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Metadata

NPP Tropical Forest: Khao Chong, Thailand, 1962-1965, R1

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Revision date: November 6, 2013

Summary:

This data set contains one net primary productivity (NPP) data file and three climate data files (.txt format) for a fully closed tropical rainforest in the Khao Chong Reserve (7.58 N 99.8 E) in southern Thailand. The Reserve comprises 500 ha of well-preserved rainforest considered typical of the region, although maximum tree height (36 m) and biodiversity were less than in Malaysian forests.

Net primary productivity (NPP) was estimated as the sum of annual net above-and below-ground biomass increase plus extrapolated annual litterfall and tree mortality. Biomass increment for trees > 4.5 cm diameter at breast height (DBH) was monitored between 1962 to 1965, and daily litterfall was measured for one month in 1962. Total NPP was estimated at 2,860 g/m^2/year. This value includes a possible over-estimate of litterfall (2,330 g/m^2/year) plus above-ground woody biomass increment and turnover as mortality combined (489 g/m^2/year) plus below-ground woody biomass increment (41 g/m^2/year). Fine root turnover and herbivory were not included in these estimates. Allometric relationships for estimating above-ground biomass were checked by destructive harvest. Leaf area index was relatively high at 11.4-12.3 m^2/m^2.

Long-term climate data for Khao Chong are available from weather stations at Songkhla, Thailand (7.2 N 100.6 E) and Trang, Thailand (7.52 N 99.62 E). Depending on station location and temporal coverage, mean annual temperature is 27.2-27.4 C and mean annual precipitation is between 1,928 and 2,696 mm.

Revision Notes: Only the documentation for this data set has been modified. The data files have been checked for accuracy and are identical to those originally published in 1998.

Figure 1. Eye-level view of interior of Stand 4 (fully closed tropical rain forest) at Khao Chong Nature Reserve. (Note the dense undergrowth of woody plants, thick stems of woody lianas and a decaying log on the ground. A rattan plant with feather-like leaves is on the left. Photograph taken January 1962 by Dr. K. Yoda, Osaka City University, Japan). Reproduced by kind permission of Prof. Tatuo Kira and Prof. Husato Ogawa.

Additional Documentation:

The NPP data collection contains field measurements of biomass, estimated NPP, and climate data for terrestrial grassland, tropical forest, boreal forest, and tundra sites worldwide. Data were compiled from the published literature for intensively studied and well-documented individual field sites and from a number of previously compiled multi-site, multi-biome data sets of georeferenced NPP estimates. The principal compilation effort (Olson et al., 2001) was sponsored by the NASA Terrestrial Ecology Program. For more information, please visit the NPP web site at http://daac.ornl.gov/NPP/npp_home.html.

Data Citation:

Cite this data set as follows:

Kira, T. 2013. NPP Tropical Forest: Khao Chong, Thailand, 1962-1965, R1. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. doi:10.3334/ORNLDAAC/217

Kira, T. 1998. NPP Tropical Forest: Khao Chong, Thailand, 1962-1965. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Table of Contents:

1. Data Set Overview:

Project: Net Primary Productivity (NPP)

The NPP measurement for a fully closed tropical rainforest in the Khao Chong Nature Reserve is the sum of annual net above- and below-ground woody biomass increase + extrapolated annual litterfall + tree mortality.

This study was conducted under the auspices of the Joint Thai-Japanese Biological Expedition to South-East Asia. The Khao Chong Nature Reserve (7.58 N 99.8 E) is comprised of some 500 ha of well-preserved rainforest on the west slope of the Malay Peninsula's central granitic range in southern Thailand, about 22 km west of the town of Trang. The forest is considered typical of the region, although maximum tree height (36 m) and biodiversity are less than in Malaysian forests, probably owing to the effects of short dry season in winter and of the sandy texture of soil of granitic origin.

Biomass increment within a 40-m x 40-m study area for all trees greater than 4.5-cm DBH (diameter at breast height, 130 cm) was monitored between 1962 to 1965, and daily litterfall was measured for one month in 1962. Allometric relationships for estimating biomass of various components were

checked by destructive harvesting of a plot 10 m x 40 m.

Climate data come from weather stations near the study site. Mean annual temperature is 27.2-27.4 C, and mean annual precipitation is between 1,928 and 2,696 mm, depending on location of weather station and temporal coverage of climatic data. Only three months (January - March) receive less than 100-mm precipitation.

Biomass data are available for stems, branches, roots, and leaves for February 1962, July 1963, and March 1965 and accumulated litter on the forest floor from January 13, 1962 to February 24, 1962. Leaf area index is relatively high at 11.4 m^2/m^2 (or 12.3 m^2/m^2 including ground cover). NPP of the forest was estimated at 2,860 g/m^2/year. This value includes a possible over-estimate of litterfall (2,330 g/m^2/year) plus above-ground woody biomass increment and turnover as mortality combined (489 g/m^2/year) plus below-ground woody biomass increment (41 g/m^2/year) (Kira et al., 1964; 1967). Fine root turnover and grazing were not included in the above estimates.

ANPP, BNPP, and TNPP values reported in Esser (1998), Scurlock and Olson (2012), Olson et al. (2013a, b), and Clark et al. (2001a, 2013) differ from values presented herein due to different calculation methods (Table 1).

Table 1. ANPP, BNPP, and TNPP values reported by various published data sources

File Name or Description	Data Source(s)	Sub-Site	ANPP	BNPP	TNPP
			gC/m^2/year		
khc_npp.txt	Kira et al. (1964, 1967)[1]	khc Stand 4/5	1,410	21	1,430
ods_xls.csv	Esser (1998) based on Kira and Shidei (1967)	750 (Stand 4/5)	1,462	28	1,489
NPP_Multibiome_EnvReview _Table_A1_R1.csv	Scurlock and Olson (2012) based on Kira et al. (1964)	khc (Stand 4/5)	NA	NA	1,125
GPPDI_ClassA_NPP_162_R2.csv	Olson et al. (2013a); Clark et al. (2001a)[2] based on Kira et al. (1964)	Class A 46 (MI 47) (Stand 4/5)	987	691	1,678
EMDI_ClassA_NPP_81_R2.csv	Olson et al. (2013b); Clark et al. (2001a)[2] based on Kira et al. (1964)	Class A 46 (Stand 4/5)	987	691	1,678
Table 1 in Clark et al. (2001a)	Clark et al. (2001a)[2] based on Kira et al. (1964)	Khaochong	990	200-1,180 (av 690)	1,180-2,170 (av 1,675)
tropfornpp.csv	Clark et al. (2013)[3] based on Kira et al. (1967)	Thailand-Khao Chong	1,471	NA	NA

Notes: NA = Not available. MI = Measurement ID number.

 The differences in NPP values reported in this table are mainly due to differences in calculation methods, as explained in these notes. Please consult original references for details.

 Revised data sets (R1, R2, etc) are accompanied by ORNL DAAC Data Set Change Information files. Please see the corresponding documentation for reasons why the data values were revised.

[1]For this table, NPP data from the original data source were converted from grams of dry weight per meter square per year to grams of carbon per meter square per year using a conversion factor of 0.5. NPP was estimated as the sum of annual net increase in above and below-ground biomass + extrapolated annual litterfall + tree mortality.

[2]Clark et al. (2001a) used a different approach to calculate NPP values. ANPP was calculated by summing reported above-ground biomass increment + reported fine litterfall + estimated losses to consumers + estimated VOC emissions. BNPP was calculated by summing 0.2 x estimated ANPP for a low BNPP estimate + 1.2 x estimated ANPP for a high BNPP estimate. TNPP was calculated as the range between the low and high values of ANPP + BNPP. Average BNPP and TNPP estimates were also calculated. See Clark et al. (2001a) for a discussion of calculation methods, including how unmeasured components of ANPP were estimated and the basis for setting bounds on BNPP.

[3]Based on litterfall + branchfall + above-ground biomass increment in Clark et al. (2001b) using a carbon conversion factor of 0.5.

2. Data Description:

Spatial Coverage

Site: Khao Chong, Thailand

Site Boundaries: (All latitude and longitude given in decimal degrees)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Elevation (m)
Khao Chong, Thailand	99.8	99.8	7.58	7.58	NA

Spatial Resolution

The study areas (Stand 4 and 5) were 40-m x 40-m each. Data are the average of the two plots. Clear-felling of trees to determine allometric equations occurred in a 10 m x 40 m sub-plot in Stand 4. Litterfall was collected in a 0.9 m x 12 m sub-plots in both stands.

Temporal Coverage

In January and February of 1962, the census of dbh and height was taken of all trees over 4.5 cm dbh in two sample plots (Stand 4 and 5). Allometric relationships for estimating biomass of various components were checked by destructive harvest of Stand 4 in February 1962. Non-destructive biomass measurements were made in Stand 5 on February 4, 1962, July 21, 1963, and March 30, 1965. Annual increment of the total tree biomass on Stand 5 was calculated from the difference between the estimations.

Litter accumulation was monitored from January 13, 1962 to February 9, 1962 (Stand 4) and February 9 to 24, 1962 (Stand 5). LAI was measured at Stand 4 on February 4, 1962 before clear-felling was completed.

Climate data are available from four time periods: 1956/01/01 through 1961/12/31 (mean); 1981/01/01 through 1990/10/30 (average temperature); 1958/01/01 through 1976/12/31 (precipitation amount); and 1951/01/01 through 1990/12/31 (minimum/maximum temperature; precipitation amount).

Temporal Resolution

Biomass harvest was made once at Stand 4, and biomass increment measurements were made on three occasions at Stand 5. Litterfall was measured daily in Stand 4 and 5. LAI was measured once.

All NPP estimates are based on plant dry matter accumulation, expressed as g/m^2/year (dry matter weight).

Climate data are expressed as monthly and annual precipitation amounts (mm), monthly and annual average temperature (C), and monthly and annual average maximum/minimum temperature (C). Monthly and annual climatic means are provided for the 1951-1990 period (minimum/maximum temperature; precipitation) and 1956-1961 (precipitation).

Data File Information

Table 2. Data files in this data set archive

FILE NAME	TEMPORAL COVERAGE	FILE CONTENTS
khc_npp.txt	1962/02/04-1965/03/30	Above- and below ground biomass, litter accumulation, LAI, and NPP data for a fully closed tropical rainforest at Khao Chong, Thailand
khc1_cli.txt	1956/01/01-1961/12/31	Mean precipitation amount over 6 years from weather station near Khao Chong, Thailand
khc2_cli.txt	1958/01/01-1990/10/30	Monthly and annual climate data from weather station at Trang, Thailand about 22 km from the Khao Chong study site
khc3_cli.txt	1951/01/01-1990/12/31	Mean monthly and annual climate data from weather station at Songkhla, Thailand near the Khao Chong study site

NPP Data

NPP estimates for the Khao Chongsite are provided in one text file (.txt) (Table 1). The variable values are delimited by semicolons. The first 18 lines are metadata; data records begin on line 19. The value -999.9 is used to denote missing values. Biomass and NPP units are in g/m^2 and g/m^2/year (dry matter weight), respectively.

Table 3. Column headings in NPP file

Column Heading	Description	Units
Site	Site where data were gathered (code refers to site identification)	Text
Treatmt	Subsite(s) where data were gathered	Text
Year	Year in which data were collected	Numeric
Month	Month in which data were collected	
Day	Day on which data were collected	
	Parameters measured (see definitions in	

parameter	Table 4)	Text
amount	Data values	Numeric
units	Unit of measure	Text

Table 4. Parameter definitions in NPP file

Parameter	Description	Units	Source
leaves	Leaf biomass[1]		
branches	Branch biomass[1]	g/m^2	Table 1[2]; Table 4[3]
trunks	Trunk biomass[1]		
newrecruits	Biomass of trees newly recruited during period	g/m^2	Table 4[3]
AGtotdead	Biomass of trees which died between sampling periods		
Undstory	Understory biomass	g/m^2	Table 1[2]
Totroots	Root biomass[1]	g/m^2	Table 1[2]; Table 4[3]
leaflitter	Leaf litter accumulation between sampling periods		
branchlitter	Branch litter accumulation between sampling periods	g/m^2	Table 5[3]
otherlitter	Other litter accumulation between sampling periods		
Totlitter	Total litter accumulation between sampling periods		
LAI_trees	Leaf area index of trees > 4.5 cm DBH (live minus dead tree LAI)	m^2/m^2	Table 4[3]
LAI	Leaf area index, including ground vegetation	m^2/m^2	Table 1[2]; Kira et al. (1967)
ANPP	Estimated litter accumulation + above-ground woody biomass increment + mortality		Kira et al. (1967)
BNPP	Estimated below-ground woody biomass increment	g/m^2/year	
NPP	Estimated total net primary production		Sum of above from Kira et al. (1967)

Notes:

[1] 1963 and 1965 data are based on annual rate of biomass increase from the initial 1962 measurement.

[2] Kira et al. (1964). [3] Kira et al. (1967).

Sample NPP Data Record

```
Site; Treatmt; Year; Month; Day; parameter; amount; units

khc; Stand4/5; 1962; 2; 4; leaves; 820; g/m2
khc; Stand4/5; 1963; 7; 21; leaves; 833; g/m2
khc; Stand4/5; 1965; 3; 30; leaves; 859; g/m2
khc; Stand4/5; 1962; 2; 4; branches; 8000; g/m2
khc; Stand4/5; 1963; 7; 21; branches; 8203; g/m2
khc; Stand4/5; 1965; 3; 30; branches; 8544; g/m2
khc; Stand4/5; 1962; 2; 4; trunks; 21600; g/m2
khc; Stand4/5; 1963; 7; 21; trunks; 21080; g/m2
khc; Stand4/5; 1965; 3; 30; trunks; 21913; g/m2 ...
```

Climate Data. The climate data set is a text file (.txt format). The first 18 lines are metadata; data records begin on line 19. The variable values are delimited by semicolons. The value -999.99 is used to denote missing values.

Sample Climate Data Record <khc1_cli.txt>

```
parameter year Jan Feb Mar Apr May June July Aug Sept Oct
Nov Dec Total
prec mean 72.0 34.0 70.0 144.0 259.0 227.0 259.0 302.0 403.0
355.0 325.0 246.0 2696.0
```

Where,
  prec = precipitation for month or year (mm)
  mean = mean over 6 years (1956-1961) reported in table

Sample Climate Data Record <khc2_cli.txt>

parameter year Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec Total/Avg

parameter year Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec Total/Avg
tavg men1 26.7 27.6 28.7 29.0 28.0 27.7 27.2 27.4 27.0 27.1 26.8 26.4 27.4
prec men2 60.1 28.4 48.8 100.1 263.2 246.5 256.7 266.8 343.7 291.9 249.9 119.2 2275.3

tavg 1981 26.10 27.80 28.80 28.80 28.30 28.00 27.30 28.00 27.10 27.30 26.30 25.80 27.5
tavg 1982 26.50 27.30 28.80 28.50 28.10 27.80 26.80 27.30 27.10 27.10 27.30 26.51 27.4
tavg 1983 27.50 28.00 28.80 29.50 28.60 28.00 27.50 27.10 27.10 27.10 26.80 26.30 27.7
tavg 1984 26.10 27.30 28.10 28.30 27.80 26.80 26.80 27.50 27.00 26.80 27.00 26.10 27.1
tavg 1985 26.30 27.80 27.80 28.30 27.60 27.30 26.50 26.80 26.50 26.50 26.30 26.11 27.0
tavg 1986 25.80 27.10 28.50 29.10 27.60 27.60 27.30 27.60 26.50 26.60 26.50 26.61 27.2
tavg 1987 26.60 26.80 29.00 29.80 28.00 28.30 27.80 27.30 27.60 27.60 27.00 26.10 27.7
tavg 1988 27.10 28.80 29.30 29.60 28.10 27.60 27.30 27.50 26.80 27.00 26.10 26.00 27.6
tavg 1989 27.10 26.10 28.00 27.61 27.30 27.10 26.50 26.31 26.51 26.60 28.00 27.82 27.1
tavg 1990 27.80 29.30 29.80 30.00 28.80 28.50 28.00 28.60 27.50 28.10 -999.99 -999.99 -999.9
prec 1958 16.00 1.00 32.00 46.00 328.00 487.00 181.00 290.00 189.00 443.00 267.00 2.00 2282.0
prec 1959 41.00 0.00 82.00 97.00 165.00 101.00 421.00 311.00 264.00 202.00 290.00 147.00 2121.0
prec 1960 12.00 21.00 79.00 95.00 333.00 235.00 287.00 222.00 339.00 168.00 293.00 58.00 2142.0
prec 1961 71.00 90.00 62.00 124.00 220.00 170.00 183.00 230.00 326.00 306.00 168.00 132.00 2082.0
prec 1962 20.00 16.00 54.00 267.00 207.00 144.00 232.00 255.00 527.00 425.00 196.00 146.00 2489.0
prec 1963 35.00 0.00 3.00 3.00 185.00 255.00 145.00 286.00 438.00 369.00 246.00 70.00 2035.0 …

Where,
  prec = precipitation for month or year (mm)
  tavg = average temperature for month or year (C)

  men1 = mean for complete years 1981-1990
  men2 = mean for complete years 1958-1976

Sample Climate Data Record <khc3_cli.txt>

Site;Temp;Parm; Jan; Feb; Mar; Apr; May; Jun; Jul; Aug; Sep; Oct; Nov; Dec; Year

sng;mean;prec; 97.26; 39.29; 40.43; 70.47; 126.00; 100.84; 104.47; 103.21; 130.77; 282.00; 529.41; 428.31;1928.38
sng;mean;tmax; 29.54; 30.52; 31.33; 32.66; 33.17; 32.62; 32.63; 32.70; 32.13; 31.01; 29.77; 29.27; 31.48
sng;mean;tmin; 23.98; 23.86; 24.11; 24.32; 24.29; 24.28; 23.75; 23.82; 23.79; 23.79; 23.65; 23.71; 23.95
sng;numb;prec; 38.00; 36.00; 37.00; 39.00; 40.00; 38.00; 38.00;

39.00; 39.00; 40.00; 37.00; 36.00; 40.00
sng;numb;tmax; 38.00; 38.00; 36.00; 40.00; 40.00; 38.00; 37.00;
39.00; 40.00; 40.00; 37.00; 36.00; 40.00
sng;numb;tmin; 38.00; 38.00; 36.00; 40.00; 40.00; 38.00; 37.00;
39.00; 40.00; 40.00; 37.00; 36.00; 40.00
sng;stdv;prec; 104.38; 39.50; 43.40; 56.06; 61.61; 44.50; 48.92;
59.12; 57.41; 115.48; 232.54; 236.60; 508.53
sng;stdv;tmax; 0.60; 0.59; 0.46; 0.49; 0.38; 0.49; 0.45; 0.50; 0.34;
0.33; 0.48; 0.61; 0.31
sng;stdv;tmin; 0.60; 0.59; 0.46; 0.49; 0.38; 0.49; 0.45; 0.50; 0.34;
0.33; 0.48; 0.61; 0.29
sng;1951;prec; 106.00; 24.00; 9.00; 50.00; 237.00; 20.00; 166.00;
156.00; 157.00; 222.00; 515.00; 617.00;2279.00
sng;1951;tmax; 29.38; 29.73; 31.01; 32.57; 32.94; 32.27; 31.84;
32.44; 31.77; 31.01; 29.76; 29.48; 31.18
sng;1951;tmin; 23.82; 23.07; 23.79; 24.23; 24.06; 23.93; 22.96;
23.56; 23.43; 23.79; 23.64; 23.92; 23.68 …

Where,
Temp (temporal) - specific year or long-term statistic:
 mean = mean based on all years
 numb = number of years
 stdv = standard deviation based on all years
Parm (parameter):
 prec = precipitation for month or year (mm)
 tmax = mean maximum temperature for month or year (C)
 tmin = mean minimum temperature for month or year (C)

3. Data Application and Derivation:

The accumulation of biomass, or NPP, is the net gain of carbon by photosynthesis that remains after plant respiration. While there are many fates for this carbon, this data set accounts for annual net biomass increase + extrapolated annual litterfall + turnover as tree mortality.

This study was undertaken to examine the physiognomy, structure, and productivity of a typical Southeast Asian rainforest.

The tropical forest biomass dynamics data for the Khao Chong site are provided for comparison with models and estimation of NPP. Climate data are provided for use in driving ecosystem/NPP models.

4. Quality Assessment:

Only a very limited number of production estimates for tropical rainforest communities were available at the time of this study. Kira (1967) compares the results for Khao Chong to several estimates of hardwood forest production obtained using more or less similar procedures.

Sources of Error

Information not available.

5. Data Acquisition Materials and Methods:

Site Information

Khao Chong is a well-preserved rainforest located on the west slope of the central granitic range of the Malay Peninsula of Thailand. The structure and physiognomy of the forest are described in detail by Ogawa et al. (1965). Although somewhat inferior to equatorial rainforests of Malaysia in tree size (maximum height of dominants 35-40 m) and in floristic diversity (98 species of trees and woody climbers over 4.5 cm dbh per 0.32 ha), its physiognomic features are quite typical of a tropical rainforest with its multi-layered structure, absence of seasonal aspects, development of plank-buttresses, and abundance of woody lianas. The leaf area index (12.3 m^2/m^2 including ground vegetation) suggests a high level of productivity.

Only trees over 4.5-cm DBH are treated in this data set. The amount of smaller saplings and ground vegetation in the tropical rainforest at Khao Chong is no more than 1-2 % of the total biomass of the community.

In 2000, the Khao Chong Forest Dynamics Plot was initiated under the direction of Sarayudh Bunyavejchewin of the Thai Royal Forest Department and the Smithsonian Tropical Research Institute. The field crew, led by graduates from Kasetsart University, completed the census of the first 16 ha in 2001 and completed the total 24-ha census in 2003. The plot encompasses a valley that extends up the side of steep granite and includes ridge forest dominated by massive trees of *Dipterocarpus costatus*. The field data are not yet available and thus are not included in this data set.

A forest phenology study monitoring ~1,300 mature trees of ~250 species in and around the study plot has been ongoing since 2001. Khao Chong forest phenology appears to coincide with the "general flowering" events that occur to the south of peninsular Malaysia. The field data are not yet available and thus are not included in this data set.

Other recent ongoing studies include a study of seedling recruitment of seven dominant species of *Dipterocarpaceae* in the forest and a study of seasonality of biomass dynamics in the forest.

Figure 2. Fish-eye photograph of canopy of Stand 4 (fully closed tropical rain forest) at Khao Chong Forest Reserve. (The leaf area index of this stand was estimated at 12.3. The large-leaved tree in the center is *Croton* sp. Plao Lintin, one of the most important among understory trees. Photograph taken January 1962 by Dr. K. Yoda, Osaka City University, Japan). Reproduced by kind permission of Prof. Tatuo Kira and Prof. Husato Ogawa.

Increment of Tree Biomass

Allometric relationships for estimating biomass of various components were checked by destructive harvesting of a plot 10 m x 40 m. In an undisturbed stand (Stand 5), all trees larger than 4.5-cm DBH were mapped, numbered, and marked at a height of 130-cm above the ground (breast height) on February 3-4, 1962. DBH of every trunk was measured with a diameter tape. The census was repeated on July 21, 1963 and March 30, 1965 using the same diameter tape. The interval between the first and the second census was 533 days and that between the second and third census was 618 days. Records of dbh increments over a total of 1,151 days (3.15 years) were thus obtained, and enabled the trends in biomass change to be calculated by the method described in Kira (1967). The net increase of biomass in a specified period was largely determined by the balance between growth of living trees and the death of some individuals, since only a few small trees attained 4.5-cm DBH during each period. Herbivory and loss of live roots were not measured.

Litterfall

The amount of litterfall was measured daily in a 0.9 m x 12 m plot from January 13 to February 9, 1962 (Stand 4). Total accumulation of litter in the trap was also recorded from February 9 to 24, 1962 (Stand 5). Litter was separated into leaf, branch, and other minor components (including bark, fruit, flower, etc) and weighed. Annual amount of litterfall was estimated by multiplying the daily average rate by 365.

Climate

Meteorological data are available from weather stations located on-site, in the town of Trang, Thailand (7.52 N 99.62 E, about 22 km from Khao Chong), and at nearby Songkhla, Thailand (7.2 N 100.6 E).

Figure 3. Interior of Stand 4 (fully closed tropical rain forest) at Khao Chong Forest Reserve after clearing of undergrowth (plants under 4.5 cm dbh). (The thickest trunk in the center is *Alstonia spathulata*. Near the right side of the picture is a buttressed *Ficus*. Two large stems to the left are *Eugenia clarkeana* [right] and *Harpullia cupanoides* [left]. Photograph taken 13th January 1962 by Dr. K. Yoda, Osaka City University, Japan). Reproduced by kind permission of Prof. Tatuo Kira and Prof. Husato Ogawa.

Figure 4. Profile of Stand 4 (fully closed tropical rain forest) at Khao Chong Forest Reserve, exposed on one side of the clear-felled plot, 10 m x 40 m. (The tallest tree in the center is *Alstonia spathulata*, 35.5 m in height. Photograph taken 25th January 1962 by Dr. K. Yoda, Osaka City University, Japan). Reproduced by kind permission of Prof. Tatuo Kira and Prof. Husato Ogawa.

6. Data Access:

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

Data Archive Center:

Contact for Data Center Access Information:
E-mail: uso@daac.ornl.gov
Telephone: +1 (865) 241-3952

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