

ARCHAEOLOGICAL LOOTING IN EGYPT: A Geospatial View (Case Studies from Saqqara, Lisht, and el Hibeh)

Thousands of looting pits visible from space at the site of Abusir El Malek, a Late Period–Ptolemaic Period cemetery (near Fayoum, Egypt).
Imagery courtesy of Google Earth.

Sarah Parcak

Following the Egyptian revolution in January 2011, looters soon entered the Cairo Museum. News then emerged about looting at multiple archaeological sites (Butler 2011; Stanton 2011; El Dorry 2011), including Saqqara, Lisht, and at storehouses in the Delta. As stability in Egypt decreased, looting apparently increased, especially with a lack of armed guards at less-visited sites. From fall 2012–spring 2013, it became easier to see visual evidence of site looting as reported on social media (Marchant 2011; Hanna 2013; Ikram and Hanna 2013). To date, a comprehensive report quantifying the total looting in Egypt has not appeared in print. This would provide a much clearer picture of site damage, and is forthcoming (Parcak et al. 2016). For this study, our team used Google Earth satellite imagery from 2002–2013 to examine archaeological sites across Egypt to map looting trends.

Background

It should be noted that Egypt's Ministry of Antiquities has made tremendous efforts to stop looting at local as well as international levels, and without these efforts, the situation would be far worse. These efforts include numerous instances of local archaeology inspectors often risking their lives to stop looting on sites, which has not received good press coverage compared to general

looting stories. The Ministry of Antiquities' Recovery and Repatriation Unit has recovered thousands of stolen objects in Egypt and abroad using a comprehensive website-tracking database. The Egyptian government requested an MOU to stop the illegal import of Egyptian Antiquities via the US State Department's Cultural Property Advisory Committee (CPAC), with hearings in June of 2014. While we await the results of the hearing from the US State Department, it shows the commitment of the Egyptian government to engage with the international community in recovering looted objects and looting prevention.

Globally, archaeological sites are affected by looting, exacerbated in times of war or political conflict. Accessing satellite data rapidly to determine and quantify the extent of site looting has proven problematic. Using only Google Earth, it is difficult to recognize looting on archaeological sites versus excavated areas without an existing Geographic Information System. Also, Google Earth may not have recently tasked satellite imagery for areas of interest (often the case in Syria, Iraq, and Egypt). No open-source or well-published techniques currently exist that detect countrywide patterns of archaeological site looting from space, yet a number of scholars have used satellite imagery to map looting patterns and site damage at specific sites or in regions of countries in the Middle East/North Africa region

(AAAS 2014; Casana and Panahipour 2014; Contreras and Brodie 2010; Stone 2008; Parcak 2007). Without satellite imagery, it is difficult to verify and quantify the extent of the ongoing looting in Egypt.

This report assesses and quantifies the extent of archaeological site looting in Egypt at four sites: Saqqara, Dashur, Lisht, and el Hibe based on 10 separate high resolution satellite images (including Quickbird, Geoeye, WorldView-2, and EROS B satellite imagery) from 2009–2013. We chose those sites for this article because they each received significant press coverage about looting post-2011 (in both Egyptian and international press outlets), each is an important ancient Egyptian site, and all have high value material culture in which looters are clearly interested. Saqqara and Dashur have numerous pyramids and tombs going back to ca. 3000 B.C.E., and represent major tourist sites. Lisht is the site of Egypt's Middle Kingdom capital and contains two pyramids of the founders of the Middle Kingdom along with tombs of many Middle Kingdom officials. El Hibe has an important temple and many tombs from the Late Period–Ptolemaic Period.

This study has implications for the protection of archaeological sites across the Mediterranean, North Africa, and the Middle East. Overall, the satellite images show a significant increase in site looting in Egypt at these sites. Quickly tasked satellite imagery can aid governments and the scientific community in the protection of their cultural heritage, and is critical to stopping the illicit trade in antiquities. Looted archaeological materials may allow crime syndicates to raise funds for drugs, guns, and other crime-related activities, but this needs extensive further investigation. This makes the stopping of archaeological site looting a critical matter for international security efforts, especially in Egypt where site looting is tied closely with economic instability and a drop in tourism (Ikram 2013). The report focuses on three sites through the end of 2013, when our overall analysis of the looting in Egypt stopped pending the release of 2014–2015 imagery, and includes results from multiple ground visits to assess looting. It appears from an initial assessment of the 2014 satellite imagery that looting has slowed or stopped at these sites, showing an improvement in security at these and other sites thanks to the efforts of the Egyptian Ministry of Antiquities.

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Methodology and Results

This project utilized Quickbird imagery of the Saqqara-Dashur regions (taken May 11, 2009), GeoEye-1 imagery of Saqqara-Dashur (Taken February 15, 2011, May 11, 2011, and September 12, 2012), EROS-B imagery from Saqqara/Dashur (March 1, 2013), Quickbird imagery of Lisht (November 28, 2009), and GeoEye-1 imagery (May 11, 2011), EROS-B imagery (September 12, 2012), and Quickbird/GeoEye-1 imagery from El Hibe (2009 and September 2012). One of the authors (Parcak) visited each area (save el Hibe) on the ground in November, 2010, and thus confirmed the majority of the site looting happened post January 25.

Partnering with the Geoeye Foundation, we tasked Geoeye-1 satellites for images on February 15 (North Saqqara/Dashur) and May 11 (North Saqqara/Dashur and Lisht), giving near real-time visualization of looting. By 2013, another satellite, EROS-B, provided near real-time (one week turnaround) data. Prior to analysis in ArcGIS, we created data with resolutions of 0.5 m–0.6 m

(Parcak 2008). We analyzed each of the Quickbird, GeoEye-1, and EROS-B (black and white) satellite images using ER Mapper to clarify the looting pits. We examined excavation reports for each site and images from Google Earth to determine longer-term site looting versus potential unfilled excavation pits or tomb shafts. Looting pits generally have a telltale donut shaped boundary of sand around it, while exposed shaft tombs lack any surrounding fill. We drew boundaries around each looting pit, which allowed us to calculate the total looted area for each site. We replicated this approach in the North Saqqara/Dashur, Lisht, and el Hibe regions. In Lisht, we created two regions (for each pyramid), while in Saqqara/Dashur we had 6 separate areas (fig. 1), each representative of an archaeological zone. El Hibe only had one area.

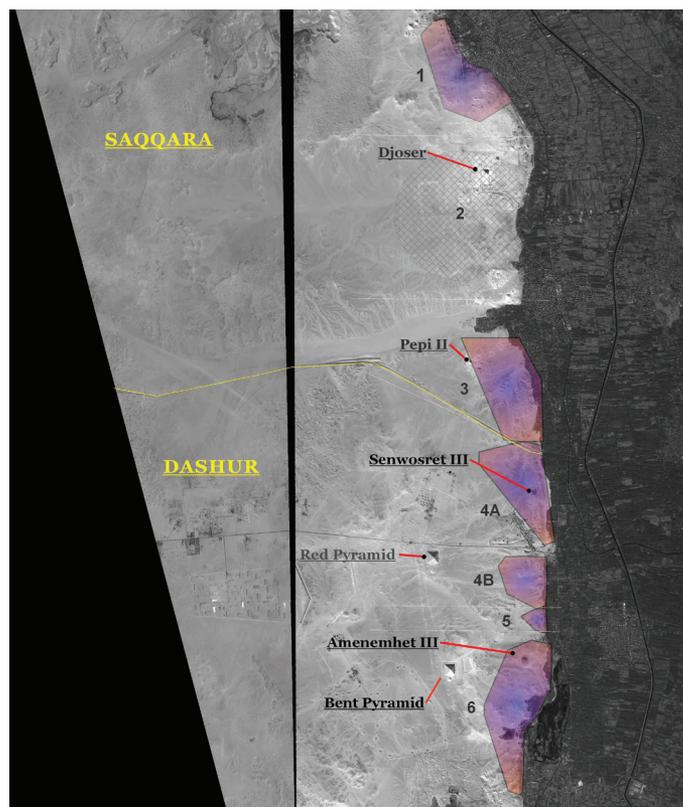


Figure 1. Map showing total areas of Abusir, Saqqara, and Dashur mapped. Image by Sarah Parcak and David Gathings, satellite imagery courtesy of DigitalGlobe.

We counted the total number of pits and areas from the 2009, 2011, 2012, and 2013 imagery (fig. 2).

The most badly looted area in the areas of Abusir-Saqqara (Areas 1–3) extended south from the pyramid of Raneferef to an area north of Saqqara's early dynastic cemetery (fig. 3) (an area of 1493 m² with 711 pits on February 15). The looting did not worsen from February 15–May 11, but people bulldozed a looted area for illegal cemetery construction (Viney 2012). Additional

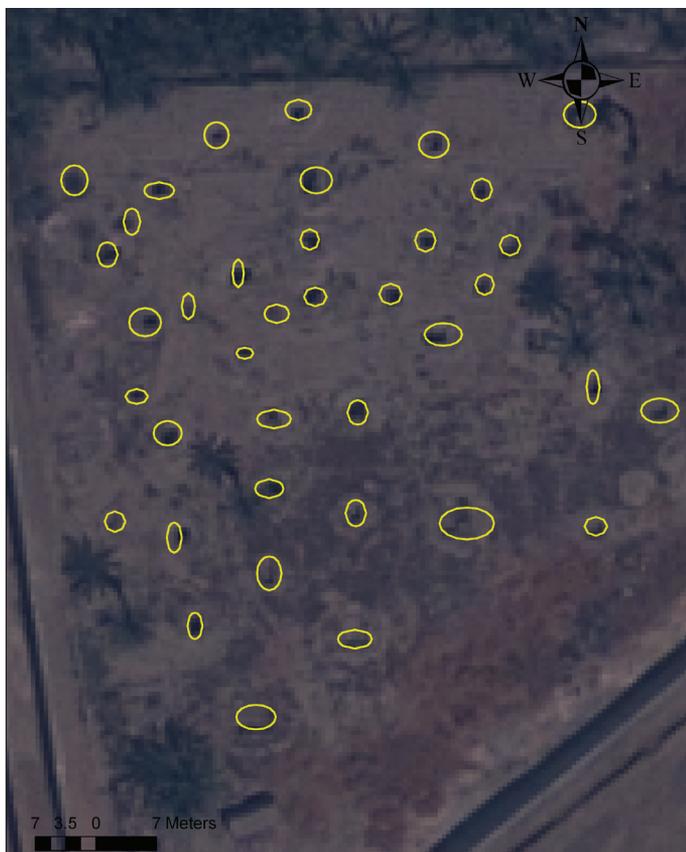
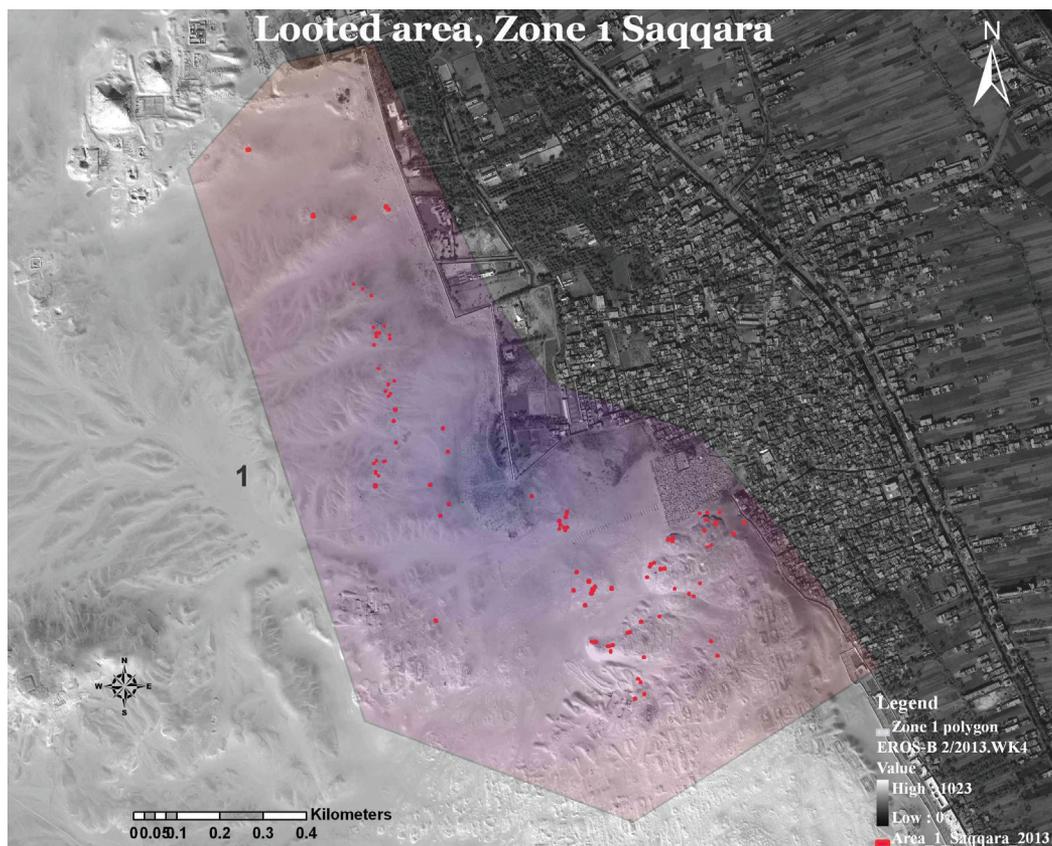


Figure 2 (above). Zoomed in image showing polygons drawn over looting pits near North Saqqara. Satellite imagery courtesy of DigitalGlobe.
Figure 3 (below). Four areas looted in March 2013 are within Area 1. Image by Sarah Parcak and David Gathings, satellite imagery courtesy of DigitalGlobe.

protected. This appears why looters mainly spared this area. I visited **Area 3** in South Saqqara in late November 2010. No looting pits appear in 2009 imagery, while three appear in February 2011. By May, seven pits appear (which I saw in-progress on the ground in late March 2011). By Sept 2012, the number of pits increases to 60 in the northern Middle Kingdom cemetery and to the south of the unfinished pyramid.

For **Areas 4–6** (Dashur), a railroad provides a boundary between South Saqqara and north Dashur. We subdivided this into areas 4a (Senwosret III) and 4b (Sneferu Red Pyramid and Pyramid of Amenemhet III). In **Area 4a** no looting can be seen prior to the revolution. Two pits appear in May 2011, and by June 2012, we mapped 12 pits. By September 2012, 84 pits can be seen. This is surprising as the area is next to a military base. The looting then appears to stop by March 2013. In **Area 4b** in the 2009 imagery no looting pits can be seen, although in a Google Earth comparative image from November 2010 one small possible looting pit is noted. By May 2011, 65 pits can be seen at an area of 550 m². From May 2011 to September 2012, we mapped 218 total pits (2269 m² area), primarily to the north of the Pyramid of Amenemhet II. Many of these pits fill in by March 2013, with only 96 pits visible (1042 m² area). In **Area 5** (between Amenemhet II and III pyramid complexes), similar looting patterns are noted as those found to the north and south. Looting started in this area in May 2011 with 15 pits (165 m²), increasing to 39 pits in 2012 (396 m²) and 65 pits (739 m²) in March

pits filled in by September 2012, with a slight increase in pits (43 and a 676 m² area) by March 2013, showing increased activity. The satellite imagery confirmed a range of looting activities: some pits appeared as shallow depressions, while others had surrounding larger piles of sand, showing deeper digging. This confirmed visual reports of youth digging randomly, with other looters focused on tomb shafts. Visiting the site in late May 2011 showed that some pits were 3–4 m deep, surrounded by broken pottery, human remains, and mummy bandages. In **Area 2**, the main site of Saqqara, no looting appeared on the satellite imagery. This area has the highest concentration of archaeological materials in the pyramid fields and is the most well



2013. **Area 6** (Amenemhet III pyramid complex) had no looting in the 2009/2010 imagery. Looting in this area was not brought to our attention until 2012, so we did not extend the May 2011 imagery far enough south. However, Google Earth imagery from May 2011 shows 50 pits. A significant jump occurs from May 2011 to September 2012, with 988 pits noted (7279 m² area). At this point, no direct looting at the pyramid of Amenemhet III can be seen. By March 2013, the number of pits increases to 1159 (6623 m² area), showing some infilling on previously looted pits. A massive illegal cemetery construction to the north of Amenemhet III measuring 174 m x 226 m can be seen in the March 2013 imagery.

Starting in 2012 and continuing to March 2013, people are looting directly on pyramid sites and in their cemeteries. Slightly to the south, looting can be seen in a series of mastabas 630 m to the north of the Pyramid of Amenemhet III. Eighteen pits can be seen there from May 2011, with a huge jump from May 2011–June 2012 (based on Google Earth imagery). The Pyramid of Amenemhet III itself is not disturbed, with open shafts to mastabas to the northeast and north. There are some open mastabas with limited looting from the 2009/2010 imagery. By May 2011, there are a few pits near mastabas, with a shift by June 2012–end of 2012, with 2 larger pits noted, measuring 4.5 m x 2.5 m. There is no looting noted at North Magzhuna. South Magzhuna is a different story. There are seven looting pits seen there, with clear evidence of major bulldozing.

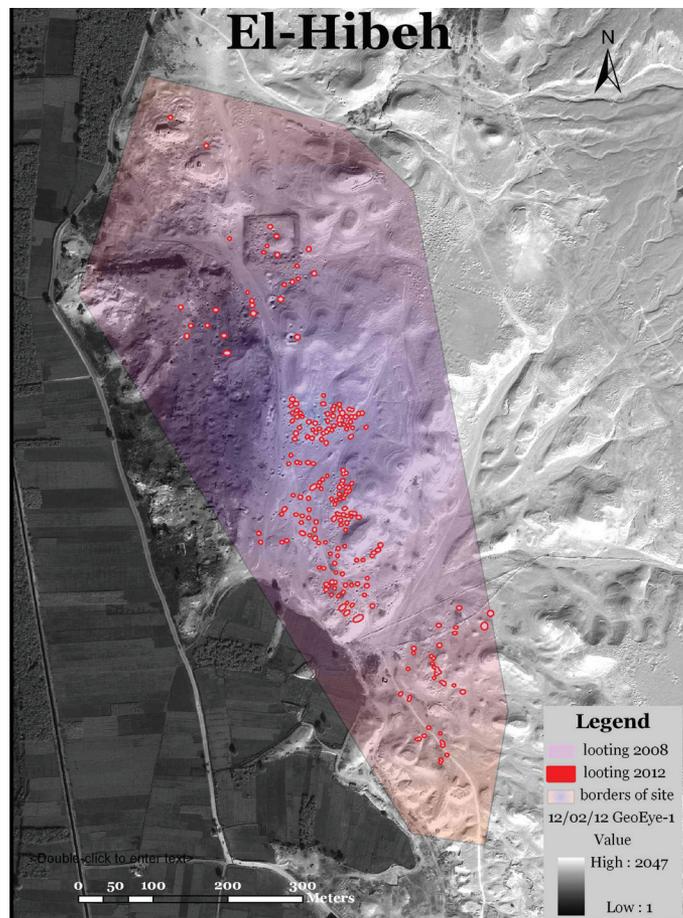
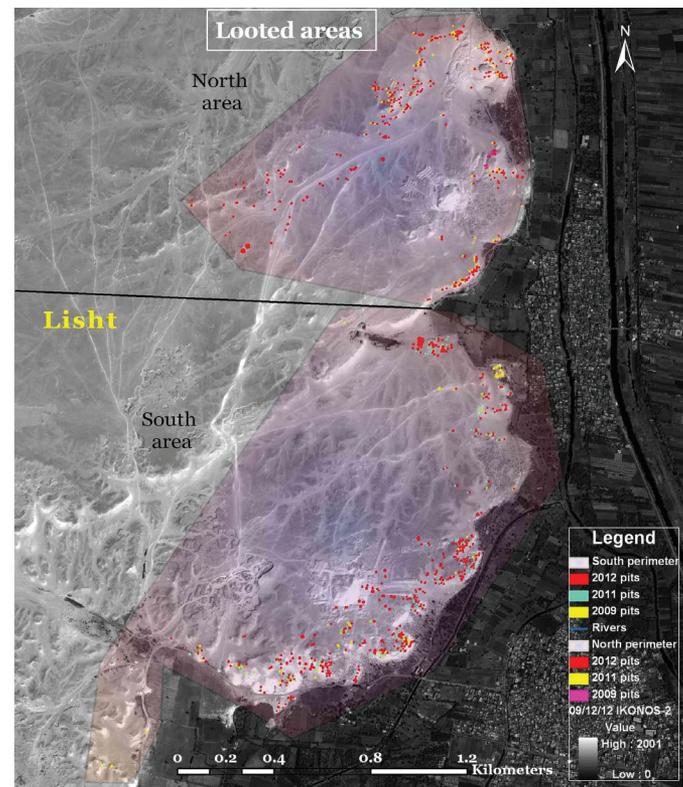


Figure 4 (above). Total pits mapped at el Hibeh.
Figure 5 (below). Map of total looting pits at Lisht. Images by Sarah Parcak and David Gathings, satellite imagery courtesy DigitalGlobe.



A 75 m x 63 m cemetery and buildings can be seen in 2010, and by 2012, a 150 m x 80 m stone wall appears around the outbuildings, showing that illegal construction is as big a threat to archaeological sites as looting.

The area of **el Hibeh** received the most international press regarding site looting, with serious criminal involvement (fig. 4). From the 2009 imagery, we counted 221 pits (1734 m²). In September 2012, the amount of the site looted had nearly doubled, with 358 pits (3177 m²).

Lisht appeared to be the site most damaged by looting from the 2011–2013 time period (fig. 5). We subdivided the total site into two regions, north and south Lisht, to match the pyramid and associated cemeteries of Amenemhet I (north) and Senwosret I (south). By May 2011, 179 pits can be seen in North Lisht, and 336 in South Lisht. The 515 looting pits (2.02 km² area) occurred mainly along the desert edges where there are known Middle Kingdom cemeteries. Unlike Dashur/North Saqqara, the majority of the pits appear to be deep and wide, with the largest looting pit measuring 1.5 m x 2.5 m. The largest jump in looting occurs from May 2011 to September 2012, with an increase in looting pits in the north to 281 and the south to 409. What is most disturbing, however, is an increase in the total area: 2.81 km² in the north and 5.478 km² in the south for a total of 8.29 km². The pits have grown larger in size, with one measuring 5 m x 2 m. Presently, the looting appears to have mainly ceased at Lisht, thanks to the efforts of the Ministry of Antiquities and the local inspectorate. It is



not known how many objects the looters took from Lisht, but it is expected to be a substantial amount.

Ground Truth Visit to Lisht

In May 2015, with permission from the Ministry of Antiquities, I visited Lisht to document site looting pits from the 2011–2013 time period. This was prior to a joint mission with the ministry for inspectors to document looting and to teach about digital heritage management. I spent one day there, visiting an area where I had seen over 150 pits (fig 6a–b). Based on the 50 tombs I mapped, 95% of them represent actual tombs that looters dug out and looted. A few of the pits are very small and represent some initial exploration, and then they stop. Based on this percentage from the documentation, it seems likely that over 1000+ “new” tombs have been discovered by the looters at Lisht, but this needs to await confirmation from fieldwork. Many are deep (10+m shafts), and I saw eight tombs with possible Middle Kingdom courtyards. We must document the tombs before they are further damaged (fig. 7). Most of this looting happened through the end of 2013, as many of the pits had garbage and partial infilling.

Figure 6a–b (above). This is an area in north Lisht where numerous pits were noted. 6a is from 2010 (no looting) and the 6b is from 2014 (150+ looting pits, here seen as darker areas). Imagery courtesy Google Earth.
Figure 7 (below). This photo was taken at the archaeological site of Lisht looking at 6 looted tombs, evident as darker rectangular areas. The arrows point to them. Note the close proximity of the modern cemetery on the right hand side of the image. Photograph by Sarah Parcak.



One tomb (fig. 8) is part of a series of three tombs cut directly into the bedrock on the eastern side of Lisht. Some of the tombs have multiple chambers, but with no writing. Another tomb (fig. 9) is located near the top of the outcropping, with an 8 m deep shaft, and a 3 m x 2 m entrance. It has six courses of mudbrick that remain from a mudbrick mastaba. Based on the density of broken and intact mudbricks nearby, this tomb was intact and likely full of Middle Kingdom objects. Thus, many tombs at Lisht may have been partially to completely intact. Another tomb (fig. 10) measures 3.5 m long and 1.5 m wide (oriented N–S). The shaft has well-preserved hand holds from antiquity. Another mapped tomb has a clear courtyard. Its room is also curved, with obvious worked flat walls. It is not likely that this was intact in antiquity since the tomb interior has dense burning which may be evi-

dence of habitation, perhaps by a monk. However, it is 5m long by 4m wide, with a nearly 4 m tall roof, and a shaft in the back that extends for 5 m–6 m with additional interior chambers that appear to be mostly intact (based on the amount of debris filling them). I noted a few potential new pits, but there is nowhere near



the intense amount of looting compared to 2011–2013.

Conclusions

There is a clear upward trend in archaeological site looting from the 2009–2013 satellite imagery. The total area noted from these three archaeological zones began at 4,335 m² in 2008–2009 (Lisht and el Hibeh, where we noted earlier site looting). By May 2011, when we had coverage of Lisht and Saqqara, we mapped a total of 3844 m² of site looting. By fall 2012, it had increased to 19989 m², an increase of 520% at those two sites alone. The looting at el Hibeh had nearly doubled by the end of 2012, suggesting that sites where a history of looting existed already may not have been affected as badly as other mainly non-looted sites. Our satellite study found a total of 5,400+ looting pits that have been dug at these sites alone since the January 2011 revolution, only counting large looting pits, which we reasonably equate with mainly “new” tombs based on ground

Figure 8 (above). Photograph of looted tomb at Lisht with what appears to be the remains of a courtyard on the exterior of the entrances, noted by the arrow. **Figure 9** (below). Photograph of looted tomb with looted and formerly intact superstructure. There are six layers of mudbrick that have been cut into, seen above the tomb shaft, shown by the arrows. Photographs by Sarah Parcak.



our results with multiple ground truth trips (we know that this is not possible in Syria and Iraq today). It would be possible to do machine learning in order to train computers to do the same.

truth visits and press reports. Our ongoing imagery analysis from the 2014–2015 imagery suggests that the looting has largely slowed down or stopped at Dashur, Saqqara, and Lisht, with some new pits occasionally appearing, but nowhere near the scale of the 2011–2013 looting. Sadly, looting appears to continue at el Hibeh, which is not as well guarded as the other sites. Also, it appears that a mafia element is involved with looting there, which is harder to stop.

This initial report has quantified the site looting at Saqqara, Lisht, and el Hibeh, based on ten separate high resolution images. It has larger implications for the protection of archaeological sites across the MENA region. Quickly tasked satellite imagery can aid governments and the scientific community in the protection of their cultural heritage and is critical to stopping the illicit trade in antiquities. Since looted archaeological materials may be used by crime syndicates to raise funds for drugs, guns, and other related activities, efforts to stop the looting of archaeological sites should be of crucial concern for international security officials. We suspect that research into looting operations in Iraq, Syria, and Libya will yield similar results. A future solution might include looting detection automation, whereby one could process looting areas in an entire country. Discerning between old and new looting pits might initially appear difficult, but by looking at our images, we did not confuse the pits, and double-checked

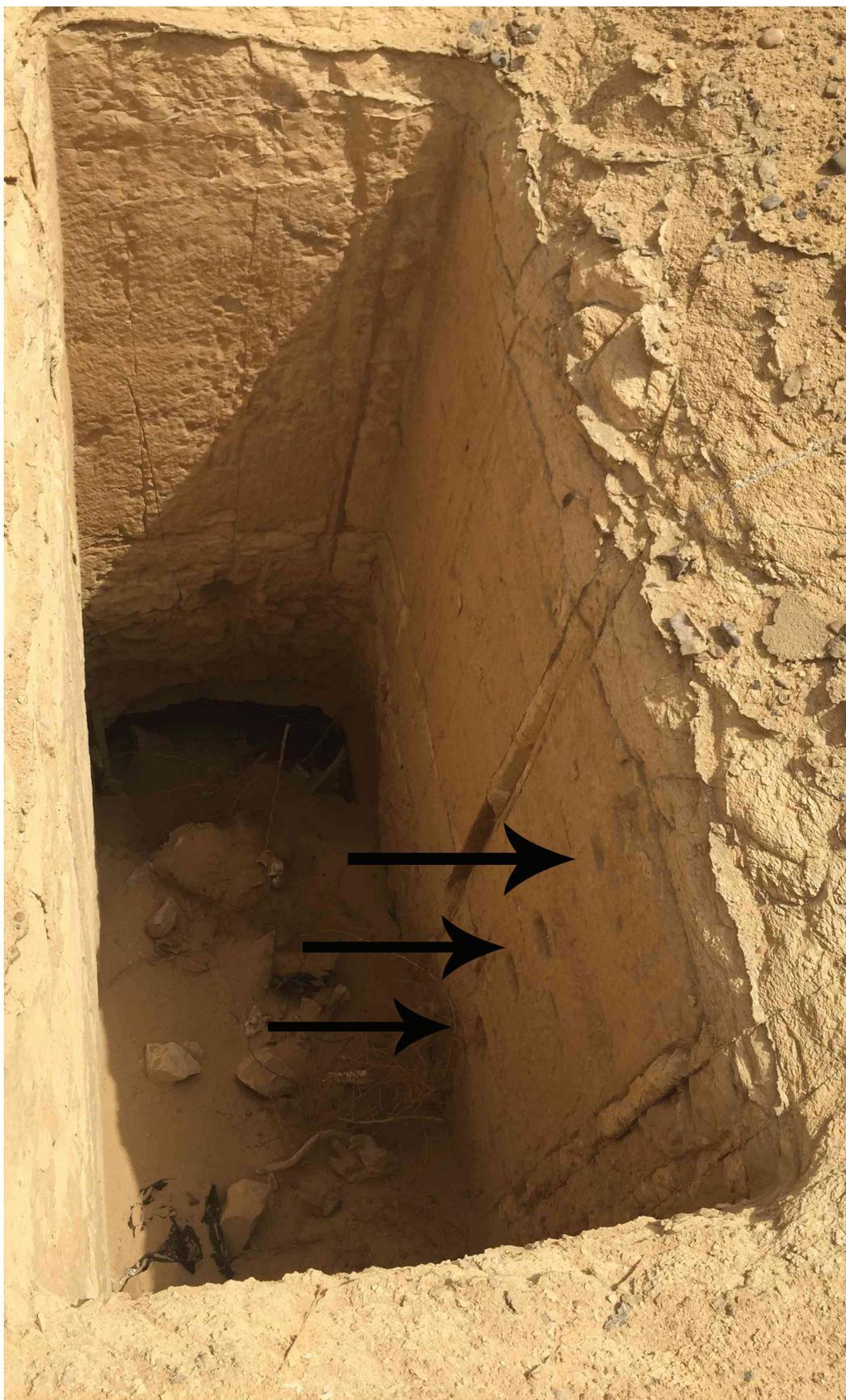


Figure 10. Photograph of tomb with obvious handholds in the upper part of the tomb in the photo, shown by the arrows.
Photograph by Sarah Parcak.

The international community has been involved and collaborating with Egyptian authorities regarding solutions to looting and related training. In May 2015, the Antiquities Coalition, in partnership with UNESCO, the Middle East Institute, and the Egyptian Ministry of Antiquities, hosted a conference with multiple partner countries (Libya, Sudan, Jordan, Iraq, UAE, Kuwait, Saudi Arabia, Oman) and international experts to discuss looting and heritage management solutions. It was a historic gathering in that it represented the first time these nations had convened to discuss heritage. This suggests that dialogue and collaboration between multiple countries experiencing the same challenges is one solution. Additional solutions may be found in creating new economic opportunities for local people similar to what the Sustainable Preservation Initiative has done in Peru. Increasing tourist numbers will also help.

Other solutions will be tested with a Joint Mission with Egypt's Ministry of Antiquities at Lisht. We will document site looting at Lisht as well as offer training in digital heritage management for collaborating team members. We will work with them on using open source tools on their cell phones to record damage and looting at sites, and how to describe it using standardized forms in English and Arabic. We hope to create a countrywide ground truthing site damage report, and even more importantly, a network of connected inspectors who can strategize on social media platforms for how best to protect their sites using open source or free tools. We

will also host an archaeology event open to the public, where we will bring common everyday items (plastic bottles, boxes, bags, sand, rocks) and challenge all our attendees to come up with new ideas for how to protect sites and features at risk. We also plan to meet with key stakeholders at towns in the Lisht region to plan for a potential playground and picnic area at the site, as well as potential economic development strategizing. We will start at one site, and in future, in close collaboration with the Ministry of Antiquities, expand our efforts. The task is great, but well worth the effort, in Egypt, and across the globe.

Acknowledgments

I would like to thank David Gathings for his assistance with the initial imagery processing, and Chase Childs for assisting with the photographs. I would like to thank the National Geographic Society, the BBC, the Capital Archaeological Institute at The George Washington University, and the University of Alabama at Birmingham for their financial support of this project work, and the Ministry of Antiquities in Egypt for their ongoing support of my fieldwork and the Joint Mission to Lisht, especially H. E. Dr. Mamdouh el Damaty, Minister of Antiquities, Mr. Kamal Waheed, Head of the Pyramid Fields, Dr. Hany Abu el Azm, Head of Foreign Mission Affairs, and Mr. Mohammed Josef Ali, Chief Inspector of Dashur. ♀

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