

## Parah Forest Clusters at Khao Nan National Park, Thailand

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### Abstract

Parah (*Elateriospermum tapos* Blume) is a native species of southern Thailand. There are few studies of Parah clusters at Khao Nan National Park, Nakhon Si Thammarat, but no investigation of the locations and boundaries of this species has been undertaken. This study is the first attempt to use open standard Geographic Information Systems (GIS) to investigate Parah forest clusters. Park rangers used a Global Positioning System (GPS) device, a Garmin 76CSx, to survey Parah cluster boundaries during May - June 2011. The coordinates of the Parah boundary were analysed in MapSource and overlaid on a Google Earth map. The area of Parah clusters was then estimated. There are five main clusters of Parah forests at Khao Nan National Park: (1) Ban Na Phra Chao, (2) Ban Tub Namtao, (3) Ban Hok Phu, (4) Namtok Hin Toh site 1 and (5) Namtok Hin Toh site 2. The Parah cluster at Ban Tub Namtao was the largest Parah cluster with a total area of 410.08 hectares. The total area of the five main Parah forests was 810.24 hectares. The size distribution of Parah trees and its density was varied among Parah clusters.

**Keywords:** Cluster, Parah, Khao Nan National Park, GIS, GPS

### Introduction

Since the inception of the Global Positioning System (GPS) in 1995, the integration of GPS and Geographic Information Systems (GIS) technology has expanded to a great number of ecological and conservation applications [1]. In the tropics, the mapping of individual trees is beginning to yield great insight into patterns of recruitment limitation, seed dispersal and tree diversity [2-5]. Forest plotting and the measurement of species diversity are thus important components of forest conservation and management [6].

Classic methods of ground-based mapping frequently involve triangulation from a known point, which in a rain forest may involve extensive labour without being outstandingly accurate. Distance accuracy using reconnaissance-type mapping is at best only 1 part in 80 (4.5°) with a hand-held compass, and 1 part in 300 (1.2°) with a staff-held forester's compass [7]. These techniques have served tropical ecology well, but mapping

accuracy and efficiency can be greatly improved today by utilising GPS and GIS technologies [2]. It is possible to fix the coordinates of the forest boundary points, which are found by the combined activities of GIS and GPS, and to transfer this information to computers and to map them without applying classical measurement activities. GPS has the ability to determine and measure the coordinate values of a specific point fixed by the survey machine on earth and the one in space. The transfer of these data to GIS software makes it possible to write the accurate coordinate values on numerical maps [8].

The harvest of wild non-timber forest products represents an important source of income to millions of people worldwide. Parah forest at Khao Nan National Park serves both direct and indirect non-timber benefits to the local communities [9]. For direct non-timber benefits, local people collect a variety of forest products

from Parah forest such as Parah seed, Stink bean (*Parkia speciosa* Hassk), Jiringa (*Archidendron jiringa* Nielsen), *Parkia javanica* Merr., honey etc. Most of these products can be harvested throughout the year, except Parah seeds which are available only in fruiting season during August to October. Local people collected a total of 60,132 kg Parah seeds (with an average of 293.33 kg per household) from 205 households [9]. In addition, Parah forest plays an important role in tourism. Parah trees show strong leaf shedding and bud burst. Young leaves are pinkish red in colour during February-March that makes the Parah forest one of the main tourist attraction sites in the area.

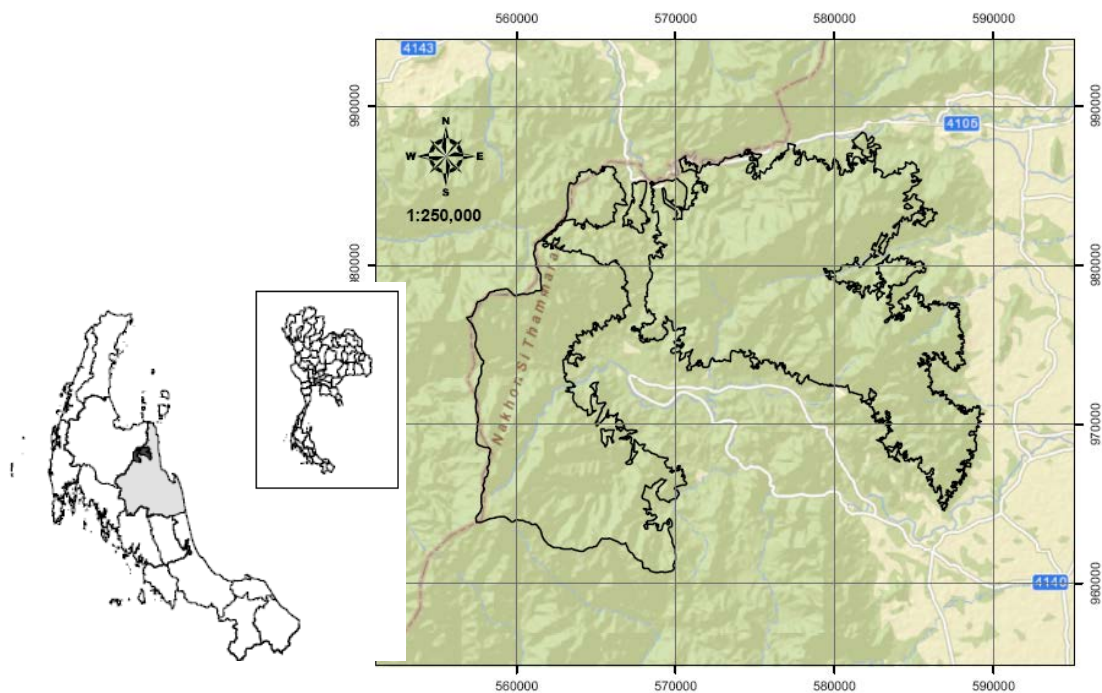
As an indirect non-timber benefits, Parah forest has a function in the ecosystem in many ways such as being a main watershed, sources of nutrition for animals, ecosystem balance, energy transfer, and nutrients current. Due to high human disturbance in the Parah forest in some areas, the forest degradation, food source depletion, decreases in the sapling recruitment and waste

management occurs. This study aims to determine the location, boundary and areas of Parah clusters at Khao Nan National Park. The collected data will provide baseline information for future studies and research of the Parah forest.

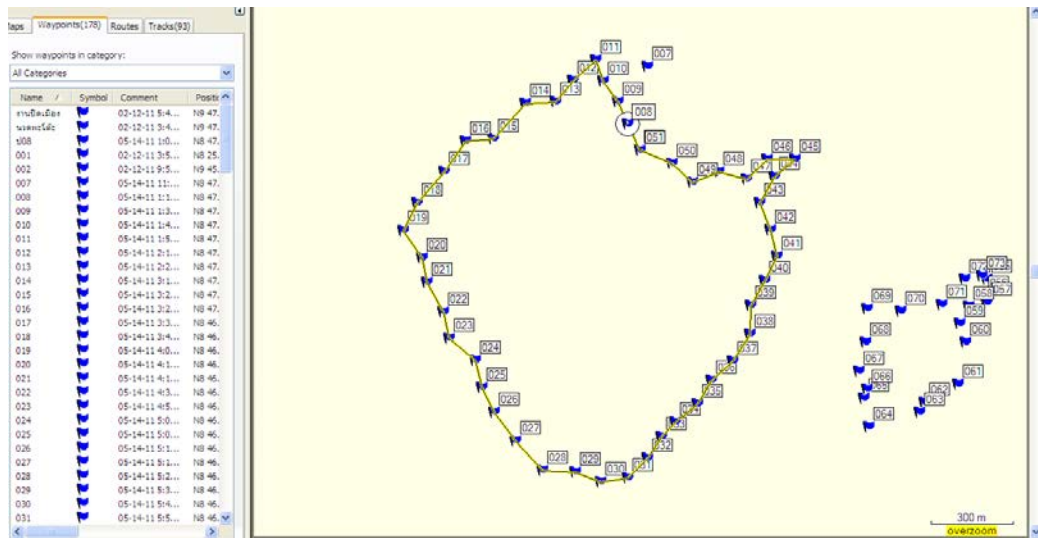
## Materials and methods

### Parah biology

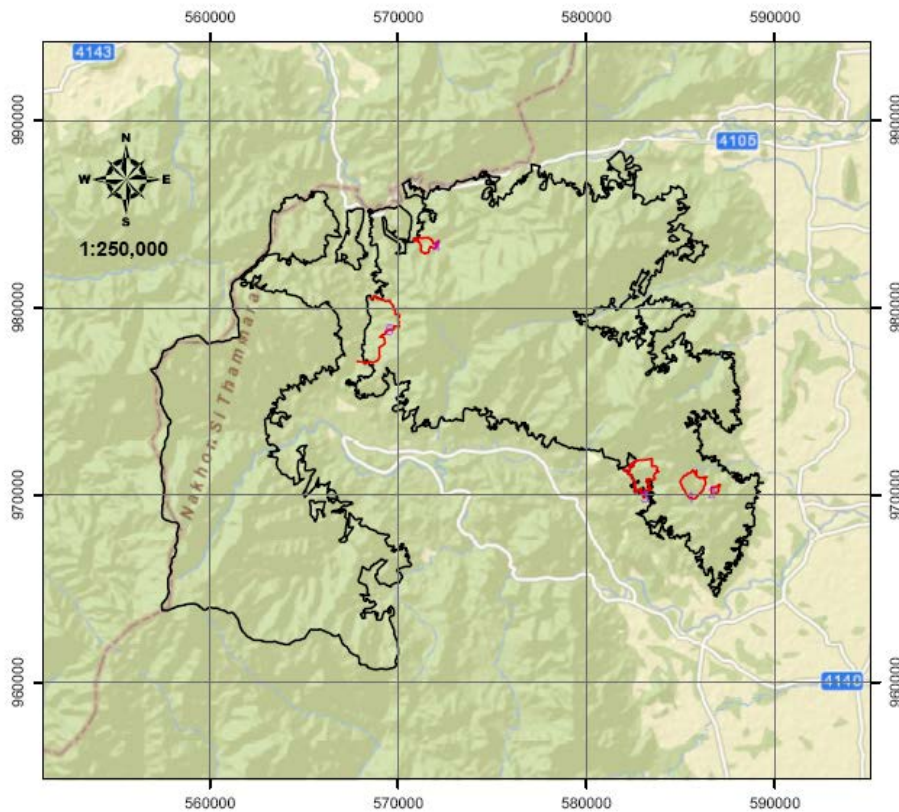
Parah (*Elateriospermum topos* Blume (Family Euphorbiaceae) is the only species of the homotypic genus native to peninsular Malaysia, Thailand, Borneo and Sumatra. Parah trees are found at Jengka national forest in Malaysia [10], Belalong forest in Brunei [11] and Khao Nan National Park in Thailand [12] (**Figure 1**). Parah trees at Khao Nan National Park tend to cluster densely in some areas. They are found in the hilly primary (mixed dipterocarp) and secondary forest with deep yellow-coloured soil, mainly clay, clay-loam, sandy clay, loam, sometimes sandstone or (silty) laterite at an altitude of 600 m a.s.l. [13].



**Figure 1** Khao Nan National Park location and boundary.



**Figure 2** The MapSource program estimating the Parah cluster boundary and area.



**Figure 3** Locations of five main Parah clusters at Khao Nan National Park. Black and red lines represent national park boundary and five main Parah clusters, respectively.

### Data collection

Data on the location, boundary, and area of Parah clusters at Khao Nan National Park were collected. Ten park rangers recorded the latitude, longitude, and altitude of the Parah boundary at Khao Nan National Park using a Garmin 76CSx (accuracy  $\pm 3$  m) during May-June 2011. The data were then downloaded and overlaid on the Google Earth map.

### Size distribution and density

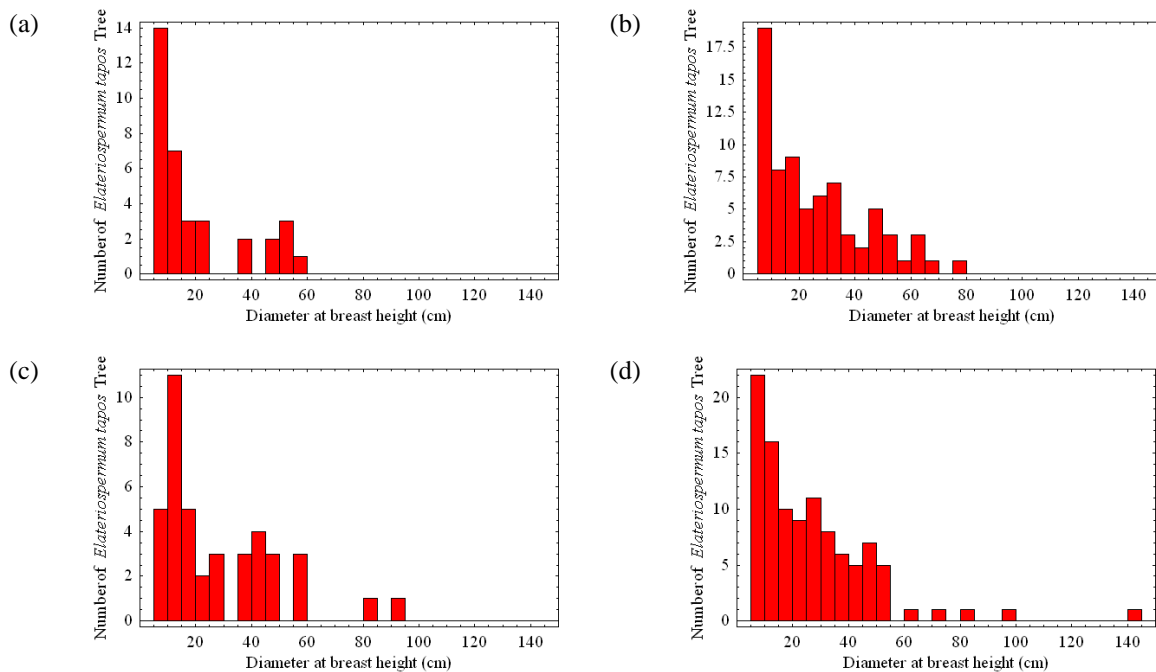
Namtok Hin Toh sites 1&2 had very small areas, we grouped them as one site for the size distribution and density study. We set five 20 $\times$ 20 m<sup>2</sup> plots in each Parah cluster with a total of 20 plots: Namtok Hin Toh sites 1&2, Ban Na Phra Chao, Ban Hok Phu and Ban Tub Namtao. We counted and measured all Parah tree DBH that had a DBH size greater than 1.5 cm within plots.

### Data analysis

We estimated the area of Parah clusters by using the GIS software, MapSource® Version 6.12.4 developed by Garmin Ltd. Latitude and longitude data of the Parah cluster boundaries were analysed in MapSource using the “Distance/Bearing” tool on the toolbar to plot the Parah cluster map [14] (**Figure 2**).

### Results

There are five main clusters of Parah forests at Khao Nan National Park: (1) Ban Na Phra Chao, (2) Ban Tub Namtao, (3) Ban Hok Phu, (4) Namtok Hin Toh site 1, and (5) Namtok Hin Toh site 2 (**Table 1, Figure 3**). Ban Tub Namtao is the largest Parah cluster with a total area of 410.08 hectares (**Table 1**). The total area of the five main Parah forests is 810.24 hectares (**Table 1**).



**Figure 4** Size distribution (DBH) of Parah trees in four Parah clusters. (a) Namtok Hin Toh sites 1&2, (b) Ban Na Phra Chao, (c) Ban Hok Phu and (d) Ban Tub Namtao.

**Table 1** Parah cluster locations and areas at Khao Nan National Park.

Parah Cluster	Latitude (UTM-X)	Longitude (UTM-Y)	Altitude (m)	Area (hectare)	Density (trees/hectare)
Namtok Hin Toh site 1	586984-587476	969708-970259	280-497	10.08	168.75
Namtok Hin Toh site 2	585299-586753	969498-971033	308-660	130.08	
Ban Na Phra Chao	571140-572517	982554-983449	175-358	60.00	370.00
Ban Hok Phu	582553-584193	969537-971618	184-536	200.00	256.25
Ban Tub Namtao	568402-570416	976710-980313	228-455	410.08	254.55
<b>Total</b>				810.24	262.39

Size distribution (DBH) of Parah trees in four Parah clusters are shown in **Figure 4**. Parah tree DBH varied among Parah clusters: Namtok Hin Toh sites 1&2 ( $\bar{x} \pm SD = 18.3 \pm 16.2$  cm), Ban Na Phra Chao was ( $\bar{x} \pm SD = 25.5 \pm 18.1$  cm), Ban Hok Phu was ( $\bar{x} \pm SD = 28.8 \pm 21.0$  cm) and Ban Tub Namtao ( $\bar{x} \pm SD = 25.0 \pm 21.2$  cm). The largest Parah tree was found at Ban Tub Namtao with a DBH of 142.92 cm.

### Discussion

Our results showed that Parah density differed among Parah clusters. Ban Na Phra Chao had the highest density of Parah trees. This site has the least human disturbance due to no road access to the site. There are many small Parah forest clusters each with an area of less than ten hectares that we did not include in this study. The Ban Hok Phu Parah cluster exhibits a high level of human disturbance and Parah forest degradation. Our results showed that Ban Hok Phu Parah cluster had low seedling recruitment. The average DBH size of Parah trees at Ban Hok Phu was highest due to the lower seedling recruitment. Local villagers tend to set forest fires during the seed harvesting season which usually occurs yearly in August-October.

The results of this study provide baseline information on the Parah forest boundary which would help us gain a better understanding of how the Parah cluster areas increase or decrease over the years so that a conservation program can be deployed where it is needed.

### Conclusions

Utilising GPS and GIS technologies can be greatly applied for forest ecology by improving

mapping accuracy and efficiency. We concluded that there were five clusters of Parah forest at Khao Nan National Park. Namtok Hin Toh site 1 cluster at had very low density. There was less new seedlings at Ban Hok Phu site.

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