

# The Brown University Petra Archaeological Project: Landscape Archaeology in the Northern Hinterland of Petra, Jordan

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In three field seasons, between 2010 and 2012, the Brown University Petra Archaeological Project (BUPAP) conducted a diachronic archaeological survey of the northern hinterland of Petra, Jordan. While regional reconnaissance has a long history in Jordan, it has rarely been conducted with the “intensive” methodologies today characteristic of projects elsewhere, most proximately in the Mediterranean. Such an approach is ideally suited for the territory north of Petra, the setting for a wide-ranging variety of human activity from the Lower Paleolithic to the present. The survey component of BUPAP, the Petra Area and Wadi Silaysil Survey (or PAWS), covered some 1,000 ha (10 km<sup>2</sup>), most of which was traversed by closely spaced (10 m) fieldwalking in 1,321 individual survey units. In the course of this work, PAWS recorded patterns in the distribution of tens of thousands of artifacts. In addition, more than 1,000 individual archaeological features were identified and documented; geophysical survey was conducted in several areas; and test excavations were carried out in 10 locations of particular interest. This article provides an overview of the PAWS survey and related activity—discussing motivations, methods, and results—and touches on key issues concerning the long-term human history of the study area.<sup>1</sup>

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<sup>1</sup>We are extremely grateful to the institutions and individuals that made this project possible, especially the Department of Antiquities of Jordan (particularly Fares ad-Hmoud, Jihad Haroun, Akram Atoom, and Husain Askar) and the Petra Archaeological Park (esp. Emad Hijazeen and Tahani al-Salhi); the American Center for Oriental Research in Amman provided additional support. Brown University, the Joukowsky Institute for Archaeology and the Ancient World, the Loeb Classical Library Foundation, and the Curtiss T. & Mary G. Brennan Foundation provided funding and institutional support. Warm thanks go to our hosts, the Dakhillala Qublan family of Umm Sayhun, and the residents of the Petra area. Finally, we are grateful to all team members who contributed to this project: Linah Ababneh, Ameen Al-Duqs, Filip Ani, Michelle Berenfeld, Emanuela Bocancea, Sarah Craft, Nick De Pace, Colleen Donahoe, Andrew Dufton, Michal Dzedziniewicz, Athanasiou Geolas, Linda Gosner, Katherine Harrington, Susan Herringer, Fuad Hourani, Nancy Khalek, Morag Kersel, Bronwen Konecky, Sophia Laparidou, Brita Lorentzen, Sturt Manning, Kathryn McBride, Allison Mickel, Andrew Moore, Claudia Moser, Megan Perry, Tareq Ramadan, Sarah Rhoads, Felipe Rojas, Yorke Rowan, Oscar Sanabria, Timothy Sandiford, Alexander Smith, Harrison Stark, Ian Straughn, Julia Troche, and Milena Zafirova. Additional figures and an appendix can be found under this article’s abstract on AJA Online ([www.ajaonline.org](http://www.ajaonline.org)).

## INTRODUCTION: AIMS AND SCOPE

Since its inception in 2010 (after a brief pre-season in 2009), the Brown University Petra Archaeological Project (BUPAP) has explored the landscapes north of Petra through the successive implementation of different forms of reconnaissance.<sup>2</sup> Our primary goal was to document the distribution of material culture throughout the northern hinterland of Petra, as well as regional connections into and around the city center. Under the umbrella of BUPAP, a flexible mix of teams carried out different aspects of this investigation in Petra's hinterland, the city center itself, the Islamic-period village at Bayda, and the understudied wadi access routes between Petra and its surrounding territory.<sup>3</sup> Detailed results of the various additional wings of the project are being published in other contexts.<sup>4</sup>

The first step and the largest component of BUPAP, however, was the Petra Area and Wadi Silaysil Survey

(PAWS), an intensive pedestrian survey that—by mapping and quantifying artifacts of all periods and recording all archaeological features within a defined study area—provided the project with a baseline of landscape documentation. Subsequent additional stages of work, involving other methodologies and personnel, followed, such as more detailed assessment of archaeological features in their broader setting. On the basis of particular surface finds or other indicators of interest, geophysical survey was conducted in several zones within the study area, and 10 locations were selected for further investigation through test excavations.

The theoretical foundations and research aims of our project are drawn from the field of landscape archaeology, especially as practiced in the Mediterranean, which for us denotes a systematic, intensive, multidisciplinary, and interpretative account of the history of a clearly defined, coherent landscape over the *longue durée*.<sup>5</sup> Our project thus involved the systematic collection of data concerning all periods of the human past in the context of the natural environment, in order to study—from a diachronic perspective—how people inhabited, traversed, cultivated, and exploited this space. While this article focuses chiefly on project results and the broad, long-term trends illuminated in the study area, we believe that the remarkably rich PAWS data set will have a further role to play in placing the complex site of Petra, which is too often studied in isolation, within a more grounded local and regional context.

PAWS operated in an area of approximately 10 km<sup>2</sup> in the agriculturally viable hinterland to the north of the Petra city center (figs. 1, 2; table 1).<sup>6</sup> The survey

<sup>2</sup> Knodell served as field director of the archaeological survey. He and Alcock had primary responsibility for the design, execution, and dissemination of this arm of BUPAP. Many specialists and researchers contributed to this work. Lithic analysis was conducted by Rollefson and Vella; ceramic analysis was done by Erickson-Gini (Early Bronze Age to Early Islamic periods) and Sinibaldi (Middle and Late Islamic periods); Cloke and Feldman undertook a detailed study of the archaeological features; Urban was responsible for the geophysical survey; test excavations were overseen by Vella and Bocancea. The project as a whole operated under the codirection of Alcock and Tuttle.

<sup>3</sup> This article makes use of the following abbreviations for project, subproject, and general acronyms: BUPAP = Brown University Petra Archaeological Project; PAWS = Petra Area and Wadi Silaysil Survey; SU = survey unit; TS = test square; GIS = geographic information systems; GPS = global positioning system; ARK = Archaeological Recording Kit. We use the following abbreviations for other archaeological projects in the area: FJHP = Finnish Jabal Harun Project; SAAS = Shammakh to Ayl Archaeological Survey; NHG = Naturhistorische Gesellschaft Nürnberg; WMS = Wadi Musa Water Supply and Waste-water Project.

<sup>4</sup> The following BUPAP publications have appeared or are in press. Annual field reports: Alcock and Tuttle 2010, 2011, 2012. Petra Upper Market Archaeology excavations in the city center: Alcock et al. 2010. PAWS: Knodell and Alcock 2011, Knodell and Alcock (forthcoming); Alcock and Knodell 2012. Looting and vandalism in the PAWS survey area: Vella et al. 2015. Excavations at Islamic Bayda: Sinibaldi and Tuttle 2011. Excavations at Jabal al-Qarn: Vella et al. 2012. Geophysical survey: Urban et al. 2012, 2013, 2014a. Local perspectives and public engagement: Mickel and Knodell 2015. Petra Routes Project (PRP): Rojas and Berenfeld 2012; Berenfeld et al. 2016. An up-to-date list of project publications is maintained on the bibliography page of the BUPAP website: [https://brown.edu/Departments/Joukowsky\\_Institute/fieldwork/bupap/8501.html](https://brown.edu/Departments/Joukowsky_Institute/fieldwork/bupap/8501.html).

<sup>5</sup> We acknowledge, however, the capacity of landscape archaeology to mean many things in many contexts (see, e.g., the widely differing approaches of Cherry et al. 1991; Tilley 1994; Ashmore and Knapp 1999; Wilkinson 2003; Johnson 2007; Thomas 2012). We draw particularly on traditions of Mediterranean-style intensive survey; these methods were largely developed in Greece in the last quarter of the 20th century (Alcock and Cherry 2004; Knodell and Leppard 2017).

<sup>6</sup> Arabic to English transliteration can result in multiple spellings of the same words, and thus alternative spellings of certain places appear in the text and bibliography of this article. In consultation with Nancy Khalek, who conducted a preliminary study of toponyms in the PAWS survey area, we have decided to transliterate place names in keeping with the system used by the *International Journal of Middle East Studies*. Thus, for example, we use "Bayda" where others have used "Beida" or "Beidha," and "Silaysil" where "Suleisel" or "Slaysil" also appear. The following Arabic terms refer to physical features and appear in toponyms: wadi = a (typically dry) streambed or watercourse; *siq* = a narrow canyon; *jabal* = a mountain.

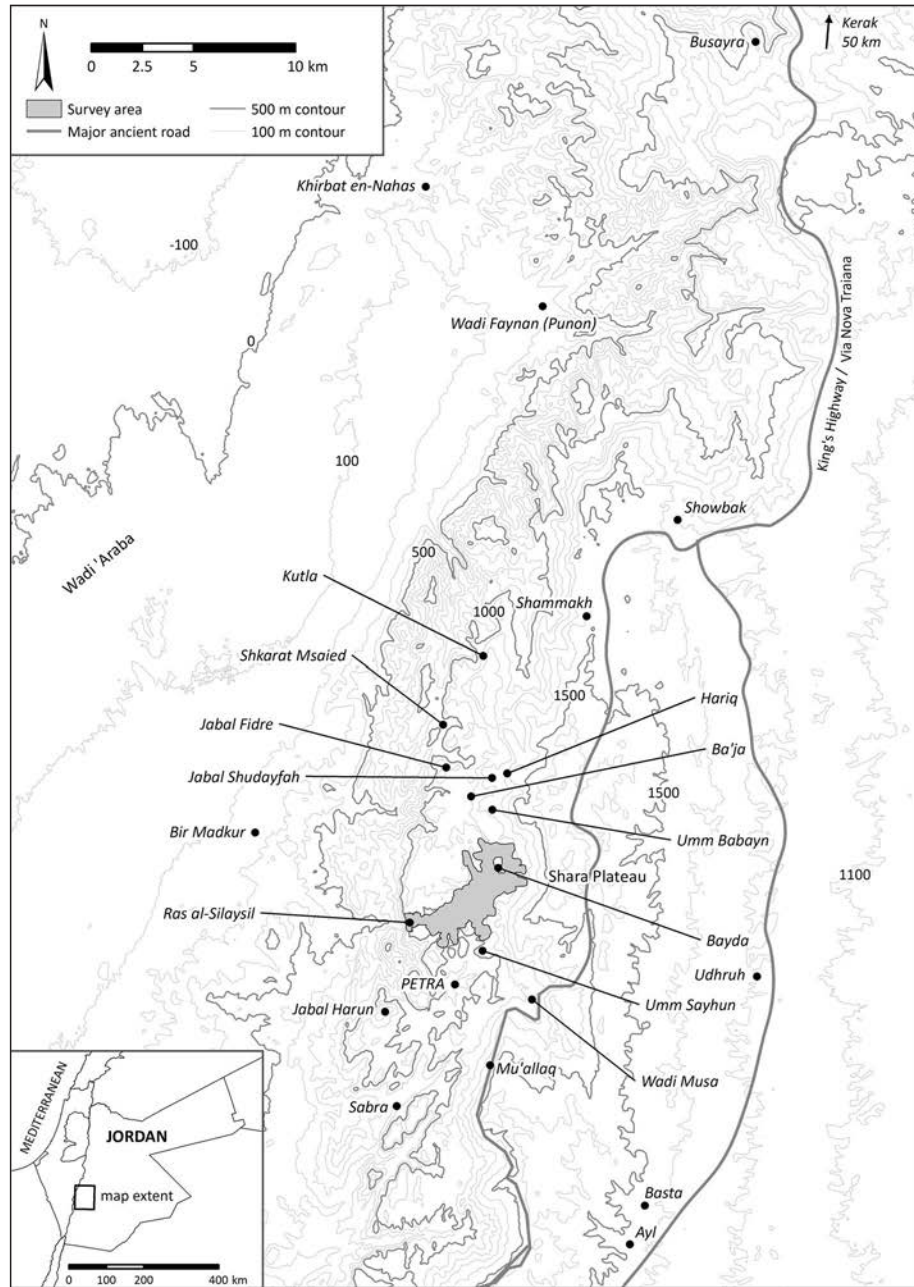


FIG. 1. Regional map showing the BUPAP survey area, its location in Jordan, and sites mentioned in the text (drawing by A. Knodell).

area forms a kind of natural basin, interspersed with and surrounded by mountainous landscapes and rock outcrops and bisected by several seasonal watercourses. One of these is the eponymous Wadi Silaysil (in certain segments also called the Wadi Siq al-Ghurab and Wadi Bayda), which in turn is fed by several tributary wadis throughout the survey area, such as Wadi Baqa'. This makes Silaysil an important point of convergence in the watershed that comes down from the Shara Mountains (another flow from these same heights can be traced

into Petra proper).<sup>7</sup> To the south, the survey area is bounded by the mountains that surround the city center; the northern limit, the Siq al-Hayran, is the narrow beginning of the precipitous Namala pass, which leads north and then west to descend into the Wadi 'Araba. The western boundary is located at the end of Wadi Silaysil, at a nearly vertical 400 m drop to Wadi 'Araba

<sup>7</sup>Al-Muheisen and Tarrier 1997, 147; Bellwald 2008, 60–4.



FIG. 2. WorldView-2 satellite image map showing the BUPAP survey area (dotted line), with sites and locations mentioned in the text (A. Knodell; base image courtesy DigitalGlobe).

TABLE 1. BUPAP survey areas, indicating number of survey units, areas, and size.

| Zone               | Survey Units | Area (ha) | Total Features   | Feature Numbers <sup>a</sup> |
|--------------------|--------------|-----------|------------------|------------------------------|
| Area a (2010)      | 179          | 79        | 110              | a1–a149                      |
| Area b (2010)      | 84           | 27        | 77               | b1–b102                      |
| Area c (2010)      | 70           | 27        | 72 <sup>b</sup>  | c1–c80                       |
| 2010 totals        | 333          | 133       | 259              | n/a                          |
| Area d (2011)      | 107          | 33        | 106 <sup>c</sup> | d1–d112                      |
| Area e (2011)      | 285          | 127       | 201 <sup>c</sup> | e1–e219                      |
| Area f (2011)      | 144          | 71        | 67               | f1–f72                       |
| 2011 totals        | 536          | 231       | 374              | n/a                          |
| Area g (2012)      | 396          | 183       | 343              | g1–g474                      |
| Area h (2012)      | 56           | 25        | 24               | h1–h34                       |
| 2012 totals        | 452          | 208       | 367              | n/a                          |
| Area s (2011–2012) | n/a          | n/a       | 36               | s1–s36                       |
| Overall totals     | 1,321        | 572       | 1,036            | n/a                          |

<sup>a</sup> The feature numbers assigned differ from the total number of features, as several features in each survey area were combined after further study. We include both the total number of features and feature numbers to avoid confusion when, e.g., we refer to Feature c78 and Area c has only 72 features in it. This regrouping of features was particularly common in areas with large numbers of wall systems for terraces or dams, such as Area g.

<sup>b</sup> Intensive pedestrian survey was undertaken in Area c in 2010, though feature documentation was only cursory because of the large amount of previously published work in this area. In 2012, the features of Area c were redocumented completely to maintain correspondence between this and the rest of the survey area.

<sup>c</sup> Additions made in 2012 counted here.

and the rough and rocky landscapes running to the northwest. To the east, the intensive survey extended some distance up the slopes of the Shara Mountains, stopping when the slope and topography made such a methodology either unproductive or outright impossible. More extensive work at higher elevations—for example, above the Dabadba Spring (see fig. 2)—revealed a continuation upslope of a busy landscape that holds much promise for future work.

Final definition of our survey area was prompted by several factors. Some were acknowledged before fieldwork started, others became rapidly apparent as the project developed:

1. This landscape north of Petra is manifestly an artifact- and feature-rich environment with a long history; although it has been subject to several archaeological investigations, it had never witnessed the type of comprehensive, high-intensity survey methodologies espoused here.<sup>8</sup>

2. The diachronic scope of the area was clear from the wide chronological range of previously known archaeological sites in the region, especially in the vicinity of the modern village of Bayda; these include Neolithic Bayda (which also has a significant Natufian phase), the Nabataean remains at Bayda and “Little Petra” (in the Siq al-Barid), and the Islamic-period village at Bayda.<sup>9</sup>
3. The study zone is located on a plateau immediately north of Petra (even the farthest end of our northern survey boundary lies only some 7 km from the city center) and appears—with its basin-like character, seasonal watercourses, and thousands of

of the history of survey archaeology in Jordan. Banning (2001, 634) notes in particular that off-site or nonsite survey has not been widely used. That said, the nearby Finnish Jabal Harun Project (FJHP) did employ methods roughly similar to ours, at least in terms of walker spacing. Methodology is discussed in greater detail below.

<sup>9</sup> Kirkbride 1960, 1961, 1962, 1966, 1967, 1968, 1984; Byrd 1988, 1989, 2005; Bikai et al. 2005a, 2007, 2008; Sinibaldi 2009.

<sup>8</sup> See Banning (2001) and MacDonald (2007) for summaries

meters of terrace walls and other water-management features—to offer some of the best agricultural land proximate to the city.

4. Land routes run south from this area into Petra, binding the city to this hinterland; on a larger scale, the Silaysil Basin forms an important link between the lowlands of the Wadi ‘Araba to the west and the highlands atop the Shara Plateau to the east.
5. While the immediate study area lies within the boundaries of the Petra Archaeological Park, there remains a constant threat of development or other depredations, given Petra’s immense touristic appeal and economic importance.

Three seasons of active fieldwork (2010–2012) have greatly expanded our knowledge of the landscapes north of Petra with detailed and at times dramatic results.<sup>10</sup> Finds ranged from the Lower Paleolithic to the present (table 2) and varied markedly in density and spatial distribution across the landscape. This article first reviews our knowledge of the study area prior to the work of BUPAP, then describes our methodological choices, summarizes the results of our work, and provides an overview of the long-term history of what can now be recognized as a highly dynamic landscape north of Petra.

#### ARCHAEOLOGICAL RECONNAISSANCE PRIOR TO BUPAP

Since the Western rediscovery of Petra in 1812 by Johann Ludwig Burckhardt, the site has held a steady fascination for archaeologists and an even greater one for members of the general public.<sup>11</sup> Consequently, synthetic accounts concerning the history and archaeology of Petra or the Nabataean civilization tend to be written primarily for nonspecialist audiences or take the form of exhibition catalogues, and many are doomed to be out of date within a few years of publication—assuming the large and disparate bibliography concerning the site can even be corralled in the first place.<sup>12</sup> Most archaeological projects conducted in the city center have focused closely on particular

structures, notably temples or tombs, most of which date to the Nabataean and Roman floruit of the site.<sup>13</sup> Compounding the difficulty of approaching the area holistically is the major problem of unpublished fieldwork, which is endemic to archaeology but perhaps particularly acute at Petra. Paradoxically, despite the considerable amount of attention paid to it, much about the site—its “foundation” date, its size over the centuries, its urban composition—remains unknown or deeply uncertain.<sup>14</sup> Even less work has been done in the hinterland that underpinned and supported the city and its population, although some major exceptions to this pattern inspired aspects of our own work.

Burckhardt and many of the early travelers that followed him entered Petra from Wadi Musa via the narrow, canyon-like Siq, which remains the primary public entrance for the site today.<sup>15</sup> A few, however, took a different route. Edward Robinson and Eli Smith, biblical scholars who traveled extensively in the Holy Land, give an account of their approach to Petra that provides some description of the BUPAP survey area.<sup>16</sup> These men appear to have ascended from Wadi ‘Araba via the Namala pass, entering the PAWS survey area near its western extent in Wadi Silaysil, where they noted the geological combination of porphyrite and sandstone characteristic of much of the area.<sup>17</sup> They seem to have walked up Wadi Silaysil and into Wadi Siq al-Ghurab before entering the area called “Sutuh Bayda” (meaning “White Plains”), still named for this characteristic color palette today. The travelers proceeded south

<sup>10</sup> Fieldwork took place in three five-week field seasons in the summers of 2010–2012, followed by a study season in the summer of 2013.

<sup>11</sup> Burckhardt 1822; van der Meijden 2012.

<sup>12</sup> E.g., Augé and Dentzer 2000; Taylor 2002; Markoe 2003. See the book-length bibliography on Petra and the Nabataeans, which now suffers from this very problem of being out of date (Crawford 2003).

<sup>13</sup> E.g., Brown University’s own Great Temple excavations (Joukowsky 1998, 2007, 2016).

<sup>14</sup> Mouton and Schmid 2013.

<sup>15</sup> Burckhardt 1822, 422–24; see also Irby and Mangles 1823, 403–6; Laborde and Linant 1830.

<sup>16</sup> Robinson and Smith 1841, 504–12. Stephens (1839:2, 51) praised the Siq as “the most extraordinary [entrance] that Nature, in her wildest freaks, has ever framed,” but added “[u]nfortunately, I did not enter by this door, but by clambering over the mountains at the other end.”

<sup>17</sup> “Namala” is a rather ambiguous toponym, used both generally and specifically to describe the area between Siq al-Hayran and the Wadi ‘Araba. We have heard it used to describe a variety of locations along this route, as well as in the Wadi ‘Araba itself, so it is difficult to know precisely which pass Robinson and Smith are describing (they themselves use the term to refer to a large area). Our assessment of their approach to Petra is based on other landmarks and landscape descriptions along their way. “Wadi Silaysil” is a name first given to the area in the early 20th century (Musil 1907, 333). See Lindner and Gunsam (1995a) for a summary of the toponymy of the area.

TABLE 2. Chronological framework employed by BUPAP.

| Period                      | Date Ranges        | Other Cultural/Historical Dates and Designations |
|-----------------------------|--------------------|--|
| Lower Paleolithic           | 1 Ma–250 ka BP     | early prehistory                                 |
| Middle Paleolithic          | 250–50 ka BP       | (ca. 1 Ma–6350 B.C.E.)                           |
| Upper Paleolithic           | 45–19 ka BP        |  |
| Early/Middle Epipaleolithic | 21000–15300 B.C.E. |  |
| Natufian                    | 15700–10000 B.C.E. |  |
| Pre-Pottery Neolithic A     | 10000–9000 B.C.E.  |  |
| Pre-Pottery Neolithic B     | 9000–6900 B.C.E.   |  |
| Pre-Pottery Neolithic C     | 6900–6350 B.C.E.   |  |
| Late (ceramic) Neolithic    | 6350–5500 B.C.E.   | late prehistory                                  |
| Chalcolithic                | 5500–4300 B.C.E.   | (ca. 6350–2500 B.C.E.)                           |
| Early Bronze Age            | 4300–2500 B.C.E.   |  |
| Middle Bronze Age           | 2500–1550 B.C.E.   |  |
| Late Bronze Age             | 1550–1200 B.C.E.   |  |
| Iron Age I                  | 1200–1000 B.C.E.   |  |
| Iron Age II                 | 1000–500 B.C.E.    | Kingdom of Edom                                  |
| Iron Age IIa                | 1000–900 B.C.E.    | (ca. 1000–539 B.C.E.)                            |
| Iron Age IIb–c              | 900–586 B.C.E.     |  |
| Iron Age III                | 586–539 B.C.E.     |  |
| Babylonian/Persian          | 539–300 B.C.E.     |  |
| Early Hellenistic           | 300–200 B.C.E.     | Nabataean Kingdom                                |
| Late Hellenistic            | 200–50 B.C.E.      | (ca. 168 B.C.E.–106 C.E.)                        |
| Early Roman                 | 50 B.C.E.–100 C.E. |  |
| Middle Roman                | 100–250 C.E.       | Roman annexation (106 C.E.)                      |
| Late Roman                  | 250–450 C.E.       |  |
| Byzantine                   | 450–650 C.E.       | Umayyad–Abbasid (630–969 C.E.)                   |
| Early Islamic               | 650–1000 C.E.      | Fatimid (969–1171 C.E.)                          |
| Middle Islamic              | 1000–1400 C.E.     | Ayyubid (1171–1263 C.E.)                         |
| Late Islamic                | 1400–1800 C.E.     | Mamluk (1263–1516 C.E.)                          |
| Modern                      | 1800 C.E.–present  | Ottoman (1516–1918 C.E.)                         |

*Note:* All dates are approximate, and not all periods listed here are present in our survey area. Further ceramic analysis, notably in terms of fabric classifications, may modify our present reading of the material. Prehistoric dates (Lower Paleolithic to Early Bronze Age) follow Levy (1995, xv–xvi) and Weninger et al. (2007), with slight adaptations to reflect the specific situation in southern Jordan. For Iron Age dates, see Herr 1997; Bienkowski 2001. For Hellenistic to Byzantine dates, see Erickson-Gini 2010; Erickson-Gini and Israel 2013. For an alternative chronological schema that covers the Nabataean period (here Hellenistic to Roman), see Schmid 2000. For reasons of practicality, very broad subdivisions within the Islamic periods are indicated with the chronology proposed by Whitcomb (1992), though they have been amended slightly with regard to the end date of the Byzantine and the start of the Early Islamic period. Periodizations are intended to indicate material culture transitions in a broader historical framework, rather than cultural or religious identities (e.g., Edomite, Nabataean, or Islamic).

toward Petra, probably along the course of the modern north–south road, describing topography that is familiar to anyone who has been there. Rock formations, many carved with water channels, olive and wine presses, and tombs, are juxtaposed with open fields, some cultivated, to the west of the road. To the east are the heavily terraced slopes of the Shara. Such accounts are of great interest, especially for their recording of contemporary land use, demography, and premodern modes of transportation and mobility.<sup>18</sup> While Brünnow and von Domaszewski undertook a systematic accounting of the major monuments of Petra and parts of its hinterland in the 1890s, significant archaeological activity in this northern hinterland did not occur until well into the 20th century.<sup>19</sup>

In the course of such work, briefly reviewed here, several important locales have been noted, mapped, surveyed, or excavated to various degrees, with work tending to focus on individual sites or on delimited periods of interest. BUPAP's explicit emphasis on the spectrum of material culture from the Paleolithic to the present thus provides a contextual backdrop for prior studies in the territory north of Petra and in many cases has enhanced significantly our knowledge of previously recorded sites and periods.

Multiple surveys, variously conducted, have included the greater Petra region in their scope, from the early work of Glueck in the 1930s onward.<sup>20</sup> Glueck's projects focused either on the city center or on major sites of the surrounding macroregion, as has most subsequent survey work; examples include several extensive surveys, such as those led by MacDonald, in the general area.<sup>21</sup> A different form of reconnaissance is represented in Nehmé's *Atlas archéologique et épigraphie de Pétra*, the goal of which is to document comprehensively the rock-cut features and inscriptional record of Petra proper.<sup>22</sup> The closest spatial overlap with PAWS is the Wadi Musa Water Supply and Wastewater Project (WMS),<sup>23</sup> which in the late

1990s surveyed the course of a pipeline connecting a treatment plant just north of Bayda to Wadi Musa and communities to the south.<sup>24</sup> The eastern part of our survey zone comes close to Tholbecq's survey project on the Shara Plateau, conducted under the auspices of the Institut Français du Proche-Orient in 1996 and 1997.<sup>25</sup> MacDonald's Shammakh to Ayl Archaeological Survey (SAAS) also nearly abuts the BUPAP survey area on the east side.<sup>26</sup> Finally and most notably, the Finnish Jabal Harun Project (FJHP), employing methodologies relatively similar to our own, surveyed some 11.3 km<sup>2</sup> on the opposite, southwest side of Petra.<sup>27</sup> All these projects contribute to a broader regional understanding of Petra's hinterland and factor into our larger-scale interpretations. Nevertheless, the great diversity of approaches, methodologies, and scales employed in regional work around Petra does not make combining data sets straightforward.

Within our study zone, the area around Bayda has attracted particular archaeological attention. Two surveys have focused on the documentation of prehistoric remains,<sup>28</sup> and Jansson has synthesized the prehistory of the greater Petra area.<sup>29</sup> Neolithic Bayda, which also boasts significant Natufian levels, remains one of the more important type-sites in the Middle East. Kirkbride, who discovered the site with local assistance in 1956, conducted several campaigns of excavation and survey between 1957 and 1983.<sup>30</sup> Since then, several contemporary sites have been discovered and excavated in the wider region—for example, at Ba'ja, Basta, and Shkarat Msaied.<sup>31</sup> Bayda itself has been the subject of more recent work, especially by

<sup>18</sup> A full listing of early travelers' accounts can be found in Crawford 2003. See McKenzie (1991) for a summary of early travelers' accounts as they relate to the local inhabitants, as well as Lewis (2003) and Llewellyn (2003) for more general summaries of early travelers' visits to Petra.

<sup>19</sup> Brünnow and von Domaszewski 1904.

<sup>20</sup> Glueck 1934, 1935, 1939. See Fiema (2002) for a summary of survey work in the Petra region.

<sup>21</sup> MacDonald 2015, 7–9. For a list of recent surveys, of various types, in southern Jordan, see Ward 2008, 435, table 0-1.

<sup>22</sup> Nehmé 2003, 2012.

<sup>23</sup> See supra n. 3 for a list of abbreviations used in this article.

<sup>24</sup> Amr et al. 1998; Amr and al-Momani 2001. For an overview of the political and social ramifications of the project, see Addison 2005.

<sup>25</sup> Tholbecq 2001, 2013.

<sup>26</sup> MacDonald et al. 2010, 2011.

<sup>27</sup> Intensive survey was conducted across 4.8 km<sup>2</sup>, and more "extended" survey covered an additional 6.5 km<sup>2</sup> (Kouki and Lavento 2013, 7; see also Frösén et al. 1999, 2000, 2004; Lavento et al. 2007).

<sup>28</sup> Kirkbride 1966; Gebel and Starck 1985.

<sup>29</sup> Jansson 2002.

<sup>30</sup> Kirkbride 1960, 1961, 1962, 1966, 1967, 1968, 1984.

<sup>31</sup> On the Neolithic in Jordan, see Rollefson 2008. On Ba'ja, see Gebel 1986; Gebel and Bienert 1997; Gebel and Hermansen 2001; Bienert et al. 2002; Gebel 2004. On Basta, see Nissen et al. 2004; Gebel et al. 2006. On Shkarat Msaied, see Jensen et al. 2005; Hermansen et al. 2006. On the Neolithic Heritage Trail now linking these various sites, see [www.exorient.org/associated\\_projects/neolithic\\_heritage\\_trail.php](http://www.exorient.org/associated_projects/neolithic_heritage_trail.php).



Byrd, who also synthesized the results of Kirkbride's excavations;<sup>32</sup> by Comer, who examined patterns of human-environmental interaction at the site;<sup>33</sup> and by a team led by Finlayson, which conducted a paleoenvironmental study.<sup>34</sup> Replicas of Neolithic housing at Bayda were erected in the early 2000s for experimental purposes, which included deliberate destruction by fire—they are now falling into further disrepair.<sup>35</sup> More worrying is the erosion of the site proper, notably on its steep western slopes. Ongoing conservation efforts remain crucial, especially in the face of development across the broader region.<sup>36</sup>

Bayda has been a magnet for archaeological attention for later periods as well, especially in light of the significant Nabataean activity in the vicinity. The rock-cut complex popularly called "Little Petra" in the Siq al-Barid has long been known but has received limited systematic study and publication.<sup>37</sup> Just outside of the Siq al-Barid, Bikai directed the recent Beidha Documentation Project, which, among many other things, recorded the remarkable remains (including both architectural elements and statuary) of the so-called Nabataean Hall and Palace structures.<sup>38</sup> Rock-cut features both practical and ritual abound in this area, including a series of Nabataean inscriptions in the Siq al-Amṭi to the immediate northeast of Little Petra. Al-Salameen conducted a targeted survey of wine presses in this general area,<sup>39</sup> examples of which have been incorporated into more holistic studies of agriculture in southern Jordan.<sup>40</sup> The importance of viticulture near Bayda is underscored by one particularly famous Nabataean inscription from the Siq al-Amṭi (mentioning a symposiarch at Petra) that draws connections between wine-making rituals and the immediate landscape.<sup>41</sup>

The Beidha Documentation Project also described and partially mapped the remains of an Islamic-period village,<sup>42</sup> a project subsequently taken up as a compo-

nent of BUPAP. Detailed mapping and targeted excavations were undertaken in 2010 and 2011 as a means of expanding our knowledge of the relatively understudied post-Byzantine periods at Petra.<sup>43</sup> Apart from this somewhat surprising gap in archaeologies of the Islamic era, a fair amount of work has been done concerning the material culture of more recent times. In the 1980s, Banning and Kohler-Rollefson, for example, carried out an ethnoarchaeological survey geared toward understanding pastoral practices, and various researchers have also worked on the recent history and impact of tourism on the current population and settlement at Bayda.<sup>44</sup> Our own approach to archaeological ethnography in the region has built on this work.<sup>45</sup>

In addition to the work around Bayda, the Naturhistorische Gesellschaft Nürnberg (NHG) has a notable record of research in the wider environs of Petra. Begun in the 1970s under the direction of Lindner, this group undertook several seasons of fieldwork in the vicinity of the city center, focusing on remains of various periods.<sup>46</sup> Lindner and his colleagues are responsible for the observation and preliminary study of a handful of sites in and around our survey area, which have provided a sense of potential periods of activity and "hot spots" in the landscape. For example, Umm Saysaban (see fig. 2), about 1 km northwest of the Petra city center, was the only Early Bronze Age site recognized in the immediate vicinity of Petra and our study area prior to BUPAP's discovery of contemporary ceramic and lithic scatters, most notably at the fortified site of Jabal al-Qarn (just east of Bayda).<sup>47</sup>

Within our survey zone, Lindner and the NHG team undertook limited investigations at the hilltop site of

<sup>32</sup> Byrd 1988, 1989, 2005.

<sup>33</sup> Comer 2003.

<sup>34</sup> Rambeau et al. 2011; see also Finlayson and Warren 2010.

<sup>35</sup> Dennis 2003, 2008.

<sup>36</sup> See essays in Comer 2012.

<sup>37</sup> Zayadine and Farajat 1991; Al-Muheisen and Tarrier 1997, 145.

<sup>38</sup> Bikai et al. 2005a, 2005b, 2007, 2008.

<sup>39</sup> Al-Salameen 2005.

<sup>40</sup> Al-Muheisen 1986, 1990, 1992; Al-Muheisen and Tarrier 1997; Al-Salameen 2004.

<sup>41</sup> Zayadine 1986. Al-Salameen (2005, 121) remarks that "Bayda was the Bordeaux of the Greater Petra Region."

<sup>42</sup> E.g., Bikai et al. 2007, 2008.

<sup>43</sup> Sinibaldi and Tuttle 2011. For research into the Islamic periods at Petra prior to the work of BUPAP, see Brown 1987; Vannini and Vanni Desideri 1995; Vannini and Tonghini 1997; Lindner 1999; Sinibaldi 2009; 'Amr and al-Momani 2011. Interest is growing quickly; for more recent studies and observations on settlement in the Petra region in the Islamic period, see, e.g., Sinibaldi 2013, 2014, 2015a, 2016a, 2016b. Additional fieldwork at Bayda for the Islamic Bayda Project is ongoing under the direction of Sinibaldi (Sinibaldi 2015b).

<sup>44</sup> Banning and Kohler-Rollefson 1983, 1992; see also Russell 1993, 1995; Addison 2004. On Bayda, see Shoup 1985; Bille 2009; Mustafa and Abu Tayeh 2011.

<sup>45</sup> Mickel and Knodell 2015.

<sup>46</sup> E.g., Lindner 1986, 1996, 1999.

<sup>47</sup> Lindner et al. 2001. On BUPAP's Early Bronze Age discoveries, see Knodell and Alcock 2011, 495–97; Vella et al. 2012. Jabal al-Qarn had been noted and mapped earlier but was thought at the time to be the remains of a castle (Kob 1967).

Shamasa, which they describe as a “fortified suburb” of Petra stretching over the area between the Rock of Shamasa and the so-called Dushara Shrine nearby.<sup>48</sup> Similar exploration was done at the village and High Place sanctuary at Ras al-Silaysil at the very western end of our study area, as well as at the Pond Temple located some 400 m below to the southeast; these two ritual sites were once connected by a serpentine path practically impassable today.<sup>49</sup> NHG activity at all these sites consisted of a basic site description, sketch plans, a few more detailed drawings of archaeological features, and an assessment of the chronological and typological scope of pottery found on the surface. While we added substantially to Lindner’s documentation and interpretations of Ras al-Silaysil and Shamasa, this by no means diminishes the vital contributions of Lindner and the NHG—not least since they observed and recorded sites before episodes of more recent damage (such as the destruction by vandals of much of the High Place at Ras al-Silaysil in the 1980s).

#### THE PEDESTRIAN SURVEY: METHODOLOGIES AND OUTCOMES

To achieve the goals of PAWS—investigating relationships between a major ancient city and its productive hinterland, as well as the long-term history of a landscape situated in a strategic location—we developed a particular plan of work. The project was designed in the tradition of “Mediterranean-style” intensive survey. Fieldwork was conducted on a regional scale; its temporal scope was completely diachronic, ranging from the Paleolithic to the present; and the artifact, rather than the site, was treated as the minimum (and primary) unit of analysis and quantification.<sup>50</sup> The decision was also made to document surface remains and features across as continuous a landscape as was feasible, rather than concentrating exclusively on places of special interest or focusing on some kind of partial sample (however systematic). Such an approach to survey coverage seemed both appropriate and necessary in the materially rich environ-

ment around Petra, where traces of cultural activity are both densely distributed and under persistent threat of damage by development or other deleterious processes. Research questions and ambitions thus played a role in our choices, as did ethical considerations and a desire to assist in cultural resource management in the region. The frequently perceived sharp divide between academic, research-driven fieldwork and more pragmatic cultural resource management approaches strikes us as increasingly invalid and unhelpful in instances where sites and landscapes, such as at Petra, face serious ongoing challenges.<sup>51</sup>

PAWS fieldwork took place in layered, interrelated stages. First came what could be termed the baseline survey: side-by-side fieldwalking, mapping, and artifact collection in defined survey units (SUs). Second was detailed documentation of archaeological features observed in the course of fieldwalking.<sup>52</sup> Finally, a third stage involved further work at select locations of particular significance; this took various forms, including total-station mapping, architectural drawing, geophysical survey, and excavation.

#### *Fieldwalking and Coverage*

The survey zone was divided into eight areas, each given an alphabetical designation (see table 1; fig. 3). While variable in size and the number of SUs, each area is identifiable as a contiguous sector surveyed in the same year (Areas a, b, and c were walked in 2010; d, e, and f in 2011; g and h in 2012); units were numbered sequentially by area (PAWS\_a1, PAWS\_a2, etc.).<sup>53</sup> The boundaries of individual SUs (sometimes called tracts in other survey literature) were determined based on considerations of size and topography. Natural limits were used whenever appropriate: for example, individual agricultural fields were treated as separate SUs; roads, walls, fences, and the like were also used as breaking points. When boundaries had to be established artificially, we generally opted to keep

<sup>48</sup> Lindner and Gunsam 2002.

<sup>49</sup> Lindner and Gunsam 1995a, 1995b; Ben-David 2013.

<sup>50</sup> Mediterranean landscape work has for the most part tended to be more intensive and less site oriented than Near Eastern work (Wilkinson 2000). For recent Jordanian examples of more intensive, multidisciplinary methodologies, see Banning 2001; Barker et al. 2007a; Finlayson and Mithen 2007; Kouki and Lavento 2013.

<sup>51</sup> For a thorough review of conditions at and around the site, see Comer 2012.

<sup>52</sup> Fieldwalking teams were led by Knodell, Linda Gosner, and Sarah Craft, while feature documentation teams were led by Cloke and Feldman.

<sup>53</sup> Brief summaries of findings in individual areas can be found in reports published in the *Annual of the Department of Antiquities of Jordan*. For 2010, see Knodell and Alcock 2011. For 2011 and 2012, see Knodell and Alcock (forthcoming); see also Alcock and Tuttle 2010, 2011, 2012.

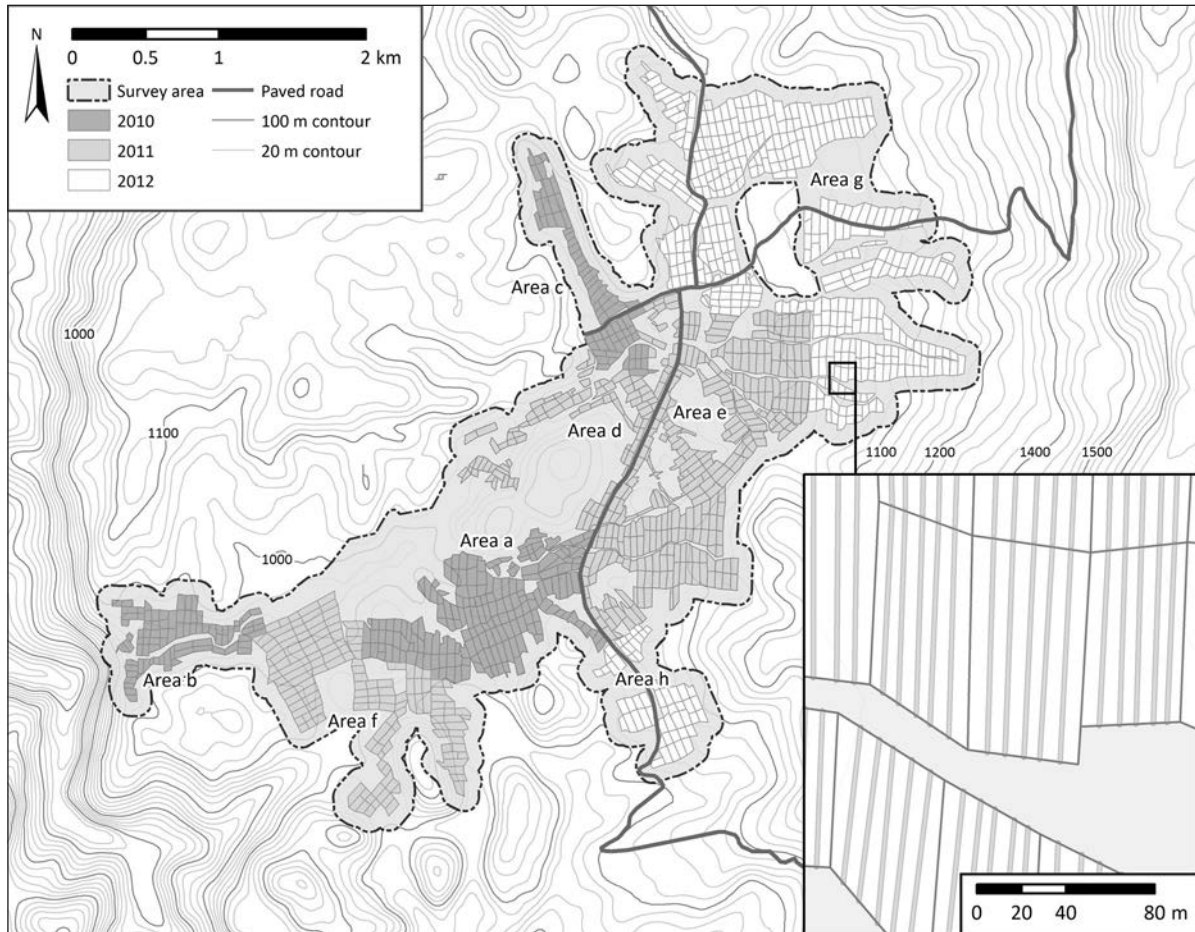


FIG. 3. Survey zones, individual SUs, and transect sampling (drawing by A. Knodell).

SUs in the vicinity of 50 x 100 m, to maintain both reasonable spatial control over the data and comparability between units while at the same time avoiding unnecessarily small divisions. In all, we walked 1,321 SUs over the three full field seasons.

Fieldwalking involved team members walking parallel straight lines (transects), spaced 10 m apart, carefully inspecting the ground surface in an approximately 2 m swath in front of them (fig. 4). The walker spacing of 10 m was selected as a distance that would allow detailed but time-efficient coverage: relatively subtle changes in artifact density would be detectable, and archaeological features, even outside the individual 2 m transects, easily observed. A total sample of 20% of the ground surface was then subject to artifact quantification and collection, while feature-based reconnaissance took place throughout the entirety of the survey zone.

Field teams were typically composed of six people: five fieldwalkers and a team leader who was responsible for mapping and recording, in addition to defining

individual SUs. We found it useful to have two team leaders when possible—one for recording and one for laying out and marking boundaries of SUs—especially in areas where the landscape was relatively homogeneous, making it difficult at times for fieldwalkers to maintain their bearings while also paying careful attention to the ground surface. Paper field forms were designed to record information about topography, land use, and artifact counts and collections, as well as relevant metadata concerning time of day, fieldwalker order, and other notes (online fig. 1).<sup>54</sup> Information from the form's individual fields was entered into our digital database daily; this allowed for the rapid generation of data summaries for each SU, paired with information for individual walkers, in the interest of creating a reflexive and adaptive recording system.

<sup>54</sup> See AJA Online for all online-only figures accompanying this article.



FIG. 4. Fieldwalking near Bayda, conducting side-by-side survey with 10 m spacing. View to the north, with the early modern village of Naq'a in the background (left) and Siq al-Hayran beyond (A. Knodell).

#### *Quantification and Collection Strategy*

In the course of fieldwalking, surveyors counted all artifactual material, of any period, that fell within their 2 m wide transects: ceramics, lithics, and a wide range of contemporary/recent material culture (split into categories: plastic, metal, glass, and other). To maintain the integrity of our sampling strategy, we did not count or collect artifacts falling outside of individual transects. The length and direction of transects were determined by the overall size and shape of the SU: a typical SU was approximately 50 x 100 m, consisting of five walker transects of 2 m in width each; the result is a sample in which 20% of the ground surface is inspected in each SU. However, it is the length of transects, rather than the size of the SU, that we ultimately used to project density information. For example, if five walkers each walked 100 m, the total area covered would be 1,000 m<sup>2</sup> (100 m length x 2 m width x 5 transects). If these walkers counted 50 total ceramics in the SU, the sherd density for the SU would be calculated by dividing the total number of sherds by the total amount of ground surface inspected (50 sherds / 1,000 m<sup>2</sup> = 0.05 sherds per m<sup>2</sup>), then converted into the number of sherds per hectare by multiplying by 10,000. Thus, 50 sherds counted in a 50 x 100 m SU equates to a

projected density of 500 sherds per hectare. Such a calculation provides an immediate and comparable measure of artifact distributions across the landscape.

Collection strategy was determined by type of material encountered. PAWS walkers collected all lithics (chipped-stone artifacts). For ceramics, we collected only diagnostic artifacts, identified as sherds that would or could be identifiable to the project's ceramic specialists in terms of shape, function, or date. We defined this category rather broadly, to include anything other than plain body sherds lacking any type of distinctive fabric.<sup>55</sup> We chose to limit our ceramic collection in this way largely for practical reasons. This is an extremely artifact-rich landscape. As it was, we collected 19,913 sherds, or about 9% of the 215,281 counted. Artifact-storage needs are a concern for all archaeological projects, as is collection and processing time. This decision to limit collection to diagnostic material (in theory the only material that would yield

<sup>55</sup> Collection of diagnostic sherds is a relatively common practice in Mediterranean survey, although definitions tend to vary, even within projects. In our near vicinity, the Finnish Jabal Harun Project collected all surface archaeological finds, apart from modern debris (Lavento et al. 2013a, 11).

chronological or functional information) was determined to be the best course in terms of time and resource management. Nevertheless, we do acknowledge that some information can be lost in this approach, especially for classes of material that are not as highly diagnostic as, say, decorated fine wares. By adopting a broad definition of what was diagnostic and by having field teams work closely with ceramic specialists, we aimed to reduce the potential for such losses.

A range of occasional special finds was also collected. Contemporary/recent material (almost exclusively refuse), although left in the field, was counted like any other category of information since we deemed the systematic quantification and location of this material important for tracking modern use (and abuse) of the landscape.<sup>56</sup>

#### *Data Management: GIS and the Archaeological Recording Kit*

Archaeological projects, not least surface surveys, generate massive quantities of data in a variety of forms. While in the field, teams capture information about features of the natural and human environment and raw artifact counts, producing a meticulous record of the quantities and types of material taken from each unit. Collected artifacts are analyzed to extract formal, functional, and chronological information. Detailed spatial information is amassed to evaluate and represent the extent of features and artifact distributions, as well as their broader contexts. Such complex data sets require a dynamic database capable of relating these diverse types of information, which are often collected in multiple stages. For PAWS, spatial information was recorded in the field with GPS devices outfitted with ArcPad software, then processed using Esri's ArcGIS software. All other information was recorded on paper, then digitized into a centralized, open-source system: the Archaeological Recording Kit (ARK).<sup>57</sup>

Field teams mapped all features and SU boundaries on paper maps, printed daily from QuickBird or WorldView-2 satellite imagery, and took individual GPS coordinates at the corners of SUs and along the extent of particular features. Handheld devices running

ArcPad software were connected to Garmin GPS receivers and used to create point-based shapefiles in the field. These could then be uploaded to the project GIS to draw SU boundaries encompassing these points, make field maps, and view plotted data in concert with satellite imagery or aerial photographs.<sup>58</sup> SUs were mapped and assigned alphanumeric designations (e.g., PAWS\_d14) in the field, then drawn in GIS, together with transects for each individual walker; notations of the latter were used to compute the total ground surface inspected. Preliminary artifact counts were totaled from SU forms and entered into an Excel document to render density information. Fields from such tables were then used to create GIS maps indicating the absolute number and/or calculated density—by SU—of ceramic, lithic, or modern artifacts distributed across the landscape. Such quantifications and spatial renderings were particularly useful for identifying overall patterns and areas of further interest, expediently and while fieldwork was ongoing.

After the initial download of GPS points taken in the field, features were recorded in ArcGIS in two manners. First, each feature was assigned a single point coded with its alphanumeric designation (like SUs, in the format of, e.g., PAWS\_d96), which could then be linked to a more easily searchable and sortable Excel format, including typological information and a brief description of said feature. This allowed for easy display of the distribution of features by type. Second, all features were drawn as line files in ArcGIS. This was especially important for documenting the spatial extent of particular features and feature complexes at a variety of scales.

Our central database, the ARK, is a relational data-storage system with two especially useful and distinguishing aspects: first, it is web-based, making it possible for multiple individuals to use and edit the database at the same time—a particularly relevant factor for the ongoing task of data analysis, since team members are dispersed across the globe; second, its relational capacity allows for responsive linking of different types of data. Information from all field forms and analysis is entered into this database under the following broad categories: SU, feature, trench, locus,

<sup>56</sup> Vella et al. 2015.

<sup>57</sup> ARK was designed by L-P Archaeology (<http://ark.lparchaeology.com/>) to be a flexible format for recording archaeological excavation and survey data. Andrew Dufton, a project member and former software designer for L-P Archaeology, modified the system to suit the particular needs of BUPAP.

<sup>58</sup> We also experimented with making fuller use of ArcPad capabilities by drawing polygons and line files in the field, but the level of GPS accuracy was found to be too inconsistent to make this a useful exercise. A system of taking reference points combined with paper drawings and photographs was most effective for consistent and faithful mapping of features in GIS.

special find, ceramics, photograph, and drawing. This information is then conjoined to reflect spatial overlaps, where they are present; that is, an entry for a SU will contain links to any features found within it (and features in turn are linked to their associated SU), scans of all relevant field forms, associated artifact information, photographs, and any additional documentation (drawings, total-station survey, test excavation, etc.). ARK also has a spatial interface that makes use of the project's GIS data. In this way, all information recorded by the project in the course of fieldwork and analysis is digitized in a fully searchable, indexed, and interlinked format accessible to project members and to other scholars by request.<sup>59</sup>

### *Finds Analysis*

All collected artifacts were studied and their formal, chronological, and functional information recorded. Lithics dated from the Paleolithic to the Early Bronze Age, ceramics from the Bronze Age to the present (see table 2). Lithic specialists Rollefson and Vella examined all stone tools to record period designations (identified by numeric code), along with formal classifications (tool, point, blade, bladelet, flake, debitage, etc.) and specific notes concerning the assemblage from each SU. Representative and exceptional examples were selected for photography and illustration.

Erickson-Gini and Sinibaldi undertook the ceramic analysis, with Erickson-Gini responsible for Early Bronze Age to Early Islamic materials, Sinibaldi for the Middle and Late Islamic periods.<sup>60</sup> This chronological division is reflected in the discussion of results below. For each sherd, information was recorded concerning the part of the vessel (rim, body, base, etc.), technique (hand- or wheelmade), form, use class, fabric, decoration, diameter, and typology, as well as general and specific chronology; chronological information was then quantified to provide, for example, the total number of sherds per period in each SU. As with lithics, both representative and exceptional pieces were pulled during initial analysis for photography and drawing.

### THE ARTIFACTUAL RECORD

Results of the survey and the study of its material are presented below. In general, these data are presented

<sup>59</sup> The project database is online at <http://archaeologydata.brown.edu/petra>.

<sup>60</sup> Erickson-Gini and Sinibaldi were assisted at various times by Linda R. Gosner, Katherine Harrington, Kathryn McBride, and Julia Troche.

only cursorily, as individual subjects and materials discussed will be subjects of separate, more detailed publications.<sup>61</sup> Emphasis here is placed on quantification and tabulation, along with making clear the spatial patterning and extent of our results (table 3).

### *Lithics*

Chipped-stone artifacts were widely distributed across the landscape and were found in nearly all SUs (fig. 5). From the Lower Paleolithic onward, most major periods of prehistory are represented in varying concentrations across the survey area. There is a marked dominance of late prehistoric artifacts, particularly Chalcolithic/Early Bronze Age lithic types (table 4). The number of chipped-stone artifacts in individual SUs ranged from 0 to 99 with densities (projected lithics per hectare) ranging from 0 to 1,492. Raw materials used for lithic production, mainly variants of flint, differed widely in appearance and overall quality, as did the tool types and forms produced. Differing levels of preservation, affected by geomorphological processes, were also perceptible; for example, the presence of rounded edges and pitted surfaces from rolling and long-term exposure to weather conditions were common. There is also a clear variation in the surface patina, which was particularly marked in Lower to Middle Paleolithic artifacts. In contrast, later stone tools—dating anywhere from the Pre-Pottery Neolithic to the broadly defined “Late” periods—tend to have less patina, unless the inhabitants reused earlier Paleolithic artifacts (which were typically made of high-quality flint), a practice well attested in materials dated to the Chalcolithic/Early Bronze Age.

Distinct differences in lithic concentrations characterized the varied topographies of the survey area. Overall, areas of high density in Area a were noted alongside Wadi Baqa', on a small plateau just west of Shamasa, and scattered over a large open area to the east of Shamasa. In Area b, stone tools were found especially near the western end of Wadi Silaysil. In contrast, Area d yielded concentrations near Neolithic Bayda (though only a limited number were actually

<sup>61</sup> Separate treatments will include comprehensive studies of lithics (Vella and Rollefson), ceramics (Erickson-Gini and Sinibaldi), and features (Cloke and Feldman), as well as excavation (Vella and Bocancea) and geophysical survey (Urban), some of which are already published (*supra* n. 4).

TABLE 3. Artifact counts and densities per survey zone.

|  | Area a | Area b | Area c | Area d | Area e | Area f | Area g | Area h | Total              |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------------------|
| Lithics counted and collected                    | 1,957  | 841    | 290    | 422    | 1,431  | 513    | 3,454  | 76     | 8,984 <sup>b</sup> |
| Avg. lithics/SU                                  | 11     | 10     | 4      | 4      | 5      | 4      | 9      | 1      | 7                  |
| Avg. lithics/ha                                  | 140    | 170    | 62     | 59     | 58     | 37     | 98     | 19     | 84                 |
| Sherds counted                                   | 24,588 | 39,244 | 16,609 | 20,053 | 49,212 | 10,045 | 50,454 | 5,076  | 215,281            |
| Sherds collected                                 | 2,747  | 2,696  | 780    | 2,046  | 4,455  | 1,123  | 5,459  | 607    | 19,913             |
| Avg. sherds counted/SU                           | 137    | 467    | 237    | 187    | 173    | 70     | 127    | 91     | 163                |
| Avg. sherds/ha                                   | 1,770  | 10,080 | 4,135  | 3,043  | 1,948  | 735    | 1,556  | 1,287  | 2,368              |
| Modern counted                                   | 18,900 | 724    | 3,431  | 9,806  | 19,177 | 6,648  | 25,380 | 10,642 | 94,708             |
| Avg. modern/SU                                   | 106    | 9      | 39     | 92     | 67     | 46     | 64     | 190    | 72                 |
| Avg. modern/ha                                   | 1,398  | 165    | 736    | 1,516  | 863    | 479    | 822    | 2,843  | 967                |
| Total area (ha) of walker transects <sup>a</sup> | 15     | 5      | 5      | 7      | 26     | 14     | 36     | 5      | 113                |
| Total area (ha) of SUs                           | 79     | 84     | 70     | 107    | 285    | 144    | 396    | 56     | 572                |

<sup>a</sup>Total ground surface inspected (the sum of the 2 m wide transects of each fieldwalker).

<sup>b</sup>Of the 8,984 counted and collected, 7,542 were kept.

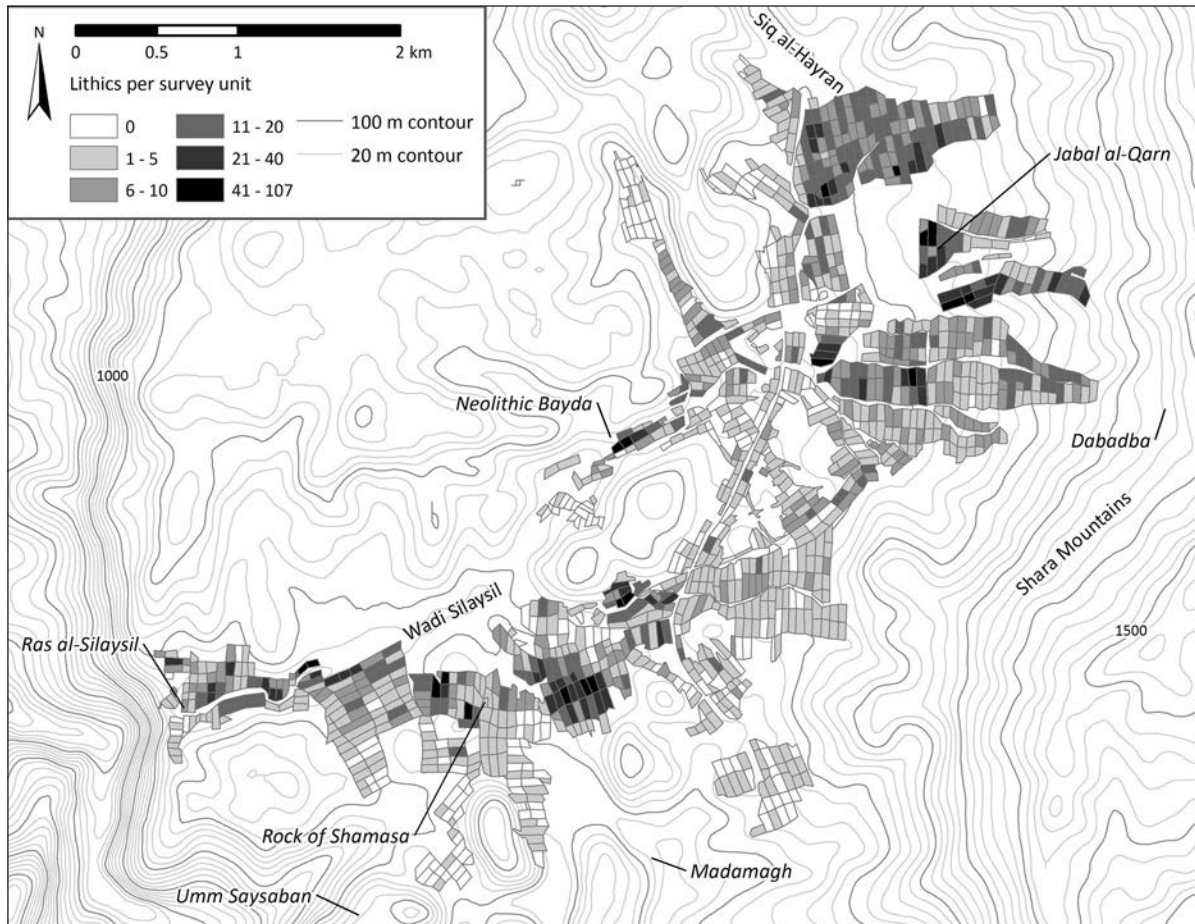


FIG. 5. Overall lithic density map (drawing by A. Knodell).

TABLE 4. Lithics recovered by BUPAP, separated into tool quantities and assemblage totals by period.

| Period                        | Tools | Total |
|-------------------------------|-------|-------|
| Lower Paleolithic             | 23    | 36    |
| Lower/Middle Paleolithic      | 26    | 142   |
| Middle Paleolithic            | 78    | 231   |
| Middle/Upper Paleolithic      | 10    | 36    |
| Upper Paleolithic             | 12    | 25    |
| Upper/Epipaleolithic          | 3     | 4     |
| Epipaleolithic                | 22    | 125   |
| Epipaleolithic/Neolithic      | 11    | 82    |
| Pre-Pottery Neolithic A       | 0     | 0     |
| Pre-Pottery Neolithic B       | 14    | 51    |
| Pre-Pottery Neolithic         | 9     | 40    |
| Late Neolithic                | 17    | 41    |
| Late Neolithic/Chalcolithic   | 10    | 81    |
| Chalcolithic/Early Bronze Age | 491   | 3,861 |
| Late                          | 177   | 2,485 |
| Unidentified                  | 32    | 302   |
| Total                         | 935   | 7,542 |

dated to the Neolithic), and Areas e and g exhibited high densities on the slopes of the Shara Mountains.<sup>62</sup>

The clearest explanations for these patterns of distribution relate to the availability of raw materials and water, as well as issues of visibility. For instance, a number of scattered flint veins in limestone outcrops on the Shara Mountains provide a useful source of siliceous raw materials, while nodules found throughout wadis make up another.<sup>63</sup> Some materials, especially in earlier periods, may have been brought from much farther afield. Scattered nodules of local origin were especially being used during the Chalcolithic/Early Bronze Age occupation of the landscape, when lithics were pro-

duced from all types of flint (varying in quality from good to poor). Such scattered nodules are particularly common in the wadis formed by the stronger water flows from the Shara Mountains, which are capable of carrying larger flint pebbles. As for proximity to water, again, wadis were crucial for seasonal flows, though perennial springs were also significant. One known relict spring is located near Neolithic Bayda. According to recent paleoenvironmental analysis, it appears to have been productive in the Natufian period and then again in the Pre-Pottery Neolithic B (PPN-B): the resulting gap neatly echoes the pattern of human occupation at the site.<sup>64</sup> Finally, significant densities of chipped stone were recorded at higher elevations in many places, especially on the slopes of the Shara Mountains in the northeast corner of the study area (Areas e and g), suggesting that surveillance for hunting may have been a factor in such settings.

Chronological patterns are also revealing and can be summarized using a dot-density distribution (fig. 6). Paleolithic artifacts were relatively common throughout the survey area, occurring in 38% of SUs and making up 8% of total artifacts collected. The Lower Paleolithic was predominantly represented in the form of hand axes, with notable concentrations in Areas g and e on the lower slopes of the Shara (fig. 7). Middle Paleolithic chipped-stone tools were abundant throughout the entire survey area (only the ubiquitous late prehistoric lithics were more widespread), with Levallois technologies particularly prevalent (fig. 8a–c). A number of these Lower Paleolithic hand axes and Middle Paleolithic implements clearly piqued the interests of later Chalcolithic/Early Bronze Age communities, who turned some of these earlier tools into flake cores (fig. 9c). Presumably such expedient recycling of earlier lithics is indicative of the procurement strategies of later communities. Those communities seem to have focused on producing lithics from scattered surface occurrences of flint, which occur throughout the region.<sup>65</sup>

Upper Paleolithic scatters are significantly thinner and less widespread. Small concentrations of such materials occurred in three distinct areas: (1) just east

<sup>62</sup> Despite this relative scarcity of Pre-Pottery Neolithic B (PPN-B) lithics, Vella et al. (2015, 230) note that Neolithic stone tools are frequently offered to tourists for sale in the vicinity of Neolithic Bayda.

<sup>63</sup> Kirkbride (1966, 37–9) identified these as the two principal sources for flint in the area. The variety of flint types observed, however, requires additional investigation, particularly to explore whether differing outcrops were being exploited (perhaps according to period), beyond the siliceous veins she identified.

<sup>64</sup> Rambeau et al. 2011.

<sup>65</sup> Recycling or “curation” of earlier lithics is well documented. See Lemorini et al. (2015) and Parush et al. (2015) for examples of work being done at Qesem Cave (Israel); see also Odell 1996.



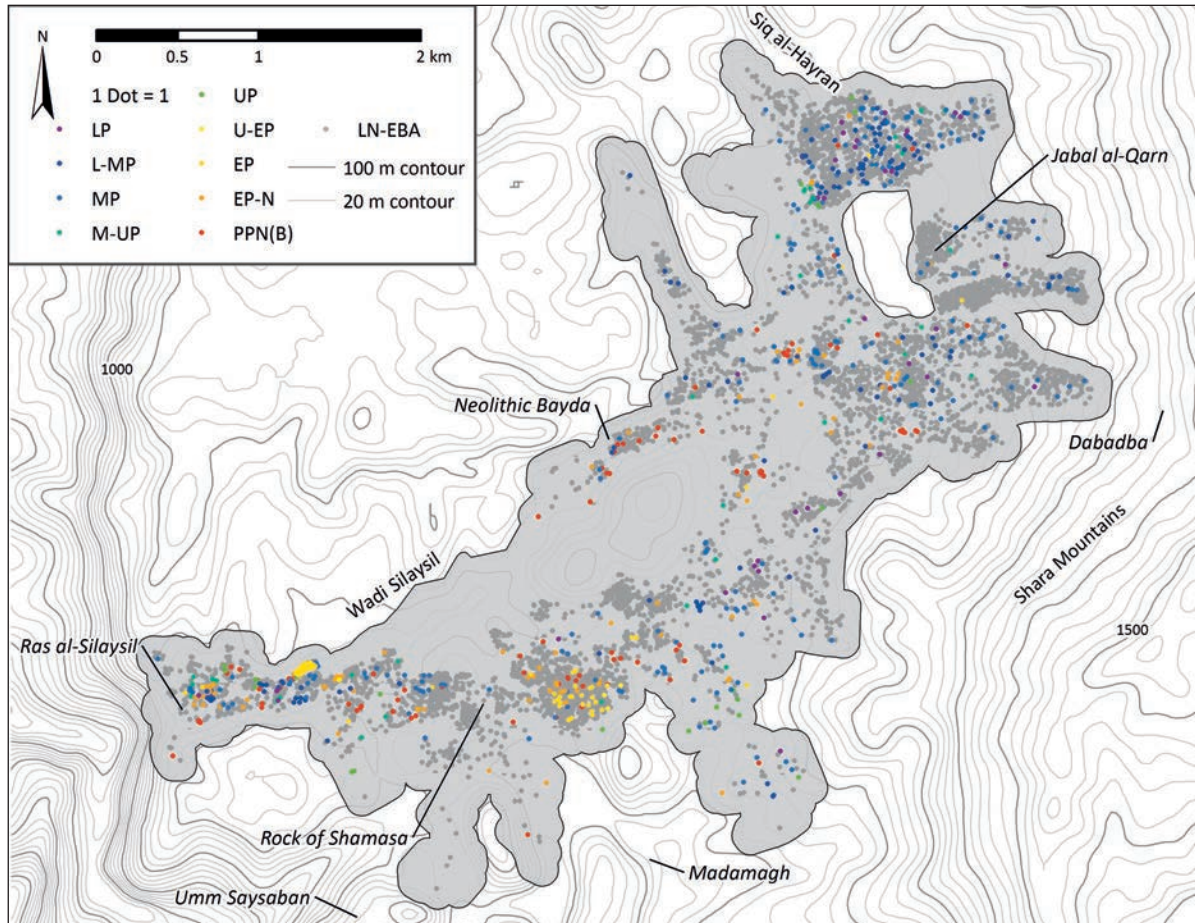


FIG. 6. Dot-density distribution of lithic finds from BUPAP's 2010–2012 seasons by period, where one dot represents one artifact. Each dot is placed randomly within the bounds of the SU in which it was found (LP = Lower Paleolithic; MP = Middle Paleolithic; UP = Upper Paleolithic; EP = Epipaleolithic; N = Neolithic; PPN-B = Pre-Pottery Neolithic B; LN = Late Neolithic; EBA = Early Bronze Age) (drawing by A. Knodell).

of Ras al-Silaysil, where the wadi opens into a wider area; (2) near Siq al-Hayran, which opens to the Namala pass; and (3) in the middle of Area h. All these locations constitute bottlenecks for regional movement, which was a significant factor in earlier periods as well. Two final observations can be made about the PAWS Paleolithic materials: first, they occurred as either isolated finds or open-air scatters with no cave sites reported in the survey region. And second, while Paleolithic material had been noted locally before, PAWS data now constitute the first properly documented finds from these periods in Petra's northern hinterland.<sup>66</sup>

Some typological considerations further illuminate the trends described above. The Lower Paleolithic hand axes are comparable to examples found across the Levant and are made from good-quality flint, perhaps procured from outside of the Petra hinterland.<sup>67</sup> Middle Paleolithic technologies were also similar to other examples across the Levant.<sup>68</sup> In particular, signs of Levallois technology clearly distinguished Middle Paleolithic lithics from their predecessors, although some, categorized as Lower/Middle Paleolithic, were bulky in their appearance and of an uncertain date. The Levallois lithics identified were mostly cores

<sup>67</sup> See, e.g., Gilead 1970; Macumber 1992; Bar-Yosef 1994.

<sup>68</sup> See, e.g., Rolland and Dibble 1990.

<sup>66</sup> On the Paleolithic in the Petra area, see Jansson 2002.

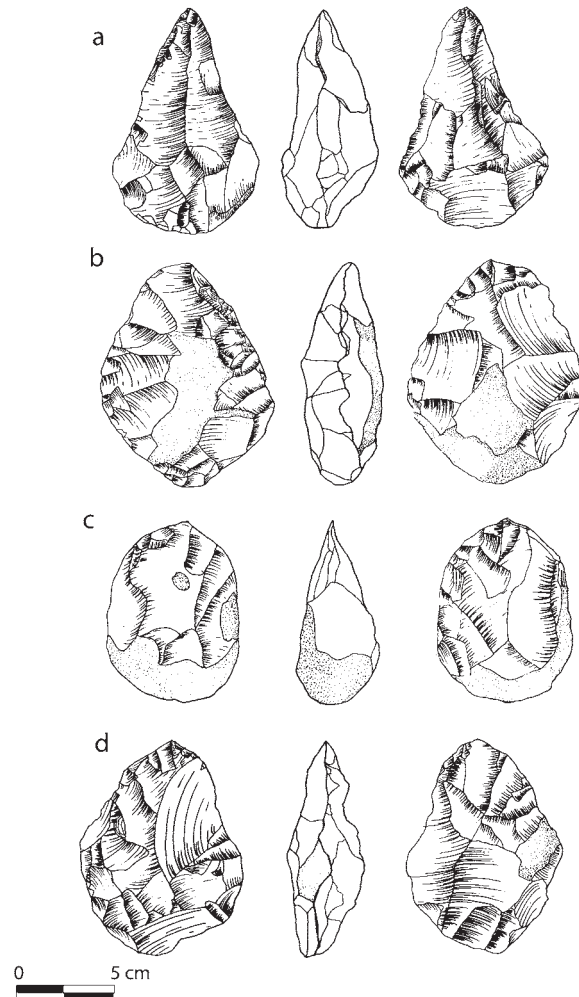


FIG. 7. Lithic illustrations, Lower Paleolithic period: *a*, Micoquain hand axe (g345); *b*, hand axe (g39); *c*, hand axe (g210); *d*, bifacial hand axe (g159) (drawing by C. Vella).

(see fig. 8a), a large number of points (see fig. 8c), and blades—all well-known Mousterian types associated with *Homo neanderthalensis*. The Upper Paleolithic represents a fundamental transition, notable for the total absence of Levallois technology. Moreover, Upper Paleolithic blades are considerably larger than any preceding examples, often more than 10–12 cm in length. Despite the importance of this period and the new presence of anatomically modern humans, the evidence encountered by BUPAP was very limited.

Epipaleolithic and Neolithic finds were relatively rarer than expected given the direct proximity of Neolithic Bayda. The sweeping social transformations of the Epipaleolithic and Pre-Pottery Neolithic periods

in the Levant were profound, but our survey adds little evidence for lithic technologies (characterized mainly by bladelets) to the vital contributions made by the study of Neolithic Bayda and Ba'ja (located to the north of Petra and outside of the BUPAP survey area).<sup>69</sup> The Epipaleolithic and Pre-Pottery Neolithic B (PPN-B; no PPN-A artifacts were found) lithic assemblages are limited but quite varied in function. For instance, while most examples were used as cutting and scraping implements, five arrowheads were also dated to the Pre-Pottery and Late Neolithic periods. This continued use of hunting implements corresponds with evidence from Bayda and Ba'ja, which suggests that communities were farmers and herders who still hunted extensively.

The total assemblage of chipped stone was dominated by the broad category of late prehistoric, encompassing Late Neolithic, Chalcolithic, and Early Bronze Age materials (see fig. 9); these were found in more than 90% of SUs and make up approximately 80% of the total collection of lithics. While many of these artifacts could be assigned more precisely to individual periods, most are best characterized in generic terms simply as “Late.” Two general points can be made. First, flint quality for the Chalcolithic/Bronze Age period is inferior when compared with that of earlier periods. The procurement of siliceous raw materials was opportunistic and sometimes led to the reuse of earlier lithics. Second, the study of late prehistoric lithic assemblages has much to offer to the study of the Levant and its interconnections. For instance, broken Canean blades and cortical scrapers are clearly related to other examples spread across the region.<sup>70</sup> Although a substantial decline in the use of lithic tools has been quantitatively noted in the Levant from the Middle Bronze Age into the Iron Age, this broad category of “Late” likely includes stone tools from subsequent, even recent, periods as well.<sup>71</sup> Unfortunately, current knowledge of chipped-stone tools from the historical periods in southern Jordan is extremely limited. Although these numbers for late prehistory may thus be somewhat artificially inflated by the inclusion of materials from later periods, we expect that the general patterns described here, by and large, will hold.

<sup>69</sup>E.g., Mortensen 1970; Byrd 1989, 2005; Gebel and Bienert 1997.

<sup>70</sup>Rowan and Levy 1994; Quintero et al. 2002.

<sup>71</sup>Rosen 1997, 151–59.

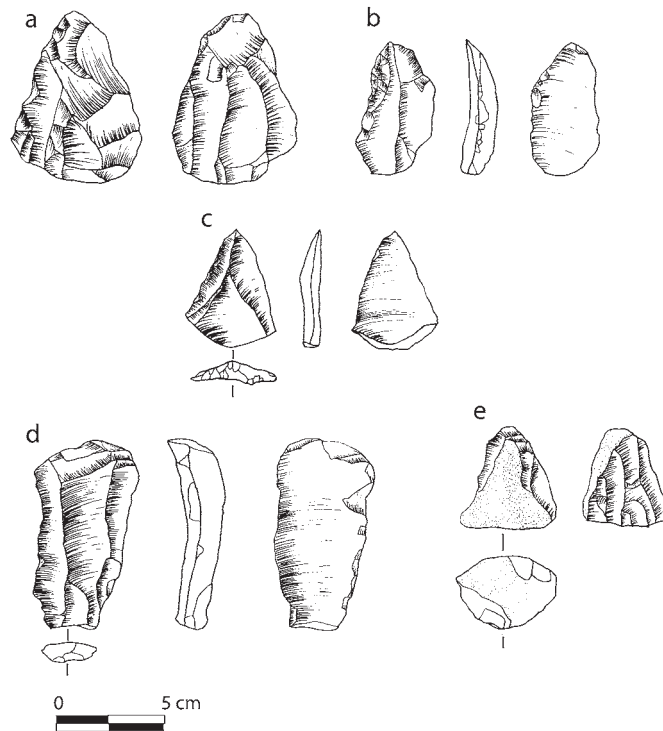


FIG. 8. Lithic illustrations, Middle and Upper Paleolithic periods: *a*, Middle Paleolithic Levallois blade core (g227); *b*, Middle Paleolithic sidescraper on Levallois blade (g194); *c*, Middle Paleolithic Levallois point (g149); *d*, Upper Paleolithic blade (g212); *e*, Upper Paleolithic pyramidal blade core (g106) (drawing by C. Vella).

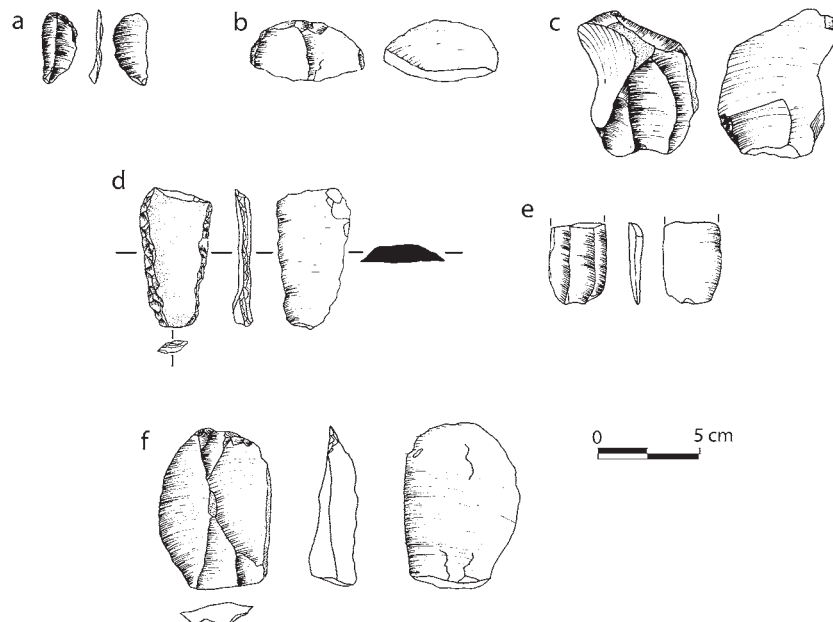


FIG. 9. Lithic illustrations, representative types from Late Neolithic to Early Bronze Age periods: *a*, Late sickle blade (g263); *b*, Late Neolithic/Chalcolithic scraper (a145); *c*, Late reused blade core (g175); *d*, Chalcolithic/Early Bronze Age cortical scraper (g233); *e*, Late Canaanite blade (e261); *f*, Chalcolithic/Early Bronze Age endscraper (g70) (drawing by C. Vella).

The lithic record recovered by PAWS offers a rich view into the early history of a landscape best known for its much later material traces. Yet from the Lower Paleolithic onward, the survey area covered by BUPAP was host to a diverse human occupation. The Paleolithic presence in this area builds on the growing evidence for early human ancestors throughout Jordan.<sup>72</sup> Our understanding of *Homo erectus* and *Homo neanderthalensis* in this part of the Levant would surely benefit from further investigation, although the lack of sheltered sites in the Petra area will make such research difficult. In contrast, our knowledge of the Pre-Pottery Neolithic discoveries made at Bayda and Ba'ja has not been greatly supplemented by the BUPAP pedestrian survey. Certainly, a few scatters were noted, but lithic finds from this period were uncommon, perhaps because of their minute nature. Recognizing and collecting microliths is a notorious problem for archaeological surveys, one for which there is not an obvious solution. By far, the Chalcolithic/Early Bronze Age lithics recovered and studied made up the most impressive part of the total lithic assemblage. Further test excavations at lithic scatters of this epoch would likely yield even more evidence of what must have been an intense use of this landscape, well before the establishment of any site that could be called Petra.

#### Ceramics

Ceramics were ubiquitous throughout the survey area. In only 13 SUs (less than 1% of the 1,321 total) were no ceramics observed, and densities in some SUs were projected as high as 140,000 sherds per hectare (fig. 10). High-density concentrations of ceramics were found in several locations, with marked “spikes” in the vicinity of known archaeological sites, such as the Islamic village near Bayda, Ras al-Silaysil, and Shamasa, and near newly discovered archaeological features. Overall, however, off-site distributions were nearly continuous, representing widespread patterns of activity throughout the landscape.

Collected sherds were consistently datable, at least to broad periods, ranging from the Early Bronze Age to the modern period (fig. 11; table 5). The earliest material found dates to within the Early Bronze Age (3200–2200 B.C.E.) and is similar in typology and fabric to material from Umm Saysaban.<sup>73</sup> Most of these

sherds belong to hole-mouth jars (fig. 12, no. 1; for a catalogue, see online appx. on AJA Online).<sup>74</sup> Given the close proximity of this previously known Early Bronze Age site to the study region, and the widespread, dense distribution of later prehistoric lithics, it is somewhat surprising that so little contemporaneous ceramic material was found, although, as mentioned above, our discovery that the site of Jabal al-Qarn dates to the Early Bronze Age represents a significant addition to the prehistoric record of the region.<sup>75</sup>

The Iron Age sherds can be most closely dated to the Iron II period (see figs. 12, nos. 2–30; 13, nos. 11–23). Concentrations of locally produced wares of the later Iron II period were recorded in Areas a and c in the 2010 season. Large sherds of vessels of this period were also discovered in excavations at the northern edge of the Islamic-period village at Bayda. The Iron II wares generally have thick walls with light gray cores and reddish-yellow surfaces, although gray ware jar sherds were also collected (see fig. 13, no. 13). Some sherds bear traces of dark red paint, particularly on or near vessel rims. A very small number of fine, painted sherds were noted (fig. 14, nos. 2, 3). The forms generally represented are deep kraters and cooking pots, although several jugs and storage jars were also recovered (see fig. 13, nos. 1–19). At least one sherd incised with possible letters was also collected (see fig. 13, no. 22). Unsurprisingly, many of the Iron II vessels have parallels with those discovered at the nearby site of Tawilan (in Wadi Musa; see fig. 2).<sup>76</sup> In addition, a rim of a glazed, black Attic bowl of the Persian period (an unusual find) was recovered in Area e (see fig. 14, no. 1).

The largest concentration of Nabataean material of the Hellenistic period was found in the vicinity of Ras al-Silaysil, where architectural remains likewise indicate the existence of a village of that period (fig. 15); this same location also produced a particularly clear range of dates for later Nabataean wares, ranging from ca. 50 B.C.E. to ca. 150 C.E. A second, smaller concentration of Late Hellenistic sherds of the first century B.C.E. was discovered near a cistern associated with a large structure in the southeastern quadrant of Area e

<sup>74</sup>The online appendix provides a catalogue for all pottery appearing in figs. 12–14, 16, and 17.

<sup>75</sup>Lindner and Genz 2000; Vella et al. 2012.

<sup>76</sup>Bennett and Bienkowski 1995.

<sup>72</sup>Olszewski 2008, 35.

<sup>73</sup>Lindner et al. 2001.

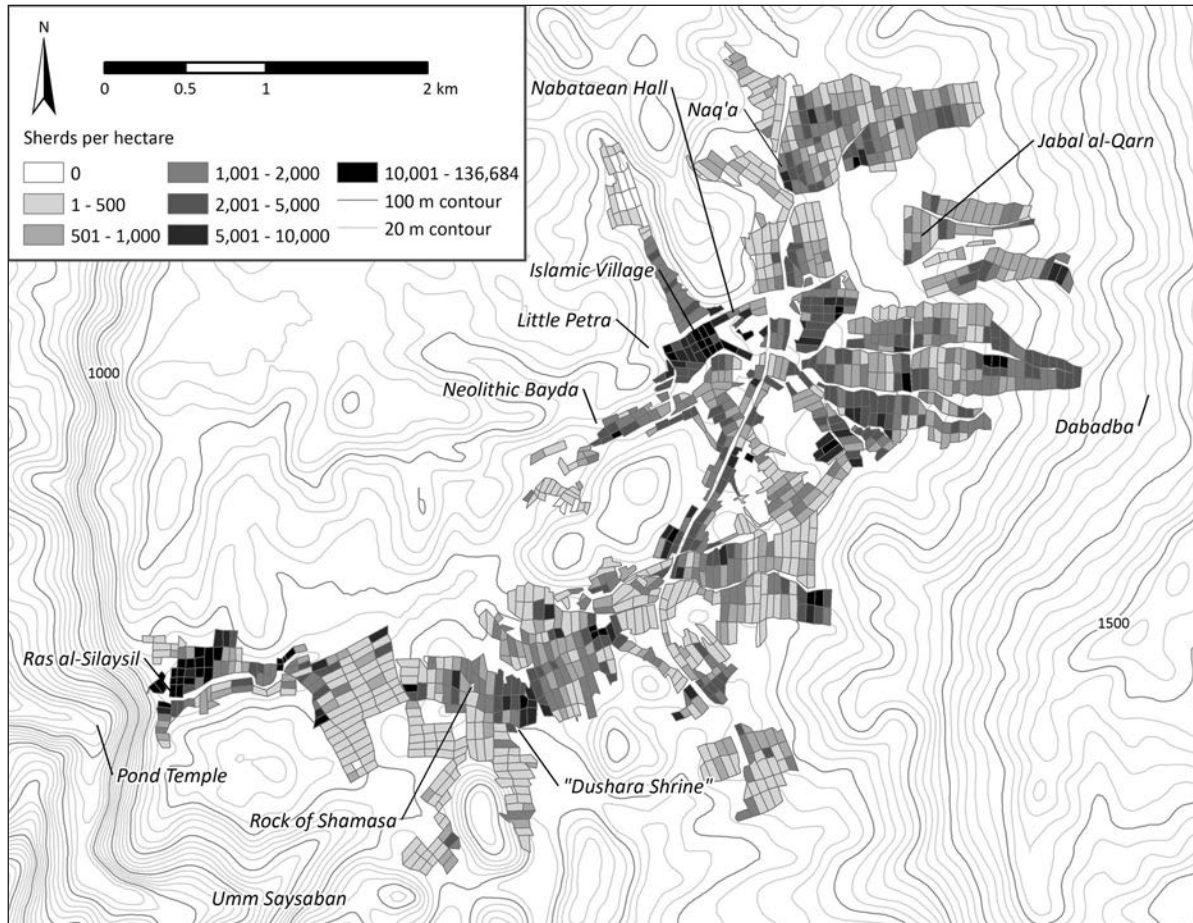


FIG. 10. Sherd density map, showing projected sherds per hectare for each SU (drawing by A. Knodell).

(PAWS\_e120; see fig. 11); this may have served as a farmhouse north of Petra during that time.

The most abundantly represented category of ceramic sherds throughout the survey area is locally produced Nabataean wares of the Early and Middle Roman periods (mid first century B.C.E. through the mid third century C.E.) (see figs. 14, 16).<sup>77</sup> These were generally red wares, although a small number of buff wares were also represented. Only a very small amount

of imported material was detected from the survey collections. Most of the locally produced forms appear to have been cooking and serving pots and fine ware and semi-fine ware bowl bases and rims, particularly those corresponding to Schmid's Gruppe 9 (see fig. 16, nos. 3, 4) and Gruppe 7 (see fig. 16, no. 5),<sup>78</sup> as well as painted fine ware bowls, cups, beakers, juglets, jugs, kraters, piriform unguentaria, strainer jars, bottles, lamps, small jars, and, finally, thick-walled vessels that may have been used as chamber pots. Early variations of ridged-neck jars were collected in SU e277, in association with feature PAWS\_e207, a multiroom hilltop structure interpreted as a lookout post (see fig. 14, nos. 23, 24, 26, 27). Numerous large storage jar handles belonging to vessels with three or more handles were noted throughout the survey area.

<sup>77</sup> Our chronological schema for the Hellenistic to Byzantine periods differs from others employed in the Petra region (see table 2). We chose to work with periodizations that align with many (by no means all) regional projects in the eastern Mediterranean. We did this, in part, to allow cross-regional comparison across a broader zone while still allowing results to be compared more locally; cf. Gerber et al. 2012. For further elaboration on phasing distinctions, see Erickson-Gini 2010, 101–28, 191; Erickson-Gini and Israel 2013, 46–51.

<sup>78</sup> Schmid 2000, figs. 52–6 (Gruppe 7), 61–5 (Gruppe 9).

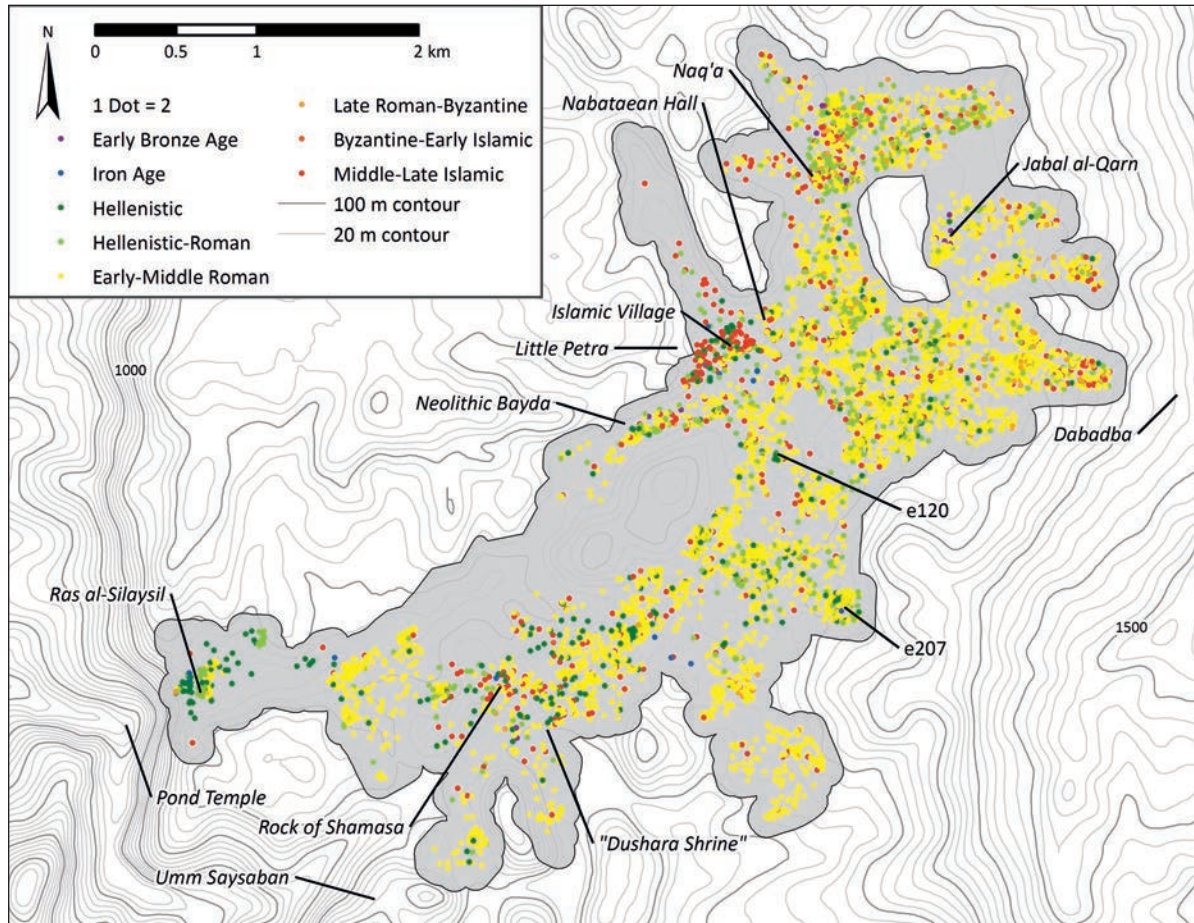


FIG. 11. Dot-density distribution of ceramics collected by period, where one dot represents two sherds. Each dot is placed randomly within the bounds of the SU in which the sherds represented were found (drawing by A. Knodell).

Sherds from vessels of the Byzantine period (mid fifth to seventh century C.E.) were scarce across most of the survey area, as were vessels of the Early Islamic period; a number of Late Roman C bowls (see fig. 16, nos. 19–23) were, however, discovered in the excavation at the Islamic-period village at Bayda.

While Middle Islamic (11th- to 14th-century) to Late Islamic (15th- to 18th-century) and modern (19th- to 20th-century) pottery was found in all areas investigated by PAWS, it was mostly concentrated in the northeastern parts of the survey zone, between the Shara Mountains and the main road connecting Petra to Bayda (Areas e and g), and in those tracts immediately west of it (Areas c and d). A particularly high concentration of finds of these periods was found in association with the site of Islamic Bayda (in Area c), reflecting the considerable extent of this rural village.

The Islamic assemblage consists almost entirely of handmade ceramics, with the exception of very rare fragments of other classes of pottery (unglazed wheel-thrown, glazed wheel-thrown, molded); the fabric associated with the handmade group is predominantly characterized by its ample mineral, chaff, and calcareous inclusions. All these elements are typical of an assemblage of the Middle/Late Islamic period in the greater Petra area, which probably extends into the modern period, since handmade pottery is known to have been manufactured in the Wadi Musa area until the 20th century. Creation of more specific chronological subdivisions within the categories of Middle to Late Islamic pottery and modern handmade pottery is complicated by the still-developing state of their study in the region, which is also the case for Jordan generally. In the specific case of the pottery from PAWS, the scarcity

of painted examples among the handmade ceramic group is an additional difficulty: surface treatment, and particularly painted decoration, is currently recognized as the most diagnostic aspect of this type of pottery.<sup>79</sup>

In the areas surveyed by BUPAP on the slopes of the Shara Mountains (Areas e and g), handmade pottery was mostly unpainted and in three cases found in association with Ottoman tobacco pipes (e.g., fig. 17, no. 1).<sup>80</sup> Such artifacts have been dated by FJHP to between the 18th and 20th centuries.<sup>81</sup> The most diagnostic ceramic fragments from Areas e and g also have a close affinity with finds from the last phase of the Islamic-period village in Bayda (see fig. 17, nos. 2–4); that phase has been interpreted as Late Islamic (specifically Ottoman) on the basis of the ceramic material.<sup>82</sup> Attributing the assemblages from Areas e and g primarily to this period would align well with the FJHP results: similar pottery from Jabal Harun, painted in only a few cases, was assigned to a broad date range spanning the Ottoman period (early 16th to early 20th century). This dating was based on comparison with stratified ceramics and in some cases the spatial association of the finds with Ottoman pipes and (indicating a later, 19th- to 20th-century date) Gaza Ware. Such a chronology in the case of Jabal Harun is also supported by documentary sources that record occupation at this time.<sup>83</sup>

Area c encompassed Islamic Bayda, and the ceramics here appear to reflect primarily the last, extended phase of the rural village, dated as Late Islamic (see fig. 17, nos. 5–11). Area h, finally, was notable for the presence of several examples of Gaza Ware (see fig. 17, nos. 12, 13).<sup>84</sup> This distinctive material was also present in other areas of the BUPAP survey, such as Area d (see fig. 17, no. 14).

#### *Recent/Contemporary Material*

The general patterning of recently deposited material culture found throughout the survey area was telling, if somewhat predictable (fig. 18). Finds were almost exclusively garbage, including aluminum cans, glass and

plastic bottles, plastic bags, clothing, and shoes. Initial counts were split into categories by material (glass, metal, plastic, and other), then added together to indicate the overall density of detritus. In general, high-

TABLE 5. Number of sherds collected by PAWS, by period.

| Period                     | Total Sherds  |
|----------------------------|---------------|
| Early Bronze Age           | 16            |
| Iron Age                   | 23            |
| Iron II                    | 523           |
| Edomite                    | 2             |
| Persian                    | 1             |
| Iron II to Hellenistic     | 6             |
| Iron II to Roman           | 162           |
| Hellenistic                | 550           |
| Hellenistic to Roman       | 1,634         |
| Hellenistic to Byzantine   | 49            |
| Roman                      | 3,250         |
| Early Roman                | 1,493         |
| Middle Roman               | 1,613         |
| Early to Middle Roman      | 8,576         |
| Middle to Late Roman       | 42            |
| Late Roman                 | 13            |
| Roman to Byzantine         | 140           |
| Byzantine                  | 94            |
| Late Byzantine             | 2             |
| Byzantine to Early Islamic | 6             |
| Islamic                    | 10            |
| Early Islamic              | 0             |
| Middle Islamic             | 9             |
| Middle to Late Islamic     | 842           |
| Mamluk                     | 2             |
| Ottoman                    | 74            |
| Modern                     | 281           |
| Undetermined               | 501           |
| <b>Total</b>               | <b>19,914</b> |

*Note:* Each sherd was given a single designation (i.e., a sherd counted as Early Roman would not also be counted as Early to Middle Roman). Some designations represent overlapping periods or more specific designations within a particular period. These are combined as appropriate in graphic representations but are presented here as recorded by ceramic specialists (T. Erickson-Gini and M. Sinibaldi).

<sup>79</sup> Sinibaldi 2013, 170–74.

<sup>80</sup> More complete fragments were special finds PAWS\_a1 (SU PAWS\_a59) and PAWS\_e7 (SU PAWS\_e180); a smaller fragment was found in SU PAWS\_g143.

<sup>81</sup> Kouki 2013a, 198.

<sup>82</sup> Sinibaldi and Tuttle 2011.

<sup>83</sup> Sinibaldi 2013, 182–83.

<sup>84</sup> Sinibaldi 2013, 193–94.

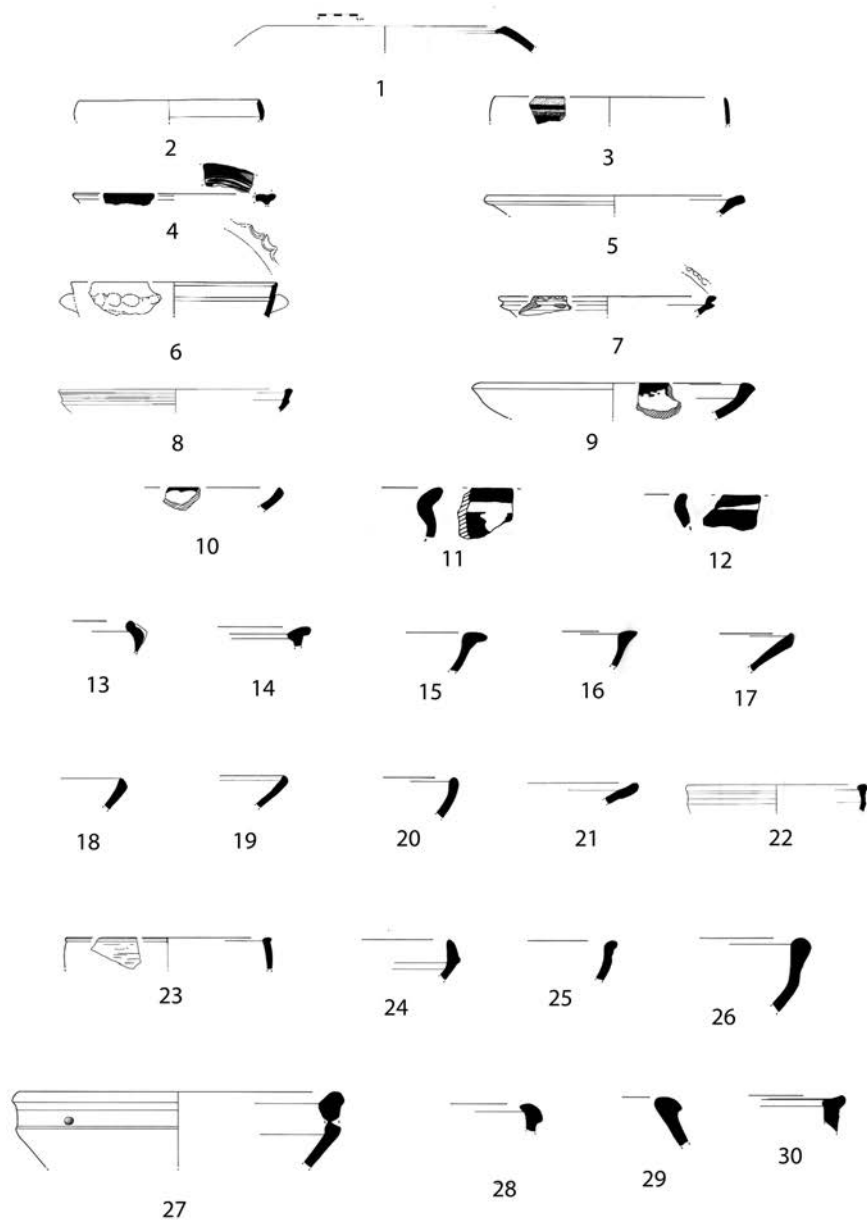


FIG. 12. Bronze Age (1) and Iron II (2–30) ceramics (drawing by T. Erickson-Gini).

density areas of recent/contemporary material fall into three broad categories: (1) regularly traversed areas, such as the sides of the paved road running north–south through the survey area; (2) locations of regular occupation, such as living or working areas; and (3) incidentally used picnicking or camping sites.<sup>85</sup>

<sup>85</sup>See Vella et al. (2015) for a discussion of contemporary material culture in relation to the treatment of the archaeological landscape.

#### FEATURE DOCUMENTATION AND PATTERNING

One of the project's more methodologically challenging aspects was the process of documenting a landscape densely populated with archaeological features. No fewer than 1,036 features (defined as the result of any past human intervention in the landscape) and feature systems (i.e., integrated arrays of multiple related features, such as terrace walls, dam systems, or multi-component agricultural complexes) were recorded between 2010 and 2012. Most interventions fell into two broad categories—built and rock-cut—although



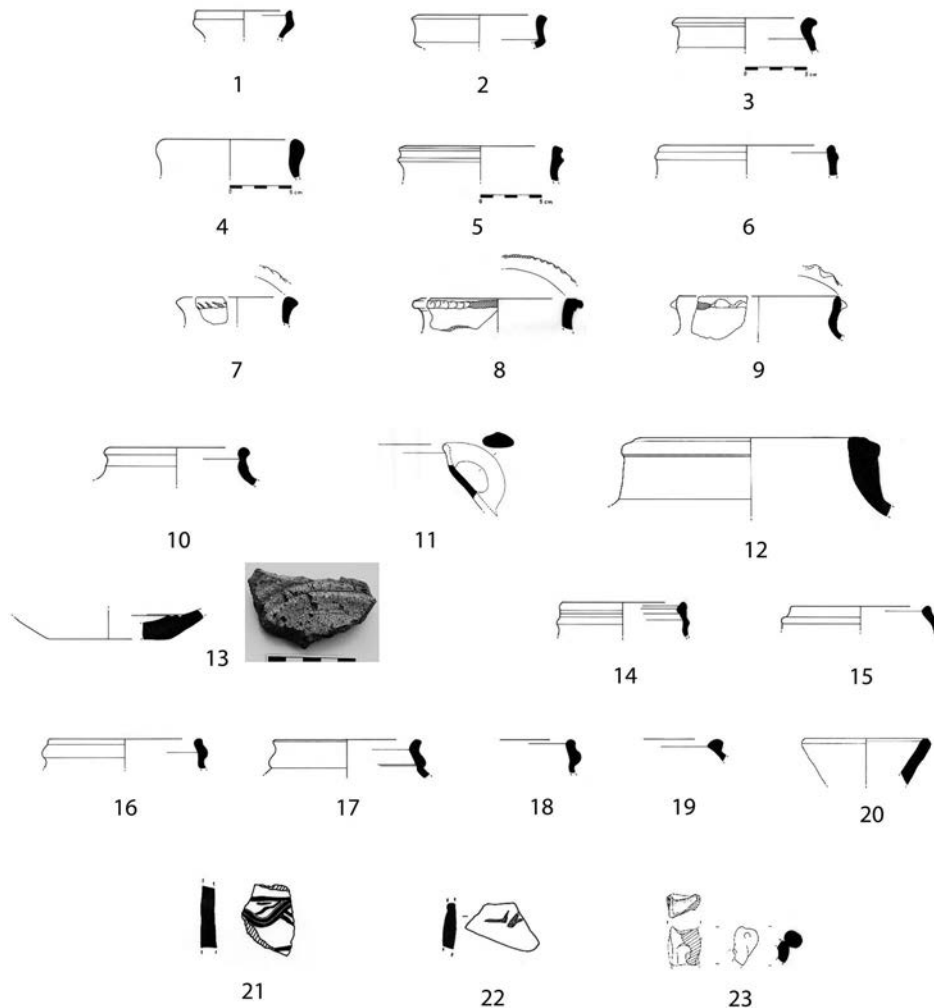


FIG. 13. Iron II ceramics (drawing and photograph by T. Erickson-Gini).

designations for smaller-scale or miscellaneous remains (artifact scatters and other) were also used, albeit rarely (fig. 19). In addition to being recorded and grouped by the type(s) of intervention represented, each feature was also assigned a functional class (e.g., funerary, quarry) and a more specific feature type (e.g., basin, relief). Detailed GIS mapping of all features illustrates, even if in palimpsest, the landscape's remarkable degree of modification (fig. 20).

Most features were first recorded by the pedestrian survey team and assigned alphanumeric designations based on the area and order in which they were discovered (e.g., PAWS\_c32 and PAWS\_g78, a rock-cut basin in Area c and cuttings for a dam wall in Area g, respectively). A second team would then follow the survey team, recording features from the initial maps, GPS coordinates, and notes. Recording consisted of

filling out a "feature form" on which a given feature was drawn by hand and described, and measurements, photographs, GPS points, and other information and metadata were recorded (online fig. 2). In the case of particularly complex or otherwise significant features, more detailed and precise architectural drawings were undertaken by skilled draftspersons, as was done, for example, at the Hellenistic and Roman settlement and ritual High Place at Ras al-Silaysil (see fig. 15).<sup>86</sup>

<sup>86</sup>Michelle Berenfeld and Felipe Rojas, who also led the Petra Routes Project component of BUPAP, were our principal project draftspersons. We also wish to thank Nick De Pace, Michal Dziejdziniewicz, Athanasiou Geolas, and Sarah Rhoads from the Rhode Island School of Design, and Oscar Sanabria, an architect practicing in Bogotá, Colombia.

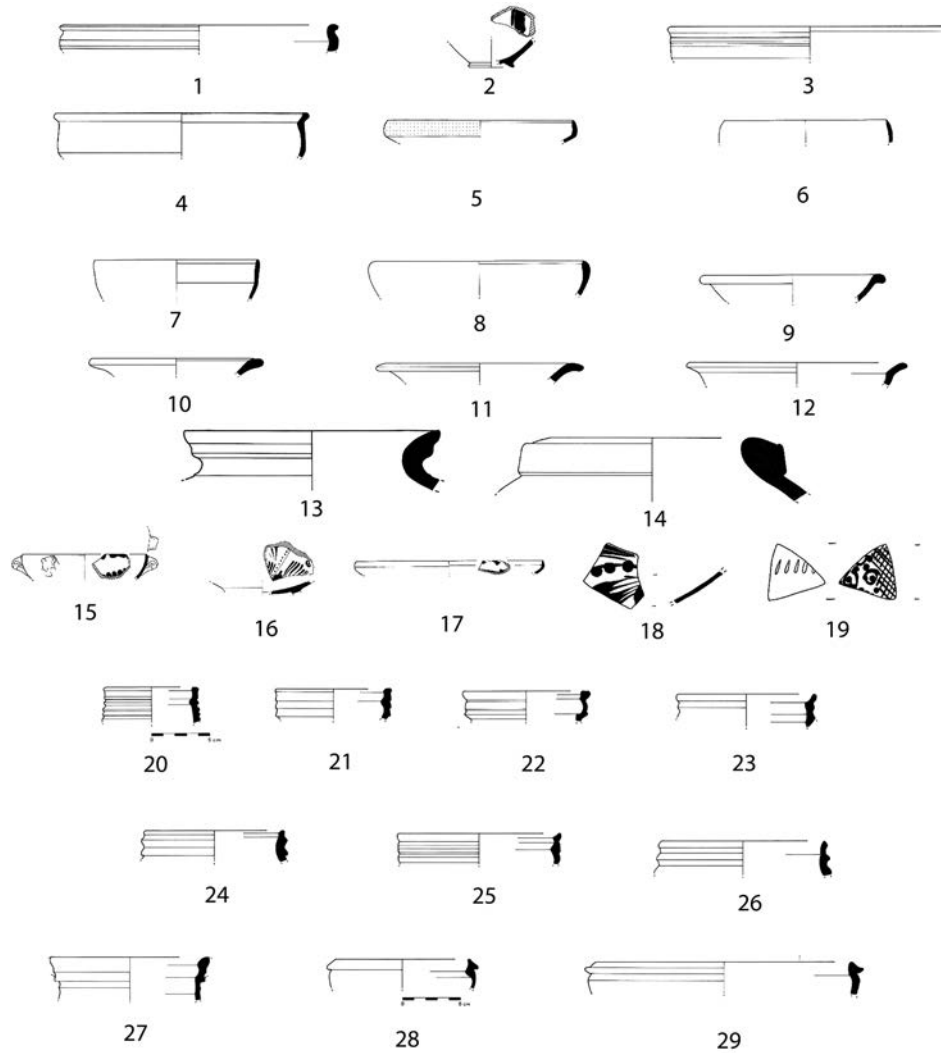


FIG. 14. Persian period (1), Hellenistic period (2–16), and Early Roman period (17–29) ceramics (drawing by T. Erickson-Gini).

In addition to documenting places already noted through pedestrian survey, feature-recording teams also conducted further extensive reconnaissance in areas that were either inaccessible or unsuitable for side-by-side fieldwalking. These efforts, undertaken to investigate the landscape as thoroughly as possible, typically extended 50–100 m beyond the edges of surveyed territory and covered, where possible, all accessible ground between contiguous SUs. Of great help to the feature teams was the occasional assistance of members of the local community, who helped by locating or identifying notable elements in the landscape and, at times, by communicating stories about them.

Both during and following in-field documentation, it became necessary to create a comprehensive, flex-

ible, and yet still manageable typology of features, as well as a system of determining and representing potential associations (spatial, functional, symbolic) between features initially recorded separately. For example, interrelated series of terrace walls (though they might first have been encountered at different times and in different SUs) in the end could be perceived as forming part of a larger, chronologically and/or functionally related system and thus were ultimately grouped together. Several rock-cut complexes necessitated similar treatment, especially in the case of water-management and agricultural systems, which tended to incorporate diverse arrays of components spread over a wide area (e.g., fig. 21). The reality that many such systems crossed the boundaries of several SUs (and in

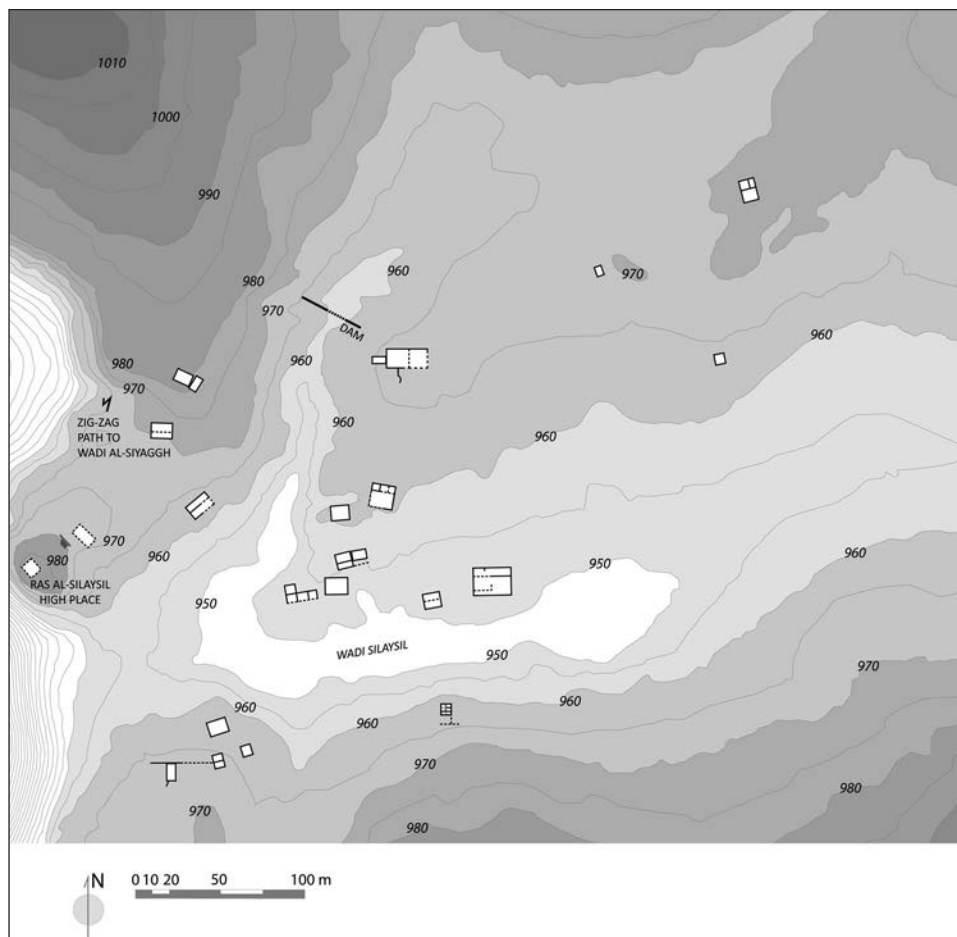


FIG. 15. Ras al-Silaysil area plan, indicating the topography, structures, and other architectural features of a Nabataean village occupied from Hellenistic to Roman times (drawing by M. Berenfeld, F. Rojas, and M. Dzedziniewicz).

some cases were recorded during fieldwork in different years) required careful review after each season. Mapping and drawing of all features in GIS was likewise indispensable for understanding their relationships and the ways in which they could be grouped functionally and chronologically.

Spatial distribution of feature types and functions was influenced by both natural topography and population needs (fig. 22). Dams and terraces between and across wadis and bedrock outcrops maximized the amount of land and water available for agriculture. Channels and cisterns, carved into the rock or built in a variety of masonry styles, carefully directed and collected water needed for other purposes (e.g., drinking by humans and/or animals, industrial use). Other major components of the landscape included graves and tombs as well as a variety of religious sym-

bols, often cut into rock faces, indicative of dispersed religious and funerary activity north of Petra.<sup>87</sup> Both the natural and social landscapes of Petra and its hinterland clearly influenced the location and layout of burials, which were clustered in certain areas and often situated and designed for maximum visibility and impact. For example, while burials were found throughout the study zone, facade tombs in particular were most common in outcrops along the major travel routes into the Petra city center, which follow

<sup>87</sup> On water management and storage in and around Petra see, e.g., Oleson 1995; Bedal 2002, 2003; Ruben 2003; Lindner 2004; Orloff 2005; Cloke 2008, 2016. On burials and tombs, see McKenzie 1990, 2004; Schmid 2007; Schmid et al. 2008; Wadson 2012, 2013. On religious symbols, see Healey 2001; Wenning 2001; Bikai et al. 2007.

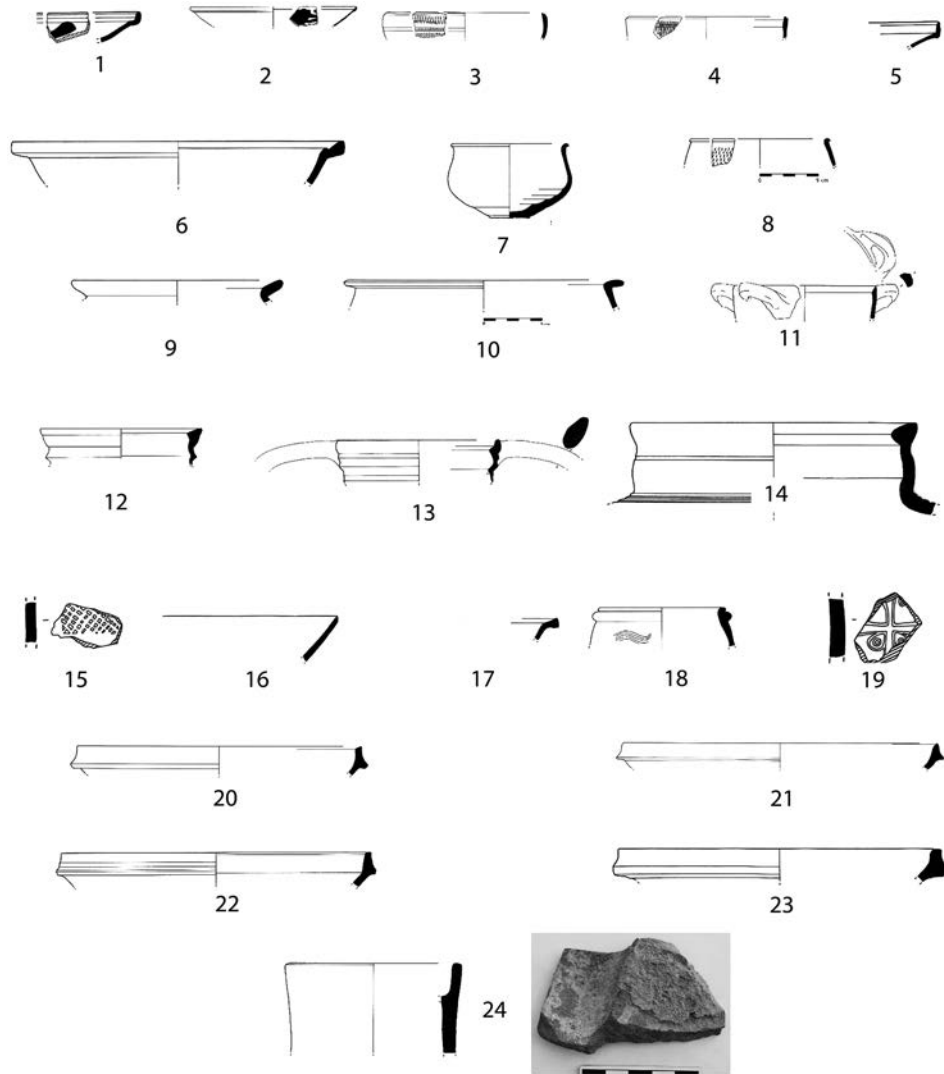


FIG. 16. Middle Roman (1–14), Early Byzantine (15–18), and Late Byzantine (19–23) ceramics and a water-pipe fragment (24) (drawing and photograph by T. Erickson-Gini).

the modern road between Bayda and Umm Sayhun and also approach Petra from the north via the Wadis Mu'aysara (see fig. 2).

Interventions in the landscape predominantly served the purpose of water management, collection, and storage, as well as land management (chiefly terracing). The great array of features belonging to these two functional classes created a substantial cultivable zone north of the city. The water-management and agricultural systems, along with many features designed for processing agricultural products such as grain, olives, and grapes (e.g., 31 olive and/or wine presses),<sup>88</sup>

attest to a highly productive landscape and one surely vital to the support of the population of Petra. What is interesting, however, is that most agricultural water features found to the north of the city were placed, following local topographies, outside the main watershed of the city center proper. In this way, those responsible

crops throughout the survey area, were of several types. Some were approximately circular with high walls and an outlet channel marked by a low ledge for separating liquid from the fruit; others were larger, with wide, flat circular pressing floors with multiple levels; still others were carved with a series of square basins. Most of these could have been used for processing olives and/or grapes, but ascribing a single specialized function is in most cases difficult to do with any certainty.

<sup>88</sup>Presses of various design, typically carved into bedrock out-

for designing and performing the upkeep of such agricultural or industrial systems ensured that their needs did not interfere with urban water requirements. To give an example, while wadi flows and rainwater were collected, distributed, and used locally, spring water in the northern hinterland appears generally to have been directed toward the city via pipelines. Parts of ceramic pipes, some bearing interior traces of calcification, were collected along a roughly northeast to southwest line in Areas g, e, and h, likely part of a pipeline running between the Dabadba Spring and the city center (fig. 23).<sup>89</sup>

Such an interpretation of course assumes the existence of Petra at the time these extensive hinterland systems were developed. The precise chronology of features is far more difficult to assess than their typological and functional groupings. The majority of features in the survey area are rock-cut (751 in total), making even relative dating an extremely difficult prospect. Instances in which tool marks are visible have the potential to aid in assigning a general time period to decorative rock-cut elements, but the soft and friable nature of the bedrock (which made it so easy to carve in the first place) also makes it susceptible to erosion over time.<sup>90</sup> Some of our test excavations shed light on the use of complex rock-cut features, such as a small stepped baetyl (PAWS\_d97) associated with pottery and votives dated from the first century B.C.E. through the first century C.E. Other teams working in the region have made efforts to date agricultural terraces using optically stimulated luminescence (OSL),<sup>91</sup> and one of our own teams was tasked with investigating several dams in the Wadi Baqa’.

#### LOCATIONS OF SPECIAL INTEREST: GEOPHYSICAL SURVEY AND TEST EXCAVATION

Throughout the course of fieldwalking and feature documentation, several locations were selected for fur-

<sup>89</sup> Ortloff (2005, 103) noted the presence of a pipeline or “underground channel” in this general area, based on a (then) unconfirmed report from local sources. These findings of pipe fragments would seem to corroborate that observation.

<sup>90</sup> Studying the tool marks on the carved facades and masonry blocks has the potential to provide relative chronology indicators, because there was evolution in the tools employed at Petra over time. However, there are not enough data or analyses at present to employ this methodology. Works that discuss this potential include Rababeh 2005; Bessac 2007.

<sup>91</sup> Beckers and Schütt 2013; Beckers et al. 2013.



FIG. 17. Islamic-period to modern representative pottery types (drawing by M. Sinibaldi).

ther study through geophysical survey and excavation. Geophysical survey was conducted by Urban in five places in the Petra city center and at the nearby site of Udhruh (table 6), as well as at seven locations in the PAWS study territory (table 7). In the latter cases, this was often done in conjunction with or prior to test excavations. Three different geophysical methods were used: ground-penetrating radar (GPR), magnetometry, and electromagnetic induction (EM).<sup>92</sup> These surveys sometimes included dense topographic (relief) mapping when warranted and other geoarchaeological sampling. Not all methods were used at each location, and approaches to data collection also varied from site to site depending on the surface conditions and features under

<sup>92</sup> Brief descriptions of the methods and certain results of geophysical surveys conducted by BUPAP have been published separately. For work in the city center, see Urban et al. 2012. For ground-penetrating radar, see Vella et al. 2012; Urban et al. 2013, 2014a.

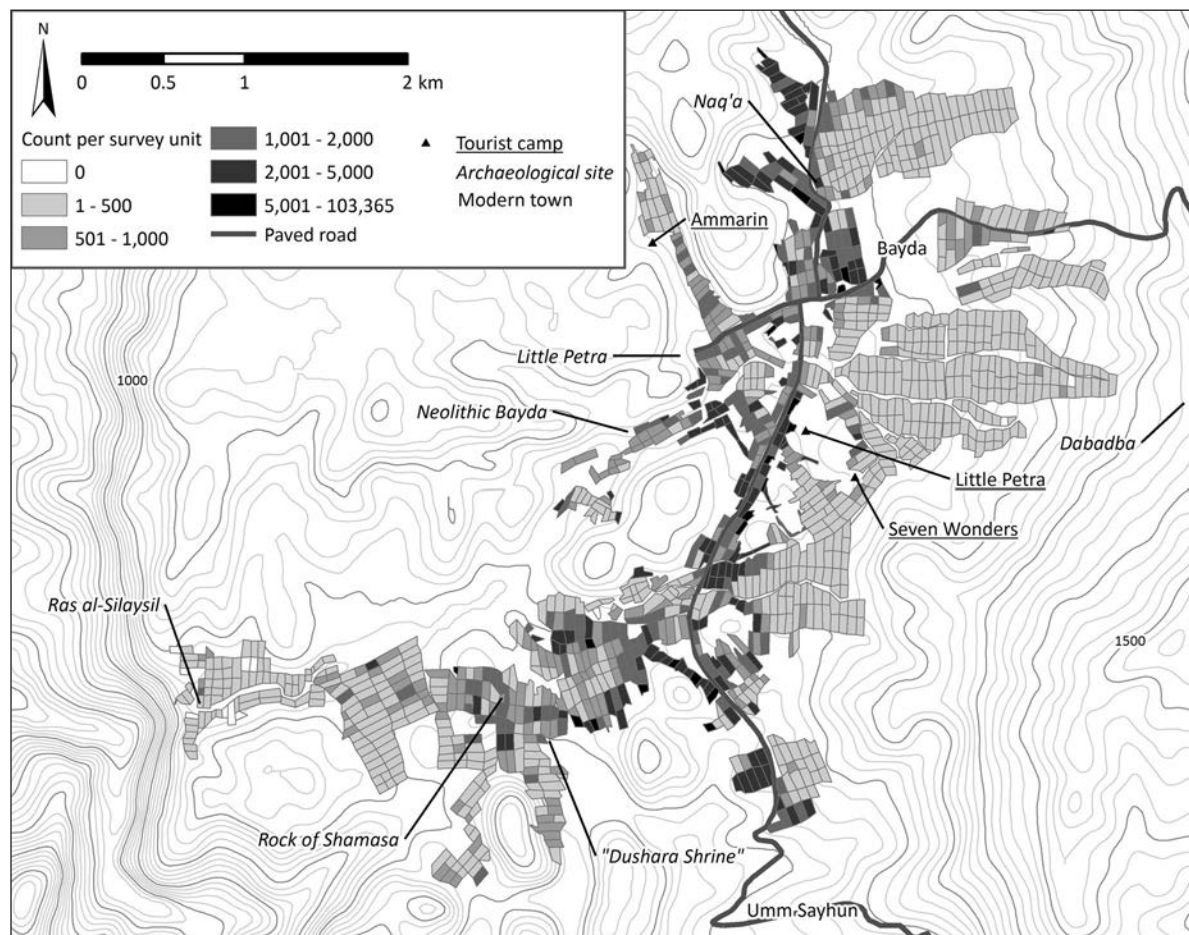


FIG. 18. Density map showing projected count of modern/contemporary material per hectare for each SU (drawing by A. Knodell).

investigation. Some areas were surveyed in gridded systems with very dense data collection (e.g., 0.25 m line spacing); elsewhere (particularly with GPR) sample transects at wider intervals were used to collect extensive test profiles in order to determine the potential for further investigations, in terms of both subsurface features and general GPR suitability. It was found that certain areas with high electrical conductivity were not suitable to GPR survey; such areas were also shown to exhibit high pH, fine texture, and, significantly, moisture retention.<sup>93</sup> Unfortunately, certain zones of interest contained substantial metallic debris, limiting the usefulness of all geophysical methods.

Despite such limiting factors, several geophysical applications were very successful in the PAWS study area. GPR, for example, was used to map a series of walls in

the Islamic village at Bayda. At Jabal al-Qarn, GPR and magnetometry pointed to features such as walls and a cooking surface, which were subsequently ground truthed by test excavation (fig. 24).<sup>94</sup> The Wadi Baqa' quickly became an area of particular interest, in part owing to the visible traces of a series of walls placed at irregular intervals along a considerable stretch of the wadi; GPR did much to augment this picture by discovering buried dams and terrace walls.<sup>95</sup> Test excavations were again done here in concert with the geophysics, with a trench (TS\_a138) dug to uncover the buildup behind the dam; in addition, this facilitated the extraction of samples for OSL dating. A concurrent study of soil parameters was also conducted in the Wadi Baqa'. This entailed assessments of volumetric

<sup>93</sup>Urban et al. 2014b.

<sup>94</sup>Vella et al. 2012; Urban et al. 2014a.

<sup>95</sup>Urban et al. 2013.

| Intervention | No. | Type                   | No. |
|--------------|-----|------------------------|-----|
| Built        | 718 | Architectural fragment | 9   |
| Rock-cut     | 751 | Artifact               | 5   |
| Scatter      | 13  | Artifact scatter       | 9   |
| Other        | 267 | Basin                  | 50  |
|              |     | Burial                 | 7   |
|              |     | Channel                | 144 |
|              |     | Cistern                | 34  |
|              |     | Complex                | 24  |
|              |     | Game board             | 34  |
|              |     | Grave (marked)         | 19  |
|              |     | Inscription            | 40  |
|              |     | Mound                  | 28  |
|              |     | Niche                  | 49  |
|              |     | Other                  | 47  |
|              |     | Petroglyph             | 15  |
|              |     | Press                  | 31  |
|              |     | Relief                 | 36  |
|              |     | Road                   | 1   |
|              |     | Shelter                | 26  |
|              |     | Steps                  | 80  |
|              |     | Structure              | 86  |
|              |     | Surface (horizontal)   | 71  |
|              |     | Surface (vertical)     | 62  |
|              |     | Tomb (with facade)     | 15  |
|              |     | Wall                   | 581 |
|              |     | Undetermined           | 245 |

FIG. 19. Numbers of features recorded by PAWS, categorized by intervention, function, and type (drawing by C. Cloke and C. Feldman).

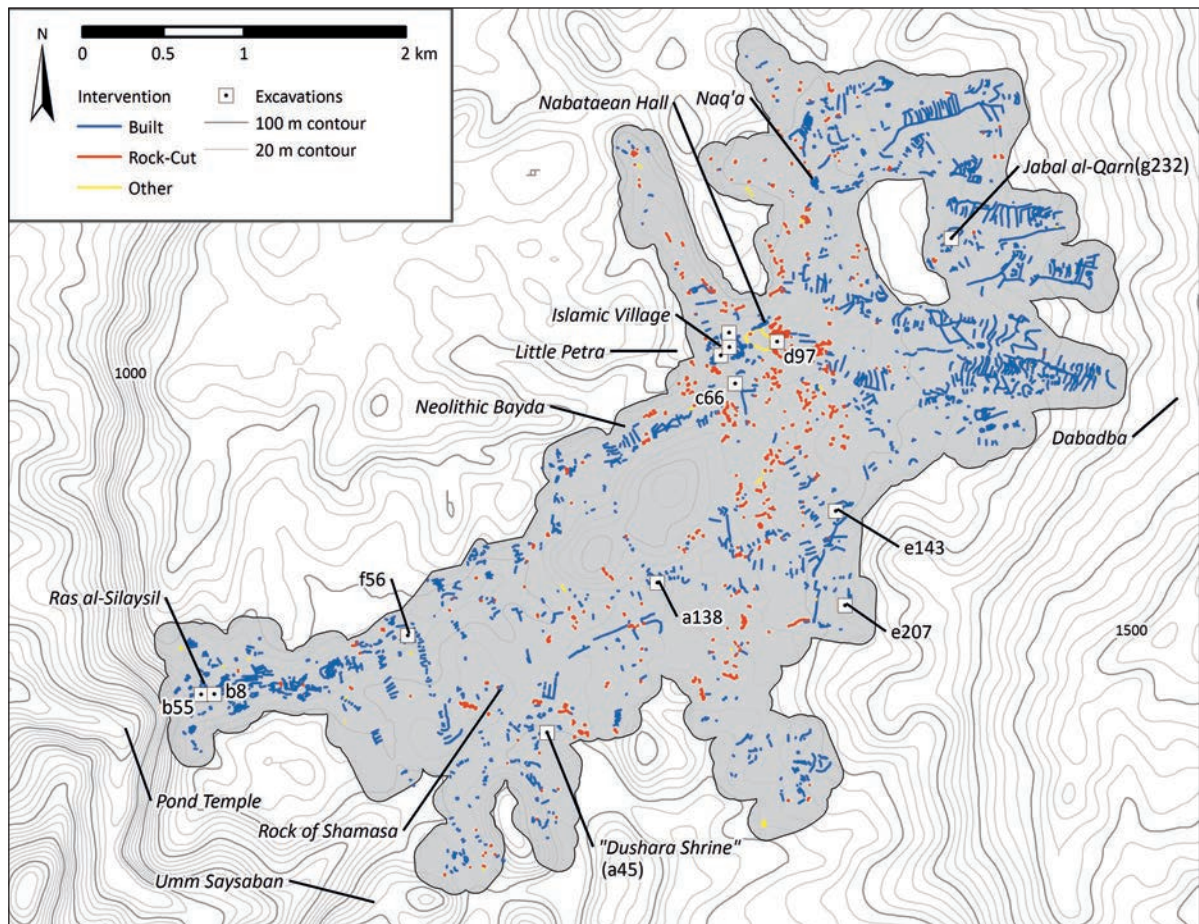


FIG. 20. Archaeological features, locations of interest, and test-excitation sites in the PAWS survey area (drawing by A. Knodell).

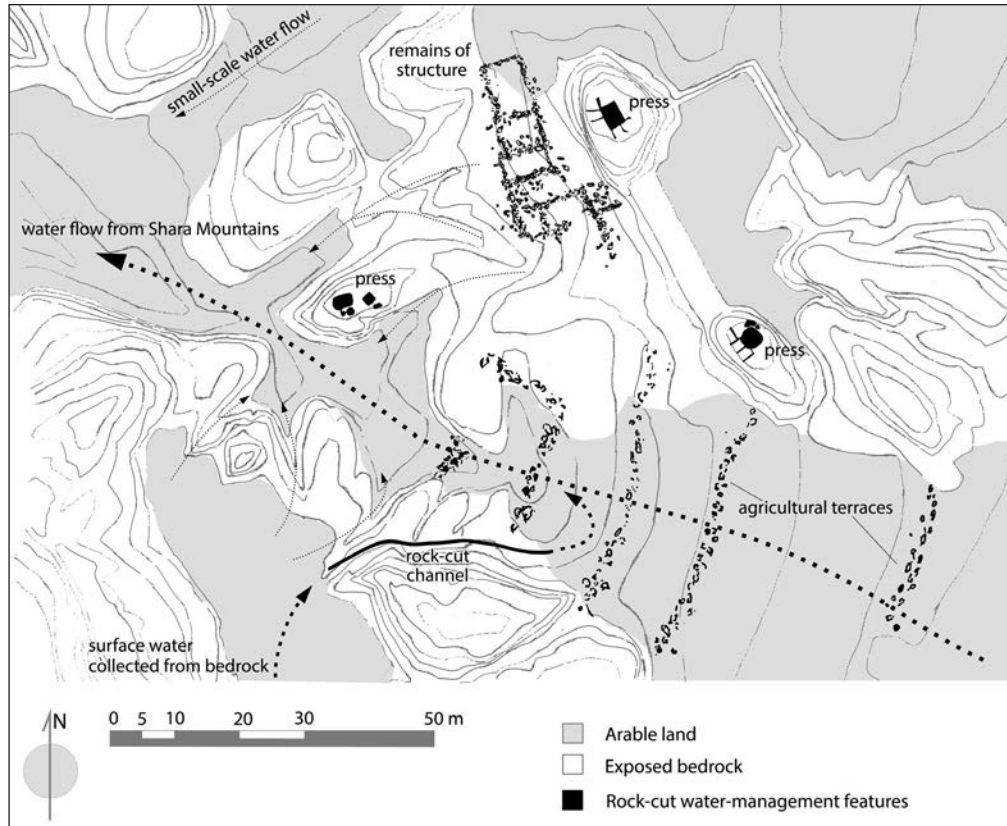


FIG. 21. Agricultural and water-management complex from Area e, consisting of terraces, a water channel, a multiroom structure, and three wine presses. Nabataean pottery of Hellenistic to Middle Roman date was found in association with the complex (drawing by S. Rhoads, F. Rojas, and M. Dziedziniewicz).

water content (VWC) with a dielectric probe, textural analysis, pH testing, compositional analysis with inductively coupled plasma mass spectrometry (ICP-MS), and OSL dating—all to aid in the interpretation of data collected through the combination of GPR and test excavations. This full battery of investigative strategies has illuminated a highly sophisticated system of water control and soil amelioration extending from the Shara Mountains to the cultivable plateau below. In the Wadi Baqa' (as in the Upper Market of the Petra city center), geophysical results demonstrated that water-management features are often well integrated with natural geologic formations, thus making efficient use of existing flow paths and obstacles as guides in the physical landscape. Such integration of the built landscape with the natural environment can make interpretation difficult; decoupling natural and anthropogenic features (as manifested in geophysical data) is not always straightforward.

Based on the results of the pedestrian survey, feature documentation, and initial geophysical studies, 10

locations were chosen for further investigation through limited test excavations (table 8; see fig. 20). The main purpose of this program was to answer certain questions regarding the chronology and function of particular features and, in turn, to evaluate the potential benefits of additional investigation. With the exception of PAWS\_g232 (the Bronze Age hilltop settlement at Jabal al-Qarn), all selected sites were of Hellenistic/Roman date, the period of Nabataean or Roman political dominance in the region and the landscape's "busiest" incarnation. All of these sites were approached with the same methodology and techniques, including soil sampling when possible, and the complete (dry) sieving of all excavated deposits.

Excavation locations, identified as high-potential areas based on significant surface artifact scatters or the close proximity of visible cultural features, were chosen during the 2012 season. The trenches ("test squares," or "TS" in project parlance) varied between 1 x 1 m and 2 x 2 m in size. Once excavations were completed, these test squares were covered in meshed textile



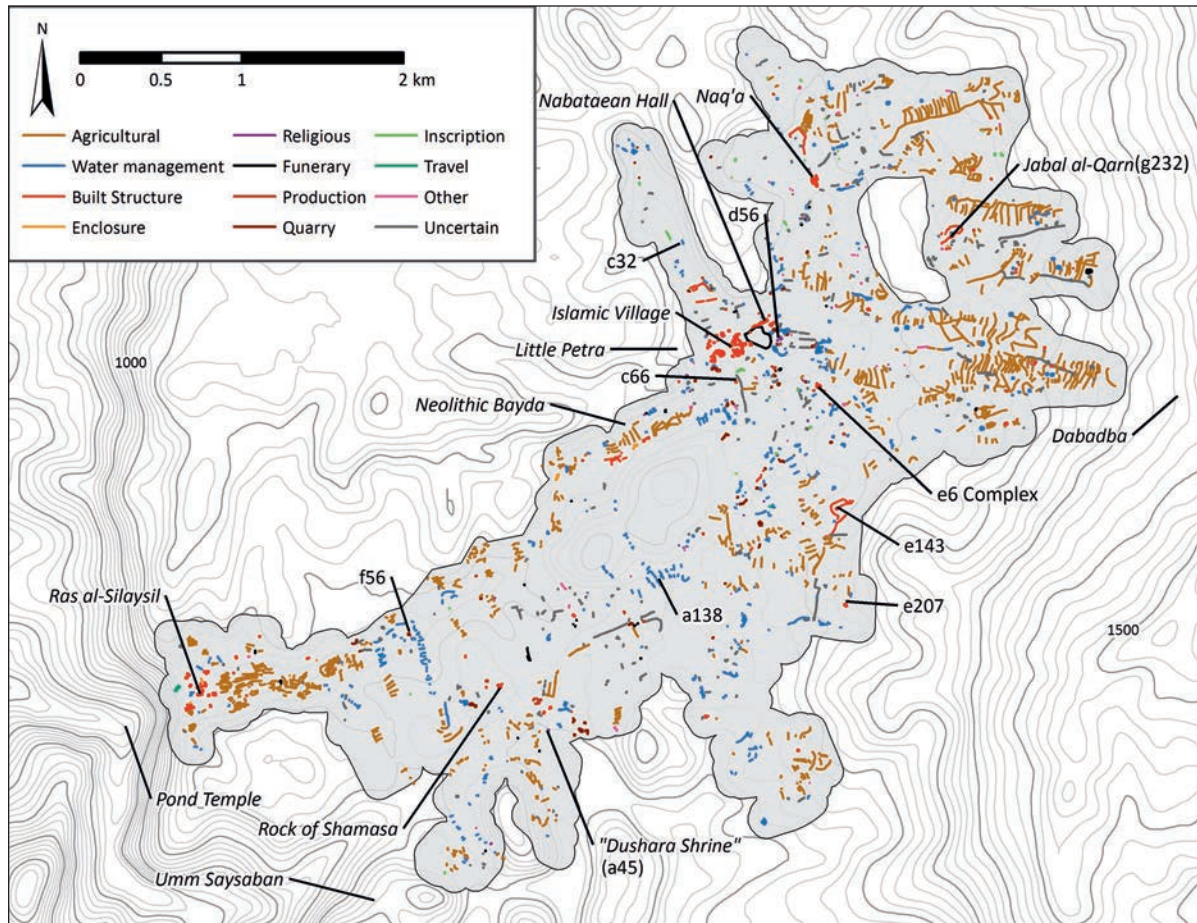


FIG. 22. Distribution of features in the PAWS survey area, categorized by function (drawing by A. Knodell).

and completely covered (using excavated backfill) to protect each site from subsequent damage; detailed notes were also taken on the condition of associated structures and other elements.

To optimize the placement of squares at earmarked sites, geophysical survey prior to excavation was conducted when possible, and this effectively improved our test-square placement at TS\_d97, TS\_g232, and TS\_a138, all of which had somewhat ambiguous surface remains.<sup>96</sup>

The test excavations confirmed or revealed a sometimes overlapping array of past activities, which can be loosely characterized as ritual, domestic, surveillance, and agricultural (see table 8). Of the 49 features with apparent religious significance (niches, baetyls, *nefesh*

symbols) scattered across the survey area, we chose to excavate at three that were typologically different from one another and in distinctive locations, although in the end excavation results dated each from the first century B.C.E. through the first century C.E. The first was a small baetyl with steps in front of it (PAWS\_d97) (figs. 25, 26), which yielded an apparent votive assemblage with an abundance of fine ceramics, as well as animal bones, shell, metal, glass, and figurine fragments. A somewhat larger complex, the so-called Dushara Shrine at Shamasa (PAWS\_a45),<sup>97</sup> boasted several visible niches (figs. 27, 28). Our excavations uncovered the remains of a paved floor partially destroyed

<sup>96</sup> To clarify our terminology, TS\_g232, e.g., refers to the excavation at feature PAWS\_g232.

<sup>97</sup> So designated by Lindner and Gunsam (2002, 230–34), who admit the tenuous association of the site with this specific deity.

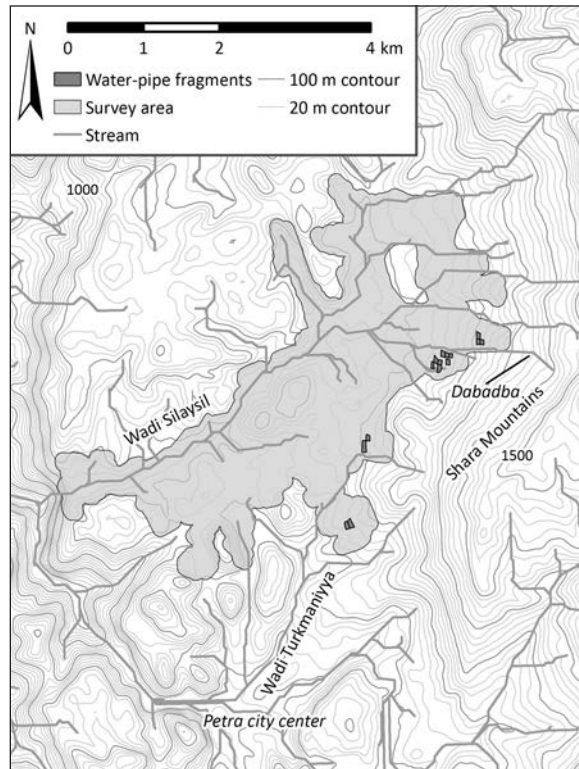


FIG. 23. Map showing the locations of water-pipe fragments in SUs moving from Dabadba Spring toward Petra. Stream accumulations in the regional watershed are also marked (drawing by A. Knodell).

by episodes of looting;<sup>98</sup> this naturally sheltered site has also clearly become a favorite place for night picnicking in recent times. Both the baetyl and the shrine consciously exploited the morphology of the massif landscape, since they were nestled in relatively secluded spots that were nevertheless easily accessible from substantial contemporary settlements at Bayda and Shamasa, respectively.

By contrast, we interpreted an unusual rectangular structure built of fine ashlar blocks (PAWS\_c66) as an altar platform built in an open plain (fig. 29). The structure is unmistakably oriented north toward Siq al-Amṭi in the Bayda area, with Little Petra to the west and the so-called Nabataean Hall complex to the east. Unfortunately, given the high quality of the platform's construction, relatively little artifactual material was discovered by our test probes, aside from pottery indi-

ating a general chronology of the first century B.C.E. to first century C.E. The platform appears to have been repurposed well after its initial construction and period of use, with a small addition later placed on its south side, possibly serving as a mihrab in an open-air prayer area. This test probe proved especially tantalizing since the zone around Little Petra and Siq al-Amṭi has in recent years been recognized as forming a special, even sacred, landscape and a stage for numerous types of Nabataean religious rituals, agricultural activities, and elite residential experiences (fig. 30).<sup>99</sup>

We have already mentioned the earliest domestic site where test excavations took place, the Bronze Age settlement at Jabal al-Qarn (PAWS\_g232; see fig. 24). We also explored two domestic contexts in the community of Ras al-Silaysil, the Nabataean village site located on the edge of the steep drop down to the Wadi 'Araba (PAWS\_b8, PAWS\_b55; see figs. 15, 20). As noted earlier, finds of high-quality Nabataean painted fine ware were abundant on the surface of this site, and excavations confirmed occupation phases ranging primarily from the Hellenistic to Early Roman periods, with activity curtailed no later than the end of the first century C.E. The relative paucity of material recovered from within the village structures is no doubt due to routine cleaning and maintenance; many dwellings were constructed directly on top of bedrock and showed no evidence of later reuse. Like the Bayda area, Ras al-Silaysil is worthy of greater attention, both because it remains in relatively good condition (though, as noted, its spectacular High Place has been badly damaged) and because it represents a rare coherent "suburban" community in the Petra hinterland.<sup>100</sup>

In the course of the survey, we identified two examples of what we term "lookout structures," or structures strategically placed to offer surveillance opportunities but likely serving other, perhaps domestic functions as well.<sup>101</sup> They both have two main rooms and, based

<sup>99</sup> Bikai et al. 2008.

<sup>100</sup> See Lindner and Gunsam (2002) for a definition of "suburb," a term used to designate a secondary locus of settlement, distinct from but clearly linked to the Petra city center.

<sup>101</sup> Several other locations of interest may have served similar functions, including fortified hilltops at Shamasa (PAWS\_a91) and in Wadi Mu'aysara (PRP\_wmw6); the uncertain function of PAWS\_e143 may place it in this category as well. At least two further such structures were located farther up the slopes of the Shara to the north and south but were outside of the survey area. On Nabataean watchtowers, see Kennedy 2013.

<sup>98</sup> Vella et al. 2015, 227–28.

TABLE 6. BUPAP geophysical survey, Petra city center and Udhruh.

| Year       | General Location                        | Method(s)               |
|------------|---|-------------------------|
| 2010, 2011 | Petra Upper Market area                 | EM, magnetic, GPR, topo |
| 2010, 2011 | Temple of the Winged Lions              | EM, magnetic, GPR       |
| 2010, 2011 | Turkmaniyya Tomb area <sup>a</sup>      | EM, magnetic, GPR       |
| 2012       | Royal Tombs area <sup>b</sup>           | magnetic, GPR           |
| 2013       | Udhruh Roman drainage area <sup>c</sup> | GPR, carbonate sampling |
| 2013       | Petra Great Temple                      | GPR                     |

*Note:* Methods include electromagnetic induction (EM), ground-penetrating radar (GPR), magnetic gradiometry, and surface mapping (topo).

<sup>a</sup>In cooperation with UNESCO assessment.

<sup>b</sup>In support of the Swiss/German project at the invitation of Stephan Schmid.

<sup>c</sup>In support of the Udhruh Archaeological Project at the invitation of Mark Driessen, Leiden University.

TABLE 7. Geophysical survey in PAWS study area.

| Year       | General Location                                  | BUPAP Feature No(s).<br>and/or SUs   | Method(s)                                 |
|------------|---|--------------------------------------|---|
| 2011       | Little Petra Nabataean tomb                       | –                                    | GPR: test profiles                        |
| 2011       | Shamasa area (multiple locations)                 | PAWS_a45; SUs a123, a126             | GPR: test profiles                        |
| 2011       | Siq al-Amti                                       | PAWS_c1                              | GPR: test profiles                        |
| 2012       | Jabal al-Qarn Early Bronze Age site               | PAWS_g232                            | magnetic, GPR, topo                       |
| 2012       | Bayda Islamic Village, including Byzantine church | PAWS_c80                             | GPR                                       |
| 2012       | Bayda Nabataean tombs area                        | PAWS_d54, d55, d56, d57, d97; SU d71 | magnetic, GPR                             |
| 2012, 2013 | Wadi Baqa' drainage area                          | PAWS_a133, a138, a145, a146, a147    | GPR, VWC, topo, soil samples <sup>a</sup> |

*Note:* Methods include ground-penetrating radar (GPR), magnetic gradiometry, surface mapping (topo), and volumetric water content (VWC) measured with dielectric probe.

<sup>a</sup>Samples underwent textural analysis, elemental analysis with inductively coupled plasma mass spectrometry (ICP-MS), pH measurement, and optically stimulated luminescence (OSL) dating.

on excavation evidence, appear to have been first occupied in the second to third century C.E. In the case of PAWS\_f56, the structure sits on a high hill overlooking the intersection of two wadis, a present-day pathway, and an array of terraced agricultural fields (see figs. 22, 31). PAWS\_e207 rests high on the flanks of the Shara and offers a sweeping perspective over the territory below (fig. 32), including other strategic points, such as PAWS\_f56 and the High Place sanctuary at Ras al-

Silaysil. The locations and the date of these two sites suggest they can be tied to broader patterns of agricultural exploitation and oversight.

From the wide variety of features apparently associated with agricultural activity, we also chose to investigate PAWS\_e143, a rather enigmatic circular structure built from (for the area) unusually large stones and now largely collapsed. While interpreting this structure ultimately proved difficult, the likeliest conclusion is

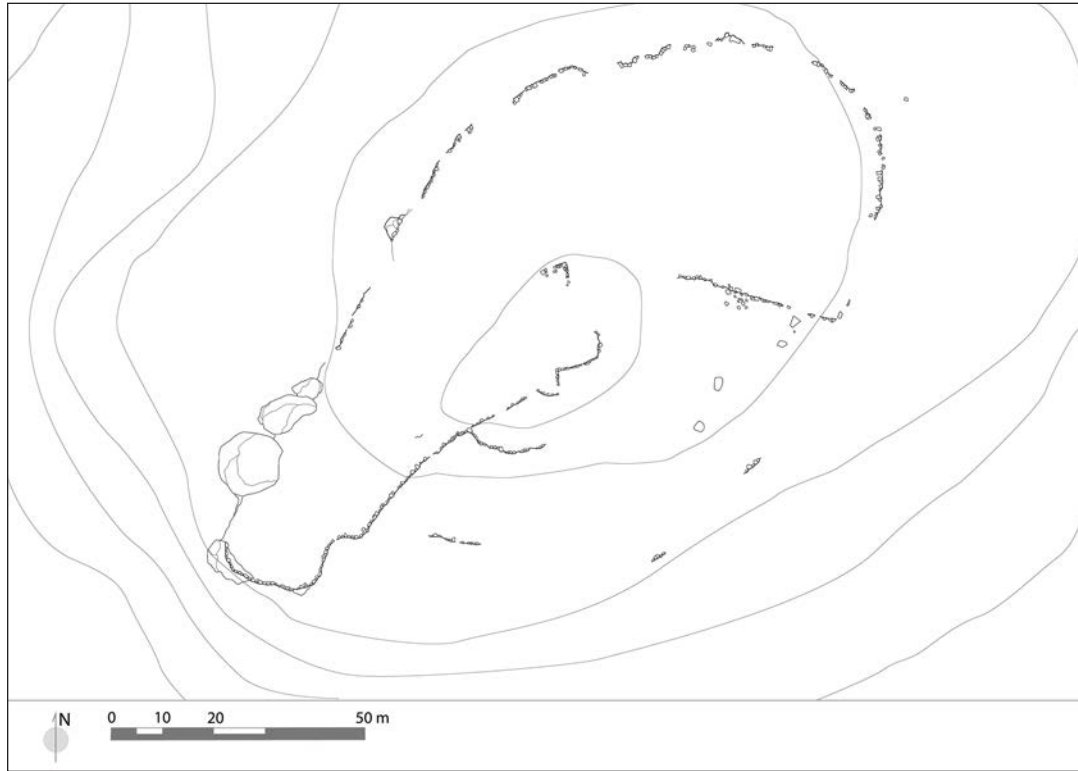


FIG. 24. Plan of the Early Bronze Age site of Jabal al-Qarn, showing topography and wall lines that most likely represent a habitation site atop the hill, with a perimeter boundary wall lower down; excavations (based on the results of geophysical survey) revealed lithics and ceramics of Early Bronze Age date (drawing by F. Rojas, M. Berenfeld, and O. Sanabria).

TABLE 8. Test excavation locations in PAWS study area.

| Feature No.<br>(PAWS_) | Interpreted Function   | Structure Type                              | General Chronology<br>(Initial Construction) |
|------------------------|------------------------|---|--|
| a45                    | ritual                 | shrine                                      | first century B.C.E. to first century C.E.   |
| a138                   | agricultural           | terrace/dam                                 | second to third century C.E.                 |
| b55                    | domestic               | rectilinear house                           | first century B.C.E. to first century C.E.   |
| b8                     | domestic               | rectilinear house                           | first century B.C.E. to first century C.E.   |
| c66                    | ritual                 | altar                                       | first century B.C.E. to first century C.E.   |
| d97                    | ritual                 | stepped baetyl                              | first century B.C.E. to first century C.E.   |
| e143                   | agricultural structure | circular structure                          | second to third century C.E.                 |
| e207                   | domestic/lookout       | rectilinear house with small adjoining room | second to third century C.E.                 |
| f56                    | domestic/lookout       | rectilinear house with small adjoining room | second to third century C.E.                 |
| g232                   | domestic               | wall with cooking platform                  | Early Bronze Age                             |



FIG. 25. Tomb feature PAWS\_d56, view to the southeast (A. Knodell).

that it was used as a kind of agricultural storage place for equipment, agricultural produce, or a combination thereof. Materials found in association with the structure place it in the second to third century C.E.

Test excavation (a trench placed behind PAWS\_a138) was also used, in conjunction with surface reconnaissance, geophysical work, and various forms of sediment analysis, to investigate the extensive agricultural terracing and dam system in the Wadi Baqa'. A multistage dam and terrace system was here traced running from the Shara Mountains down to connect with Wadi Silaysil, varying along its course both in construction style and in the nature of the sediments captured or passed on. Larger blocks and the capture of rubbly, coarser sediments characterized the higher elevations, compared with more carefully built walls and much finer silt downslope. It would seem that, while functioning and maintained, this dam system worked progressively to slow, filter, and refine waterborne sediments rushing down from the Shara Mountains to the substantial benefit of the flatter agricultural fields below and to the west. The system has long since passed out of coherent use, of course, as the collapse of walls and sediment accumulation over them make

clear. Nonetheless, sediment testing from the test excavation at PAWS\_a138 indicated significantly better



FIG. 26. Excavation at feature PAWS\_d97, located at the bottom of the rock formation seen at right in fig. 25, view to the southeast (E. Bocancea).



FIG. 27. Feature PAWS\_a45, the so-called Dushara Shrine at Shamasa, front view (E. Bocancea).



FIG. 28. Feature PAWS\_a45, view to the west-northwest, showing the excavation trench that exposed a paved floor (C. Vella).



FIG. 29. Feature PAWS\_c66, south of the Bayda Islamic Village, view to the northwest with Siq al-Amṭi opening directly behind in the background. The feature has been interpreted as an altar platform (C. Feldman).

moisture-retention levels below the topsoil deposit—even today and even during the hot summer months.<sup>102</sup>

Finally, more extensive excavations were carried out in 2010 and 2011 at the site of Islamic Bayda (see fig. 30).<sup>103</sup> Although this effort was aimed primarily at understanding the organization and chronology of the Islamic-period settlement, results overlapped considerably with other wings of the overall project. Ceramics from both excavation and survey were analyzed together, with the goal of refining the chronologies used for categorizing surface materials. The PAWS team also thoroughly mapped the village structures. Based on survey data and information from the Beidha Documentation Project, three trenches were situated at the site in areas of high potential.<sup>104</sup> BUPAP excavations recorded a type of settlement not often documented in Jordan: a cluster of rural habitations belonging to the Middle/Late Islamic periods, with the evidence

of surface ceramics tilting toward the later period. Habitation here is often characterized by the practice of shared walls and the considerable use of courtyards, in particular for clay ovens. Archaeobotanical and phytolith analyses are allowing the reconstruction of elements of the diet at the village. Excavations at the site are ongoing under the direction of Sinibaldi; this more recent work suggests, not unexpectedly, earlier signs of activity and therefore a long span of use for the rural village, through at least most of the Islamic period.<sup>105</sup>

As this review suggests, we deliberately investigated a broad spectrum of features rather than exploring any one category in great depth. It is clear that more work on all feature types would be productive and enlightening.

#### DIACHRONIC OVERVIEW AND DISCUSSION

In the course of all elements of our work at BUPAP, several questions emerged of common interest across

<sup>102</sup> Urban et al. 2013.

<sup>103</sup> Sinibaldi and Tuttle 2011.

<sup>104</sup> Bikai et al. 2005a, 2007, 2008.

<sup>105</sup> Sinibaldi 2015a.

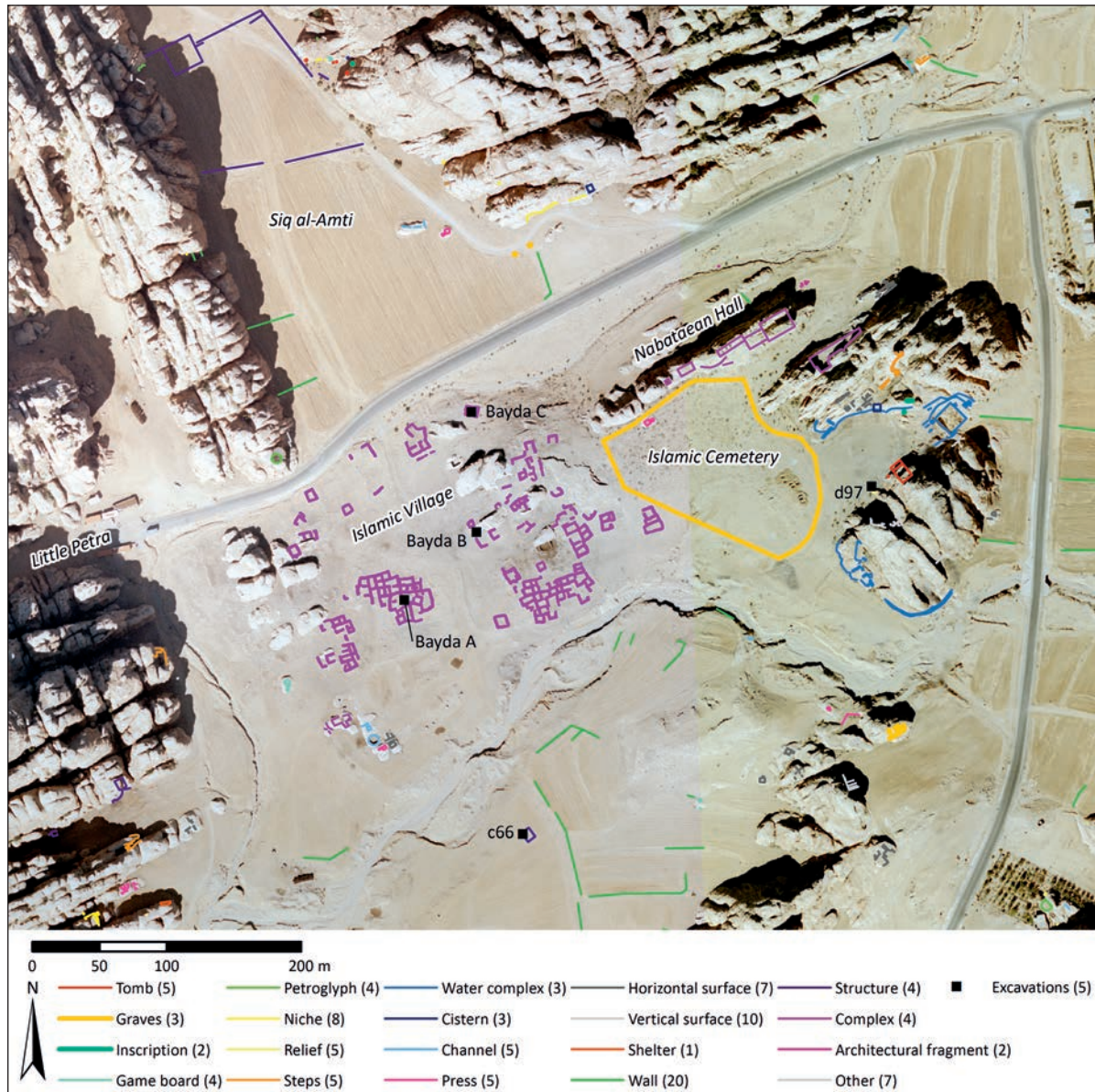


FIG. 30. Area plan of Bayda Islamic Village and surroundings, indicating feature types (with quantities represented in the present map extent), excavation locations, and locations of special interest; the base image is an aerial photograph (A. Knodell; base image courtesy Royal Jordanian Geographic Centre).

multiple—or indeed all—periods. Salient themes of particular long-term relevance to our study include (1) subsistence strategies and exploitation of the natural landscape, (2) patterns of settlement, (3) water management and use, and (4) movement within and beyond the survey area.<sup>106</sup> These themes are fore-

grounded in our diachronic discussion below and set in broader context by the results of other archaeological projects where relevant. Our hope is that such a long-term perspective, adopted here in our specific study area, will contribute to larger debates on a macro-regional scale. Certainly other topics, such as ritual or

<sup>106</sup> Such topics, of course, have been explored in varying degrees of detail by previous scholars; see, e.g., Al-Muheisen and

Tarrier 1997; Bienert and Häser 2004; Lindner 2004; Ohlig 2008; Shqiarat 2008.



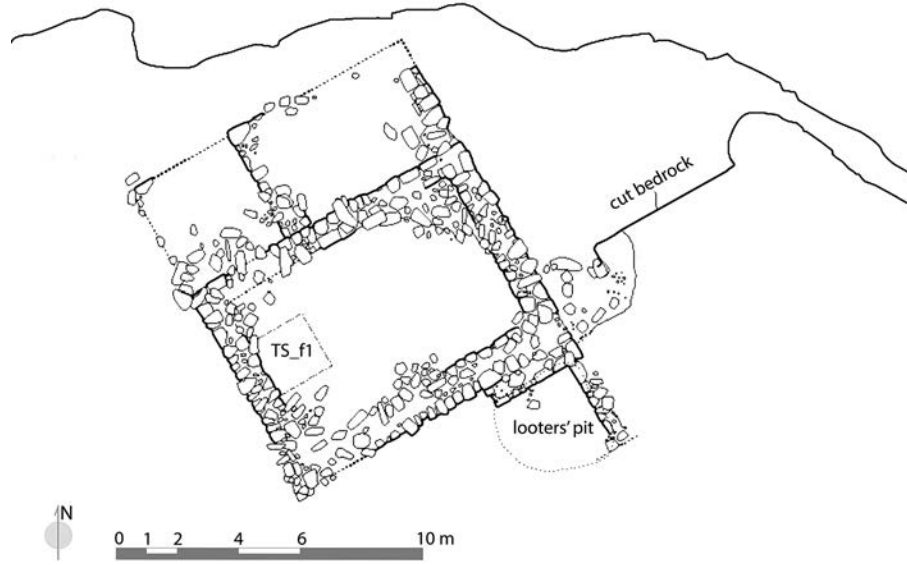


FIG. 31. PAWS\_f56 lookout (drawing by M. Berenfeld and F. Rojas).

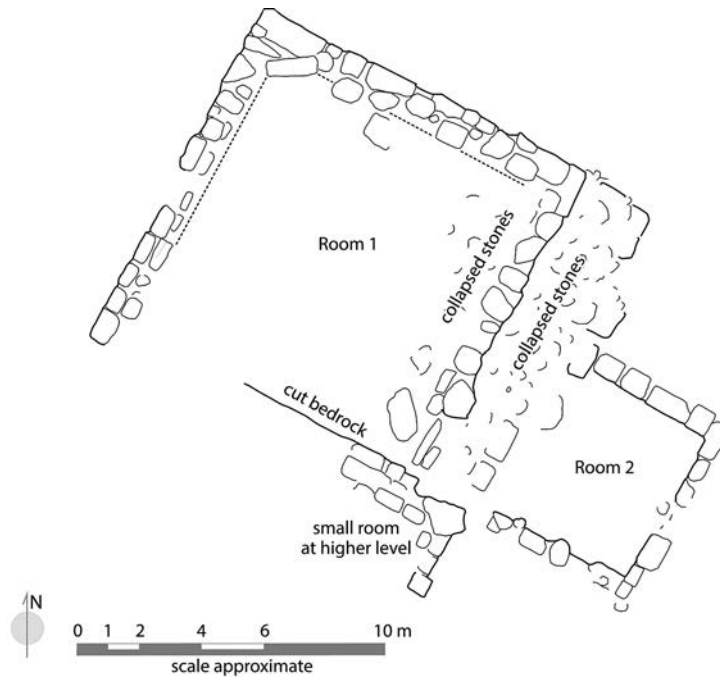


FIG. 32. PAWS\_e207 lookout (drawing by M. Berenfeld and C. Cloke).

mortuary landscapes, could and should be highlighted in further studies.

*Hunter-Gatherers in the Paleolithic*

Given Petra’s location just above the Wadi ‘Araba, on the northern end of the Great Rift Valley, it was no surprise to find evidence of premodern human occupa-

tion near the city.<sup>107</sup> The numerous Lower and Middle Paleolithic stone tools found in Petra’s northern hinterland point to occupation by *Homo erectus* and *Homo*

<sup>107</sup> Lower and Middle Paleolithic findspots in Jordan appear fairly regularly along this axis (Olszewski 2008).

*neanderthalensis* populations going back (potentially) as far as 1 million years. The distribution of early material, as already observed, is especially notable on the lower slopes of the Shara Mountains (fig. 33), which we interpret as owing to the excellent vantage points for hunting surveillance and to the presence of water from intermittent and migrating springs within the limestone layers of the mountains. The zones in which most of the Lower Paleolithic artifacts were collected are in clear view of Siq al-Hayran, which forms a bottleneck between the survey area and the Namala pass, recognized as a key migratory route for prey animals exploited by premodern humans.

While Lower Paleolithic hand axes have been noted in the wider region for some time,<sup>108</sup> the relatively abundant quantity of PAWS finds is noteworthy. Until fairly recently, the closest documented Lower Paleolithic findspots to Petra were located some 10–20 km to the south, one in the vicinity of Sabra and one just east of Basta (see fig. 1) at Jiththa 15.<sup>109</sup> The FJHP<sup>110</sup> also has documented small concentrations of Lower Paleolithic artifacts on the southern slopes of Jabal Harun.<sup>111</sup> If we count these as three distinct locales with limited finds in a region of at least a few hundred square kilometers, it is impressive that the 10 km<sup>2</sup> surveyed by PAWS yielded several such locations with 36 clearly diagnostic Lower Paleolithic finds.<sup>112</sup>

The prevalence of Middle Paleolithic finds throughout the survey area is part of a wider pattern in southern Jordan that sees a remarkable proliferation of tool technologies in the archaeological record. The adjacent SAAS saw a marked spike in the distribution of Middle Paleolithic chipped stone as well, with material of this date present in more than half of the 58 randomly sampled squares surveyed in 2010.<sup>113</sup> FJHP recorded a wide distribution of Middle Paleolithic material (present in 48% of survey units, with denser concentrations in the western part of their survey area).<sup>114</sup> Our lithic

distributions show a remarkable coincidence of Lower and Middle Paleolithic finds. While Middle Paleolithic finds are much more widely dispersed—231 artifacts in 144 SUs (11% of the total number of SUs)—they are found in almost all locations where Lower Paleolithic tools were located, suggesting similar patterns of behavior across the two periods, as well as a remarkable infilling of the landscape into the Middle Paleolithic—a trend observed in the wider region as well.

Upper Paleolithic material is more thinly distributed across the survey area, with concentrations in Area b near Wadi Silaysil, and in Area g. In the wider region, Upper Paleolithic material has been found chiefly to the south of Petra proper, at a variety of locations near Sabra.<sup>115</sup> SAAS recorded a handful of Upper Paleolithic finds in 2010; their survey area, too, showed a marked drop following the Middle Paleolithic boom. Finds from FJHP were few, indeed so much so that they were not distinguished from Epipaleolithic materials in diachronic discussion.<sup>116</sup> Hertell has suggested that the scarcity of Upper Paleolithic finds may be owing to the distance of FJHP sites from springs, proximity to which seems to correlate with Upper Paleolithic blade density.<sup>117</sup> This fits well with our patterning in the northeast and southwest extremes of the PAWS survey area, which are close to the Dabadba Spring and the debouchment of Wadi Silaysil. A final location of note, just barely outside the southern end of the survey area, is the Upper Paleolithic to Epipaleolithic (Kebaran) transitional rock shelter of Madamagh.<sup>118</sup> Excavated levels from this site date to the later Upper Paleolithic and may help explain the presence of contemporaneous materials in Area h and the south side of Area a.

This chronological patterning of widespread Middle Paleolithic activity followed by Upper Paleolithic retraction requires some explanation. While climatic variation may have contributed to some degree, we should also consider the possible impact of a transition from Neanderthals to *Homo sapiens* as the predominant inhabitants of the landscape. There are no Pleistocene hominid fossil remains from Jordan, but, based on our knowledge of Middle Paleolithic Levantine Mousterian

<sup>108</sup>Jansson 2002.

<sup>109</sup>Amr and Momani 2001, 281, fig. 39.

<sup>110</sup>See n. 3 for abbreviations of project names.

<sup>111</sup>These were especially prevalent in tract 188 and its surroundings, consisting of a “handaxe and a few other eroded and heavily patinated artifacts” (Hertell 2013, 82).

<sup>112</sup>PAWS results correlate well, however, with the Dana-Faynan-Ghuwayr Early Prehistory Project (Clegg and Mithen 2007, 134; Mithen et al. 2007, 82, fig. 3.33).

<sup>113</sup>MacDonald et al. 2010.

<sup>114</sup>Hertell 2013, 80–2, table 1.

<sup>115</sup>Schyle and Uerpmann 1988, 41.

<sup>116</sup>Hertell 2013, 103.

<sup>117</sup>Hertell 2013, 104; see also Williams 2003.

<sup>118</sup>Gebel and Starck 1985; Schyle and Uerpmann 1988, 47–52.

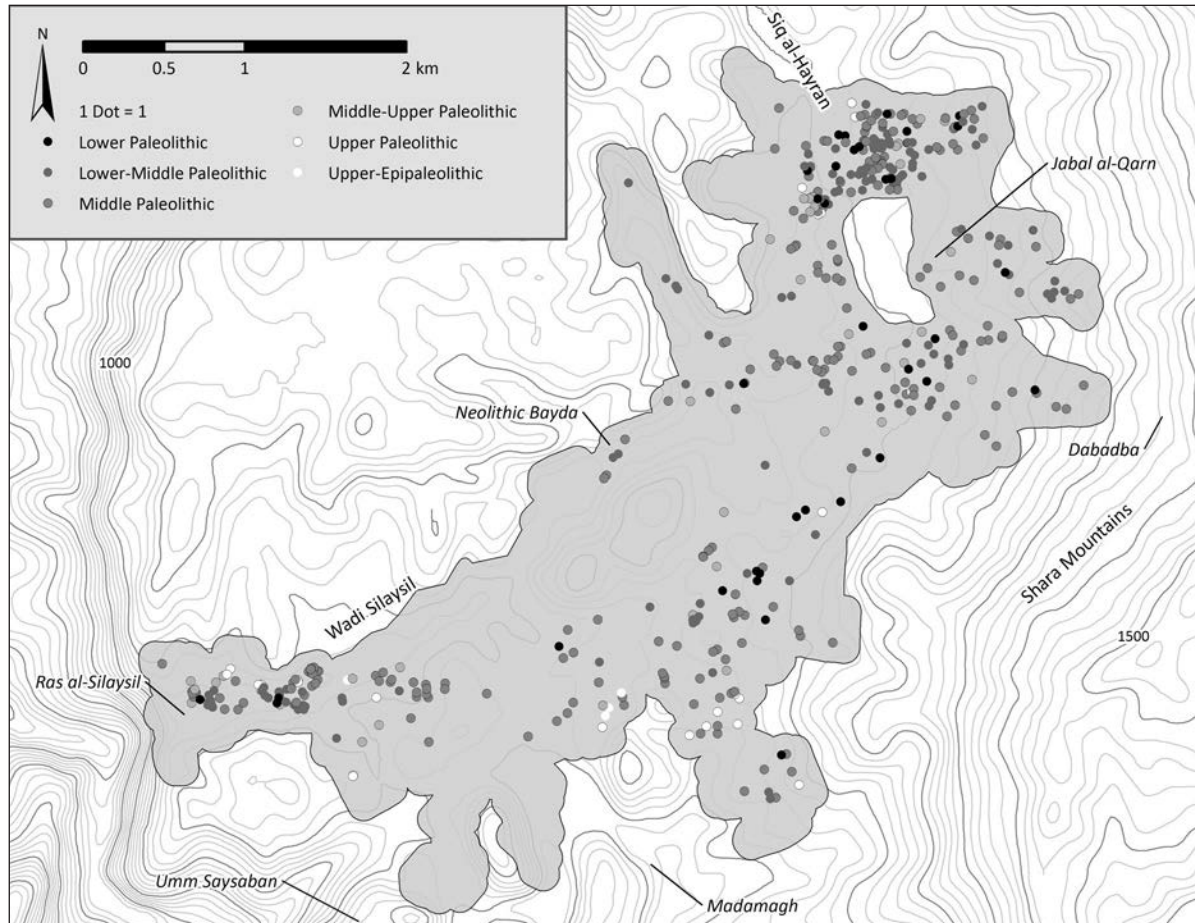


FIG. 33. Dot-density map of Lower, Middle, and Upper Paleolithic finds; one dot represents one artifact (drawing by A. Knodell).

assemblages (linked to Neanderthals) and Upper Paleolithic Ahmari and Levantine Aurignacian assemblages (linked to modern humans), this drastically altered distribution may represent a steep population decline concomitant with the shift from Neanderthal to modern human populations. At the very least it signals a major techno-behavioral change.<sup>119</sup>

It must be emphasized that PAWS finds for the early prehistoric periods—however they are compared and parsed—are remarkably dense, especially for the Lower Paleolithic. This suggests that (1) this zone was a regional hotspot for Paleolithic activity or (2) PAWS methodology is better suited to the discovery of such lithic scatters than other methods previously applied.

<sup>119</sup>We acknowledge, however, that Levantine Mousterian traditions are not linked exclusively to Neanderthals (Henry 1995, 108).

We would argue that a combination of these two factors affected our results. Lower Paleolithic artifacts are typically isolated or found in small scatters, meaning that intensive methods using close walker spacing are more likely to find such material. Yet FJHP, employing similar methods and levels of intensity, discovered only a limited amount of Lower Paleolithic material. This implies that the PAWS results are not simply a methodological byproduct; they also suggest a more intensive use of this landscape in the Lower Paleolithic than at Jabal Harun. It is worth noting that incidental finds of hand axes and other likely Lower Paleolithic artifacts have been reported throughout the region, and one overview of the prehistory of Petra even notes that Middle Paleolithic artifacts can be found “almost everywhere” in the greater Petra area.<sup>120</sup> This picture

<sup>120</sup>Jansson 2002, 35.

is generally in line with the FJHP and SAAS findings for this period (which are even more abundant than our own). To date, however, detailed documentation and publication of incidental finds for both of these periods remains rather thin, especially for the Lower Paleolithic materials. With these factors in mind, we argue that more active efforts are needed throughout the region to achieve higher-resolution data collection and to facilitate comparison between projects. Until then, articulating meso- and macroregional patterns for these very early periods of human history will remain somewhat frustrating.

*Sedentism and Landscape Change from the Natufian Period to the Bronze Age*

With the arrival of the Natufian period and first apparent movements toward sedentism, the hinterland of Petra witnessed several material, social, and landscape transitions. These are reflected in the spatial distribution of material within and around the PAWS survey area (fig. 34). Bayda is of course the best-known Natufian site in the survey area.<sup>121</sup> There are also Natufian remains from Wadi Mataha and Madamagh in the immediate vicinity, and Wadi Sabra, Tugra, and Sunkh to the south (see figs. 1, 2).<sup>122</sup> In general, more sheltered areas within canyons or valleys became occupied with greater frequency, while open-air settings at higher elevations were favored in earlier periods. Crucial bottlenecks at the western end of Wadi Silaysil remain important, as in the earlier Paleolithic, but preferences were clearly shifting toward places more favorable to occupation in the longer term. A thin scatter of Epipaleolithic and Epipaleolithic to Neolithic material running north–south from Siq al-Hayran toward Umm Sayhun indicates the importance of this regional axis. The very high density of finds in Wadi Silaysil accords with Gebel's earlier discovery of Natufian remains in the area.<sup>123</sup> An even more widespread concentration in Area a represents a hitherto-unknown locus of activity at Shamasa, where subsequent occupation perhaps has obscured until now substantial evidence for a prehistoric presence. Bayda, Wadi Silaysil, Shamasa, and Madamagh represent an increasingly utilized Natufian landscape, and all of these zones—inhabited from the

very earliest signs of sedentism—would remain hubs of settlement in later periods as well.

We lack any signs of definitive PPN-A activity. For the PPN-B period, Bayda was again the principal location of settlement in the Petra area.<sup>124</sup> A major development at this time, however, was the appearance of several similar village communities in the immediate area, sites that were also tied to wider networks reaching as far as the Red Sea (to the south) and Anatolia (to the north).<sup>125</sup> Shkarat Msaied and Ba'ja, for example, were established immediately north of Petra, while various sites in Wadi Sabra and especially Basta constituted substantial settlements to the near south (see fig. 1). A combination of population increase, and, even more importantly, community and network growth appears for the first time to have brought our study area into regular contact with a wider world. For all this intensification of the broader regional settlement pattern, however, the PAWS survey yielded a remarkably limited number of PPN-B chipped-stone artifacts (51 total, less than 1% of the total assemblage; see table 4). This represents, we would suggest, a greater degree of nucleation of both settlement and production activities: it is possible that inhabitants tended to stay close to main settlements precisely because of the growth of neighboring communities. Exceptions to this behavior would include certain activities that necessitated venturing farther afield, such as various types of resource acquisition and intercommunity trade. While these activities must have been relatively common, we have evidence for them only in the form of isolated finds and small scatters at select areas.

Following the PPN-B period, with its major settlement at Bayda, evidence of activity is more widespread, but we are less clear on the nature of the society it reflects. Our survey results point to late prehistoric activity (again, defined by us as encompassing the Late Neolithic, Chalcolithic, and Early Bronze Age) across the landscape: late prehistoric chipped-stone artifacts are nearly ubiquitous, with concentrations appearing in several distinct locations, the most notable of which is Jabal al-Qarn (fig. 35).<sup>126</sup> Other late prehistoric hot spots were located just to the south of that site in the

<sup>121</sup>Byrd 1989.

<sup>122</sup>Gebel 1988. On Wadi Mataha, see Johnson et al. 1999; Baadsgaard et al. 2010.

<sup>123</sup>Gebel 1988.

<sup>124</sup>Byrd 2005.

<sup>125</sup>Interregional connections are evident namely in the form of a few obsidian pieces, cowrie shells, and mother-of-pearl. Bayda: Kirkbride 1967, 9. Ba'ja: Gebel and Bienert 1997, 252. Shkarat Msaied: Jensen et al. 2005, 130.

<sup>126</sup>Vella et al. 2012.

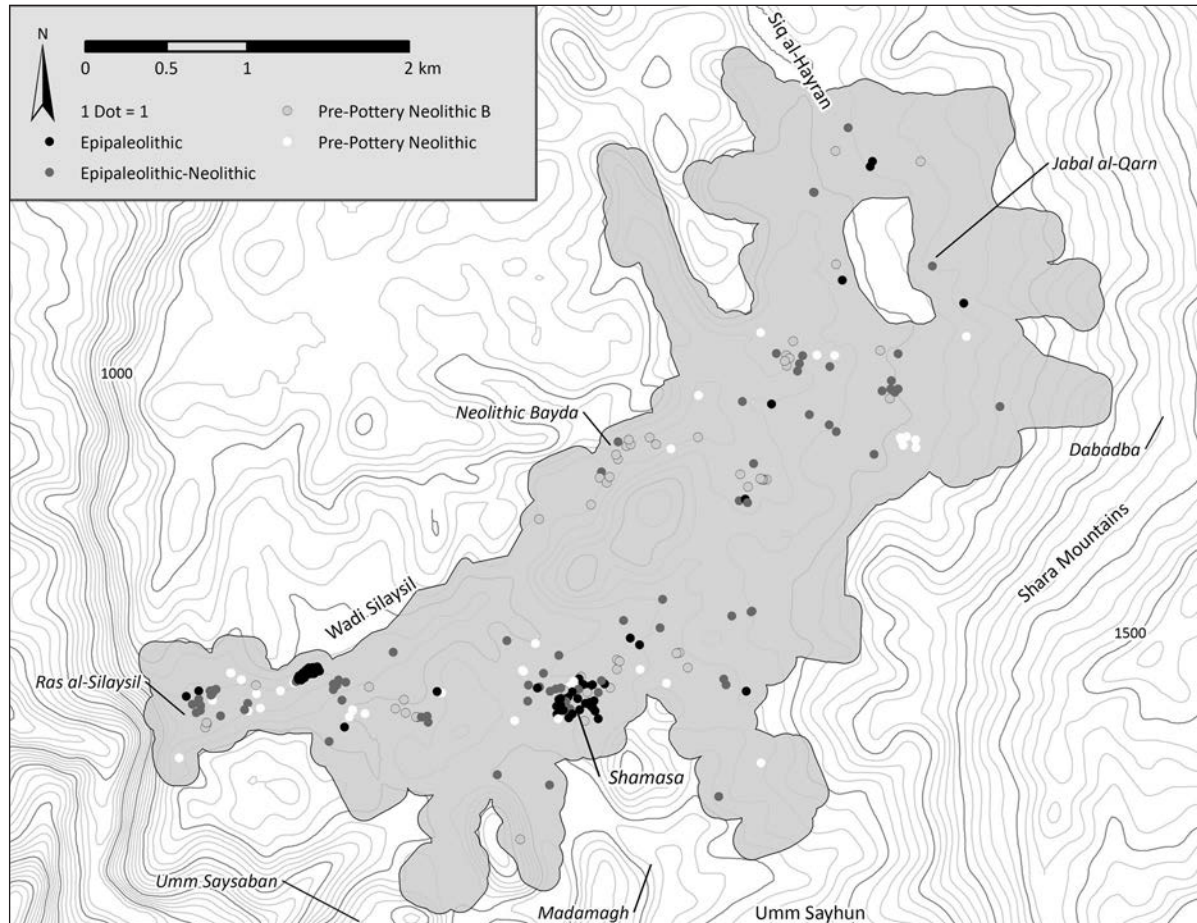


FIG. 34. Dot-density map of Epipaleolithic and Neolithic findspots (Natufian finds are included within the category of Epipaleolithic); one dot represents one artifact (drawing by A. Knodell).

northeast corner of Area e, in three parts of Area a (the northeast corner, northwest corner, and center), close to Neolithic Bayda in Area d, and along the western end of Wadi Silaysil.

A range of possible explanations could be advanced for this marked increase in lithic distribution. Demographic and agricultural shifts could well be factors; depositional variables may also be in play. We suggest, however, that the most important influence on the period's archaeological footprint was a change in the nature of stone-tool production and consumption from the Late Neolithic period onward. Following the Pre-Pottery Neolithic, specialized stone-tool production in the Levant was supplemented by the practice of expedient production and discard.<sup>127</sup> Tools produced on this more ad hoc basis were more quickly made,

used, and discarded, resulting in not only a nearly ubiquitous pattern of distribution but also an artifactual record highly variable in terms of the form, technique, quality, and material of tools. Our lithic record appears to represent this practice to the extreme, with more than 90% of the total assemblage falling into this category—mostly flakes that were presumably used and discarded on the spot.

By contrast, the ceramic record for these periods is quite minimal, which supports the idea of technological change in lithic production as opposed to a significant population increase. Early Bronze Age ceramics were found in only 14 of the 1,321 SUs (ca. 1%), although these correspond quite closely with particularly high concentrations of lithics—for example, at Jabal al-Qarn and near Neolithic Bayda. There remain, however, massive concentrations of lithics, including definite Early Bronze Age examples, with no associated ceramics.

<sup>127</sup>Rosen 1997, 103–6.

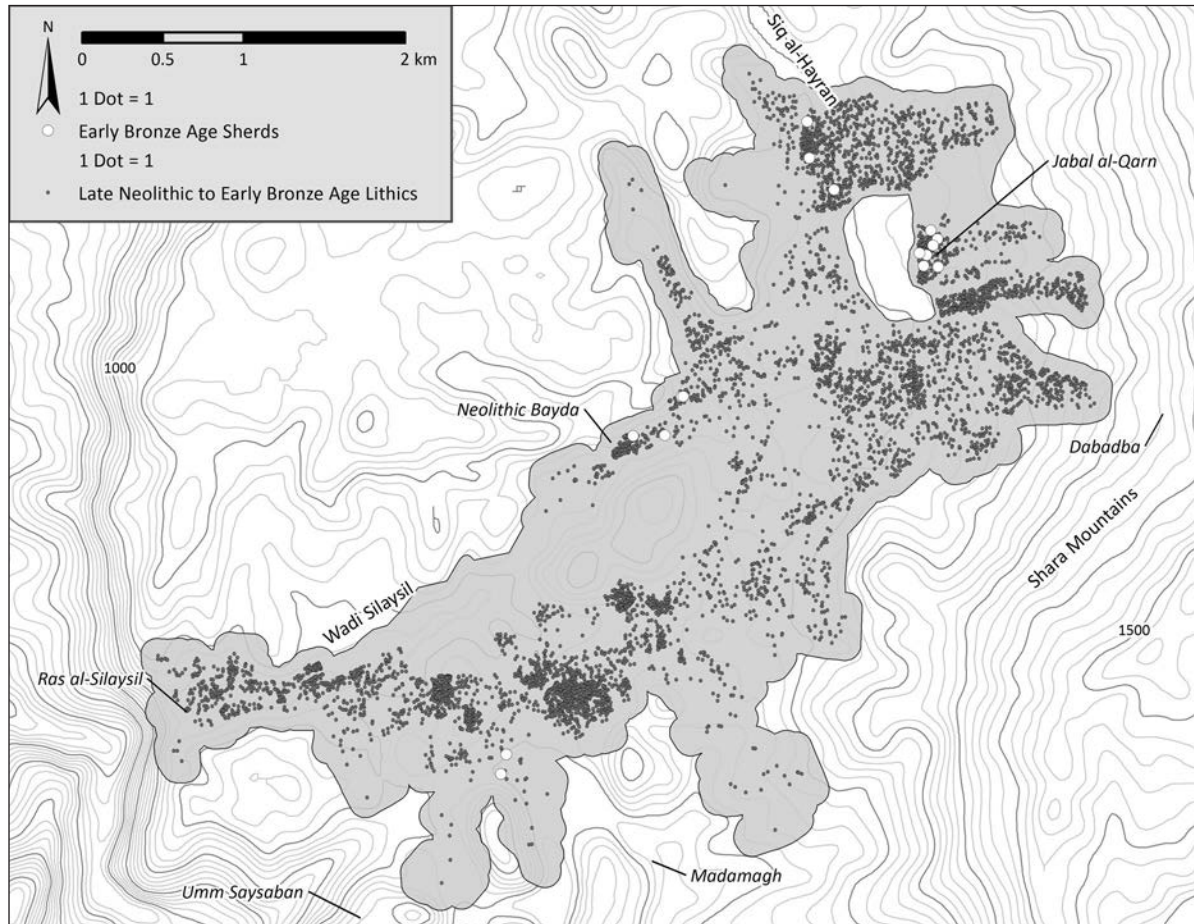


FIG. 35. Dot-density map of Late Neolithic to Early Bronze Age lithics and Early Bronze Age ceramics; one dot represents one artifact (A. Knodell).

To put our PAWS patterns in context, FJHP observed rising numbers of Late Neolithic to Early Bronze Age lithics, if not to the extent we observed.<sup>128</sup> And while Early Bronze Age sites are more numerous in the greater Petra region than Neolithic sites, the increase is quite small. Only five Early Bronze Age sites have been identified in the general vicinity of Petra—Jabal Fidre, Umm Babayn, Hariq, Jabal Shudayfah, and Umm SAYSABAN—all of which seem to date principally to Early Bronze II (see fig. 1).<sup>129</sup> Excavations at one of these sites, Umm SAYSABAN, yielded mostly storage vessels and grinding installations, which were interpreted in turn as evidence for a storage facility and seasonal camp.

<sup>128</sup> A total of nine sites broadly defined as “Postpaleolithic” were recorded (Hertell 2013, 104–5).

<sup>129</sup> Lindner and Genz 2000; Lindner et al. 2001.

The settlements are characterized as being relatively small and located in easily defensible locations; Jabal al-Qarn, for example, covers approximately 0.5 ha and is on an isolated hill with an excellent view in all directions. It should also be noted that the few Early Bronze Age sites in the Petra area can be correlated with the equally sparse findspots of contemporary ceramics from the Tafila-Busayra Archaeological Survey and SAAS project.<sup>130</sup>

This relative paucity of settlement activity is intriguing for two reasons. First, it stands in stark contrast to the period’s much richer record as documented in the north of Jordan. In fact, significant Early Bronze Age settlements do not appear with great regularity anywhere south of Wadi Faynan, some 30 km to the north

<sup>130</sup> MacDonald 2015, 15.

of Petra.<sup>131</sup> The densely inhabited, hierarchical, and socially complex landscapes of habitation and metallurgical production at Wadi Faynan are virtually unrecognizable when compared with the Early Bronze Age equivalent in Petra's northern hinterland. One potential explanation is that southern Jordan—at least this part of it—may have been largely excluded from the burgeoning Early Bronze Age copper trade that tilted decidedly toward the more socially complex communities north and west of the source, leaving the south comparatively marginalized. Such exclusion from trade networks may have resulted in less complex, more egalitarian societies engaged in seminomadic lifestyles; this would have in turn resulted in an abundant lithic record, with much thinner architectural or ceramic traces of settlement.

Middle to Late Bronze Age material is, on current understanding, completely absent from the PAWS survey area. While a gap of a millennium and a half certainly requires clarification and explanation, it is not out of character for the wider region. The SAAS project collected Middle Bronze Age pottery from only one site; the Ayl to Ras an-Naqab Archaeological Survey collected Late Bronze Age finds from a single location; the WMS survey recorded one potentially Middle Bronze Age site in Wadi Musa.<sup>132</sup> FJHP recorded no “reliably dated” pottery earlier than the Iron Age.<sup>133</sup> Unlike the Early Bronze Age settlement pattern, which is much denser to the north, this Middle to Late Bronze Age dearth is mirrored throughout much of Jordan, although sites and signs of activity appear somewhat more frequently near and to the north of the Dead Sea.<sup>134</sup> In the south, the absence noted may represent continued and further marginalization, perpetuating a process begun in the Early Bronze Age.

#### *Increasing Complexity in the Iron Age and the Nabataean and Roman Periods*

The later Bronze Age lacuna continues well into the Iron Age, until the Iron II period, which is contemporary with the historical Kingdom of Edom (ca. 1000–539 B.C.E.). After a subsequent, apparently near-total gap in material evidence, we see signs of settlement in Petra's northern hinterland increase significantly in

the Hellenistic period, prior to the busiest, most artifact-rich era for this landscape, that spanning Early to Middle Roman times (fig. 36).

The most important Edomite site in the region is Umm al-Biyara, whose stronghold location high above the Petra city center is characteristic of sites of this period.<sup>135</sup> Wadi Musa boasts two Edomite sites—Tawilan and Khirbat an-Nawafra—although their proximity suggests that these were either part of one large settlement or very closely related (see fig. 2).<sup>136</sup> Considerable evidence of habitation exists in the wider region as well, with sites documented by the NHG to the north and south of Petra, including Ba'ja III and the site of Kutla II at Jabal as-Suffaha (north of our survey area) and Khirbat al-Mu'allaq (south of Wadi Musa).<sup>137</sup> SAAS (to the east) recorded Iron II material in 33% of randomly sampled squares and at 26.5% of their sites.

By comparison, the PAWS team documented Iron Age materials in 286 (22%) of 1,321 SUs. While Iron II ceramics are found in several parts of the survey area, two significant concentrations, possibly indicating the presence of villages, could be identified: in the terraced fields of Area a and along the northern perimeter of Islamic Bayda. Scatters of Iron II sherds were also found throughout Areas g and e on the lower slopes of the Shara; signs of activity in these locations may reflect the more usual apparent Iron II preference for high-elevation sites with access to agricultural land suitable for terracing.<sup>138</sup>

Following the Iron II period, there is another gap in the PAWS ceramic record until the Hellenistic period, with the exception of one black-glazed sherd of the Persian period (see fig. 14, no. 1). These results are not unprecedented. At one time Glueck argued for a near-total abandonment at this time throughout Jordan, a position that has since been modified and refuted.<sup>139</sup> Excavations to the north, at Busayra, for example, yielded Persian-period remains, and Tawilan produced a cuneiform tablet dated to the ascension year of an unspecified king named Darius.<sup>140</sup> While it

<sup>131</sup> Barker et al. 2007b.

<sup>132</sup> MacDonald 2015, 15–16.

<sup>133</sup> Silvonen 2013, 135.

<sup>134</sup> Falconer 2008; Strange 2008.

<sup>135</sup> Bienkowski 2011.

<sup>136</sup> Bennett and Bienkowski 1995; 'Amr et al. 2000, 231–33; Levy et al. 2014; MacDonald 2015, 32.

<sup>137</sup> Lindner and Farajat 1987; Lindner et al. 1996a, 1996b, 1998; Biener et al. 2000.

<sup>138</sup> Bienkowski 2013, 28.

<sup>139</sup> E.g., Glueck 1940. On the refutation of this idea, see Sauer 1986; Bienkowski 2013, 32.

<sup>140</sup> Bienkowski 2008, 337–38.

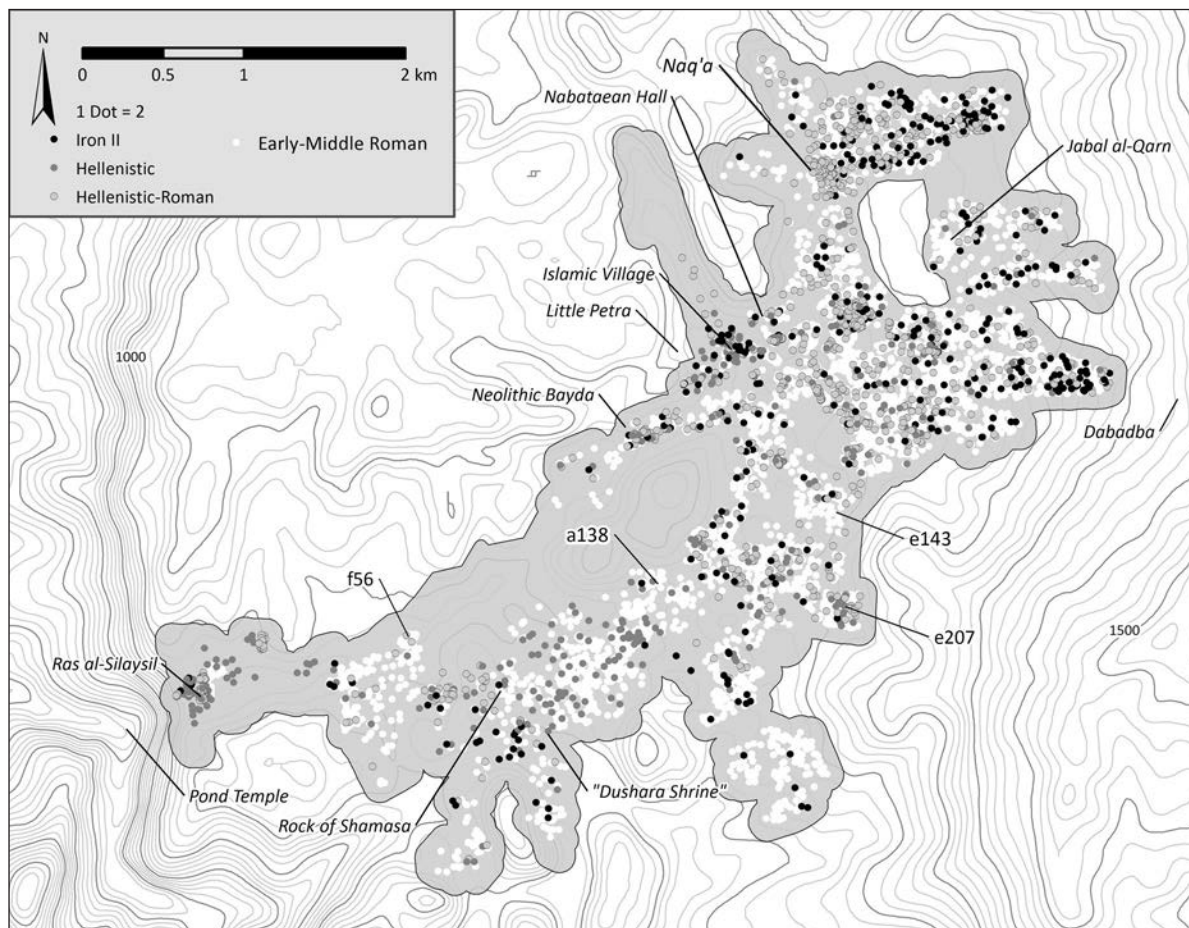


FIG. 36. Distribution of Iron II to Roman-period pottery; one dot represents two sherds (drawing by A. Knodell).

is true that work at Umm al-Biyara offers no evidence between the Iron II period and the last century B.C.E., recent work in the Petra city center itself has revealed finds from this era.<sup>141</sup>

It remains the case, nonetheless, that very few regional surveys have recognized specific evidence from the Iron III or Babylonian/Persian period (586–300 B.C.E.). This may be the result of continuity in ceramic styles from Iron II onward, changes in material behavior, or a genuinely substantial thinning of human occupation in southern Jordan. Whatever the answers, this gap in the PAWS record forms part of a larger documented pattern.

The centuries that follow—from ca. 300 B.C.E. to 250 C.E.—are by far the best-represented era in the northern hinterland of Petra, in terms of both surface

artifacts and (as far as can be determined) archaeological features. This upsurge of activity in the landscape marks a sharp departure from the apparent low levels observed for the preceding periods. An expanded use of the hinterland seems to be part of a broader pattern of sedentarization, population growth, and agricultural intensification in the last centuries B.C.E., which coincides with the establishment, development, and monumentalization of Petra known from historical sources and archaeological work in the city center.<sup>142</sup> These centuries also span the moment of Roman annexation (106 C.E.), though this moment is no longer

<sup>142</sup>What constitutes “Early Petra” is still coming into focus, although recent work points to signs of occupation in the fourth century, a consolidation of activity and importance after ca. 240 B.C.E., and then the meteorically flourishing capital of the later second and first century B.C.E. See papers in Mouton and Schmid 2013; see also Twaissi 2007.

<sup>141</sup>Bienkowski 2013, 31; Graf 2013.



viewed as a sharp caesura in regional history; rather, it is seen as the political formalization of Nabataea's ties to the Roman world, which had been close for some time. The long-term history of the landscape for these periods, as revealed through the work of BUPAP, is characterized by distinct patterns of change that coincide with overarching geopolitical developments, although explanations for the archaeological phenomena observed cannot necessarily be dictated by particular historical events.

To trace developments through this epoch, we can begin with the marked increase in activity in the third to second centuries B.C.E. The first places to be occupied in the Hellenistic period tended to remain significant foci in the centuries immediately following (notably, several of these locations also saw signs of activity in the Iron II period; see fig. 36). Prominent locations with good and accessible land, proximity to water and to communication routes, and high visibility were (unsurprisingly) attractive places for occupation in multiple periods, as attested at "suburban" settlements such as Ras al-Silaysil, Bayda, and Shamasa.<sup>143</sup> It thus appears very likely that many of the largest and most lasting sites of the hinterland in the following periods were established during the same time that Petra itself was becoming a more impressive and permanent center.

Additional escalation of suburban activity, again indicated by the proxy measure of ceramic scatters, occurred throughout the greater Petra area in the first centuries C.E.<sup>144</sup> Pottery of Early to Middle Roman date is by far the most widespread chronological group throughout the survey area, and we correlate this increase in pottery consumption and deposition with a parallel intensification of land use in the northern hinterland of Petra. We believe that much (although certainly not all) of the agricultural and hydraulic intervention observed throughout the survey area occurred during these first centuries C.E. This assessment is supported by OSL dates taken from terraces in the region, by our own team (at Wadi Baqa', Feature PAWS\_a138) and by others, which suggest initial con-

struction in the first century C.E. and continued use for several centuries after.<sup>145</sup>

A rise in local population and a "push" on local resources, with these visible consequences, fits well with the floruit of Petra, when it was a significant, and demanding, central place under the long-reigning monarchs Aretas IV, Malichus II, and Rabbel II, a trio whose rules spanned the entirety of the first century C.E. It is likely also that the annexation of the Nabataean kingdom into the Roman empire brought its own pressures, as witnessed by the continued, and perhaps even expanding, vitality of extra-urban land use in the Middle Roman period. One possible sign of a growing concern for the maintenance of control over and productivity of agricultural land is the appearance of lookout structures, which were first occupied, based on test-excavation results, in the second to third century C.E. The broad visual purview of such features is matched by their relatively high altitude, suggesting the potential of these outposts as places to watch over the area and safeguard its overland routes as well as the resources along their paths.

The last centuries B.C.E. and first centuries C.E. are a rich and intriguing epoch in the region's history. It is during this time that the site of Petra took on the monumental character for which it was so famed in antiquity and rose to a place of prominence, wealth, and strategic importance that assured its annexation by Rome. The urban fabric of Petra was elaborated considerably in this period, and practical elements, such as the city's robust water supply and storage systems, attest to a significant population and its needs. The hinterland, too, was exploited at a high level. While the city drew on its own watershed, the area to the north put to use a separate catchment and maximized its potential through the construction, and long-term maintenance, of agricultural terraces. The output of this terraced landscape is also demonstrated by the proliferation of presses discovered throughout the survey area, many of which date probably to the later Nabataean or Roman period.

Much more can be done in further studies to correlate monumental and infrastructural developments in both center and hinterland. The PAWS data set also offers significant opportunities for additional analysis of other facets of the extra-urban landscape in these

<sup>143</sup> Given the nature of the features observed, this is probably also the case in the Wadis Mu'aysara, which connect the city center with the northern hinterland, although in these cases no ceramic collections were made (Berenfeld et al. 2016). For another "Nabataean-Roman" suburb at Jabal Khubthah, see Tholbecq et al. 2014.

<sup>144</sup> Graf 2013; Kouki 2013b; Wenning 2013.

<sup>145</sup> Beckers and Schütt 2013; Beckers et al. 2013; Bocancea et al. (forthcoming).

centuries, including its evolving religious and mortuary structures and meanings.

#### *Late Roman to Byzantine Contraction*

Events recorded in Petra and its environs during the third and fourth centuries C.E., from epidemics to earthquakes, have often been interpreted as causes for, and signs of, civic decline and shrinkage; archaeological evidence to a degree supports such an assessment.<sup>146</sup> Nevertheless, it is equally true that some sectors of Petra continued to function, as witnessed by the construction of the Petra Church, which was active from ca. 450 to 600 C.E. and served as the episcopal basilica, as well as two smaller churches.<sup>147</sup> Especially pertinent to our own research questions for this period, the Petra Papyri—found in the Petra Church—refer extensively to systems of land tenure and agriculture and to instances of taxation and property transfers in the center's hinterland.<sup>148</sup>

We are left wondering, then, where this activity took place and what the nature of its material correlates might be, for—at least in the PAWS results—we recorded a sharp decline in the quantity of material observed in the survey area for the Late Roman, Byzantine, and Early Islamic periods.<sup>149</sup> While our survey evidence does not preclude Late Roman and Byzantine activity in the landscapes north of Petra—since terraces and agricultural systems built in earlier periods could have been, and probably were, in ongoing use (or reuse)—there appears to have been a marked change in the type and/or intensity of activities going on, or in the material culture commonly in use. Perhaps suburban life at this time left behind far fewer ceramic traces than that of previous periods.

While the overall pattern is one of contraction, several significant concentrations of ceramic and other material do belong to the Late Roman to Byzantine periods. The most notable structure is a rock-cut church at the Bayda Islamic Village, dated by Bikai to

the Byzantine period.<sup>150</sup> There are also signs that the site was frequented and possibly occupied during the Early Islamic period, as observed in the excavation and survey records of the Beidha Documentation Project.<sup>151</sup> Other concentrations of Byzantine material were noted at Naq'a (although based on both ceramics and architecture this site appears to have been more active in later periods) as well as among the architectural remains of several buildings, constituting a possible village site below the Dabadba Spring. It is also true, however, that there is material of earlier periods at this latter site, suggesting continuity rather than a new occupation. A similar concentration was observed in Area h, albeit on a much smaller scale.

The final pattern worth noting for these periods is a dispersal of Late Roman to Byzantine ceramics across the lower slopes of the Shara in the northeastern sector of the survey zone, suggesting at least limited ongoing use of terrace systems at their higher elevations. Such traces are almost totally absent in the lower, southwestern portion of the terraced area. Overall, even when Late Roman to Byzantine ceramics are present, numbers of finds are dramatically reduced in comparison with those of the preceding periods (cf. figs. 36, 37).

Returning to the Petra Papyri, which span much of the sixth century C.E., we are again faced with the contradiction between the activities they document in the city's surroundings and the relative lack of material evidence, at least in the northern hinterland. The papyri have been used, understandably, to suggest a dense population throughout southern Jordan in the Byzantine period.<sup>152</sup> The chronology of the papyri is secure and confirmed by patterns elsewhere in the Petra region—for example, at Udhruh, where the Byzantine and Early Islamic periods appear “prosperous,” and in the vicinity of Wadi Musa and Jabal Harun.<sup>153</sup>

How, then, do we explain this relative lack of Late Roman and Byzantine material culture in our survey area? This pattern may indicate a shift in dwelling practices, whereby people during the Nabataean/Roman period were living among their fields or at second-tier settlements such as Ras al-Silaysil, Shamasa, or Bayda, thus generating debris more likely to end up scattered

<sup>146</sup> Fiema 2002, 220.

<sup>147</sup> Fiema et al. 2001; Fiema 2002; Bikai 2002.

<sup>148</sup> On the Petra Papyri, see Frösén et al. 2002; Arjava et al. 2007, 2011; Koenen et al. 2013. Koenen et al. (2003, 251) remark, “The Petra Papyri are silent about trade, but they are focused on agriculture”; see also Caldwell 2001; Kouki 2009; Nasarat et al. 2012.

<sup>149</sup> See ‘Amr and al-Momani (2011) and Tholbecq (2001, 404–5; 2013) for somewhat stronger evidence from Wadi Musa and the Shara Plateau.

<sup>150</sup> Bikai et al. 2008.

<sup>151</sup> Examined by Sinibaldi in consultation with the Beidha Documentation Project.

<sup>152</sup> Nasarat et al. 2012, 107.

<sup>153</sup> Abudanah 2006, 494; ‘Amr and al-Momani 2011; Silvonon 2013; Driessen and Abudanah 2015.

across the landscape; by contrast, these sites (excepting Bayda) may well have ceased to be occupied in subsequent periods. A genuine decline in occupation for much of the western part of the survey area thus seems to be the most likely explanation for the patterns observed (fig. 37). As the economic and religious character of Petra changed, attention focused tightly on the churches in the city center, and ritual landscapes on the outskirts lost their primacy; the once heavily used zones in Areas a, b, and f were largely abandoned, while locations along the northern route into Petra remained in use, albeit less intensely.

Preferential agricultural strategies in the face of climatic instability may provide some further explanation for what we have observed for the Late Roman to Byzantine periods.<sup>154</sup> The most heavily terraced zones (Areas g and e), which are at higher elevations, have also the highest ceramic densities from the Late Roman to Byzantine periods. These concentrations suggest that farmers continued to use previously existing infrastructure in certain locations. Indeed, use of certain terraces at this time is also supported by the OSL dates from Wadi Baqa' and Wadi Silaysil.<sup>155</sup> While it is not immediately clear why local populations did not make use of other parts of the landscape already suitably terraced, differences between areas of low and higher elevation may provide an answer. Jabal Harun, although its landscape was used with less intensity than in the Nabataean/Roman periods, provides signs of continued farming in subsequent centuries, which suggests that higher ground may have been particularly sought out.<sup>156</sup> Jabal Harun is also mentioned in the Petra Papyri, together with Wadi Musa, Udhruh, and other locations at much higher elevations, which are likely to have received more rainfall than the lower-lying PAWS survey area. If a climatic shift resulted in a preferential use of higher-elevation lands, this may provide important context for understanding the continuing, but somewhat reduced, evidence of activity on the lower slopes of the Shara, compared with a virtual absence of activity in terraced landscapes at lower elevations. The microclimatic variability characteristic of this region can be seen today in terms of rainfall, soil moisture, and overall agricultural viability of land, even between locations separated by only a few kilometers. It is possible that even a slight amount of annual

variation, within a broader period of climatic instability, would have made this landscape considerably less productive, and so considerably less used, than it was in its heyday of the first centuries C.E.

While a specific study of this microregion has not been conducted, the most comprehensive study of paleoclimatological information across the Roman empire reveals a broadly consistent pattern indicating that climate change may have played a significant role in shifting patterns in occupation and land use. Several proxies for ancient climate suggest that a general period of stability from ca. 100 B.C.E. to 200 C.E. was followed by a much less stable period until ca. 600 C.E., with a particularly unstable climate and generally cooler, drier conditions between the mid sixth and seventh centuries C.E.<sup>157</sup> When viewed in diachronic perspective, the intense use of the landscape in the preceding Early to Middle Roman period may have caused soil depletion and/or erosion, which—when combined with such environmental factors—could have made this area less desirable than others at higher elevations and with heavier annual rainfall.

Such trends can be connected back to the city center, coinciding with an apparent decline in the maintenance of water-management systems in the city center, which would have resulted in the exponential reduction in available stored water resources. There was also a significantly smaller population at Petra at this time than in its Nabataean heyday, with concomitant diminishment in centralized coordination for infrastructure maintenance and other state activities.<sup>158</sup> None of this is to say that the region became unoccupied—we know it did not and that certain areas (e.g., Petra itself) remained in use—but rather that the pattern of material culture suggests a marked shift away from the intense agricultural exploitation of Petra's northern hinterland evident in the preceding centuries.

#### *Islamic to Modern Settlement and Revival*

An important aspect of the PAWS survey was recording the presence of a range of Islamic-period pottery, which provides new evidence for settlement during the Middle to Late Islamic period in the Petra region (see fig. 37). Following an apparent lack of Early Islamic material (probably better viewed in terms of continuity with the previous period), the Middle and

<sup>154</sup> Arjava 2005; McCormick et al. 2012; Manning 2013.

<sup>155</sup> Bocancea et al. (forthcoming).

<sup>156</sup> Lavento et al. 2013b, 225.

<sup>157</sup> McCormick et al. 2012; Manning 2013, 135–43.

<sup>158</sup> Fiema 2002.

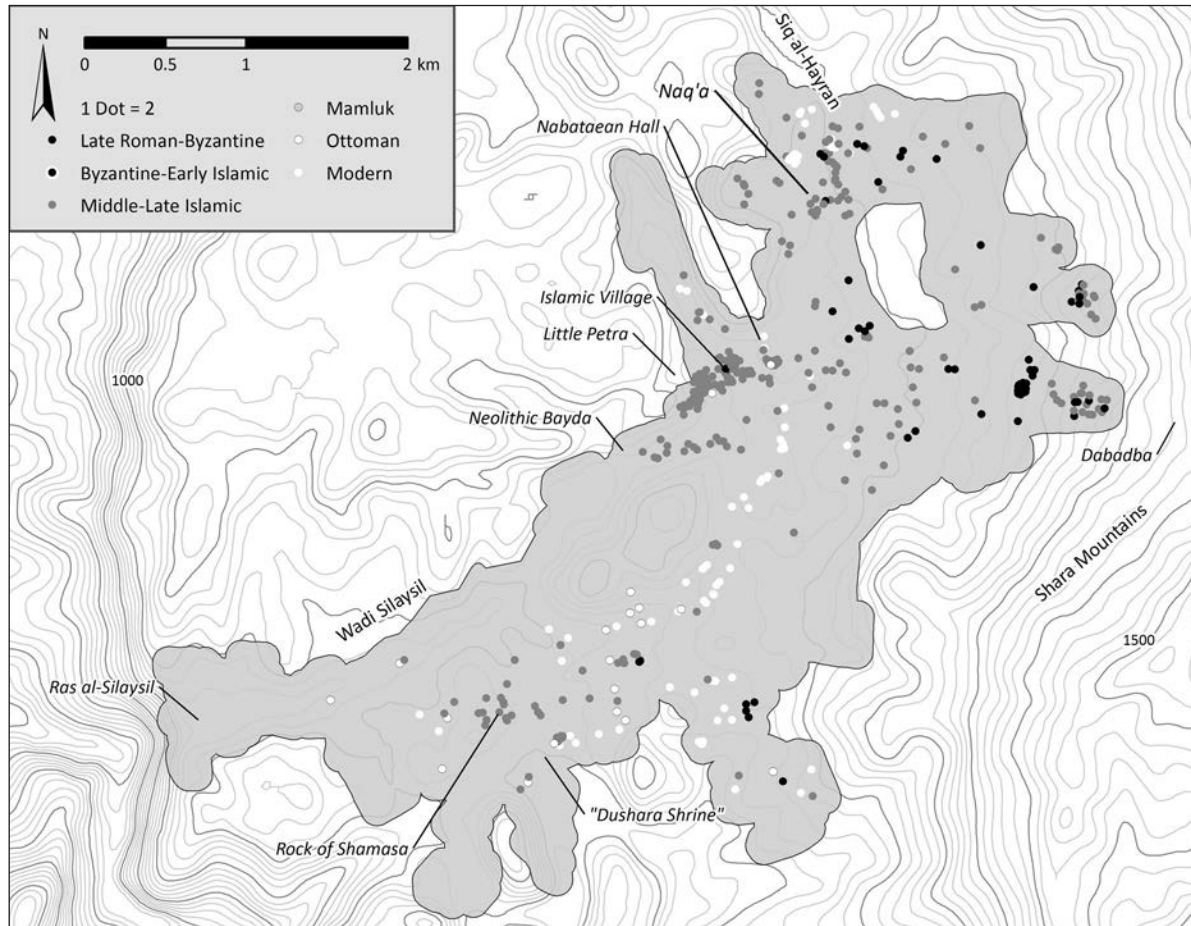


FIG. 37. Distribution of Late Roman, Byzantine, Islamic, and modern pottery; one dot represents two sherds (drawing by A. Knodell).

Late Islamic periods are more strongly represented in the PAWS survey area, although within this broad period low chronological resolution is a complicating factor. For example, 852 (70%) of the 1,218 sherds dated to this broad period were assigned a date range of “Middle to Late Islamic” or “Islamic,” a span that covers fully 800 years at least (see tables 2, 5), making it somewhat difficult to talk about diachronic trends or patterning with a high degree of chronological specificity. Nevertheless, we can draw out some useful observations by considering this evidence in its wider historical and archaeological context.

Historical sources and archaeological evidence suggest that southern Jordan was rather marginalized following the Islamic conquest (630s) and up to the Crusader period of the 11th to 12th centuries, although there was never a complete gap in settle-

ment in the broader region of Transjordan.<sup>159</sup> In the greater Petra area, substantial settlements are reported at Udhruh and at Wadi Musa; moreover, Khirbat an-Nawafra was occupied continuously and without notable gaps through the Byzantine period and the entirety of the Islamic period. The Early Islamic phase of Khirbat an-Nawafra was actually quite substantial, though the subsequent Ayyubid/Mamluk phase (1171–1516) was even more expansive.<sup>160</sup> Although no Early Islamic finds were recorded in the PAWS survey area, recent research has shown that the Petra Valley was occupied through the entirety of the Islamic period and that narratives of total abandonment should be viewed

<sup>159</sup> Walmsley 2001; MacDonald 2015, 83.

<sup>160</sup> Amr et al. 2000, 241–47.

more in terms of population dispersal and increased provincialism.<sup>161</sup>

In the Middle Islamic period, the major north–south route known as the King’s Highway (and in the Roman period as the *Via Nova Traiana*) was used both for military movements and as a pilgrimage route to Mecca and Medina. The major castle installations at Kerak (built 1142) and Showbak (built 1115) signal an expanded interest in this axis and its regional significance (see fig. 1).<sup>162</sup> In the Petra region, Frankish settlements were interested primarily in agricultural exploitation, which the Franks controlled with several castles, including one at Bayda. Well-preserved castles at al-Wu’ayra and al-Habis point to increasing investment closer to the Petra city center (see fig. 2).<sup>163</sup>

In the Late Islamic or Ottoman periods, the wider region lost some of its strategic importance. The associated land routes, nonetheless, remained well traversed until they were subsumed by the railroad constructed to connect Damascus and Medina, with the intention of eventually connecting Istanbul and Mecca. Throughout Ottoman times and into the 20th century, the greater Petra region was characterized by small agricultural villages, such as the ones at Naq’a (PAWS\_g100) and around the Dabadba Spring (PAWS\_r13). Several other such villages are located in zones surrounding the PAWS survey area and remain visible in the landscape today.<sup>164</sup> These villages and apparently contemporary constructions are typically designated as “early modern” and are characterized by stone-wall construction with mud, thatched roofs, and fairly well-preserved wooden beams. This type of construction is distinct from more recent interventions, which make extensive use of cinder blocks and concrete.

Our work enriches this picture with a significant quantity of material, especially from the Bayda area. The distribution of PAWS Middle and Late Islamic material is nowhere else particularly dense, though other concentrations can be noted around Shamasa, at the northern end of the survey region (near Naq’a), and on the higher slopes of the Shara. The vast majority of pottery collected and dated to this period consisted of handmade wares assigned a broad date range

of Middle to Late Islamic. This is a trend paralleled to some extent by other projects in the region.<sup>165</sup>

While occupation at Wadi Musa was continuous, patterns of activity in the wider area are less clear. The WMS survey reported material representing the entire span of the Islamic period in the area of Wadi Musa and the territory to the south, yet for the Bayda area the WMS survey found only very scattered traces of what has been recorded as Ayyubid/Mamluk pottery—that is, Middle and Late Islamic.<sup>166</sup> We can compare our results from the lower slopes of the Shara (Areas e and g) with those from Tholbecq’s earlier survey on the higher slopes, which roughly bordered the area covered by PAWS. That project recorded only a few sites dated to the Byzantine/Early Islamic period and reported a complete absence of (painted) ceramics of the Ayyubid/Mamluk period, though it identified a few Ottoman-period sites.<sup>167</sup> PAWS in some ways mirrors these results, showing a poorly represented Byzantine/Early Islamic period, no definite pre-Ayyubid Islamic activity, and a resumed use of the area in the later, Ottoman period. The combined evidence of historical and archaeological sources has shown that occupation of the plateau of Jabal Harun probably occurred without a substantial gap across the entire Islamic period. This suggests that continuity elsewhere should not be ruled out based on archaeological gaps alone, given our still-developing understanding of ceramic sequences and production at this time. Painted pottery of the early part of the Late Islamic period (Late Mamluk to Early Ottoman) is present in the broader area: this material, for example, was found in more significant quantities during excavations of an Islamic-era village at Ba’ja.<sup>168</sup>

One striking aspect of the PAWS results, in comparison with evidence from elsewhere in the region, is the scarcity of finds from the Crusader, Ayyubid, and Early Mamluk periods, not least since Bayda and other nearby locations are documented as being settled in the Crusader period. At present, however, it seems that ceramics representing the earlier phases of the Middle

<sup>161</sup> Fiema 2002, 192; Sinibaldi 2016b.

<sup>162</sup> See Brown (1991) on findings from Kerak Castle and the Kerak Plateau Survey; see also Walmsley 2008, 530.

<sup>163</sup> See Brown (1987) and Sinibaldi (2016b) on al-Wu’ayra and al-Habis.

<sup>164</sup> MacDonald 2015, 91–4.

<sup>165</sup> E.g., FJHP collected large quantities of painted handmade pottery in some areas of their project. These finds point to occupation or land use between the 12th and 15th centuries, a period associated in the Petra city center with higher quantities of richly painted pottery (Sinibaldi 2013, 182–83).

<sup>166</sup> Amr et al. 1998.

<sup>167</sup> Tholbecq 2001, 405; 2013, 299–300.

<sup>168</sup> Bienert et al. 2000. The assemblage is being studied by Sinibaldi; see also Sinibaldi 2015b.

Islamic period (10th to early 12th centuries) are less easily identifiable than those of the mid 12th to 15th centuries.<sup>169</sup> We must be cautious, therefore, about any firm or detailed conclusions, but the overall pattern seems to be that settlement expanded north of Petra increasingly through the Middle to Late Islamic period.

In sum, the Islamic to early modern periods represent well over a millennia of dynamic culture history in the region, yet from an archaeological perspective they are among the least studied and least well understood. This is partly due to the initial stage of research on this period, despite the still-untapped wealth of documentary material that could be used in conjunction with archaeological work. This thin picture is changing, however, and we hope that further work at sites in the Petra region, especially at Bayda, can contribute to improving our state of knowledge. We also hope that the pottery chronology resulting from our survey can be refined in light of further excavation work at Bayda and other sites in the area, such as some of the early modern villages, to provide better resolution for our chronological picture of these important centuries.

#### *Contemporary Engagements with the Archaeological Landscape*

Local relationships to archaeology in the greater Petra area are complex and are more worthy of archaeologists' consideration than ever. Our efforts to document contemporary engagements with this landscape, which has been predominantly valued for its archaeological remains, were twofold, as they were incorporated into our survey practices and documented through an ethnographic component of the project. The results, while often presenting conflicting information, are significant in revealing both positive and negative sides to the story and form an important complement to previous work concerned with the local populations of Petra.<sup>170</sup>

By documenting the contemporary archaeological record (mostly refuse) across the study area we have been able to indicate a handful of broad ways in which local populations and visitors interact with the landscape. Distribution patterns of contemporary material (see fig. 18) indicate three predominant types of assemblages where contemporary material culture oc-

curs in high densities: (1) general discard zones—for example, along the road running between Umm Sayhun and Bayda—consisting mainly of food or beverage containers thrown from car windows or discarded by those on foot; (2) semipermanent occupation sites, such as camps used by locals or tourists; and (3) overnight camping or picnicking sites, in habitual—but not sustained—use by locals or tour operators.<sup>171</sup> Many locations of contemporary interest coincided with ancient remains. Some of this is practical: shaded locations or access to water are valued resources for humans now, as they have been since the Paleolithic, and former tombs and rock-cut chambers make convenient storage facilities and living quarters today. But it is clear in other cases that the presence of archaeological remains generates intrinsic interest in particular locations, as an attachment or access point to an often-abstract past. By treating evidence for these engagements as part of the archaeological record—and part of our study of long-term regional history—we hope to contribute to a growing scholarly recognition that the present study of archaeological remains must involve the recent past as well. Such interests pertain not only to the study of long-term historical processes but also to pressing questions of heritage management.

The foremost tourist destination in Jordan, Petra has received more than 400,000 visitors annually since its designation as one of the “New 7 Wonders of the World” in 2007, with a maximum of 975,285 in 2010.<sup>172</sup> This status makes tourism by far the largest industry in the area, although access to the site—and to touristic engagement and economic opportunities—remains largely tribally based and unequal. With the archaeological landscape at the center of this industry, and the asymmetry of access to it, local attitudes toward the archaeological record vary dramatically. No fewer than five separate tribal communities occupy the immediate vicinity of the Petra Archaeological Park.<sup>173</sup> Our interactions in the northern hinterland of Petra were primarily with two of these communities: the Ammarin tribe, who inhabit the area around Bayda, and the Bdul community of Umm Sayhun. From a combination of material documentation and interviews we encoun-

<sup>169</sup> Sinibaldi 2014.

<sup>170</sup> Mickel and Knodell 2015; Vella et al. 2015; see also, e.g., Bille 2009; Akrawi 2012; Addison 2015.

<sup>171</sup> See Vella et al. (2015, 225–26) for a more detailed discussion.

<sup>172</sup> Statistics from the website of the Petra Development and Tourism Regional Authority (2015).

<sup>173</sup> Farajat 2012.

tered a range of attitudes toward the archaeological landscape. Unsurprisingly, those with whom we spoke more frequently discussed an interest in protection and preservation, along with practical concerns about visitor numbers and the capacity to conduct business as shop owners, operators of tourist camps, and tour guides.<sup>174</sup> A darker side of local engagement was rarely discussed explicitly, despite being manifest throughout the landscape. Illegal excavation and antiquities sales, along with vandalism of archaeological sites, were well documented in various parts of the survey area, occasionally—and unfortunately—at locations where our team had evinced special interest.<sup>175</sup>

We assert that further engagement with and interest in local communities is the single most important cultural heritage management issue in the area.<sup>176</sup> This is not to diminish the utility of preservation work in the Petra city center, but without local interest in this work and investment in its broader value, both at Petra and throughout the region, there will be little opportunity for more than occasional foreign interventions at major sites, while the smaller-scale vestiges of the past are overlooked in the face of development or other more immediately perceived advantages. Ongoing conservation efforts, such as the establishment of a buffer zone to preclude large-scale development around the archaeological park, are laudable, but these efforts require archaeological investment and data such as those presented here to support them as well as the support of local communities to maintain them.

#### CONCLUSIONS

Decisions made in the course of survey design inevitably affect results and interpretations and thus require us to be both explicit and accountable for the choices made. We chose a high-intensity, diachronic, multistage project design, seeing this as an opportunity to make an original contribution to the study of archaeological landscapes around Petra. As a result, our total study area was relatively small (10 km<sup>2</sup>), but the effort we invested yielded abundant data. A more site-based or extensive research strategy certainly would have resulted in more expansive coverage but with the inevitable trade-off of acquiring much less detailed information. While our preference for high-

intensity methods (what has been called “Mediterranean myopia”)<sup>177</sup> is obvious and, we would argue, essential to answer the types of questions we posed, an equally important obligation is methodological transparency—lack of which has too often inhibited our capacity to understand, employ, or reinterpret the results of past surveys in any kind of comparative or aggregated fashion.<sup>178</sup>

As noted at the start, this article was intended to present an initial overview of PAWS: its goals, methodologies, and results. These data merit in turn richer, more thorough treatments, which will follow in future articles detailing—among other things—the plethora of features (esp. those related to water) in the survey area, additional data from geophysics and excavation, new insights into routes in and out of Petra, and more comprehensive presentations of ceramic and lithic finds. We further anticipate that either BUPAP team members or others working in the region with access to our data set will undertake additional, more targeted investigations—for example, into the organization of the sacred landscape, the distribution of inscriptions and rock art, or the variety of mortuary evidence. Work placing the diachronic landscapes of Petra’s northern hinterland side by side with other areas, both near and far from the city, would also be highly productive.

Indeed the encouragement of such comparative, macroscale research may be the most significant impact of PAWS. Our landscape-oriented approach forces us to see Petra and its hinterlands as in many ways conjoined and to break away from approaches that isolate this “Wonder of the World” and prevent synthesis. A diachronic perspective reminds us that—for many of the millennia discussed here—Petra either did not exist at all as a regional focal point, or the site played roles different from those it assumed during its Nabataean and Roman floruit. Bearing these lessons in mind encourages us to avoid anachronistic thinking about both regional definition and chronological marginalization.

In sum, BUPAP has accrued a wealth of new data across the landscapes north of Petra. PAWS represents the most substantial, data-rich, and spatially extensive aspect of this project. We have provided a detailed overview of this work, which we hope will be useful to other researchers working in the Petra area, together

<sup>174</sup> Mickel and Knodell 2015.

<sup>175</sup> Vella et al. 2015.

<sup>176</sup> Comer 2012; Tuttle 2013.

<sup>177</sup> Blanton 2001; cf. Alcock and Cherry 2012, 236–39.

<sup>178</sup> Knodell and Leppard 2017.

with our own views on the significance of these findings for long-term regional history. Other scholars in this area are invited to work with our “raw” data, which is now accessible online.<sup>179</sup> In closing we stress that this data set, while at the time of writing the most comprehensive landscape survey in the immediate vicinity of Petra, nevertheless covers only a small part of a much larger hinterland. We hope that this publication of our methods and results will provide a useful model for other survey work in the area and that we have demonstrated the benefits of using intensive methodologies and a diachronic scope to investigate a remarkably diverse archaeological landscape.

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<sup>179</sup> See <http://archaeologydata.brown.edu/petra>.



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