Remote Assessments of the Archaeological Heritage Situation in Afghanistan
Journal of Cultural Heritage
Revisions after acceptance, December 2017

Emily Hammer
The Oriental Institute, The University of Chicago
University of Pennsylvania

University of Pennsylvania
Williams Hall
255 South 36th Street #847
Philadelphia, Pennsylvania, USA 19104
(corresponding author: ehammer@sas.upenn.edu)

Rebecca Seifried
The Oriental Institute, The University of Chicago
Institute for Mediterranean Studies, Foundation for Research and Technology – Hellas

Kathryn Franklin
The Oriental Institute, The University of Chicago

Anthony Lauricella
The Oriental Institute, The University of Chicago

Abstract

Analysis of spatial and temporal patterns in looting and destruction at archaeological sites using satellite imagery has become a focus of multiple research groups working on cultural heritage in conflict zones, especially in areas controlled by the Islamic State in Syria and Iraq. In this paper, we apply similar methods to investigate looting and destruction at archaeological sites in the Islamic Republic of Afghanistan, where Taliban-related cultural heritage destruction events have also frequently made international headlines. Using the time depth provided by high-resolution, time-stamped DigitalGlobe satellite and BuckEye aerial images as well as CORONA and other historical satellite images and maps, we quantitatively document spatial and temporal patterns in destruction from looting, agricultural activity, military occupation, urban growth, mining, and other kinds of development at over 1000 previously known archaeological sites across Afghanistan. This analysis indicates that several common narratives about cultural heritage destruction in Afghanistan may require revision. Specifically, we conclude that significant amounts of systematic looting of archaeological sites in Afghanistan already occurred before Taliban-related conflicts, that there has been little increase in systematic looting in Taliban-controlled areas post-2001, and that the most pressing threats to Afghanistan's heritage sites come from development activities, including agricultural expansion, urban growth, and future mining. The analysis demonstrates that the situation in Afghanistan both parallels and contrasts with that seen in the post-Arab-Spring Middle East.

Keywords: Afghanistan, cultural heritage, satellite imagery, archaeology, spatial analysis

Highlights
- Satellite images provided data on 1000 Afghan heritage sites' preservation 2001-17
- Spatial-temporal patterns in heritage destruction contradict media reports, prior assumptions
- Analysis showed little increase in systematic looting in Taliban-controlled areas
- Systematic looting of archaeological sites already occurred before 2001
- Development activities are the most pressing current threat to heritage sites

1. Introduction

In recent years, the study of the relationship between conflict, the destruction of archaeological sites, and the black market has been defined by the cultural heritage crisis in Syria and Iraq. The performative destruction at iconic sites like Nimrud, Hatra, Nineveh, and the Mosul Museum by the Islamic State has understandably captured the attention of archaeologists, policymakers, and the public [e.g., 1]. Satellite images of systematically looted sites in Syria like Dura Europos, Mari, and Apamea, as well as art market data and other forms of evidence indicate a thriving illegal trade in stolen antiquities [2-4]. Parallels have been drawn between the situation in Afghanistan and that in Syria and Iraq, with both providing examples of similarly organized looting as a possible funding source for Islamic terror groups [5]. The destruction of the Bamiyan Buddhas and other sites in Afghanistan by the Taliban in 2001 provides very direct foreshadowing of the actions more recently taken by the Islamic State [e.g., 6: 1, 7: 229]. These destructions were filmed and distributed all over the world, and they were justified as the destruction of pre-Islamic idols [8-11].

The cultural heritage of Syria, Iraq, and Afghanistan has frequently been a topic of international media reports because of these attention-grabbing incidents. But the overwhelming focus on such events paints a biased picture of the fate of cultural heritage in these nations, where a multitude of factors result in heritage destruction. The media and some sectors of the cultural heritage community draw on the shock and performativity of destruction events to highlight the urgency of cultural heritage problems and to argue for Western intervention in the form of funding and other resources for cultural heritage work. The predominant public narrative holds that looting and destruction specifically by extremist groups—the Taliban in Afghanistan and the Islamic State in Syria and Iraq—are currently the most pressing and dangerous threats to archaeological sites in these nations. Through systematic, critical research of various kinds, it is becoming increasingly apparent that many media and even academic reports have inflated and otherwise mischaracterized the role of the Islamic State in the cultural heritage crisis in Syria and Iraq [12-16]. A quantitative assessment of spatial and temporal patterns in looting and other forms of site destruction in Afghanistan is essential in order to provide the broader picture needed both for cultural heritage efforts and for research into the funding of international criminal activity.

Unlike in Syria and Iraq, the academic archaeology community has not responded to the recent phases of the heritage crisis in Afghanistan with the creation of multiple collaborative projects to quantitatively and systematically document looting and destruction. Academic researchers have assembled a considerable body of diachronic data on looting and other forms of destruction at sites across Syria and Iraq using satellite imagery. A large volume of Syria/Iraq publications cover peacetime heritage destruction [17-19], conflict-related looting and destruction since the beginning of the Iraq War in 2003 [20-27], and especially conflict-related looting since the 2011 Arab Spring [2, 7, 28-32]. By contrast, the situation in Afghanistan has been reported only anecdotally and primarily by the international media [33-38] as well as through reports from officials or heritage NGOs [e.g., 39, 40-43] with few systematic analyses [but for analyses of the sites of Jam and Lashkari Bazar, see 44, 45]. Contradictory statements concerning the archaeological heritage situation in Afghanistan, especially regarding the relative importance of looting and other sources of revenue for the Taliban, discussed further in the next section, highlight the need for data on looting in the country.

The difference in the academic archaeology community's response to these two heritage crises reflects two factors: the difference in availability of satellite imagery for monitoring threats to heritage between 9/11 and the Arab Spring, and the history of foreign involvement in fieldwork in these nations. First, at the time of the American invasion of Afghanistan in 2001, free public access to modern high-resolution satellite imagery did not yet exist. Google Earth was launched in 2005, and many areas were not covered with high-resolution imagery until considerably later. This made it impossible for the archaeology community to affordably track destruction to heritage sites for years following the invasion and subsequent occupation. By the time of the Arab Spring and the commencement of the Syrian Civil War in 2011, free access to high-resolution satellite imagery had greatly expanded, enabling various spatial and temporal analyses of newly commenced looting in Syria and Iraq of a detailed type that never occurred for old or new looting in Afghanistan. However, the unavailability of free high-resolution imagery at the beginning of the Iraq War in 2003 did not prevent the proliferation of looting studies, which instead used purchased imagery [19, 23, 25], so other reasons must also explain the observed discrepancies in the amount of academic attention devoted to Syria/Iraq versus Afghanistan. Whereas many foreign archaeological teams worked in Syria before the Arab Spring in 2011 and in the Kurdistan region of northern Iraq from roughly 2010 onwards, few foreign archaeologists outside of the Délégation Archéologique Française en Afghanistan (DAFA) have worked in Afghanistan since the Soviet invasion in 1979, and constant conflict has prevented local archaeologists from conducting excavations or surveys [37]. As a result, the archaeology of Afghanistan remains significantly less known than that of Syria/Iraq. Further, the 2001 invasion of Afghanistan came only after two decades of conflict and widespread looting. While the post-2011 crisis in Syria and northern Iraq as well as the post-2003 (post-second American invasion) conditions in southern Iraq have been seen as a shift in the cultural heritage situation in those countries, post-2001 reports of looting in Afghanistan are viewed as continuous with the situation before the American invasion. Whether correct or not, such a view shapes reactions toward the situation in Afghanistan.

Here, we provide the first quantitative country-wide assessment of ongoing and potential damage to archaeological sites in Afghanistan. This work draws on GIS and satellite imagery methodologies that allow us, first, to track past damage to sites over time and, second, to calculate threats to sites in the future. In a first assessment, we drew on visual inspection of time-stamped series of high-resolution satellite imagery and other datasets to evaluate temporal and spatial patterns of looting and other forms of site destruction. While the assessment began with a focus on looting, it soon became apparent that sites in Afghanistan have been recently affected by many different processes, and we expanded our assessment accordingly to include damage caused by agricultural expansion, military activity, urban growth, and mining. Damage to archaeological sites from looting, agricultural expansion, and military activity were assessed for a group of over 1000 previously known archaeological sites that were examined in modern high-resolution satellite images of all available dates. In a second assessment, we integrated datasets drawn from historical and modern satellite imagery, Soviet-era topography maps, and the US Geological Survey (USGS) Afghanistan website to quantify ongoing and potential future damage to archaeological sites from urban growth and mining.

On the basis of this remote analysis of sites, we draw three conclusions about the fate of archaeological heritage in Afghanistan. First, a significant amount of systematic looting in Afghanistan took place decades ago, and not during the post-2001 conflict. Second, areas controlled by the Taliban have not experienced increases in looting after the American invasion, particularly when compared to the rest of the country. There are areas that have experienced continual looting at a dramatic scale since 2001, especially in the northern oases like Balkh, but these are not representative of the situation across the country. Third, outside of these hotspots, the major threats to archaeological sites are instead from urban growth, other forms of development, agricultural expansion, and potential future mining. These conclusions show that the looting and archaeological heritage situation in Afghanistan both parallels and contrasts with that documented in Syria and Iraq.

2. Afghanistan's Archaeological Heritage and History of Conflict

The archaeological heritage of Afghanistan is rich over a long chronological span from the Bronze Age through recent periods [46]. This richness is in large part due to the country's location along the cross-continental trade routes that are now referred to as the "Silk Roads" and to its position at a number of environmental interfaces (Figure 1). The northern foothills of the Hindu Kush were one of the early centers of plant and animal domestication in the Neolithic; the steppes, oases, and river valleys both to the north and south of these mountains were for millennia the meeting point of Iranian, Indus Valley, Central Asian, and Chinese civilizations. The mountains of Afghanistan are geologically diverse—rich in deposits of gold, silver, iron, copper, tin, and precious stones. Trade networks dispersed these resources across Eurasia as early as the fifth millennium BC. Afghanistan's role as a source of minerals and its position on trade routes meant it played an important role in the transmission of technology, materials, and culture, from silks and spices to glass and ceramics to the Zoroastrian, Buddhist, and Islamic religions.

However, Afghanistan has endured more than three and a half decades of war, which has resulted in the degradation of state institutions, including those involved in heritage management. The situation also has made it impossible for state authorities to enforce laws such as those that would prevent the destruction of archaeological sites and the trafficking of antiquities. At the same time, the destruction of large parts of the agricultural and pastoral subsistence base during and after the 1979 Soviet invasion due to violence, drought, and the long-term replacement of the state with a war economy has promoted the growth of smuggling networks that transport drugs, antiquities, and other contraband. This situation has also forced both individuals and groups to turn to alternative means of income such as looting, poppy cultivation, and membership in militarized groups or smuggling networks [47]. Destruction of archaeological heritage in Afghanistan occurs in the nexus of all of these factors: individual families' and warring factions' need for income, lawlessness, declining respect for heritage associated with a lack of education and large-scale migration, and the existence of networks that can transport antiquities to outside markets [39: 16-18, 48: 984-985].

2.1 Independent Monarchy Period (1919-1979)

In the 1960s, Afghanistan was an independent constitutional monarchy. Some of the core state institutions concerned with heritage preservation were established during Afghanistan's era of independence, including the National Museum (early 1920s), various provincial museums, and the Afghan Institute of Archaeology (1966) [40: 44, 48: 982-983]. The state intervened to recover illegally excavated objects from prehistoric sites like Mir Zaka in Paktiya Province (in 1947) and Khosh Tepe in Baghlan Province (in 1966) [49: 86]. Severe looting had already begun in some parts of the country by the end of this period. A Soviet-Afghan mission achieved some of the most important archaeological research in the northern oasis areas in 1969-1979, and a member of this team estimated that roughly 80% of sites in the Dashli, Nichkin, and Farukabad oases had been destroyed by looting [personal communication in 50: 160].

2.2 Soviet Period (1979-1989)

The 1979 Soviet invasion and subsequent occupation of Afghanistan 1979-1989 created instability that in turn increased damage to archaeological sites from military activity and subsistence looting. Sites such as the stupa-monastery complex of Tepe Shotor at Hadda near Jalalabad were destroyed during the course of fighting in 1980 [51: 40]. Many historical buildings and monuments within and surrounding the city of Herat were flattened by Soviet bombardment [52]. Both drought and the destruction of pastoral and agricultural land caused ordinary Afghans to turn to other sources of income such as looting and smuggling [47, 48: 984-985]. Large-scale looting was reported at major sites in northern Afghanistan such as Ai Khanoum in Takhar Province, and systematic looting in this area seems to have begun in this period and continued through the 1990s. Paradoxically, the National Museum seems to have remained relatively intact during the Soviet period, despite temporary physical relocation of the collection [40: 44, 42: 64-65].

2.3 Civil War (1989-2001)

Following the departure of the Soviets, Afghanistan was wracked by war between different factions who sought to control the country, most infamously the Taliban, who took control of Kabul in 1996. It was during the early part of this Civil War period, 1992-1995, that the National Museum experienced major destruction from rockets, fires, and looting [39, 40, 42, 43] and that provincial museums were looted [53: 1197-1198]. The fate of the National Museum made Afghanistan's cultural heritage crisis internationally visible for the first time, even though large-scale looting of archaeological sites had been ongoing for more than a decade. Reports indicate that looting of archaeological sites continued during this time. For example, villagers resumed extensive, highly organized looting operations at Mir Zaka in Paktiya Province in 1992-1995, recovering an estimated 2-3 tons of coins and 200 kilograms of gold and silver objects [41, 49: 86-87]. Extensive looting began at Jam in Ghor Province in 1995 [54: 356].

In the latest phase of the Civil War, the international media increasingly highlighted Afghanistan's cultural heritage crisis due to dramatic actions taken by the Taliban. These actions included not only the well-known explosion of the Bamiyan Buddhas and the Taliban's smashing of large unmovable objects that had remained in the National Museum, both in 2001, but also many less publicized destructions at sites such as Hadda near Jalalabad and Minar-i Chakari near Kabul [41]. In retrospect, however, there has been a tendency to blame the Taliban

too much for their role in Afghanistan's cultural heritage crisis [51: 39-40]. It is important to remember that the major destruction of the National Museum took place before the Taliban controlled Kabul and that large-scale looting had been ongoing since the Soviet period. The Taliban sometimes attempted to protect antiquities, and in the case of early threats against the Bamiyan Buddhas, they made commitments to protect cultural heritage in response to international pressure. Mullah Omar issued general edicts protecting museum collections and making looting and artifact trafficking punishable, but also issued the contradictory edict against statues in February 2001 that led to the destructions in Bamiyan and Kabul [43: 11]. Radio Shariat announced that looted objects had to be surrendered to the authorities, but the Society for the Preservation of Afghanistan's Cultural Heritage (a heritage NGO) argued this only accelerated looting. As long as a tax of 1/5 the value of the artifacts was paid to authorities, no one seemed to care about looting [55].

Large-scale looting, sometimes sanctioned or even directly carried out by Taliban commanders or the local warlords of other factions, continued at major sites like Ai Khanoum in Takhar Province, Telya Tepe, a site near Qaisar in Faryab Province, various monastery sites in Nangarhar Province, various sites in Badghis Province, and Rabatak on the border of Baghlan and Samangan Provinces [41, 53, 55].

2.4 After the American Invasion (2001-present)

In the aftermath of the American invasion, Afghanistan has seen continual instability, including Taliban insurgency. This has created situations in which the looting and sale of archaeological objects are typically easy and profitable. Pakistan is the exit point for most looted objects [5], some of which seem to be trafficked through refugee camps [56]. International aid for heritage programs has improved some aspects of Afghanistan's heritage crisis since 2001. Several different programs have worked to reopen and restore the National Museum [39, 42, 57] and to create a digital registry of objects [58, 59]. Other programs have sought to preserve specific historic sites and to perform rescue excavations at Mes Aynak in Logar Province [11, 38, 53, 54, 60, 61]. Previous work by our team used novel semi-automated methods to investigate the scale of looting at the site of Ai Khanoum [62].

Direct reports of looting have been scattered, and there are conflicting statements about the situation. The former head of the Délégation Archéologique Française en Afghanistan, Philippe Marquis, made the extraordinary claim that 99% of sites have been looted [quoted in 34], and many people familiar with Afghanistan stated that looting only increased following the American invasion (Bopearachchi quoted in [33], [39]: 19, [49]: 87). It is widely believed that antiquities are one of several different items being illegally trafficked and sold to finance the Taliban and Al-Qaeda, and this might suggest that looting has increased. However, the scale of the antiquities trade is notoriously difficult to determine [5]. A UNESCO cultural heritage officer in Kabul argued that the antiquities trade "may rival or even surpass opium sales" [quoted in 33]. Contrary to those statements, a Marine colonel and assistant district attorney in New York City, Matthew Bogdanos, suggested that the Taliban have not engaged in the antiquities trade to the same extent as the Islamic State due to the availability of high-profit opium, which they can smuggle instead [quoted in 63]. A recent analysis argued that there is no evidence Al-Qaeda ever profited from the antiquities trade and that the Taliban do not profit directly from it either, but instead both

groups gain profit through taxes levied on smuggled goods (including antiquities), with the smuggling network organizations being the main beneficiaries [5]. This would perhaps suggest that certain types of looting might have decreased.

Has looting increased, decreased, or held constant in Afghanistan since the American invasion? Are patterns different in Taliban and non-Taliban influenced areas and in mountainous and lowland areas or rural and urban areas of the country? Systematic examination of sites through time can help to answer some of these questions, and it is with this aim that our project began in 2015.

3. Methods, Data Sources, and Data Limitations for a Remote Assessment

Like many other research groups monitoring heritage resources in conflict zones [e.g., 2, 28, 30, 31, 64], we rely on commercial satellite imagery to remotely assess damage to archaeological sites in inaccessible areas. We also rely on the innovative integration of a variety of geospatial datasets generated by the Soviet Union and by the US government, in concert with historical and modern satellite imagery, to predict possible future damage to sites by urban growth and mining. Because of the government partnerships that US State Department funding afforded us, our team had access to an unusually large number and variety of imagery sources. This level of access is currently unparalleled among other similar projects, except those of the American Schools of Oriental Research Cultural Heritage Initiative (ASOR CHI) [28, 30].

3.1 Damage Assessment

3.1.1 Imagery Sources
In our first assessment, we remotely evaluated temporal and spatial patterns of looting and other forms of site destruction using two main imagery sources. Our primary data collection involved visual inspection of known archaeological sites in high-resolution, time-stamped images from the DigitalGlobe Corporation, dating from 2000 to 2017 and viewed in a repository accessed through special permission given by the US State Department. This repository, also used by the ASOR CHI, contains tens of thousands of images of various dates purchased by the US government, many times the number publicly available through sources such as Google Earth and Bing Maps. The majority of these images date to the last ten years (2007-2017). They vary in resolution from roughly 30 to 60 cm and are available as single-band panchromatic and true-color pan-sharpened images. Team members viewed these images online through the EnhancedView Web Hosting service. Very high-resolution (10 cm) imagery and topographic models from the Army Corps of Engineers' BuckEye Program provide a second important source of data. BuckEye data are limited in their temporal coverage (2007-2015) and do not cover the whole country. However, both the resolution of this imagery and the accompanying topographical data allow us to see certain types of damage that might go unrecognized from a DigitalGlobe image. US State Department contacts provided hard drives storing BuckEye data, and these data were viewed in ArcGIS.

Based on their date ranges, our main imagery sources only provide data on destruction occurring after the American invasion, at the very end of the conflict timeline reviewed above (Figure 2). Early looting from the late monarchy period, the decade of Soviet occupation, and the Civil War

pre-dates the earliest available high-resolution commercial satellite imagery. Unfortunately, the major free/low cost source of historical satellite imagery—the CORONA spy satellite program—was of limited use. The earliest CORONA images of Afghanistan date to 1962 but have a maximum resolution of ca. 7-10 m, too low for the detection of looters' pits. In our analysis, we relied on CORONA images from 1964 to 1970 from ten different KH-4A and 4B missions[1] that had a maximum resolution of 1.8-2.7 m. This higher resolution only sometimes allowed for damage assessment, when the image happened to be especially clear or when the site was located in the center (highest resolution) part of the image. However, the resolution was too low in 96% of the cases (712/744 sites covered by CORONA) for a looting assessment to be performed. Recently-declassified KH-9 HEXAGON imagery, from the higher-resolution satellite program that succeeded CORONA, can allow for detailed analysis of the situation in the period between 1971 and 1984. A future paper drawing on difficult-to-access HEXAGON imagery will discuss the appearance of large-scale looting in northern Afghanistan in the early 1980s on the basis of select images.

3.1.2 Site Database
We draw our site lists and basic information from the *Archaeological Gazetteer of Afghanistan* [65]. Where possible, the Gazetteer sites have been located on DigitalGlobe satellite imagery in order to derive more accurate location information and to enable diachronic analysis. Certain types of sites such as lithic scatters, rock art, and caves cannot be seen in satellite imagery and therefore cannot be monitored. Of the 1284 sites covered by the Gazetteer, 765 were visible in imagery. These sites mostly consist of settlement mounds, forts or caravanserais, and "ruin fields" with standing architecture. Many of the sites listed in the Gazetteer are in fact agglomerations of several mounds or distinct "ruin fields" that have separate histories of looting and other forms of damage. For this reason, various components of such sites were digitized separately, and the total number of separately analyzed areas ("sites") in the reported figures and graphs below is 1002.

The Gazetteer sites form a biased sample of Afghanistan's archaeological heritage, and so regional conclusions require caution. Archaeological knowledge in Afghanistan is concentrated in river valleys and along roads, leaving large blank spaces, especially in mountain and desert areas (Figure 3). Our ability to monitor sites is contingent on them appearing in satellite imagery, and greater imagery coverage of more populated areas likewise shapes where sites can be well studied diachronically. Where we make regional statements, these are offered as hypotheses that must be considered in light of data limitations.

3.1.3 Damage Assessment and Definitions
Each of the 1002 sites was inspected on every available image, and information was recorded in a FileMaker Pro database about the different types and extent of damage, listed by image and date. The database comprises over 10,000 records, each corresponding to a single dated image and site. Analysis of a site involved the following steps: (1) The analyst chronologically arranged

---

[1] KH4A Mission 1007, June 1964; KH4A Mission 1021, May 1965; KH4A Mission 1039, March 1967; KH4A Mission 1043, September 1967; KH4A Mission 1048, October 1968; KH4A Mission 1052, September 1969; KH4B Mission 1104, August 1968; KH4B Mission 1107, July 1969; KH4B Mission 1108, December 1969; KH4B Mission 1110, May 1970.

all the imagery available for the site and created a new record in the database for each image, recording the analyst's name, date, and the image ID; the image ID was linked relationally to a separate table which stored the image's metadata (source, date, and resolution). (2) The analyst assessed the visibility of different types of damage relative to the previous images. We made a distinction between damage due to looting and damage caused by agriculture, development, or military occupation (Figure 4). Other human activity and natural damage was also recorded, but as these types of damage did not pose the same degree of threat to the sites in Afghanistan, we do not discuss them here. For each damage type, the analyst selected one of the following visibility options: "unknown" (if the site was not visible in that image), "none," "earliest image: already damaged" (if this was the first image in which the site was visible), "first seen" (if the site had appeared in earlier imagery undamaged), "same", or "increased." (3) The analyst assessed the extent of damage for the site as a whole using a rubric (Table 1). This enabled us to nuance our diachronic understanding of impacts to the Afghan archaeological landscape with a sense of damage intensity as well as frequency. (4) Finally, the analyst made comments about specific forms or locations of damage and other relevant information. A summary table in the FileMaker Pro database allows a user to view all the records for a given site, and thereby track change on a year-to-year and sometimes month-to-month basis, noting when different forms of damage began and whether they continued or intensified. In total, 766 of the 1002 sites (corresponding to 575 of 765 Gazetteer entries) showed some form of damage in one or multiple available images.

The four categories of damage analyzed below—looting, agriculture, development, and military occupation—require definition in order to clarify how each type of damage was remotely identified. The category of "looting" includes all forms of illicit excavation of a site in order to obtain artifacts or other archaeological materials. In imagery, looting is visible in the form of pitting and trenching along exposed sections of archaeological sites. Its severity varies not only with horizontal extent of pits, but also with their depth. Looting is distinct from, but often occurs in tandem with, other forms of destructive activity. "Agricultural" damage to sites occurs when they are covered with plowed fields or used as part of irrigation systems. Such damage can be relatively superficial or more severe depending on the stratigraphic depth of the site and the modern activities affecting it. For example, plowing may not significantly transform larger mounds, but may totally erase surface architecture. Other types of activities such as major earthmoving for terracing or irrigation are more universally destructive. Damage from "development" occurs due to existing human occupation on the site or the encroachment of new construction for infrastructure projects and/or the expansion of towns and cities. Development also includes a range of differentially invasive activities, from the building of garden walls to mining. Our final category, "military activity," covered all destructive uses of archaeological sites for military or strategic purposes. Forms of military destruction include the construction of roads, the excavation of trenches and foxholes, and the installation of buildings, towers, and other fortifications at a site. Sites also may be damaged by explosion, bulldozing, shelling, or gunfire, though these activities are not always visible in satellite imagery. Our methodology emphasizes that the presence of one form of damage at a site does not preclude others, and we developed the FileMaker Pro database so that multiple forms of damage could be recorded for each individual image.

It should be noted that is not always possible to tell the difference between military and development-related destruction to sites, as both involve construction that can look very similar.

Where military-related destruction has been identified, we relied on clues in the imagery to disambiguate it from development-related destruction, such as the use of HESCO "concertainer" fortification emplacements, armored vehicles, tents and/or temporary buildings, radio towers, and other diagnostic objects like radar signal-jamming equipment and surveillance blimps. Known militarized sites, for instance the border post of Islam Qal'a in Herat Province (Gazetteer site 454) and the US Operating Bases at Begram in Parwan Province (Gazetteer site 122) and Spin Boldak in Kandahar Province (Gazetteer site 1108), helped us to identify features distinctive to modern military installations.

3.2 Prediction of Future Damage

To complement the systematic diachronic assessment of damage to archaeological sites, in a second assessment we used GIS to model patterns of development that could potentially damage sites in the future. We spatially integrated disparate datasets generated by the Soviet Union, the US government, and our own project in order to quantify the potential threat that a lack of infrastructural (mining) and urban planning may pose in the near future to archaeological heritage in Afghanistan.

Our assessments of potential future damage relied on both the location of Gazetteer sites used in the damage assessment and on the locations of previously un-catalogued and/or unmapped sites. The additional sites were identified using high-resolution imagery and georectified 1:50,000 topography maps produced by the Soviet Military Topography Service that date to the mid-1980s. Similar map series exist for all of former Soviet Central Asia and are an important data source for archaeological and heritage research [66, 67]. Soviet topographers marked the location of a variety of types of archaeological sites visible in the aerial photographs used to produce the maps, including mounds, partially standing architecture, and ruins. Within areas that might be susceptible to destruction from urban growth or mining, we digitally catalogued and mapped the sites marked in Soviet maps using GIS and satellite imagery. We also performed systematic "remote survey" within certain areas of interest (such as the Balkh Oasis and Dusar Sha'ida; see Figure 3) using satellite imagery in order to map additional sites missed by the Soviet topographers.

For our assessment of potential future damage due to mining, we targeted mining areas of interest mapped by the US Geological Survey (USGS) across Afghanistan and compared these areas of interest with sites from the Gazetteer, Soviet maps, and our remote surveys. USGS information packages, available for download on the organization's Afghanistan webpage [68], contained digital map (GIS) files on roads, population, topography, and the spatial extent of mineral deposits for mining areas of interest. The USGS determined the spatial extent of mineral deposits ("mineral halos") using hyperspectral mapping [69].

For our assessment of potential future damage due to urban growth, we generated maps of urban expansion for Afghanistan's ten largest cities and compared these with the locations of mapped sites. Urban growth was included in the general category of "development"-related damage during the analysis described in the previous section. In this second assessment, however, we focused specifically on urban growth because it is a type of damage that is particularly easy to track over time and predict for the future, given that it is concentrated on the fringes of the

largest and fastest-growing cities. CORONA, LANDSAT, and DigitalGlobe imagery shows increasing urban growth since the 1960s. "Urban footprint" polygons were traced from these images and overlaid on the locations of archaeological sites from the Gazetteer and Soviet maps. Distance buffers based on the most recent urban footprints (from 2016 to 2017) show which sites are likely to be affected in the near future.

4. Systematic and Diachronic Assessments of Different Types of Observed Damage

4.1 Looting

The project was built on the model of several projects concerning heritage destruction in Iraq, Syria, and Egypt, and so our initial focus was on looting. 474 out of 1002 analyzed sites (47%) showed signs of looting. However, the diachronic analysis reveals that a much lower percentage have been looted within the study period: only 173 out of 1002 sites (17%) showed an increase in looting between 2000 and 2017 in the available imagery. Both looted sites in general and sites where looting has increased cluster in the northern oases of Afghanistan (Figure 5), an important point we consider at greater length in the discussion section.

Imagery availability shapes our ability to draw finer-grained conclusions. No sites were covered by imagery in every year within the study range (2000-2017), and only 27% of the sites were covered by imagery captured prior to 2007. The number of sites with an increase in looting by year and the limitations in our data (mainly the limited number of observations earlier in time) are best visualized in chart form (Figure 6a).

The major conclusions we draw from these data are: (1) A large percentage of all looted sites were already looted by the time we first saw them in the DigitalGlobe imagery, (418/474, 88%). Frustratingly, the earliest date of the imagery available for each site was highly variable and ranged across a decade (2001-2010), making the 10 years after the US invasion of Afghanistan very difficult to track. Nonetheless, a majority of all looted sites (301/474, 64%) did not experience a visible increase in looting during the study period, suggesting that most looting occurred prior to the US invasion. (2) The number of sites experiencing an increase in looting in the last 10 years (2007-2017) has remained relatively constant, between roughly 3 and 9% of the sites that were observable in imagery dating to that year (Table 2). A far greater percentage of sites each year either remained not looted or looting that had begun in previous years did not appear to continue.

CORONA imagery, as we have already noted, is typically too low in resolution to assess possible looting during the 1960s and early 1970s. However, we can detect small amounts of looting between 1968 and 1970 at a handful of sites (12 sites out of the 32 total visible in high resolution) that are covered by good-quality CORONA images.

4.2 Agricultural Expansion

Agriculture has undoubtedly encroached on and damaged archaeological sites for decades. Data from the UN's Food and Agriculture Organization show that 58% of Afghanistan's total area has been dedicated to agricultural purposes since at least 1961, and the amount of land under

irrigation increased steadily up until 1993, when conflict intensified [70]. Our analysis shows that agricultural activities continue to affect a large number of archaeological sites. 420/1002 assessed sites (42%) showed signs of agricultural damage, and 215 sites (21%) showed an increase in this type of damage during the study period (Figure 6b). Agricultural damage was most widespread in the central parts of the northern oasis areas (Balkh, Kunduz, and Kokcha River Oases) and in the Helmand, Hari Rud, and Kabul River Valleys because these are the areas of Afghanistan with the most arable land (Figure 7).

Recent agricultural expansion in some areas may be related to the cultivation of poppy for opium production. The United Nations' Opium Surveys in 1994-2016 show a nearly steady increase in the estimated number of hectares dedicated to opium poppy cultivation in 2002-2007 and again in 2009-2016. Increases in agricultural damage to the analyzed archaeological sites were highest in 2013, 2015, and 2016; it is probably not a coincidence that the UN reports the largest number of hectares (> 175,000) under opium poppy cultivation in 2013, 2014, and 2016 [71: 14]. These Opium Surveys indicate that there have been some significant shifts in the locations of intensive poppy cultivation in recent decades, but that consistently over the last twelve years Helmand has been the province with the largest poppy production, distantly followed by Kandahar, Uruzgan, Farah, Nangarhar, Badghis, and Nimroz Provinces [71: 14-27]. Clusters of sites damaged by agriculture were documented in the river valleys of Kandahar, Farah, Nangarhar, Badghis, and Nimroz Provinces and especially in Helmand Province.

4.3 Development

Development activities affect a similar number of sites as agriculture. 403/1002 assessed sites (40%) showed signs of development-related damage (Figure 6c). 288 sites (29%) showed an increase in this type of damage during the study period. Spatial patterns of damage from development and agricultural activity are similar; a chart of damage types by geographic region indicates that these two types of damage threaten roughly equal numbers of sites across the country (Figure 8). As one would expect, there are clear clusters of development-related damage in river valleys/oases and around the 10 largest cities (except Farah) (Figure 9). Two areas of the country—south of the city of Herat and south of the capital at Kabul—show development-related damage but little or no agricultural-related damage.

4.4 Military Installations

The reuse of archaeological sites, especially mounds and fortified sites or enclosures, is common because of the strategic advantage provided by these places. They are often higher than the surrounding area, making them valuable for surveillance, and the largest of these sites are frequently located on long-used routes through difficult terrain.

111/1002 sites (11%) showed military-related destruction (Figure 6d). 67 sites (7%) showed an increase in this type of damage during the study period. These sites are heavily concentrated in three areas: in the vicinity of Kabul and in the northern oases of Balkh and especially Kunduz (Figure 10). CORONA imagery shows us that military damage of some sites stretches back to

the 1960s. For example, Cham Qal'a (Gazetteer site 169)[2] in Baghlan Province and Islam Qal'a (Gazetteer site 454)[3] in Herat Province both appear to have been damaged by military installations in the mid-to-late 1960s.

4.5 Summary and Extent of Different Forms of Damage

We began with a cultural heritage assessment focused on damage caused by looting, but soon realized that damage to archaeological sites is the result of many factors, and that looting frequently co-occurs with damage related to other activities. Where looting is visible at archaeological sites, this destruction is accompanied by another type of damage 80% of the time (377/474). In analyzing the extent of damage to the sites, it is readily apparent that agricultural activity and development are the leading causes of total and extensive destruction. 55 sites were totally destroyed by the end of the study period, 26 solely by the expansion of agricultural activity, 17 by increased development, and 5 by a combination of the two. Two of the sites were totally destroyed by the construction of military complexes, while a further 5 were swept away by the changing course of rivers on which they were situated. Another 298 of the analyzed sites were extensively damaged, but portions of the sites remain intact as of 2017. Agricultural activity and/or development (in the absence of documented looting or military activity) were responsible for damage to nearly one-fifth of the extensively damaged sites, with 21 sites affected solely by agricultural activity, 20 by development, and 26 by a combination of the two. Looting was also a contributing factor to substantial damage: it was the sole cause of extensive damage to 35 sites, and it co-occurred with other types of damage at another 171 extensively damaged sites.

These observations point to the need for management strategies aimed at the many activities—not just looting—that are affecting archaeological sites in Afghanistan. Looting associated with development, urban expansion, and agricultural intensification may frequently be more opportunistic than systematic, but it is widespread and suggests that those who loot sites are not always simply "looters" but are also involved in construction, farming, irrigation, and other activities. Building on these observations, we constructed two spatial queries in GIS to quantify the potential impacts of unmanaged infrastructural expansions in Afghanistan, focused specifically on the extraction of mineral resources and the spread of major cities into their hinterlands.

5. The Ongoing and Potential Future Impacts of a Lack of Development Planning

5.1 Future Mining

Alongside looting, mining has been the most-discussed threat to Afghanistan's archaeological sites in recent years, mostly due to international outcry over plans for a mine at Mes Aynak, an important archaeological site southeast of Kabul. This huge Buddhist city, composed of forts, a citadel, fortified monasteries, stupas, a fire temple, as well as numerous workshops and domestic areas, sits on top of Afghanistan's largest copper deposit [11, 38, 61]. The Afghan government

---

[2] DS1104-2153DF232 (17 August 1968)
[3] DS1021-2135DF024 (27 May 1965)

has leased the Mes Aynak copper-producing area to a Chinese corporation for 30 years. As mining in the area would destroy the site, there have been recent salvage archaeology efforts. Various aspects of these efforts and the corruption surrounding the planned mining and archaeological activities have been widely reported in the media and depicted in a recent documentary film [60, 72-78].

In the last decade, US efforts to help re-build Afghanistan have included geological programs that have identified, mapped, and valued mineral deposits across the country. The jobs, revenue, and infrastructure generated through mineral extraction could significantly improve Afghanistan's economy. With the goal of attracting investment from foreign mining corporations, the USGS used remote-sensing and ground-survey data to prepare "information packages" for 25 different mineral "areas of interest," 8 of which were identified as "high priority" for development (including Mes Aynak, which had already been leased) (Figure 11). These information packages contained digital map (GIS) files on roads, population, topography, and the spatial extent of mineral deposits and were publicly available on the USGS' Afghanistan webpage in order to "entice companies to bid on the rights to deposits" [79: 727].

From an archaeological and cultural standpoint, these USGS information packages are problematic because no heritage data was provided, even though lists of archaeological and historical sites have long existed and digital versions were held by other sectors of the US government (including the United States Central Command [CEMML database, which replicates portions of the 1982 Gazetteer in digital form] and the National Geospatial-Intelligence Agency [whose Geographic Names Database contains a large number of heritage sites]). Considering only the 1284 major sites in the 1982 Gazetteer, the USGS mineral areas of interest cover 210 archaeological sites. Using files generated by the USGS, we can say even more. While all 210 sites could be at risk from future mining and associated infrastructure, 61 sites fall within the bounds of "mineral halos" identified by the USGS via hyperspectral aerial mapping as mineral-bearing areas where mining itself might occur. Unsurprisingly, one such site is Mes Aynak. Like many other sites, Mes Aynak has long been known and included in heritage lists (it was first excavated in the 1970s), and the inclusion of its location within the information packages might have contributed to a consideration of the potential impact of mining on cultural heritage before the China Metallurgical Group signed a contract with the Afghan government in 2008. Likewise, Bamiyan lies just 11 kilometers away from the mineral halos of the Hajigak iron deposits, which were almost leased to an Indian consortium before talks on the deal ceased in 2015 [54, 80], and the inclusion of heritage data for that region should be a priority if talks ever resume.

The impact of future mining on Afghanistan's cultural heritage could be much greater than the numbers above might suggest, especially as many of the mining areas of interest lie in mountain and desert areas that archaeologists have never explored. For example, the Dusar Sha'ida mining area, which is designated "high priority" for development by the USGS, has been minimally explored archaeologically, and contains only 11 Gazetteer sites. When we systematically inspected satellite imagery of Dusar Sha'ida, we found 44 additional archaeological sites of significant size. 21 of these were marked in Soviet maps of the area and therefore were known (though not catalogued) at the time the USGS information packages were produced (Figure 12).

5.2 Future Urban Growth

The impact of future urban expansion is a major concern for Afghanistan due to the dual demographic pressures of mass-scale repatriation of citizens from Iran and Pakistan and rural-urban migration. Afghanistan's rate of urbanization has been among the highest in the world in the last two decades [81: vii]. The antiquity of several of Afghanistan's major cities and a general lack of urban planning ("informal urban growth") [82] mean that important archaeological remains are continually threatened. Unchecked urban growth is, of course, not a new problem. The destruction of historical buildings has occurred as part of partly foreign-funded modernization and development programs since the mid-twentieth century [54]. The current situation is very difficult for planners: they are "caught in the legacy of outdated Master Plans [from the 1960s], while they often lack the resources and commitment to safeguard urban monuments" [54: 357-359]. The problem will only grow in the coming years.

With historical satellite imagery, we can trace the scale of the potential effect that urban expansion has had on heritage sites in recent decades and predict the effect that urban expansion may have on additional sites in the future. We tracked urban growth in the ten largest cities of Afghanistan since the 1960s using methods described in section 3 (Figure 13). "Urban footprint" polygons were overlaid on locations of archaeological sites listed in the Gazetteer and marked on Soviet topography maps (Figure 14). These data show that at least 166 archaeological sites have been swallowed by cities in the last 50 years, since the time of CORONA imagery. Another 134 mapped sites are within 1 kilometer of the current city boundaries and therefore are likely to soon be at risk (Table 3). A more nuanced model of archaeological heritage sites potentially threatened by the unchecked expansion of the city of Herat is forthcoming [83].

5.3 Summary

The spatial integration of disparate datasets generated by the Soviet Union, the US government, and our own project allowed us to quantify the potential threat that a lack of planning for mining projects and urban growth may pose in the near future to archaeological heritage in Afghanistan. In some cases, these threats could be mitigated in straightforward ways, but in quantitative terms their threat to cultural heritage is as significant as that of systematic or incidental looting. They could affect hundreds of known sites and previously uncatalogued sites across the country.

6. Discussion

Our systematic, diachronic assessment allows us to draw a number of conclusions regarding temporal and spatial patterns in damage to archaeological sites. Further, our historical analysis using maps, geological data, and satellite imagery allows us to quantify the scale of ongoing and potential future threats to archaeological sites from mining and urban expansion.

A large percentage of archaeological sites in Afghanistan are looted, but in terms of ongoing damage, looting is not the most pressing threat to archaeological sites in most regions of the country. Only 17% of assessed sites have experienced increases in looting during the study period of 2000-2017, but during this same period 21% of sites (215/1002) have experienced increases in destruction due to agriculture, 29% of sites (288/1002) have experienced increases in

destruction due to development, and 46% of sites (456/1002) have experienced increases in destruction due to a combination of development, agricultural intensification, and/or military activity. To further illustrate this point, 45 of the sites we analyzed for this study were not yet damaged in the earliest available DigitalGlobe images but later showed damage. Only 5 of these 45 sites were later looted, while some other form of human intervention caused damage to the other 40 sites (29 of them were later damaged by development and 12 by agriculture). Our predictive analyses of urban expansion (a specific type of development-related damage) and of the occurrence of archaeological sites in mining areas also indicate that these are two significant forms of ongoing and potential future damage to hundreds of archaeological sites, many of which have not been previously catalogued in the 1982 Gazetteer or existing databases.

Looting is a regional phenomenon that is unevenly distributed throughout Afghanistan. Broad geographical differences across Afghanistan have resulted in different types of ancient settlement and modern activity, which in turn shape the cultural heritage situation because they affect the number of sites attractive for looting as well as the presence of other modern processes that result in damage. When we graph the statistics for sites analyzed within the northern oases, the western lowlands, the southern lowlands, and the Hindu Kush Mountains separately, strong spatial patterns emerge (Figures 5 and 8). There are pronounced looting "hotspots" in the northern oases, where 75% of the analyzed sites were looted and 44% of looted sites experienced an increase in looting from 2000-2017. Elsewhere in the country, looting accounts for damage at less than 50% of the analyzed sites and 24-32% of the looted sites experienced an increase in looting from 2000-2017.

Philippe Marquis, former head of the Délégation Archéologique Française en Afghanistan, has recently claimed that 99% of sites in Afghanistan are looted [quoted in 34]. Our study reveals that this statement is, tragically, broadly true for the northern regions of Balkh and Kunduz, where collectively 75% of sites are looted, but does not accurately represent the situation in the country as a whole. Outside of the 1002 sites included in this diachronic study, we have documented over 2000 new sites in the Balkh Oasis, northwest of Mazar-i Sharif. Nearly 100% of the most highly visible sites in our Balkh study area—mounds and qalas—had been looted before the capture date of recent DigitalGlobe imagery (2010-present), but other types of sites like large enclosures were typically not looted [84]. This very thorough pattern of looting is not present elsewhere, and is a special situation related to local and regional factors: a large number of highly-visible mounded sites in the Balkh oasis, expansive agriculture, and a lack of government control. Similar analyses across Syria, Iraq, southern Turkey, and Lebanon found that mounded sites are most likely to be looted—80% of looted sites were mounds [28]. Although our study did not address site morphology, we can confidently state that this general conclusion is also true for Afghanistan.

Spatial patterns revealed by the looting analysis provide some insight into the parties responsible for the ongoing destruction. When these spatial patterns are overlaid on a map of areas of Taliban insurgent activity 2004-2009, culled from Wikileaks data, and maps of areas of Taliban control or influence 2015-2016 created by the Institute for the Study of War, it becomes apparent that significant amounts of looting have occurred outside of those regions (Figures 15 and 16), especially in northern provinces that have not been Taliban strongholds. This indicates that the Taliban are not the only actors driving looting in parts of Afghanistan. This conclusion will come

as no surprise to cultural heritage specialists working in both Afghanistan and in other areas of the Middle East. Several authors have already pointed out the fact that the Taliban tend to be blamed too much or too singly for their involvement in the destruction of Afghanistan's archaeological sites [51: 39-40] and that local warlords of every political and ethnic affiliation are to blame for looting [24: 25]. However, this conclusion is still important to emphasize because it goes against the prevailing narrative perpetuated by the media and some elements of the cultural heritage community, who over-emphasize events tied to the Taliban—like the explosion of the Bamiyan Buddhas—in the service of gaining attention and funding for cultural heritage programs.

Our study has a number of limitations that are shared among all satellite imagery-based regional cultural heritage assessments. Many of these limitations we have already discussed: our conclusions are limited by the spatial and temporal coverage of the available imagery; image availability changes from site to site and region to region; some types of damage cannot be recognized from a remote, aerial perspective; our maps of known archaeological sites contain systematic regional biases; not all types of sites can be effectively monitored from a remote perspective. A further limitation lies in the two-dimensional nature of standard single-band satellite imagery. While tunneling can be detected under the right circumstances, the extent of damage caused by this kind of disturbance is difficult to quantify. Systematic looting may be ongoing at archaeological sites and may remain undetectable in most single-band imagery if it occurs within systems of earlier looting pits, although analyses utilizing multispectral imagery and space-borne radar have been able to model change within already looted areas [85, 86].

Further work could address some of these limitations. Acquisition of other high-resolution imagery datasets to fill in the gaps in our image timeline (including declassified HEXAGON imagery) would allow for assessments of pre-Taliban and Taliban-era cultural heritage conditions. Detection of looting that might have occurred within systems of earlier looting pits might be possible with finer-grained analysis using the highest resolution imagery available (BuckEye), as well as with on-the-ground assessments. The study could be expanded to consider other destructive forces that our analysis has not systematically recorded, particularly damage caused by forces like erosion that are at least partially natural but can also be accelerated or slowed by human intervention [87, 88: 17]. Other useful refinements to our datasets could come from more detailed assessment of sites where increased looting has occurred. Assessing the size of the area of increased looting, paralleling ongoing projects in Syria/Iraq [e.g., 2, 28, 29], and assessing patterns in the date of archaeological sites targeted for looting, paralleling past projects in Iraq [25], could provide useful quantitative data on the scale of looting increases and on the demands of the antiquities market. Inclusion of a broader range of site types should be a primary aim in any future extension of our damage assessment. To date, we have examined only sites from the 1982 Gazetteer, which are likely to be among the largest sites in Afghanistan. Different phases of systematic damage assessment across Syria, Iraq, southern Turkey, and Lebanon show that heritage conclusions shift based on whether assessments include only large, important "priority" sites [2, 29] or whether they include sites mapped only via satellite imagery that have previously been unknown to researchers [28].

Our major conclusions—that looting is a regionally-specific phenomenon in Afghanistan carried out by multiple actors (not just the Taliban) and that other forms of development-related

destruction (related to agriculture, urban expansion, and mining) are individually and collectively more pressing threats to archaeological sites than looting—are paralleled by those of collaborative projects studying the fate of cultural heritage in the post-Arab-Spring Middle East. For example, spatial analysis of recent looting patterns at over almost 3000 sites in Syria showed that looting is carried out in territory controlled by various factions involved in the Syrian Civil War, not just extremists like the Islamic State, whose performative destructions have been the focus of international media reports [2, 28]. Further, this systematic study found that agricultural and urban expansion were the most prevalent forms of damage to heritage sites in war-torn Syria, not looting or military damage. Recent debates arising from satellite-imagery assessments of the preservation of thousands of archaeological sites in Egypt have revealed that looting is only a pressing preservation problem in the Nile River Valley and in the Nile Delta, although "encroachment," or the unregulated expansion of human activities, damages the greatest total area of archaeological sites. Broader assessments of a greater variety of types of archaeological sites throughout the Eastern Desert indicate that development and "encroachment" cause much more severe and widespread destruction [64, 89, 90].

However, other aspects of our conclusions point to important differences in the cultural heritage situation in Afghanistan versus the post-Arab-Spring Middle East. A critical distinction in the histories of looting in these two regions lies in their timing. On the one hand, the percentages of sites affected by war-related looting in Syria and over the last 10 years in Afghanistan appear to be remarkably similar. The ASOR Cultural Heritage Initiative's initial satellite imagery analysis of 700 "priority" sites reported that 22% of the analyzed sites in Syria have experienced war-related looting since 2011 [2: 145, 151], and their expanded analysis of 2641 sites in Syria reported that 13.4% of sites have experienced war-related looting [28]. Our analysis, which is more comparable to their initial set of numbers because of its examination of larger "priority" sites, recorded an increase in looting at 17% of analyzed sites in Afghanistan since 2007. The difference in these cases is that many more sites in Afghanistan were looted before the study period: 25% of the "priority" sites analyzed in Syria (20% in the expanded dataset) were looted before 2011 [2: 145, 28], while a much larger number (47%) of the sites we analyzed in Afghanistan were looted at some point, and 42% of all sites were looted prior to their first appearance in DigitalGlobe imagery dating 2000-2017. While our current imagery sources do not allow us to pinpoint the exact period in which systematic, large-scale looting began in Afghanistan, our analysis suggests that looting is staggered across this timeframe, and, critically, cannot solely be attributed to performative or other strategies of destruction undertaken by Islamist groups. Our results also suggest that looting has been a much more severe and widespread threat to sites in Afghanistan over time than it has in Syria/Iraq. This would make sense given the much longer history of multi-factional conflict in Afghanistan.

7. Conclusion

The cultural heritage of Syria, Iraq, and Afghanistan have frequently been a topic of international media reports because of attention-grabbing destruction events by extremist groups. But in many ways, the overwhelming focus on such events tells a biased story of the fate of cultural heritage in these nations. Our spatial and temporal assessment of over 1000 sites across Afghanistan using time-stamped high-resolution satellite imagery suggests that common narratives about Afghan cultural heritage that focus on the Taliban and highly publicized destruction events are at

best incomplete. Our analysis indicates a protracted timeline for looting in Afghanistan, with significant amounts of damage to sites occurring before and after the US invasion and continuing up to the present. Damage to sites in Afghanistan is caused by a plurality of factors not directly motivated by the sale of looted antiquities. Nonetheless, these factors (especially agriculture and development) destroy sites and open up possibilities for the looting of artifacts. Ongoing looting occurs across the country, but it is heavily concentrated in northern areas that have not been Taliban strongholds. This suggests that actors of various factions and ethnic affiliations engage in looting and antiquities trafficking, not just the extremist Taliban. While both Syria/Iraq and Afghanistan have seen similar rates of looting at archaeological sites in recent years, Afghanistan has a much longer and more intensive history of systematic, highly-destructive looting dating back decades, reflecting its longer history of conflict.

Our quantitative assessment points towards the most pressing issues endangering Afghan heritage—development and agriculture—and therefore should help enable more effective cultural heritage protection strategies. Future threats to heritage are not effectively combated by an exclusive focus on the looted antiquities trade. The systematic destruction analysis we conducted demonstrates the importance of diachronic and regional quantification for untangling local and broader patterns from countrywide generalizations and popular narratives reported in the media. Further, our second assessment of urban growth and mining identifies which sites should be a priority for protection and planning in the future. Systematic and quantitative cultural heritage research must balance the use of performative site destruction and looting to drive popular concern for global heritage, even as ongoing research is dependent on such popular concern for its support.

Going forward, the digital databases we have developed during the course of our research—a GIS database of archaeological sites and a related database of damage assessments for these sites—will be critical tools for antiquities officials, heritage professionals, and archaeologists working in Afghanistan. The GIS database is the first Afghanistan-wide database containing highly accurate site locations, and it can be spatially queried alongside GIS data generated by Afghan government ministries. We hope it will become a planning tool that will allow heritage protection to be incorporated into mining, economic, and urban development projects. The damage assessment database can be expanded as new imagery becomes available, and it can be queried in both spatial and non-spatial ways to reveal patterns beyond those we have presented here. The Department of State-funded Afghanistan Heritage Mapping Partnership, of which our analyses here are only a part, works to move beyond data-sharing by training a cohort of Afghan information technology specialists and heritage professionals in the use of GIS technology for heritage management, and by extending existing Afghan university GIS curricula for urban planning and geology students to include archaeological applications of GIS. In the future, when the security situation allows it, individuals trained through our Kabul-based GIS programs will hopefully be in a position to check our remote assessments of sites and landscapes. This "ground-truthing" should be an essential step in transforming our assessments into actionable policies.

Through the project's commitment to an exchange of data and management tools with collaborative partners on the ground in Afghanistan, we respond to broadening concerns regarding the politics and end goals of satellite imagery-based heritage research. Our analyses

would have been impossible without access to non-public government repositories of high-resolution commercial satellite imagery and other datasets generated by the US in its role as an occupying military power. Echoing the recent statements of Casana and Laugier [28], we call for expanded public access to high-resolution commercial satellite imagery purchased by the US and European governments. We also insist on the importance of pairing remote satellite imagery-based heritage assessments with a broad commitment to local capacity-building in the fields of geospatial technologies and heritage protection. As our results demonstrate, advocating for the protection of archaeological heritage in Afghanistan and elsewhere requires not only attending to global trends in consumption of looted antiques, but also understanding the everyday relations between people and archaeological landscapes under conditions of conflict and rapid development.

Acknowledgements

Figure Captions

Figure 1: Major topographical features and modern cities of Afghanistan. Provinces discussed in the text are labeled. Topographical data are from the Shuttle Radar Topography Mission (SRTM) and is distributed by the USGS.

Figure 2: Timeline of major political changes in Afghanistan and how these temporally intersect with available satellite imagery datasets.

Figure 3: Distribution of the 1002 archaeological sites included in the diachronic analysis of looting and other forms of destruction, in relationship to four major geographical zones in Afghanistan. These correspond to 765 entries in the 1982 Gazetteer. Topographical data are from the SRTM and is distributed by the USGS. The extent of two additional study areas mentioned in the text are marked: the Balkh Oasis and the Dusar Sha'ida mining area.

Figure 4: Examples of each type of damage to archaeological sites as seen in DigitalGlobe imagery: (a) Looting at Abu Huraira in Balkh Province (Gazetteer site 8); (b) Military activity at Gur Tepe in Kunduz Province (Gazetteer site 400); (c) Development-related damage at Lashkari

Bazar in Helmand Province (Gazetteer site 685); (d) Agricultural-related damage at Kafir Qal'a in Kunduz Province (Gazetteer site 487). Base imagery courtesy of DigitalGlobe.

Figure 5: Distribution of the 474 looted sites, 173 of which showed an increase in looting 2000-2017, in relationship to four major geographical zones in Afghanistan. Note the major concentration of looted sites in the northern oases.

Figure 6: Graphs showing the number and type of observations made for each year of the study period for each of four types of damage to archaeological sites: (a) looting; (b) agricultural expansion; (c) development; (d) military activity. This method of display clearly shows that the number of available satellite images (and therefore also possible observations) dramatically increases beginning in 2007. For each type of damage, color differences show the proportion of observations that showed no damage, versus increase or first appearance of damage, versus no change in previously observed damage.

Figure 7: Distribution of the 420 sites damaged by agricultural development, 215 of which showed an increase in this type of damage 2000-2017, in relationship to four major geographical zones in Afghanistan. Note the concentration of these sites in river valleys and the northern oases.

Figure 8: Graph of damage types by general geographical region.

Figure 9: Distribution of the 403 sites damaged by development, 288 of which showed an increase in this type of damage 2000-2017, in relationship to four major geographical zones in Afghanistan. Note the concentration of these sites in river valleys and the northern oases as well as around major cities.

Figure 10: Distribution of the 111 sites damaged by military activity, 67 of which showed an increase in this type of damage 2000-2017, in relationship to four major geographical zones in Afghanistan. Note the concentration of these sites in the northern oases.

Figure 11: Map of the mineral-bearing "areas of interest" for which the USGS distributed geospatial data packages in order to encourage investment by foreign mining corporations. 210 archaeological sites from the 1982 Gazetteer fall within these mining zones.

Figure 12: Map of the Dusar Sha'ida mineral area of interest, one of the areas designated as "high priority" for mining development by the USGS, and the "mineral halos" identified by USGS' hyperspectral aerial mapping. This area contains 11 archaeological sites listed in the Gazetteer and an additional 44 archaeological sites newly identified by our project during the course of a remote satellite imagery-based survey.

Figure 13: The extent of the ten largest cities in Afghanistan as visible in 1960s CORONA imagery and 2015-2017 DigitalGlobe imagery, showing massive urban growth of the last decades. All cities shown at the same scale.

Figure 14: Urban growth in Kabul, as documented in a 1965 CORONA image (DS1021-2087DA024, 24 May 1965), 1985 Soviet 1:50k topography map (I-42-55), and 2017 DigitalGlobe imagery. This urban growth has engulfed a variety of archaeological sites catalogued from the 1982 Gazetteer and 1985 Soviet maps. Future growth of the city (modeled with a 1 kilometer buffer around the current extent) could imminently threaten additional sites.

Figure 15: Distribution of sites showing an increase in looting sometime during the period 2007-2010 compared to a point density interpolation of insurgency activity 2007-2009 as reported in spatial data from Wikileaks, in relationship to four major geographical zones in Afghanistan.

Figure 16: Distribution of sites showing an increase in looting sometime during the periods 2011-2014 and 2015-2017 compared to a 2016 map of areas of Taliban control/influence generated by the Institute for the Study of War.

Table Captions:

Table 1: Four-part scheme employed to assess damage extent.
Table 2: Percentage of analyzed sites showing an increase in looting by year.
Table 3: Number of sites that have been surrounded and potentially damaged by urban growth since the 1960s and number of sites likely to be in danger in the near future because they lie within one kilometer of the current city boundaries.

Table 1:

Damage Extent	Description
Minimal	Up to 25% of site area affected. Visible looting pits, soil removal, construction. Damage may be extant but non-progressive.
Moderate	25-50% of site area affected. Significant portions of site removed, clear active progression of excavation or construction. This may also include large areal coverage of less invasive damage, such as cemetery burials.
Extensive	50-100% of site affected or removed. Damage is dense and/or invasive; major coverage with construction, earthworks, etc.
Total	Site has been fully removed or obscured and is no longer visible in imagery.

Table 2:

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
No Looting	2	19	5	22	0	39	24	105	38	108	137
Same Looting	2	56	10	15	7	31	40	114	48	117	145
Increased Looting	0	1	0	0	0	2	1	6	5	13	10
Total Observations	4	76	15	37	7	72	65	225	91	238	292
Increased Looting %	0.00%	1.32%	0.00%	0.00%	0.00%	2.78%	1.54%	2.67%	5.49%	5.46%	3.42%

	2011	2012	2013	2014	2015	2016	2017
No Looting	169	232	219	75	177	190	112
Same Looting	282	251	334	136	266	327	221
Increased Looting	38	25	53	6	39	41	13
Total Observations	489	508	606	217	482	558	346

Increased Looting %	7.77%	4.92%	8.75%	2.76%	8.09%	7.35%	3.76%

Table 3:

City	Sites incorporated into city since 1960s	Sites soon to be threatened (within 1 km of 2015-2017 city extent)
Kabul	112	26
Kandahar	13	5
Herat	15	11
Mazar-i Sharif	12	10
Kunduz	0	3
Jalalabad	0	29
Ghazni	11	21
Balkh	3	21
Baghlan	0	0
Farah	0	8
Total	166	134

References

[1] Ö. Harmanşah, ISIS, Heritage, and the Spectacles of Destruction in the Global Media, Near Eastern Archaeology, 78 (2015) 170-177.
[2] J. Casana, Satellite Imagery-based Analysis of Archaeological Looting in Syria, Near Eastern Archaeology, 78 (2015) 142-152.
[3] M. Danti, Ground-Based Observations of Cultural Heritage Incidents in Syria and Iraq, Near Eastern Archaeology, 78 (2015) 132-141.
[4] C. Ali, Syrian Heritage under Threat, Journal of Eastern Mediterranean Archaeology & Heritage Studies, 1 (2013) 351-366.
[5] P.B. Campbell, The Illicit Antiquities Trade as a Transnational Criminal Network: Characterizing and Anticipating Trafficing of Cultural Heritage, International Journal of Cultural Property, 20 (2013) 113-153.
[6] A.A. Bauer, Editorial: The Destruction of Heritage in Syria and Iraq and Its Implications, International Journal of Cultural Property, 22 (2015) 1-6.
[7] E. Cunliffe, Archaeological Site Damage in the Cycle of War and Peace: A Syrian Case Study, Journal of Eastern Mediterranean Archaeology and Heritage Studies, 2 (2014) 229-247.
[8] P. Centlivres, The Controversy of the Buddhas of Bamiyan, South Asia Multidisciplinary Academic Journal, 2 (2008) 1-11.
[9] C. Colwell-Chanthaphonh, Dismembering/disremembering the Buddhas: Renderings on the Internet during the Afghan purge of the past, Journal of Social Archaeology, 3 (2003) 75-98.
[10] F.B. Flood, Between Cult and Culture: Bamiyan, Islamic Iconoclasm, and the Museum, The Art Bulletin, 84 (2002) 641-659.
[11] C. Wyndham, Reconstructing Afghan Identity: Nation-building, International Relations and the Safeguarding of Afghanistan's Buddhist Heritage, in: P. Basu, W. Modest (Eds.) Museums, heritage and international development, Routledge, New York, 2015, pp. 122-142.
[12] M. Press, How Antiquities Have Been Weaponized in the Struggle to Preserve Culture, in: Hyperallergic, 2017, https://hyperallergic.com/415471/how-antiquities-have-been-weaponized-in-the-struggle-to-preserve-culture/?
[13] C. Ruiz, What do we really know about Islamic State's role in illicit antiquities trade? Experts at London symposium warn against misinformation and lack of evidence, in: The Art Newspaper, 2016, http://old.theartnewspaper.com/news/news/what-do-we-really-know-about-islamic-state-s-role-in-illicit-antiquities-trade/
[14] N. Brodie, Good luck with that, in: Market of Mass Destruction, 2016, http://www.marketmassdestruction.com/good-luck-with-that/
[15] C. Jones, How Much Money is ISIS Making from Antiquities Looting?, in: Gates of Nineveh, 2016, https://gatesofnineveh.wordpress.com/2016/01/12/how-much-money-is-isis-making-from-antiquities-looting/
[16] H. Neuendorf, Islamic State Income from Looted Antiquities Grossly Overestimated, in: Artnet News, 2014, https://news.artnet.com/art-world/islamic-state-income-from-looted-antiquities-grossly-overestimated-189913
[17] E. Cunliffe, Satellites and Site Destruction: An Analysis of Modern Impacts on the Archaeological Resource of the Ancient Near East, in: Archaeology, Durham University, 2013.
[18] E. Cunliffe, Remote Assessments of Site Damage: A New Ontology, International Journal of Heritage in the Digital Era, 3 (2014) 435-474.

[19] K. Hanson, Considerations of cultural heritage: Threats to Mesopotamian archaeological sites, in: Near Eastern Languages and Civilizations, The University of Chicago, 2012.

[20] R.W. Baker, S.T. Ismael, T.Y. Ismael, Cultural cleansing in Iraq: Why museums were looted, libraries burned and academics murdered. Pluto Press, London, 2010.

[21] G. Emberling, K. Hanson, M. Gibson, Catastrophe! : The Looting and Destruction of Iraq's Past, in, Oriental Institute of the University of Chicago, Chicago, IL, 2008.

[22] K. Hanson, Ancient Artifacts and Modern Conflict: A Case Study of Looting and Instability in Iraq, in: P.G. Stone (Ed.) Cultural Heritage, Ethics and the Military, Boydell Press, 2011, pp. 113-128.

[23] C. Hritz, Remote Sensing of Cultural Heritage in Iraq: A Case Study of Isin, The American Academic Research Institute in Iraq Newsletter, 3 (2008) 1-8.

[24] L. Rothfield, The Rape of Mesopotamia: Behind the Looting of the Iraq Museum, The University of Chicago Press, Chicago, 2009.

[25] E. Stone, Patterns of Looting in Southern Iraq, Antiquity, 82 (2008) 125-138.

[26] P. Stone, J. Farchakh-Bajjaly, The Destruction of Cultural Heritage in Iraq, in, Boydell Press, Woodbridge, Suffolk, 2008.

[27] M. Van Ess, H. Becker, J. Fassbinder, R. Kiefl, I. Lingenfelder, G. Schreier, A. Zevenbergen, Detection of Looting Activities at Archaeological Sites in Iraq Using Ikonos Imagery, in: J. Strobl, T. Blaschkle, G. Griesebner (Eds.) Angewandte Geoinformatik; Beitra¨ge zum 18: AGIT-Symposium, Salzburg, Wiechmann-Verlag, Heidelberg, 2006, pp. 668–678.

[28] J. Casana, E.J. Laugier, Satellite imagery-based monitoring of archaeological site damage in the Syrian civil war, PLoS One, 12 (2017) e0188589.

[29] J. Casana, M. Panahipour, Notes on a Disappearing Past: Satellite-Based Monitoring of Looting and Damage to Archaeological Sites in Syria, Journal of Eastern Mediterranean and Heritage Studies, 2 (2014) 128-151.

[30] M. Danti, S. Branting, S. Penacho, The American Schools of Oriental research Cultural Heritage Initiative: Monitoring Cultural Heritage in Syria and Northern Iraq by Geospatial Imagery, Geosciences, 7 (2017).

[31] L. Rayne, J. Bradbury, D. Mattingly, G. Philip, R. Bewley, A. Wilson, From Above and on the Ground: Geospatial Methods for Recording Endangered Archaeology in the Middle East and North Africa, (2017).

[32] E. Stone, An Update on the Looting of Archaeological Sites in Iraq, Near Eastern Archaeology, 78 (2015) 178-186.

[33] A. Lawler, Afghani Looting Rampant, in: Latest News, Science Magazine, 2003, http://www.sciencemag.org/news/2003/06/afghani-looting-rampant

[34] J. Wendle, Who's Stealing Afghanistan's Cultural Treasures?, in: Weekly In Focus, National Geographic, 2013, https://news.nationalgeographic.com/news/whos-stealing-afghanistan-cultural-treasures/

[35] H. Pringle, New Evidence Ties Illegal Antiquities Trade to Terrorism, Violent Crime, National Geographic, 13 (2014), https://news.nationalgeographic.com/news/2014/06/140613-looting-antiquities-archaeology-cambodia-trafficking-culture/

[36] P. Brems, W. van den Eynde, Blood Antiquities, in, Journeyman Pictures, Surrey, UK, 2009.

[37] A.S. Haidari, Plunder Goes on Across Afghanistan as Looters Grow Even Bolder, in: Daily Outlook Afghanistan, 2011, http://outlookafghanistan.net/topics.php?post_id=742

[38] H.H. Curvers, Saving Archaeological Heritage in Afghanistan, in: American Schools of Oriental Research Blog, 2013.

[39] B. Cassar, A.R. Rodriguez Garcia, The Society for the Preservation of Afghanistan's Cultural Heritage: An Overview of Activities Since 1994, in: J. van Krieken-Pieters (Ed.) Art and Archaeology of Afghanistan: Its Fall and Survival: A Multidisciplinary Approach, Brill, Boston, MA, 2006, pp. 15-38.

[40] N.H. Dupree, Museum Under Siege, Archaeology, 49 (1996) 42-51.

[41] A.W. Feroozi, Z. Tarzi, The Impact of War upon Afghanistan's Cultural Heritage, Archaeology (2004),
https://www.archaeological.org/pdfs/papers/AIA_Afghanistan_address_lowres.pdf

[42] C. Grissman, The Kabul Museum: Its Turbulent Years, in: J. van Krieken-Pieters (Ed.) Art and Archaeology of Afghanistan: Its Fall and Survival. A Multidisciplinary Approach, Brill, Boston, 2006, pp. 61-75.

[43] O.K. Massoudi, At the Crossroads of Asia, A History of the National Museum of Afghanistan, in: J. Aruz, E. Valtz Fino (Eds.) Afghanistan: Forging Civilization Along the Silk Road, Metropolitan Museum of Art, New York, 2012, pp. 6-15.

[44] D.H. Thomas, A. Gascoigne, Recent Archaeological Investigations of Looting around the Minaret of Jam, Ghur Province, in: J. van Krieken-Pieters (Ed.) Art and Archaeology of Afghanistan: Its Fall and Survival. A Multidisciplinary Approach, Brill, Boston, 2006, pp. 155-167.

[45] M.J. Murdock, C.A. Hritz, A Report on Archaeological Site Stability and Security in Afghanistan: The Lashkari Bazar Survey, in: J.D. Kila, J.A. Zeidler (Eds.) Cultural Heritage in the Crosshairs: Protecting Cultural Property During Conflict, Brill, Leiden, 2013.

[46] F.R. Allchin, N. Hammond, Archaeology of Afghanistan: From Earliest Times to the Timurid Period Academic Press, 1978.

[47] C. Schetter, The 'Bazaar Economy' of Afghanistan: A Comprehensive Approach, in: C. Noelle-Karimi, C. Schetter, R. Schlagintweit (Eds.) Afghanistan: A Country without a State?, IKO, Frankfurt am Main, 2004, pp. 1-19.

[48] N.H. Dupree, Cultural Heritage and National Identity in Afghanistan, Third World Quarterly, 23 (2002) 977-989.

[49] N.H. Dupree, Prehistoric Afghanistan: Status of Sites and Artefacts and Challenges of Preservation, in: J. van Krieken-Pieters (Ed.) Art and Archaeology of Afghanistan: Its Fall and Survival. A Multidisciplinary Approach, Brill, Boston, 2006, pp. 79-93.

[50] P.L. Kohl, Central Asia: Palaeolithic Beginnings to the Iron Age, Éditions Recherche sur les civilisations, Paris, 1984.

[51] W. Ball, The Archaeology of Afghanistan: A Reassessment and Stock-Taking, in: J. van Krieken-Pieters (Ed.) Art and Archaeology of Afghanistan: Its Fall and Survival. A Multidisciplinary Approach, Brill, Boston, 2006, pp. 39-48.

[52] O. Tirard-Collet, After the War: The Condition of Historical Buildings and Monuments in Herat, Afghanistan, Iran, 36 (1998) 123-138.

[53] A. Lawler, Resuscitating Asia's Damaged Heart, Science, 298 (2002) 1196-1200.

[54] A.W. Najimi, Built heritage in Afghanistan: threats, challenges and conservation, International Journal of Environmental Studies, 68 (2011) 343-361.

[55] N.H. Dupree, Museum Under Siege: The Plunder Continues, Archaeology, (1998),
https://archive.archaeology.org/online/features/afghan/update.html

[56] M. Ansari, Plundering Afghanistan, Archaeology, 55 (2002) 18-20.

[57] W.C.S. Remsen, L.A. Tedesco, US Cultural Diplomacy, Cultural Heritage Preservation and Development at the National Museum of Afghanistan in Kabul, in: P. Basu, W. Modest (Eds.) Museums, heritage and international development, Routledge, New York, 2015, pp. 96-121.

[58] M.T. Fisher, G. Stein, Aks of War: A Digital Museum Inventory for a War-Torn Afghanistan, in: A. Jamieson (Ed.) 9th ICAANE, Basel, Switzerland, 2014, pp. 449-463.

[59] G.J. Stein, The War-Ravaged Cultural Heritage of Afghanistan: An Overview of Projects of Assessment, Mitigation, and Preservation, Near Eastern Archaeology, 78 (2015) 187-195.

[60] B.E. Huffman, Saving Mes Aynak, in, Kartemquin Films, 2014.

[61] P. Marquis, Les activités récentes de la Délégation archeologique française en Afghanistan (DAFA), Cahiers d'Asie centrale, 21/22 (2013) 93-98.

[62] A. Lauricella, J. Cannon, S. Branting, E. Hammer, Semi-automated detection of looting in Afghanistan using multispectral imagery and principal component analysis, Antiquity, 91 (2017) 1344-1355.

[63] R. Wilson, The illegal antiquities trade funded the Iraqi insurgency. Now it's funding the Islamic State., in: The Washington Post, 2015, https://www.washingtonpost.com/posteverything/wp/2015/03/09/how-shady-art-dealers-help-fund-the-islamic-states-violent-insurgency/?utm_term=.850084fb447b

[64] S. Parcak, D. Gathings, C. Childs, G. Mumford, E. Cline, Satellite Evidence of Archaeological Site looting in Egypt: 2002–2013, Antiquity, 90 (2016) 188-205.

[65] W. Ball, J.-C. Gardin, The Archaeological Gazetteer of Afghanistan, ADPF, Paris, 1982.

[66] B. Rondelli, S. Stride, J.J. García-Granero, Soviet military maps and archaeological survey in the Samarkand region, Journal of Cultural Heritage, 14 (2013) 270-276.

[67] K. Franklin, E. Hammer, Untangling palimpsest landscapes in conflict zones: a 'remote survey' in Spin Boldak, Southeast Afghanistan, Journal of Field Archaeology, 43 (2018, in press).

[68] US Geological Survey, USGS Projects in Afghanistan: View and Download the Information Packages, 2017, https://afghanistan.cr.usgs.gov/infopack-index

[69] S.G. Peters, T.V.V. King, T.J. Mack, M.P. Chornack, U.S. Geological Survey Afghanistan Mineral Assessment Team, Summaries of important areas for mineral investment and production opportunities of nonfuel minerals in Afghanistan: U.S. Geological Survey Open-File Report 2011–1204, 2 vols, in: USGS Afghanistan Project Product No. 199, 2011, https://pubs.usgs.gov/of/2011/1204/

[70] Food and Agriculture Organization of the United Nations, FAOSTAT Land Use Data, in, 2016, http://www.fao.org/faostat/en/#data/RL

[71] United Nations Office on Drugs and Crime, Islamic Republic of Afghanistan Ministry of Counter Narcotics, Afghanistan Opium Survey 2016: Cultivation and Production, in, UNODC Research
MCN/NSD Nacotics Survey Directorate, 2016.

[72] A. Lawler, Mining Afghanistan's Past, Archaeology, 64 (2011) 18-23.

[73] W. Dalrymple, Mes Aynak: Afghanistan's Buddhist Buried Treasure Faces Destruction, in: The Guardian, 2013, https://www.theguardian.com/books/2013/may/31/mes-aynak-afghanistan-buddhist-treasure

[74] A. Lawler, Time Ticks Away for Ancient Afghan Monasteries, Science, 337 (2012) 1279-1280.

[75] A. Lawler, Copper Mine Threatens Ancient Monastery in Afghanistan, Science, 329 (2010) 496-497.

[76] A. Lawler, In the line of fire, New Scientist, 227 (2015) 31-35.
[77] C. Bernard, E. Sugarman, The Perils of Development: Afghanistan's Threatened Treasures, World Affairs, 176 (2013) 73-82.
[78] I.S. Blacksin, Contested Terrain: Development, Identity and the Destruction of an Ancient City in Afghanistan, Kyoto Journal, 77 (2013), http://www.kyotojournal.org/the-journal/culture-arts/contested-terrain-in-afghanistan/
[79] R. Stone, Mother of all lodes: The United States is putting scientific boots on the ground in Afghanistan to assess its mineral riches, Science, 345 (2014) 725-727.
[80] Unknown Correspondent, Hajigak mining contract was "never signed" with Indian consortium, says Minister of Mines, in: Afghan Zariza, 2015, http://www.afghanzariza.com/2015/05/26/hajigak-mining-contract-was-never-signed-with-indian-consortium-says-minister-of-mines
[81] Government of the Islamic Republic of Afghanistan, The State of Afghan Cities, in, GoIRA, Kabul, 2015.
[82] T. Giovacchini, Governance and Representation in the Afghan Urban Transition, Afghanistan Research and Evaluation Unit, Kabul, 2011.
[83] G. Kristy, The Effect of Urbanization on the Cultural Heritage of Herat, Afghanistan, in: Center for Middle Eastern Studies, The University of Chicago, 2017.
[84] E. Hammer, A. Lauricella, The Land of a Thousand Cities: Fortified Mounds and Settlement Patterns of the Balkh Oasis (Northern Afghanistan), forthcoming.
[85] R. Lasaponara, G. Leucci, N. Masini, R. Persico, Investigating Archaeological Looting Using Satellite Images and GEORADAR: The Experience in Lambayeque in North Peru, Journal of Archaeological Science, 42 (2014) 216-230.
[86] D. Tapete, F. Cigna, D.N. Donoghue, 'Looting marks' in space-borne SAR imagery: Measuring rates of archaeological looting in Apamea (Syria) with TerraSAR-X Staring Spotlight, Remote Sensing of Environment, 178 (2016) 42-58.
[87] C. Margottini, F. Fidolini, C. Iadanza, A. Trigila, Y. Ubelmann, The Conservation of the Shahr-e-Zohak archaeological sites (central Afghanistan): Geomorphological processes and ecosystem-based mitigation, Geomorphology, 239 (2015) 73-90.
[88] D.H. Thomas, Looting, heritage management and archaeological strategies at Jam, Afghanistan, in: Culture Without Context 14, Illicit Antiquities Research Center, Cambridge, 2004, pp. 16-19.
[89] M. Fradley, N. Sheldrick, Satellite imagery and heritage damage in Egypt: a response to Parcak et al. (2016), Antiquity, 91 (2017) 784-792.
[90] S. Parcak, Threats to the archaeological sites of Egypt: a response to Fradley and Sheldrick, Antiquity, 91 (2017) 793-795.