Applied archaeobotany of southwest Asia: a tribute to Naomi F. Miller

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Introduction

It is with great pleasure that we dedicate this issue of *Vegetation History and Archaeobotany* to Naomi F. Miller in honour of her career as a preeminent archaeobotanist and prolific researcher. At the 2017 Society for American Archaeology annual meeting in Vancouver, BC, Naomi was awarded the prestigious Fryxell Award for Interdisciplinary Research in recognition of her interdisciplinary archaeobotanical work and her significant contributions to American archaeology. The papers in this special issue recognize her continuing efforts to push the boundaries of archaeobotany and archaeology broadly through interdisciplinary collaborations, contributions to the discipline's standards for research methods, and current innovative work on archaeological site preservation.

Dung fuel in the archaeological record

In the early 1980s Naomi forged an entirely new interpretation of archaeobotanical assemblages and site formation processes based on her ethnographic observations in southern Iran. She witnessed modern villagers using sheep and goat dung as a source of fuel for cooking, and she examined burned dung pellets to reveal the preserved remains of charred seeds inside. This observation of dung fuel use and its presence in archaeological contexts was outlined in both her dissertation research at the Bronze Age site of Malyan, Iran (Miller 1982), and in subsequent journal publications (e.g., Miller 1984, 1990, 1996, 1997a, c; Miller and Marston 2012; Miller and Smart 1984). Her dung fuel research has had a substantial impact on archaeobotanical interpretations, first in southwest Asia, and then in many environmentally similar regions across the world.

In the following decades, a new focus on dung fuel use emerged in archaeological literature: the journal *Environmental Archaeology* published a special issue on “Fodder: Archaeological, Historical and Ethnographic Studies” in 1996 and a second issue on “Bioarchaeological Research

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on Animal Dung” in 2013. One of the most important contributions of Naomi’s dung fuel model lies in its recognition of the complex depositional processes that play a critical role in the formation of archaeological contexts and the contributions that archaeobotanical interpretations can make toward understanding site taphonomy. In a network analysis of the citation patterns of Naomi’s dung fuel publications, Khazraee and Gasson (2015, p. 152) identify this work as “one of the most meaningful contributions of archaeobotany” to the field of archaeological site taphonomy.

Three articles in this issue directly address Naomi’s dung fuel model (Spengler 2019; Allen 2019; Smith et al. 2019). Spengler (2019) draws on ethnographic observations, historical ethnographies, and experimental work to characterize the carbonized seed assemblages produced by dung burning in central Asia. Pairing this study with a thorough review of the literature on other archaeological markers of dung use (following that of Miller and Gleason 1994b, among others), Spengler concludes that, although a wide variety of seeds pass through the guts of ruminant animals and are carbonized when dung is burned, these effects are disproportionate by seed taxon and favour the preservation, in particular, of *Chenopodium* in archaeobotanical assemblages of central and western Asia. Smith et al. (2019) consider carbonized seeds and wood alongside phytoliths and dung spherulites recovered from paired sediment samples at Tell Zeidan, Syria. These multiple lines of evidence allow the authors to infer patterned use of various fuel types in specific depositional contexts across the site. Notably, the authors identify for the first time dung spherulites in the smallest fraction of flotation light fraction residue, though generally in reduced numbers when compared to original sediment samples, which they suggest will permit future testing of a new line of evidence for dung fuel use when studying archival flotation samples that were collected without paired sediment samples. Allen (2019), in a study also discussed further below, develops a new set of statistical tests that combine Miller’s seed to charcoal ratio with considerations of seed fragmentation, density, and grain to chaff ratios to disentangle the relative contributions of dung fuel and crop processing debris to the formation of archaeobotanical assemblages at the site of Fıstıklı Höyük, Turkey.

Innovative quantitative methods

Naomi has also been a trailblazer with her emphasis on the use of quantitative methods to address broad anthropological and archaeological issues of environmental, agricultural, and animal diet change. The effects of her empirical explorations of these phenomena have reverberated deeply with many contemporary archaeologists working at the interface of archaeology and the plant sciences. In particular, her

foundational work on ratios in the analysis of archaeological plant remains, especially her chapter in Hastorf and Popper’s edited volume *Current Paleoethnobotany* (Miller 1988), is among her most-cited contributions to date. Her innovative approach was to adopt incredibly straightforward, reproducible indices that comprise simple comparative ratios of counts or weights of different plants and plant parts (e.g., number of seeds to weight of wood charcoal) as direct correlates of past human and animal behaviours. Some of Miller’s most influential work applied these simple ratios to address complex archaeological questions, such as fuel use (e.g., Miller 1990, 1996, 1997a, 1999b), agricultural intensification (Marston and Miller 2014; Miller 1997a, 2002b; Miller and Marston 2012; Miller et al. 2016), and anthropogenic landscape change (Miller 1999b, 2004, 2010, 2011).

Naomi’s major research projects at Malyan and Gordion, interspersed with work at Hacinebi, Kurban Höyük, and Tell es-Sweyhat, span across Iran, Turkey, and Syria, the centre of her archaeobotanical studies. Additionally, her secondary area of research in central Asia (Anau, Gonur Depe, and Monjukli Depe in Turkmenistan, Kyzyltepa and Djarkutan in Uzbekistan, and the Talgar fan sites in Kazakhstan) forms a critically important corpus of studies for that understudied region. These studies together have laid an analytic foundation for archaeologists dealing with plant data worldwide to look beyond reporting numbers alone and instead to mobilize them to make arguments of environmental, human, and animal importance. Her research on deforestation at Malyan (Miller 1982, 1985a) utilized ethnoarchaeological insights to construct novel indices of plant remains, which were used to assess the extent to which archaeological deposits were formed through dung fuel burning or wood burning. She has been a tireless advocate of using this quantitative approach to “elucidate the connections between people, plants and animals” (Miller 2013a, p. 247), a goal that continues in her ever-active research, especially at Gordion. Many archaeobotanists around the world have been influenced by her innovative approach to the exploration of plant data and her integration of quantitative botanical analyses with those of faunal assemblages, allowing a broader perspective on the agropastoral system as a whole (e.g., Miller et al. 2009; Moore et al. 1994; Smith and Miller 2009; Wu et al. 2015). Additionally, Naomi has authored a series of synthetic regional reviews of archaeobotanical evidence for agriculture in the Near East (Miller 1985b, 1991, 1992, 1997b, 2002b, 2003, 2004, 2013a) and beyond (Miller 2015; Miller et al. 2016; Spengler et al. 2017) that have served as the backbone of many scholars’ efforts to fit new site-level data on ancient agriculture into a broader regional context.

In this issue, four articles touch on these themes (Allen 2019; Fuller and Stevens 2019; Buffington and McCorriston 2019; Rosen et al. 2019). Building on Naomi’s pioneering work with standardizing ratios, Allen (2019) addresses the

presence of dung fuel use at Fıstıklı Höyük, a late Early Halaf site located in southeastern Turkey, through the use of several non-parametric statistics to evaluate multiple standardizing ratios. Her research encourages a consideration of both contextual variation and taphonomic processes, particularly when investigating the complexities of crop processing debris vs dung fuel assemblages. Fuller and Stevens (2019) adopt an even simpler set of analytical tools on a much broader spatial and temporal scale, comparing sites across Eurasia from 10,000 to 1000 BCE by the percentage of sites at which wild and domesticated fruit trees appear, a form of ubiquity analysis (*sensu* Popper 1988), in comparison to the presence of domesticated annual grain crops. From the spatial distribution of well-dated archaeobotanical finds, Stevens and Fuller are able to date the domestication of fruit trees in both north and south China. They then compare the speed and timing of fruit tree domestication and the rise of arboriculture with the timing of cereal and pulse domestication and the advent of urbanism in the region. In keeping with Naomi's integration of archaeobotanical evidence from both southwest and central Asia, Stevens and Fuller examine the roles of arboriculture in the cultural sequences of southwest and east Asia. They conclude that both speeds of domestication and the different roles of annual and perennial crops help to illustrate the diversity of pathways to complex urban agricultural systems in Eurasia.

Following Naomi's aims to integrate multiple lines of evidence to reconstruct interactions among people, plants, and animals, Buffington and McCorriston (2019) investigate pastoralist relationships with wood fuel resources in Dhufar, Oman. Drawing on an ethnographic study of modern wood use by pastoral communities from this same region, which allows them to distinguish an emic categorization of local wood fuels by perceived fuel value, they interpret the wood charcoal assemblage of Iron Age Şakal as emphasizing low-smoke wood types for interior burning, while smokier, but easier to cut, *Ficus* was used preferentially in outdoor contexts. In a parallel study of the environmental impact of pastoral groups in Middle and Late Holocene Mongolia, Rosen et al. (2019) draw on paired geoarchaeological and phytolith datasets to distinguish the role of changing monsoon patterns and domestic animal husbandry in forming Late Holocene vegetation communities in the region of Ikh Nart. They conclude that pastoralists, through the movement of animal herds, structured plant communities in the Ikh Nart region, creating grass-rich environments that would not have occurred without the grazing and dung deposition of ruminant animals.

Analysing textual and iconographic records

Additionally, Naomi has leveraged her anthropological and botanical expertise to make significant contributions to the identification and interpretation of plants in textual and iconographic records from the ancient Near East. In this regard her work is remarkably broad, ranging from early Sumerian iconography on the Warka Vase (Miller et al. 2017) and in the jewellery of burials in the royal cemetery at Ur (Miller 2000a, 2013b) to the identification of key botanical terms in early Sumerian administrative texts (the KHALUB-tree; Miller and Gadotti 2009) and the works of Pliny the Elder and Dioscorides (*aspalathus*; Miller 1995). Miller has described her approach to this art historical and epigraphic work from an anthropological perspective: “for the cultures of antiquity... the natural world was an explicit source of meaning and reference. The process of trying to identify the real-world referent for an unknown plant is both an intellectual puzzle and an act of empathy, as we try to envision an ancient world, or at least a word” (Miller and Gadotti 2009, p. 239). Partnering with art historians (e.g., Pittman) and Assyriologists (e.g., Gadotti, Jones), Miller has drawn on her expertise in the plant ecology, iconography, and epigraphy of the ancient Near East to provide compelling insights into relationships between people and their botanical environment, regardless of the type of evidence available. This research has led to the reinterpretation of some of the most iconic elements of Mesopotamian visual culture: namely the Warka vase and the jewellery of Puabi.

This special issue includes three articles that adopt Naomi's diverse toolkit to explore plant use in the past, drawing on Roman murals (Gleason 2019), Hittite and Old Assyrian texts (Fairbairn et al. 2019), and early 20th century cookbooks (Popper 2019). Gleason (2019), who previously co-edited the volume *The Archaeology of Garden and Field* with Naomi (Miller and Gleason 1994a), considers what we can learn about Roman gardening practices by examining archaeobotanical evidence from the gardens of Pompeii and Herculaneum alongside Roman murals from those and other neighbouring sites. She finds that each line of evidence gives a distinct set of insights into Roman garden design and maintenance practices, and that together they produce new understandings of both Roman landscape aesthetics and pruning technologies. Fairbairn et al. (2019) consider the unique composition of the archaeobotanical assemblage from the fill of a single shaft-like room at the Middle Bronze Age site of Büklükale, Turkey, which they interpret in light of Old Assyrian and Hittite texts as a ritual deposit. Along with imported artefacts, the inclusion of rare and exotic plant types, especially fruits and spices, in both the seed and wood assemblages, as well as the inclusion of seeds from species with well-known medicinal uses, found in this context

alongside imported artefacts, offers a new perspective on ritual feasting practices during the Bronze Age. The authors suggest that these remains best match a foundation ritual (for the adjoining monumental building complex) described in later Hittite texts, which include the burning of plant offerings prior to deposition. Finally, Popper (2019) explores the archaeobotanical and zooarchaeological assemblages of the 19th century CE Market Street Chinatown of San Jose, California, through the lens of early 20th century English-language Chinese cookbooks. Popper parses out the ingredients of Chinese origin that could be grown in California versus “inauthentic” Euro-American ingredients that might be both substituted in the place of hard-to-obtain imported Chinese ingredients and added to create new, distinctively Chinese-American, flavours. In so doing, she is able to interpret the food items, dishes, and specific Chinese cuisines that were prepared and consumed in San Jose in the late 18th century. In addition, she identifies foods not described in English-language Chinese cookbooks that were used in San Jose’s Chinatown, highlighting the selectivity of cookbooks as a source of cultural information.

Site preservation

In her fieldwork and publications, Naomi has also addressed a challenge facing many archaeologists: a responsibility for the continued preservation of archaeological sites. At the first millennium BCE earthen Tumulus MM (also known as the “Midas Tumulus”) at Gordion, Turkey, Naomi confronted the issue of archaeological preservation through the creation of a unique ecological program using native plants to stabilize its steep surface. As part of this program, Naomi has employed her intimate knowledge of local flora to encourage the spread of native steppe plants to infill deep erosion channels through an innovative system of mudbrick barriers inset with seeds collected from particular local plants (Miller 1999a, 2000b; Miller and Bluemel 1999). Her results have been nothing short of remarkable—the surface of the large Gordion tumulus has been successfully repopulated with a resilient community of steppe vegetation (Miller 2012). As part of this conservation project, Naomi also co-developed a plan to stabilize the ancient stone walls of the Citadel (exposed during excavation, and now vulnerable to deterioration) with a cap of topsoil and shallow-rooted grasses, as described in her contribution in this volume, as well as other recent publications (e.g., Gönen et al. 2018).

She has wisely advocated expanding her soil and architectural-stabilization approach both on a landscape scale surrounding a site (Erder et al. 2013) and to other archaeological sites, arguing that similar management plans can be initiated at sites across the region and beyond, with a key component of archaeological preservation focused on the

incorporation of native vegetation. To this end, Naomi considers an archaeological site to be a “specialized kind of garden” (Miller 2012, p. 243), with long-term management programs requiring the knowledge of gardeners, botanists, and local residents (Erder et al. 2013). In order to educate others about this low-cost, low-tech, and environmentally sustainable approach, Naomi generously agreed to write the final paper in this issue (Miller 2019b) about her ongoing site- and landscape-conservation work at Gordion, to encourage more archaeobotanists to implement a form of “applied ethnoarchaeobotany” in their fieldwork and to participate in ongoing efforts to preserve cultural heritage sites (e.g., Caneva 1999; Minissale et al. 2015; O’Grady et al. 2018; Vanderplank et al. 2014; White et al. 2015a, b).

Additional contributions

Despite working for most of her career as the sole American archaeobotanist of southwestern and central Asia, Naomi has still had a transformative impact on the field of Old World archaeobotany in the US and worldwide. Her online bibliography of archaeobotanical publications on the Near East (Miller 2019a), neatly divided by country and region, has been an invaluable resource for colleagues worldwide since the 1990s, well before the days of Google Scholar and Web of Science. In addition to serving on numerous editorial boards and as sole editor of the *Journal of Ethnobiology* for five years, she has also trained numerous students and junior colleagues in archaeobotanical methodologies, including issue co-editors Mac Marston and Alan Farahani, as well as several of the authors in this issue. But Naomi’s outreach extends well beyond the academic world. She has written numerous articles in public magazines, including bilingual articles in Turkish (e.g., Miller 1999a), to spread knowledge of plants and their roles in both ancient societies and the preservation of ancient sites, and she conducts public outreach in the communities where she works (e.g., Erder et al. 2013). Naomi is also the first Fryxell awardee to have authored a picture book for a popular audience illustrated with her own watercolours (Miller 2002a). These forms of innovative outreach within both the academic and public communities show her deep commitment to the dissemination of knowledge.

Over the last 40 years, archaeobotany in southwest Asia has moved from a peripheral area of specialization concerned primarily with crop domestication (e.g., Renfrew 1973) to a robust body of research deeply embedded in the study of past communities, environmental change, and the practices of daily life (Marston et al. 2014; Miller 2013a). Naomi Miller has been a steadfast advocate for the anthropological study of plant remains to address such questions, transforming the field of Near Eastern archaeology, as

well as archaeobotany. The papers in this issue honour her achievements and demonstrate how her research continues to influence scholars, both young researchers and established academics, in the discipline of archaeobotany and beyond.

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