

Houston, Texas, estimates that the study will need to include about 700 children, at a cost of \$5 million to \$10 million—which the SmartTots leadership hopes will come from government sources in the United States and abroad.

Planning the trial and navigating ethical concerns “has been daunting, to say the least,” says IARS Executive Director Thomas Cooper, who manages the SmartTots initiative. Despite the scientific appeal of a randomized study, investigators are obligated to not place children into a treatment group that may increase the risk of harm, he says, or give care that deviates from what is already accepted as safe and effective.

Because dexmedetomidine hasn’t been widely used or studied in children, SmartTots collaborators are preparing a preliminary study in 50 kids to check that it’s suitable for long surgeries; warning signs would include slowed heartbeat, low blood pressure, or a child who stirs too much while “under,” Andropoulos says. He also anticipates a nonhuman primate study to scrutinize the drug’s effects on the brain.

Warner, also an adviser on the project, notes that because the preliminary study would be on a tightly controlled population—children getting urological procedures is one favored option—any findings might not apply to kids getting anesthesia under other circumstances. “You would, in theory, need to do a different trial in every group of kids, which nobody’s going to do.”

With even this limited evidence years away, SmartTots is crafting a short “consensus statement,” planned for December release, to convey current knowledge about risks of childhood anesthesia. A draft, unlike its 2012 predecessor, explicitly suggests delaying or postponing surgical procedures that require full anesthesia if possible.

That suggestion sparked lively discussion among the FDA science board. “Postponement is really bad medicine,” argued pediatric orthopedic surgeon Laura Tosi of Children’s National Health System in Washington, D.C. With surgeries for congenital defects, she said, any delay can lead to worse outcomes.

Several advisers supported the idea of a new FDA warning on the anesthetics that have been called into question. But others, including Tosi, vehemently opposed adding the most severe “black box” warning, which signifies a risk of serious adverse effects.

Some parents wary of cognitive damage are already resisting necessary procedures for their children, Tosi noted. “We have to be very careful about how we present that data,” she said. “I think the fear of anesthesia in the public is already out there.” ■

## ARCHAEOLOGY

# Satellites track heritage loss across Syria and Iraq

Vandalism, looting, and collateral damage erase history

By Andrew Lawler, in San Diego, California

**M**ore than 4000 years ago, the Bronze Age metropolis of Mari on the banks of the Euphrates River bustled with trade and boasted a half-dozen temples and a royal palace. But for millennia since then, its eroding walls and buried artifacts remained undisturbed until French archaeologists began excavating in the 1930s.

Today, this Syrian site just 10 kilometers from the Iraqi border is once again a busy place. A satellite image of Mari taken on 11 November shows alarming signs of massive, orchestrated looting, according to Scott Branting, an archaeologist at the Boston-based American Schools of Oriental Research (ASOR). Trucks and backhoes traverse the site, systematically uncovering artifacts while destroying the ancient structures. Looters have even built what may be a large storage depot for sorting and storing

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***“It is all seemingly never-ending and disheartening.”***

**Michael Danti,** Boston University

the valuable goods before they are exported for sale abroad.

Such destruction is widespread across Syria and northern Iraq. Branting and other researchers lamented at ASOR’s annual meeting here. Part of the ancient Fertile Crescent, the region holds archaeological riches spanning thousands of years. Since 2011, however, it has also been a battleground, fought over by the Syrian government and opposition groups, the radical Islamists of the Islamic State group, and their various opponents including Iraqi, Kurdish, and U.S. forces.

In an initiative funded by the U.S. State Department, ASOR is monitoring and assessing the damage. Recent satellite photos, as well as reports from observers on the ground, indicate that the artifacts and sites face multiple perils: Islamists who destroy ancient sites for religious reasons, systematic looters like those threatening Mari, and the collateral damage of war. “It is all seem-

ingly never-ending and disheartening,” says Michael Danti, a Boston University archaeologist who helps lead the ASOR project.

Shut out of a region plagued with competing armies, humanitarian crises, and hostile ideologies, archaeologists have largely been distant and anguished bystanders to the wave of ruin. But by tracking the damage, the ASOR researchers hope they can help raise a global outcry and lay the foundation for salvage and reconstruction when the wars end. “Even if what we are doing is largely ineffectual, it is better than sitting on our hands,” Branting said at a special 23 November session on the crisis.

The Islamic State group has emerged as a particular threat, making concerted efforts to destroy the sacred sites of groups it views as heretical. The group has publicized its intentional destruction of dozens of sacred sites online or in its glossy magazine, *Dabiq*. “A soldier of the Islamic state clarifies to the people the obligation to demolish the tombs,” states one caption in a recent issue that includes images of exploding shrines.

“It is all very choreographed,” Danti says. He adds that the biggest spike in destruction took place in May, with nearly 20 sites demolished, followed by a half-dozen or so incidents each month thereafter. Almost half of the destroyed sites are associated with Shia Muslims, while the remainder are places sacred to Sufis, a mystical branch of Islam, as well as Christians and Yazidis, an ancient ethnic group centered in northern Iraq. More than 15% are statues and buildings predating Islam; images on the Internet, for example, show a yellow front loader toppling and pulverizing two massive black stone lions dating to the 9th century B.C.E. in the Islamic State provisional capital of Raqqa in northern Syria.

But researchers say that even more damage to archaeologically important sites stems from military action by all parties in the conflict, including the Syrian government and perhaps Iraqi and U.S. forces. “There is a lot of damage from military garrisoning,” says Jesse Casana, an archaeologist at the University of Arkansas, Fayetteville, who is part of the ASOR team and has been closely examining dozens of Syrian sites. Tells, remnants of ancient settlements that dot the Syrian and Iraqi landscape, offer high ground for mili-



In a December 2012 satellite image of Apamea in Syria, holes dug by looters pepper the site of the ancient Roman city (inset).

tary units, which wreak havoc with heavy equipment as they fortify the sites. Archaeologists also fear that the warring forces are heavily mining strategic tells, creating a daunting threat for future excavators.

In October, Kurds captured Tell Shair, a site near the hotly contested Syrian town of Kobane. Images taken by the victors showed that the ousted Islamic State group fighters had dug trenches 2 to 3 meters deep on the mound, devastating the upper layers of the millennia-old settlement. The images also showed signs of bomb craters, possibly from U.S. raids—in the first half of October alone, the U.S. military reported conducting more than 135 airstrikes in the area. A Defense Department advisory group provides data to the U.S. military on important cultural heritage monuments so it can limit bomb damage. But whether such protection extends to smaller sites such as Tell Shair is unclear, several U.S. archaeologists say.

Casana is also using satellite photos to track another major source of damage: looting. At the important classical city of Apamea outside Hama in western Syria, for example, areas largely undisturbed in images from 2011 are pocked with large holes in 2012—holes big enough to suggest that they were dug by heavy machinery such as backhoes rather than shovels. Looting has since spread across the site in what looks like a “very organized fashion,” Casana says. The Syrian government built a major military garrison, complete with bunkers and artillery emplacements, at the site of the former tourist restaurant at Apamea. “This strongly implicates the military as complicit or participating in looting,” Casana adds. At another tell nearby, the looting holes are located within a few meters of military tents.

Classical sites like Apamea and Bosra, an ancient city in southern Syria that has also suffered significant damage, are more prone to looting than older sites because their artifacts are more sought-after on the international market. Archaeologists have observed

a massive expansion in looting between August 2013 and April 2014 at Dura-Europos, a sprawling Roman-era city on the Euphrates in Syria. But Bronze Age cities like Ebla in the west—damaged by a Syrian government military garrison—and Mari, which is under the Islamic State group’s control, are not immune. “There are rumors that armed groups are undertaking the work,” ASOR’s Branting says about Mari. Other reports suggest that the Islamic State group is profiting from the business, possibly by exacting a tax as well as by overseeing looting operations. But Danti adds that most looting appears to be the work of desperate Syrians attempting to survive in a devastated economy.

Massive looting, bomb craters, and damage by military garrisons can be spotted on satellite images, but smaller thefts, kidnapping, and violence against guards and inspectors at sites are difficult to confirm

without on-the-ground intelligence. Sources told *Science* that Islamic State group forces kidnapped and tortured at least one antiquities inspector in northern Iraq before releasing him a few weeks ago. A 24 September circular from the group declared archaeology to be un-Islamic and closed the archaeology department at the University of Mosul, effective 18 October. And the Islamic State group’s forces now occupy the Mosul Museum, which houses a collection of statues, friezes, and inscriptions from the Assyrian capital of Nimrud and Hatra, a classical site 110 kilometers southwest of Mosul. One source said the occupiers have emptied the museum and smashed objects too large to move. Many Iraqi archaeologists in Islamic State group-controlled areas are in hiding or have fled to Kurdistan.

Western colleagues hope that by gathering data on the situation, they will be ready to help rebuild cultural heritage sites and institutions once peace returns. And they hope that some of the region’s heritage will survive the conflict. Archaeologists at the meeting were relieved to see a recent image of Hatra; Branting says it shows few signs of destruction or looting at the site, home to a large number of intact statues and buildings.

“It is incumbent on those of us who have built a research career in Syria to help,” says Graham Philip of Durham University in the United Kingdom, who is organizing European archaeologists to analyze the situation and plan for the future. The human toll of the conflict is immense, but Abdal-Razzaq Moaz, a Syrian art historian at Indiana University, Bloomington, says the destruction of thousands of years of history inflicts its own pain. “We must consider cultural heritage as part of the humanitarian crisis.” ■

## Damage assessment

Many of Syria’s ancient sites have sustained damage (red), as shown on a map based on satellite data. Sites in blue appear undamaged.

