
Research Proposal for the 2019 IRAW@Bagan Settlement Archaeology Project

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IRAW@Bagan Mission Statement

The world’s tropical zones are witnessing the negative impacts of unchecked population growth, increasing wealth disparities, unbridled agricultural expansion, growing water demands, diminishing biodiversity, environmental degradation, escalating disease rates, and climate change. These are all urban issues. The proposed IRAW@Bagan study will highlight archaeology’s true strength – namely the ability to trace changes in urban forms and lifeways over time, and across multiple climate regimes, technological advances, and socio-ecological changes – to explore the root causes of the myriad issues faced by contemporary tropical metropolises.
The IRAW@Bagan Logo

The IRAW@Bagan logo on the cover of this proposal is derived from Jataka plaque #543 from the West Hpetleik Stupa: Sāma Jātaka (Sāma the Devoted Son). In the traditional Pali canon this story is listed as #540 of 547, but at Bagan three additional stories are often included as #s 497, 498, and 499 (for a total of 550), which pushes this story to #543.

A summary of the story can be found here:
http://usamyanmar.net/Buddha/Article/Sama%20jataka.pdf
**IRAW@Bagan Project Summary**

The IRAW@Bagan project (Phase I) will generate an integrated socio-ecological history for residential patterning, agricultural practices, and water management at the Classical Burmese (Bama) capital of Bagan, Myanmar (11th to 14th century CE) across a range of significant ecological, climatic, economic, socio-political, and religious changes. This objective will be achieved through a settlement archaeology study within the peri-urban (mixed urban-rural) settlement zone immediately surrounding Bagan’s regal-ritual epicenter, which is still clearly defined by remnants of its original walls and moat. The importance of the proposed program of survey, excavations, and geo-spatial inquiry is grounded in the fact that our current understanding of Bagan society continues to be biased towards its upper echelons, namely its high-ranking nobles and religious functionaries. A settlement archaeology study within Bagan’s peri-urban zone will: 1) generate a more nuanced understanding of Bagan as a dynamic capital city; 2) provide insights into the unique characteristics of early urbanism in the tropics; and, 3) contribute to considerations of resilience and vulnerability in contemporary tropical metropolises.

One of history’s great Buddhist kingdoms, Bagan’s peri-urban settlement zone covers roughly 80 km² and encompasses over 2800 Buddhist monuments, including temples with decorated interior space, solid stupas containing relics, and monasteries. Given the context, it is understandable that scholarly investigations at Bagan have almost exclusively focused on elite and/or religious architecture, art work, and texts. Nevertheless, inscriptions and retrospective chronicles suggest that Bagan’s peri-urban zone was also home to a large and diverse support population that lived in well-organized (i.e., orthogonally planned) “clusters” or “wards” based on commonalities in status, ethnicity, occupation, and clientage (i.e., formal “bondage” to a patron, such as the Crown or Church). Unfortunately, the veracity of this tightly integrated and highly organized, “cellular” residential pattern has yet to be confirmed on-the-ground. Recent archaeological investigations have also suggested that Bagan’s peri-urban zone was of the “dispersed,” agrarian variety, and included significant green space as well as productive land, in addition to a small-scale, but nonetheless sophisticated water management system. Once again, these suppositions require empirical confirmation. Taking these issues into consideration, the following questions will serve to frame both the methodological approach for the IRAW@Bagan settlement archaeology study, and the integrated socio-ecological history that will result from this long-term research program.

1) **How accurate is our current understanding of the commoner population that inhabited Bagan’s peri-urban settlement zone, given the elite-centric focus of our current data sets?**

2) **Can the posited heterogeneity and cellularity of Bagan’s peri-urban population be materially confirmed, given the diversity in status, ethnicity, occupation, and bondage suggested by the historic records?**

3) **If such diversity can be recognized archaeologically, what might this tell us about commoner agency, and shifting levels of adherence or resistance to the dominant, merit-based, Buddhist ideology, and the system of bondage that supported it?**

4) **Did different segments of Bagan’s peri-urban population exhibit varying degrees of resilience to changing socio-ecological circumstances – such as climate change – and if so, why?**
5) How were individual Bagan houses, house-lots, and villages configured, what kinds of activities took place in these residential spaces, and did the nature of these spaces change over time?

6) Does the residential patterning in Bagan’s peri-urban zone reflect the orthogonal/compact tradition of China, or the quasi-orthogonal/dispersed tradition found elsewhere in the tropics?

7) Did Bagan’s city-scape transition from being more dispersed and haphazard to more compact and grid-like over time?

8) How extensive and interconnected were Bagan’s peri-urban water management and agricultural systems, how did they develop, and in what ways did different stakeholders engage with them?
ဗုဒ္ဓဟူးများခြင်းကို ရိုးရိုးသောစာလုံးသောစားပေးသော သူ့အမျိုးအစား (၁)စာလုံးကို စာလုံးများဖော်ပြထားသည်။ သူ့အမျိုးစား သောအခြေခံအပေါ် ဗုဒ္ဓဟူးများခြင်းကို ကြည့်ရှုနိုင်ပါသည်။ အလုပ်များကို သောစာလုံးများသောစားပေးသော သူ့အမျိုးအစား (၁)စာလုံးကို စာလုံးများဖော်ပြထားသည်။ သူ့အမျိုးစား သောအခြေခံအပေါ် ဗုဒ္ဓဟူးများခြင်းကို ကြည့်ရှုနိုင်ပါသည်။

1) သူ့အသောက်ကြီး စာလုံးများသောစားပေးသော်လည်း အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။ အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။ အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။

2) သူ့အသောက်ကြီး စာလုံးများသောစားပေးသော်လည်း အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။ အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။ အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။

3) သူ့အသောက်ကြီး စာလုံးများသောစားပေးသော်လည်း အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။ အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။ အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။

4) သူ့အသောက်ကြီး စာလုံးများသောစားပေးသော်လည်း အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။ အချိန်အချိန်စာလုံးများဖော်ပြထားသည်။

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5) ဗုဒ္ဓဘာသာကျောင်းသားများ၏ စေးစုံသင်ကြားမှုထပ်မံစိုက်မှုအတွက် အဘိဓာန်ဖြစ်ခြင်း? မိဘအစိုးရသားစေးစုံသင်ကြားမှုကို မှားကြမှုကို လိုအပ်ပါသည်။

6) ဗုဒ္ဓဘာသာကျောင်းသားများ၏ စေးစုံသင်ကြားမှုထပ်မံစိုက်မှုအတွက် အဘိဓာန်ဖြစ်ခြင်း/အဘိဓာန်ဖြစ်ခြင်း၏ ကျောင်းသားစေးစုံသင်ကြားမှုသားစုံသင်ကြားမှုကို မှားကြမှုကို မှန်ကန်သောစာကြော်စာမျက်နှာဖြင့် ၎င်းကို မှန်ကန်သောစာကြော်စာမျက်နှာဖြင့်

7) ဗုဒ္ဓဘာသာကျောင်းသားများ၏ စေးစုံသင်ကြားမှုထပ်မံစိုက်မှုအတွက် အဘိဓာန်ဖြစ်ခြင်း/အဘိဓာန်ဖြစ်ခြင်း၏ ကျောင်းသားစေးစုံသင်ကြားမှုသားစုံသင်ကြားမှုကို မှားကြမှုကို မှန်ကန်သောစာကြော်စာမျက်နှာဖြင့်

8) ဗုဒ္ဓဘာသာကျောင်းသားများ၏ စေးစုံသင်ကြားမှုထပ်မံစိုက်မှုအတွက် အဘိဓာန်ဖြစ်ခြင်း/အဘိဓာန်ဖြစ်ခြင်း၏ ကျောင်းသားစေးစုံသင်ကြားမှုသားစုံသင်ကြားမှုကို မှားကြမှုကို မှန်ကန်သောစာကြော်စာမျက်နှာဖြင့် ၎င်းကို မှန်ကန်သောစာကြော်စာမျက်နှာဖြင့်
Proposed Field Operations for April-May 2019

2019 Surface Collection and Excavations

During the 2019 field season the IRAW@Bagan team will conduct quadrant-based surface collection (diagnostic sherds and special finds) and sub-surface testing of the Shwe Creek (Operation 315) and Otein Taung (Operation 748) occupation sites (see Figure 1). Both locales were examined multiple times during our initial reconnaissance within Bagan’s peri-urban (mixed urban-rural) settlement zone, and both have plausible evidence for domestic occupation. The sub-surface testing will involve the excavation of a 1 x 4 m trench in the approximate center of a significant ceramic scatter at each site (N-S orientation), and an additional 1 x 4 m trench 10 m to the east of each of the central units (E-W orientation; see Figures 2 and 3). The quadrants for surface collection will be oriented based on a primary “operation” datum to be established in the approximate center of each ceramic scatter (adjacent to the central excavation unit), and the two 100 m baselines that will extend out from this operation datum on the cardinal directions (e.g., N-S and E-W). This configuration will form four 50 x 50 m surface collection quadrants: NW, NE, SE, SW (Figures 4 and 5).

Excavations will be conducted using trowels and hand-picks, following a combination of natural and cultural contexts. All excavated matrices will be processed using ¼” screens, and matrix samples will be collected when deemed useful. Munsell colors will be assigned to each matrix, and color “smears” will be recorded on context specific Data Record forms. Information pertaining to specific excavation contexts and associated artifactual finds will be recorded using the same Data Record forms. More elaborate excavation narratives will be recorded in the excavator’s personal notebooks. Profile/Section drawings and top-plans will be hand-drawn for specific excavation contexts. In addition, a series of high resolution (RAW) photographs will be taken for each excavation context to facilitate photogrammetric-based 3D-imaging.
Figure 2. Google Map showing the location of excavations at the Shwe Creek site (Op. 315).

Figure 3. Google Map showing the location of excavations at the Otein Taung site (Op. 315).
Figure 4. Google Map showing the surface collection area for the Shwe Creek site (Op. 315).

Figure 5. Google Map showing the surface collection area for the Otein Taung site (Op. 748).
2019 Survey and Reconnaissance

During the 2019 field season, the IRAW@Bagan team will conduct reconnaissance and mapping of an NNE-SSW transect between the Shwe Creek and Otein Taung locales (Figure 6), two “possible residential neighborhood” (PRN) sites that will undergo test excavations during the same time period. The positioning of the transect, running between the two known PRNs and bisecting Bagan’s peri-urban settlement zone, will increase our understanding of the distribution of Bagan era residential neighborhoods and associated features, and inform the location of future test excavations. The pedestrian transect survey will emphasize the rapid and efficient identification of locales deemed indicative of PRNs through the documentation of high-density surface scatters (HDSS) of artifacts, defined as those that meet or exceed a minimal density criteria (MDC) of 25 artifacts per square meter, over a contiguous area of at least 100 square meters. These criteria are consistent with the characteristics of the previously identified Shwe Creek and Otein Taung PRN sites. The proposed transect survey will be 200 m wide x 1.75 km long. Individual survey lines (SL) will be established every 10 m across the width of the transect, along the northern boundary (from east to west), beginning at 5 m west of the eastern boundary line (i.e., at 5 m, 15 m, 25 m etc.). Each survey line will be digitized over satellite imagery to help maintain the survey formation, and assigned a unique, sequential designation, from east to west (i.e., Transect 1, Survey Line #1 = T1-1). The survey lines will serve as the designated “walking paths” running parallel to the long axis of the transect (e.g., they will be 1.75 km long).

The survey team will be composed of eight transect walkers, with one individual designated as the team leader. The team leader will have the responsibility for maintaining Survey Line Record forms (SLR) and anchoring the team’s movements along the transects. The pedestrian survey of the transect will begin by aligning the field walkers in 10 m intervals along the northern boundary, beginning with the most eastern survey line (T1-1), which will be inset from the eastern transect border by 5 m (i.e., by walking along the survey line, this field walker will be scanning 5 m to the east and west of their survey line, thus covering the 10 m wide [E-W] area immediately adjacent to the transect border, but not beyond it). Each individual walker will subsequently be positioned at 10 m intervals, with the final field walker stationed at the 75 m survey line (T1-8). The team leader will be positioned along one of the middle survey lines (i.e., T1-4/35 m or T1-5/45 m) and equipped with a handheld GPS to maintain the survey orientation and to mark the distances walked. All other field walkers will carry a directional compass to assist in maintaining their orientation along the survey lines.

Field walkers will progress southward along their designated 1.75 km long survey lines in increments of 50 m, completing what is referred to as a transect unit or TU (50 x 10 m in size). The survey lines will serve as the central (longitudinal) axis for each transect unit, and the 50 m increments will establish the northern and southern boundaries of each transect unit. Each transect unit will be given a spatial designation based on the survey line being traversed (e.g., T1-1), and the sequential number of the 50 m increment along the survey line, beginning with the most northern transect unit, and ending with the last transect unit, at the southern boundary (i.e., T1-1:1, T1-1:2 etc.). The distance traveled by each individual field walker will be determined by counting paces, with the assistance of handheld counters. At the end of each transect unit
increment the team leader will confirm the appropriate distance and orientation on the GPS and establish a marker flag on their survey line. The field walker on the outside survey line will also place a flag on their line at the end of each transect unit increment to assist in maintaining the orientation of the subsequent set of returning survey lines. Survey line walking and ground scanning will continue until the southern boundary of the transect is reached, at which point the survey team will reorient itself on the southern boundary, in 10 m intervals, to proceed with the next set of survey lines, this time moving to the north. The orientation of the new survey lines will continue to be assisted by using the GPS and compasses, in addition to the survey flags previously left by the team leader and outside edge field walker. This approach will be applied to the entire transect except where terrain is impassable or modern development has obscured the archaeological record. In order to complete the NNE-SSW transect between the Shwe Creek and Otein Taung occupation sites the survey team will cover a total of 700 transect units (50 x 10 m in size) over 20 days of field work, requiring the survey of 35 transect units per day, or a little over four transect units per person/per day for each of the eight field walkers.

During the process of completing each 50 x 10 m transect unit, each field walker will be responsible for scanning the ground surface 5 m to either side of them, with the goal of identifying any potential high-density surface scatters (HDSS) of artifacts, and/or other relevant cultural and natural features. All potential HDSS locales, along with any cultural or natural features of interest, will be flagged for more intensive investigation following the completion of each transect unit. At the conclusion of each transect unit increment, each field walker will record initial observations on a Survey Line Recording form (SLR) specific to each 50 x 10 m transect unit. Each potential HDSS artifact scatter flagged by the field walkers will then be investigated in more detail by the entire survey team to determine if it meets or exceeds the minimal density criteria (MDC) of 25 artifacts per square meter, over a contiguous area of at least 100 square meters. If these criteria are met, the team will attempt to determine the approximate boundaries of the HDSS, mark these boundaries on the relevant satellite image, and acquire a GPS point for the approximate center of the scatter. The locale will then be recorded on the SLR form as a possible residential neighborhood (PRN) site and be given a preliminary site designation that includes the transect number and a sequential number for each PRN discovered (i.e., T1-PRN1, T1-PRN2 etc.).

As PRN sites are, by definition, large – given the HDSS criteria – it is likely that they will cut across multiple transect units, requiring that descriptions of transect unit-specific characteristics for a particular HDSS/PRN be recorded on all relevant Survey Line Recording forms (SLR) for all associated transect units. The individual SLR forms should include an inventory of any cultural or natural features indicative of ancient settlement, agricultural practices, and water management – including temples, stupas, monasteries, canals, ponds, streams, and vegetation cover – that are associated with the HDSS within a particular transect unit, as well as a check list of the types of artifacts making up the HDSS. Significant features should also be marked on the associated satellite image in preparation for digitization within a GIS program. All collected data will be entered into a Microsoft Access database as well as a GIS (geographic information systems) program to facilitate future analysis and to guide the choice of future PRN test excavations.
Figure 6. Map showing the location of the Shwe Creek and Oteing Taung PRN sites, and the transect that will be surveyed between them during the 2019 field season.
ဗျာဒီယာဒေးယံလုံးကို၊ အောက်ပါအရာပေးများအလွန်အနည်းဆုံး (၄)ရာပေးသည်။ တောင်းဆိုထားသည်။

(၁) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

(၂) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

(၃) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

(၄) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

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(၆) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

(၇) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

(၈) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

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(၁၄) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

(၁၅) လက်နက်အက်းအသက်ရှိးလောက် (SLR) ကို ဤစာကြည့်ကိုများစွာ ရရှိသည်။

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ဤသို့မှုအပေါ် (T1-1) ကို အားလုံးပေါင်းလျှင် (၂၀) မီလိုချင်းမှာ ရှိပြီး၊
(၁၀)မီလိုချင်းမှာ ဤသို့မှုအပေါ် (T1-1:1, T1-1:2 စသဖြင့်) အားလုံးပေါင်းလျှင်
ဤသို့မှုအပေါ် အနီးဆုံး အကြောင်းကို
ဤသို့မှုအပေါ် အသေးစိတ်အရေအတွက်ကို ဖော်ပြထားသည်။ သို့သော်
အောက်ပါအတွက် မိတ်ဆွေ့ချင်သည်။ GPS မှ မိတ်ဆွေ့ချင်သည်။ ဤသို့မှုအပေါ်
အခြေခံချက်များကို အသေးစိတ်အရေအတွက် ဖော်ပြထားသည်။
ဤသို့မှုအပေါ် အခြေခံချက်များကို စိတ်ချင်းစိုးတွေ့ရသည်။
အတည်ပြုသောအချက်များကို မိတ်ဆွေ့ချင်သည်။
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ဤသို့မှုအပေါ် အသေးစိတ်အရေအတွက် ဖော်ပြထားသည်။ GPS မှ
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မိတ်ဆွေ့ချင်သည်။ ဤသို့မှုအပေါ် အခြေခံချက်များကို
အခြေခံချက်များကို မိတ်ဆွေ့ချင်သည်။
င်္က္း ြယ္မုပ္းြအးး္းွယကမခက္းႈ္ုးတ္းးြင္ ကမ်ဘပရႈ္္ု ုပး္ုင်္မနတ္းိ က န္းပားင္အနနွုင္မတ္က ႈ္ပာ တ္သ}

HDSS/PRN လ်ကဏကးပ္မခကး်ွု း္မရး္းွယကမခကးပ

SLR မခကးးြင္ မရး္းမ္းက တည္ႈြ်္ငကးးမတ္သ

SLR းႈ္္ု္ခင္းႈး ြင္ ယဥ္ အ်ခးမမ ရငည္

ဘကး္္ခင္း္းကမခကးက ႈ္ေ် တည္ ရမ gob အႈး ဘုန္းႀ် းအ်ခကင္းမခကး
ပေါင်းစပ်လိုက်သော စာကြောင်းများ ဖန်တီးခြင်း၌ စာလုံးများဖော်ပြသည်။ အခြားသော စာလုံးများဖော်ပြသည်။ စာလုံးများဖော်ပြသည်။ ပေါင်းစပ်လိုက်သော စာကြောင်းများ ဖန်တီးခြင်း၌ စာလုံးများဖော်ပြသည်။ အခြားသော စာလုံးများဖော်ပြသည်။ စာလုံးများဖော်ပြသည်။
### 2019 Staff List

1. **Dr. Gyles Iannone** (Trent University), Principal Investigator
2. **Dr. Scott Macrae** (Trent University), Co-Director (Survey)
3. **Nyein Chan Soe** (Yadanabon University), Survey Assistant
4. **Naing Soe** (University of Yangon), Survey Assistant
5. **Paing Thet Phyo** (University of Yangon), Field Assistant
6. **Dr. Pyiet Phyo Kyaw** (Mandalay University), Co-director (Excavations)
7. **Kong Cheong** (American University), Field Director
8. **Dr. Nwe Nwe Moe** (Mandalay University), Unit Supervisor
9. **Ellie Tamura** (Trent University), Unit Supervisor
10. **Daw Khin Phyu Phyu Tun** (University of Yangon), Field Assistant
11. **Keiko Lui** (Eco K Company), Environmental Consultant
12. **Khin Lay Maung** (University of Yangon), Field Assistant
13. **Hsu ThinZa Toē** (Mandalay University), Field Assistant
14. **Saw Tun Lin** (University of Yangon), Unit Supervisor
15. **Raiza “Stephany” Rivera-Borbolla** (Trent University), Unit Supervisor
16. **Daw Khin Thet Su Hlaing** (University of Yangon), Field Assistant
17. **Daw Thaw Thaw Nyein San** (University of Yangon), Field Assistant
18. **Moe Sat Wathan** (University of Mandalay), Field Assistant
19. **Khin Kyi Phyu Thant** (University of Yangon), Field Assistant

<table>
<thead>
<tr>
<th>Shwe Creek Unit 315a-1 &amp; Otein Taung Unit 748a-1</th>
<th>Shwe Creek Unit 315a-2 &amp; Otein Taung Unit 748a-2</th>
<th>Survey Team</th>
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<tr>
<td>• Nwe Nwe Moe</td>
<td>• Saw Tun Lin</td>
<td>• Scott Macrae</td>
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<td>• Ellie Tamura</td>
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<td>• Khin Lay Maung</td>
<td>• Moe Sat Wathan</td>
<td>• + four rotating team members from the excavation crews</td>
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<td>• Hsu ThinZa Toē</td>
<td>• Khin Kyi Phyu Thant</td>
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### April 2019

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**Notes:**
1. Leave for airport in the evening
2. Depart YYZ BR35 departs 1:45 am
3. Arrive TPE 5:15
4. Depart MDL FD244 departs 11:00 am
5. Arrive MDL 12:15
6. Airport Shuttle (to Bagan)

### May 2019

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**Notes:**
1. Foreign staff hotel days = 29 (26+3); Myanmar staff hotel days = 26
2. Foreign staff meal days = 29 (26+3); Myanmar staff meal days = 26
3. Van rental days = 23
4. Airport shuttle trips = 2

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**Bangkok Hotel:** [https://www.tripadvisor.ca/Hotel_Review-g293916-d549706-Reviews-New_Siam_Guest_House_Il-Bangkok.html](https://www.tripadvisor.ca/Hotel_Review-g293916-d549706-Reviews-New_Siam_Guest_House_Il-Bangkok.html)


**Mandalay Hotel:** [http://www.diamondrisehotel.com/](http://www.diamondrisehotel.com/)
DETAILED DESCRIPTION

OBJECTIVES: Insight Grant (IG) funding is requested to support Phase I of a long-term archaeological research program aimed at generating an integrated socio-ecological history of residential patterning, agricultural practices, and water management at the “classical” Burmese (Bama) capital of Bagan, Myanmar (11th to 14th century CE). The IRAW@Bagan project gains its importance from the fact that our current understanding of Bagan society is biased towards its upper echelons, being based almost entirely on elite-focused texts, art, and architecture. A settlement archaeology study within the peri-urban (mixed urban-rural) zone immediately surrounding Bagan’s walled and moated, regal-ritual epicenter will: 1) provide much needed balance to our conception of Bagan as a dynamic capital city; 2) generate insights useful to elucidating the unique aspects of urban development in the tropics; and, 3) inform considerations of resilience and vulnerability in contemporary tropical metropolises.

CONTEXT: Bagan (aka Pagan), like most of the historic Buddhist capitals of Myanmar, was located in the central “dry zone” (Aung-Thwin 1987:88, 1990:1; Aung-Thwin and Aung-Thwin 2012:38; Cooler 1997:19-20; Hudson 2008:553; Strachan 1989:8), on the eastern bank of the strategic and economically important Ayeyarwady River (Higham 2001:134; Hudson 2004:221, 265). Recent archaeological and scientific assessments support a mid-9th century CE date for the establishment of the Bagan community (Hudson 2004:220, 265-266; Moore et al. 2016:285; Nyunt Nyunt Shwe 2011:26), with the 11th to 14th centuries being the period when Bagan was the capital of a polity that controlled much of what is now the country of Myanmar (Daw Thin Kyi 1966:187; Galloway 2006:35; Higham 2001:134; Hudson 2004:183, 266, 2008:553, 555; Kan Hla 1977:17; Moore et al. 2016:285; Stadtner 2011:214-215, 2013:14, 18). Bagan’s florescence was followed by an era of socio-political “collapse” and reorganization, after which time it saw continued usage as a provincial capital and pilgrimage center (Hudson 2004:234-245, 266, Table 15, 2008:555; Hudson et al. 2001:53; Stadtner 2011:215-216, 2013:14, 18). These periods of growth and decline coincide with, and may have been influenced by, two significant climate changes: The Medieval Climate Anomaly (MCA; 900-1300 CE), marked by warmer conditions with increased rainfall, longer monsoon seasons, shorter dry season droughts, and rains more evenly distributed throughout the year – which were ideal conditions for agriculture – and the subsequent Little Ice Age (LIA; 1300-1570 CE), a cooling period that brought negative changes in both rainfall and temperature, and hence deteriorating agricultural conditions (Buckley et al. 2010, 2014; Cook et al. 2010; Lieberman 2003:103, 2009:330, 792, 2011:939; Lieberman and Buckley 2012:1052; Wohlfarth et al. 2016; Wündsch et al. 2014; Yamoah et al. 2017).

The Bagan epicenter, as is true for other historic Myanmar capitals, was an “exemplary” center that was imbued with cosmological and regal-ritual significance, at the same time that it was home to royals, nobles, military leaders, guards, servants, and elite craft workers (Aung-Thwin 1985:50-51, 1987:88, 94-98; Aung-Thwin and Aung-Thwin 2012:81, 100-101; Daw Thin Kyi 1966:187; Hudson 2004:221; Kan Hla 1977:21). Such epicenters were normally characterized by a walled and moated regal-ritual space with 12 gates that housed royal temples (with interior space), stupas (solid cores with offerings), ordination halls, libraries, monasteries, “preaching halls,” and a palace (Aung-Thwin 1985:50-52, 1987:89-91; Aung-Thwin and Aung-Thwin 2012:81; Daw Thin Kyi 1966:179; Hudson 2004:220; Stadtner 2011:219-220). Historically, Myanmar epicenters were roughly 2.5 km² in size (Aung-Thwin 1987:90; c.f., Daw
Thin Kyi 1966:179). Bagan’s epicenter is slightly smaller, at 1.5 km$^2$ (Aung-Thwin and Aung-Thwin 2012:78), although it is impossible to determine its original dimensions because its western wall washed into the Ayeyarwady River sometime in antiquity (Daw Thin Kyi 1966:179; Hudson 2004:221; Luce 1969:7, 106; Stadtner 2013:125).

When considered today, Bagan’s epicenter clearly: “represents an elite core, not an urban boundary,” given that a dense amalgamation of brick temple complexes, stupas, and monasteries extends out and away from the walled enclosure in all directions, thereby forming an extensive peri-urban settlement zone (Hudson 2004:221; see also Aung-Thwin and Aung-Thwin 2012:78; Kan Hla 1977:21; Luce 1969:229). Most of these features were constructed during Bagan’s florescence (Hudson 2004:236), and the spatial extent of the peri-urban zone itself appears to have been established by the end of the 11th century (Kan Hla 1977:18). This peri-urban zone is estimated to have covered around 80 km$^2$ (Grave and Barbetti 2001:75; Hudson 2004:237; Hudson et al. 2001:48; Moore et al. 2016:294; c.f., Aung-Thwin and Aung-Thwin 2012:91), and it encompassed at least 2200 brick temples (Hudson 2004:236; Kan Hla 1977:15), and possibly as many as four thousand (Aung-Thwin 1985:169; Kan Hla 1977:15; Prichard 1992-2003). The emphasis on channeling resources into monumental architecture during Bagan’s early development suggests that these edifices were considered strategic mechanisms for broader societal integration (Hudson 2004:243; Hudson et al. 2001:51; see also Trigger 1990). Crucial to this integration was the Buddhist notion of “merit,” which was fundamental to the Bagan belief system, and indeed to the daily life of all members of the kingdom (Aung-Thwin 1987:89; Aung-Thwin and Aung-Thwin 2012:83-84). It was good deeds, and more significantly donations of capital and both human and natural resources to the Buddhist church (the Sangha), that allowed all citizens – but mostly those with access to such resources – to secure “social recognition and spiritual benefits,” along with a higher quality rebirth (Aung-Thwin 1985:26, 43-44, 169-171; Aung-Thwin and Aung-Thwin 2012:94; see also Luce 1969:89-90, 107, 109, 112, 115; Stadtner 2013:18).

Hudson et al. (2001:70) posit that: “By the twelfth century A.D., [Bagan’s peri-urban zone was] characterized by a low-density, monument-rich complex that could expand without the constraint of a predefined outer boundary,” such as a perimeter wall or any other type of defensive feature (Daw Thin Kyi 1966:187; Kan Hla 1977:19). The inscriptions inform us that although the majority of temples and stupas were made of brick, some monasteries, and the many palaces, commoner residences, and schools scattered throughout the peri-urban zone were crafted from wood and built on “stilts” (Aung-Thwin and Aung-Thwin 2012:91; Kan Hla 1977:20; Luce 1969:229; Strachan 1989:7). As a result, other than the clay roof tiles used in elite structures, these buildings have all perished (Aung-Thwin and Aung-Thwin 2012:91). According to John Miksic (2001:100): “Subjective impressions of Pagan obtained by walking over the ground suggests that many areas in fact may have been densely inhabited, to judge from the dense scatters of ceramic sherds littering the ground” (see also Aung-Thwin and Aung-Thwin 2012:79-80; Daw Thin Kyi 1966:187; Stadtner 2013:15, 50). Hudson et al. (2001:70) concur, positing that: “Spatio-temporal evidence from Bagan’s key multi-attribute artifacts, its buildings, indicates that there may have been a number of long-term settlements spread throughout the urban complex” (see also Strachan 1989:7). Indications are that these settlement “clusters” were normally surrounded by greenery and located adjacent to agricultural plots of various size (Kan Hla 1977:21; Moore et al. 2016:294). Recent analysis also indicates that the peri-urban zone contains remnants of a complex and extensive, yet comparatively “small-scale” water

What then do we know about the population that inhabited Bagan’s peri-urban city-scape? It is here where Bagan’s inscriptions and retrospective chronicles provide us with some important information. We are told that a small portion of Bagan’s society was made up of officials of upper and lower rank, and an even smaller number of nobles, including those comprising the royal court (Aung-Thwin 1985:71, 96; Aung-Thwin and Aung-Thwin 2012:97; Stadtner 2013:25). The apex of the commoner class included village heads, artisans, and crown service troops (Aung-Thwin 1985:72-73). By far the largest segment of Bagan’s support population was made up primary producers, most of which were involved in some form of agricultural production (Aung-Thwin 1985:71-73, 95; Aung-Thwin and Aung-Thwin 2012:49). Besides farmers, Bagan was also home to myriad craft specialists (Aung-Thwin and Aung-Thwin 2012:49, 90-91; Higham 2001:134; Hudson 2004:212; Kan Hla 1977:21; Luce 1969:108, 112, 230-232; Miksic 2001:100; Stadtner 2013:25). Regardless of their occupation, most commoners were formally “bonded” to either the Crown, the Sangha (Buddhist church), or less frequently to wealthy nobles, in a complex web of patron-client relationships that were codified into law (Aung-Thwin 1985:71, 74, 78, 87, 1987:88; Aung-Thwin and Aung-Thwin 2012:97). Indications are that Bagan’s support population was multi-ethnic (Aung-Thwin 1985:71; Aung-Thwin and Aung-Thwin 2012:88, 96-97), and although Theravada Buddhism was the state religion, other Buddhist schools (i.e, Mahayanist), traditional animistic practices, and even Hindu beliefs were apparently tolerated (Luce 1969:72-73; Nyunt Nyunt Shwe 2011:26). The historic texts also imply that this societal heterogeneity conditioned Bagan’s residential patterning, giving it both a clustered and cellular character, wherein a combination of one’s “socio-spiritual” status, clientage, occupation, and ethnicity determined where and with whom one lived (Aung-Thwin 1985:74, 91-96; Hudson 2004:212).

Regardless of the apparent details provided by the historic records, it is accurate to state that there is little attention paid to the general lifeways of Bagan’s peri-urban population (Luce 1969:116; Miksic 2001:91). We must also remain cognizant of the fact that such elite-focused representations are, by their very nature, one-sided, and they should therefore not only be reviewed with a critical eye, but also actively challenged using alternative datasets. This is likely to result in contrasting, multivocal, and undoubtedly more realistic renditions of Bagan society (see Feinman 1997; Overholtzer 2013). The elite-biased perspective that governs our current understanding of Bagan’s peri-urban population stimulates a series of research questions that will help guide the long-term IRAW@Bagan research program 1) How accurate is our current understanding of the commoner population that inhabited Bagan’s peri-urban settlement zone, given the elite-centric focus of our current text-based data sets? 2) Can the posited heterogeneity and cellularity of Bagan’s peri-urban population be materially confirmed, given the diversity in status, ethnicity, occupation, and bondage suggested by the historic records? 3) If such diversity can be recognized archaeologically, what might this tell us about commoner agency, and shifting levels of adherence or resistance to the dominant, merit-based, Buddhist ideology, and the system of bondage that supported it? and, 4) Did different segments of Bagan’s peri-urban population exhibit varying degrees of resilience to ecological, climatic, economic, socio-political, and religious changes, and if so, why?

Another area that requires further investigation is the character of Bagan’s peri-urban ground plan. The inscriptions and retrospective chronicles relating to Bagan have led some to imply that
its peri-urban settlement zone was formally planned on an orthogonal, grid and block system, with distinct “wards” housing individuals sharing the same occupation (Aung-Thwin 1987:92; Aung-Thwin and Aung-Thwin 2012:91; Kan Hla 1977:21), not unlike what is found in the Chinese tradition of “compact urbanism” (Wheatley 1971). Others have underscored that Bagan’s peri-urban zone does not appear to have been either gridded or orthogonal in plan, although the placement of prominent structures was surely intentional (Kan Hla 1977:21-23; Moore et al. 2016:302). The latter characterization has also been advocated by those advancing a cross-cultural, comparative perspective, wherein Bagan’s city-scape is considered an example of a quasi-orthogonal, “low-density” (Fletcher 2009, 2012; Hudson et al. (2001:70), or dispersed urban center (Iannone 2015). As such, it is posited to equate with a unique urban tradition that persisted for a considerable length of time in the world’s tropical zones (Fletcher 2009, 2012; Haviland 1969:431-432, 1970; Iannone 2015; Isendahl and Smith 2013; Miksic 2001:102, 2012:179; Stark et al. 2015:1442; Wheatley 1971). Given these alternative perspectives, four additional questions will help frame the IRAW@Bagan research program:

1) How were individual Bagan houses, house-lots, and villages configured, what kinds of activities took place in these residential spaces, and did the nature of these spaces change over time?
2) Does the residential patterning in Bagan’s peri-urban zone reflect the orthogonal/compact tradition of China, or the quasi-orthogonal/dispersed traditions of the tropics?
3) Did Bagan’s city-scape transition from being more dispersed and haphazard to more compact and grid-like over time?
4) How extensive and interconnected were Bagan’s peri-urban water management and agricultural systems, how did they develop, and in what ways did different stakeholders engage with them?

METHODS: The IRAW@Bagan project will employ theoretical and methodological tools from the applicants’ previous settlement archaeology project in the Maya subarea (e.g., Iannone 1996, 2003, 2004, 2005; Iannone and Connell 2003; Iannone et al. 2008; Longstaffe and Iannone 2011; Macrae and Iannone 2011, 2016; McCane et al. 2010), and their six years of comparative research (2010-2016) into socio-ecological resilience in South and Southeast Asia (Iannone 2014a, 2014b, 2015, 2016; Iannone et al. 2015). Three interconnected sub-projects will frame the research program.

The Residential Patterning Sub-Project: This sub-project will explore diversity in settlement unit location, size, composition, ground plan, orientation, and activities, with the goal of evaluating the tight integration, residential clustering/cellularity, and orthogonal/grid-block ground plan suggested by the historic records (Aung-Thwin 1985:74, 91-96; Aung-Thwin and Aung-Thwin 2012:91; Kan Hla 1977:21). The principal challenge for the residential patterning sub-project is that: “Excavations in Mainland Southeast Asia have yet to reveal a single complete house plan” (Higham 2017:369; emphasis mine). Indeed, the settlement patterns and residential architecture of the classical period polities of Southeast Asia have rarely received archaeological attention (Miksic and Goh 2017:26, 358), with the exception of Angkor, Cambodia (Bâty 2005; Stark et al. 2015), and Trowulan, East Java (Miksic 2001:100, 2012), where recent excavations have been specifically aimed at exposing house remains. As such, the fundamental goal of Phase 1 of the IRAW@Bagan residential patterning sub-project is to find ancient living surfaces and reveal the city’s first complete house plans. As is common practice in such “exploratory” situations, our initial investigations will employ non-probabilistic (purposive/judgmental) sampling methods to enhance the potential for finding buried residential features (Banning 2002:28-29; French 2015:21). This sampling strategy has been informed by
prior archaeological observations concerning the possible locations of settlement clusters at Bagan (Hudson 2004:208-220, 234--266; Hudson et al. 2001:53-62). Based on such knowledge, preliminary surface reconnaissance by the IRAW@Bagan research team (May 2017) resulted in the discovery of four potential residential loci, given the presence of exceptionally dense ceramic scatters: 1) Shwe Creek, 2) Otein Taung, 3) South Wall, and 4) Kiln #4. Our Phase I excavations will focus on these four possible residential sites, and any other possible sites encountered during GPS-guided pedestrian survey of three 200 m wide transects (see the field work plan [below] for more details). These “purposively” situated transects will be used to locate extensive scatters of ceramic detritus (Banning 2002:90), a plausible proxy for residential occupation (Banning 2002:15, 75, 206). This reconnaissance will be aided by scheduling our fieldwork in April-May, coinciding with the end of the dry season and the time when ground cover is most limited. A series of 1 x 4 m test trenches and larger 4 x 4 m horizontal exposures will subsequently be used to search for and uncover buried residential features, such as postholes (please see the fieldwork schedule [below] for more details). Context information will be recorded in notebooks and on level/feature forms and entered into a Microsoft Access database. A hand-held digital SLR camera and georeferenced ground control points (using a total station) will be used to record all excavation contexts, on-floor artifact distributions, features, and both plans and sections. Processing of these data using “Structure from Motion” (SfM) photogrammetric software (Agisoft LLC 2017a, 2017b) will allow for the production of high resolution orthophotos (sub-millimeter), digital elevation models (DEM), accurate 3D and 2D maps, precise post-excation measurements (e.g., lengths, heights, and volumetrics), and geospatial analysis in ArcGIS ([ESRI 2016]; Benavides López et al. 2016; Green et al. 2014; Koenig et al. 2017; Quatermaine et al. 2014). Samples for radiometric (bone or charcoal) and/or luminescence (ceramics) dating will be collected to aid in chronology building. Artifacts will be processed and analyzed using standard procedures (e.g., Rice 1987), including the use of both identification guides (e.g., Brown 2000) and reference collections in the Bagan Museum.

**The Agricultural Practices Sub-Project:** The Bagan polity was supported by an agrarian economy, but the city itself was not well suited to wet-rice cultivation (Aung-Thwin 1990:8; Cooler 1997:22-23). This sub-project will therefore explore the agricultural potential of the peri-urban settlement zone in terms of “dry weather crops” – such as sesame, millet, sorghum, legumes, palm trees, dry rice, onions, and root crops (Aung-Thwin 1990:5-6; Cooler 1997:23; Kan Hla 1977:15; Moore et al. 2016:302-303; see also Spate 1945:524-526) – in addition to assessing the distribution of fields, gardens, and granaries. This research will build on earlier assessments of Bagan’s agricultural capacity (Aung-Thwin 1990), taking into consideration that the agricultural potential of Bagan’s peri-urban zone would have varied across the MCA and LIA climate regimes. The agricultural practices sub-project will involve total-station mapping and excavation of possible remnant field “walls” and adjacent field surfaces (1 x 2 m trenches) encountered during the transect surveys (please see the fieldwork schedule [below] for details). Excavation areas will be selected based on their connection with identified hydrological features and proximity to known settlement units (see Macrae 2017:123). Soil samples collected from each stratigraphic profile will be subjected to pedological tests, including: soil taxonomy, textural classes, organic matter, exchangeable micro- and macro-nutrients, and trace element concentration, as well as chemical constituents such as pH, electrical conductivity, and estimated cation-exchange capacity (French 2015). Subsequent analysis will focus on interdependent soil characteristics such as soil fertility, soil moisture retention capability, and vulnerability to soil
erosion (Macrae 2017:155-168). The soil samples will also be subjected to macro- and micro-
botanical analysis (phytolith, starch, and pollen). Results of these tests will be examined in terms
of expected crop production and intensity. A developmental model for sections of the ancient
Bagan agricultural field system will then be generated using excavation data, proximity to
datable hydrological or settlement features, and correspondences between fields and
temple/monastery spatial orientations, as determined through remote sensing (e.g., Hawken
2013). Finally, a global information system (GIS) model for crop suitability and productivity
potential will be produced through an analysis of crop suitability based on precipitation (as
extrapolated from regional climate signatures), soil quality (from the archaeopedological
analysis), topographic conditions (from available DEMs and hydrological mapping), and the
biophysical requirements of the crops identified by macro- and micro-botanical analysis (Macrae
2017:226-253). Production potential will be modeled by examining the manipulation of crop
suitability through farm management practices, technological advances, and cropping systems,
assigning each management condition a unique value that influences potential levels of
production (Elsheikh et al. 2013:98). Production potential will then be evaluated for a series of
crop groups (cereal, fiber crops, oil crops, roots and tubers, stimulants, fruit trees, and
vegetables) under different management practices.

**The Water Management Sub-Project:** Access to water was an endemic issue at Bagan
(Cooler 1997; Luce 1969:7), and most kings attempted to augment the city’s water supply
through the construction of brick wells, dams, canals, and brick or stone-lined holding tanks
(Kan Hla 1977:22; Luce 1969:76, 84, 256; Pe Muang Tin and Luce 1923:65, 131; Stargardt
1968:360-361). **This sub-project will attempt to reconstruct the broader water management
system associated with Bagan’s peri-urban settlement zone.** It will build on prior examinations
of Bagan’s water management system, (Moore et al. 2016:283; see also Win Kyaing 2016; c.f.,
Cooler 1997:32), including preliminary examinations of known water management features in
the peri-urban zone carried out by the IRAW@Bagan research team in May 2017. This sub-
project will involve a GIS-based hydrological study of Bagan’s peri-urban settlement zone. The
analysis will be based on hydrological modeling programs (Arc Hydro [see Maidment 2002])
within a geographical information system (ArcGIS [ESRI 2016]). The foundation of this analysis
will be a high-resolution DEM derived from existing remote sensing datasets (i.e., recent aerial
photographs and prior mapping initiatives) and traditional total station and GPS survey data
collection. The Hydrological analysis will include the direction of flow, flow accumulation, and
watershed delineation (see Macrae 2017:214-225; Macrae and Iannone 2016:374-388). The
identification of these hydrological characteristics across the landscape will provide information
on both naturally occurring features – such as slope, streams, and seasonal ponds – as well as
cultural features, such as reservoirs, canals, weirs, and moats. Identifying potential areas of
strategic water management and zones of high flow accumulation will provide the basis for
traditional total station survey of both natural and anthropogenic water flow. Sub-meter accurate
GPS devices will be used to ground-truth and map these features in real time. The results will be
used to both identify and differentiate between natural and cultural features, and these
observations will be used in conjunction with data derived from remote sensing to facilitate the
analysis of changing hydrological processes. This analysis will include assessments of localized
weather patterns indicative of annual wet and dry periods (see Aung-Thwin 1990:6), providing
the necessary comparative data for identifying changing water levels across the anthropogenic
system. This analysis will also facilitate investigation of the potential ramifications that the MCA
and LIA climatic regimes had on both domestic water security and agricultural production during Bagan’s rise and fall as a political center. Targeted excavations of water management features will focus on cross-sectioning canals and weirs (1 x 2 m trenches) that functioned to distribute water between the agricultural fields and larger reservoirs (please see the fieldwork schedule [below] for details). The location of these excavations will be based on considerations of the hydrological flow and accumulation maps, and insights generated through the systematic transect surveys. Excavations will address both the chronological sequence and techniques of construction. Soil samples will be collected and soil organic matter (SOM) will be radiocarbon dated to substantiate the results of ceramic date attributions, and to facilitate direct temporal correlation with adjacent agricultural fields and settlement units.

Our proposed fieldwork schedule is as follows. October 2018: The PI (Iannone) and Co-Director (Pyiet Phyo Kyaw), accompanied by a few additional project members, visited Bagan in preparation for the April-May 2019 field season. Our activities included securing permissions from landowners, establishing the locations for excavation units, arranging for staff housing and meals, and consulting with the DOA-Bagan concerning the forthcoming excavation and survey activities. April-May 2019: Quadrant-based surface collection (diagnostic sherds and special finds) and sub-surface testing of the Shwe Creek and Otein Taung occupation sites, including excavation of a 1 x 4 m trench in the center of each ceramic scatter (N-S orientation), and a 1 x 4 m trench 10 m to the east or west of the central units (E-W orientation); Reconnaissance and mapping of a 200-m wide x 1.75-km long NE-SW transect between Shwe Creek and Otein Taung occupation sites. April-May 2020: Surface collection and sub-surface testing of the South Wall and Kiln #4 occupation sites, including excavation of a 1 x 4 m trench in the center of each ceramic scatter (N-S orientation), and a 1 x 4 m trench 10 m to the east or west of the central units (E-W orientation); Reconnaissance and mapping of a 200-m wide x 2.15-km long NW-SE transect between Otein Taung occupation site and Minnanthu Village. April-May 2021: Surface collection and sub-surface testing of two occupation sites discovered during the Years 1 and 2 transect surveys, including excavation of a 1 x 4 m trench in the center of each ceramic scatter (N-S orientation), and a 1 x 4 m trench 10 m to the east or west of the central units (E-W orientation); Reconnaissance and mapping of a 200-m wide x 2.75-km long SE-NW transect between Otein Taung occupation site and the South Wall occupation site. April-May 2022: Horizontal excavation of the previously tested occupation site with the clearest signs of residential occupation. This will involve 3-4 contiguous 4 x 4 m excavation units strategically positioned based on the results of prior test excavations; Sectioning of field walls and adjacent field surfaces (1 x 2 m trenches), soil sample collection and flotation analysis (macro-and micropalaeobotanical recovery), ground-truthing of GIS-based hydrological analysis, and test excavation (1 x 2 m trenches) of canals and weirs along the three survey transects; Artifact analysis for socio-cultural reconstructions and chronology building. April-May 2023: Horizontal excavation of a second previously tested occupation site with clear signs of residential occupation. Once again, this will involve 3-4 contiguous 4 x 4 m excavation units strategically positioned based on the results of prior test excavations; Sectioning of field walls and adjacent field surfaces (1 x 2 m trenches), soil sample collection and flotation analysis (macro-and micropalaeobotanical recovery), ground-truthing of GIS-based hydrological analysis, and test excavation (1 x 2 m trenches) of canals and weirs along the three survey transects; Artifact analysis for socio-cultural reconstructions and chronology building.
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Knowledge Mobilization Plan

The ultimate goals of the proposed research program are to: 1) foster an understanding of peri-urban development at the “classical” Burmese capital of Bagan, Myanmar (1100-1400 CE); 2) explore the broader implications this knowledge holds for understanding the unique characteristics of early tropical urbanism; and, 3) mobilize knowledge of the past to better equip communities and policy makers to deal with the various issues that are currently facing urban centers in the tropics. The knowledge mobilization plan has four components:

• **Public Outreach**: We will strive to disseminate knowledge generated through the proposed pilot project through a series of public lectures at Trent University and other universities and museums, and in Myanmar itself, where we have been building strong ties with both the newly founded *Myanmar Archaeological Association*, and the various communities surrounding “Old Bagan.”

• **Scholarly Conferences**: We will present annually at two major scholarly conferences, the *American Anthropological Association* meetings (winter), and the *Society for American Archaeology* meetings (spring). We will also present at one regional conference (*SEAMEO-SPAFA*) that attracts archaeologists, educators, and government officials from across Southeast Asia (usually held every two to three years).

• **Publications**: It is anticipated the project will result in annual open-access field reports that will be published online through the *Trent University Occasional Paper* series. We also anticipate at least three open access journal articles (likely in a regionally specialized or methods focused journals), three book chapters, and three “research bulletins” to be published in Myanmar. It is also expected that between 5-10 individuals Master’s theses (Trent University and University of Yangon), and 2-3 PhD dissertations (University of Yangon), will result from the proposed project.

• **In-Class Instruction**: A significant portion of our knowledge mobilization occurs in our classrooms, where we are able to share the results of our research with future public and private sector leaders. Over the past six years the PI (Iannone) has transitioned his teaching load to focus on four principal courses that are high enrollment and cross-listed with multiple departments (Anthropology, Environmental Sciences, Geography, and Ancient History and Classic), and which will all benefit from various aspects of the proposed research program: *Archaeology of Natural Disasters, Archaeology of Climate Change, Human Impact on Ancient Environments,* and *Collapse of Complex Societies.*
Expected Outcomes

This project will: Enhance graduate-level HQP training, and augment undergraduate instruction; Build collaborative and logistical networks in Myanmar; Advance understanding of the methods and theories of settlement archaeology and resilience theory within Southeast Asian archaeology; Permit the training of graduate students from North America and Myanmar in both the theory and methods of an “integrated” settlement archaeology, and the application of resilience theory to the study of early urban communities in the tropics; Make a significant contribution to our understanding of urbanism in the tropics, with particular emphasis on the nature of the early urban footprint, its resilience aspects, and the factors responsible for, and implications of, the transition from dispersed to compact urbanism over time.

The project will also foster: Critical knowledge of the unique characteristics of early urbanism in the tropics, and the factors contributing to the eventual transition from dispersed to more compact urbanism that occurred across Southeast Asia; Economic outcomes by providing information about Bagan’s early peri-urban community that can be shared with the growing number of tourists that are visiting Bagan year-over-year, and which will augment the current application for UNESCO World Heritage Site status, the conferring of which will have huge financial benefits for Myanmar, and especially the contemporary communities surrounding the archaeological park; New collaborations by pioneering research partnerships with faculty and students at the University of Yangon, as well as UNESCO Myanmar, the Departments of Archaeology of Myanmar, its local administrative office at Bagan, and the Bagan Museum.
Research Team and Training

A) DESCRIPTION OF THE RESEARCH TEAM: A team approach is required to carry out most archaeological field work, and this endeavour is no exception. The Principal Investigator (Iannone) and Co-applicant (Macrae) have worked together on archaeological projects since 2005, and this bodes well for the success of the proposed research program. When initiating a large project in a foreign country a strong collaborator is also crucial, and Pyiet Phyo Kyaw (University of Yangon) has already proven to be an invaluable colleague in terms of navigating government bureaucracy and community relations.

In brief, the proposed “Integrated Socio-Ecological History of Residential Patterning, Agricultural Practices, and Water Management at the “Classical” Burmese (Bama) Capital of Bagan, Myanmar” project (IRAW@Bagan) has been crafted to take advantage of the Principal Investigator’s (Iannone) extensive understanding of “integrated” settlement archaeology and the comparative approach to tropical resilience, both of which are areas of research that are not well developed in Myanmar. The project also leverages the Co-applicant’s (Macrae) understanding of tropical agricultural practices and methodological skills in GIS-based geospatial analysis and hydrological studies. Finally, the collaborator (Pyiet Phyo Kyaw) has considerable experience with Bagan’s art and architecture, textual record, and water management system. Clearly, the combined skillsets of these three are highly complementary, and promise to result in a successful research project. Further details concerning areas of expertise, and the roles and responsibilities of the three principal participants in the IRAW@Bagan pilot project, are outlined below.

Principal Investigator: Gyles Iannone, PhD; Professor, Department of Anthropology, Trent University. The PI will be responsible for roughly 50% of all project related activities. No other major research projects will be taken on during the proposed investigations. The PI’s principal areas of expertise include: 1) Archaeology; 2) Resilience Theory; 3) Settlement Archaeology; 4) Early Tropical States; 5) Mesoamerica; and, 6) South and Southeast Asia. In terms of the ability to lead the project, the Principal Investigator has considerable experience with formulating and overseeing a large, well-funded, transdisciplinary settlement archaeology project in Belize (1999-2014) that included examinations of integrative mechanisms, residential patterning, agricultural practices, water management, climate change, and advanced geospatial data. The Principal Investigator has also devised and overseen an extensive field-based investigation of resilience in early tropical state formations across South and Southeast Asia (2013-2015), and has visited Bagan three times (2012, 2013, 2017). He has published extensively on settlement patterns, socio-ecological systems, climate change, resilience theory, and the collapse of complex societies. During the proposed IRAW@Bagan settlement archaeology project the Principal Investigator’s roles and responsibilities will include: 1) serving as the Principal Investigator; 2) administration of all intellectual, regulatory (e.g., fieldwork permits), and financial aspects of the project; 3) field supervision of the residential patterning (survey and excavations) sub-project; 4) oversight of the agricultural practices and water management sub-project; 5) co-supervision of all field and lab activities; 6) co-ordination of, and major contributions to, an effective program of knowledge mobilization; and, 7) direct supervision of 5-7 MA students from Trent University.

Co-Applicant: Scott Macrae, PhD; Adjunct Graduate and Research Faculty, Trent University. The Co-applicant will be responsible for roughly 40% of all project related activities. No other major research projects will be taken on during the proposed investigations. The Co-
applicant’s areas of expertise include: 1) Mesoamerican and Southeast Asian Archaeology; 2) Environmental Archaeology; 3) Comparative Archaeology; 4) Socio-Economic and Socio-Political Systems of the Ancient Maya; 5) Agricultural Strategies; 6) Relic Agricultural and Water Management Systems; 7) Settlement Patterns; 8) Landscapes Archaeology; 9) Applied Anthropology; 10) Socio-Ecological Systems; 11) Resilience Theory; 12) Geographic Information Systems; 13) LiDAR; 14) Remote Sensing; and, 15) Archaeological Field Methods. The Co-applicant has considerable experience supervising sub-projects focused on residential patterning, agricultural practices, and water management. His use of GIS-based spatial analysis tools is particularly well developed and innovative. The Co-applicant has also participated in the Principal Investigator’s comparative study of early tropical state formations in South and Southeast Asia (2013-2016), and he has visited Bagan once (2013). Although a “new scholar,” the Co-applicant has already begun to develop a laudable publication and conference presentation record, a large portion of which focuses on ancient agricultural practices and water management strategies in the tropics, with particular emphasis on GIS-based geospatial analysis. During the proposed IRAW@Bagan settlement archaeology project the Co-applicant’s roles and responsibilities will include: 1) assisting with the administration of all intellectual, regulatory (e.g., fieldwork permits), and financial aspects of the project; 2) field supervision of the agricultural practices and water management sub-projects; 3) assistance with the residential patterning sub-project, especially the transect surveys and associated total station mapping; 4) supervision of all of the remote sensing, GIS-related, and “Structure from Motion” (photogrammetry) aspects of the project; 5) co-supervision of all field and lab activities; 7) assistance with, and major contributions to, an effective program of knowledge mobilization; and, 8) co-supervision of 5-7 MA students from Trent University.

Collaborator: Pyiet Phyo Kyaw, PhD; Lecturer, Department of Archaeology, University of Yangon and Advisor, Myanmar Archaeological Association. The Principal Investigator and Collaborator recently met at the SEAMEO-SPAFA archaeology conference in Bangkok (May-June 2016), and have been in regular contact since that time. They co-supervised preliminary field investigations relating to the proposed study in May 2017. The Collaborator will be responsible for roughly 10% of project related activities, with his principal focus being collateral projects in his areas of interest, which include: 1) Myanmar History; 2) Archaeology; 3) Art History; 4) Iconography; 5) Material and Visual Culture (Semiotics); 6) Ancient History; and, 7) Landscape Archaeology. In terms of his value to the project, the Collaborator has extensive experience with the history, art and architecture, and landscape of Bagan, and has published on the city’s art and epigraphy, as well as its water management system. During the proposed IRAW@Bagan project the Collaborator’s roles and responsibilities will include: 1) assistance with regulatory issues (e.g., permitting processes); 2) service as the principal liaison with government and archaeological officials, the Myanmar Archaeological Association, and local communities and their principal stakeholders; 3) contributions to an effective program of knowledge mobilization; and, 4) direct supervision of 3-5 MA students from the University of Yangon, all of whom will participate in the proposed IRAW@Bagan fieldwork.

B) DESCRIPTION OF ONGOING AND PREVIOUS RESEARCH RESULTS: The proposed IRAW@Bagan research program will build on the Principal Investigator’s 24 years (1991-2014) of settlement archaeology experience, which focused on ancient Maya communities in Central America. Most relevant is the project he directed in Belize’s north Vaca Plateau, which included both thesis and dissertation work on the part of the Co-applicant. Our Phase I
investigations (1999-2005) – supported by a SSHRC Standard Research Grant (#410-2002-0150 [2002-2005]) – involved extensive excavations within the regal-ritual epicenter of Minanha. This research provided us with a view of the rise and fall of this small city-state capital from the perspective of its royal court. Our subsequent Phase II (2006-2009) investigations – also funded by a SSHRC Standard Research Grant (#410-2006-0788 [2006-2009]) – generated a multifaceted history of the commoners who inhabited the settlement zones surrounding Minanha’s epicentral court complex, thus providing us with a view of the rise and fall of the city-state from the standpoint of its support population. Finally, our Phase III Investigations – supported by two separate grants from the Alphawood Foundation of Chicago (2010-2014) – expanded our research focus from the Minanha micro-region to the north Vaca Plateau sub-region, resulting in an integrated socio-ecological history that incorporated considerations of integrative mechanisms, residential patterning, agricultural practices, water management, and climate change. This research program was augmented by a multi-project “consortium” grant from Alphawood (2012-2013) for LiDAR acquisition, which allowed the Co-applicant to conduct a sophisticated hydrological analysis of a relic agricultural field system southwest of Minanha.

The transition to a similar settlement-focused investigation in Myanmar was enhanced by six self-funded visitations made by the Principal Investigator to South and Southeast Asia (2010-2016), and a two-year SSHRC Insight Development Grant (#430-2013-001006[ 2013-2015]) in support of the Socio-ecological Entanglement in Tropical Societies (SETS) project. The latter project allowed the Principal Investigator to lead student research teams – including the Co-applicant – on four field trips to the “classical” capitals of South India, Sri Lanka, Cambodia, Thailand, Vietnam, Java, and Myanmar, resulting in a number of detailed field reports, book chapters, and conference presentations (in Canada, the United States, and Thailand). The original intent of the IDG study was to assess the quality and quantity of various data sets in preparation for a broader, comparative study of resilience in tropical societies. Although the investigations did indicate that there was sufficient data to carry out a more comprehensive comparative study, it was also readily apparent that the data sets for residential patterning, agricultural practices, and water management strategies were extremely limited in South and Southeast Asia. The subsequent offer to conduct archaeological fieldwork at Bagan focusing on these three areas – which was extended to the Principal Investigator by UNESCO-Myanmar following presentation of some of the results of the initial IDG study at a SEAMEO-SPAFA conference in Bangkok in 2016 – was therefore both timely, and intellectually enticing. The current Insight Grant proposal aims to take advantage of the extraordinary opportunity to utilize a similar theoretical and methodological approach to the one that has been effectively employed by the Principal Investigator and Co-applicant in their past investigations in the Maya sub-area, and the ability to leverage the knowledge gained from the recent comparative study of tropical societies, to expand our understanding of the complex socio-ecological relationships at the base of one of Southeast Asia’s most renowned preindustrial urban centers.

Preliminary groundwork for the proposed investigations was carried out by the Principal Investigator and the Collaborator in May 2017, with support from Trent University’s Vice-President of Research Strategic Initiatives Fund (2016-2017). This funding allowed the IRAW@Bagan research team to examine all of Bagan’s known water management features, and to carry out surface reconnaissance in areas that our literature review suggested were likely to contain residential sites, resulting in the discovery of the four potential occupation loci that are
the focus of the current grant proposal. Finally, a pending National Geographic Society grant submitted by the Principal Investigator, Co-applicant, and Collaborator will support forthcoming ethnoarchaeological research (December 2017) within ten traditional villages located in and around what was once Bagan’s peri-urban settlement zone. These investigations will inform the proposed settlement archaeology study by enhancing our understanding of the characteristics of traditional houses, house-lots, villages, and both water management strategies and agricultural practices.

C) DESCRIPTION OF PROPOSED STUDENT TRAINING STRATEGIES:

- **Build both academic (research and teaching) competencies and general professional skills, including knowledge mobilization, that would be transferable to a variety of settings.**
  - The various MA and PhD students involved in the IRAW@Bagan project – including those based at both Trent University and the University of Yangon – will acquire various “transferable” skills as a result of their formal training and practical experience in:
    - Settlement archaeology
    - Excavation methods
    - Settlement survey
    - Soil sampling, processing, and analysis
    - Artifact processing, curation, and data-basing
    - Total station and GPS mapping techniques
    - Structure from Motion (photogrammetry) recording and imaging
    - GIS-based geospatial analysis, including hydrological analysis
  - The students will also be encouraged to actively assist in the dissemination of project results through the following means:
    - Production of annual site report chapters
    - Presentation of research proposals and results at their home institution, and to interested local groups, such as the Myanmar Archaeology Association
    - Presentation of research findings at professional conferences in North America and Southeast Asia
    - Publishing of their research results as book chapters and/or journal articles (including open access versions)
  - The students will also benefit from being taught the theory and methods of settlement archaeology, broadly construed, in both the classroom and field setting, and in countries with very different archaeological traditions.
  - Student participants will also be instilled with a strong sense of research ethics by contributing to an international research program, by working with their Myanmar colleagues, by living in Myanmar communities and consulting with diverse stakeholders, and by conducting research on an archaeological site that not only attracts many tourists, but which has been recently nominated for UNESCO World Heritage status.
  - At its heart, the IRAW@Bagan project is transdisciplinary – with its focus on residential patterning, agricultural practices, and water management – meaning that students will learn the value of focusing on specific research problems but
drawing on diverse methodological and theoretical approaches, without being hindered by the conceptual parameters of traditional, disciplinary specific research (i.e., the “silo” approach).

- Students on the IRAW@Bagan project will also be fully involved in the daily operations of the project, including field and lab work, and daily project management; this will not only allow them to appreciate the complexities of running a research project, but also instill in them the importance of building research teams and fostering individual leadership skills.

- **Include international and/or intersectoral opportunities whenever possible and applicable.**
  - The IRAW@Bagan is largely an international project, and students will gain from working with faculty and team members from both Canada and Myanmar.
  - The students will also engage with local and federal resource managers on a regular basis, and as Bagan moves towards designation as a UNESCO world heritage site, they will also be encouraged to participate in intersectoral workshops and seminars involving myriad stakeholders.

- **Include specific, effective mentoring and institutional support.**
  - Full-time MA students attending Trent university will be provided with teaching experience through the Graduate Teaching Assistantship program.
  - Trent students will also be able to take advantage of various career enhancement workshops and seminars while at Trent.
  - Both Myanma and Canadian students will be able to attend IRAW@Bagan faculty-led training seminars on an annual basis, in both Yangon and Bagan; these training sessions will focus on specific archaeological methods, and be arranged in conjunction with Myanmar’s *Department of Archaeology*, and the *Myanmar Archaeology Association* (e.g., the Principal Investigator led a seminar on settlement archaeology in Yangon in May 2017, with assistance of the *Myanmar Archaeology Association*).