



**Chronology of the Occupation Pattern Distribution: A Case Study At
The Mun River Valley Prehistoric Settlement Site, Northeast Thailand**

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ABSTRACT

Chronological framework can be used to identify the distribution of occupation patterns. This study was based on fourteen radiocarbon samples from the eight excavation pits at Ban Non Wat and Nong Hua Raet archaeological sites. The chronology of the cultural layers was developed using AMS radiocarbon dating to supplement existing data, specifically to examine the dating of the end of the Iron Age occupation. The objective of this study was to continue testing the premise that the end of the Iron Age on the Mun river floodplain in Northeast Thailand that is better defined as either a singular more or less contemporaneous de-population event characterized by widespread abandonment of settlements or a gradual transition from dispersing a rural settlement to more concentrated urban style of settlement. The results support the existing chronological framework of the study area and suggest that the end of the Iron Age in the Mun River valley is better defined as a gradual transition from dispersed rural settlements to a more concentrated urban style settlement. Occupation commenced at the center of the mound of Ban Non Wat during the Neolithic period, and gradually spread radially to the margin by the Iron Age. Occupation at the neighboring site of Nong Hua Raet commenced during the Iron Age period, parallel to that at Ban Non Wat.

1. Introduction

The Mun Valley in northeast Thailand contains a considerable number of large, moated prehistoric sites. Two years of excavation at Ban Non Wat have uncovered an area of 878 m² in the center of the mound. The Bayesian statistical analysis developed and obtained 76 radiocarbon samples. Results provided a definitive chronological framework for the entire sequence from the Neolithic to the end of the Iron Age (Higham, 2011). The cultural sequence of the site began with a probable hunter-gatherer group and ended in the late Iron Age. Higham and Higham (2009) identified two Neolithic phases, five Bronze Age phase and four Iron Age phases at the upper Mun Valley prehistoric settlements. Two Neolithic phases were encountered at Ban Non Wat and the initial Neolithic settlement took place in the seventeenth century BC. Three phases of the Early Bronze Age at Ban Non Wat lasted for nearly two centuries and the first evidence of the Bronze Age has been dated to the late eleventh century BC (Higham and Rispoli, 2014). Ban Non Wat dates reveal the six-phase of Bronze Age occupations underlay the Iron Age occupation layers. This long sequence has identified the transition into the initial Bronze Age in the late 11th century BC and indicates a smooth transition from one phase to the next. The transition from the late Neolithic to the Early Bronze Age settlement took place between 1053-996 cal BP (Higham and Higham 2009). It is, therefore, a widely held assumption that moated Iron Age sites in northeast Thailand accumulated as a result of millennia of continuous human occupation (Higham 2011, Nitta, 1997, O'Reilly, 1997).

The radiocarbon method is a standard method for determining conventional ¹⁴C ages of organic matter. Carbon has three isotopic forms that are Carbon-12, Carbon-13, and Carbon-14. The numbers refer to the atomic weight, and the extra neutrons in Carbon-14 make it radioactive. Radiocarbon is produced in the upper atmosphere after

Nitrogen-14 isotopes have been impacted by cosmic radiation. Radiocarbon is then taken in by plants through photosynthesis, and these plants in turn are consumed by organisms on the planet (Arnold and Libby, 1949). Thus, every living thing has a certain amount of radioactive carbon within them. After an organism dies, the radiocarbon decreases through a regular pattern of decay. This is called the half-life of the isotope. The time taken for half of the atoms of a radioactive isotope to decay in Carbon-14 is about 5730 years (Butzer, 1972).

The objective of this study is to continue testing the premise that the end of the Iron Age on the Mun river floodplain in Northeast Thailand is better defined as either: a singular more or less contemporaneous de-population event characterized by widespread abandonment of settlements; or a gradual transition from a dispersed rural settlement to more concentrated urban style of settlement. This study examines significant socio-cultural and socio-environmental relationships in this prehistoric settlement site.

2. Materials and Methods

2.1 Sample selection

While previous research had resulted in 76 radiocarbon dates (Higham, 2011), more detailed chronologies were important for many sites across this landscape to confirm the date for the end of the Iron Age settlement of the site. Researchers on this project aim to excavate as many sites as possible to examine and date very precisely the upper limit of the Iron Age. It is anticipated that each site will yield different end-of-settlement dates and patterns of Iron Age closure, and these data will provide a framework for the re-examination of the existing site dates. Radiocarbon dating samples from the two sites of the upper Mun River Valley floodplain site were selected for this study. Ban Non Wat is a moated site about 300 m in diameter rising up from the surrounding floodplain.

Nong Hua Raet is a mound site, situated about 4 km from Ban Non Wat and excavated since 2009 to investigate the evidence of the prehistoric inhabitants at the neighboring sites of Ban Non Wat. Fourteen samples (Table 1) were selected from Ban Non Wat site and three samples were selected from Nong Hua Raet site according to the significance of the layer changes, the

importance of the specific archaeological features (Table 1). Ban Non Wat samples cover different excavation squares (named as P300, S400, G104, N96, N100, TU 199 and V200) roughly through the diameter of the mound (Figure 1-B). Nong Hua Raet represents the excavation pit of HI100 (Figure 1-A).

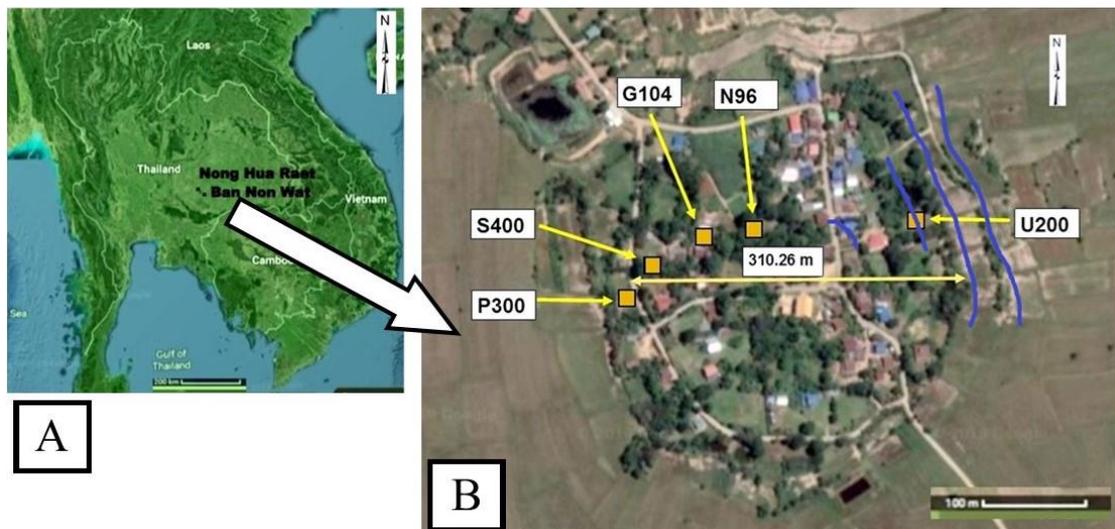


Figure 1. A. Regional location map of the study area. B. Aerial photographic view of the moated settlement of Ban Non-Wat and distribution of excavation pits across the moated settlement. Some excavation squares: P300, S400, G104, N96 and U200 are marked.

2.2 Laboratory Procedure

Samples were prepared for Accelerator mass spectrometry (AMS) dating at the Australian Nuclear Science and Technology Organization (ANSTO) environmental laboratory. Samples were treated according to the instructions in the ANSTO VI 3179 AMS chemistry-pretreatment of radiocarbon samples protocol. Chemical pre-treatment included acid alkali acid method to remove contaminants such as carbonates and soluble organics (fulvic acids and humic acids). Other steps of chemical treatments were sample processing, carbon dioxide transfer, graphitization and cathode loading. Conventional radiocarbon age BP results

were calculated using Calib 5.02 (Reimer et al., 2004).

3. Results and Discussion

Uncalibrated ages of the samples ranged from 1705 ± 30 yr BP to 3430 ± 30 yr BP (Table 1). Overall results support the existing dating results of continuous occupation from Neolithic to Iron Age at the prehistoric occupation sites at Ban Non Wat. The results from Nong Hua Raet support an argument that the Iron Age occupation at other sites around Ban Non Wat was contemporary with occupation at Ban non Wat (Table 1). Different layers of the occupation have been

identified according to the cultural materials of the excavation pits.

Eight cultural layers of occupation were identified in the studied excavation pits. Each layer depth is different among the excavation pits because of the uneven surface elevation of the mound (Figure 2). Layer two, as an example, in excavation pits of S400, G104 and N100 are in different depths but belong to the

Iron Age period of occupation and also same to the other layers (Figure 2). Layers were initially assigned during the excavations depending only on the cultural materials characteristic to the different occupation periods. The dating results aligned well with the macroscopic evidence of the occupation periods at each excavation layer.

Table 1. Radiocarbon Dating results at the two excavation sites of Ban Non-Wat (BNW) and Nong Hua Raet (NHR)

ANSTO code	Sample type	Site	Square	Layer No.	Conventional Radiocarbon Age (BP)	Calendric Age (Cal BP)	Calendar Age (BC/AD)
OZ0721	Charcoal	BNW	P300	3	1960 ± 30	1919 ± 32	31 ± 32 AD
OZP206	Charcoal	BNW	P300	5	2350 ± 40	2398 ± 49	448 ± 49 BC
OZ0719	Charcoal	BNW	S400	2	1705 ± 30	1627 ± 52	323 ± 52 AD
OZ0724	Charcoal	BNW	G104	2	2600 ± 30	2745 ± 12	795 ± 12 BC
OZP202	Charcoal	BNW	G104	6	3430 ± 30	3693 ± 41	1743± 41 BC
OZP204	Charcoal	BNW	N96	1	1705 ± 30	1627 ± 52	323 ± 52 AD
OZP203	Charcoal	BNW	N96	4	2535 ± 30	2637 ± 88	687 ± 88 BC
OZ0723	Charcoal	BNW	N100	2	2170 ± 30	2215 ± 73	265 ± 73 BC
OZP201	Charcoal	BNW	N100	3	2535 ± 30	2637 ± 88	687 ± 88 BC
OZ0720	Charcoal	BNW	TU199	4	2520 ± 30	2623 ± 88	673 ± 88 BC
OZ0722	Charcoal	BNW	V200	4	2195 ± 30	2231 ± 63	281 ± 63 BC
OZP207	Charcoal	NHR	HI100	3	2465 ± 35	2559 ± 111	609 ± 111 BC
OZ0717	Charcoal	NHR	HI100	3	2450 ± 30	2539 ± 125	589 ± 125 BC
OZ0718	Shell	NHR	HI100	3	2275 ± 30	2272 ± 65	322 ± 65 BC

Seven cultural layers of occupation were identified in the excavation pit of P300 (Figure 2) from Iron Age to Bronze Age and two dating results confirmed the observed pattern. Six cultural layers of occupation were identified in the excavation pit of S400 and dating results confirmed that layer two

belongs to late Iron Age occupation period. Seven cultural layers of occupation were identified in the excavation pit of G104 from Iron Age to the Neolithic. Radiocarbon results confirmed the predicted occupations at layers two and six. Six cultural layers of occupation were identified in the excavation

pit of N96 and layer four in the early Iron Age and layer one is late Iron Age. The excavation pit N100 has identified occupation layers from Iron Age to Neolithic and layer three confirmed the Iron Age occupation. However, layer two was identified in the N100 excavation as the historic period but the dating results suggested that it belonged to the late Iron Age. Eight cultural layers of occupation were identified in the excavation pit of TU199 up to the Neolithic. Eight cultural layers of occupation were identified in the excavation pit of V200 and they also extended up to the Neolithic. Dating result of layer four confirmed the Iron Age settlements. Only three cultural layers that

belonged to the Iron Age of occupation were identified in the excavation pit HI100 which is the nearby site to the Ban Non Wat. Evidence from the excavation suggested that the initial occupation was beginning at this site in the early Iron Age and dating results also confirmed it. According to the observed evidence, Iron Age was the highly populated and highly productive period of the Mun River valley region. Iron Age occupation at Nong Hua Raet may suggest that the population was spread into the nearby sites from Ban Non Wat and other highly populated sites during this period.

		Excavation pits							
		G104	N100	TU199	V200	P300	S400	N96	
Cultural Layers and Date (cal BP)	surface	surface	surface	surface	surface	surface	surface	surface	1627±52
	Iron Age	2 2745±12	2 2215±73	2 3 4 2623±88	2 3 4 2231±63	2 3 4 5 2398±49	2 1627±52 3	2 3 4 2637±88	
	Bronze Age	4	4 5 6 7	6	6	6 7	4 5 6	5 6	
	Neolithic	5 6 3693±41 7	8 9	7 8	7 8				
	natural	natural	natural	natural	natural	natural	natural	natural	natural

Figure 2. Summary of the dating results and identified cultural layers (named them as 2 to 8) by excavations in seven excavated pits at Ban Non Wat (layer heights are not to a scale).

Dating results of seven excavation pits across the Ban Non Wat archaeological site were categorized according to the cultural layers identified in the excavations depending on

the macroscopic evidence (Figure 2). As this testing was focused mainly to identify the end of Iron Age occupations, most of the results are confined to the Iron Age. The previously

estimated ages of Iron Age cultural layers are supported by the new radiocarbon dating results (Figure 2). The excavation pits of G104, N100 and S400 have identified two layers of Iron Age occupation. N96 has three layers and TU199, V200 and P300 have four layers each (Figure 2). The sequential layers in the same occupation period seem to suggest that the use of the area was intensive over a long period of time. Available dates of the end of Iron Age from several sites (McGrath and Boyd, 2001; Higham et al., 2007) provide a reasonably consistent picture of a closure date for the Iron Age. Each site contains its own chronology, and the conformity to a singular event cannot be assumed. For example, identify possible chronological phasing of settlement between sites, implying variability in the timing of social events across this floodplain (Kanthilatha, 2016 and Kanthilatha et al., 2020).

Until recently, models of social change in Southeast Asia included a late Iron Age phase of significant change and inferred crisis response to changing environmental conditions. Despite a long-term history of continuous social change, Higham and Higham (2009) describe this as a "vibrant, innovative and constantly changing cultural pattern", and the increasingly engineered Iron Age landscape has generally been viewed as evidence of an increasingly hierarchical society and/or the social response to an increasingly stressed environment. The argument is that increasing reliance on environmental resources and engineered resource management reflected an increasingly unstable resource supply, and thus an inherently unsustainable system. This was, globally, a time of climate change; it was assumed that climate change (possibly with deforestation) caused a socio-environmental crisis. Evidence of alluvial infilling and a significant change of fluvial regime (Boyd et al., 1999; McGrath and Boyd, 2001) were also taken to reflect the crisis.

Boyd and Chang (2010) developed an alternative model predicting socio-environmental changes, suggesting that the Iron Age archaeological record continues a long time period between dynamic social and environmental conditions. They conclude that the settlement has shown a unique combination of socio-environmental circumstances and the uniqueness is due to the interrelationships between people and environment, the roles of memory, continuity, discontinuity and transformation. Their study examines the broader patterning and landscape distribution of the sites, and mutual relationships and feedbacks between people and the landscapes inherited, occupied, constructed and modified throughout prehistory.

Archaeological evidence for the initial Neolithic settlement at Ban Non Wat found that domestic pigs and cattle were raised, and unlike the hunter-gatherer sites, there is evidence for the domestic dog and also the cultivation of rice. According to Higham and Higham (2009), these indicate that the initial settlement of Ban Non Wat by rice farmers took place in the mid-17th century BC. This phase lasted for about four centuries, until the inception of Neolithic-2 in the mid-13th century BC. The first phase of the Bronze Age is dated to ca.1000 BC (Higham and Higham, 2009; Higham and Rispoli, 2014). Present evidence may suggest that the first civilization commenced beside the prehistoric channel found in the excavation pit of 'Y' at Ban Non Wat (Figure 3). Above evidence suggest that the Neolithic occupation has been confined to the center of the mound. Neolithic occupation layers that have been found from the excavation pits of G104, N100, TU199 and V200 approximately mark the area of initial occupants (Figure 3). When the population increased, occupation area most likely spread radially towards the edge. As an example, the excavation pit of P300 which is at the edge of the mound evidenced human population since the Bronze Age. The buried channel features

found through the excavation pits of TU199, U200 and K500 may evidence a new water source; however, it is hard to say that this channel is a natural phenomenon or a constructed one. Another two moat features are clearly visible around the Ban Non Wat site (Figure 3) and may indicate that another water body had been constructed after infilling of the previous channels. According to McGrath and Boyd (2001), the moat bank of Ban Non Wat indicates an older construction phase around 200 BC to 0, from earliest Mid to Late Iron Age. The moats appear to have in-filled rapidly, with channels closest to the mounds being overtopped by rapidly expanding occupation mounds, in some cases shortly after construction. They further suggested that the timing of the construction of the moats at Noen U-Loke and other similar sites in the area occurred between 0-600 AD and infilling and overtopping of the channels buried by the mounds

dates to around 0-250 AD. More dating results through the channels and channel fillings are needed to confirm the infilling process and mound construction. However, present evidence clearly supports the predicted view of the site occupation that initial civilization commenced in the central area of the site and has spread radially across the mound of Ban Non Wat.

Chronological results are consistent with the results of fatty acids analysis, multi-elements identified in floor areas, phytolith and diatom analysis of the site and sediment analysis of the occupation layers (Kanthilatha et al., 2014, 2017a, 2017b). Analysis of this nature has great potential to provide rich evidence of a connection to the daily social life of man throughout a long period of prehistory from Neolithic to Iron Age in this region.

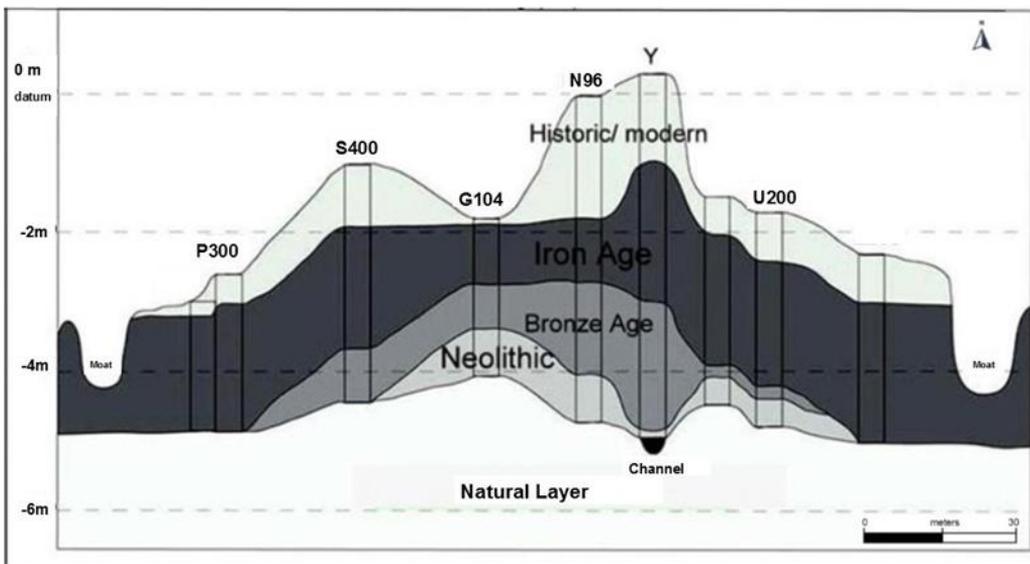


Figure 3. Basic stratigraphic profile of Ban Non Wat from west to east (not to a scale) (image from Nigel Chang).

4. Conclusion and Recommendations

This study was based on fourteen radiocarbon samples from the eight excavation pits at Ban Non Wat and Nong Hua Raet archaeological sites. Most of the samples

represent Iron Age occupation layers. Further analysis is needed representing all cultural layers identified by excavations based on the macroscopic evidence of different occupations belonging to the Iron Age, Bronze Age and Neolithic, to demonstrate the

population distribution across the site in each prehistoric time period. Lack of suitable dating materials and limited funds restricted opportunities to obtain a continuous chronological sequence of dates of each occupation layer at each study site.

Nevertheless, the radiocarbon results obtained coincide with the pre-assigned time periods based on the macroscopic evidence observed in the excavations. Most of the dates are from the Iron Age period of occupation at the different sites of the study area. The end of the Iron Age on the Mun river floodplain occurred at about 1627 ± 52 BP, as a gradual transition. According to the present results and the existing chronological framework of the study area, the end of the Iron Age on the Mun river floodplain in Northeast Thailand is better defined as a gradual transition from dispersed rural settlement to more concentrated urban style of settlement. Occupation commenced at the center of the mound of Ban Non Wat during the Neolithic period, and gradually spread radially to the margin by the Iron Age. Occupation at the neighboring site of Nong Hua Raet commenced during the Iron Age period, parallel to that at Ban Non Wat.

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