Syria's ancient site of Palmyra was attacked by militants beginning in the spring of 2012.

for nearby populations and whether such revelations can inadvertently license the destruction of cultural heritage by militant groups like ISIS.

"The scale of the intentional damage is nothing like we've ever seen before," said Hanson about ISIS' attacks in Syria and Iraq. "Nothing like what happened even during World War II in terms of just the sheer quantity of heritage that was destroyed."

As concern over the region's ancient heritage sites spread, AAAS was alerted that ISIS had decimated Hatra, an ancient northern Iraq landmark with a history of having repelled Roman invaders and being the capital of the first Arab Kingdom. AAAS' subsequent analysis found that the site had not, in fact, been leveled.

A debate over whether the project's finding should be disclosed evolved into a discussion of the advantages and drawbacks of the collection, use, and storage of such data in crisis situations. AAAS brought together stakeholders and soon concluded it best to keep confidential the site's identity, determining that revealing the information could invite further destruction.

"This gave rise to a bigger question about what the ethical responsibilities should be of those who have access to location-based data that are relevant in the humanitarian context or with regard to human rights questions in crisis situations," said Jessica Wyndham, director of AAAS' Scientific Responsibility, Human Rights & Law Program.

The debate over the confidentiality of collected data led AAAS to pursue a broader review of the topic. From 2016 to 2017, AAAS held three multiday workshops, assembling a cross-section of academic, nongovernmental organizations, government, industry, and scientific groups, to examine more deeply the ethical issues raised by location-based data drawn, for instance, from remote sensing imagery and geotagged social media.

In late March, AAAS' Scientific Responsibility, Human Rights & Law Program issued guidelines and implementing tools as a result of its extensive review. The materials are meant to inform the use of location-based data in crisis zones by human rights and aid groups, academic researchers, volunteer networks of technical experts, local partners and participants of international and multinational organizations. The program also hosted a closing webinar on its work on 24 June as the project pivots its work and expands its vision to the topic of emerging technologies.

The guidelines and tools also are intended to assist volunteers working with human rights groups and other organizations to enhance their awareness of the range of metadata that social media posts

and videos can reveal to avoid endangering affected populations or prompting the targeting of infrastructure and cultural heritage sites.

The principles and guidelines set out five central pillars for organizations to incorporate into their planning for conflict-area projects. The principles urge participants to: "do no harm" by avoiding hasty identification of locations; "define their purpose" by carefully setting missions and goals driving their work; "do good science" by using rigorous scientific methods; "collaborate and consult" by engaging and tapping the knowledge of local partners; and "give access to data" by establishing when data is ready and safe to share.

In "Collecting & Sharing Geo-Located Data in Crisis Situations," the principles and guidelines are condensed into an easy-to-use decision tree format, able to be displayed in field offices and made accessible to those working in crisis zones. It lays out best practices in the handling of gathered data and how to come to such decisions. A separate compilation of six case studies is meant to provoke discussion and spread knowledge about the use of such data.

Scientists, volunteers, and others affiliated with organizations using location-based data are urged to consider the risks and benefits of data disclosures; keep affected populations foremost in mind; monitor each stage of data collection; have data storage and data breech response plans in place; and among other guidelines, adopt ethical research practices that serve the public good and protect the privacy and safety of human subjects.

"The scale of the intentional damage is nothing like we've ever seen before."

Katharyn Hanson,
Smithsonian Institution

Increasing consideration by scientific and affiliated communities of such ethical implications come at a time when satellite imagery is a rapidly advancing and expanding technology, particularly in the commercial realm with more private companies launching satellites. The range of disciplines relying upon location-based data also is growing beyond archeological preservation and natural disaster responses.

"As the availability and use of technologies continue to grow simultaneously so does our excitement about their potential value in supporting human rights and humanitarian efforts. Yet, our chief focus remains on using these technologies to address societal needs – from protecting cultural heritage to promoting accountability for mass human rights violations," said Wyndham. "The guidelines and implementing tools we have developed provide principled anchors needed for thoughtful, timely reflection and responsible action."

AAAS' EPI Center shares the science of election security

New program to deliver evidence to policy-makers ahead of 2020 elections

By **Andrea Korte**

In 2020, millions of Americans will cast votes in local, state, and federal elections. Voters no longer use outdated processes to cast ballots by pulling a mechanical lever or punching holes in a card, according to the Verified Voting Foundation. Instead, computers record or tally nearly every vote cast in the United States.

Yet many scientists contend that some computerized voting systems currently in use are fundamentally unreliable and insecure.

"Computerized voting systems should be backed up by paper ballots," said the leadership of the American Association for the Advancement of Science's Section on Social, Economic, and Political Sciences, one of AAAS' two dozen disciplinary sections, in a March 2018 statement. The section draws experts from a cross-section of fields that study the electoral processes, and many of them "have long noted the vulnerability of computerized voting systems to breakdowns, subversive manipulation, and unintended errors."

The AAAS Section on Information, Computing, and Communication leadership also issued a statement in conjunction with the social scientists, calling for voting systems to enshrine "a comprehensive legal framework" to ensure electronic voting systems are equipped with paper ballots that can verify the outcome and ensure an election's integrity.

Last year, AAAS launched the Center for Scientific Evidence in Public Issues—also known as the EPI Center—which is now slated to deliver a body of scientific evidence on voting integrity to policy-makers and election officials across the country as they prepare for the 2020 elections.

The center's mission is to bring clear, concise, and nonpartisan information to decision-makers as they act on pressing public issues. The center has selected voting technology and security as its first endeavor.

"The promise of the EPI Center is not simply to study and publish policy recommendations but to see that scientific evidence is incorporated into decision-making," said Rush Holt, chief executive officer of AAAS and executive publisher of the *Science* family of journals.

Scientists agree that the most secure voting systems involve paper ballots.

The EPI Center's work begins with gathering and distilling the vast body of evidence that can be drawn from a wide range of scientific fields, including computer science, social science, statistics, cryptology, and cybersecurity. It is consulting reports such as the 2018 National Academies of Sciences, Engineering, and Medicine's "Securing the Vote: Protecting American Democracy."

Such groundwork comes at a pivotal time when election officials across the country are making choices about what voting systems to buy before the 2020 elections. "There is abundant scientific evidence from computer scientists, statisticians, and security experts that should inform these decisions," said Michael D. Fernandez, the director of the EPI Center. "The American people deserve to know that when they vote their votes have been correctly recorded and counted."

The center also is in regular contact with scientific experts working on election technology and security issues and monitoring the body of emerging research to spur new conversations and inform events like the AAAS Forum on Science & Technology Policy held over two days beginning on 2 May.

"We have the luxury of tapping into the AAAS network," said Fernandez.

The forum examined scientific evidence that underpins the most secure computerized voting systems, which generate backup paper ballots. Such systems permit a risk-limiting audit, which is "a well-designed statistical method to examine a sample of the paper ballots and determine with high statistical confidence that the outcome claimed by the computers is actually consistent with what voters actually marked on the paper," said Andrew Appel, a Princeton University professor of computer science, during the forum.

Audits are "the premier technology for telling whether the votes cast are consistent with the outcome," added Ron Rivest, a Massachusetts Institute of Technology professor in the Department of Electrical Engineering and Computer Science.

With local officials in 254 jurisdictions in 37 states planning to purchase new voting equipment in the near future, according to the Brennan Center for Justice at the New York University School of Law, the EPI Center is initiating conversations with policy-makers and state and local election officials to ensure they have the scientific evidence needed to make the decisions to govern how voters will cast their ballots in 2020.

The EPI Center is concentrating its efforts on the state and local level where changes are enacted, with a particular focus on the 11 states that use computerized voting systems that lack paper trails. The center is taking a targeted approach, engaging in one-on-one conversations with local voting authorities whenever possible. To avoid entering political debates, the center will not endorse specific legislative proposals or particular voting machines.

The center is sensitive to the multitude of concerns election officials face, including having to juggle security issues, funding constraints, and voter accessibility needs all at the same time, said Kathryn McGrath, communications director at the EPI Center. "We want to help local officials," she said.

The center plans to make inroads in the many states considering implementing risk-limiting audits on a regular basis. Such audits would be conducted regularly, not just when an election is too close to call. Colorado and Rhode Island are currently the only states that will require risk-limiting audits statewide by 2020, while several other states are piloting such audits or considering legislation to put them in place.

"When our election systems have been under attack, election officials are very concerned about restoring and keeping faith and confidence in the system, and risk-limiting audits are an answer," said McGrath.

The center also will bring evidence to emerging voting technology issues that will have implications beyond the 2020 elections, such as online voting. Although public interest in voting by computer or mobile phone is rising, the expert consensus states that online voting is unable to preserve voter privacy or protect the integrity of the system from breaches.

"Voting technology will continue to evolve, creating new risks and new opportunities," said Fernandez. "Supporting decision-makers with the best available evidence as they make choices on how to administer elections and how to ensure the integrity of the results will be more important than ever."

Screeners needed for journalism awards

Scientists from the United States and abroad who will be in the Washington, D.C., area between late August and late September are needed to review the scientific accuracy of entries in the prestigious AAAS Kavli Science Journalism Awards competition. If you can volunteer, please email sja@aaas.org for screening dates and categories.

Science

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