



# บทคัดย่อชุดโครงการ

# ป่าเมฆ – เขาน้ำ



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## Liverwort diversity at the Summit of Khao Nan, Khao Nan National Park, Nakhon Si Thammarat Province

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The summit of Khao Nan of Khao Nan National Park in Nakhon Si Thammarat Province of Thailand is situated *ca.* 1,438 meters above mean sea level. The vegetation at the peak is classified as cloud forest because it is covered with mist nearly all year round, and is thus suitable as bryophyte habitat. Thus far, few studies have been taken to study bryophyte diversity in the cloud forests of Thailand. Therefore, the diversity of liverworts at the summit of Khao Nan was investigated from January 2006 to June 2007. Exploration and field collection of liverworts were carried out at elevations ranging from 1,000 to 1,438 m. In total, 539 specimens were enumerated comprising 71 species in 28 genera in 14 families. With respect to their habitats, it was found that they are epiphytic, terrestrial, and lithophytic. Among 14 families, ten families, *viz.* Aneuraceae, Frullaniaceae, Geocalycaceae, Jungermanniaceae, Lejeuneaceae, Lepidoziaceae, Plagiochilaceae, Radulaceae, Schistochilaceae and Trichocoleaceae, were represented at this summit by 2 or more species. In terms of species richness, the family Lejeuneaceae was the richest represented by 15 species in 9 genera, including *Chilolejeunea* (1), *Cololejeunea* (1), *Colura* (1), *Drepanolejeunea* (4), *Leptolejeunea* (1), *Lopholejeunea* (2), *Metalejeunea* (1), *Spruceanthus* (1) and *Thysananthus* (3). Moreover, of all liverwort species found, those which had the highest relative abundance were members of *Bazzania* found at elevations from 1,000 m to the summit of Khao Nan.

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## Pteridophyte diversity in tropical lowland rainforest of Khao Nan National Park, Nakhon Si Thammarat Province, Thailand

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An enumeration of the pteridophytes in tropical lowland rainforest of Khao Nan National Park, Nakhon Si Thammarat Province, is presented. This is the first report for the area. The site is composed of tropical lowland rain forest located in southern Thailand. A total of 418 specimens were collected. They were classified into 27 families, 67 genera, 204 species, 1 subspecies and 7 varieties. Selaginellaceae had the highest number of species among fern allies, i.e. 10. Three families of ferns, namely Polypodiaceae, Dryopteridaceae, and Aspleniaceae, were among the common families, while 25 species of Polypodiaceae, 20 species of Dryopteridaceae and 16 species of Aspleniaceae were encountered. According to habitat types, the specimens can be classified into 4 groups: terrestrial plants (116 species), epiphytes (27 species), lithophytes (80 species), and aquatic plants (1 species). It was found that 2 species are new records for Thailand, i.e. *Huperzia carinata* (Desv. ex Poir.) Trevis. var. *laxum* (C. Presl) Christ and *Selaginella commutata* Alderw. Among the 205 taxa, 5 species, i.e. *Cephalomanes* sp., *Cyathea* sp., *Hymenophyllum* sp., *Nephrolepis* sp., and *Tectaria* sp. could not be determined due to the lack of fertile structures. There were nine other species apparently requiring further observations and investigation to determine their correct status, either as new species to science or new records for Thailand. These include two species each of the genera *Adiantum*, *Asplenium* and *Nephrolepis* and a species each of *Oleandra*, *Dryopteris* and *Vittaria*.

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## Wild orchid species and their distributions at Khao Nan National Park

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This study examined species diversity and abundance of wild orchids along five nature trails in Khao Nan National Park, Nakhon Si Thammarat. The five nature trails were Bua Chak Yai, Parah forest, Thaton-Yodnum, Sanyen, and Thaton-1400 m Peak. We found 26 genera of wild orchids with 36 species. When we separated wild orchids based on habitat types, we found that 18 species of wild orchids grew on trees, ten wild orchid species grew on soil, two wild orchid species grew on rocks, two wild orchid species grew on both trees and rocks and one wild orchid species grew on a limestone mountain. When we compared the number of wild orchid species and abundance among nature trails at Khao Nan National Park, we found the highest number of wild orchid species and highest abundance at Sanyen Nature trail. We found a total of 36 wild orchid species with a total of 552 wild orchid individuals.

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## The diversity of orchids at low altitude in Khao Nan National Park, Nakhon Si Thammarat Province, Thailand

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Field exploration and data collection of natural orchids was conducted at 60-600 m above mean sea level at Khao Nan National Park, during March 2006 to January 2007. A total of 167 specimens of orchids were collected from this focal site. All specimens were identified and kept in the Kasin Suvatabhandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University. They were classified into 5 subfamilies, 51 genera, and 103 species. There were 97 species of Epidendroideae, which was the most common subfamily. In the less common subfamilies, 3 species of Orchidoideae, 1 species of Apostasioideae, 1 species of Cyripidioidae and 1 species of Vanilloideae were found. The most common genus, *Dendrobium*, had the highest number of species among orchid genera, i.e. 24. According to habitat type, specimens could be classified into 3 groups: terrestrial orchids (13 species including 3 saprophytes), epiphytes (79 species), and lithophytes (5 species). Moreover, 6 species of orchids were found in more than one habitat. Two species were found to be newly recorded species for Thailand, i.e. *Dendrobium lobatum* (Bl.) Miq. and *Oberonia semifimbriata* J.J.Sm. It is important to note that these newly recorded species were found only once and in rather small numbers. They could thus be considered as threatened species which, without good protection, might easily disappear from the area. There were 28 undetermined species; they apparently require further observations and investigation to determine their correct statuses. They were classified into the genera, *Dendrobium*, *Bulbophyllum*, *Ceratostylis*, *Coelogyne*, *Eria*, *Flickingeria*, *Thrixspermum*, *Aerides*, *Agrostophyllum*, *Kingidium*, *Liparis* and *Micropera*. The most difficult to determine species belonged to the genus *Dendrobium* (10 species).

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## Ecology and distribution of Zingiberaceae at Khao Nan National Park

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Research on the ecology, habitat and distribution of Zingiberaceae was conducted at seven park ranger stations in Khao Nan National Park during January to June 2007. Ecological data, i.e. abundance and distribution, were recorded every 3 months. Ninety-four individuals were found. One third of the gingers grew in an area that had 60% or more canopy cover. On the other hand, there were four species growing in full sunlight. All gingers increased in the number of leafy shoots in June due to an increase in the amount of rainfall. Ginger densities ranged from 1 to 46 leafy shoots/m<sup>2</sup>. We found the areas covered with gingers ranged from 0.1 to 100 m<sup>2</sup> depending on their habit. *Zingiber newmanii* I. Theilade & J. Mood had the highest density and was found at Klong Kan station. Inflorescences of favorite edible gingers, i.e., *Etilingera fulgens* (Ridl.) C. K. Lim and *Curcuma longa* L., were difficult to find because villagers collected the inflorescences or rhizomes before we could find them. The natural resources conservation plan at Khao Nan National Park still has the problem that implementers do not know the critical number of ginger species in order to conserve them.

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## Zingiberaceae diversity in Khao Nan and Khao Luang National Parks

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Zingiberaceae diversity in Khao Nan and Khao Luang National Parks was investigated from September 2006 to April 2007. Twenty-six species in 10 genera of the family Zingiberaceae were collected from nine stations at the study sites, less than 30% of the gingers recorded for southern Thailand. The Tribe Alpinieae was the largest tribe with 5 genera and 14 species. The Tribe Zingibereae was second with 4 genera and 10 species. The Tribe Globbeae included only 2 species in the genus *Globba*. Most gingers in this study grow in Tropical Evergreen Rain Forest. Only one species, *Amomum aculeatum*, grows in Lower Montane Rain Forest and Cloud Forest at 450-1,000 m in altitude, and *Globba leucantha* is the only species that grows in Lower Montane Rain Forest. Most soils in the study site were composed of sand from sandy-rock erosion. Therefore, at least 20 species grow in sandy type soil (Sandy Clay, Sandy Loam and Sandy Clay Loam). There were fewer species and a lower abundance of gingers in the interior part of the forest where they were found to be sparsely distributed. The highest diversity of species occurred at altitudes 90-300 m and decreased as altitude increased. At least 6 species of gingers observed in Khao Nan National Park can be found in the northern part of Khao Luang National Park, e.g., *Zingiber newmanii*, distributed around the Klong Klai Basin. At least 8 species are potential ornamental plants. A few species, in particular the seed of *Zingiber newmanii*, *Etilingera fulgens* and *Etilingera elatior*, may prove to be important resources for medicinal essential oils, and 7 species are edible.

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## Climate factors affecting parah (*Elateriospermum tapos*) phenology

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Leaf and flower phenology was studied in individuals of a canopy species, *Elateriospermum tapos* (Euphorbiaceae), at Khao Nan National Park. Parah trees had a mean  $\pm$  SD DAB of  $226.87 \pm 91.68$  cm, DBH of  $138.00 \pm 46.13$  cm, and tree height of  $31.03 \pm 9.41$  m. Bud burst occurred from 13th February to 24th March with a bud burst duration of 40 days. The number of bud bursts was  $2.25 \pm 2.97$  branches/day. The maximum bud burst/day occurred on 1 March 2007 with a total of 17 branches. Flower burst occurred from 15th February to 30th March with a flower burst duration of 44 days. The number of flower bursts was  $2.05 \pm 2.81$  branches/day. The maximum flower burst/day occurred on 8 March 2007 with a total of 12 branches. Parah forest during November 2006 to June 2007 had an average temperature of  $24.0 \pm 3.14$  °C, average % relative humidity of  $90.8 \pm 10.61$  %, and average daily rainfall of  $42.10 \pm 100.06$  mm.

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## Species diversity of *Ficus* L. (Moraceae) in Khao Nan National Park, Nakhon Si Thammarat Province

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The species diversity of fig species in Khao Nan National Park was thoroughly studied with the aims to reveal native species richness and local utilization. Transect lines were set up in the park and its neighboring areas; the total line length stretching over more than 40 km. Eight surveys were conducted to collect data and specimens. Specific identification followed largely the monumental works of Berg (2003a, 2003b, 2003c, 2003d, 2004), Berg and Corner (2005), Corner (1965), King (1887, 1888) and Ridley (1924) and collected materials were also compared to labeled materials kept in many herbaria. Plant-utilization data were compiled by directly interviewing local people. From the results, as much as 50 *Ficus* species were found. They were divided into 6 subgenera: *Urostigma* with 19 species; *Pharmacosycea* with 4 species; *Sycomorus* with 11 species; *Synoecia* with 6 species; *Sycidium* with 6 species and *Ficus* with 4 species. Ten fig species were found to have beneficial roles to local natives as food, and two species were well-known for consumption, i.e., *Ficus fistulosa* Reinw. ex Blume and *Ficus obpyramidata* King. Information obtained from this study can be used as baseline data for the study of the flora of Thailand, and should be of prime interest to other scientists who wish to know more about the taxonomy of fig trees. Some can be developed as food and products for business.

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**Species, abundance, feeding location, and feeding time of frugivores on dye fig (*Ficus tinctoria* forst.f. subsp. *gibbosa* (Blume) Corner) at Khao Nan National Park**

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This study examined species, abundance, feeding location, and feeding time of frugivores on dye figs at Khao Nan National Park. There were two groups of frugivores feeding on fig fruits: birds and mammals. We found 17 species of bird and 1 squirrel. Each bird species fed on fig fruits differently. The top three frugivorous birds were *Dicaeum melanoxanthu* 14 individuals, *D. trigonostig* 13 individuals, and *Plycnonotus blanfordi* 13 individuals. Frugivores fed mostly in the middle of the tree. We observed from 12.00-16.00 hr with a total of 4 hrs. We found that the frugivores fed on figs differently and mostly fed between 13.00-14.00 hr. There were differences between bird species feeding locations and interactions between bird species and feeding location.

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## Monitoring the status of some large beetles by light trap at Khao Nan National Park

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This study examined species diversity and abundance of large beetles at Khao Nan National Park. There were 6 species in the 3 families, Scarabaeidae, Carabidae and Lucanidae. The protected insect, *Prosopocoilus giraffe*, in the family Lucanidae was found in high abundance at 0.0136 individuals/spot sample. A new record for Thailand was the violin beetle, *Mormolyce castelnaudi*, which was found to visit our light trap at Khao Nan Headquarters in March 2007. However, we found the highest beetle species richness in March, with four species.

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## Diversity of butterfly fauna in Khao Nan National Park, Nakhon Si Thammarat Province

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A study on the biodiversity of the butterfly fauna in Khao Nan National Park, Nakhon Si Thammarat Province, was conducted in order to gain preliminary knowledge on the species diversity, local distributions, abundance statuses and some relevant ecological data up to the hilly regions, emphasizing the cloud forest sub-ecosystem, including those affected by selected survey lines of 1,000 m long and 10 m wide. Surveys were conducted between 8 a.m. to 5 p.m. and line trapping occurred at 6 points each along the same survey lines. Species identification was done by using keys for identifying butterfly species of the Malay Peninsula, in particular, and of Thailand, in general, together with comparison with labeled specimens deposited in many insect collections. A total of 304 species were found in 5 families: Papilionidae (31 species), Pieridae (25 species), Nymphalidae (120 species), Lycaenidae (76 species) and Hesperidae (52 species). The majority are southern subspecies of the known Thai fauna. Rare and uncommon species that were found were *Atrophaneura sycoryx*, *Losaria neptunus*, *Idealynceus*, *Neorina lowii*, *Polyura hebe*, *Cganlriodes libana*, *Poritia karenina*, *Choaspes subcaudatus*, *Odina hieroglyphica* and *Odontoptilum pygela*. Three protected species that were found were *Troides helena*, *Troides amphrysus* and *Papilio palinurus*.

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## Diversity of Olethreutinae (Lepidoptera: Tortricidae) in Khao Nan National Park, Nakhon Si Thammarat Province

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This biodiversity study of the Olethreutinae (Lepidoptera: Tortricidae) was based on a survey of species in Khao Nan National Park, Nakhon Si Thammarat. Collections were made at various sites in evergreen forest. More than 470 specimens of Olethreutinae were collected with blacklight and mercury vapor light on 70 nights during May 2006-April 2007. The survey resulted in the collection of 174 morphotypes divided into 7 tribes, namely Microcorsini, Gatesclarkeani, Bactrini, Olethreutini, Enarmoniini, Eucosmini, and Grapholitini. Of these, 27 species in 22 genera were identified and 3 species are new records for the park and for Thailand. The survey also included 60 morphotypes that could be identified to 25 genera, but not to species level and 97 morphotypes are unidentified. One olethreutine species will be published as a new species of the genus *Fibuloides* Kuznetsov, namely *Fibuloides khaonanensis*, in reference to the name of Khao Nan National Park.

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## Monitoring the status of macro-moths by light traps at Khao Nan National Park

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This study investigated species diversity of macro-moths, and their abundances at Khao Nan National Park by light traps from January to April 2007. We found 11 species of macro-moth in four families: Uraniidae, Saturniidae, Eupterotidae and Spingidae. One species of Thai Protected insect, *Actias maenas*, and the export-import prohibited insect, *Lyssa zampa*, were found. *Lyssa zampa* in the family Uraniidae had the highest abundance of 0.0136 individuals/spot sample. We found the highest macro-moth species richness in March, with nine species.

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## Ants at Khao Nan National Park, Nakhon Si Thammarat Province

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The diversity of ants was investigated by 5 sampling methods, Hand collection(HC), Honey bait (HB), Leaf litter sifting (LL), Pitfall traps (PT) and Winkler bags (WB), at 3 study sites (Bua Chak Yai, Sunantha trial and Pra forest) in Khao Nan National Park. At each study site, 3 permanent plots of 30X30 m were established, giving a total of 9 permanent plots. Ant sampling was conducted bimonthly during March 2005-March 2006. A total of 250 species belonging to 49 genera in 10 subfamilies, namely Formicinae, Myrmicinae, Ponerinae, Dolichoderinae, Cerapachyinae, Pseudomyrmecinae, Aenictinae, Amblyoponinae, Ectatomminae and Dorylinae, were collected. The subfamily Myrmicinae had the highest number of species. The dominant genera in this study were *Pheidole*, *Tetramorium*, *Pachycondyla*, *Polyrhachis* and *Camponotus*.

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## **Species composition of canopy ants (Hymenoptera: Formicidae) in tropical rainforest at Khao Nan National Park, Nakhon Si Thammarat Province**

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The species composition of canopy ants was investigated in tropical rainforest at Khao Nan National Park (KNNP), Nakhon Si Thammarat Province, Southern Thailand. The insecticide fogging method was applied to collect canopy ants, bimonthly during May 2006 to March 2007 at two study sites: evergreen forest and briefly deciduous forest (*Elateriospermum tapos* Blume). Each study site consisted of three permanent plots of 30m x 30m. A total of 36 trees was randomly selected. The results showed 7 subfamilies, 37 genera and 213 morphospecies identified from 16,585 individuals. The Subfamily Myrmicinae (87 species) was the most dominant group followed by Formicinae (86 species), Dolichoderinae (25 species), Pseudomyrmicinae (6 species), Ponerinae (5 species), Anictinae (2 species), and Cerapachyinae (2 species). The top four genera were *Crematogaster* (39 species), *Camponotus* (39 species), *Polyrhachis* (37 species) and *Pheidole* (13 species). The canopy dwelling species with the greatest abundances of individuals were *Dolichoderus thoracicus* Smith (3123), followed by *Oecophylla smaragdina* Fabricius (1806), *Dolichoderus* sp.4 (1098), *Dolichoderus* sp.5 (1065), and *Crematogaster (Paracrema)* sp.2 (1019).

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## Diversity of terrestrial ant communities at Khao Nan National Park, Nakhon Si Thammarat Province

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A study on the diversity of terrestrial ant communities at two study sites (Pra Forest and the Headquarters of Khao Nan National Park) at Khao Nan National Park was carried out bimonthly during January 2006 to January 2007. Five sampling methods were applied to collect ants: a hand collecting method (HC), leaf litter sifting (LS), Winkler extraction samples or Winkler's bags (WB), honey baits (HB) and pitfall traps (PT). Ten subfamilies, 50 genera and 235 species were identified. Myrmicinae, Formicinae and Ponrinae were dominant at the subfamily level. Large numbers of species were found in the genera *Pheidole*, *Camponotus*, *Pachycondyla* and *Tetramorium*. In this study, it was also shown that *Camponotus festinus*, *Camponotus rufifermus*, *Echinopla* sp. 2, and *Gnamptogenys menadensis* were dominant species in Pra forest while *Anoplolepis* sp.1, *Pheidole* sp. 12 and *Tetramorium cutalum* were dominant at the Headquarters of Khao Nan National Park.

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## Habitat characteristics and feeding behavior of the Sumatran tiger barb at Nhanchongfa Waterfall, Khao Nan National Park, Nakhon Si Thammarat Province

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This study aims at studying the habitat characteristics and feeding behavior of the Sumatran tiger barb (*Puntius partipentazona* (Fowler, 1934)) at Nhanchongfa Waterfall, Khao Nan National Park, Thailand. There were 42 Sumatran tiger barbs collected with 20 males and 22 females. Males were 4.00 cm in standard length, 4.69 cm in total length and 1.93g in total body weight. Females were 4.11 cm in standard length, 5.09 cm in total length and 2.35 g in total body weight. The Sumatran tiger barb is a small-sized fish with a compressed form, terminal mouth, villiform teeth, cycloid scales, and a forked tail. Body colour was yellow interrupted by four wide black stripes, the bottom portion of the dorsal fin was black, the upper portion of the dorsal trimmed was red, the upper and lower lobes of the tail and ventral fins were red, and the snout was red. The bladder had a J-shape and inside the bladder was found small insects. The body length to bowel length ratio was 2:1. The water temperature ranged from 28 – 29 C°. Acid - alkalinity ranged from 6.90 – 7.36 mg/l. Dissolved oxygen ranged from 4.31 – 4.34 mg/l.

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## Discrimination of *Tor tambroides* populations at waterfalls at Khao Nan National Park, Nakhon Si Thammarat Province

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We classified the number of *Tor tambroides* populations at three waterfalls (i.e. Sunanta, Nan Chong Fa and Wang Muang waterfalls) at Khao Nan National Park, Nakhon Si Thammarat Province, by using multivariate analysis and stepwise discriminant analysis. A total of 116 specimens of *Tor tambroides* was collected during July-August 2006 from three waterfalls. Each individual was measured using seven morphometric variables and 21 Truss variables. Multivariate analysis and stepwise discriminant analysis showed significant differences among the three waterfall populations.

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**Amphibians and reptiles of Khao Nan National Park,  
Nakhon Si Thammarat Province: species list, with  
natural history notes, and discussion of the diversity at  
the Upper Khao Luang Range**

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A herpetofauna survey was carried out in Khao Nan National Park, northern Nakhon Si Thammarat, Thailand, between April 2006 and May 2007, and documented 67 species of reptiles and 31 species of amphibians. Records of interesting species for this area include *Ansonia* sp., *Ingerana* sp., *Limnonectes* sp., *Larutia* sp., *Ramphotylops* sp. and *Pareas* sp. We herewith provide notes on the natural histories of some amphibians and reptiles in this study.

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## Installing tags along nature trails at Khao Nan National Park, Nakhon Si Thammarat

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This study involved tag installation along five nature trails at Khao Nan National Park, Nakhon Si Thammarat. These five nature trails comprised (1) Klongkai-Sanyen with a total distance of 34 km, (2) Hui Lek- Parah forest with a total distance of 12 km, (3) Buachek-Sunanta Peak with a total distance of 13 km, (4) Thaton-Yodnum with a total distance of 20 km and (5) Thaton-1400 m Peak with a total distance of 32 km. Once we installed all tags along each nature trail, we sent these data to the NBIDS-BRT database. This kind of information will be useful for park rangers, tourists, and researchers. Most of the time, researchers have some problem with finding coordinates or elevations of their study sites due to some GPS units not being able to be used in dense vegetation, especially in dense tropical rainforest canopy.

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## Assessing habitat-suitability models with a virtual species at Khao Nan National Park, Thailand

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This study investigated the use of a habitat-suitability assessment method, namely Ecological Niche Factor Analysis (ENFA). A virtual species was created and then dispatched in a geographic information system model of a real landscape in three historic scenarios: (1) spreading, (2) equilibrium, and (3) overabundance. In each scenario, the virtual species was sampled and these simulated data sets were used as inputs for the ENFA to reconstruct the habitat suitability model. The 'equilibrium' scenario gives the highest quantity and quality among the three scenarios. ENFA was sensitive to the distribution scenarios but not sensitive to sample sizes. The use of a virtual species proved to be a very efficient method, allowing one to fully control the quality of the input data as well as to accurately evaluate the predictive power of the analyses.

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## Network of Biodiversity Database System (NBIDS-BRT)

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A Network of Biodiversity Database System (NBIDS-BRT) has been developed for collecting Thai biodiversity data. The NBIDS-BRT aims at providing advanced tools for querying, analysing, modelling, and visualising patterns of species distribution for biologists. We can enter data using a web-service, search information, visualise data using web $Mathematica$  and show locations of study sites on Google<sup>TM</sup> Earth map. NBIDS-BRT has been online at URL <http://www.nbids.org> since November 2005. Now NBIDS-BRT includes three initiative projects (i.e. Khao Nan Cloud Forest, Western Thong Pha Phum, and Khanom Marine Biodiversity Initiative Projects), 54 sub-projects, 20,348 biodiversity data records, 2,883 species records including 4 new species, 110 new records for Thailand, 2 rare species, 11 endemic species, 11 dominant species, 10 new locality records, 2 newly recorded genera, 6 threatened species, 2,731 environmental data records and 2,102 field study sites.

