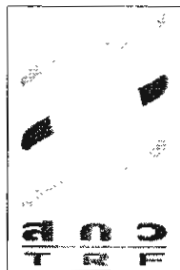


THUNGYAI NARESUAN CAVE SURVEY PROJECT

FINAL REPORT

AUTHORED BY
DEAN SMART - JUNE 2002



FUNDED BY THE
THAILAND RESEARCH FUND



ENDORSED BY THE
ROYAL FOREST DEPARTMENT

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Abstract

Thungyai Naresuan East Wildlife Sanctuary (TYE) encompasses part of a vast tract of limestone/dolomite karst in western Thailand. Topographic maps reveal that karst landforms are present over much of the area. Theoretically, an abundance of caves should also be present. However, due to the remote, harsh nature of the terrain, TYE remained virtually unknown speleologically. This project aimed to correct this situation through systematically exploring, mapping and documenting caves and other sites of speleological interest in TYE. A prolonged and sustained effort over 2 years located a total of fifty-six previously unrecorded sites and produced 9152m of surveyed cave passage. Some of the sites proved highly significant for geological and hydrological reasons with classic examples of multi-level caves, paragenetic caves, swamp notches, active corrosion plains and complex sedimentary relationships being found. The fauna of the caves proved interesting with observations of possible troglobitic invertebrates, a reconfirmation of the rare bat *Ia io*, and the discovery of an unusual rat. Archaeological and palaeontological artifacts proved rare and disappointing, the exception being a single, unbroken cord-marked pot. Measurements of cave environmental factors were also taken. The data collected by this project is presented in this report and establishes a new, elevated baseline of information for TYE. Future speleological exploration and research can use this data to direct efforts and funds more accurately. Suggestions for areas that require further work are given, together with logistical information to aid in its planning.

Project members and sanctuary staff were trained in cave exploration and survey techniques largely through direct experience. Some of these people have continued on and are now carrying out speleological work in other areas of Thailand.

In parallel to the fieldwork, a computerised database for caves was also developed. The incoming, fresh data from TYE formed a foundation for this database and enabled continuous evaluation and testing of the format and the various input/output systems. Details of the final, working database are outlined in this report. The database has been deliberately designed to be easy to operate by non-technical users. The interface is user friendly and pleasing to the eye. Data input minimises text descriptions by utilising drop-down, option boxes wherever possible. Extraction and viewing of the data is enabled via a 1 or 2 parameter search system, based on choices given by the user. Cave surveys can be opened and viewed by clicking on the link provided. Two copies of the database are being maintained - one by the Royal Forest Department, Bangkok, and the other by the author. It is anticipated that, in the future, the database will be expanded to include all the known caves of Thailand.

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Acknowledgments

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1. Introduction

A vast expanse of limestone karst lies in Western Thailand. It covers 12,000km² and stretches from Kanchanaburi in the south to Mae Sot in the north. Exploration over a number of years has discovered many caves around the edges of the karst. Some of these caves are of global significance. Maps of the interior of the area show the presence of dramatic karst topography with many large dolines and sinking streams. Unfortunately, very few speleologists had ever ventured there to see what could be found and virtually nothing was known.

The Thungyai Naresuan Cave Survey Project was created to rectify this. It ran for 30 months from November 1998 to April 2001 and had four main objectives:

- 1) Find, explore and survey caves within Thungyai Naresuan East Wildlife Sanctuary.
- 2) Create a computerised database for caves using the data gained.
- 3) Train co-workers and project staff in cave exploration and surveying techniques.
- 4) Disseminate the information gained.

Armed with 2.5 million Baht of funding from the Thailand Research Fund, some 56 caves and sites of interest were found, explored and surveyed. None of these caves had been documented before and they are all described here for the first time. Some of the caves found are extremely interesting and require further study. Some may prove to be of national and maybe even global importance. Time will tell. Project and Royal Forest Department staff were trained in cave exploration and surveying techniques and gained valuable first hand experience during the course of the fieldwork. Some of these people are now conducting their own exploration in other parts of Thailand. The Thailand Caves Database was created and tested using the fresh data gained from Thungyai Naresuan. The database continues to expand healthily as data from other sources is gathered and entered. With nearly 4,000 caves already known, this expansion will take some time and, if the finding of new caves continues unabated, it may never reach a conclusion! We can only trust that it will not.

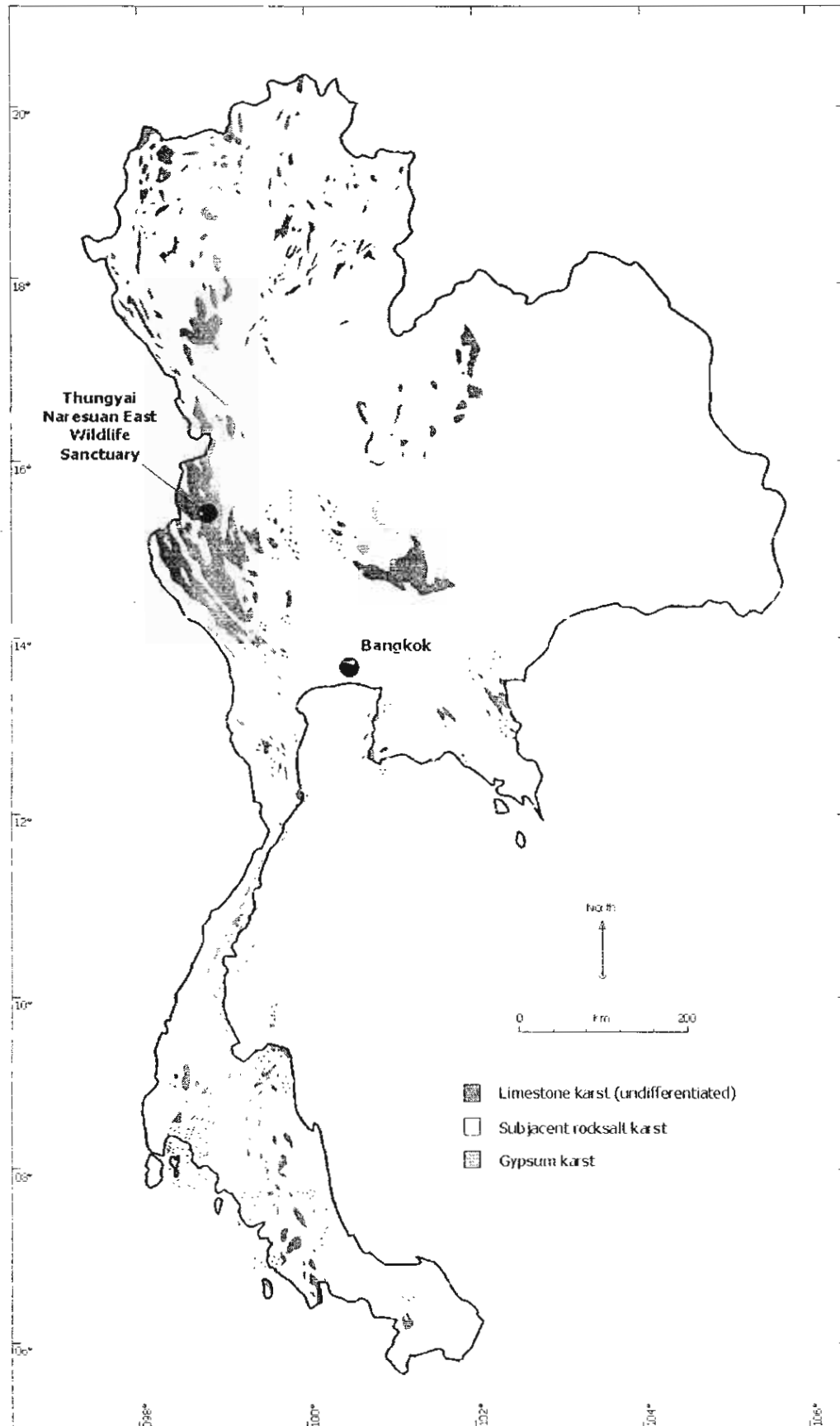
It is hoped that this is not the end of cave exploration in Thungyai Naresuan and that more projects will be forthcoming. There are many unexplored areas remaining and the prospects for discovering highly significant caves are still excellent. This project broke the ground for the area and it is now up to others to continue on.

Scientific researchers now have the opportunity to begin studying the caves of Thungyai Naresuan using the location details and basic information provided by this survey. Research conducted before such a baseline existed would have been haphazard at best and hardly worth attempting. Now there is no excuse for such work not to be carried out.

Fortune favours the brave.

Dean Smart
Bangkok, June 2002

Figure 1. Thailand Karst Map and Location of Thungyai Naresuan Wildlife Sanctuary.



2. Thungyai Naresuan East Wildlife Sanctuary.

2.1 General Description

Thungyai Naresuan Wildlife Sanctuary comes under the jurisdiction of the Royal Forest Department of Thailand and was formally declared a protected area in 1974. It is located in the Tenasserim Mountains of Western Thailand and partly borders Burma (Figure 1). The sanctuary is divided into two parts, 'East' and 'West', along the provincial boundary between Tak Province (East) and Kanchanaburi Province (West). Together, the East and West areas cover a total of 3,647km² and contain some of the most inaccessible and undisturbed forests in Thailand.

The sanctuary is part of the 'Western Forest Complex' comprising 11 National Parks and 6 Wildlife Sanctuaries which at 18,730km² represents one of the largest contiguous protected areas in the region (Figure 2). In 1991, UNESCO designated the adjoining sanctuaries of Thungyai Naresuan and Huai Kha Khaeng as a World Heritage Site.

Work carried out by this project concentrated on Thungyai Naresuan East Wildlife Sanctuary and for the rest of this report only this area will be described.

Thungyai Naresuan East is remote and difficult to access with just a single, unsurfaced road into the area. It is characterised by a high plateau around 900m in altitude, deeply dissected by the Mae Khlong River and the broader Nam Mae Chan valley. Forest cover on the high plateau is dominantly dry evergreen with patches of hill evergreen on the highest peaks. Lowland valley areas are mostly mixed deciduous forests with patches of dry dipterocarp. Pine forest is restricted to a few tiny patches on the highest summits. See Nakhasathien & Stewart-Cox, 1990, for a fuller account. Downstream of Thung Nar Noi ranger station is an area of wetland forest characterised by large, buttressed trees (personal observation).

Human population of the area is sparse with a few villages restricted to the Nam Mae Chan valley. In 1988 there were 16 villages with 1,137 inhabitants (Kanchanagama, 1988). Previously, there were villages on the plateau as well, but these were removed from the area as a conservation measure. The ranger stations for the sanctuary are built on the sites of former villages. Disused fields can still be recognised as they are dominated by the fast growing 'Elephant' grass and contain non-native plants. The indigenous people still in the sanctuary are of Karen descent and practise rotational, subsistence farming. Sources of potentially more severe impacts come from outside the area. Tourism emanating from Umphang is already encroaching on the sanctuary with trekking trips to Lake Lakatu being openly advertised. This is in spite of the fact that it is illegal under Section 37 of the 1992 Wild Animal Reservation and Protection Act. Hunting and some logging (especially for bamboo to make tourist rafts) still occur despite increased efforts by the Royal Forest Department to stop them. Fires burn through the sanctuary every few years and are usually deliberately set.

Threats to the caves of Thungyai Naresuan East are very limited. There is evidence of guano extraction having been carried out at some sites in the past, but even this threat has now gone. The greatest potential problems lie with increased tourism activity and the possibility of developing some caves for visitation. This threat needs to be firmly thwarted before it can start.

2.2 Geology

The geology of the area is complex with many different rock types of various ages folded and faulted together into a series of NW–SE oriented belts with interspersed igneous intrusions (Figures 3 and 4). This complexity is the result of a long history of tectonic movement related to the breakup of Gondwanaland, subsequent collision of what is now SE Asia with China and the uplift and formation of the Tenasserim mountain range. For a more complete account, refer to Bunopas, 1981.

Pre-Cambrian basement rocks form the mountains to the east of Thungyai Naresuan East. This thick sequence has been metamorphosed to amphibolite facies and consists of gneiss, schist and quartzite with some marble. The rocks were uplifted and deeply eroded before Cambrian sediments were deposited on top. Large discontinuous outcrops of Cambrian quartzite and schist lie along the eastern edge of Thungyai Naresuan East. Stratigraphically overlying this is several hundred metres of thinly bedded argillaceous limestone of Ordovician age. The Ordovician forms extensive karst areas to the south of the sanctuary, though little, if any, within. A sequence of shale and sandstone that has been partly metamorphosed was deposited next, stopping at the base of the most important karst supporting rock in Thailand - the massive, pure limestone of the Permian. With a known thickness of 900m, the Permian outcrops over wide areas forming prominent karst landforms with many caves. Limestone deposition continued on into the Triassic becoming dolomitic during the Jurassic. The limestones and dolomites of the Mesozoic cover the majority of the area within and to the north of the sanctuary. Outcrops of Tertiary sediments are confined to lowland valleys often overlain by quaternary river deposits. Intrusion of large masses of granitic rock began during the late Permian and ended in the Triassic. Small dikes of basic rock are also present.

Structurally, the western part of the area is controlled by a series of sub-parallel strike slip faults - the Sri Sawat Fault system. These faults splay off the larger Three Pagodas Fault to the south and head NW through the heart of the sanctuary creating the long, narrow banded outcrop pattern seen on the map. To the East, a core of Pre-Cambrian gneiss provides structural stability and large scale faulting is not seen. Deformation regimes have changed through time with some rocks being severely folded (e.g. the Silurian-Devonian) and others less so (e.g. the Ordovician). Bedding dip angles range from horizontal to vertical with some overturning in the Pre-Cambrian and with dip directions of either SW or NE in line with the general NW-SE strike of the area. Only the rocks of Tertiary age and younger display little or no deformation.

There is no evidence that the end of Permian palaeokarst episode affected the area. The limestone breccias, cavity fills and karstified upper surface of the Permian limestone seen elsewhere in Thailand are not present. The fact that the overlying Jurassic and Triassic formations are also largely carbonaceous suggests that limestone deposition was more or less continuous and no major stratigraphic break occurred. Elsewhere in Thailand, the Jurassic and Triassic are arenaceous and represent a major shift in the sedimentary regime.

At least 80% of Thungyai Naresuan East consists of carbonate rocks. This is just part of a more extensive carbonate karst stretching from Kanchanaburi in the south to Mae Sot in the north (Figure 2). This vast karst area, the 'Western Karst Complex', is the largest in Thailand and covers at least 12,000km² with additional, large contiguous extensions in Burma of undetermined size. The majority of the karst is limestone of Ordovician, Permian and Triassic ages with Jurassic dolomites. There are also small outcrops of Pre-Cambrian marble. This project concentrated on exploring and surveying caves in the Permian and Triassic formations.

Figure 3. Geological map of Thungyai Naresuan East Wildlife Sanctuary.



Geology from 1:250,000 maps supplied by the Department of Mineral Resources, Bangkok.
 Sheet ND 47-2, Ye, Geological Survey Division, 1985.
 Sheet ND 47-3, Changwat Nakhon Sawan, Geological Survey Division, 1976.
 For colour key, see next page.

— Geological boundary - - - Faults, known and inferred
 — Border of Thungyai Naresuan East Wildlife Sanctuary

Figure 4. Key to the Geological Map.

Sheet ND 47-2, Ye.

	Tertiary - Siltstone, shale and sandstone.
	Jurassic - Dolomitic limestone, sandstone and shale.
	Triassic/Jurassic - Limestone, sandstone and shale
	Triassic - Limestone, limestone conglomerate and shale.
	Permian - Limestone and sandstone
	Devonian/Carboniferous - Phyllitic shale, siltstone and sandstone
	Silurian/Devonian - Shale.
	Upper Ordovician - Limestone with argillaceous bands and shale
	Middle Ordovician - Limestone with interbedded phyllitic shale.
	Lower Ordovician - Sandstone and quartzite.
	Ordovician - Limestone with argillaceous beds.
	Triassic - Biotite granite.

Sheet ND 47-3, Changwat Nakhon Sawan.

	Permian - Massive limestone with minor shale and chert.
	?Carboniferous - Shale, sandstone and conglomerate.
	Silurian/Devonian - Quartzite, phyllite, shale, chert and conglomerate
	Ordovician - Limestone, shale and sandstone.
	Cambrian - Quartzite, phyllite and schist.
	Pre-Cambrian - Gneiss, schist, quartzite and marble.
	Mesozoic - Granite.

Information from 1:250,000 maps supplied by the Department of Mineral Resources, Bangkok
 Sheet ND 47-2, Ye, Geological Survey Division, 1965.
 Sheet ND 47-3, Changwat Nakhon Sawan, Geological Survey Division, 1976.

2.3 Geography

Altitudes for the sanctuary (Figure 5) range from 220m.a.s.l. at the lowest point (floor of Mae Khlong valley at the Southern border) up to 1,430m.a.s.l. at the highest (summit of Khao Yu Yee on the eastern border).

More than two-thirds of the area consists of a generalised plateau over 800m in altitude. This plateau is rugged and punctuated by hundreds of limestone towers and other hills up to 200m high. Many of the towers have vertical sides and are very difficult to explore. Dolines are also common and range in size from a few tens of metres in diameter to broad flat areas several square kilometres in size. Depths also vary from a few metres to 200m. Some 330 dolines and stream sinks can be counted on the 1:50,000 maps of both East and West Thungyai Naresuan, although this figure is much higher in reality.

The rest of Thungyai Naresuan East consists of the broad floodplain floor of the Nam Mae Chan and (in part) the Mae Khlong River valleys. The altitude averages between 300m and 600m.a.s.l.

There is a definite NW-SE trend shown by landforms. The valleys of Nam Mae Chan, Huai Bi, Huai Tilaku and Huai Phra follow it, as does most of the Mae Khlong valley. Positive landforms of the plateau are aligned in ridges to the same orientation. This topographic trend is a consequence of the NW-SE trending general strike of the area caused by large scale faulting. Slope changes and cliff lines of a few to several tens of kilometres in extent result from the faults themselves (e.g. the Mae Khlong River valley upstream of Huai Bi and the Permian limestone ridges between Utakhi and Ka Ngae Khi). Lithological changes have effected landforms on a local scale (e.g. the flat floor of the Huai Nam Khieo doline comprises thinly bedded, shaley limestone while the towers are massively bedded, pure limestone).

Whilst the dominant trend is overwhelmingly NW-SE, there seems to be a minor trend orientated NE-SW. The Mae Khlong River valley between Huai Bi and Nam Mae Chan, for 5km downstream of Huai Tilaku and for 2km downstream of Huai Phra trends NE-SW. The Utakhi valley and some cliff lines also follow this trend. A secondary geological structure, most likely faulting, is postulated.

2.4 Hydrology

Drainage for Thungyai Naresuan East is part of the Mae Khlong River system (Figure 6). Most of the major streams of the area, e.g. Nam Mae Chan, Huai Bi, Huai Tilaku and Huai Phra flow directly into this river within the boundary of the sanctuary itself. One stream, the Huai Mae Lamung Tai, drains the Northeast corner of the sanctuary before flowing into the Huai Kha Khaeng River and joining the Mae Khlong further South at the Sri Nekarind reservoir.

The Mae Khlong River flows through the heart of the sanctuary. It follows an angled route from the Northern to the Southern border, alternating direction between SW and SE. The river flows through deep gorges up to 500m deep where it has bisected the mountainous plateau and meanders gently in a broad, flat valley where it meets the Nam Mae Chan.

The larger streams of the sanctuary (e.g. Nam Mae Chan, Huai Bi, Huai Tilaku, Huai Phra, Huai Mae Lamung Tai and Huai Mortener) are perennial. They collect on non- calcareous rocks and flow on the surface for considerable distances before either joining the Mae Khlong or sinking on contact with limestone, e.g. Huai Mortener.

Figure 5. Elevation Map of Thungyai Naresuan East.

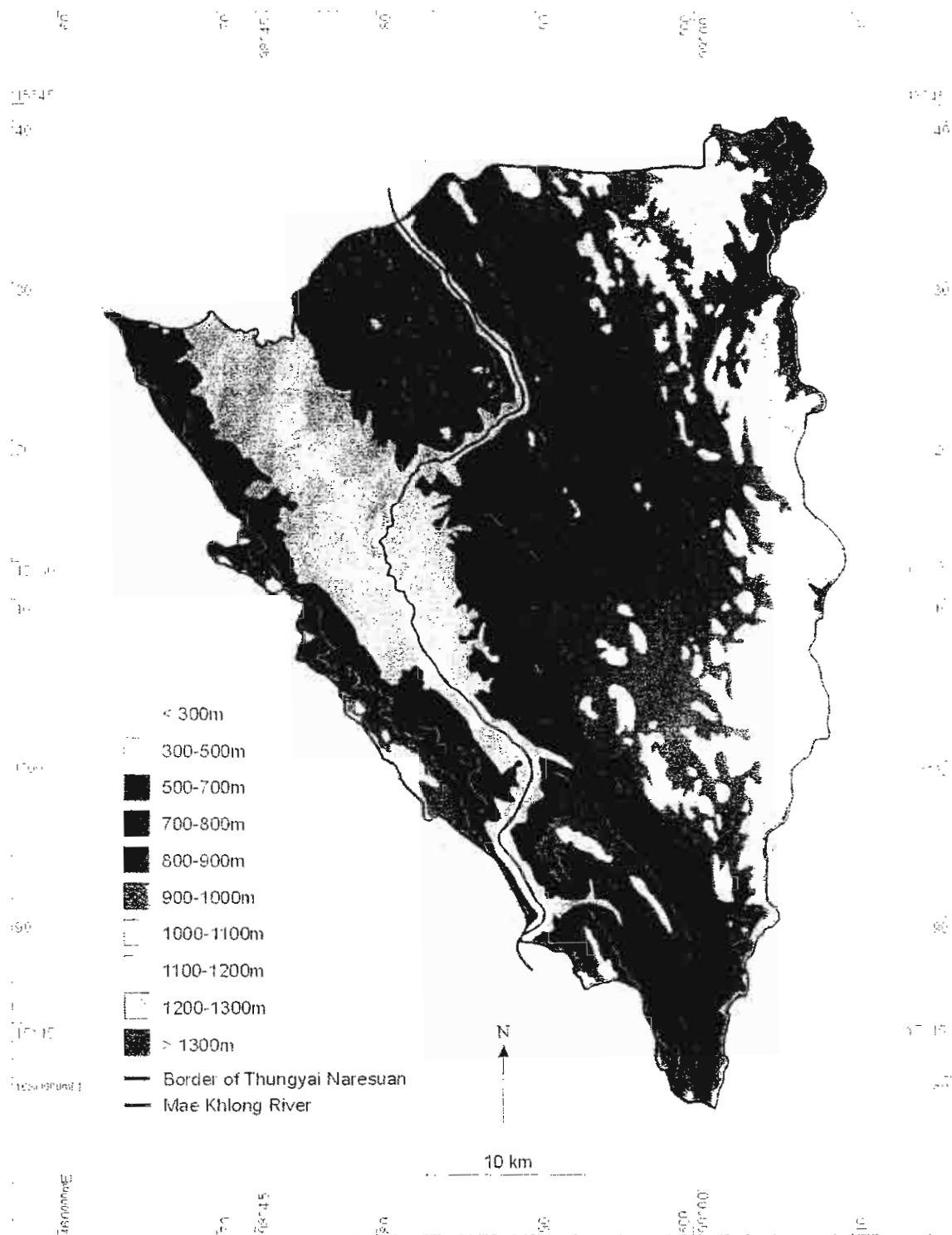
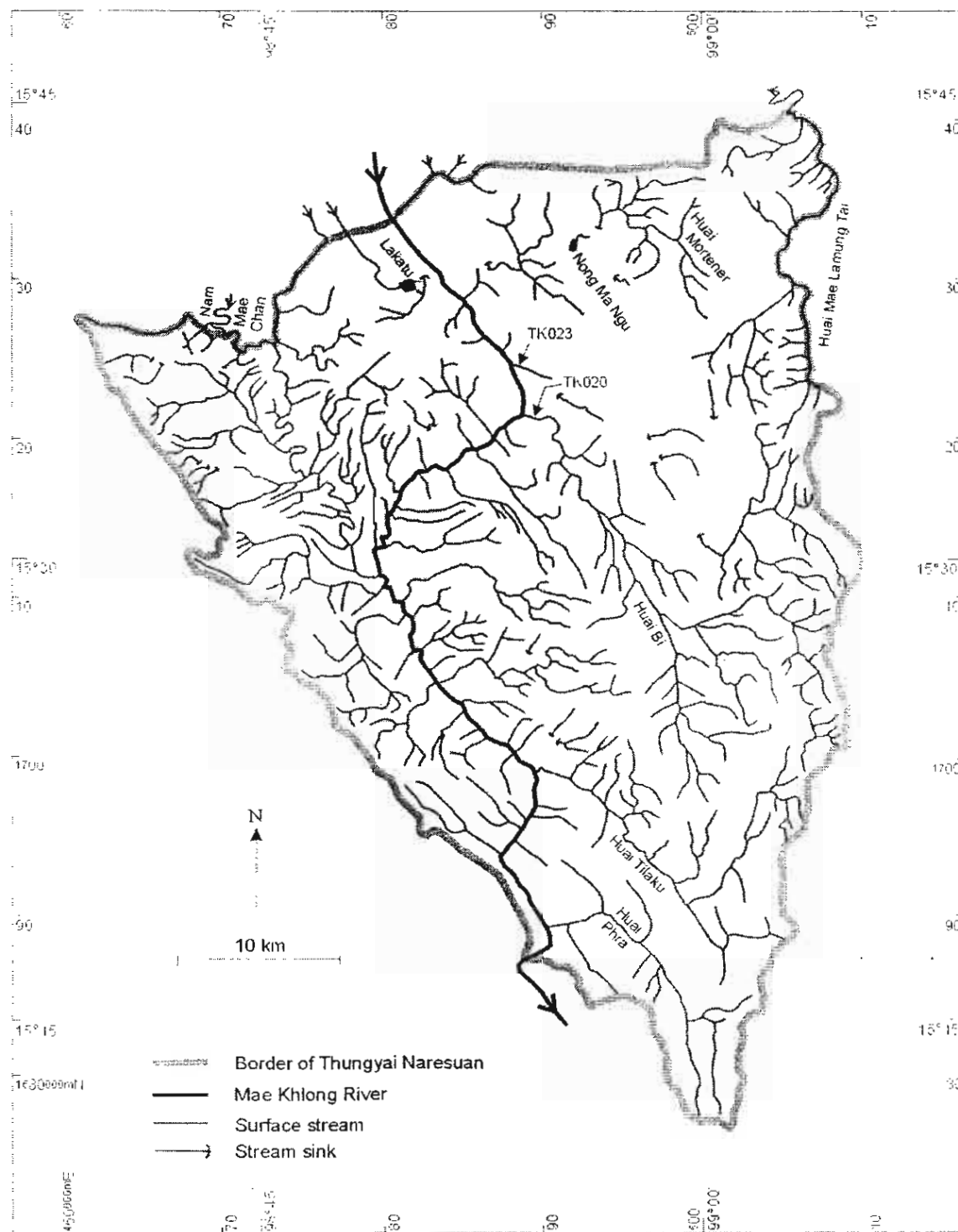


Figure 6. Hydrological Map of Thungyai Naresuan East.



During the dry season, Huai Bi sinks into extensive tufa deposits on the valley floor and rises again a short distance downstream. The majority of smaller streams, especially those found in the limestone areas, carry water only in the rainy season.

Underground hydrology for most of the sanctuary is poorly known at present as extensive cave systems have yet to been found and no tracing has been carried out. It appears that the Mae Khlong River valley is the destination for most of the water sinking at the edge of and within the limestone of the study area. Significant resurgences have been found here, e.g. TK020 and TK023 and undoubtedly more exist. None of the resurgences or stream sinks of the area can be explored very far before a sump is met indicating the possibility that the water rest level is not far beneath the surface of the limestone plateau and that most drainage is phreatic. The shallow depth (20m to 40m) and very flat floors of the larger dolines, e.g. Huai Nam Khieo and Pha Fa supports this view. They probably formed as corrosion plains at the water rest level (see TK048, TK079 and TK082). Even today, the doline floors become marshy lakes in the rainy season, implying that the water rest level is still not far below surface. A few, permanent surface water bodies, such as Lake Lakatu and Nong Ma Ngu give further evidence.

2.5 Access and Logistics

Thungyai Naresuan East is located just 300km NW of Bangkok, but access to the area is much further. As the road from Kamphaeng Phet to Umphang is not yet finished (or due to be), the only way to reach the sanctuary by road is via Mae Sot to the North.

The 480km distance from Bangkok to Mae Sot takes about 8 hours on mostly four lane highways. The road between Mae Sot and Umphang is surfaced, though not very well, and very twisty (reputed to have over 1,000 bends). Although only 150km in distance, it takes 5 hours to travel. From Umphang a further drive South of 1.5 hours, on progressively worsening roads and then tracks, reaches the headquarters of the sanctuary at Ka Ngae Khi which is located on the Northern border of the sanctuary. Alternatively, a helicopter can reach the headquarters from Nakhon Sawan airport (c.250km North of Bangkok) in about 1 hour.

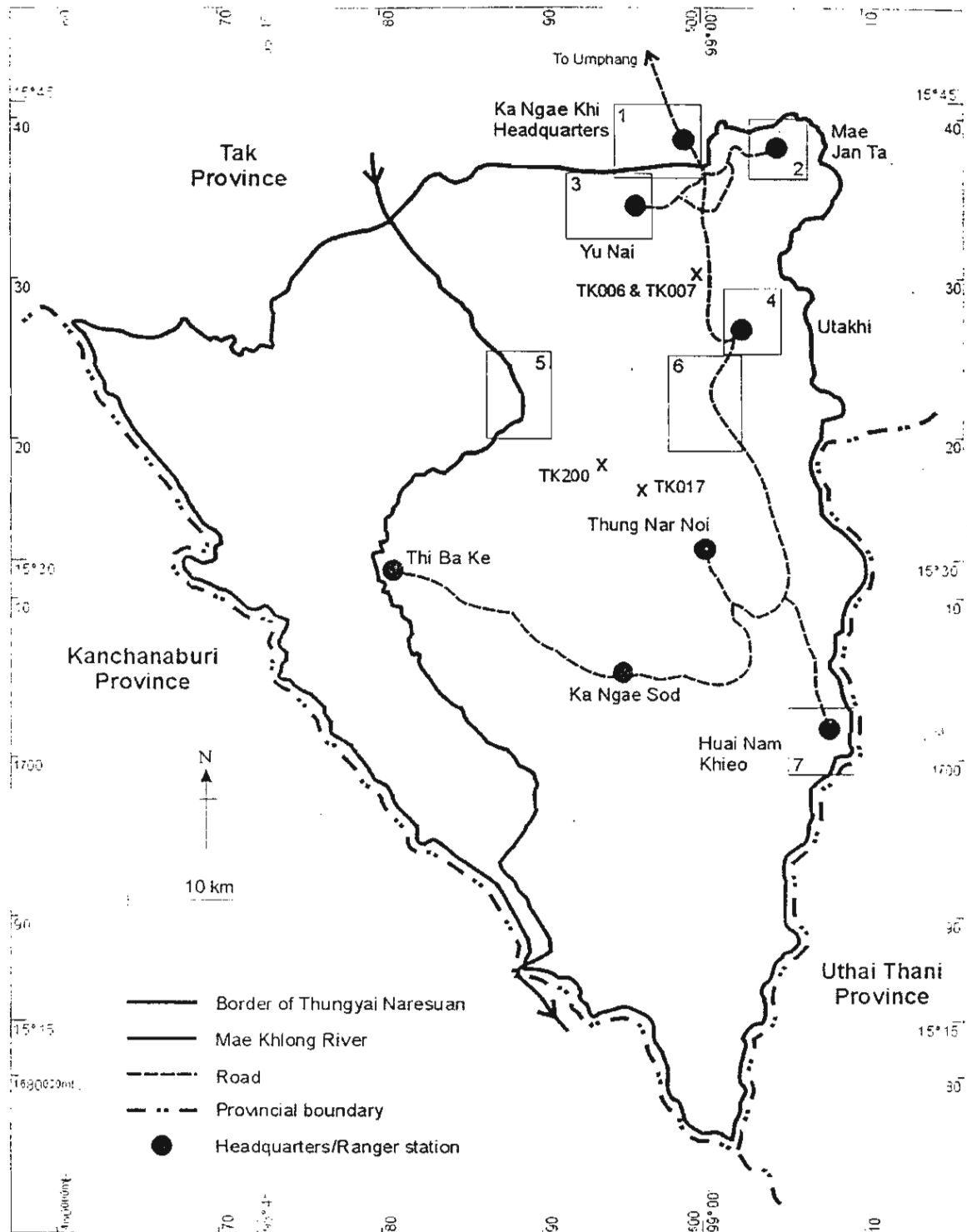
Once the headquarters of Thungyai Naresuan have been reached, the real access problems begin. Table 1 gives the distances by road from the headquarters to outlying ranger stations and Figure 7 shows their location.

Table 1. Distances and Travel Times to Outlying Ranger Stations.

Ka Ngae Khi to:	Distance, km.	Dry season time, hours
Mae Jan Ta	8	0.5
Yu Nai	9	0.5
Utakhi	14	0.75
Thung Nar Noi	50	2
Huai Nam Khieo	56	2.5
Ka Ngae Sod	60	3
Thi Ba Ke	80	6?

Note: the last 5km to Thi Ba Ke cannot be driven and must be walked.

Figure 7. Ranger Stations, Roads and Area Detail Maps of Thungyai Naresuan East.



None of the roads within the sanctuary are surfaced and most are only driveable in the dry season. Many small streams are crossed via tree trunk bridges that often need repairing en route due to elephants breaking them. During drier periods of the rainy season, a good 4WD vehicle can reach the outer stations, but due to many unforeseen stops, travel times can increase 3-4 times. The sanctuary kindly let this project use sanctuary vehicles for travel to and from Umphang and within the sanctuary. This arrangement worked well for a while, but due to mechanical breakdowns the number of available vehicles dropped and those still running were required for sanctuary work. Travel around the sanctuary and, subsequently, exploration and survey were severely curtailed. Any future projects in this area would be well advised to supply their own 4WD vehicle.

Away from the ranger stations and the roads, there are very few well-trodden footpaths. The forest has reclaimed most of those that existed in the past. The difficulties of prospecting for caves are often compounded by thick, prickly and itchy undergrowth. Navigation through the forest is best accomplished through the use of a 1:50,000 map (see Figure 8 for map sheet numbers), compass and GPS utilising any section of elephant path heading in the right direction. Large bush knives can quickly deal with thick undergrowth and annoying plants. Caves near to ranger stations were found with the help of rangers who knew the location. For further afield, guides are not available.

Walkable footpaths that do survive run from Yu Nai Ranger Station Westwards down-valley to the Mae Khlong River, from Thung Nar Noi along Huai Bi to the Mae Khlong River and from Huai Nam Khieo to the TK0012/TK0025/TK0036 area. The Nam Mae Jan valley contains several villages occupied by local Karen people. Well-used footpaths probably criss-cross this area, but it was not visited by the project.

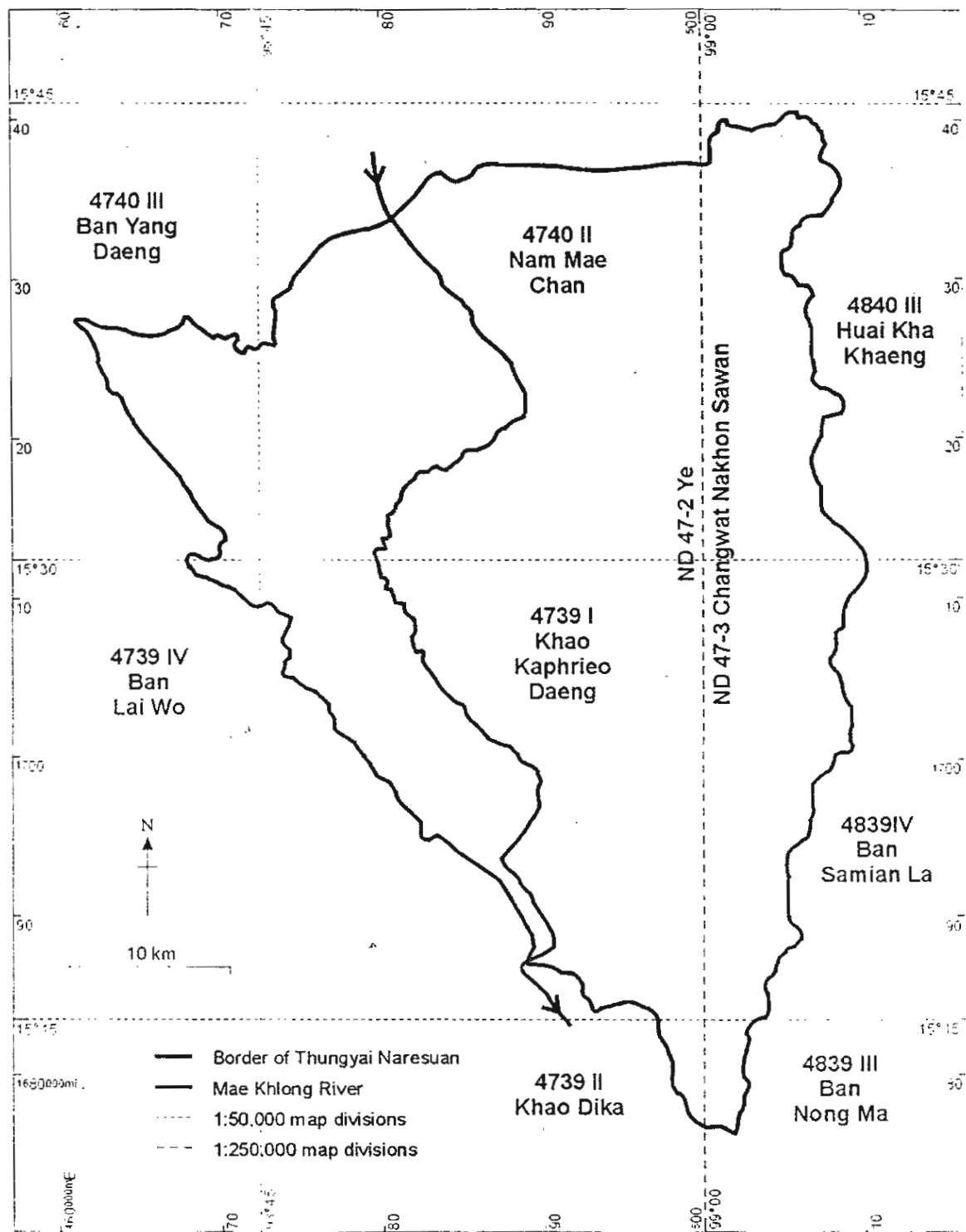
Clothing needs to be of thick enough material to withstand prickly plants and sharp grass. Ex-army long sleeved shirts and long trousers made from cotton proved the best. A hat helps prevent insects and dirt falling down the back of the neck and gloves are sometimes useful. Although hot to wear, the protection afforded by these clothes more than compensates. Wellington boots with good soles are great for short walks and caving, with walking boots used for longer distances. Some workers used anti-leech socks, others found them a nuisance and preferred to stop and 'de-leech' every so often.

Water is not a problem outside of the more expansive karst areas. Carrying 1 litre per person per day was sufficient as perennial streams can be found with ease. Boiling and iodine tablets were used for purification. No surface water can be found in the larger limestone areas (e.g. the area bounded by the Mae Khlong River, Yu Nai, Thung Nar Noi and Pha Fa) during the dry season and little exploration was carried out here. It would require a major expedition to access and explore here.

Rice, fresh vegetables and meat and preserved foods bought from Umphang provided sustenance when at a ranger station or in the forest. Fresh food tended to go off quickly without refrigeration and was cooked and eaten first saving the 'preserved' foods such as kun chiang (sweet sausage), tinned fish or dried noodles for later. During camping trips, open fires were used for cooking.

The purchase of hammocks fitted with mosquito nets made camping in the forest much more convenient. These are lighter and smaller in size than sleeping mats and reduce the risk of disturbance by nocturnal animals, ants, etc. A sleeping bag is necessary all year round, two during the cold season. Sheets of thin plastic tied above the hammocks keep most of the rain off during the rainy season.

Figure 8. 1:50,000 and 1:250,000 Map Sheets covering Thungyai Naresuan East.



2.6 Dangers and Annoyances

Thungyai Naresuan is a huge tract of little disturbed sub-tropical forest and consequently most of the hazards encountered during exploration are of natural origin.

Evidence of large mammals is everywhere. Footprints, claw marks and dung of elephants, gaur, tigers, bears and pigs are common. Of these, only pigs were actually seen and then from a safe distance. Fresh, bear faeces was found in several caves and, if met underground, would represent perhaps the most dangerous large animal.

Snakes were rarely seen and no one was bitten during this survey. Only one poisonous snake was identified, the Mountain Pit Viper *Trimeresurus monticola*. Although we did not carry one, an anti-venom could keep a bitten person alive until the hospital at Umphang can be reached.

Invertebrates are the biggest annoyance and danger in Thungyai Naresuan. Mosquitoes are common and it is a malarial zone. Several sanctuary staff caught malaria while the project was under way. Even though preventing infection is always better than cure, it is very difficult to completely avoid being bitten and anti-malarial medicine may be needed to give an infected person time to reach the hospital. Due to the long time span of the project, prophylaxis medicine was not taken. Ticks are also common and inhabit the grasslands and caves. TK008 is particularly badly infested. Tick borne diseases such as encephalitis are known from Western Thailand. One cave, TK017, contains significant quantities of porcupine faeces harbouring hookworms. These small burrowing worms cause itching and irritation but are not dangerous and disappear in time. Ants, bees, wasps and the multitudes of other biting and stinging insects in Thungyai Naresuan are annoying at times. For allergy sufferers they can be dangerous and strong anti-histamine pills should be carried at all times. Leeches are very common in the rainy season and are occasionally found in caves, e.g. TK007. Whilst not dangerous themselves, their bites are slow to heal and can become infected. Anti-leech socks work, but are cumbersome. The best solution found was a local remedy using the fruit from teak trees. The juice from these small, round fruit is rubbed over boots, socks and lower trousers and repels leeches very effectively.

Fungal infections and other skin complaints can become irritating and require medication. Taking a shower at least once a day using a cleansing soap like Asepso helps to prevent them.

Prickly and stingy plants and sharp grasses seem to be everywhere. Some plants, especially palms can be armoured with vicious spikes 2cm long, the tips of which break off under the skin and become infected. Brushing through the tall, elephant grass causes many tiny cuts on bare skin. One plant called the 'Screaming Elephant' plant, common around Huai Nam Khiao, stings rather like a nettle but the sting takes a week to recover. It has become something of a celebrity with visiting foreign cave explorers. Thick, protective clothing is obviously essential.

The border with Burma is poorly demarcated and sometimes fighting on that side spills over into Thailand. Landmines are also planted in Burmese forests. Thungyai Naresuan East is a reasonable distance from the border (10km at the nearest point) and problems of this kind seem unlikely, though not impossible.

3. The Caves of Thungyai Naresuan Wildlife Sanctuary.

3.1 Previous Work.

Dunkley, 1995, described the general area as “a larger expanse [karst plateau], as yet unexplored, is located in the remote, upper reaches of the Mae Khlong River”. He also suggested the presence of numerous depressions of all sizes and an underground drainage system based on the study of available maps.

Large dolines or sinkholes are shown on maps given by Nakhasathien and Stewart-Cox, 1990. They also stated that “none have been surveyed or properly mapped”.

Some forty caves have been recorded around the Nam Jone area and one survey of a stream cave published (Odell and Odell, 1984). The exact location of any of the caves is not given and details are scant. The Nam Jone area appears to be centred on a section of the Mae Khlong River to the South and outside of Thungyai Naresuan East.

Tham Mae Nam Yough is a large cave (although short), taking the Mae Nam Yough stream underground (Delannoy, 1982). Note: Mae Nam Yough is the local Karen name for Mae Khlong River. The location map for the cave is very poor, but the cave is believed to lie just within the Northern border of Thungyai Naresuan East as rafting trips from Umphang leave the Mae Khlong at this point and have never reported the cave. On the same map, to the West and South of Tham Mae Nam Yough, many dolines are shown. Delannoy notes that the Mae Khlong River flows through a limestone gorge and numerous springs can be seen. One particularly large one discharges between 5 and 7 cumecs of water (October), but further details are not given. He also suggests that the Nam Mae Chan sinks at some point though this has never been confirmed.

Three species of cavernicolous fish have been recorded from the Mae Khlong River system and all are endemic to the area. They are: *Nemacheilus troglodactylus* (Kottelat and Gery, 1989), *Schistura jarutanini* (Kottelat, 1990) and *Pterocryptis buccata* (Ng & Kottelat, 1998). The caves in which the fish are found all lie in Kanchanaburi Province, to the South of Thungyai Naresuan East.

The sanctuary is also home to many species of bat, some of which are known to inhabit caves (Yenbutra and Felton, 1986). Forty-one caves and rock shelters of Thungyai Naresuan West and Huai Kha Khaeng Wildlife Sanctuaries were studied by Robinson, et al, 1994, for bats and the remains of small mammals. A total of 69 species were recorded, 23 of which are new for the area. Only very brief descriptions of the caves were given which exclude entrance locations and surveys. Reported phrases such as “large cave” and “a stream 2m to 3m wide ran the length of the cave” suggest that some of the sites are significant for more than biological reasons. Kitty’s Hog-Nosed Bat, *Cruseonycteris thonglongyai*, has apparently been ‘heard’ in Thungyai Naresuan West using a bat detector (Surapon Duangkhae, pers. com.), but a confirmed sighting has yet to be made (Nakhasathien and Stewart-Cox, 1990 and Robinson, et al, 1994).

Two archaeological surveys have been conducted in the area as a result of the proposed building of a dam. The first, undertaken between 1979 and 1980, found four caves in the area of Nam Jone (Thungyai Naresuan West), two of which contained artifacts (Kanchanagama et al, 1988). Tham Suwat and Tham Stit were habitation sites for people of the Mesolithic and Neolithic periods who produced stone tools, flakes and pottery. A map of the cave locations is given in the report. The team made the interesting observation that Huai Tong Thai is “a perennial stream which flows under the ground surface for a distance of about 4km”.

A large number of caves were discovered by the second study in 1988, which covered an area of 142km². However only the sites of interest, 4 caves and 2 rockshelters, were described with simple plan surveys (Kanchanagama, 1988). Tham Chedi, Tham Thi Nao Khao, Tham Chedi Devada and a rockshelter at Ban U-Ni all contained prehistoric remains consisting of stone tools and potsherds. Tham Ka Kata and the other shelter were recently used as communist hideouts. Tham Chedi is described as an important site worthy of further investigation. Neither study carried out archaeological excavation of the cave floor deposits, preferring instead to simply note surface remains.

Many coffin caves have been discovered in the mountain belt running from Kanchanaburi to Mae Hong Son (e.g. Sorensen, 1974; Kiernan et al, 1988). None have been reported within Thungyai Naresuan (East or West), although this probably reflects a lack of exploration in the area and not a lack of sites.

No research concerning sediments, speleothems, geomorphology or hydrology of caves in Thungyai Naresuan Wildlife Sanctuary (East or West) has been carried out to date.

3.2 This Work

This project initially attempted to systematically locate caves by selecting a small area and thoroughly searching it before moving on to the next. This quickly proved to be inefficient, unpleasant and not particularly successful. A new approach was adopted that selected points of interest from the map and then making every effort to reach there. Points of interest selected were stream sinks, large dolines and resurgence. Any caves found en route were treated as a bonus.

When a cave entrance was found, it was marked with a small metal tag. Onto this tag was stamped the survey number of the cave, the date of exploration and the initials 'TCKG' to identify surveyors - the Thailand Cave and Karst Group. The survey numbers were based on the format TKXXX, starting at TK001 and rising in sequence with each new cave found. To make the tags easy to see, they were painted orange. All major entrances for each cave were marked, so a cave with several entrances would have several survey numbers associated with it. Numbered entrances are indicated on the cave surveys. The survey numbers must not be confused with the database codes, which are simple integers.

Table 2 summarises the caves explored and surveyed by this project. A total of 56 caves in 7 key areas (see Caving Areas chapter) were explored and surveyed for a total of 9,152m. The total explored length of cave was several hundred metres more than this. The longest cave found is Tham Than Lot, TK012, at 1,866m (explored length = 2,000m). This cave also has the greatest height range, +/- 28.2m. Several other notable caves are Tham Mor (TK049) = 1,139m, +/- 15.5m; Tham Sua (TK034) = 952m, +/- 27.3m; Tham Molakot (TK025) = 921m, +/- 22.5m and Tham Phet (TK036) = 801m, +/- 21.5m. All these caves occur in the same area, Huai Nam Khiao. Even though the caves of other areas proved somewhat challenged with respect to size, some of them proved to be no less interesting.

Details for every cave and site found are given in the appendix together with surveys. This information is taken from the Thailand Caves Database, developed in tandem with the surveying in Thungyai Naresuan. See the database chapter for details.

Location and access details together with a general description are given for each cave. More specific details concerning scientific disciplines, culture, management, etc. are only given for those caves where measurements were carried out, artifacts were

Table 2. Explored Caves Summary.

Area - Cave Name	Code	UTM	Map	Length	Depth	Alt	
Mae Jan Ta							
Tham Tasukhi 1	1	505112 1737571	4840 III	108	4.4	920	
Tham Tasukhi 2	2	505083 1731610		185	14.0	950	
Tham Tasukhi 3	3	505107 1737519		0	0	920	
Tham Phi Ma	4	503650 1738510		174	9.3	900	
Yu Nai							
TK005	5	493507 1734819	4740 II	43	14.1	910	
TK006	6	499038 1735918		35	3.6	970	
Tham Khang Khao Yu Nai	7	499074 1735664		244	6.0	970	
TK079	48	491485 1733600		114	5.8	920	
TK081	52	491889 1733324		26	12.1	940	
TK082	53	491484 1733498		163	3.0	920	
Yu Nai Sinks	44	492500 1735700		0	0	660	
'Hohlen'	176	492746 1734259		15	15	960	
Nong Ma Ngu Sink	177	491901 1733302		10	0	910	
Overflow Sink - Yu Nai	178	493576 1734527		0	0	910	
Utakhi							
Tham Khang Khao Utakhi	8	501246 1727885	4840 III	162	27.1	950	
Tham Nam Mut Utakhi	9	501975 1728406		384	21.2	890	
TK010	10	501975 1728406		0	0	890	
Huai Nam Khieo							
Tham Khang Khao HNK	11	506574 1702926	4839 IV	151	18.9	1090	
Tham Than Lot	12	505509 1702168		1866	28.2	1080	
Tham Molakot	21	505235 1701597		921	22.5	1090	
TK031	24	506588 1702447		69	8.8	1120	
TK032	25	506588 1702447		66	14.8	1100	
TK033	26	506644 1702471		36	9.7	1100	
Tham Seua	27	506546 1702173		952	27.3	1100	
Tham Phet	28	504832 1701436		801	21.5	1090	
Tham Tao	29	505732 1701593		100	7.2	1080	
TK047	30	506421 1701544		26	6.2	1080	
TK048	32	506184 1701516		125	2.5	1080	
Tham Mor	33	504972 1702613		1139	15.5	1070	
TK203	49	504716 1702900		0	0	1070	
TK201	50	505906 1701540		0	0	1055	
Pha Fa							
TK050	33	497850 1724677		4740 II	150	10.0	880
TK051	34	498400 1723677	25		8.6	900	
TK052	35	498400 1723677	50		0	920	
TK202	51	499750 1720800	0		0	930	
Total				8,140	-337		

Table 2. Explored Caves Summary - Continued.

Area - Cave Name	Code	UTM		Map	Length	Depth	Alt	
Mae Khlong								
TK017	13	493405	1717119	4740 II	158	4.3	860	
TK018	14	488537	1722405		13	2.5	320	
Tham Chang	15	488537	1722405		35	0	320	
Tham Huai Bi	16	488537	1722405		195	4.4	320	
Tham Yuthana	17	488050	1725258		51	17.0	370	
Tham Wichian	18	487808	1725533		41	7.8	370	
TK023	19	487908	1725611		0	0	390	
TK024	20	488074	1725477		30	0	440	
TK026	22	488217	1722262		20	11.4	320	
TK027	23	487537	1721796		80	12.6	310	
Huai Bi Sink	45	490989	1721129		0	0	940	
Ka Ngae Khi								
Tham Me Hark	36	497338	1740238	4740 II	10	0	990	
TK062	37	497162	1739945		144	14.0	950	
Tham Phran	38	497550	1740450		4	0	1000	
TK071	39	496860	1738987		12	0	1030	
TK072	40	496860	1738987		17	0	1030	
Tham Takharp	41	496860	1738987		30	22.0	1030	
TK074	42	--	--		21	14.2	--	
TK076	46	497016	1739323		30	18.0	990	
TK077	43	--	--		17	3.2	--	
TK078	47	496900	1738800		104	12.0	1010	
Total					1,012	143		
Grand Total					9,152	480		

found, or where there is some relevant significance. For the caves surveyed by this project the reader can assume that if, for example, a cave appears in the archaeology section, it does so because of the presence of artifacts or some other archaeological significance. If a cave does not appear however, that cave can be assumed to be of low archaeological significance with no artifacts found. The information is given under the following headings, in this order: Geology, Hydrology, Biology, Palaeontology, Archaeology, Culture, Environment and Management.

Several caves have great geological significance, especially those in the Huai Nam Khieo area. These caves reveal a complex evolutionary history of repeated formation, sediment infill and re-excavation coupled with phreatic, vadose and paragenetic episodes at multiple levels. The fascinating Tham Than Lot displays the best suite of features indicating this complexity. There are examples where formation of a single cave has been influenced by lithology changes in the limestone, structural discontinuities such as faults and the strike of the bedding, for example, Tham Phet. Cave sediments are varied both through space and time. Older sediments found at higher levels tend to be sandy whereas more recent and modern sediments are gravels or reworked cobbles. Within Tham Than Lot there is a situation where the gravels can be seen to cut through the older sands. Speleothems are, on the whole, of common types and mineralogy. Tham Than Lot has a small patch of boxwork formed in sediment and

several caves display small straws, helictites and false floors. The sediments of TK011 contain small vesicles lined with unusual crystals. Aesthetically, the speleothems of Tham Nam Mut Utakhi are the most pleasing. The broad, flat dolines that characterise the karst plateau of Thungyai Naresuan East contain active corrosion plains that are forming caves and modifying existing ones. This situation is rare in Thailand, as most plains have been turned into rice paddies and no longer function. The examples around Nong Ma Ngu and Huai Nam Khieo are among the finest in the country.

Biological observations were carried out on a casual basis coincidentally to surveying. Those made include the reconfirmation for the area of the very rare Great Evening Bat, *la io*, in TK048. Several other, more common species were also identified. Large, grey rats were discovered to be living in various caves. Investigations revealed them to probably belong to a new species of the genus *Leopoldamys*, though this has not yet been finalised. Some very interesting white creatures were found in TK062 including isopods and mites that may prove to be troglobitic. Fossil and sub-fossil bones were not common. TK031 has a bone stuck in old sediments, as are teeth in TK011. Tham Tao is named after the near complete carapace of a turtle found inside. This is most likely to be modern though. One limb bone found in Tham Seua had been sharpened at one end. It is not certain if this was a deliberate action by a prehistoric person or caused by an animal gnawing.

Thungyai presents a fairly hostile environment for people to inhabit. The high elevations, high rainfall, low temperatures, thick forest and wild animals make living here an unpleasant experience, especially when more hospitable, lowland valleys can be found nearby. This is reflected in the near lack of archaeological and cultural material. The little that was found probably reflects the passage of migrants through the area and not permanent habitation. The complete cord-marked pot of TK052 was the best find. Other artifacts included more pottery and crude stone tools as found in Tham Mor and Tham Seua.

Measurement of environmental factors was limited to temperature, humidity and pH due to equipment constraints. The results of this work are given in the Cave Environment chapter. Most caves conformed well to the temperature-altitude connection where higher altitude caves are cooler than lower altitude ones. Those that did not (TK020 and TK021) are located in the bottom of the 400m deep Mae Khlong valley where available sunlight is less than on the plateau and where forest cover is limited (Tham Tasukhi 2). Humidity is generally high, above 85%. Cave streams were all slightly alkaline with pH values of 7+. The marsh water at TK079 was the only acidic measurement with a pH of 6.7.

3.3 Future Work

Obviously, much remains to be explored and investigated in the vast karst area of Western Thailand. Even within Thungyai Naresuan East itself there are certainly many more caves waiting to be discovered. Continuing on where this project left off, continuing to locate, survey and document previously unknown caves must be regarded as the primary action.

Areas that warrant further exploration are:

- Mae Khlong River valley
- Yu Nai
- Huaī Nam Khieo
- Pha Fa
- Karst plateau on east bank of the Mae Khlong
- Plateau around Lake Lakatu
- Ridge west of Nam Mae Chan

Rewarding research could be carried out in many fields. Study of the geology and evolution of the Huaī Nam Khieo caves would reveal a complex history related to climate changes and mountain uplift. Cave sediments are varied and widespread over a range of elevations. A palaeoenvironmental reconstruction for western Thailand could be created though study would have its difficulties due to complex relationships. Samples of the minerals found in the sediments of TK011 can be taken for identification. Active corrosion plains are not common in Thailand. Studying the plains of Thungyai may help understanding of such things as tower formation in Ratchaburi and Phangnga Bay.

Hydrological work should rely on the continued physical exploration of caves initially. In the event that this is not possible, for example where the water table is at or near the surface, dye tracing would be needed to reveal flow routes and times. However, for this to be successful all resurgences need to be located and sampled - a very difficult task logistically.

The assemblage of surface fauna and flora in Thungyai Naresuan East is unique and consequently, it would be safe to say that the cave fauna is equally unique. A biological survey is needed to document what lives where and will likely discover many rare and endemic species. Certain caves appear to contain troglobitic fauna and TK062 near the Ka Ngae Khi presents an obvious choice for study. The cave dwelling rats require further research to confirm whether or not they do represent a new species, as seems probable at this time. Not a great deal of fossil and sub-fossil material was seen although no excavation of cave sediment was attempted. Caves where such methods may be rewarded are Tham Sua and TK079.

Given the rarity of artifacts, it seems that other areas of Thailand have greater significance archaeologically and culturally. It would therefore seem more appropriate to study those places before coming to Thungyai Naresuan East.

Environmental study of the caves should be concurrent with continued exploration. More detailed analysis of the high carbon dioxide/low oxygen phenomenon would be interesting, though other areas present better prospects, e.g. Chiang Mai, Kanchanaburi.

Overall, the work carried out by the Thungyai Naresuan Cave Survey Project was just the beginning. The cave location details, descriptions and basic information gained here will provide a springboard of opportunity for future explorers and scientists to delve into a world where little is known or understood.

4. Caving Areas

Refer to Figure 7 for the location of each area detail map within the wildlife sanctuary.

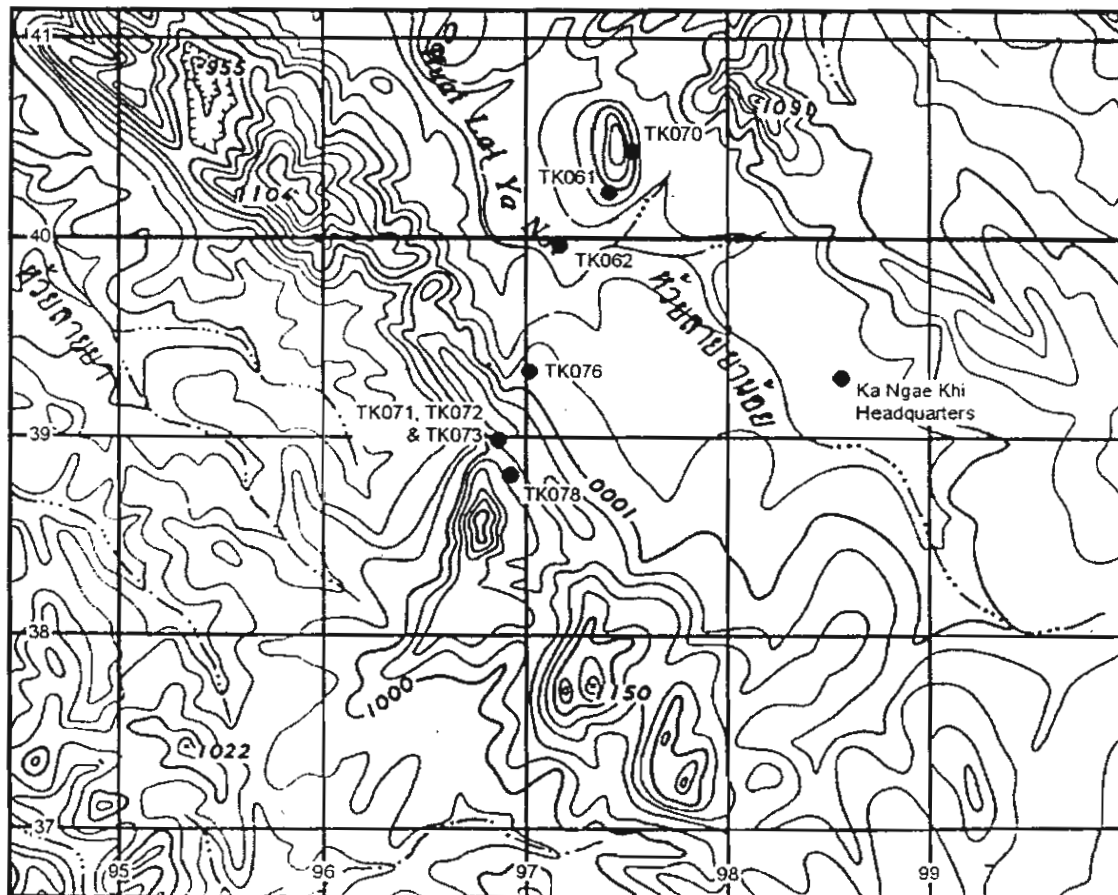
4.1 Ka Ngae Khi - Sanctuary Headquarters (1)

The headquarters at Ka Ngae Khi are located on the northern border of the sanctuary and are the first facilities reached when travelling from Umphang. A base of operations was made at Ka Ngae Khi for planning trips to outlying areas, equipment storage and somewhere to work during the rainy season when other places were inaccessible. In the surrounding area, several caves were found. Most are small and difficult to find.

Just before Ka Ngae Khi is reached, an obvious limestone mountain, Doi Rot Me, is passed by the road. Two small caves were found here, Tham Me Hark (TK061) and Tham Phran (TK070). The biologically interesting stream sink cave of TK062 lies to the SW. Further to the west is a long, prominent limestone ridge containing many small caves. This area was only partially explored.

Walking around the area is relatively easy, utilising old footpaths and open patches of forest.

Figure 9. Cave Locations around Ka Ngae Khi.

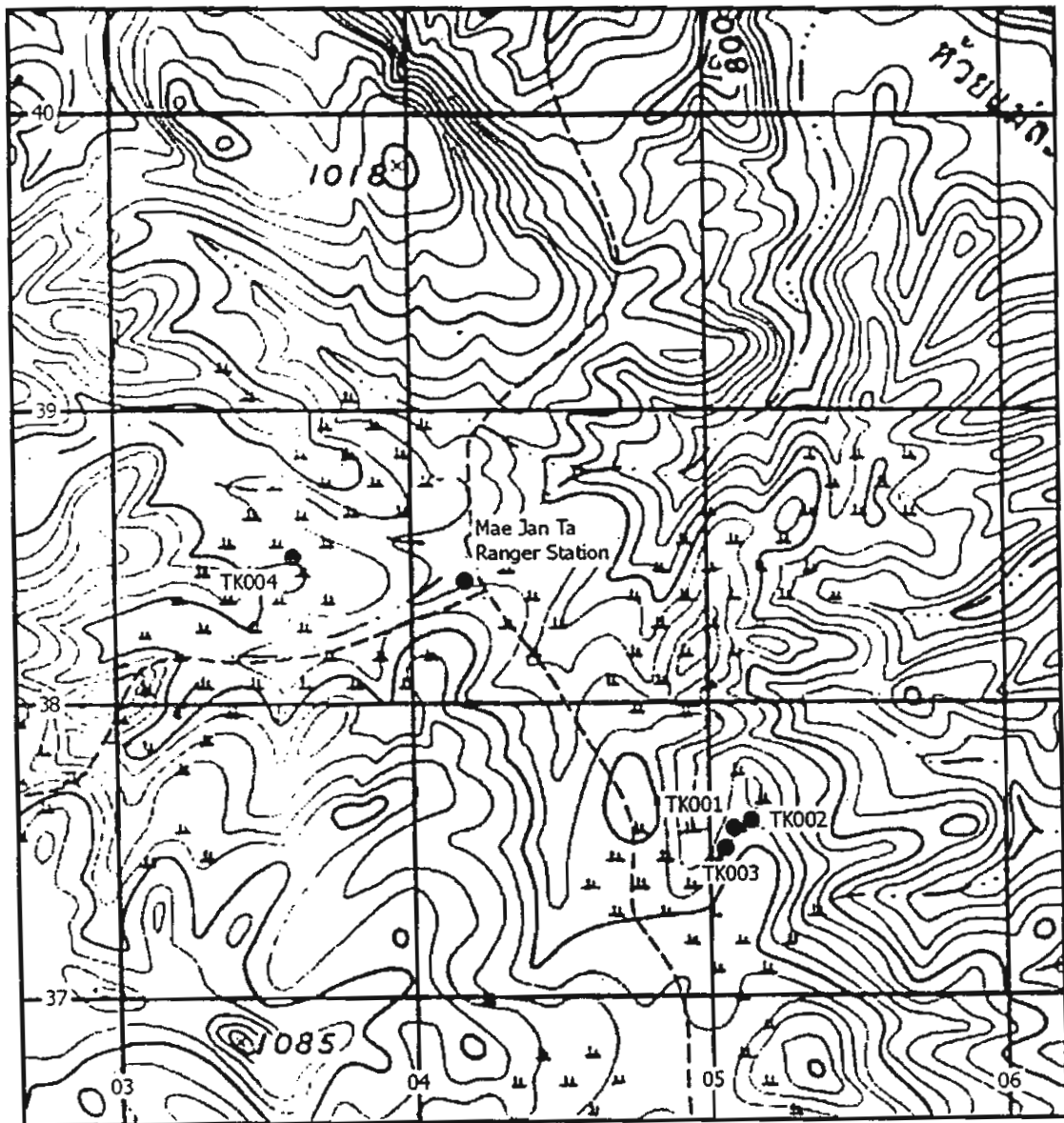


4.2 Mae Jan Ta Ranger Station (2)

This area has limited limestone outcrop and was only visited once. Four sites of interest were surveyed - Tham Tasukhi 1, 2 and 3 (TK001, TK002 and TK003 respectively) and Tham Phi Ma (TK004). It is doubtful that many more caves remain to be explored in the immediate vicinity.

To the west however, between Mae Jan Ta and Ka Ngae Khi is a long limestone ridge. This has not been checked for caves.

Figure 10. Cave Locations around Mae Jan Ta.



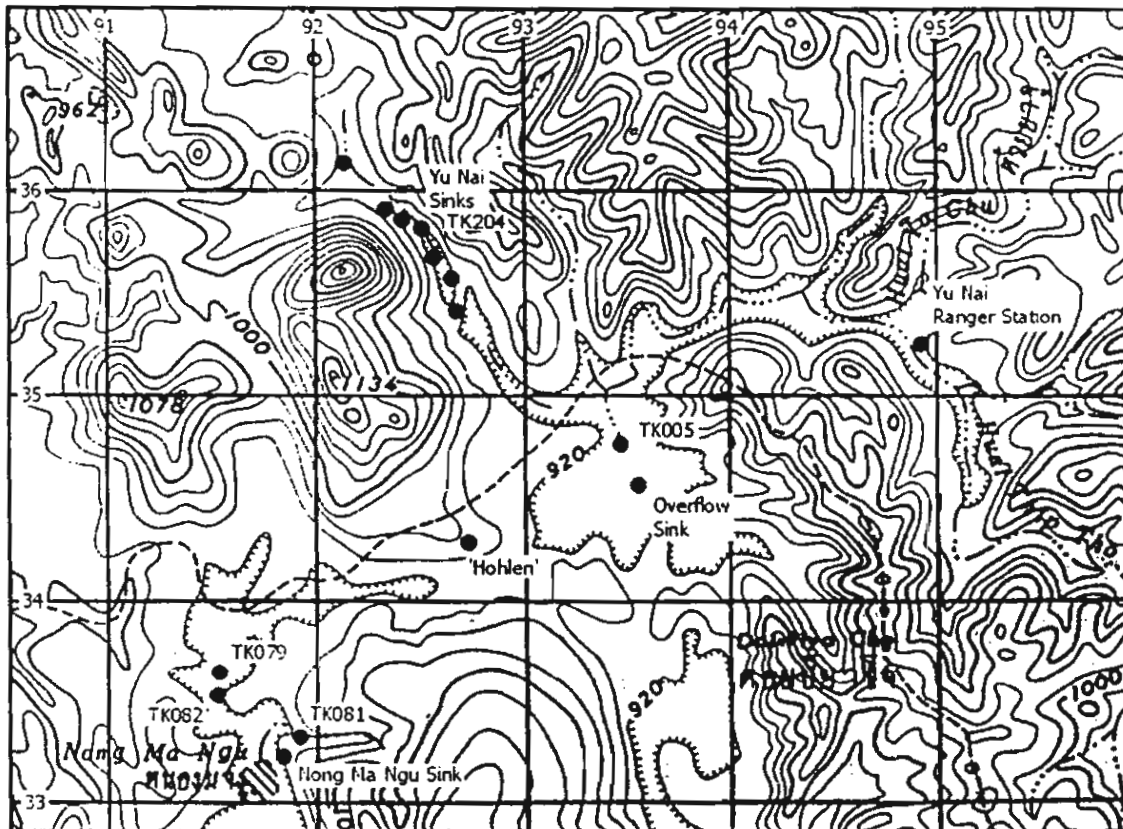
4.3 Yu Nai Ranger Station (3)

Yu Nai ranger station sits amongst shale and sandstone hills. One hours walk downstream encounters a dramatic scenery change where the limestone is met. This is the northeastern edge of the huge limestone area forming the east bank of the Mae Khlong valley.

Many caves and sites of interest were found in the karst to the west of Yu Nai. The Yu Nai stream itself disappears into a short cave (TK005) with an associated overflow sink. Seven, spectacular seasonal stream sinks were found in the valley NW of TK005 although only one had accessible cave, which was short. Further west, the footpath passes by a 15m deep shaft that remains undescended ('Hohlen') and eventually reaches the Nong Ma Ngu. This and other marshes in the area lie in the bottom of broad, flat dolines forming an active corrosion plain. Limestone towers and ridges rise out of the plain with caves at the base that are heavily modified by swamp notches. With more exploration, the Yu Nai area could reveal many, interesting caves. Only stream sinks were found during this survey and the resurgence(s) for the area are unknown. It is possible a large cave exists here although the presence of the active corrosion plain suggests that the water table is located at or near the surface and the cave may be flooded.

The path from Yu Nai is well trodden and easy to follow. Away from the path, the undergrowth is thick in places and difficult to get through. The marshes sometimes force long detours around to the other side.

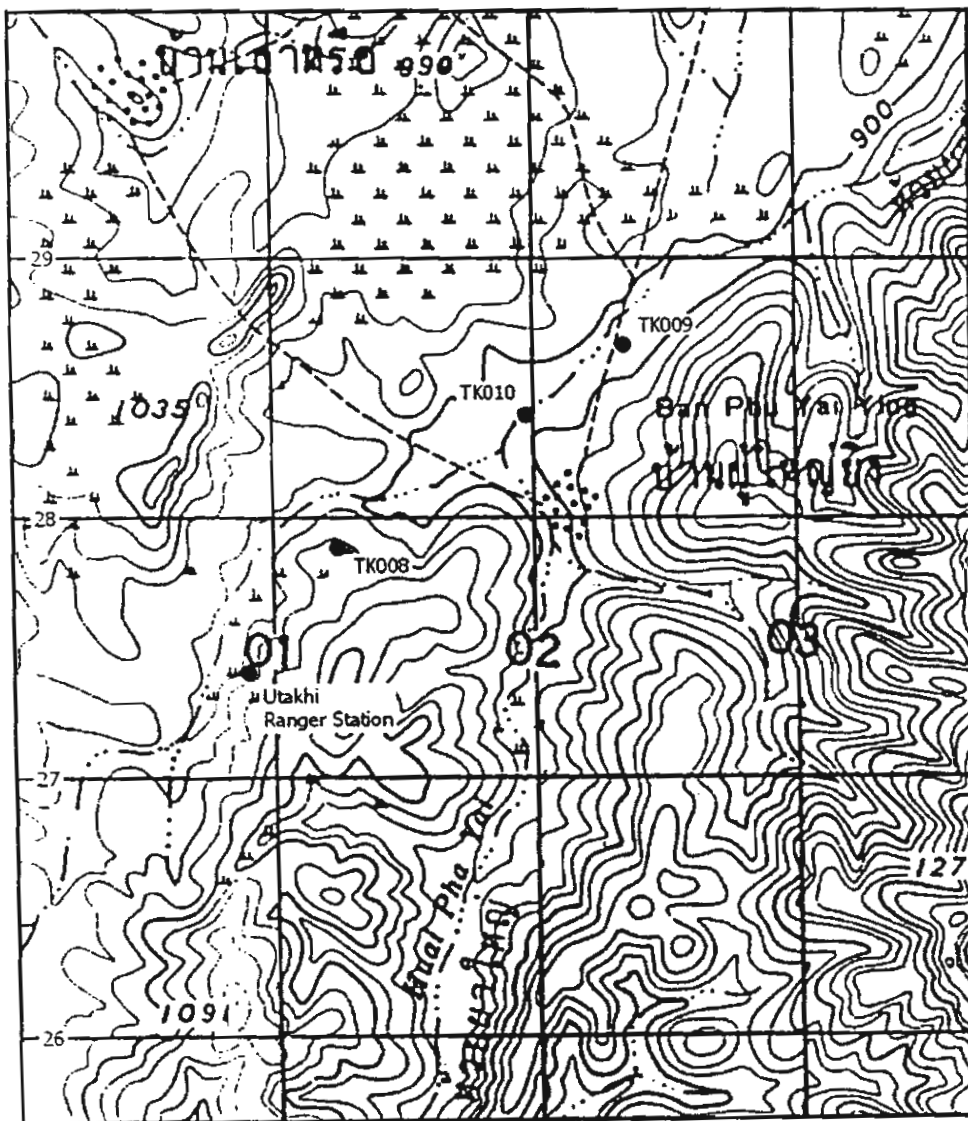
Figure 11. Cave Locations west of Yu Nai.



4.4 Utakhi Ranger Station (4)

Down the valley from Utakhi ranger station are small patches of limestone reached via a reasonable path. The first outcrop contains Tham Khang Khao Utakhi (TK008) with its bad air and ticks. Further to the NE the Utakhi stream falls over a waterfall before sinking at TK010 and rising again just before Tham Nam Mut Utakhi (TK009). The resurgence for this cave is reported to be just over the other side of the ridge. The limited amount of limestone in the area means that few caves remain to be found.

Figure 12. Cave Locations at Utakhi.



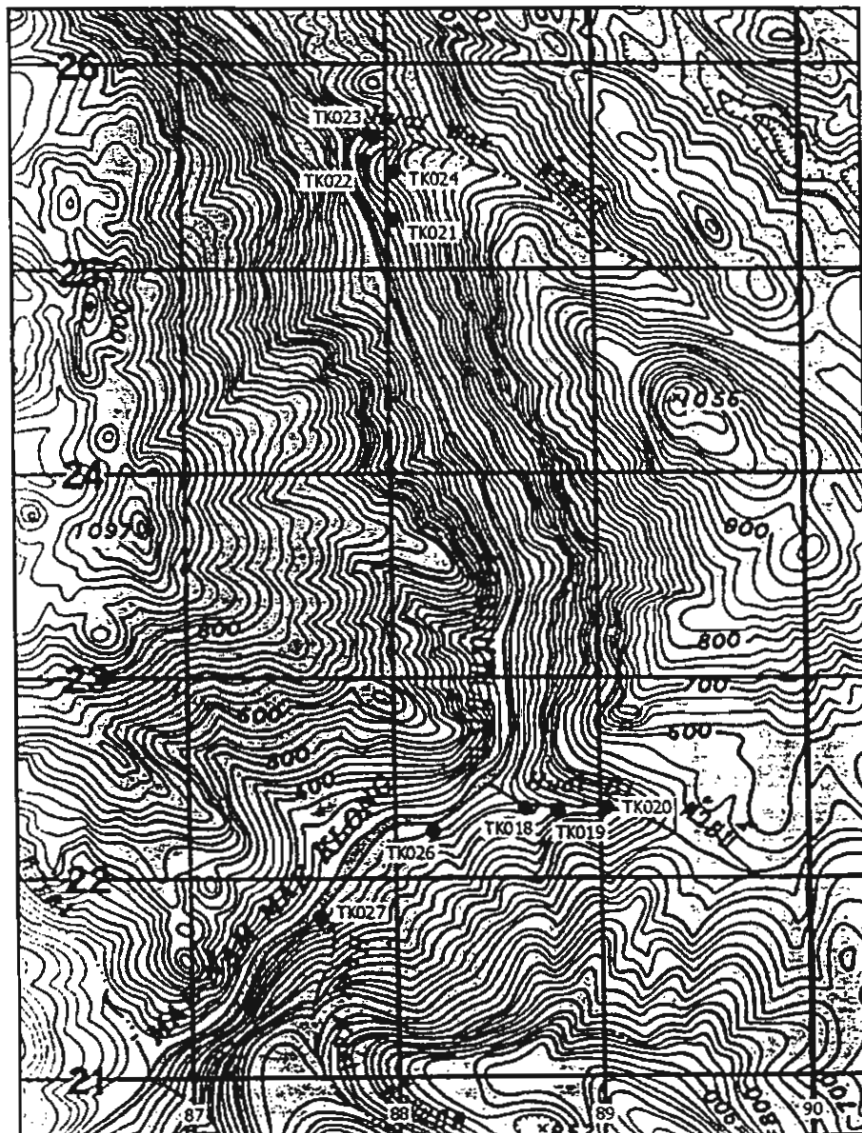
4.5 Mae Khlong Valley (5)

The part of the Mae Khlong valley investigated by this project is a difficult 1.5 days walk northwest of Thung Nar Noi ranger station at the point where Huai Bi meets the main river. The walk follows Huai Bi along a footpath that disappears and reappears constantly with long stretches of jungle bashing in between. At the end is a very steep 250m descent down to river level. Once the Mae Khlong is reached, shelter can be taken under a spacious overhang next to Huai Bi, 400m upstream from the confluence.

Huai Bi flows out of a cave of the same name (TK020) at the head of a narrow gorge. Downstream of here, Tham Chang (TK019) and TK018 can be found. Caves were found in the main river valley both upstream and downstream of the confluence. About 4km upriver, a significant resurgence is met at Huai Wak (TK023). Near here are the small caves of TK022, TK023 and TK024. Down river are 2 small caves and another resurgence at Huai Kaet (TK027).

This area is very important and requires much more exploration. TK023 appears to be draining the large karst area east of the Mae Khlong and might reveal a significant cave. Other resurgences and caves are likely to be found on either side of the river. The logistics of reaching the area however, make exploration very difficult.

Figure 13.
Caves of the
Mae Khlong Valley
and Huai Bi.



4.6 Pha Fa (6)

Pha Fa is the name of a huge limestone cliff some 10km south of Utakhi ranger station. Streams flowing off the shale/sandstone hills to the east sink where they meet the limestone. The only way to explore this area is to camp out in the forest next to the 2nd bridge from Utakhi, where there is permanent water.

There are 3 sinks in the Pha Fa area itself (TK202), 2 are seasonal and the third takes the permanent stream flowing under the 2nd bridge. Many small dolines pockmark the area as well. They and the sinks are all choked. To the north are two perennial stream sinks in small valleys (TK050 and TK051). Both caves are short.

The resurgence(s) for the area are unknown. It or they could be on the opposite side of the ridge, or alternatively, the TK023 resurgence is 10km away in the Mae Khlong valley. Future exploration should concentrate on locating the destination of the water. There may also be other, dry caves in the area and some may contain archaeological material as shown by that found in TK052.

Figure 14. Caves of Pha Fa.



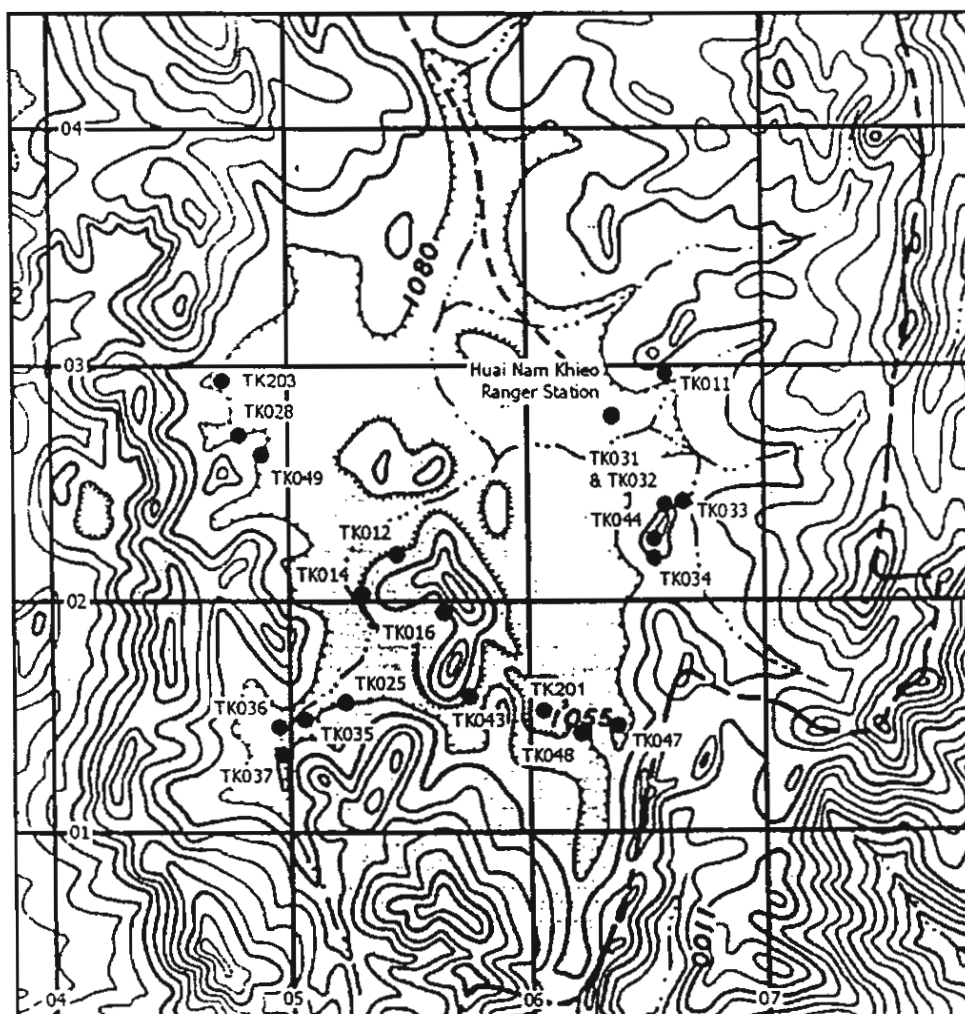
4.7 Huai Nam Khieo Ranger Station (7)

Located nearly 60km from the headquarters, the area around Huai Nam Khieo proved the most productive. The area comprises a broad, flat doline with protruding limestone towers and ridges. All of the caves are found in these hills and the longest are all active stream caves at base level. Some caves have been formed/modified by swamp notching.

To the SW and W of the ranger station, are the biggest caves - Tham Than Lot (TK012), Tham Molakot (TK025), Tham Phet (TK036) and Tham Mor (TK049). Many other smaller caves were also found here. Immediately south of the station is a small tower containing Tham Sua (TK034) and a few other smaller caves. Within the doline itself, there is still the possibility of finding new caves although most have probably now been surveyed. Extending known caves, especially Tham Than Lot, would seem the best approach. Exploration further afield, away from the doline would almost certainly be worthwhile. Rainwater collecting in the doline sinks into at least 2 low points without enterable cave. The destination of the underground water is a complete mystery. Some archaeological material was found in some of the caves.

The area contains much thick forest that hampers exploration. A few paths (some made by elephants) cross the area and are useable.

Figure 15. Cave Locations around Huai Nam Khieo.



5. Cave Environment

5.1 The Climate of Western Thailand

Eight climatic measuring stations, maintained by the Meteorological Department of Thailand, are located near to the study area. They are Umphang, Thong Pha Phum, Mae Sot, Tak, Kamphaeng Phet, Nakhon Sawan, Suphanburi and Kanchanaburi. Averaged measurements of temperature and rainfall, made by these stations over the period of 1961 to 1998/2000 (or as indicated) are shown in Figures 16 and 17. It is unfortunate that similar data is not available for Burma.

Western Thailand has a strongly seasonal climate divided into 3 seasons: cold and dry (Nov to Feb), hot and dry (Feb to May) and rainy (May to Oct). Mean temperature ranges from 23°C in the cold season to 30°C in the hot season with absolute minimum and maximum temperatures of 1°C to 44°C. Daily fluctuations in temperature are most acute during the cold season with changes of 35°C+ not uncommon. Temperatures in the western parts are generally around 2°C cooler than in the east, most likely due to higher altitudes of those parts. Rainfall varies across the region with most rain falling in the western part. Two distinct areas can be recognised and are here referred to as the 'Rain Fall Area' (Umphang, Thong Pha Phum, Mae Sot) and the 'Rain Shadow Area' (Tak, Kamphaeng Phet, Nakhon Sawan, Suphanburi, Kanchanaburi). Total rainfall per year is 1,400mm to 1,800mm in the Rain Fall Area and 1,000mm to 1,300mm in the Rain Shadow Area. About 90% of the total rainfall occurs during the rainy season. In the Rain Fall Area, rainfall rises steadily both in terms of total amount and number of days with rain. It peaks in August when there is over 300mm of rain falling in 27 days. The Rain Shadow Area shows two peaks of total rainfall in May and September, but never climbs above 250mm. The number of days with rain is quite stable at about 15 days. Extreme rainfall events occur in both areas. The single highest daily maximum was recorded in July in the Rain Fall Area at 207mm. During the rest of the year, daily maxima in this area are consistent at about 50mm to 100mm. In the dryer Rain Shadow Area, two peaks of intense rainfall are seen in May and October (175mm and 188mm respectively) corresponding with the peaks shown by total rainfall.

The nearest climatic monitoring station to Thungyai Naresuan East is Umphang, c.45km away. The data recorded here probably best reflects the climate for the sanctuary although an altitude difference of around 500m+ makes direct correlations impossible. The suggestion that an altitude gain of 1,000m equals a reduction in temperature of 5°C (Medway, 1964) would imply that Thungyai Naresuan is some 3°C cooler. Recorded data for Umphang is given in Figure 18.

Monthly mean temperature varies from 19°C in the cold season to 26°C in the hot season. Maximum and minimum temperatures are 41°C (April) and 1°C (December). Daily fluctuations are nearly 35°C in the cold season, becoming less, 17°C, in the rainy season. A total of 1,400mm of rain falls per year. Monthly rainfall peaks in August with 250mm of rain though it is fairly consistent and lacks any truly extreme events. Daily maximums of just over 100mm have been recorded. It does rain often though with 4 months receiving 25+ days of rain. Relative humidity increases during the rainy season to over 80%. During the hot season, relative humidity drops to around 65%. Average wind speeds are low throughout the year at 1 knot or less. This wind blows from the west for much of the year (Figure 19) bringing moist air from the Andaman Sea. The mountains around Umphang, Thungyai Naresuan and the rest of the Rain Fall Area are the first high ground this air meets resulting in relatively higher rainfall (Kutinatra & Bhumpakkapun, 1989, Nakhasathien & Stewart-Cox, 1990).

Figure 16. Temperature Data for Western Thailand.

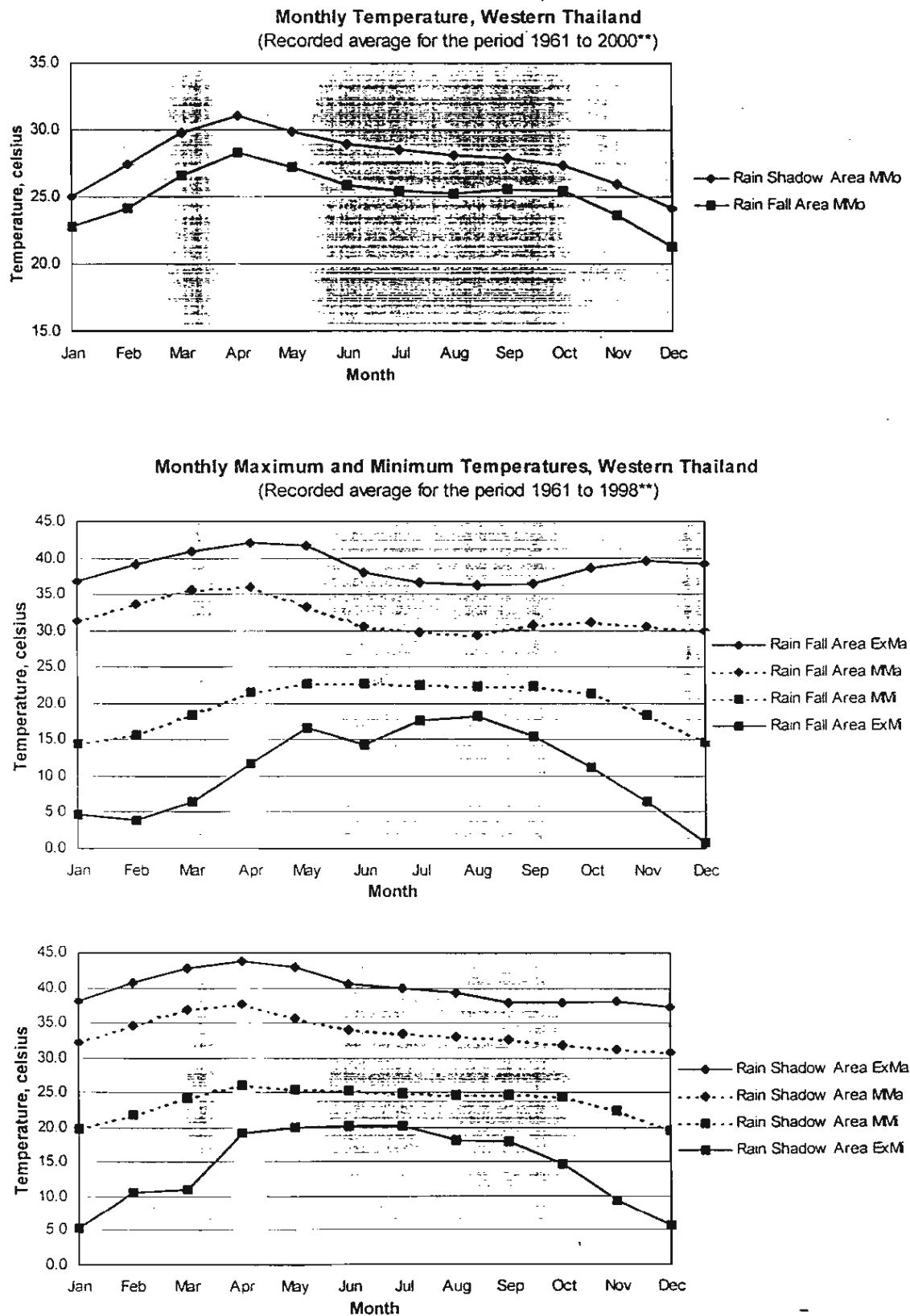


Figure 17. Rainfall Data for Western Thailand.

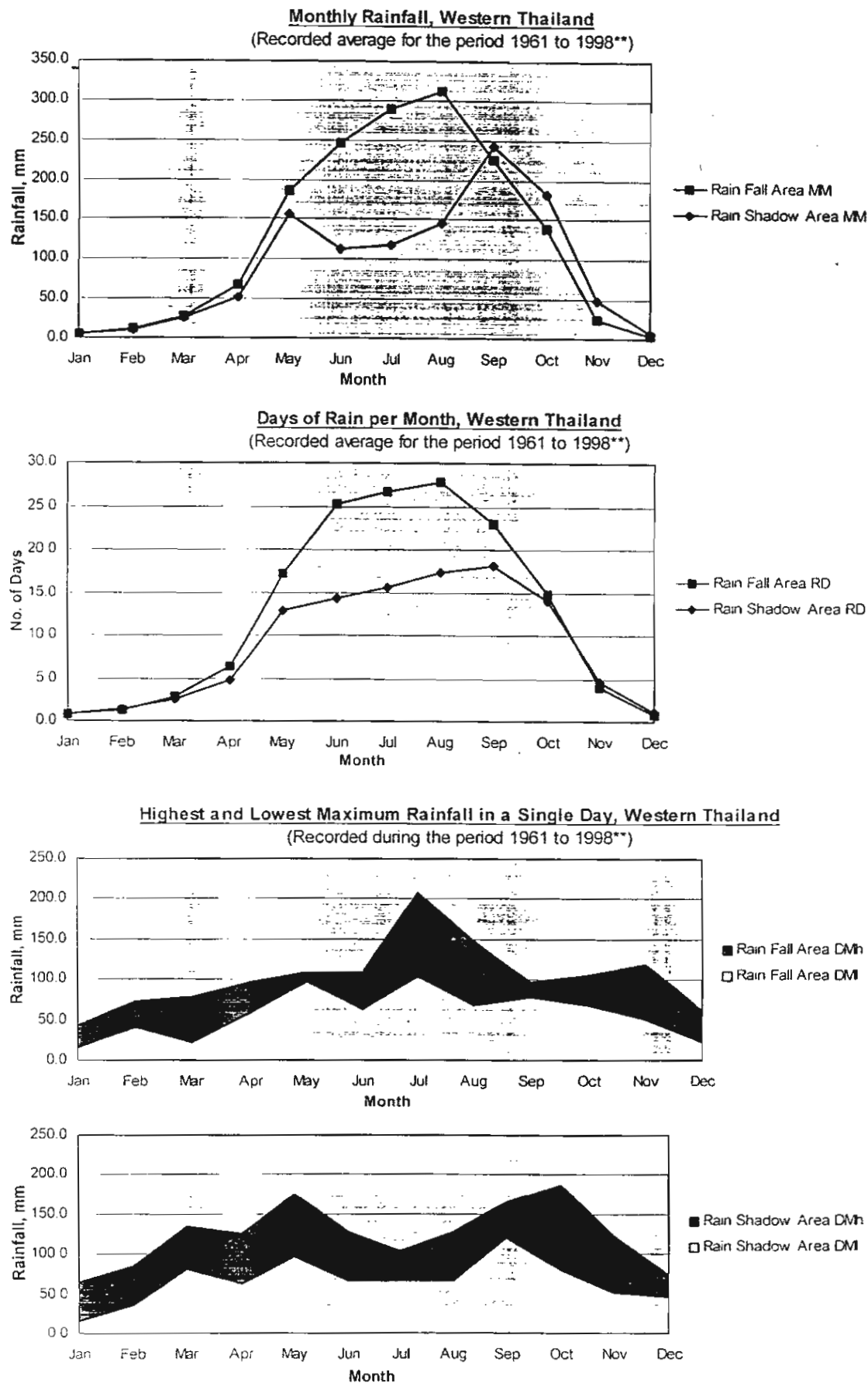


Figure 18. Climatic Data for Umphang.

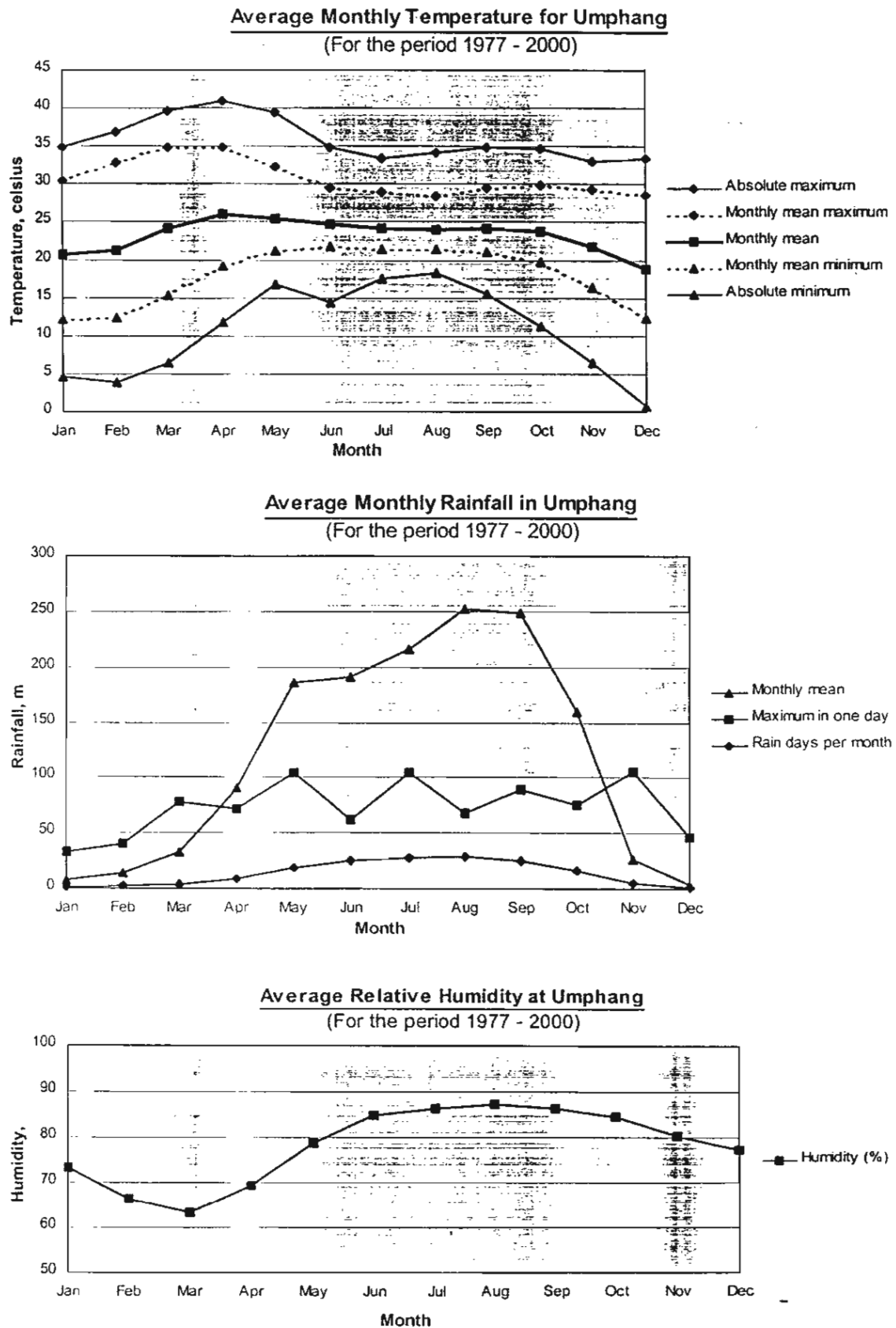
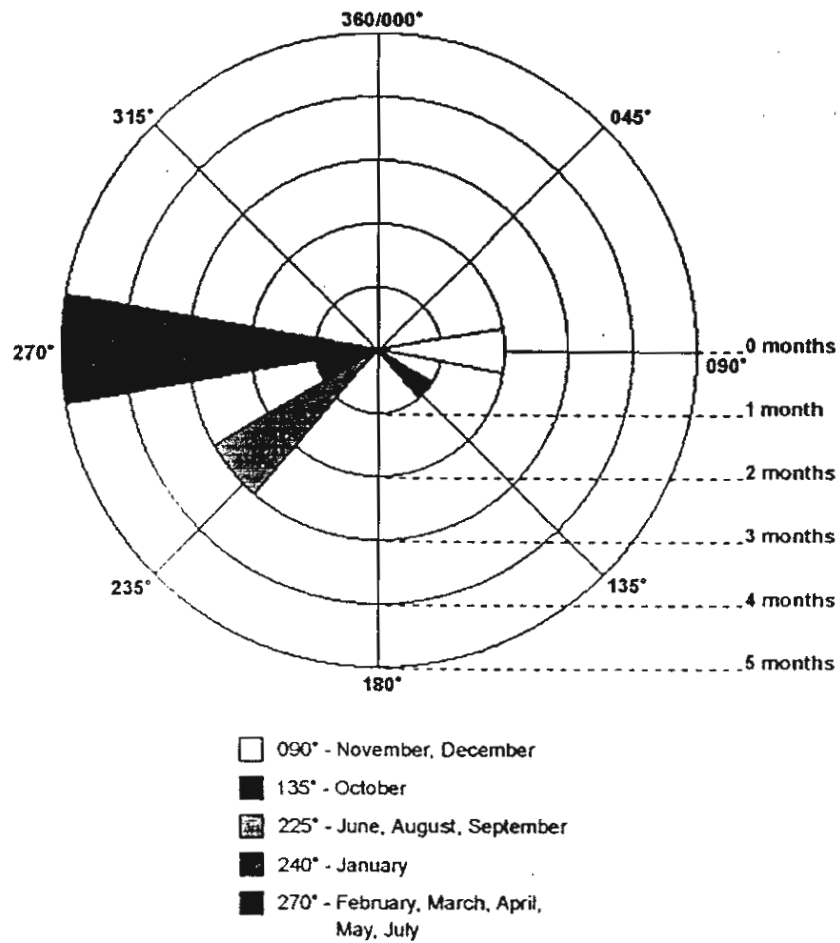


Figure 19. Wind Direction Data for Umphang.



5.2 Cave Environment Measurements in Thungyai Naresuan

Environmental measurements for caves in Thungyai Naresuan are shown in Table 3. The air temperature in caves reflects the local annual mean temperature for the outside (Moore & Sullivan, 1978). Temperature ranges from 16°C to 24°C with an average of 19-20°C. The mean annual temperature for Umphang is 23°C and the difference of 3-4°C corresponds well Medway's suggestion of 5°C change per 1,000m of altitude (Medway, 1964). The relationship of cave air temperature and altitude is shown in Figure 20. Thungyai Naresuan maintains a very consistent altitude of 900-1,100m.a.s.l. producing a very flat relationship with temperature. However, the graph does clearly show that a decrease in altitude equals an increase in temperature. Two sites, TK020 and TK021, do not fit this general trend. They are much cooler than their altitude suggests (21.5 and 20°C at 350m.). These two caves are located in the bottom of the 400m deep gorge of the Mae Khlong River. Only a few hours of sunlight each day reaches this locality creating a small microclimate, much cooler than expected.

Relative humidity is very consistent across all sites at an average of 85-95%. The relationship between humidity and altitude suggests a slight increase in humidity with increasing altitude. As with temperature, this relationship is very flat due to most measured sites being of a similar altitude. The notion that highland areas have higher moisture levels (Gardner, Sidisunthorn & Anusarnsunthorn, 2000) is backed by this data.

A comparison of temperature and humidity to number of entrances and whether the cave is active or inactive was attempted (Figure 21). The data collected contains a bias towards several measurements taken in a few sites during certain seasons and so an accurate relationship cannot be given yet. Many more measurements are needed to confirm or disprove any possible relationships. The results are presented here in the hope that more data will be collected.

The thermal conductivity of water is lower than that of air. Thus cave streams would tend to provide temperature measurements that reflect outside seasonal variations (Moore & Sullivan, 1978). Table 3 shows the results of 13 measurements. Generally cave water temperatures are lower than air temperatures by about 1°C. Not enough measurements have been made yet to show seasonal or annual variations.

Water pH measurements reveal that most cave streams in Thungyai Naresuan are neutral to slightly alkaline (pH = 7.2 to 8.3) thus indicating they are probably saturated with respect to calcium carbonate. One measurement of 6.7 was taken in TK079. This water is not a stream rather it is stagnant water from a nearby marsh.

Table 3. Cave Environment Measurements.

No.	Date of Measure	Cave	No. of Entrances	Active ?	Altitude m.a.s.l.	Air Temp	Humidity %	Water Temp	pH
1	16/11/98	TK001	1	1	920	22	91	20.5	7.5
2	16/11/98	TK002	1	2	950	24	75		
3	17/11/98	TK005	2	1	910	21	86	19	8.1
4	17/11/98	TK007	2	2	970	20	91		
5	18/11/98	TK008	1	2	940	22.5	91		
6	18/11/98	TK008	1	2	925	22	91		
7	19/11/98	TK009	1	1	880	21	95	20	8.3
8	22/11/98	TK012	2	1	1080	18.5	95	18	7.8
9	28/11/98	TK017	2	2	860	20	95		
10	08/01/99	TK020	1	1	320	21.5	95	20.5	7.2
11	09/01/99	TK021	1	2	370	20	81		
12	15/01/99	TK032	1	2	1100	20.5	86		
13	18/01/99	TK012	2	1	1080	19	95		
14	19/01/99	TK025	2	1	1090	17	90	16	8.2
15	21/01/99	TK036	2	1	1090	17.5	90	17	8.3
16	21/01/99	TK036	2	1	1090	17.5	85	16.5	8.2
17	21/01/99	TK036	2	1	1090	17	95		
18	21/01/99	TK025	2	1	1090	17	95	16.5	8.1
19	21/01/99	TK025	2	1	1090	17	95	16.5	8.2
20	22/01/99	TK034	2	2	1100	16.5	89		
21	22/01/99	TK034	2	2	1100	17	85		
22	23/02/99	TK034	2	2	1100	16.5	95		
23	24/02/99	TK034	2	2	1100	16	89		
24	24/02/99	TK034	2	2	1100	17	85		
25	24/02/99	TK034	2	2	1100	17	90		
26	24/02/99	TK034	2	2	1100	17	90		
27	25/02/99	TK011	1	2	1090	19.5	86		
28	26/02/99	TK034	2	2	1100	16.5	95		
29	26/02/99	TK034	2	2	1100	17.5	90		
30	21/04/99	TK049	2	1	1070	22	82	20	
31	01/05/99	TK011	2	2	1090	19	97		
32	02/05/99	TK049	2	1	1070	20	100		
33	03/05/99	TK012	2	1	1080	19.5	97	20	
34	22/08/99	TK062	1	1	950	22	95		
35	03/12/99	TK082	1	1	920	20	95		
36	05/12/99	TK079	2	1	920	20	93	18	6.7

Number of Entrances

1 = Single entrance

2 = Multiple entrances

Active?

1 = Active cave

2 = Inactive cave

Figure 20. Cave Air Temperature and Humidity vs. Altitude.

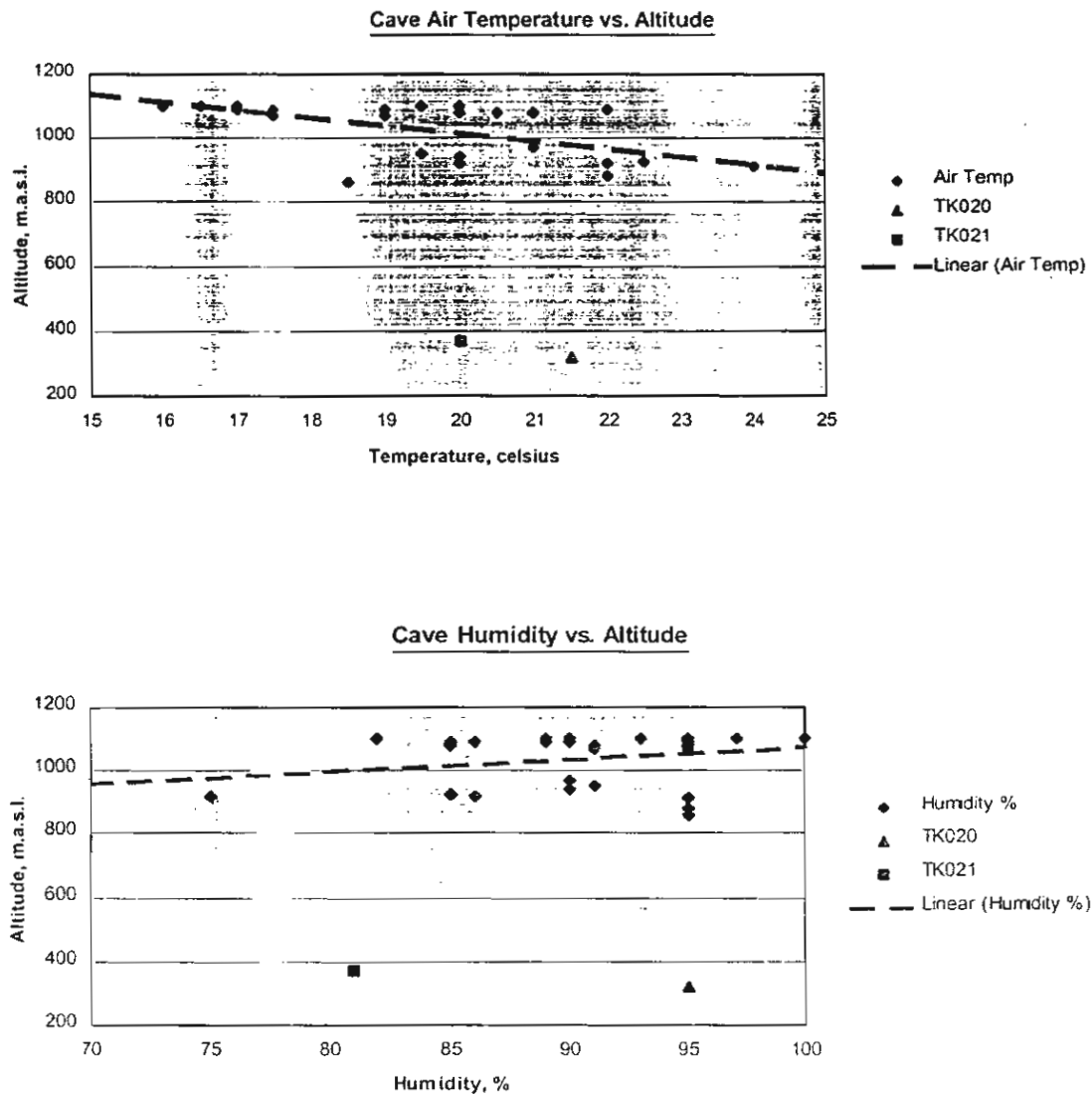
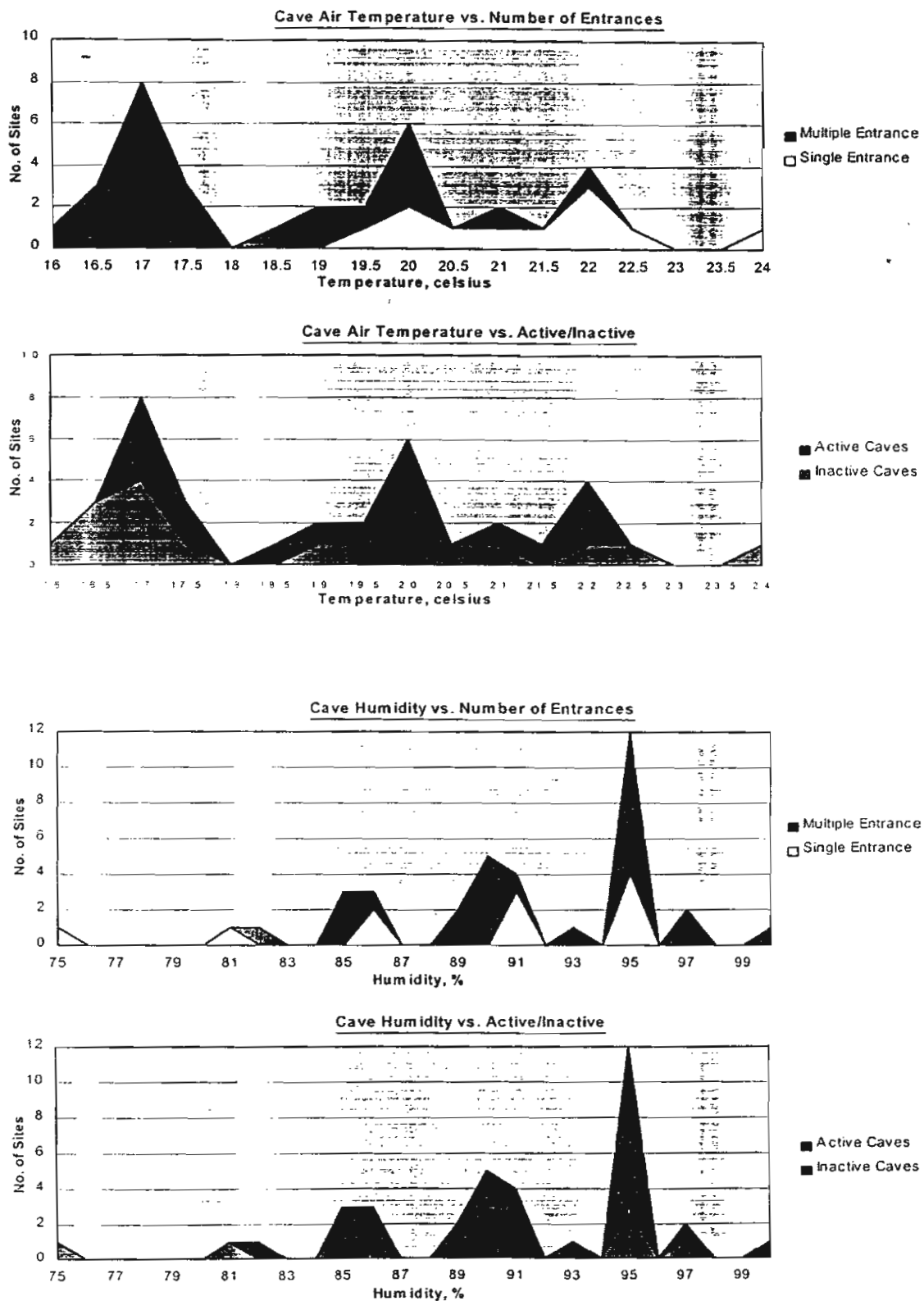


Figure 21. Cave Air Temperature & Humidity vs. No. of Entrances & Active/Inactive.



6. Cave Geology

6.1 Cave Passage Orientation

Of the caves explored and surveyed, six are of sufficient length to make a study of the overall passage orientation worthwhile. These six caves are Tham Nam Mut Utakhi (TK009), Tham Than Lot (TK012), Tham Molakot (TK025), Tham Seua (TK034), Tham Phet (TK036) and Tham Mor (TK049). Passage orientation diagrams based on total length of passage are shown in Figure 22.

An analysis of cave passage orientation has also been carried out for caves in Mae Hong Son (Kiernan, 1988). The conclusion drawn from this area is that some caves follow the strike of folded bedding planes and others follow no more than 3 or 4 principal joint trends. A situation not dissimilar to caves in Thungyai Naresuan.

To make the following interpretations the cave surveys, the morphology of the cave passages and field measurements have been also used in conjunction with the orientation diagrams.

Tham Nam Mut Utakhi (TK009).

This cave shows a very strong preferred orientation of 085-265 with a second, minor trend towards 005-185. A major, structural discontinuity such as a fault(s) is inferred to have guided development of much of the cave in the 085-265 direction. Where the cave does trend 005-185, the stream passage is smaller and tends to sump, i.e. at the entrance, in the middle of the cave and at the downstream sump. It is likely that these parts follow the bedding of the limestone between the inferred fault(s). The trend of 135-315 is hardly represented in the cave.

Tham Than Lot (TK012).

The surveyed length of this cave is 1,866m and the passages show a broad orientation around 165-345 (range = 090-270 to 240-060). There is a distinct lack of passages orientated 075-255. Structural discontinuities in the form of small faults and joints guide the central part of the cave in a 165-345 to 195-015 trend. The larger passages of the Western and Eastern sectors have a variable orientation with long, sweeping bends indicating development along the strike of folded bedding planes. The general strike of the bedding would be approximately 140-320.

Tham Molakot (TK025).

This cave exhibits at least three sets of passage orientation. The main trend is 040-220 and includes the downstream half of the cave and it's associated upper levels. These passages are guided by a large fault. On the SE side of this fault, bedding dips 25° NE with a strike of 120-300. On the NW side, it dips 22° N and strikes 075-255. In the middle of the cave, the trend changes to 120-300. A second, nearly perpendicular fault is inferred. A smaller, third trend is noticeable about 150-330. This includes the small inlet near the resurgence entrance that is developed along the strike of the bedding.

Tham Seua (TK034).

This very complex cave shows very little preferred orientation. No confident deductions can be made about geological control except that passages orientated around 065-245 are less frequent. The cave has formed phreatically along any and every available discontinuity, later developing a vadose overprint.

Tham Phet (TK036).

Two strong trends orientated 000-180 and 135-315 characterise this cave. Both the stream passage and the upper levels follow these trends. Two series of small faults/joints, angled at 45° to each other, are inferred with the cave alternating between them. In places short sections of passage have utilised the strike of the bedding at 045-225 to jump across. There is a lack of passages trending 070-250.

Tham Mor (TK049).

A very complex cave that exhibits a strong orientation centred on 120-300 with another, minor trend along 000-180. The major trend is shown by the stream passage and associated upper level. These passages follow a virtually straight line along an inferred large fault or other kind of fracture. The rest of the cave consists of upper levels with a less clear orientation pattern, although the diagram suggests a weak 010-190 preference. A set of small faults or joints is probably responsible for this trend. Passages orientated 065-245 are lacking.

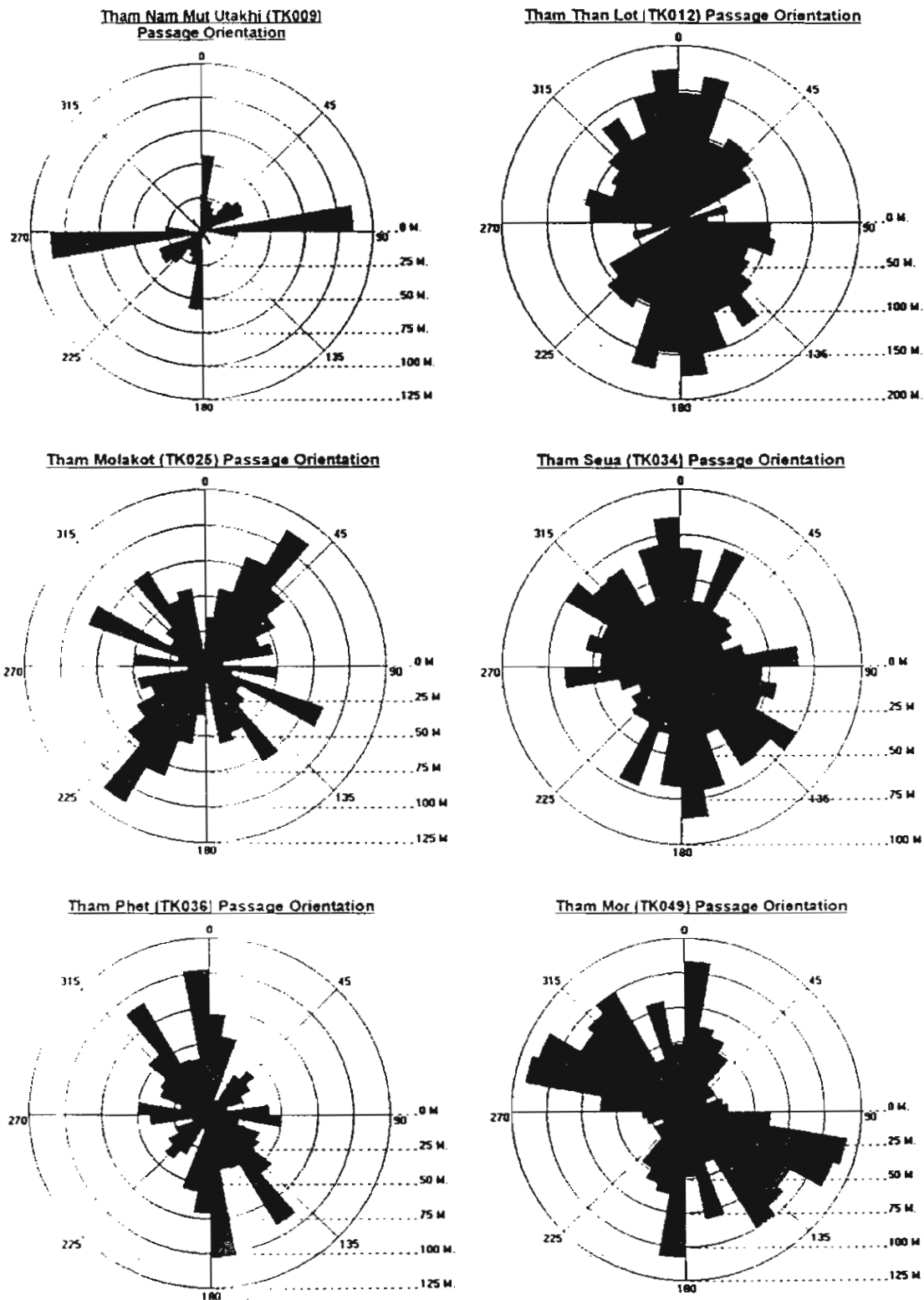
Comparison Between Caves.

Five of the caves (Tham Than Lot, Tham Molakot Tham Seua, Tham Phet and Tham Mor) are located in the same Huai Nam Khieo area. Any similarities between passage orientations may represent the geology of that area as a whole.

A trend centred on 000-180 is seen in 4 of the 5 caves. These passages are developed along a set of small, parallel joints/ faults. Another similar set may be shown by the 150-330 trend of all the caves though this is less clear. The major fault of Tham Molakot (040-220) is not seen in any of the other caves and is assumed to be a singular feature. The second fault of this cave, orientated 120-300, is paralleled by a similar feature in Tham Mor suggesting the possible presence of a series of widely spaced, larger parallel faults. Bedding dip and strike measurements vary widely across the area making broad interpretations difficult.

Four of the five caves show a distinct lack of passages orientated 065-245 to 070-250. The geology of the area therefore lacks structural discontinuities with this trend.

Figure 22. Passage Orientation Diagrams for Total Passage Length of Selected Caves.



7. Thailand Caves Database

7.1 Aims

This database is intended to fulfil a dramatic and obvious need in the field of speleology in Thailand. It was developed using the Visual Basic for Access programming language in Microsoft Access 97.

Much information already exists concerning Thai caves making Thailand speleologically one of the better known of the SE Asian countries. However, this data is spread through numerous reports, technical essays, magazine articles, newspaper stories and television reports. The data lacks consistency in both quality and content and is difficult to access due to the various authors' use of different languages, style and intention. The main aim of this database is therefore to bring all existing data together into a single, consistent entity. A standard data input format has been devised to help achieve this by eliminating subjectivity as much as possible and offering the user data input options. Hopefully this format will also influence how raw field data is collected in the future. Once data has been entered, it is very simple to edit, add or delete. Access to the stored data is via a fully user defined search system based on one or two parameters. Retrieved data can be viewed, printed or sent to other applications. The database has an interface that is visually pleasing and is easy to navigate through.

Three groups of people are the conceived users of the database - land managers, researchers and general interest groups. Land managers, especially the Royal Forest Department, will be able to determine where a particular cave stands in terms of significance, vulnerability and potential in a local and/or national context. Decisions concerning protection or development can then be made more objectively than they are at present. The data, though basic, will provide scientists with possible research opportunities and study sites and hopefully will stimulate ideas for new areas of investigation. General interest groups may include journalists, tour guides, adventurers and local people.

7.2 Database Operation

A shortcut with icon to the database is stored on the desktop. Double clicking on this will open the database at the Welcome Screen (Figure 23).

This screen displays the following features:

- Welcome message
- 'Input New Cave' button
- 'Edit Known Cave' button
- 'View Cave Data' button
- Logos of the developers, sponsors, etc
- Total Caves
- 'Players' button

Clicking one of the 'Input', 'Edit' or 'View' buttons will open the appropriate page for the required action. These sections are described in detail later. The 'Players' button opens a small page displaying a very brief description of the project and database and the names of the people involved (Figure 24). It also contains contact details if the user has suggestions, comments, data to add or changes to make. 'Total Caves' is a running total of the number of caves currently stored in the database. This updates automatically

when a new entry or deletion is made. The standard 'Menu Bar' toolbar provided by Microsoft Access appears at the top of each page to aid working with this application. The Print Preview Page also contains the 'Print Preview' toolbar. All other toolbars have been removed although they can be easily recalled if required. Running along the bottom is a status bar that contains messages explaining how to use the database.

Figure 23. Welcome Screen.

Thailand Caves Database - [Welcome]

File Edit View Insert Format Records Tools Window Help

Welcome
to the
THAILAND CAVES DATABASE

What would you like to do?

[Input New Cave](#) [Edit Known Cave](#) [View Cave Data](#)

Developed by:
Thungyai Naresuan
Cave Survey
Project

Funded by:

Administered by:

With assistance from:
THE SIAM SOCIETY
CAVING SUPPLIES
DURACELL VSO COMPASS

TOTAL CAVES
53

Players

Hello and welcome to the Thailand Caves Database. Please click a button to proceed.

NUM

Figure 24. 'Players' Screen.

Thailand Caves Database - [Welcome]

File Edit View Insert Format Records Tools Window Help

Thailand Caves Database - Project Personnel
Thungyai Naresuan Cave Survey Project

Thungyai Naresuan Wildlife Sanctuary comprises part of a vast tract of limestone karst located in western Thailand and is home to many fine caves. This project set out to find, explore and survey those caves and to use the data gained to develop a cave database. Here is the result - Feb 2002. Please enjoy and remember - cave safely.

Project Staff:

Project Head: Nooparat Nakasathit
Head Researcher: Dean Smart
Assistant Researchers:
Anukoon Som-Ek, Yan, Kiu
Admin: Piyarat ChenChon
Survey Team:
Hoi Lun Wit, Surat Kham
Survey Friends:
Terry Bolger, Simon Brooks, Paul Edmunds, Anna Rita Rivelli, Ron Simmons, Steve Smith, Steven White

Other Players:

Funding From: Thailand Research Fund
Endorsed by: Royal Forest Department
Sanctuary Staff:
Witaya Weerasamphan (Chief),
Santhi Wongkulwatt (Chief),
Somphot Maneevat (Ass. Chief)
Advocacy:
The Siam Society, VSO Thailand
Discounted Prices:
Compass Technology (computer),
Caving Supplies Ltd (caving gear),
Duracell Batteries

TOTAL CAVES
53

Players

Form View

NUM

7.3 Data Input, Editing and Viewing

7.3.1 The Data

The pages for input, editing and viewing data are all based on the same template. They have different colours to help the user distinguish them easily - grey for input, light blue for editing and orange for viewing.

The top section of the pages is occupied by the page title, the unique site code for the cave, the name of the cave in English and Thai, the location details and a box of navigation buttons. The navigation buttons make it convenient to change between the various pages, save data, delete data, print and close the currently displayed page.

The lower portion contains a series of sub-pages for a variety of data subjects. The different subjects can be selected by clicking on the appropriate tab displayed along the top of the section. Subjects offered are Description, Geology, Hydrology, Biology, Palaeontology, Archaeology, Culture, Environment and Management.

A description of the data fields by subject follows in Table 4.

Table 4. Details of Database Data Fields.

- **Location** (Details of the cave location, displayed on all data pages)

Site code	Unique code for each cave, automatic	Auto
English Names	Name or names of cave in English	Text
Thai Names	Name or names of cave in Thai	Text
Province	Name of Province, select from drop-down list	Text
District	Name of District, select from drop-down list	Text
Protected Area	Name of Protected Area, select from drop-down list	Text
Zone	Zone of Thailand, e.g. north, south, northeast, etc.	Text
UTM Zone	UTM zone, e.g. 47P	Text
Easting	UTM eastings coordinate	Number
Northing	UTM northings coordinate	Number
Latitude	Latitude coordinate	Number
Longitude	Longitude coordinate	Number
Elevation, m	Elevation above sea level in metres	Number
Mapsheet	1:50,000 map sheet number, e.g. 4839 IV	Text
Length, m	Length of cave in metres	Number
Depth, m	Depth of cave in metres	Number
Survey	Hyperlink to cave survey file	Link

Table 4. Details of Database Data Fields – Continued.

- **Description** (Description of general aspects)

Access Description	How to get to and find the cave entrance	Text
General Description	Route finding and difficulties inside the cave	Text
Technical Description	Equipment required to explore the cave	Text
Dangers	Causes of injury or death during exploration	Text
Outstanding Values	What makes the cave significant	Text
References	Code numbers of references to the cave	Text

- **Geology** (Description of geological aspects)

Geology Description	Description of the geology, morphology, etc	Text
Rock Type	Type of rock the cave formed in. Choose from list	Text
Rock Age	Age of rock the cave formed in. Choose from list	Text
Sediments	Description of sediment in the cave	Text
Speleothems	Description of speleothems in the cave	Text
Further Data	Any further geology data not included above	Text

- **Hydrology** (Description of hydrological aspects)

Hydrology Description	General description of the hydrology	Text
River System	Name of river the stream joins. Choose from list	Text
Stream Name	Name of stream flowing through the cave	Text
Catchment Area, km ²	Size of catchment area in square kilometres	Number
Flow Rate, cumec	Amount of water flowing in cumecs	Number
Traced To/From	Names of caves dye traced to or from this cave	Text
Further Data	Any further hydrology data not included above	Text

- **Biology** (Description of biological aspects)

Biology Description	General description of the biology	Text
Identified Species	Names of species ordinary found in the cave	Text
Unusual Species	Names of rare, endemic, troglobitic, etc. species	Text
Food Supply	Types of food supply routes. Choose from list	Text
Further Data	Any further biology data not included above	Text

Table 4. Details of Database Data Fields – Continued.

- **Palaeontology** (Description of palaeontological aspects)

Palaeontology Description	General description of the palaeontology	Text
Species List	Names of the species found	Text
Age Range	Age range of the material found	Text
Further Data	Further palaeontology data not incl. above	Text

- **Archaeology** (Description of archaeological aspects)

Archaeology Description	General description of the archaeology	Text
Artifacts List	List of artifacts found in the cave	Text
Excavated Who + When	Name of excavator and date	Text
Age Range	Age range of material found	Text
Further Data	Further archaeology data not included above	Text

- **Culture** (Description of cultural aspects)

Cultural Description	General description of the cultural uses	Text
Artifacts List	List of artifacts found in the cave	Text
Type of Use	How the cave was used, e.g. temple, hideout, etc.	Text
Date of Use	Time of usage	Text
Further Data	Any further cultural data not included above	Text

- **Environment** (Description of environmental aspects)

Environment Description	General description of the environment	Text
Air Temp, C	Average air temperature, degrees Celsius	Number
Humidity, %	Average relative humidity, %	Number
Water Temp, C	Average water temperature, degrees Celsius	Number
Water pH	Average acidity of the water, pH	Number
CO2, High %	Highest measured carbon dioxide level, %	Number
O2, Low %	Lowest measured oxygen level, %	Number
Other Measurements	Any other measurements carried out	Text
Further Data	Further environment data not included above	Text

Table 4. Details of Database Data Fields – Continued.

• **Management** (Description of management aspects)

Management Description	General description of the management	Text
Classification	Management classification. Choose from list	Number
Special Purpose	Reason for classifying under special purpose	Text
Comparison Site	Site code of elected comparison site	Number
Energy Rating	Energy rating of the cave. Choose from list	Text
Manager	Name of manager of cave. Choose from list	Text
Impacts	List of impacts inflicted upon the cave	Text
Impact Source	Source of those impacts	Text
Development	Description of infrastructure inside or outside	Text
Further Data	Further management data not included above	Text

7.3.2 Input Data

Clicking the 'Input New Cave' button on the Welcome page or the 'New Cave' button on the navigation box opens the Input Page (Figure 25). This page is coloured grey and opens with every field blank except for "(AutoNumber)" written the Site Code field. This code is automatically selected by the database when the first data is entered and is not user definable.

Figure 25. Data Input Page.

THAILAND CAVES DATABASE - INPUT

Site Code: 175

English Names: Tham Meud, Tham Reua

Thai Names: ถ้ำเหมือด, ถ้ำเรอ

Province: Nakhon Si Thammarat

District: Lan Sak

Protect Area: South

Zone: South

UTM Zone: 47P

Eastings: 587821

Northings: 923263

Elevation, m: 80

Mapsheet: 49251

Length, m: 486

Depth, m: 486

Latitude:

Longitude:

Survey: C:\Cave Database\Maps\Nakhon Si Thammarat\Meud.tit

Description | Geology | Hydrology | Biology | Paleontology | Archaeology | Culture | Environment | Management

Access Description

3km from Lan Sak town on the road to Ron Phibun. Entrance is behind school next to Wat Chai Khao at the base of the prominent limestone mountain

General Description

Easy walking in 3m diameter tunnel with lots of slippery mud. Leads after 300m to sharp left hand bend. Passage becomes 10m wide with sloping floor and roof and large speleothems along left wall. Outflow entrance is met after 80m with another larger entrance beyond. Small inlet remains

Technical Description

None

Dangers

Possible flooding

Outstanding Values

Fine example of how nature can dramatically impact a cave - 1988 flood deposited mud

References

Record: 1 of 1

General description of the cave including size, route finding, difficulties, etc

NUM

None of the fields are required to have data in order to make an entry. However, it is strongly recommended that the absolute minimum data for a valid entry would be:

- Name
- Province
- Protected Area
- UTM zone and coordinates
- Elevation
- Length
- Depth
- Survey hyperlink
- Access Description
- General Description
- Technical Description
- Dangers
- Outstanding Values

To aid input and to help standardise the data, drop-down 'combo' lists have been used wherever possible (Figure 26). These offer a choice of the most commonly used names or terms for the data concerned. Input is not restricted to the choices offered by the list, although most eventualities have been catered for and every attempt should be made to adhere to them. Some fields require just a number input, for example, Elevation and Air Temperature. All numbers use metric units, i.e. metres, degrees Celsius, percent and pH. The units are displayed on the page and do not need to be entered, as data, in fact they can't be. Description fields use text as data. Most descriptions are restricted in size to 255 characters to force the user to make brief, informative inputs and also to limit the amount of data stored. Stored data for the caves of Thungyai Naresuan East provide style and composition examples of how descriptions should be written.

Figure 26. Example of a Drop-Down Combo Box - Manager Name.

Thailand Caves Database - Input

Site Code: 174

English Names: Tham Hong
 Thai Names: หงษ์
 Province: Nakhon Si Thammarat
 District: Nopitarn
 Protected Area: NP Khao Nan
 Zone: South

UTM Zone: 47P Eastings: 570275 Northings: 965136
 Elevation, m: 160 Mapsheet: 4926 III Length, m: 327 Depth, m: 11

Latitude: Longitude: Survey: C:\Cave Database\Maps\Nakhon Si Thammarat\Hong.tif

Description: Geology: Hydrology: Biology: Palaeontology: Archaeology: Culture: Environment: Management

Management Description: Promoted for adventure tourism by the NP since 1998 c.50 visitors/week. Rangers are guides with electric headtorches. No gear available for tourists.

Impacts: No sign in very good condition, a few broken speleothems.

Impact Source: No sign

Classification: 1.1
 Special Purpose:
 Comparison Site: Energy Rating: High
 Manager: Tourism Authority of Thailand, Royal Forest Department, Department of Mineral Resources, Department of Religious Affairs, Electricity Generating Authority of Thailand

Record: 14 of 1
 Select who is the manager of the cave

After the data has been entered into the page, the cave must be saved into the database. Clicking on the 'Save Cave' button in the navigation box will open a small box asking for confirmation on the save action. Click 'OK' to proceed and save the entry. The input page will now be cleared of data awaiting input of a new cave.

7.3.3 Editing Data

The Edit Page is pale blue in colour and is used to edit data already saved in the database (Figure 27).

Figure 27. Edit Data Page.

Thailand Caves Database - [Edit Cave Data]

File Edit View Insert Format Records Tools Window Help

THAILAND CAVES DATABASE - EDIT Site Code: 12

English Names: Tham Than Lot TK012 Province: Tak
 Thai Names: ถ้ำทะนลอด District: Umphang
 Protect Area: WS Thungyai Naresuan East
 Zone: North

UTM Zone: 47P Eastings: 505509 Northings: 1702168 Elevation, m: 1080 Mapsheet: 4839 IV Length, m: 1866 Depth, m: 28
 Latitude: 15.3973103 Longitude: 99.0513382 Survey: C:\Cave Database\Maps\Tak\TK0012.M

Description | Geology | Hydrology | Biology | Paleontology | Archeology | Culture | Environment | Management

Environment Description
 Long, active and semi-active cave with multiple entrances. Found in a small hill with good forest cover. High humidity.

Other Measurements

Air Temp, C	19
Humidity, %	96
Water Temp, C	19
Water pH	7.8
CO2, High %	
O2, Low %	

Record: 14 of 1
 Total depth of cave, metres: NUM

Access to the Edit Page can be made in three ways. Two of these require knowing the unique site code of the cave concerned. Clicking on the 'Edit Known Cave' button of the Welcome Page or the 'Edit Cave' button of the navigation box opens a small page asking for input of the site code (Figure 28). Simply type in the number, click the search button and the Edit Page will open displaying all of the stored data for that particular cave.

If the site code is not known, the data can be accessed via the Search and View pages. Open the Search Page and enter criteria that is likely to find the cave to be edited. Look through the results of the search and when the required cave is found, click the 'Edit Cave' button on the navigation box. The Edit Page will open displaying the data for that cave and editing can begin. The procedure for searching and viewing is explained in more detail below.

Once the edits have been completed, the cave needs to be saved by clicking on the 'Save Cave' button on the navigation box.

To delete an entire cave, open it in the Edit Page and click the 'Delete Cave' button on the navigation box. The user will be asked to confirm the deletion before the action is carried out. Note that all data, including the Site Code will be lost.

Figure 28. Enter the Site Code of the Cave to be Edited.

Thailand Caves Database - [Welcome]

File Edit View Insert Format Records Tools Window Help

Welcome
Thailand Caves Database - Enter Edit Code

Enter Site Code

12

Input New Save Data

Developed by:
Thungyai Naresuan
Cave Survey
Project

Funded by:

Administered by:

With assistance from:
THE SLAM SOCIETY
UNIVERSITY PATRONAGE
OURACELL VSO CATHASS

CAVING SUPPLIES Ltd

TOTAL CAVES
33

Pages

Hello and welcome to the Thailand Caves Database. Please click a button to proceed.

NUM

7.3.4 Viewing Data

The View Data Page is orange in colour and displays data for viewing and printing purposes only (Figure 29). No inputs, deletions or edits can be made.

Figure 29. View Data Page.

Thailand Caves Database - [View Cave Data]

File Edit View Insert Format Records Tools Window Help

THAILAND CAVES DATABASE - VIEW

Site Code 2

English Names
Tham Tasukha 2

Thai Names
ถ้ำตะสุกา ๒

Province
Tak

District
Umphang

Protect Area
WS Thungyai Naresuan East

Zone
North

UTM Zone
47P

Eastings
505083

Northings
1737610

Elevation, m
950

Mapsheet
4840 III

Length, m
185

Depth, m
1.4

Latitude
15 71 35.036

Longitude
99 04 47.313

Survey
C:\Cave Database\Maps\Tak\T1 0002.M

Description | Geology | Hydrology | Biology | Paleontology | Archaeology | Culture | Environment | Management

Environment Description
Short cave with a single entrance, no airflow and no flowing water
Very warm for this elevation and with low humidity

Air Temp, C
24

Humidity, %
75

Other Measurements

Water Temp, C

Water pH

CO2, High %

O2, Low %

Further Data

Record 1 of 4

Atmospheric carbon dioxide measurement, maximum %

NUM

To view the data, a search needs to be carried out. The search is based on either one or two criteria selected by the user and can be very effective in narrowing down the number of caves displayed. Begin a search by clicking the 'View Cave Data' button of the Welcome Page or the 'Search' button of the navigation box. The Search Page will open (Figure 30).

Figure 30. Enter Search Criteria for Viewing Cave Data.

Search criteria are selected using the Subject-Field-Value system of the database itself. A subject is chosen from the first drop-down combo box provided. Subject titles are Location, Description, Geology, Hydrology, Biology, Palaeontology, Archaeology, Culture, Environment and Management. Next a data field is chosen for that particular subject from the second drop-down combo box. As each subject contains a different set of data field types, only the titles of the fields stored within the chosen subject are displayed. For example, if the subject Hydrology is chosen, the data field choices would be Hydrology Description, River System, Stream Name, Catchment Area, Flow Rate, Traced To/From and Further Data.

Following selection of subject and data field, an operator is required which is chosen from a drop-down combo box provided. Text field operators are '=', '<>' and 'Like' and number field operators are '=', '<>', '<' and '>'. The operator drop-down combo box automatically displays the appropriate operators for the selected data field.

A value is now entered to restrict the search to the required limits. Obviously a text data field requires a text value and a number data field requires a number value. If 'Like' is chosen as the operator, the text value should include bounding asterisks or the search will be the equivalent of a '=' search. For example, '*Tham*' would search for and find 'Tham' anywhere in the chosen data field, whereas 'Tham' would find only caves where the entire data field entry is simply 'Tham'.

To begin the search, click the 'Search' button at the bottom of the page. For a single criterion search, only section 1 needs to be completed before pressing the 'Search'

button. For a two criteria search, section 2 also needs to be completed and an 'And/Or' type of search chosen.

The 'And/Or' selection decides how the two criteria relate to each other during the search. Chosen from a drop-down combo box, 'And' finds caves where both criteria 1 and criteria 2 are satisfied coincidentally. 'Or' finds caves that satisfy either criteria 1 or criteria 2. For example, a search for 'Location, Province = Tak' - 'AND' - 'Location, Length > 1000' would find only caves longer than 1km that are found in Tak Province. Alternatively the same search, using 'OR', would find all caves in Tak Province together with all caves longer than 1km in the entire country.

After the search has finished, a small, dialog box opens displaying the number of caves found. If the number is acceptable, clicking 'OK' will open the View Data Page at the first cave found. If the search returns too many caves, the user can click 'Cancel' and return to try to narrow the search a bit more. If zero caves are found, a different dialog box opens suggesting that a new search be tried.

Once the View Data Page opens, the caves can be scrolled through using the selector bar at the bottom of the page. Subject data are displayed by clicking the appropriate tab along the top of the subject sub-page. Note that only data fields containing data will display information. The rest will appear blank. In the event of a subject not containing any data, that subject's sub-page will appear without any data fields.

Once the cave of interest has been reached, the data can either be edited by clicking the 'Edit Cave' button (see earlier) or printed out by clicking the 'Print' button. Both buttons are on the navigation box.

Clicking the 'Print' button opens the Print Preview Page (Figure 31).

Figure 31. Print Preview Page.

The screenshot shows a software application titled "Thailand Caves Database - [Cave Data]". It features a standard Windows-style interface with a menu bar (File, Edit, View, Tools, Window, Help) and a toolbar. The main workspace is split into two vertical panes. The left pane displays a form for entering cave data, with fields for "Cave Name", "Province", "District", "Sub-district", and various numerical fields for coordinates and measurements. The right pane shows a "Print Preview" of the data entered in the left pane, formatted for printing. At the bottom of the right pane, there is a "Print" button. The status bar at the very bottom of the window shows "Page: 1 of 1" and "Ready".

The data is displayed in a form that is ready to print. Subjects that do not contain any data will not appear on the printout.

7.4 Censorship of the Data

Some of the data to be contained within the database is considered sensitive. Distribution of this data may lead to certain caves and their contents being damaged, lost or even destroyed. This data includes information about the location of certain caves, valuable archaeological material and rare and endangered species. Current management provisions are inadequate to prevent the damage from happening if the data were to be in the public domain, so restrictions on access to the data need to be made.

Censorship is not an intrinsic part of the database and once inside, all of the data is available for viewing. This problem has been solved by installing the database on just two computers - one held by the Wildlife Conservation Division of the Royal Forest Department and the other by the author of this report. Requests for information are sent to one of the database trustees and a decision to fulfil the request is made on an individual merit basis and on the nature of the data required. For example, an antique dealer would not be given data on archaeological artifacts and an adventure tour company would not receive access details for a particularly vulnerable cave, etc. Another advantage of using this limited number of access terminals method is that updates can be easily and quickly transferred over. There will also always be another exact copy should one be lost.

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8.1 Maps

1:50,000 Topographic Maps

- Khao Khron Do, *sheet 4639I*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Amphoe Sangkhlaburi, *sheet 4639II*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Khao Bo Ngam, *sheet 4738I*, series L7017, edition 2-RTSD, Royal Thai Survey Dept., Bangkok, 1980.
- Ban Tha Madua, *sheet 4738IV*, series L7017, edition 2-RTSD, Royal Thai Survey Dept., Bangkok, 1980.
- Khao Dika, *sheet 4739II*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Khao Kaphrieo Daeng, *sheet 4739I*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Ban Thi Mong Tha, *sheet 4739III*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Ban Lai Wo, *sheet 4739IV*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Nam Mae Chan, *sheet 4740II*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Ban Yang Daeng, *sheet 4740III*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Ban Nong Ma, *sheet 4839III*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Ban Samian La, *sheet 4839IV*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.
- Huai Kha Khaeng, *sheet 4840III*, series L7017, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1969.

8.2 Other Maps

- Ye, *sheet 47-2*, series U542, edition 1-RTSD, Royal Thai Survey Dept., Bangkok, 1966. 1:250,000 topographic map.
- Changwat Nakhon Sawan, *sheet 47-3*, series 1501 S, edition 2-RTSD, Royal Thai Survey Dept., Bangkok, 1984. 1:250,000 topographic map.
- Ye, *Sheet ND 47-2*, Geological Survey Div., Dept. of Mineral Resources, Bangkok, 1976. 1:250:000 geological map.
- Changwat Nakhon Sawan, *Sheet ND 47-3*, Geological Survey Div., Dept. of Mineral Resources, Bangkok, 1985. 1:250:000 geological map.

8.3 Laws

- Wild Animal Reservation and Protection Act (WARPA)*. B.E. 2535 (1992). (Unofficial English Translation by Reik, D. 1996. Nordic Consultings Group)

APPENDIX

Cave Descriptions **and Surveys**

Taken from the
THAILAND CAVES DATABASE

Thailand Caves Database

Site Code 1

English Names

Tham Tasukhi 1, TK001

Thai Names

ถ้ำตะสุคี 1 TK001

Location

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4840 III	47P	505112	1737571	15.717399	99.047706
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
920	108	4	C:\Cave Database\Maps\Tak\TK0001.tif		

Access Description

Walk c.3km SE of Mae Jan Tha ranger station. Entrance is in boulders where stream sinks at the edge of disused fields

General Description

Seasonally active stream sink. Short climb down through boulders reaches easy walking in large passage. This ends at a choke.

Technical Description

None

Dangers

Floods severely in wet weather

Outstanding Values

Impressive mud banks

Geology

Description

Phreatic origin along faults. Thick sediment deposits mask the passage shape

Rock Type

Limestone

Rock Age

Triassic

Sediments

Extensive mud banks up to 3m high deposited by ponded water

Speleothems

Common types

Hydrology

Description

Stream sink cave with presumed resurgence about 500m to the NE

River System

Mae Khlong

Stream Name

Catchment Area, km²

0.5

Flow, Cumec

0

Further Data

date – November

Thailand Caves Database

Site Code 1

Biology

Description

Much sediment and vegetation brought in by floods. Large mudbank community with some bat guano

Identified Species

Cricket; worm; fly; web-spinning spider; Glyphillus; opilione; bat - >3 sp. Hipposideros larvatus, H. sp; Scutigera; crab; cave racer snake; frog

Unusual Species

Gecko - R

Food Supply Routes

Stream, Guano

Environment

Description

Short cave with a single entrance and no airflow. Small flowing stream. Quite warm for this elevation.

<i>Air Temp C</i>	<i>Humidity %</i>	<i>Water Temp C</i>	<i>Water pH</i>	<i>CO2 High %</i>	<i>O2 Low %</i>
22	91	20.5	8.5		

Further Data

date: November

Management

Description

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed. Sedimentation from nearby fields has ceased

<i>Classification</i>	<i>Energy Rating</i>	<i>Manager</i>
3.1	High	Royal Forest Department

Impacts

Increased Sediment

Impact Sources

Deforestation; Agriculture

Tham Tasukhi 1 (TK001)

Mae Jan Tha, Thungyai Naresuan W.S.

Tak Province, Thailand

Surveyed 08/04/1997 by

Thailand Cave and Karst Group

Royal Forest Department

Suunto compass/clino

30m fibron tape

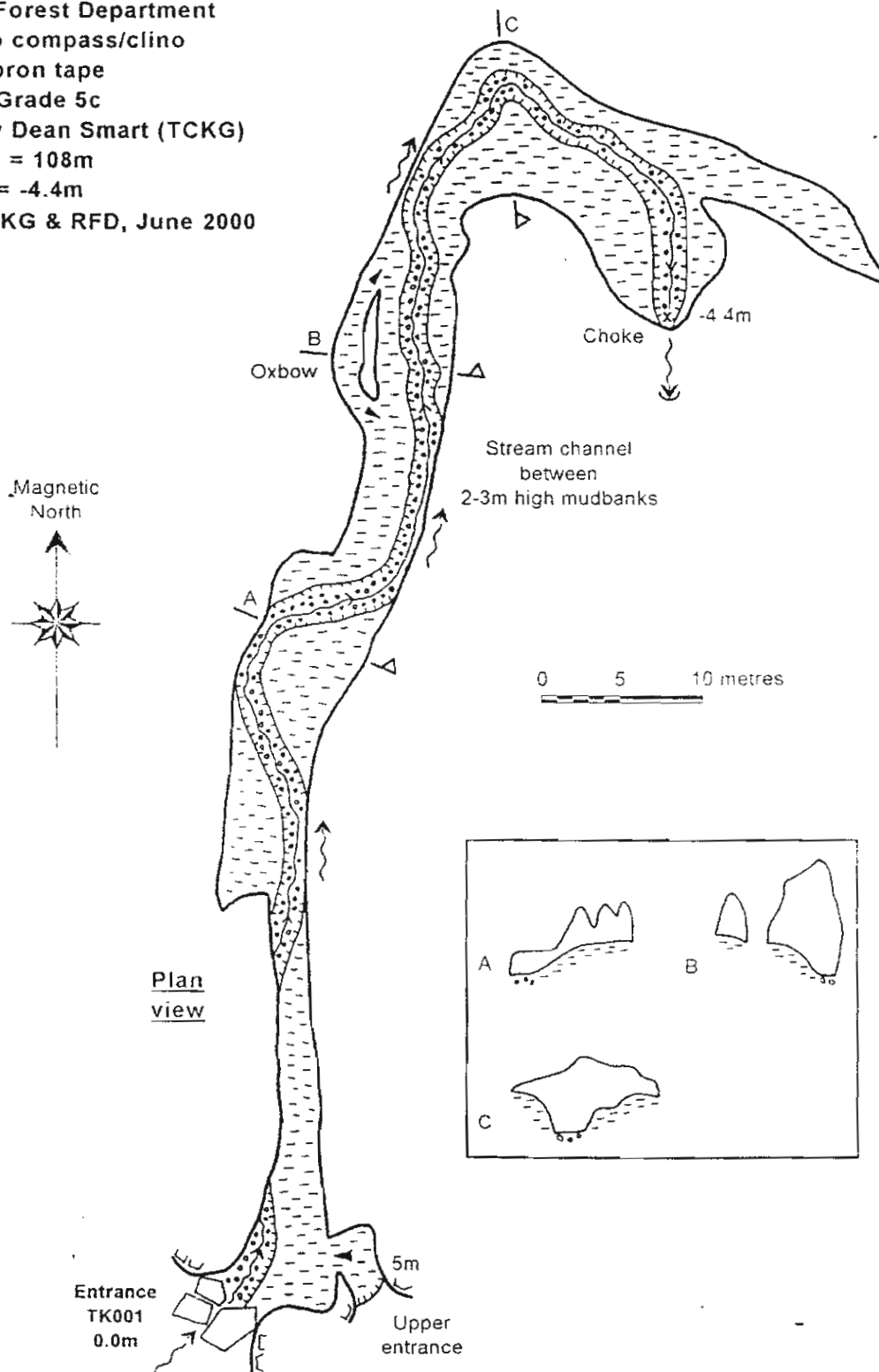
BCRA Grade 5c

Map by Dean Smart (TCKG)

Length = 108m

Depth = -4.4m

© - TCKG & RFD, June 2000



Thailand Caves Database

Site Code 2

English Names

Tham Tasukhi 2, TK002

Thai Names

ถ้ำตะสุคี 2 TK002

Location

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4840 III	47P	505083	1737610	15.713509	99.047431
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
950	185	14	C:\Cave Database\Maps\Tak\TK0002.tif		

Access Description

Walk c.3km SE of Mae Jan Tha ranger station. Small entrance is half way up hillside. 50m above Tham Tasukhi 1

General Description

Ancient phreatic cave developed on faults. Mostly easy walking passages with some short climbs. Ends too low

Technical Description

None

Dangers

None

Outstanding Values

Phreatic rift passages developed on faults

Geology

Description

Rifts of ancient phreatic origin guided by small faults. Bedding is seen in walls of rifts dipping 60 degrees to WNW

Rock Type

Limestone

Rock Age

Triassic

Sediments

Silty soil floors with guano and flowstone layers

Speleothems

Common forms

Thailand Caves Database

Site Code 2

Biology

Description

A few bats provide guano. Little fauna with no predators. Used by porcupines and serow

Identified Species

Cricket: porcupine; serow; bat - *Hipposideros* sp.

Food Supply Routes

Guano

Environment

Description

Short cave with a single entrance, no airflow and no flowing water. Very warm for this elevation and with low humidity.

<i>Air Temp C</i>	<i>Humidity %</i>	<i>Water Temp C</i>	<i>Water pH</i>	<i>CO2 High %</i>	<i>O2 Low %</i>
24	75				

Further Data

date – November

Management

Description

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed. Guano extraction has now ceased

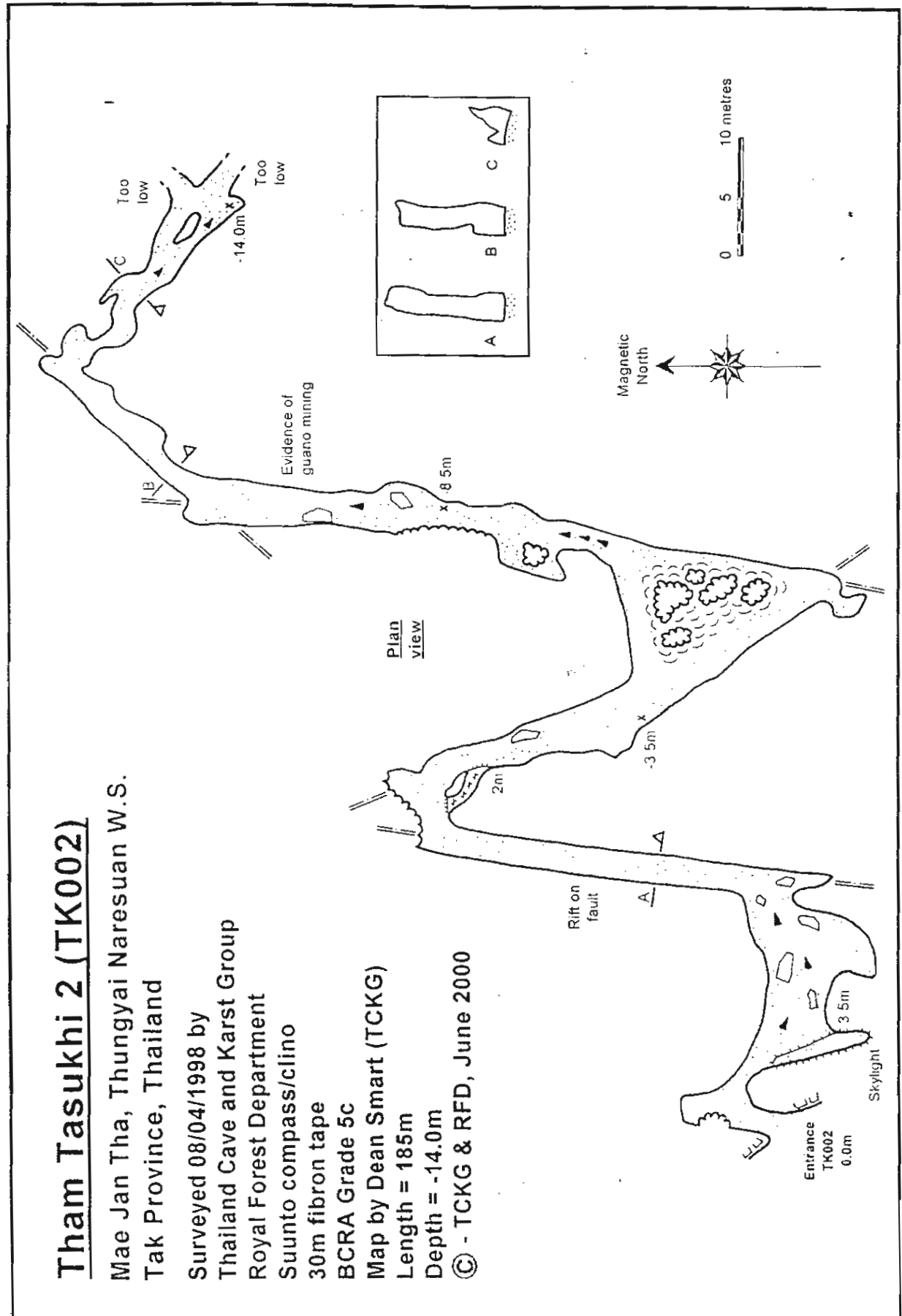
<i>Classification</i>	<i>Energy Rating</i>	<i>Manager</i>
3.1	Low	Royal Forest Department

Impacts

Sediment Disturbance

Impact Sources

Resource Extraction



Thailand Caves Database**Site Code 3***English Names***Tham Tasukhi 3, TK003***Thai Names***ถ้ำทะลุที่ 3 TK003****Location**

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4840 III	47P	505107	1737519	15.716930	99.047668
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
920	0	0	n/a		

Access Description

Walk c.3km SE of Mae Jan Tha ranger station. Stream sink is at the edge of disused fields 50m South of Tham Tasukhi 1

General Description

Seasonal stream sink blocked by boulders. Above is a narrow rift c.4m deep to soil floor. Needs boulder removing for access. About 6m above sink is narrow, undescended shaft.

Technical Description

None

Dangers

None

Outstanding Values

None

Hydrology*Description*

Seasonal stream sink, resurgence unknown possibly the same as Tham Tasukhi 1

<i>River System</i>	<i>Stream Name</i>	<i>Catchment Area, km²</i>	<i>Flow, Cumec</i>
Mae Khlong		0.5	0

Further Data

date – November

Management*Description*

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed

<i>Classification</i>	<i>Energy Rating</i>	<i>Manager</i>
3.1	High	Royal Forest Department

Impacts

None

Thailand Caves Database**Site Code 4***English Names***Tham_Phi Ma, TK004***Thai Names***ถ้ำผีมา TK004****Location**

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4840 III	47P	503650	1738510	15.725890	99.034072
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
900	174	9	C:\Cave Database\Maps\Tak\TK0004.tif		

Access Description

On the East side of an obvious tower right next to the track 1km before Mae Jan Tha ranger station

General Description

Fossil phreatic maze cave with many entrances. Short walking passages connect small chambers. Some short climbs and one squeeze

Technical Description

None

Dangers

None

Outstanding Values

None

Geology*Description*

Complex maze of ancient phreatic rifts and tubes with oxbows. Passages guided by two joint/fault sets at E-W and NE-SW

Rock Type

Limestone

Rock Age

Permian

Sediments

soils with breakdown in doline entrance

Speleothems

common forms

Thailand Caves Database

Site Code 4

Biology

Description

Strong draughts between entrances provide airborne food supply. Mainly surface derived fauna

Identified Species

Opilione; glyphyllus; porcupine

Unusual Species

Gecko - R

Food Supply Routes

Aerial; Guano

Management

Description

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed. Graffiti is old and not increasing

Classification

3.1

Energy Rating

High

Manager

Royal Forest Department

Impacts

Graffiti

Impact Sources

Uncontrolled Visitors

Thailand Caves Database**Site Code 5***English Names**Thai Names***TK005****TK005****Location**

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4740 II	47P	493507	1734819	15.692520	98.939407
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
910	43	14	C:\Cave Database\Maps\Tak\TK0005.tif		

Access Description

1 hours walk downstream of Yu Nai ranger station at obvious stream sink

General Description

Up and to the right of the stream sink, a small hole (usually choked with bamboo) drops into a muddy crawl. This leads to a short, though big stream passage sumped at both ends with a skylight entering from above.

Technical Description

10m ladder required for skylight. Belay to tree.

Danger:

Floods completely in rainy season

Outstanding Values

None

Geology*Description*

Very short cave with large mudbanks

Rock Type

Limestone

Rock Age

Permian

Sediments

Large 4m high mud banks deposited by ponded floodwater

Speleothems

large flowstone sumps downstream end

Hydrology*Description*

Large perennial stream sink. During floods, the stream overflows along a channel to a choked sink 1km to the West. The rising is unknown

<i>River System</i>	<i>Stream Name</i>	<i>Catchment, km²</i>	<i>Flow, Cumec</i>
Mae Khlong	Huai Mortener (Huai Thip Tho)	32	- 0.8

Further Data

date - November

Thailand Caves Database

Site Code 5

Biology

Description

Many predators, especially spiders. Stream and air based

Identified Species

Spider - Huntsman & web spinning; cricket; crab; bat - *Hipposideros larvatus*; frog

Food Supply Routes

Stream; Aerial; Guano

Environment

Description

Small cave with significant airflow and flowing water.

Air Temp C	Humidity %	Water Temp C	Water pH	CO2 High %	O2 Low %
21	86	19	8.1		

Further Data

date – November

Management

Description

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed.

Classification

3.1

Energy Rating

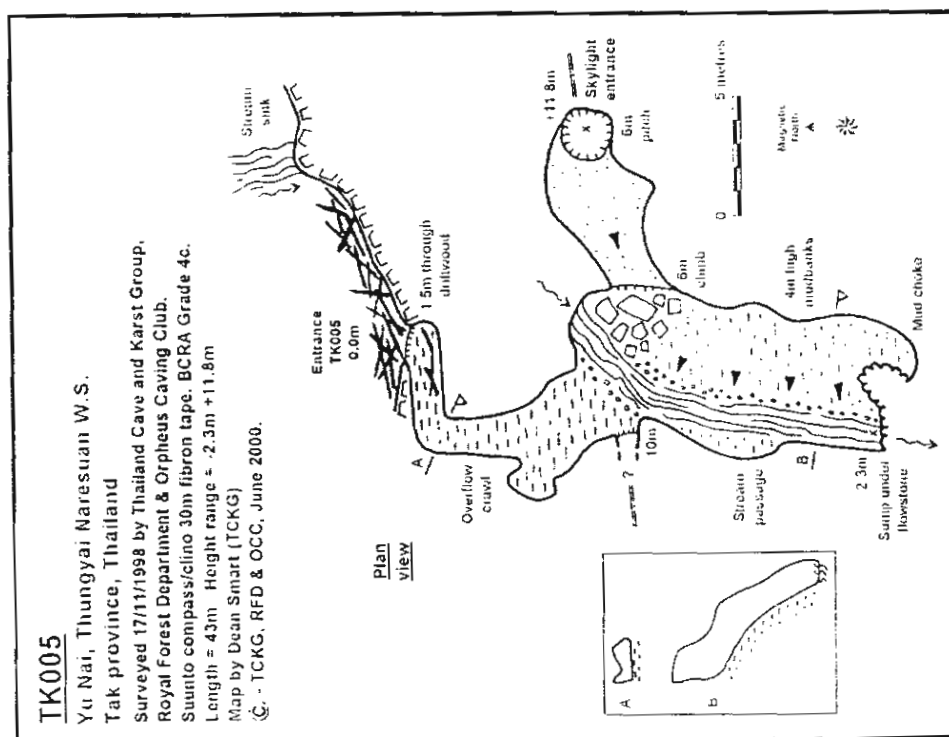
Ultra-High

Manager

Royal Forest Department

Impacts

None



Thailand Caves Database

Site Code 6

English Names

Thai Names

TK006

TK006

Location

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4740 II	47P	499038	1735918	15.702460	98.991020
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
970	35	4	C:\Cave Database\Maps\Tak\TK0006.tif		

Access Description

5km South of the Yu Nai turn off the track to Utakhi passes through an area of limestone and old fields. Walk 5 minutes to the West from the given UTM. Difficult to find

General Description

Easy walking and stooping leads to a narrow rift becoming too tight

Technical Description

None

Dangers

None

Outstanding Values

Good false floors

Geology

Description

Small cave with good false floors in roof

Rock Type

Limestone

Rock Age

Permian

Sediments

False floors in roof formed of cemented gravel and sand

Speleothems

Reasonable straws, flowstone & stalactites

Thailand Caves Database

Site Code 6

Biology

Description

Mainly surface fauna. Many predators compared to prey

Identified Species

Opilione; glyphyllus; spider - huntsman & web spinning; cricket; Scutigera; Scolopendromorph; porcupine; bat - *Rhinolophus* sp

Food Supply Routes

Near Surface; Guano

Management

Description

Remote. within a wildlife sanctuary and protected. Very unlikely to be developed.

Classification

3.1

Energy Rating

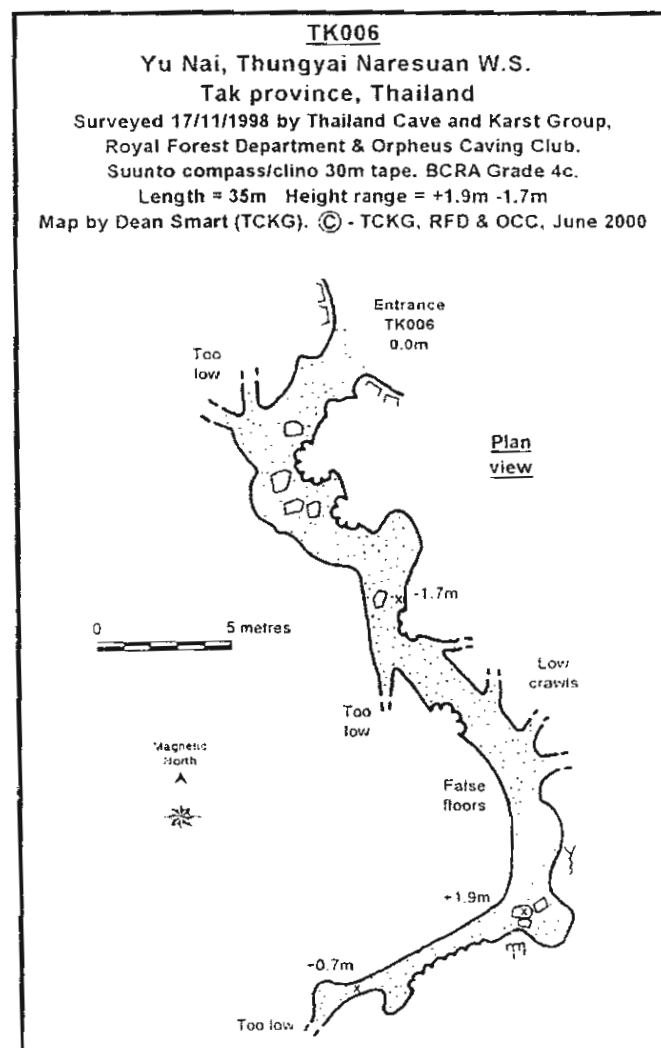
Low

Manager

Royal Forest Department

Impacts

None



Thailand Caves Database

Site Code 7

English Names

Thai Names

Tham Khang Khao Yu Nai, TK007

ถ้ำค้างคาวยูไน TK007

Location

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umpang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4740 II	47P	499074	1735664	15.700160	98.991363
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
970	244	6	C:\Cave Database\Maps\Tak\TK0007.tif		

Access Description

5km South of the Yu Nai turn off, the track to Utakhi passes through an area of limestone and old fields. Walk 10 minutes to the West from the track. Difficult to find

General Description

Stooping entrance leads down to a chamber with a huge boulder. Right leads via big passages to small chambers and crawls ending at other entrances or too low. Left from the huge boulder is walking into another chamber. A 15m climb into the roof leads to an entrance in the cliff. A short climb gains a small hole, traverse and scramble down into a muddy chamber with an aven

Technical Description

None

Dangers

None

Outstanding Values

Reasonable speleothems, especially helictites and straws

Geology

Description

Formed parallel to the cliff-line. Ancient phreatic origin. Medium sized chambers formed by breakdown of huge boulders

Rock Type

Limestone

Rock Age

Permian

Sediments

Partial rainy season flooding deposits mud on floor. Much large scale breakdown up to 8m in size

Speleothems

Common forms; good helictites and straws; some curtains

Thailand Caves Database

Site Code 7

Biology

Description

Complex biology and rich fauna due to variety of food sources and habitats. Seasonal floods. Leeches probably feed on bats and roots penetrate the cave

Identified Species

cricket; centipede; glyphyllus; bat - *Hipposideros larvatus*, *Aselliscus stoliczkanus*.
Rhinolophus sp; porcupine; slug

Unusual Species

Leeches - R; white isopod - T

Food Supply Routes

Guano: Near Surface; Stream; Roots

Environment

Description

Moderate sized cave with multiple entrances. Cave runs along the side of a forested hill and is near to surface throughout.

<i>Air Temp C</i>	<i>Humidity %</i>	<i>Water Temp C</i>	<i>Water pH</i>	<i>CO2 High %</i>	<i>O2 Low %</i>
26	91				

Further Data

date - November

Management

Description

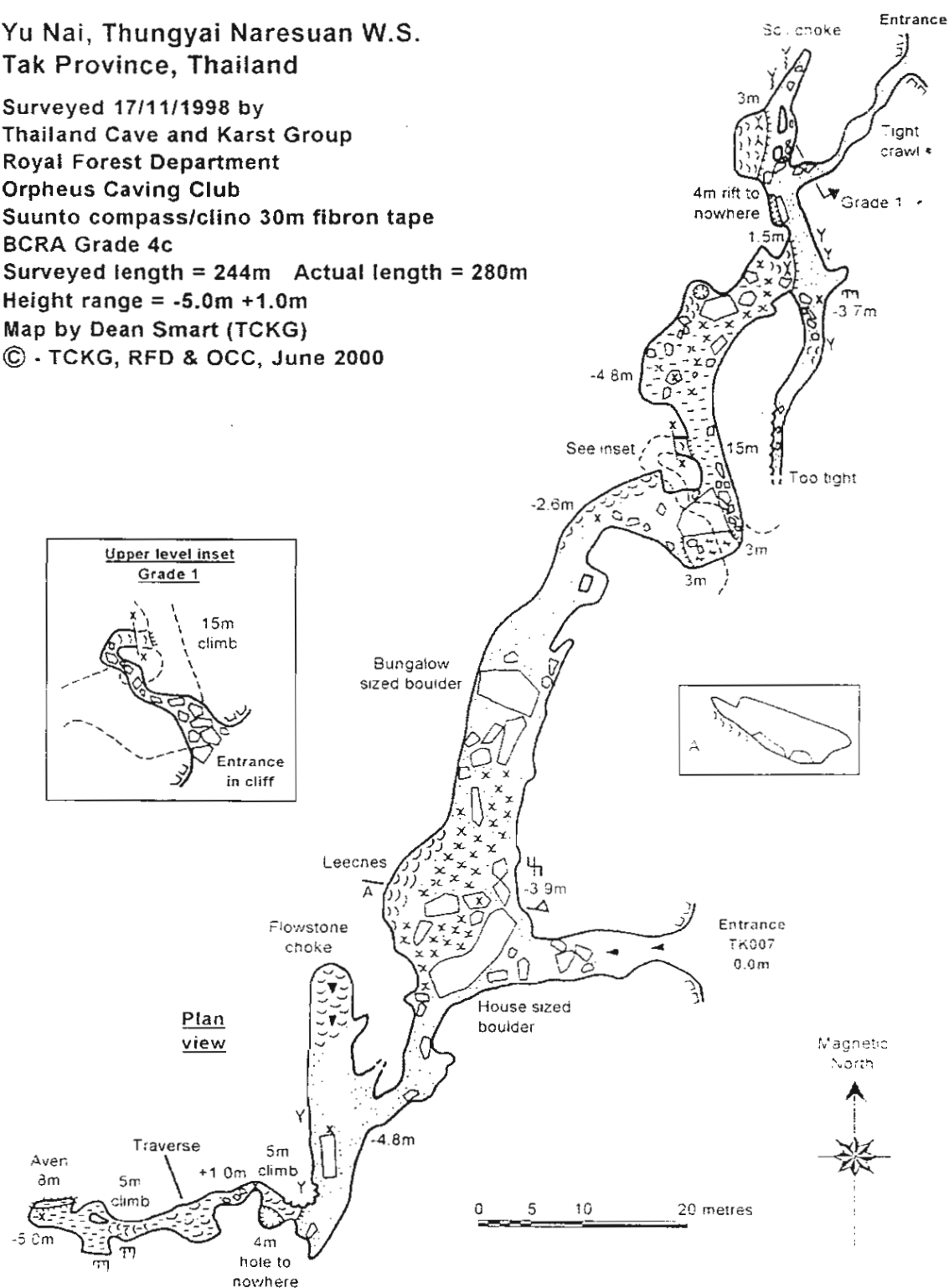
Remote, within a wildlife sanctuary and protected. Very unlikely to be developed.

<i>Classification</i>	<i>Energy Rating</i>	<i>Manager</i>
3.1	High	Royal Forest Department

Impacts

None

Surveyed 17/11/1998 by
 Thailand Cave and Karst Group
 Royal Forest Department
 Orpheus Caving Club
 Suunto compass/clino 30m fibron tape
 BCRA Grade 4c
 Surveyed length = 244m Actual length = 280m
 Height range = -5.0m +1.0m
 Map by Dean Smart (TCKG)
 © - TCKG, RFD & OCC, June 2000



Thailand Caves Database

Site Code 8

English Names

Tham Khang Khao Utakhi, TK008

Thai Names

ถ้ำค้างคาวอุตะคี TK008

Location

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4840 III	47P	501246	1727885	15.629830	99.011619
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
950	162	27	C:\Cave Database\Maps\Tak\TK0008.tif		

Access Description

Walk down valley from Utakhi ranger station for 15 mins. Entrance is in small tower next to path

General Description

Climb down of 8m from the entrance leads to a chamber with 3 passages off. Left ends at a choke. Straight ahead ends at an aven. Right is a large passage past a hole in the floor to the stream passage to a chamber with a floor steeply sloping down to the left. Climbing down here enters low muddy crawls and chambers. Climbing down the hole drops into a vadose rift with a seasonal stream. Heading upstream passes an awkward squeeze to larger passage and a small inlet. A low crawl filled with large worms emerges in the doline entrance. South of the main entrance.

Technical Description

Some climbing required. One tight awkward squeeze

Dangers

High CO₂ and low O₂ in lower chambers. Squeeze in stream passage is tight and awkward

Outstanding Values

Extensive guano based fauna. Rat living in cave. Stream passage is good example of vadose

Geology

Description

Ancient phreatic cave with a vadose overprint. Wide variety of passage types with good examples of vadose canyon. The maze like 'upper' level follows several joint sets. 'Lower' streamway is phreatic tube with a vadose canyon cut by an underfit stream

Rock Type Rock Age

Limestone Permian

Sediments

Mostly invashed soil sediments in the upper levels and near surface locations. Good layering in places. Mud in lower parts.

Speleothems

Common forms; small straws in lower streamway

Thailand Caves Database

Site Code 8

Hydrology

Description

Small seasonal stream in 'lower' level. Origin unknown. Resurgence also unknown, likely to be in the valley below

<i>River System</i>	<i>Stream Name</i>	<i>Catchment Area, km²</i>	<i>Flow, Cumec</i>
Mae Khlong			0

Further Data

date -- November

Biology

Description

Large amount of fauna based on guano and washed in soil. Surface species near entrances. Many invisible ticks

Identified Species

Cricket - >2 sp; cockroach; Scutigera; bat - Rhinolophus sp; porcupine; earthworm; tick

Unusual Species

Rats - n.sp; tiny white insect - T

Food Supply Routes

Guano: Near Surface

Environment

Description

Fairly warm cave, probably due to lack of forest cover on the small tower it is found in. Low O₂, high CO₂ in lower parts (not measured)

<i>Air Temp C</i>	<i>Humidity %</i>	<i>Water Temp C</i>	<i>Water pH</i>	<i>CO₂ High %</i>	<i>O₂ Low %</i>
22	91				

Further Data

date -- November

Management

Description

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed. Guano extraction has now ceased

<i>Classification</i>	<i>Energy Rating</i>	<i>Manager</i>
3.1	Low	Royal Forest Department

Impacts

Sediment Disturbance

Impact Sources

Resource Extraction

Tham Khang Khao Utakhi (TK008)

Utakhi, Thungyai Naresuan W.S.

Tak Province, Thailand

Surveyed 18/11/1998 by

Thailand Cave and Karst Group,

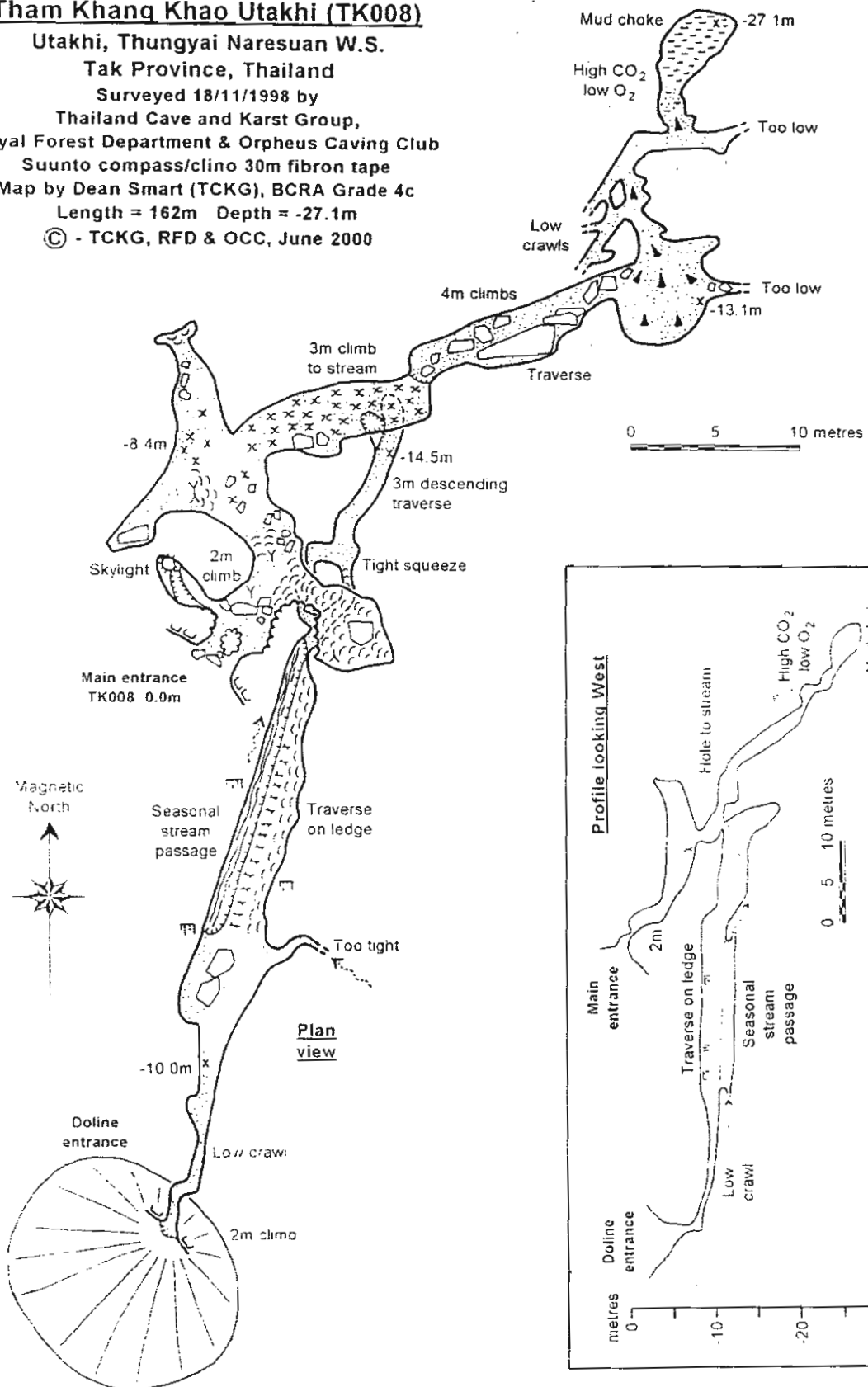
Royal Forest Department & Orpheus Caving Club

Suunto compass/clino 30m fibron tape

Map by Dean Smart (TCKG), BCRA Grade 4c

Length = 162m Depth = -27.1m

© - TCKG, RFD & OCC, June 2000



Thailand Caves Database**Site Code 9***English Names***Tham Nam Mut Utakhi, TK009***Thai Names***ถ้ำน้ำมุดอุตะกิ TK009****Location**

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4840 III	47P	502325	1728692	15.637129	99.021690
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
890	384	21	C:\Cave Database\Maps\Tak\TK0009.tif		

Access Description

Obvious stream sink entrance, 1 hours walk down valley from Utakhi ranger station

General Description

Large, active stream cave. At the entrance, the stream drops down a 2m waterfall and sumps. Bypass this via the obvious dry upper level to an awkward 2.5m climb down to the stream. Downstream passes a large skylight in the roof and leads via rapids and a climb over a rock bridge to a deep pool. This is bypassed on the right via an upper level. The stream sumps again and a traverse high in the roof through large speleothems leads to a 3m rope climb back to the stream. More rapids lead to a final deep pool with no airflow and probable sump. An upper level at the end ends too tight.

Technical Description

10m rope required on climb. Some climbing and traversing

Dangers

Cave floods quickly and severely in rainy season. Traverses are easy but require care.

Outstanding Values

Nice sporting cave with a variety of difficulties. Well decorated with large speleothems

Geology*Description*

Large stream passage follows a fault trending ENE-WSW with rapids and a 20m high roof. Shorter sections trending NNE-SSW are low gradient and often sump. They are probably bedding controlled

Rock Type Rock Age

Limestone Permian

Sediments

Varied sediments with gravel in stream passage, sands in seasonal bypasses and breakdown in upper levels

Speleothems

Common forms with good stalagmites & columns; straws; small helictites; flowstone on rapids in stream

Thailand Caves Database

Site Code 9

Hydrology

Description

Huai Pha Yai sinks into this cave and presumably resurges on the other side of the ridge about 1km to the NE

<i>River System</i>	<i>Stream Name</i>	<i>Catchment Area, km²</i>	<i>Flow, Cumec</i>
Mae Khlong	Huai Pha Yai (Huai Utakhi)	24	0.5

Further Data

date – November

Biology

Description

Permanent stream provides food to a rich and varied fauna. Many aquatic species

Identified Species

Cricket - >2 sp; huntsman spider; fish - Danio, Glyptothorax; frog; shrimp; porcupine; bat - 2 sp

Unusual Species

White isopod - T

Food Supply Routes

Stream

Environment

Description

Active stream cave in low, forested ridge.

<i>Air Temp C</i>	<i>Humidity %</i>	<i>Water Temp C</i>	<i>Water pH</i>	<i>CO2 High %</i>	<i>O2 Low %</i>
21	95	20	8.3		

Further Data

date – November

Management

Description

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed.

<i>Classification</i>	<i>Energy Rating</i>	<i>Manager</i>
3.1	High	Royal Forest Department

Impacts

None

Thailand Caves Database

Site Code 10

English Names

TK010

Thai Names

TK010

Location

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4840 III	47P	501975	1728406	15.634539	99.018432
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
890	0	0	C:\Cave Database\Maps\Tak\TK0010.tif		

Access Description

Between Nam Tok Utakhi and Tham Nam Mut Utakhi, Huai Utakhi sinks and rises again. No enterable cave

General Description

Stream sink and resurgence for Huai Utakhi. No enterable cave

Technical Description

None

Dangers

None

Outstanding Values

Good example of dry/active valley dependant on water flow

Hydrology

Description

1km long section of seasonally dry karst valley between Utakhi waterfall and Tham Nam Mut Utakhi

<i>River System</i>	<i>Stream Name</i>	<i>Catchment Area, km²</i>	<i>Flow, Cumec</i>
Mae Khlong	Huai Pha Yai (Huai Utakhi)	23	0.5

Further Data

date – November

Management

Description

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed.

<i>Classification</i>	<i>Energy Rating</i>	<i>Manager</i>
3.1	High	Royal Forest Department

Impacts

None

Thailand Caves Database**Site Code 11***English Names***Tham Khang Khao Huai Nam Khieo, TK011***Thai Names***ถ้ำค้างคาวห้วยน้ำเขียว****Location**

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4839 IV	47P	506574	1702926	15.404159	99.061256
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
1090	151	19	C:\Cave Database\Maps\Tak\TK0011.tif		

Access Description

Walk 5 minutes East of Huai Nam Khieo ranger station and turn North up the hill to an obvious entrance

General Description

Basically a single large chamber divided by large speleothems. To the left from the entrance, a low passage leads down to the lowest part of the cave. A climb up from the entrance chamber enters a chamber sloping upwards to the highest point.

Technical Description

None

Dangers

Some large boulders may be unstable

Outstanding Values

Rats live in the cave.

Geology*Description*

Single large chamber formed on near vertical bedding and small mineral veins. Much breakdown

Rock Type Rock Age

Limestone Permian

Sediments

Main chamber floored with large breakdown. Patches of cemented gravel stuck to wall with crystal lined cavities

Speleothems

Common forms; serrated curtains; large eucladioliths in back entrance

Biology*Description*

Surface and guano (rat, bat & porcupine) based biology with many predators. Daylight fills most of the cave.

Identified Species

cricket; hairy mary; spider - huntsman, small white sp; opilione; glyphyllus; bat - Hipposideros sp, Rhinolophus sp; Porcupine

Unusual Species

Rat - n.sp

Food Supply Routes

Guano; Near Surface

Palaeontology*Description*

Main chamber contains a few bones, probably rib and limb bones of a deer.

Species Found

Deer?

Archaeology*Description*

Ideal habitation site near permanent stream. Small pottery sherds, possibly recent, found under large boulders. Animal remains may be natural. Disturbed by guano extraction

Artifacts

burnished pottery; animal remains

Environment*Description*

Large single chamber with short side passages entering the dark zone with no draught and high humidity

<i>Air Temp C</i>	<i>Humidity %</i>	<i>Water Temp C</i>	<i>Water pH</i>	<i>CO2 High %</i>	<i>O2 Low %</i>
20	93				

Further Data

average of 2 measurements - February, May

Management*Description*

Remote, within a wildlife sanctuary and protected. Very unlikely to be developed. Guano extraction has now ceased although use of campfires continues

Classification

3.1

Energy Rating

High

Manager

Royal Forest Department

Impacts

Environmental Disruption; Sediment Disturbance

Impact Sources

Uncontrolled Visitors; Resource Extraction; Campfires

Tham Khang Khao Huai Nam Khieo

(TK011)

Huai Nam Khieo, Thungyai Naresuan W.S.

Tak province, Thailand

Surveyed 21/11/1998 by

Thailand Cave and Karst Group

Royal Forest Department

Orpheus Caving Club

Suunto compass/clino

30m fibron tape

BCRA Grade 4c

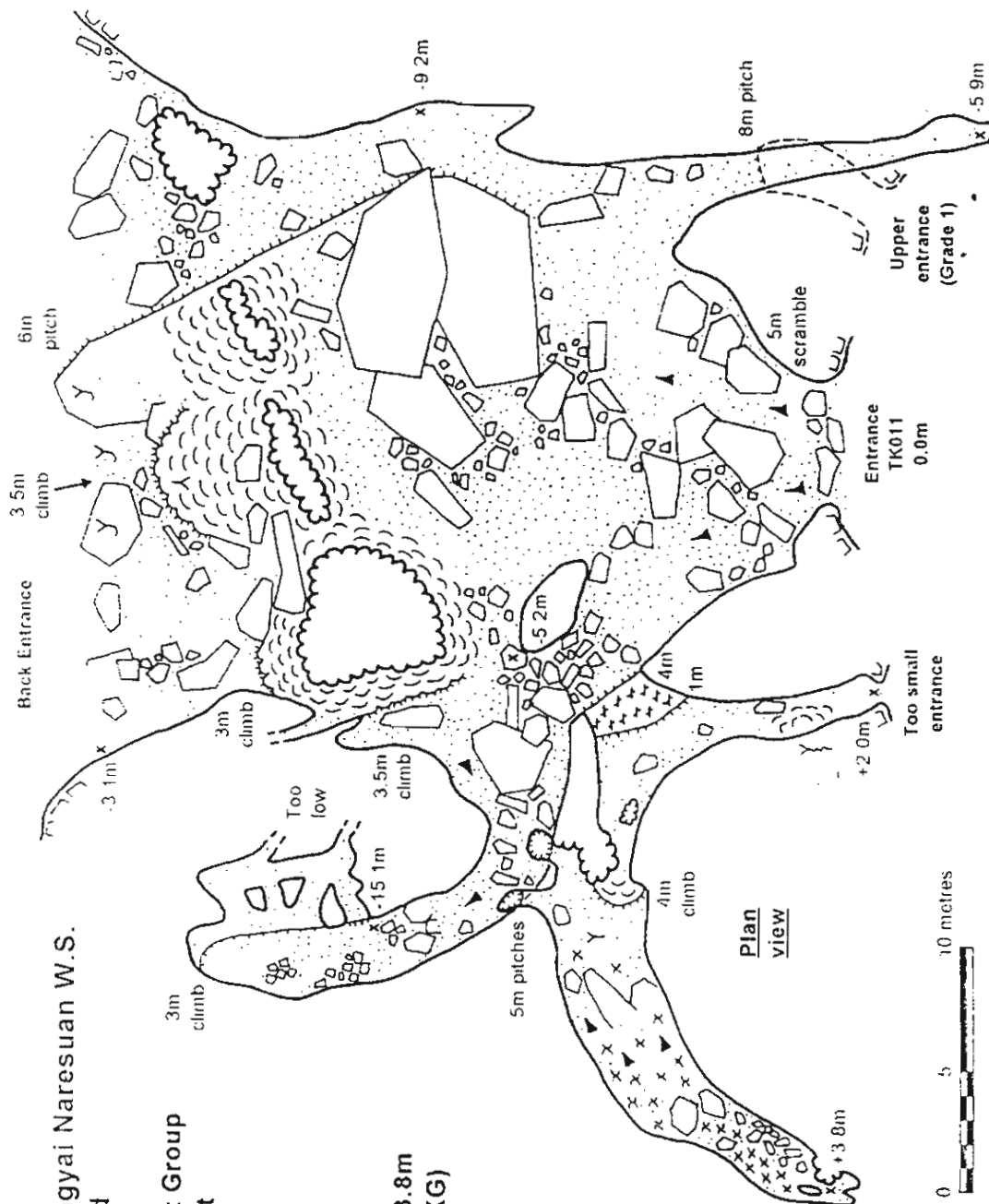
Survey length = 151m

Height range = -15.1m +3.8m

Map by Dean Smart (TCKG)

© - TCKG, RFD & OCC

June 2000



*English Names***Tham Than Lot, TK012***Thai Names***ถ้ำธารลอด TK012****Location**

<i>Province</i>	<i>District</i>	<i>Protected Area</i>		<i>Zone</i>	
Tak	Umphang	WS Thungyai Naresuan East		North	
<i>Mapsheet</i>	<i>UTM Zone</i>	<i>Eastings</i>	<i>Northings</i>	<i>Latitude</i>	<i>Longitude</i>
4839 IV	47P	505509	1702168	15.397310	99.051338
<i>Elevation, m</i>	<i>Length, m</i>	<i>Depth, m</i>	<i>Survey File</i>		
1080	1866	28	C:\Cave Database\Maps Tak TK0012.tif		

Access Description

Walk on good footpath for 30 minutes to SW from Huai Nam Khieo ranger station. Entrance is on NW side of obvious tower after crossing a stream

General Description

Large, complex cave with active, seasonal and fossil passages. Scrambling down inside the TK012 entrance drops into a passage going left and right. Walking to the right leads to a sharp right hand bend with a low crawl heading off left. In the roof here, is a series of low crawls and small chambers. Continuing along the main walking passage passes two minor entrances on the left and reaches a large junction with a stream emerging from the left. Turning left opens into a chamber with the stream entering from a low passage. Straight ahead continues in large passage to another junction. Turning left here meets the stream again which can be followed to a low crawl and another entrance. Soon after the junction, the TK013 entrance is found on the left. A low bedding crawl becomes tighter before popping out at the TK014 entrance. A passage from here heads back to rejoin the main cave at roof level near TK013. Going left from TK012 quickly meets a T junction. Left ends in a boulder choke near to the flood resurgence while right continues through phreatic maze type rifts and small chambers. After some 300m, a narrow rift becomes a low crawl over gour pools and eventually breaks out into the largest passage in the cave. This dry upper level goes both left and right. Left is very easy walking in a passage 5m square passes through a large chamber to the TK015 entrance. A series of chambers and crawls leads off from the large chamber. Turning right after the gour pool crawl climbs up into a big, dry upper level. This leads to passage carrying a seasonal stream. This eventually ends at a flowstone blockage with the stream emerging from a draughting, muddy crawl that becomes too low. The streamway can be followed downstream to a muddy crawl that loops around to the gour pool crawl. Going off the dry, upper level is a low crawl. This leads to a series of small chambers and the TK016 entrance.

Technical Description

None

Dangers

Cave may flood quickly in rainy season. Complex hydrology could unexpectedly sump some areas.

Thailand Caves Database

Site Code 12

Outstanding Values

Superb example of complex cave hydrology. Stream flow is divided and directed in different directions depending on flow rate. Good passage vadose and phreatic morphologies. Reasonable speleothems, especially boxwork, straws, helictites and gour pools. Rats live in the cave.

Geology

Description

Fine examples of most major types of geological control, passage and morphology, particularly joint controlled rift maze, meandering paragenetic canyons, anastomoses and pendants. Upper levels are phreatic and present day underfit streams are vadose

Rock Type

Limestone

Rock Age

Permian

Sediments

Highly complex suite showing variety of types, flow direction, deposition, relationships, ages, etc. Example of later sediments cutting older ones. Requires study. Mud, sand and gravel in stream passages, sandy soil in upper levels. Partly cemented

Speleothems

Common forms: boxwork in sediments; shield in main passage; straws

Hydrology

Description

Complex and fine example of diverging flow. Two streams flow through small passages maybe resurging to South. In flood, streams overpower small passages and resurge to the North. Water derives from Tham Molakot and area to East

River System

Mae Khlung

Stream Name

Catchment Area, km²

3

Flow Rate, Cumec

0.3

Further Data

date - November

Biology

Description

Complex and varied biology based on streams, guano and draughts. Rich in fauna with many invertebrate predators. >3 species of bat. Used by rats, porcupines, wild dogs and a Mountain Pit Viper

Identified Species

crickets - >2 sp; Scutigera; Opilione; huntsman spider; Glyphyllus; bat - Aselliscus stoliczkanus.

Taphozous sp. Rhinolophus sp; porcupine - Atherurus macrourus; fish - Schistura sp, Danio sp; crab - 2 sp; shrimp; Mountain Pit Viper (Ovophis monticola)

Unusual Species

Rat - n.sp; Wild Dog - R

Food Supply Routes

Stream; Guano; Aerial