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Untangling palimpsest landscapes in conflict zones: a "remote survey" in Spin Boldak, Southeast Afghanistan

ABSTRACT: Remote survey using high-resolution satellite images allows archaeologists to study ancient landscapes in regions made inaccessible by ongoing conflict as well as in regions between zones of better archaeological knowledge. Such studies frequently suffer from a lack of chronological information. This paper presents the results of remote landscape survey in the territory of Spin Boldak ('white desert') in Kandahar province, Afghanistan, and methodological efforts to detangle chronology of a landscape made inaccessible by conflict. The studied region cross cuts several environmental zones (desert, alluvial plain, river and hills) and lies within an important corridor of movement towards mountain passes on the Afghanistan-Pakistan border. Morphological comparisons of surveyed sites to better-documented examples and synthesis of data from a variety of sources allow us to draw chronological and taphonomic conclusions about three types of documented sites: fortified enclosures, caravanserai, and mobile pastoral camps. These methods provide time depth to the remotely mapped landscape and allow us to consider Spin Boldak as a place shaped by local and regional historical processes rather than merely as a timeless thoroughfare between more intensively inhabited locales.

Keywords: Afghanistan, conflict archaeology, remote survey, palimpsest landscapes, mobile pastoralism, caravanserai

Introduction

Impacts of ongoing conflict on archaeological landscapes, as well as the entanglement of archaeological heritage in sectarian and global conflicts, has increased the urgency and relevance of archaeological methodologies aimed at the study of conflict zones (cf. Bewley et al. 2016). The developing awareness that now, as in the past, archaeological monuments and landscapes are

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agentive and implicated within violent conflicts has generated increased collaboration and resource sharing between state organizations and archaeologists. At the same time, these collaborations have enabled archaeologists to expand the array of tools for the remote survey of landscapes at regional scales. This paradigm of data and research support availability is an ethically complicated 'double-edged sword:' archaeologists have increased abilities to study landscapes and monuments because the archaeological record is at increased risk of damage or destruction. These paradoxical conditions demand a long view from work on heritage in conflict zones, as archaeologists work under an imperative not only to protect sites and objects but also to build a basis for collaborative research to continue with local scholars after conflicts end.

In this paper we present results and methodological observations generated from the study of desert and circum-desert landscapes in southeast Afghanistan using systematic examination of satellite imagery ("remote survey"). Building on previous work by Thomas and Kidd (2017), we explore landscapes of infrastructure, surveillance, and mobility in a sector of the Spin Boldak region of the eastern Registan desert (see Figure 1). Our evaluation of settlement and landscape patterns is complemented by a consideration of the challenges presented by regional, remotely sensed systematic landscape survey in Afghanistan and comparable contexts that military conflict has made inaccessible to on-the-ground methods. We focus on the ways that archaeologists can use the advantages of remotely sensed datasets to mitigate their shortcomings and temporally disentangle palimpsest landscapes. Specifically, we discuss how comparisons of surveyed sites to better-documented examples and synthesis of data from a variety of sources allow us to draw chronological and taphonomic conclusions about three categories of surveyed sites: fortresses, caravanserai, and mobile pastoralist camps. These examples illustrate the ways that a proliferation of available high-resolution, dated satellite imagery for a broad region (i.e. the entirety of Afghanistan) advances the remote study of landscapes. Beyond just providing images at ever-

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greater resolution, the increased chronological and spatial spread of images and map sources across decades can produce significant insights through comparative analysis.

These questions are central to the research aims of the Afghan Heritage Mapping Partnership (AHMP). The AMHP is a three-year project supported by an institutional grant from the US Department of State and the US Embassy in Kabul to the Oriental Institute at the University of Chicago. Grant work is conducted in Chicago by the staff of the Center for Ancient Middle Eastern Landscapes (CAMEL). Kabul-based GIS training funded by the grant involves the cooperation and support of a variety of Afghan partners, including the Afghan Institute of Archaeology and Kabul Polytechnic University. In the Partnership, we aim to build foundations for long-term management and research of the archaeological landscapes of Afghanistan, drawing on satellite imagery, maps, and GIS-based methodologies (Hammer 2016). The Partnership constructs databases of site and monument data for Afghanistan, enabling multiple interconnected research projects on Afghanistan's long settlement history and multiple methodological projects concerning remote site discovery and heritage management.

Spin Boldak was selected as the focus of one of the AHMP's projects for a variety of reasons. The Archaeological Gazetteer of Afghanistan (Ball and Gardin 1982) documents only a few sites in the Spin Boldak area, mostly located along roads and rivers and known from travelers' accounts and anecdotal observation. However, a recent remote survey approximately 100 kilometers to the northwest, west of Kandahar (Thomas and Kidd 2017), mapped a diverse array of sites across different landscape zones. The position of Spin Boldak at the interface between the Registan desert, the Dori River, and the Sulaiman mountains and the prevalence of mobile lifestyles in the region offered the opportunity to test our methodology in a variety of environments and on a variety of types of highly visible and ephemeral archaeological sites, and to compare the results with those of

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Thomas and Kidd. Spin Boldak's proximity to mountain passes connecting Kandahar to Pakistan and the predominance of mobile lifeways in the region have encouraged archaeologists and historians to mention the region in passing, as a corridor through which people moved between more intensely settled areas. In choosing Spin Boldak for research, our intent is to reshape the discourse on such corridor landscapes away from a framing that sees them as empty, peripheral, or interstitial. Such perceptions are frequently an artifact of data availability and modern access; in the past these regions were important, if not central, to geopolitical projects. We focus on the shaping of these regions by local and regional historical processes. This is achieved methodologically by drawing on overlapping datasets, which allow us to break away from some longstanding modes of remote research structured by either small-scale or chronologically static visualization of sites. *Regional coverage* provided by multiple forms of imagery enables us to discuss large-scale landscapes produced by and setting the conditions of long distance mobility and power. *Diachronic data* provided by dated satellite imagery and Soviet-era maps enables us to visualize recent seasonal mobility in ways not previously possible, and thus to separate out layers of static spatial patterns.

The Registan Desert and Spin Boldak

The Registan desert is an arid, windswept dune plateau. It is bordered to the north by a tributary of the Helmand River, called the Arghandab. Spin Boldak frames the Registan on its eastern edge, just at the foot of the Sulaiman mountain range. The current border between Afghanistan and Pakistan runs through these mountains. Spin Boldak (the *white* desert) consists of basaltic and granitic outcrops emerging from hills of ancient loess deposit (Doebrich et al. 2006). In this transitional zone, the flat plain (*dasht*) of the northern Registan Desert rises abruptly, coalescing into dunes before dropping into the plain of the Dori River, a tributary of the Arghandab (Balsan 1972: 156). Visitors to the desert describe this landscape as forbidding, desolate and inhospitable to even the

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hardiest of locals: the traveler Balsan describes nomads of the "Djat, Badinzahi, [and] Tereki" tribes, who avoid the desert in their seasonal movements. Yet Balsan also notes how the dunes of the desert catch seeds carried by the wind, and support diverse systems of plants and animals, as well as communities of "true desert dwellers" (Balsan 1972: 153-5). More recent accounts of pastoral nomad economy in the Registan and Spin Boldak provide a more nuanced understanding of the ecology of the desert, both in terms of the varieties of modes of subsistence and seasonal occupation of the dunes, rivers, and hills (Degen and Weisbrod 2004: 216). A variety of sources, including medieval accounts of travelers like Ibn Hauqal, the British Boundary Commission, and recent travelogues of this so-called "desert of death" (Wood 1997: 136), see Afghanistan's southeastern region primarily as an expanse to cross, a frontier to ward, and a territory to control. The line between dunes and river has remained a geographical constant; likewise, the mountains east of Spin Boldak have historically channeled movement through the Bolan Pass into what is now Pakistan and northwestern India.

Our remote survey of Spin Boldak responds directly to methodological and interpretative challenges put forth by previous studies in the region and by remote surveys in other landscapes. Like much of Afghanistan, the region of Spin Boldak has been under-researched since exploration, survey, and excavations of sites in this region were curtailed following the Soviet invasion in 1979 and during subsequent conflicts. Our discussion here builds on a remote survey conducted by the Archaeological Sites of Afghanistan in Google Earth Project (ASAGE) in a section of the Registan Desert approximately 100 km west of Spin Boldak. The researchers only had access to one set of relatively high-resolution modern satellite images (Thomas and Kidd 2017) (Figure 1) but generated landscape observations and raised methodological challenges that inspired our further work. By using a wider range of satellite imagery, we have expanded recording of archaeological site distributions to correct sample bias in prior research in the broader region surrounding

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Kandahar, which has focused primarily on river valleys (Ball and Gardin 1982). We have also taken up the challenge put forth by many teams relying solely or primarily on satellite imagery, including the team of Thomas and Kidd, to develop methodologies for temporally untangling palimpsest landscapes that are discoverable through remote survey (cf. Ansart et al. 2016). On a very basic level, our work demonstrates that the capacity of remotely sensed systematic survey increases directly with the quantity and resolution of imagery used. On a higher level, we consider new interpretative possibilities that are opened up when imagery and map datasets of various dates are available.

Methodology: Systematic Remote Survey

Remote survey involves the use of satellite imagery to replicate the principles and procedures of systematic pedestrian landscape survey in archaeology. The systematic mapping of sites and archaeological features visible from a vertical perspective became a common research method following the expansion in availability of satellite imagery, starting with the declassification of relatively high-resolution Corona images in 1995 and the subsequent launch of civilian satellites (Wilkinson et al. 2006). Ideally, remotely survey is only one of several research stages, and the results of satellite prospection are "ground-truthed" through fieldwork (e.g. Anderson et al. 2014; Philip et al. 2002). With the explosion in availability of high-resolution commercial satellite imagery in the last decade, remote survey has increasingly become a method applied to cultural heritage problems (Casana 2015; Casana and Panahipour 2014; Cunliffe 2013; Stone 2008). The number of researchers and projects employing such methodologies has expanded in the Middle East in the last six years since the advent of humanitarian and heritage crises following the Arab Spring (Danti 2015; al Quntar 2015). As remote survey is increasingly carried out in conflict zones, the standard

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validation through ground-truthing becomes unfeasible or impossible. Systematic remote surveys in conflict zones therefore concentrate on different research and management ends, and have disparate standards of data comparison (at least initially) from projects able to ground-truth their survey results.

In Spin Boldak, we laid a 1 km by 1 km grid over a 30km by 50km study area and examined high-resolution satellite imagery of the landscape square by square. Initially, project members used the DigitalGlobe basemap layer available within ESRI's ArcMap (ca. 2.5m resolution, of varying dates between 2010-2013). During subsequent work the analysis was augmented with dated Corona satellite imagery (multiple missions, maximum resolution 2m, 1963-1972), DigitalGlobe satellite imagery (33cm-1m resolution, captured 2002-2017) acquired through a government repository to which we had access through the US State Department, aerial imagery collected by the US Army Corps of Engineers BuckEye Program (10cm resolution, recorded 2011-2016), and 1:50,000 scale Soviet topographic maps (dating to 1984-1985 for Kandahar).

Survey Results and Site Types in Spin Boldak

Our "remote survey" in Spin Boldak demonstrates that at an empirical level, the discovery rate of such methodologies increases with the resolution of the data. The average feature density (including individual karez shafts) recovered in the Spin Boldak zone using multiple imagery datasets was 1.78 sites/sq. km, while the maximum feature density (including equivalent types) observed by Thomas and Kidd (2017:30, Table 1) in the northern zone of a comparable landscape using a single set of lower resolution data was 1.3 features/sq. km. Remote survey in the Spin Boldak area recorded a range of site types, including settlement remains, hydrological features, and monumental architecture (Figure 2). The total number of sites and features recorded during the survey is 2,683. Below we review the key types of recorded sites and discuss observed landscape

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patterns. A number of the site types have comparanda and chronological linkages with sites in surrounding regions, which enabled us to expand our assessments at the site and landscape level. These are discussed in the following section.

Hydrological sites: nawars and karez systems

Hydrological features represent the numerical majority of the sites located in the survey (Figure 3). The most numerous features by far are shafts dug to access and carry groundwater in underground channels, locally called karez and known as qanat, foggara, and falaj in other regions from north Africa to China (Dupree 1970: 40; Lightfoot 2000). These systems typically access underground aquifers at the edge of highland areas and carry water via gravity to irrigated fields and settlements in lower regions. They thus enable irrigation where perennially flowing surface water is scarce, and also have the advantage of preventing evaporation in arid environments (Lightfoot 2000: 215; Beaumont 1989). The survey recorded 1610 karez shafts within the research area associated with approximately 52 linear karez systems. These systems cross the region of Spin Boldak, paralleling and cutting between wadi channels north of the Dori River. A much more limited number of qanat wells run between the wadi channels draining the mountain slopes to the southeast of the study area. This complements distributions observed by Thomas and Kidd (2017: 33-34); all of the qanat wells recorded by the ASAGE Project were located north of the Arghandab River, in equivalent formations following natural hydrology (Figure 4). While the project continues to work on dating karez systems relative to one another where they overlap, absolute dating of these systems using imagery is very difficult when they are not unambiguously associated with other types of datable structures.

Such a large number of hydrologic features might at first suggest a considerable amount of investment in irrigation agriculture during one or several period(s), but this is likely not the case.

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Karez are labor-intensive to construct and can in stable situations with proper maintenance or rehabilitation after a period of neglect remain in use for extended periods of time—centuries or even millennia. Some qanats in use in Syria before the beginning of the Civil War dated to the Roman period (Wessels 2005). However, Spin Boldak is a dynamic geological landscape affected by seismic activity along the Chaman fault line at the Afghanistan-Pakistan border, and such activity can disrupt karez water flow or cause underground tunnels to collapse. For example, the 2003 earthquake near the city of Bam in Kerman province, Iran, caused the collapse of 40% of the qanat systems (Zahrai and Heidarzadeh 2004: 5). The large number of karez in Spin Boldak is therefore likely to represent a palimpsest of shorter-lived systems dating to various periods in time, rather than representing a major investment in irrigation of particular period(s). Figure 5 shows the research area in relation to a wider regional seismic landscape, including the locations of epicenters of major earthquakes over a recent 10-year period.

While karez are dug to take advantage of groundwater, other features—dams and nawars (dug reservoirs) demonstrate efforts to channel and contain seasonally available surface flow, especially meltwater streams. The project recorded 222 reservoir features, distributed across landscape zones (Figure 3). In a preliminary test of the correlation between hydrological features and other forms of settlement and construction, including pastoral encampments, we buffered the reservoir features in the survey area by the distance that might be covered in half a day's movement by mobile pastoralists on hilly terrain, about 7km (Chang 2013: 70). The result indicates that, while many campsites are associated with nawar, reservoir access does not appear to be a determining factor in settlement or camp distributions within the research zone, at least in temporal aggregate. The availability of high-resolution imagery has made the dating of nawar features more complex.

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Images show the ongoing use and continuous bulldozer-assisted upkeep of nawar contained within the mud flats of the Registan using mechanized methods. This observation pushes back against association of this form of water collection method with any particular time, subsistence strategy, or 'pre-mechanical' mode of landscape modification. Corroborating the observations made by Thomas and Kidd in the western Registan, numerous large nawar in the Spin Boldak zone are visible in Corona satellite imagery and have been maintained through the present day, demonstrating the upkeep of these features over multiple decades (Thomas and Kidd 2017:38).

Fortified enclosures

This category includes fortified sites ranging in size and complexity, from small mud-walled enclosures with corner towers measuring approximately 70m along one side, to the 200m-diameter Qala-i Boldak, built in the second half of the 19th century as a stronghold of the Afghan Emirate (Adamec 1980: 81-82). These are rebuilt and reutilized into the present, making them difficult to date from the air. We recorded seven sites classified as 'fort'. All but two of these sites are located along the Dori River and its tributaries to the north, therefore in areas with reliable water supplies that are also likely to be the major routes through the region (Figure 6). In the next section, we detail how regional comparisons allow us to date a subset of fortified enclosures to medieval (10th-12th c AD) political landscapes.

Two of the fortified structures recorded are known to date to the early modern period, and represent artifacts of the imperial encounter between the British (and Tsarist Russia/Soviets) and local tribal groups inhabiting Spin Boldak from the 19th into the 20th century. The first, the aforementioned Qala-i Boldak (AHMP_00893), is a double-walled brick fortress, and was described in 1904 by C.E. Yate of the Afghan Boundary Commission. Yate, who was imprisoned in the fortress in 1903, described the fort in detail during his stay, enumerating fortifications, storage facilities,

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and noting the garrison and adjoining bazaar (Adamec 1980: 82-83). In official Emirate correspondence this fortress was called Islamabad, and the Achakzai tribes who occupied the border territories in the early 20th century called it Qala-i Boldak. These people left their own marks in the fortified landscape: the survey recorded a rectangular fortified tower ruin in the foothills to the east of the Registan desert (AHMP 3042), below the Gwaja Pass. On Soviet topographical maps, this fort is labeled "border post of the Achakzai." (Adamec 1980:16-24). The Achakzai were a formidable tribal federation occupying almost the entirety of the Khwaja Amran range and Spin Boldak. These pastoral nomads were characterized in British accounts as uncouth, inhospitable tent dwellers with flocks of sheep and goats. The Achakzai were further renowned for raids and highway robbery: their border control post therefore represented a potential nexus of contest in colonial-local sovereignty over movement of people, flocks and trade (cf. Yate 1906: 22-23).

Pastoralist Camps

Pastoralist sites in Afghanistan are marked by agglomerations of square tent foundations, rounded corrals, and other associated features, including wells and distinctive rectangular foundations of mosques marked by *mihrab* niches. These sites are distributed throughout the survey area, though primarily in the transitional hill lands and on the high dunes at the edge of the desert near water sources. Depending on topography and social and cultural factors, structures within a camp may be clustered or arranged in linear formations, usually following the contours of a hill slope or the crest of a dune. The remote survey recorded two hundred and twenty campsites, each containing 10 or more individual structures. These sites will be discussed in greater detail below.

Mounds

Mounded sites or tells are characterized by layers of decayed mudbrick architecture and distributed through the survey area (Figure 6). The 22 mound sites found by the survey fall into

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two broad categories: round mounds and square mounds, the latter of which are similar to qalas or forts (Figure 7). While some of the rectangular mounded sites in the Spin Boldak research area are similar in layout to Kushan-Sasanian sites elsewhere in Afghanistan, we do not yet have enough data to date any of these mounded sites. Mounded earthen sites in Afghanistan, as elsewhere in the ancient world, are frequently occupied over millennia, and accurate dating of such sites ultimately requires systematic surface collection and excavation. Ongoing research by the AHMP in the densely occupied landscape of the Balkh Oasis currently focuses on parsing chronological differences based on the appearances of mounds from satellite imagery, supported by data from previous fieldwork in Afghanistan and excavated sites in neighboring regions (Lauricella and Hammer n.d.). Results from this and other research efforts will inform our continuing work on the mounded sites of Kandahar region.

Caravanserai/Rabat

Caravanserai (also called *khan* or sometimes *rabat*) were a specific class of fortified building designed for housing travelers, whether caravans of merchants, pilgrims, soldiers or traveling courts. In general these buildings are distinguished from other types of forts by large internal courtyards lined with cellular chambers (Hillenbrand 1994: 331-376). The caravanserai recorded in Spin Boldak have standardized plans, with equivalent dimensions and orientations (see Figure 7). Each building is approximately 75m square, and oriented with the main entrance to the northeast. In each structure, double galleries of connected cellular rooms surround a large courtyard that is frequently bisected by a dividing wall parallel to the primary monumental *iwan* entrance. In many cases, the courtyard contains a small building situated to the southern side: this may be a shrine though in some examples it resembles a bathhouse. As will be discussed in greater detail in the next section, we have dated these monumental buildings to the early modern period (16th-17th century), a period of Safavid and Mughal influence in Spin Boldak. Caravanserai of this

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period in Iran and Pakistan usually contain wells within their courtyards, as well as mosques, baths and other facilities; undoubtedly, the outbuildings and substructures of the caravanserai in Spin Boldak would have served a variety of social functions over time. The primary and most diagnostic example from inside the survey area is the Rabatmil Caravanserai (Figure 7B).

Untangling palimpsest landscapes using satellite imagery

The AHMP's access to regional and diachronic datasets enhanced our ability to research sites and landscape in a broader comparative mode and enabled us to begin to address a primary challenge of remote landscape archaeology: a lack of chronology, which inevitably results in the compression of temporal differences and mobility patterns into amalgamated survey map(s). In this section we discuss three examples from the Spin Boldak data of how we have used the high resolution imagery and diachronic data available to us in order to more effectively research regional distributions of sites and patterns of human activity shifting and overlapping in time. In the first two examples, we use regional data sources and architectural features visible in high-resolution satellite imagery to date two types of sites with a distinctive form: forts and caravanserai. In the third example, we use diachronic series of datasets to investigate the long-term surface visibility of campsites in the Spin Boldak region, which in turn allows us to draw conclusions about the dates and seasonality of these sites.

Regional data sources and site type dating: caravanserai

Caravanserai need to be studied not only in the context of any single site's situatedness in a particular landscape, but also as connected within regional networks of travel infrastructure in the service of governmentality. While the number of caravanserai surveyed in Spin Boldak small (two), these sites provide an opportunity for a historically-specific discussion of how state projects

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intersected with the mobility of people, animals, and material culture in southeastern Afghanistan. Caravanserai in frontier regions like Afghanistan would have served as both defensive rest houses and, by being posts for soldiers and messengers, as nodes of border control (for a discussion of the Mughal case, see Campbell 2011).

Remote dating of caravanserai, as with all structures, is a challenge. As early modern buildings they frequently did not attract the attention of archaeological surveyors. For example, according to Ball and Gardin (1982: 33), DAFA surveyors who visited the multi-phase site of Akhundzada (which features a caravanserai identical in plan to those in Spin Boldak) collected only Indo-Parthian and Ghaznavid ceramics from the adjoining settlement. Remote survey also means that we only have access to the plans of ruins, which are not always the most chronologically diagnostic features of a building. Because the AHMP constructs a country-wide database of archaeological sites, it was possible to demonstrate based on imagery that the two caravanserai found by the project in Spin Boldak represent part of a broader network (Figure 8). Buildings of analogous form and size line the east-west route across the north rim of the Registan leading from Kandahar to the Bolan Pass.

Based on the characteristics and locations of these structures, we hypothesize that the caravanserai system dates to the early modern period (16-17th centuries) and in Spin Boldak mediated the frontier zone between the Safavid and Mughal empires. In the early modern period Kandahar was a nexus of sometimes-violent contention between these two polities, as well as a node in routes of travel connecting Iran and the Deccan. The caravanserai may therefore draw from architectural traditions of both of those contemporary and culturally interlinked polities. Both Mughal and Safavid caravanserai are centered on a court surrounded by cellular galleries and fortified with towers and monumental *iwan*-style gates (Campbell 2010, Begley 1983: 168). Passing one such caravanserai near Herat, the early-19th century traveler J.P. Ferrier noted that these structures are

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attributed to a "Shah Abbas," ambiguously (and perhaps apocryphally) indicating one of a number of Safavid rulers by that name (Ferrier 1856: 263). The *rabat* (caravanserai) at Islam Qala/Kafir Qala, located on the main road west from Herat to the Iranian border, is also of the same plan (Ball and Gardin site number 454). This site was visited in 1887 by Colonel C.E. Yate as part of the work of the British Afghan Boundary Commission; Yate dated the caravanserai based on "an inscription carved on some small marble-slabs in the wall over the doorway" to A.H. 1037 (A.D. 1628)—the end of the reign of Shah Abbas I (Yate 1887:55). The Mughal emperors, for their part, prioritized safety on the roads between Kabul and Kandahar in the 17th century, and from Kandahar eastward—even to the point of collaborating with the Safavids against the mutual threat of robbery to secure the safe passage of merchants in the region (Floor 2012: 210).

While remotely-sensed data is not typically useful for dating individual buildings, combinations of data at multiple scales can help us date multiple, very similar buildings. Using our datasets of high-resolution imagery covering the whole of Afghanistan, as well as the digitized data from the 1982 Gazetteer, we are able to demonstrate that caravanserai similar to the two surveyed in Spin Boldak are distributed not only across Kandahar, but also along the core river routes through Afghanistan. The caravanserai system links major Safavid-era centers such as Herat, Kabul, Kandahar, and Balkh and marks major routes extending outward from Afghanistan to the east and west. Dated Safavid caravanserai that are analogous in dimensions and plan exist along the roadways radiating from the Safavid capital at Isfahan (Kleiss 1998: 50, 45). The system of caravanserai across Afghanistan, as well as implications of caravanserai for travel and political control, will be explored in more detail in a future publication. Already, however, it is possible to argue for the significance of 'border regions' like Spin Boldak within early modern infrastructures. The Safavids (and Mughals) constructed these large monumental buildings to make spaces for merchants and soldiers, but the caravanserai also represent loci for other services, market

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activities, and infrastructure. This lasting material imprint of state-sponsored travel indicates the centrality of mobility as a historical practice linked to sovereignty at various scales in the Registan. Such built evidence for political investment in the landscape of Spin Boldak is paralleled in the fortified landscape of previous centuries, discussed below.

Regional data sources and site type dating: forts

Monumental fortresses are a second type of architecture that can be dated and best understood through broader regional analysis and reference to features documented elsewhere in the region. A sub-type of fortified features is a style of east-west-oriented fortified building with rounded corner and center-wall towers, and a monumental entrance in the long wall, usually to the south. One such fortress, in a highly eroded state, is located in Spin Boldak. As demonstrated in Figure 9, this structure is directly comparable with the sites of Hayat Khan and Zara Qala, both located north of the Arghandab River to the northwest of Spin Boldak, and identified by systematic review of Soviet-era maps. Based on architectural comparison with the major Ghaznavid site of Lashkari Bazar (Lashkar Gah/Bost) located on the northwestern edge of the Registan (Schlumberger 1952) these three fortresses can be dated with some confidence to the high medieval period (10-12th c), and tentatively attributed to the period of the Ghaznavids (977-1186 AD), a Turkish dynasty who administered a core territory from Khorasan to Northern India. Like the palace at Lashkari Bazar, the fortresses in Kandahar and Spin Boldak appear to be constructed of unbaked mudbrick, possibly on baked brick foundations (Schlumberger 1952: 253). The forts in Kandahar and Spin Boldak also make use of *iwan* entrances and rounded external *contreforces* in arrangements and ratios similar to that deployed in the original Ghaznavid palace structure at Lashkhari Bazar, especially in the southern monumental entrance of the first phase of the palace layout (according to Schlumberger 1952: 257 see Fig. 3). Further substantiation of these connections will depend on data from the field, but our data do show a program of high medieval civic building evidenced by

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monumental works along the Arghandab. It is possible that the monumental fortresses in Kandahar and Spin Boldak were way stations on the medieval route connecting the Ghaznavid capital at Lashkari Bazar with the Bolan Pass to the south, on the route to India. The 'desert fort' Qala'i Hauz, recorded by Thomas and Kidd, is also part of this system, though smaller than the other fortresses (Balsan 1972: 156; Thomas and Kidd 2017: 36). Lashkari Bazar is cited as a key moment in the cross-pollination of central Asian enclosed forms into what would later be categorized as "medieval Islamic architecture" (Peker 1991: 10). We thus see in the fortresses distributed across Kandahar and into Spin Boldak the development not only of an architectural type, but also of the mechanics of landscape surveillance in the 10th-12th centuries in Afghanistan.

As we extend our assessment of large-scale systems of caravanserai and fortresses temporally as well as spatially, regional remote data enriches our picture of densely overlaid human activity through centuries of movement and interaction. For instance, comparing the regional caravanserai data from the early modern period with the fort data from the medieval period shows diachronic patterns of landscape use by pre-modern empires in Afghanistan, as points of either control or hospitality (depending on one's subject position) were constructed at different locales along river routes and at the edge of the desert. These case studies of caravanserai and fort networks demonstrate the methodological benefits of working at various scales using multiple datasets, from 30cm resolution imagery of a single site, which shows important architectural details, to maps and imagery coverage spanning a whole country, which reveals larger patterns and networks.

Assessment of 'remote taphonomy' and site dating from multiple images: pastoral campsites

The data produced by remote survey in Spin Boldak present us with a palimpsest landscape: a picture of accumulated human activity along the riverbanks, hills and dunes through

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multiple centuries (if not millennia). In any single satellite image, the time depth of this palimpsest is compressed or 'flattened' into a single temporal moment. Such temporal flattening is a recurring challenge for survey archaeology, which relies on other dating methodologies to read time back into spatial patterns (cf. Richard 2015: 240). The same techniques and datasets (layered satellite imagery, GIS, aerial photography, historical mapping) which enable us to carry out a study of archaeological landscapes in otherwise inaccessible areas also challenge us to find new ways to give temporal depth to our reconstruction of the past via remote survey.

In the case study discussed here, we approach chronology by tracking changes in site visibility resulting from abandonment, erosion, colluviation, and aeolian sediment deposition. Reliable models of taphonomy—post-depositional processes through which sites are differentially preserved, transformed or destroyed—are crucial to the effective dating of archaeological sites even when we have access to other datasets (i.e., artifacts). Taphonomy strongly impacts the findability of sites using satellite imagery (Alizadeh & Ur 2007; Wilkinson et al. 2006: 748). We are developing remote methods for taphonomic modeling, the results of which provide insight into the dating of abandoned pastoralist campsites seen throughout the Spin Boldak survey area. We selected this site category for analysis due to the large number of examples in the area and because of archaeology's general neglect of such sites.

The problems of "flattening" and taphonomy take on elevated importance when we are dealing with past actors generally assumed to be 'ephemeral' or less materially visible such as the pastoralists of the Spin Boldak area. In an increasingly technologically mediated practice and in landscapes that will not be accessible for fieldwork in the near future, we must if at all possible account for chronology in order to explicitly avoid 'silencing' or masking certain parts of the human landscape record, especially those that are most vulnerable to taphonomic processes. Pastoralist

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sites are doubly vulnerable to the temporal flattening that challenges remote landscape study (cf. Tucker 2008: 2). Because of their 'ephemerality,' specifically their frequent lack of substantial stratigraphy and surface artifacts, pastoralist campsites are difficult to date even using pedestrian survey (Hammer 2014; Ur and Hammer 2009). Such sites are also subject to tautologies of chronological categorization based on long-held assumptions in social science. Due to anthropologists' lingering tendency to relegate pastoral nomadic or semi-nomadic peoples into a "savage slot" outside of linear chronologies (Cobb 2005), many archaeologists tacitly assume that abandoned pastoral campsites and activity areas are the remains of ancient rather than 'modern' nomads. This assumption is premised on a presumed continuity in pastoralist lifeways and, therefore, a presumed continuity in the traces they leave behind over the *longue durée* of Mediterranean and Middle Eastern pre/history (Barker 2008: 55)., The implicit assumption is that nomads are still 'primitives' in an otherwise modern world, and so the archaeological record is 'primitivized,' erasing the practices of people living today.

The archaeological investigation of pastoral campsites is conceptually daunting and has for a long time relied on ethnographic analogies, a practice that encourages conflation of the past and the present and contributes to the chronological flattening of pastoral landscapes in archaeological reconstructions (Barnard 2009: 22). The black tent camps, mobility practices, and animal management strategies of twentieth century pastoral nomads are frequently used uncritically to interpret archaeological signatures (cf. Cribb1991; Hole1979). Recent work strongly criticizes over-reliance on ethnographic analogy and attempts to ground our understanding of pre-modern pastoralists in concrete zooarchaeological, paleobotanical, isotopic, landscape, and historical data, which clearly show variability in pastoral practices through time (Honeychurch and Makarewicz 2016; Makarewicz 2013; Potts 2014; Hammer and Arbuckle 2017). Our aim here is to prevent nomadic pastoral sites documented in satellite imagery from being treated as background

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indications of unchanging practices, especially given that our datasets demonstrate the agency of contemporary mobile pastoralists in producing the landscape of southeastern Afghanistan, for example through the maintenance of desert reservoirs.

Baluch and Pashtun Kuchi pastoralists currently inhabit the Registan desert and its margins, and pre-2004 they practiced seasonal transhumance between the desert and river (Degen and Weisbrod 2004). Their transhumance cycles involve either grazing animals in the desert during the winter/spring and summering along the river; or grazing in the desert year round sustained by water and fodder sources. However, pastoral lifeways in the Registan were drastically shifted by a massive drought between 1998 and 2002, during which 100,000 Kuchi nomads were evacuated from the desert and resettled in Internally Displaced Person (IDP) camps by the Taliban. Flocks in the region were decimated: 90% of sheep and 40% of camels perished (Degen and Weisbrod 2004: 217). The progress of recovery from this disaster has not yet been completely assessed, but as of 2008 nomads displaced by the drought still made up almost half of the total IDPs within Afghanistan (UNHCR, 2008).

Our pastoralist site taphonomy investigation was based on our access to a complete set of 1:50,000 scale topographic survey maps produced by the Soviet Military Topographical Service prior to and during the 1979-1989 occupation of Afghanistan. Similar map series exist for all of former Soviet Central Asia, and are an important source for archaeological and heritage research because they document the location of many archaeological sites and mobile pastoralist camps (cf. Rondelli et al. 2013). According to the metadata included in the margin of each map, the Soviet maps of Afghanistan were all published between 1984-1986 (Bohme and Anson 1993; Wiles 2007), based on material collected in single years between 1976 and 1984. The maps of Spin Boldak in particular (H42-25 A-Г and H42-37 A-Г) were produced in 1984-5 from data collected in 1983.

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Soviet cartographers marked the locations of occupied goat-hair tent camps, differentiating them from camp 'ruins' (*razvaleniye*) (see Figure 9). The maps thus provide a spatial dataset for camps that were occupied and active at the date of production of these maps, with their latest possible date of observed occupation being 1984.

Because these maps indicate the locations of active pastoral campsites, they allow us to investigate the rate of decay and disappearance of pastoral campsites between 1983 (the earliest point that a campsite marked as "occupied" on a Soviet map could have been subsequently abandoned) and the dates of our high-resolution satellite images. We collected diachronic data on campsite reoccupation, abandonment, and visibility using time-stamped series of DigitalGlobe images dating from 2005 to the present. Corona imagery from the 1960s is not high resolution enough to reliably and clearly show campsites. Our methodology is similar to that employed by cultural heritage analysts monitoring looting and other forms of damage to known archaeological sites in Syria and Afghanistan (Casana and Panahipour 2014, Murdock and Hritz 2013, Hammer et al. forthcoming). Analysts create a virtual 'stack' of images, arranging them from the earliest date of capture to the latest. We were able to trace many campsites from active, to abandoned, to invisible, obscured by shifting sand dunes, *wadi* deposits, or the robbing of their stones for other buildings. Our primary observation is that without ongoing re-visitation and continued maintenance, pastoralist campsites that were marked occupied in 1984 maps may be invisible after as brief an interval as 30 years. This means that the pastoralist features surveyed in satellite imagery will typically not be ancient sites (contra Thomas and Kidd 2017), unless recent campsites have reoccupied the locations of older campsites—which does happen in other parts of Central Asia (cf. Frachetti 2015: 11). These possible older inhabitations would require ground survey (and likely excavation) for verification and investigation of seasonality.

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These diachronic data on campsite location and occupation further allow us to trace patterns in recent pastoralist demography and seasonal mobility. The conclusions we are able to draw are heavily shaped by the available data sources. We observed that between the 1983 maps and DigitalGlobe Imagery from 2015 that the number of occupied campsites in Spin Boldak had decreased by more than a third (see Figure 10). Also, in the Soviet maps active nomad campsites extended from the hills into the desert dunes, but active campsites in 2015 were limited to only the hills north of the Dori. This observed shift in the distribution of pastoral nomadic campsites may be indicative of a number of interrelated factors—one of which is the seasonality of the satellite imagery available for a given year.

With the intent of examining the effects of seasonal mobility on the site distributions detected in remote imagery, we re-evaluated our pastoralist camp data using the Buckeye aerial image dataset, which offered multiple images per year of the same area for some recent years (unlike the DigitalGlobe images). Given the more limited coverage of Buckeye data, our investigation of the seasonal mobility of camps was confined to a 20x50km section of the study area. As noted above, pastoral nomads following pre-drought strategies will winter in the desert and summer along the river if they lack fodder and water supplies to camp in the dunes year-round. Summer months in Kandahar are April through October, with the hottest months falling between June and August. The month stamp of high-resolution Buckeye images revealed seasonal pastoral movements (see Figure 11). For example all of the sites which appear occupied in Buckeye images from 2015 are clustered in the area near the river but not in the desert; all 2015 imagery is dated March to November, or summer season. The same river sites also appear occupied in our Buckeye images from 2013, as do additional river sites, and sites ranging through the desert; our 2013 imagery is dated between January and March, or winter season. So, while river valley sites in the Buckeye imagery were occupied in both summer and winter, only winter images show occupation

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in the desert. This trend underscores the correlation of occupied campsites in the post-drought period with the qanat-irrigated landscape, and with the seasonal reliability of streamfed reservoirs in the desert. These patterns indicate seasonal landscape strategies have continued in Spin Boldak ten years following the drought, though with some reduction in the scale and range of movements. These image sets highlight that systems of nomadic traces recorded in survey—whether remote or on the ground—must be parsed for seasonality and that aspects of seasonal transhumance change over time. At the same time, this case study opens up possibilities for the use of satellite imagery and remote sensing not only for the control and surveillance of pastoral populations (as was the case in the Soviet period) but for more nuanced and comprehensive research on both recent and past mobile lifeways at the regional scale.

Discussion

The constellations of sites and features found through remote survey in Spin Boldak contribute to our understanding of complex palimpsest landscapes in the corridor of the Bolan Pass, the valley of the Dori River, and the 'desert coast' transition between hills and the dunes of the Registan. These datasets allow us to explore and to problematize modern conceptualizations of this region, which are filtered through the perception of Spin Boldak as a pinch point and Kandahar more generally a frontier. The status of Spin Boldak as a liminal space extends into the early modern period, when Kandahar and Spin Boldak were at the Safavid-Mughal frontier. The remains of caravanserai discovered by the survey demonstrate that the survey area is part of a larger landscape of early modern governmentality concerned with maintaining control and boundaries along the mountain passes and desert roads.

Ongoing discussions among archaeologists present two main criticisms of remote survey. The first is the lack of chronological information available through this method—more specifically,

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a lack of artifact collections and detailed observations on the ground results in a "flattened" view of settlement history and land-use that cannot account for change through time or the effect of mobility and other processes that shape the formation of site patterns (e.g. Joyce 2012). Within our methodological discussions here, and in ongoing work, we attempt to address this issue through strategic deployments of the advantages provided by extensive sets of remote data that are 'high resolution' in terms of both spatial and (modern) temporal coverage. Our case studies show how remotely sensed imagery can be used to partially unpack chronologically compressed data. We have utilized the broad coverage of high-resolution imagery to frame survey results within regional understandings of landscape use and standardized architectural patterns of particular periods, and we have utilized temporal sequences of imagery and map data to develop strategies to investigate how the visibility of sites has changed over time. Our study has clearly not resulted in a complete "unflattening" of the palimpsest archaeological landscape in the way that an effective ground survey could, as only on-the-ground methods can establish the duration and changing nature of occupation at different locales. However, employment of methods similar to ours should advance both the research of landscapes still inaccessible due to conflict and the ongoing critical development of GIS-based strategies for landscape archaeology as a whole.

The second critique is that remote survey is rooted in a western cartographic perspective made even more extreme by the 'bird's eye view" of satellite imagery, and that this perspective is not consistent with the ways that ancient people would have perceived, organized, and moved through the landscapes they inhabited (Tilley 1994, Begley 2017). We attempt to address this issue by choosing a frame and analyses that aim to explore the histories of those who lived within the Registan, rather than only considering those who passed through the region. We use our regional

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imagery coverage to incorporate small rural sites and previously overlooked "marginal" areas into synthetic analyses that aim to understand how these rural sites and "marginal" areas played critical roles in local and regional historical processes. Seasonal analysis of nomadic pastoral campsites over the last several decades shows practices of transhumance across environmental zones, paralleling but also cutting across linear routes and roads. As we build on the results of the initial experiments in remote taphonomic modeling and dating analysis, we can apply these methods toward constructing more robust models of how sedentary polities and mobile pastoral groups spatially interacted in the ancient and recent past. Our ongoing analyses of site taphonomy and damage to heritage in Afghanistan have also brought into focus the ways that the fortified infrastructure of earlier periods have created a "signature landscape" of strategic defensibility for 21st century conflicts. Within the survey area this is illustrated, for example, in the re-use of sites like the Qala-i Boldak as a US Forward Operating Base (FOB Spin Boldak) over the last decade. Such cases of active re-use complicate straightforward 'readings' of the landscape, but also contribute to understanding the history of human-landscape interactions in Afghanistan.

Conclusions

The methods developed and the data collected by remote surveys like the one we present of Spin Boldak demonstrate the importance of high-resolution satellite imagery in site discovery and recording in landscapes made inaccessible by military conflict and political instability but also show the 'double edged sword' of prolonged US military involvement in Afghanistan. Long-term regional conflict and terrible humanitarian crises result in the creation of the necessary tools—high-resolution satellite imagery, large numbers of images of various dates, grant programs—for systematic research made otherwise impossible by those same conflict conditions. Furthermore, without explicit commitment to collaboration with local scholars and professionals, these tools remain in outside hands, perpetuating the 'imperial gaze' that results in the generation of datasets

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like topographic maps and surveillance satellite imagery. This Spin Boldak research has generated the basis and impetus for a number of daughter projects focused both on southern Afghanistan and on the site categories recorded by the remote survey: these projects continue to produce data aimed at the nuanced recording and protection of Afghanistan's rich heritage landscapes. As part of our larger grant project, which includes a multi-year GIS and survey archaeology training program for Afghan students and professionals in Kabul, our colleagues in the grant project are trying to ensure Afghan access to satellite imagery data and the technical skills to use it for cultural heritage planning and archaeological research. We will continue to develop techniques for investigating chronology and taphonomy through the detailed analysis of a suite of modern and historical satellite imagery, which will contribute to the ongoing, collaborative work on Afghanistan's landscapes for years to come.

Acknowledgments

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Figure Captions

Figure 1. A general map showing the region of Kandahar, the Registan desert, and the research areas covered in this paper as well as in previous work by Thomas and Kidd (2017). *Basemap source: Esri, DigitalGlobe, geoEye, Earthstar Geographics, CNES/AirbusDS, USDA, AeroGRID, IGN, and the GIS User Community.*

Figure 2. A map of the survey area showing overall site distribution recorded by the project.

Figure 3. A map showing the distribution of hydrological features: nawar reservoirs and qanat/karez wells, demonstrating that reservoirs are primarily found in the desert and qanat/karez wells are primarily found north of the river

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Figure 4. The relationship between Spin Boldak and regions of high seismicity to the east and southeast. The map shows the location and intensity of major earthquakes along the Chaman fault system between 2000 and 2010. Map produced from GTOPO SRTM data; seismic data courtesy of the USGS Earthquake Hazards Program searchable catalog at https://earthquake.usgs.gov/earthquakes/search/.

Figure 5. A map of the survey area showing the distributions of mounded, fortified, and enclosure sites.

Figure 6. Examples of mounded sites in the Spin Boldak research area: AHMP_00904 (Zara Qala) (Left) and site AHMP_00903 (Right) in Buckeye imagery from 2013

Figure 7. Figure demonstrating the standardization of caravanserai architecture within the survey area (structures B and C) and extending towards Kandahar (A). These buildings form part of a larger network extending north and joining Herat, Kabul and Balkh. A: Akhunzada (Gazetteer number 23); B: Rabatmil (AHMP_00888); C: Dabarye (AHMP_00887). *Basemap source: Esri, DigitalGlobe, geoEye, Earthstar Geographics, CNES/AirbusDS, USDA, AeroGRID, IGN, and the GIS User Community.*

Figure 8. A comparison of the form of fortified structures along the eastern rim of the Registan (A and B) and within the survey area (C). A: Hayat Khan; B: Zara Qala; C: Babuksahibkalay (AHMP_00896). *Basemap source: Esri, DigitalGlobe, geoEye, Earthstar Geographics, CNES/AirbusDS, USDA, AeroGRID, IGN, and the GIS User Community.*

Figure 9. Figure showing continuing occupation of a pastoral campsite, both in the Soviet map (occupied tents circled) and in a Buckeye image from January 2013. Note also the ruins alongside the occupied tents.

Figure 10. A map showing the distribution of occupied pastoral camps as marked in 1985 Soviet maps, and as observed in Buckeye imagery captured in 2013 and 2015. Note the wider distribution of sites dating to 2013, due to the bi-seasonality (both winter and summer) of that data providing images of summer and winter occupations.

Figure 11. Demonstration of how satellite imagery dated to the month captures a seasonal palimpsest. At any given moment within the year, the landscape will contain abandoned and occupied campsites due to the mobility of pastoralists. Only by comparing regional data for the entire year is it possible to effectively parse patterns of settlement.