The archaeobotany of Khao Sek

Introduction

Archaeological studies conducted in the Thai-Malay Peninsula show that an exchange network existed between peninsular sites, South Asia, East Asia and the South China Sea (Bellina et al. 2014). These links extended beyond material culture and transmitted technologies. Crops were also brought into the Thai-Malay Peninsula from other regions as part of the diet of travelers and perhaps also for trade (Castillo et al. 2016). This paper discusses the role of crops and agriculture in prehistoric settlements functioning as industrial sites and trading posts.

Bellina (this volume) compares the two ports of trade Khao Sek and Khao Sam Kaeo. Radiocarbon dating shows that Khao Sek was occupied during *ca*. 4th - 3rd centuries BC coinciding with the initial occupation of Khao Sam Kaeo. Similarities between sites include settlement positioning and geography although Khao Sek was a smaller settlement than Khao Sam Kaeo. Furthermore, terraces where people lived were built using similar techniques, and both had craft industries such as hard stone and secondary glass production and perhaps metal workshops. However, differences are also noted such as the absence of Indian Fine Ware and Han pottery in Khao Sek (Favereau, this volume).

Khao Sam Kaeo located on the east coast of the peninsula has evidence of both East Asian and South Asian plant domesticates, including rice, foxtail millet and pulses (Castillo & Fuller 2010). The population at Khao Sam Kaeo relied on rice as the staple and probably cultivated rice in the hills or their vicinity. Pulses, such as mungbeans, were also cultivated locally having been brought over from India during this period. Khao Sam Kaeo has the earliest evidence of Indian pulses in Southeast Asia. Located in the other side of the peninsula is the entrepôt, Phu Khao Thong, which yielded more Indian taxa compared to Khao Sam Kaeo due to its closer proximity to South Asia. It is therefore of interest to investigate the archaeobotany of the contemporaneous site, Khao Sek to see if the crop assemblage was similar to that of Khao Sam Kaeo and Phu Khao Thong. A similar crop assemblage as Khao Sam Kaeo could mean crops were brought in either directly from the source (eg. India) or the crops from Khao Sam Kaeo or Phu Khao Thong were traded or sent to neighbouring areas, such as Khao Sek. Khao Sek lies 80 km south of Khao Sam Kaeo and due to its proximity to the coast, could have been accessed either by sea or land from Khao Sam Kaeo.

Macrobotanical results

The macroremains analysis presented in this paper is preliminary but it is already evident that to obtain more information regarding the plants used at Khao Sek, more samples need to be analysed. The macroremains were collected using the simple bucket wash-over flotation method and although one hundred and four samples have been floated, only eight samples have been studied and are reported in this paper.

An average of nine litres of soil were floated from contexts belonging to test pits KK22, KK26 and KK30. Plant parts per litre varied from as little as 0.7 to 46.3. Not

all samples were sorted to 0.25-0.5 mm fraction and therefore, the summary statistics table only includes data taken from the eight samples sorted to 0.5mm (Figure 1). The full list of identifications is presented in Figure 3.

	Total
NISP	699
No. of samples	8
Plant parts per litre MEAN	9.88
Plant parts per litre MIN	0.7
Plant parts per litre MAX	46.3
No of taxa* MIN	1
No of taxa* MAX	10
* excludes unidentified plant parts, parenchyma, IDs 24, 187, 189, 196,198 & non-plant material.	

Figure 1: Summary statistics of the botanical dataset in Khao Sek excluding the 0.25-0.5 mm fraction.

Overall, the botanical plant remains results are poor. There is a high degree of bioturbation in all the samples analysed, caused by modern roots penetrating ancient stratigraphic layers. This type of bioturbation is expected in sites located in tropical environments and has been documented in two other peninsular sites, Khao Sam Kaeo and Phu Khao Thong (Castillo 2013). This means that context security for archaeobotanical results in Khao Sek is low and AMS radiocarbon dating would be the best way to establish the age of the plant remains.

The only economic crop reported from Khao Sek is rice (*Oryza sativa*). It occurs in one context (KK22 special soil 2) and only one rice fragment and seven husk fragments (Figures 2A and 2B) were found. However, context 'KK22 special soil 2' is relatively secure since there are no modern seeds and it also contains only two taxa, rice and *cf.* Rubiaceae. KK22 contained a cultural layer represented by a horizon of ceramic sherds. It is therefore possible that the rice present in this context is human waste. Although the rice evidence is scant, we can infer that rice was consumed at Khao Sek. However, beyond consumption of rice, it is impossible to discuss issues of rice agriculture or rice processing. Because rice agriculture was already established in some parts of the Thai-Malay Peninsula in the Late Prehistoric period, it follows that the people of Khao Sek would have been familiar with rice. At Khao Sam Kaeo, the local population relied on rice, which was found in abundance (n=1599). Dehusking took place on a household level and probably daily on an 'as needed' basis (Castillo 2013).

The need for increasing the sample size analysis at Khao Sek has already been stressed. At Khao Sek only eight samples were analysed compared to the eighty-eight samples at Khao Sam Kaeo. The rice ubiquity at Khao Sam Kaeo is 49%, which shows that more than half of the sampled contexts did not yield rice remains. Furthermore, the amount of soil floated in Khao Sam Kaeo was fourfold that of Khao Sek, which increases the chances of finding archaeobotanical remains.

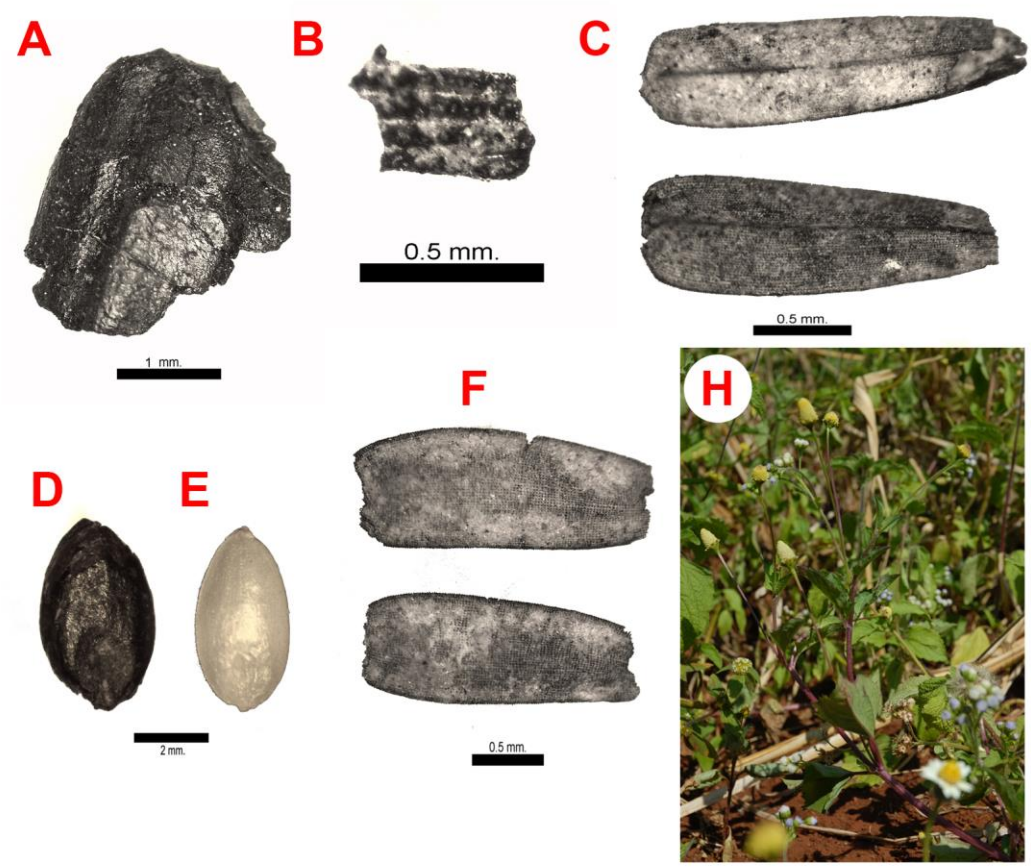

Figure 2: A, B - Rice grain fragment and rice husk from KK22 special soil 2; C - cf. *Grangea maderaspatana* from KK26 US9; D: *Digitaria* cf. *fuscescens* from KK26 US6; E - modern *Digitaria fuscescens* seed from the UCL Rice Weed Collection; F - *Acmella paniculata* from KK30 US4; H - image of *Acmella paniculata* plant in an upland rainfed ricefield located in Chiang Mai, Thailand. (Images by author).

A few fragments of long pepper (*Piper* cf. *longum*) were identified in KK26. Although a good match with modern long pepper was made, the possibility remains that it is from a weedy species found in the Thai-Malay Peninsula. Long pepper was also identified at Khao Sam Kaeo and Phu Khao Thong. But a fragment of long pepper from Khao Sam Kaeo was radiocarbon dated and yielded a modern date. More work on long pepper, including dating, needs to be done.

Habitat of Khao Sek

We do not have a good representation of economic crops in Khao Sek. Instead, the floral remains represent the habitat of Khao Sek during its period of occupation. Khao Sek is situated in a tropical wet environment and the inhabitants were engaged in industrial activities but also in daily activities such as building, maintaining and cleaning their houses and their surroundings. The settlement was probably cleared of most large trees and houses would have had adjacent garden plots.

The list of weedy and wild species includes herbaceous plants, grasses and evergreen shrubs that thrive in disturbed moist environments. Some species, such as *Phyllanthus urinaria* (chamber bitter), prefer fertile soils and are readily found in gardens. Other plants such as *Acmella paniculata* (para cress), *Brachiaria mutica* (para grass), *Digitaria* cf. *fuscescens* (yellow crabgrass), *Diplacrum caricinum, Galium* cf. *verum* (ladies bedstraw / yellow bedstraw) and cf. *Grangea maderaspatana* are found mostly along roadsides, ditches, drains and wastelands, and in close association to human settlements, such as gardens or paths (Figures 2C-2H). *Rhodomyrtus tomentosa* (Rose myrtle), an evergreen shrub found in moist and wet forests, in bog margins and riverbanks was also identified from the plant remains.

However, some of these plants may have been used in traditional medicine or eaten as a vegetable as is common in many parts of Southeast Asia today, particularly Thailand. So, their presence could also indicate an economic use. For example, the immature leaves and inflorescences of para cress (*Acmella paniculata*) are sold in many markets in Southeast Asia as a vegetable (Castillo 2013). Some *Phyllanthus* species are edible such as *P. emblica*, and used for traditional medicine such as *P. amarus*. Two species were identified in Khao Sek, *P. amarus* and *P. urinaria.*

Several weedy species found at Khao Sek are also identified in other sites in the Thai-Malay Peninsula. At Khao Sam Kaeo the following species were present: *Acmella paniculata, Brachiaria mutica, Phyllanthus urinaria, Rhodomyrtus tomentosa* and *Rubus* sp. type B. Whereas at Phu Khao Thong, *A. paniculata, B. mutica,* and *R. tomentosa* were present. *A. paniculata, B. mutica* and *P. urinaria* were associated with rice and were considered in these two sites weeds of cultivation, although they could also be indicators of habitats since Khao Sam Kaeo and Phu Khao Thong are like Khao Sek located in hills with lowland rain forests and a perhumid climate.

Summary

The peninsular sites, Khao Sam Kaeo and Khao Sek, have evidence of craft production and industries during the Late Prehistoric period. A settlement with specialized industries (hard stone, glass, metal) and a division of labour would necessarily require a subsistence economy dependent on agriculture, particularly rice in the case of the Thai-Malay Peninsula. The archaeobotanical study of Khao Sam Kaeo gives credence to this by demonstrating a rice-based economy with farming taking place in close proximity to or in the settlement itself. However, this has not been so far established in Khao Sek, which may be due to the poor results from the archaeobotanical study.

Furthermore, Khao Sam Kaeo also has evidence of imported foodstuffs, which may have been brought by traders initially as their preferred food items. It is likely that their introduction into the Thai-Malay Peninsula may have initially been to feed the foreign craftsmen and traders, but later on became part of the local diet. This again has not been demonstrated in Khao Sek due to the limited archaeobotanical data. Nevertheless, the close proximity of these two sites in geography and chronology suggests that at Khao Sek, people were also

consuming rice and may have even been familiar with some of the Indian domesticates found at Khao Sam Kaeo. Perhaps Indian domesticates were occasionally traded in exchange for local products.

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		KK22 special soil 1	KK22 special soil 2	KK22 US5	KK26 US6	KK26 US7	KK26 US8	KK26 US9	KK30 US4	NSP
	Total soil floated (l)	7	6	10	10	9	10	10	10	
	Plant parts per litre	6.57	5.5	0.7	1.5	46.2	0.8	14.4	3	
	no. of taxa	1	2	1	9	10	4	6	2	
	Total sample volume (ml)	30	15	25	130	160	40	250	60	
	CEREALS									
Poaceae	*Oryza* grain fragment		1							1
Poaceae	*Oryza* husk silicified		1							1
Poaceae	*Oryza* husk charred		2							2
	ECONOMIC CROPS									
Piperaceae	*Piper* cf. *longum*				1	2		2		5
Piperaceae	*Piper* cf. *longum*					5	1	1		7
	WILD & WEEDY									
Asteraceae	*Acmella paniculata*								7	7
Poaceae	*Brachiaria mutica*					4		2		6
Cyperaceae	*Diplacrum caricinum*							1		1
Asteraceae	cf. *Grangea maderaspatana*				1	342		95		438
Rubiaceae	*Galium* cf. *verum*								1	1
Poaceae	*Digitaria* cf. *fuscescens*				1					1
Phyllanthaceae	*Phyllanthus amarus*					1				1
Phyllanthaceae	*Phyllanthus urinaria* - charred					7				7
Myrtaceae	*Rhodomyrtus tomentosa*				2		1			3
Rosaceae	*Rubus* sp. type B				1					1
	OTHER									
Asteraceae	Asteraceae capitulum				1					1
Cannabaceae	cf. Celtis				2	1	1			4
Cucurbitaceae						1				1
Piperaceae					1					1
Poaceae	type G - grass culm nodes					8				8
Rubiaceae	*cf.* Rubiaceae	40	28			2		6		76
Thymeliaceae/ Violaceae						4				4
	type 7					1		2		3
	type 9						1			1
	type 10				2					2
	type 25 - small tuber			1			1	14		16
	type 27 - Nymphaceae?				1					1
	type 45 - rhizome parenchyma							1		1
	type 47 - roots					4				4
	unidentified	2	1	6	2	30	3	20	17	81
	parenchyma	4				4			5	13
	modern				54	115	37	93	9	308
	coprolite	25		27		2		4		58
	mouse dropping?						1	1		2
	modern insect egg clusters							5		5
	NSP	71	33	34	69	533	46	247	39	1072
	NISP	46	33	7	15	416	8	144	30	699

* does not include 0a (unidentified whole seed), 0b (unidentified fragment), 11 (parenchyma), C (coprolite) and 12a, 12c & 12d (termite frass).
NISP excludes modern plant parts and coprolites.

Figure 3: List of identifications.