are no large-scale disturbances such as wind storms, volcanoes, fire, or floods in the plot. Canopy trees mainly die standing.

Human Disturbance

The 15-ha plot is well protected from human disturbances, except for moderate animal hunting and plant collecting by local peoples. However, Hmong people who have inhabited the park since the end of the 19th century have practiced shifting cultivation and destroyed a huge area of the park's montane zone, especially below 1500 m. This montane forest area has been replaced by secondary evergreen oak forest and pine plantations (*Pinus kesiya* [Pinaceae]). Because shifting cultivation practices have been halted by the government, the Hmong now participate in flower, fruit, and vegetable cultivation in permanent fields through the aid of projects within the Royal Project Foundation and the Thai Royal Forest Department.

Populations of tiger (*Panthera tigris*), sambar deer (*Cervus unicolor*), elephant (*Elephas maximus*), and other large mammals are either locally extinct or drastically reduced due to hunting and habitat loss.

Plot Size and Location

Doi Inthanon is a 15-ha, 500 × 300 m plot; its long axis lies approximately north-south (S16°W). The northwest corner of the plot is located at 18°31′34″N, 98°29′39″E.

Funding Sources

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