ARTIFICIAL INTELLIGENCE FOR CONSERVATION
WORKSHOP REPORT

MIT ENVIRONMENTAL SOLUTIONS INITIATIVE | MacArthur Foundation | CONSERVATION INTERNATIONAL

OVERVIEW

Artificial intelligence (AI) is changing the way we live our daily lives. What was once in the realm of science fiction is now our reality.

AI is routinely found in our cars, phones and everyday appliances and is transforming research and business around the world. However, the promise of AI and related technologies to transform conservation science is just emerging. In September 2017, Conservation International and the Massachusetts Institute of Technology co-hosted a workshop on how best to utilize AI technologies in conservation. This workshop brought together thought leaders and practitioners in computer science, technology and conservation to explore and advance the application of artificial intelligence and machine learning to the complex issues of climate change and the degradation of nature globally. Over two days, attendees worked together to set the stage for longer-term collaboration. Their purpose was to bring about meaningful change in conservation through the use of technology.

Objectives
With support from the MacArthur Foundation, Conservation International (CI) and the Environmental Solutions Initiative (ESI) at the Massachusetts Institute of Technology (MIT) co-hosted a workshop to:

1. Facilitate a knowledge exchange between AI and conservation domains
2. Develop conservation projects that can utilize and significantly benefit from AI technologies
3. Create a space for continued collaboration.

Workshop Date and Location
September 18-19, 2017
Samberg Conference Center
Massachusetts Institute of Technology
Cambridge MA, USA

WORKSHOP RESULTS AND OUTCOMES

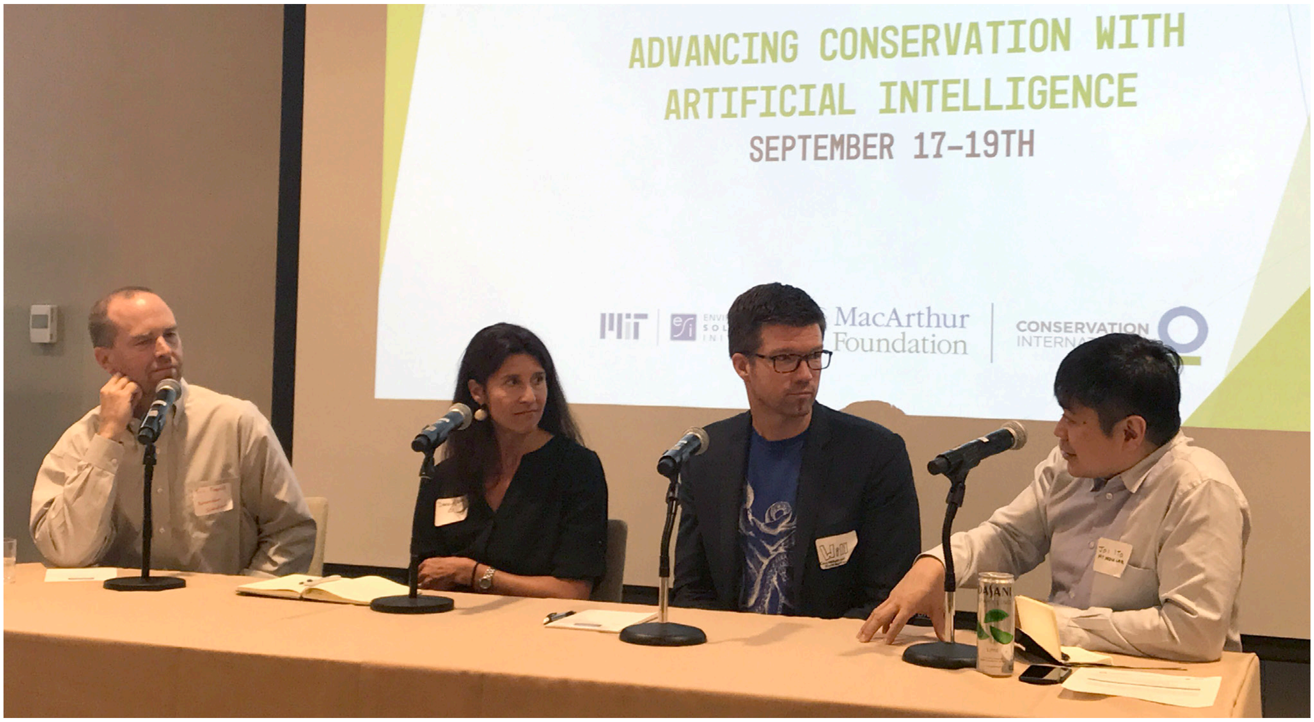
1. Knowledge Exchange

The workshop included a robust knowledge exchange between 30+ participants with backgrounds ranging from robotics and engineering to wildlife trafficking and marine science.

Speakers included Joi Ito, Director of the MIT Media Lab and Daniela Rus, Director of Computer Science and Artificial Intelligence Laboratory (CSAIL); a panel session on the use of technology by the conservation community featuring CI experts Daniela Raik, Will Turner and Eric Fegraus; and 16 presentations by participants from 8 external organizations and several departments at MIT. Students from several departments were also in attendance.

An observation by Professor Ito in his opening remarks underscored the significance of the workshop and continued collaboration. Ito noted that while the rationale for the workshop focused on the opportunity to leverage AI, robotics, and machine learning to improve and advance conservation science, he saw an equally important opportunity to leverage conservation to improve and expand AI. The wide diversity of applications for AI in observing and monitoring natural systems provides engineers and computer scientists with challenging environments in which to develop, test, and refine their technologies – and this draw is important for fostering strong collaboration between this community and conservation.

Workshop discussions were peppered with additional insights from many participants on what could make the collaboration between these two communities most fruitful. CI and ESI intend to craft a brief publication outlining a framework for advancing this compelling kind of partnership.



Seated at the panelist table (from left to right): Eric Fegraus, Senior Director of Technology and External Relations, Moore Center for Science, CI; Daniela Raik, Senior Vice President and Managing Director, Moore Center for Science, CI; Will Turner, Senior Vice President of Global Strategy and Senior Scientist, CI; Joi Ito, Director, MIT Media Lab

2. Using AI in Conservation

An important part of the workshop included brainstorming, identifying and defining conservation challenges that could be addressed by deploying AI and machine learning solutions.

Conservation practitioners gave short speed talks on conservation challenges and potential projects. They were followed by technologists who gave short speed talks on their respective technologies. The groups then came together to brainstorm how to utilize and/or adapt the technologies to real-world conservation scenarios. The project concepts were then more fully developed to concisely describe the purpose and problem to solve, the proposed solution, who will benefit from the solution, what metrics are needed to measure success and what risks are foreseeable. In addition, participants were asked to consider the primary costs of getting the project started (e.g., produce a minimum viable product), potential sources of revenue, and how to get to scale from a technology and conservation perspective (e.g., scale from a pilot in one location to many more places where that solution is needed).

Brief summaries of the seven conservation projects crafted at the workshop:

1

Wildlife Trade Application

Customs enforcement officers at border points around the world face an increasingly difficult challenge in effectively enforcing wildlife trade regulations, due to the complexities in distinguishing between legally and illegally traded wildlife. Wildlife that is traded legally through the pet and collector market is a growing multi-billion dollar industry, yet it currently lacks the proper technologies and tools needed to function properly – opening the way for increased illegal wildlife trade. To eliminate illegal wildlife trade and effectively monitor legal wildlife trade, new tools and technological advancements are needed across the board. We propose an app modeled on image and pattern recognition software, allowing users to visually verify key wildlife and derivatives at various taxonomic levels. Our solution is unique in that it will provide a scalable, wildlife trade application solution that can be used by customs enforcement officers to accurately and rapidly identify mammal, bird, reptile, and insect species at the point of inception.

2

Anti-Poaching/Tactical AI

One way to stop poaching is to alert protected area managers before it happens. Integrating technologies such as remote cameras, infrared sensors along with AI into a software and hardware package will create a nearly fully automated detection system. This system will also include near real-time alerts that provide protected area managers the information they need to respond to poaching threats. This multi-sensor package will be focused on single, highly threatened species populations (such as the African lion, Black and White rhinoceros, African elephant, etc.) to ensure their population health increases over time in a protected area. A pilot is needed to refine and evaluate this system in two African protected areas that have flagship species under threat.

3

Listening for Ocean Health: An Autonomous Vehicle for Acoustic Monitoring of Large Scale Marine Protected Areas and Other Conservation Priority Areas

Recently, there has been a global increase in the establishment of large-scale Marine Protected Areas (MPAs). However, there is little information on how to monitor the health of the species and ecosystems these MPAs are designed to protect. Vast isolated areas make regular, comprehensive monitoring using traditional diver-based approaches cost-prohibitive. This project will combine cutting edge acoustic technology, soundscape libraries that can identify target species ecosystems, and independent autonomous surface vehicles to monitor ecosystem health.

4

Smart Habitat Mapping for Improved Dynamic Fisheries Management

While rotational closures are well suited to sustainable management of fisheries, particularly under changing ocean conditions, this management approach currently suffers from ad hoc, inefficient and ineffective assessment and monitoring. This lack of timely and targeted information results in ineffective decision making and significantly undermines management effectiveness, resulting in reduced resource availability and frustrated fishing communities. A more complete system, using AI-enabled autonomous vehicles for mapping, assessing habitat and target fish species populations under variable ocean conditions at higher resolutions and larger areas is needed to achieve the full ecological and economic potential of rotational closure policies.

5 **Mapping Shallow Water Habitats**

Despite their critical importance for biodiversity, livelihoods, fisheries, coastal protection and other ecosystem services, nearshore coastal habitats such as seagrasses, shellfish beds, and reefs are almost completely unmapped outside populated regions. Currently, labor intensive mapping by divers on scuba or using remote operated vehicles is needed to assess and monitor these ecosystems. Remote sensing techniques have not been able to gather and analyze data from these subsurface ecosystems at useful spatial scales. Prioritizing and designing effective conservation and management strategies for these habitats, therefore, severely hampered. An autonomous, AI-driven solution is needed to map and monitor these critical shallow water habitats.

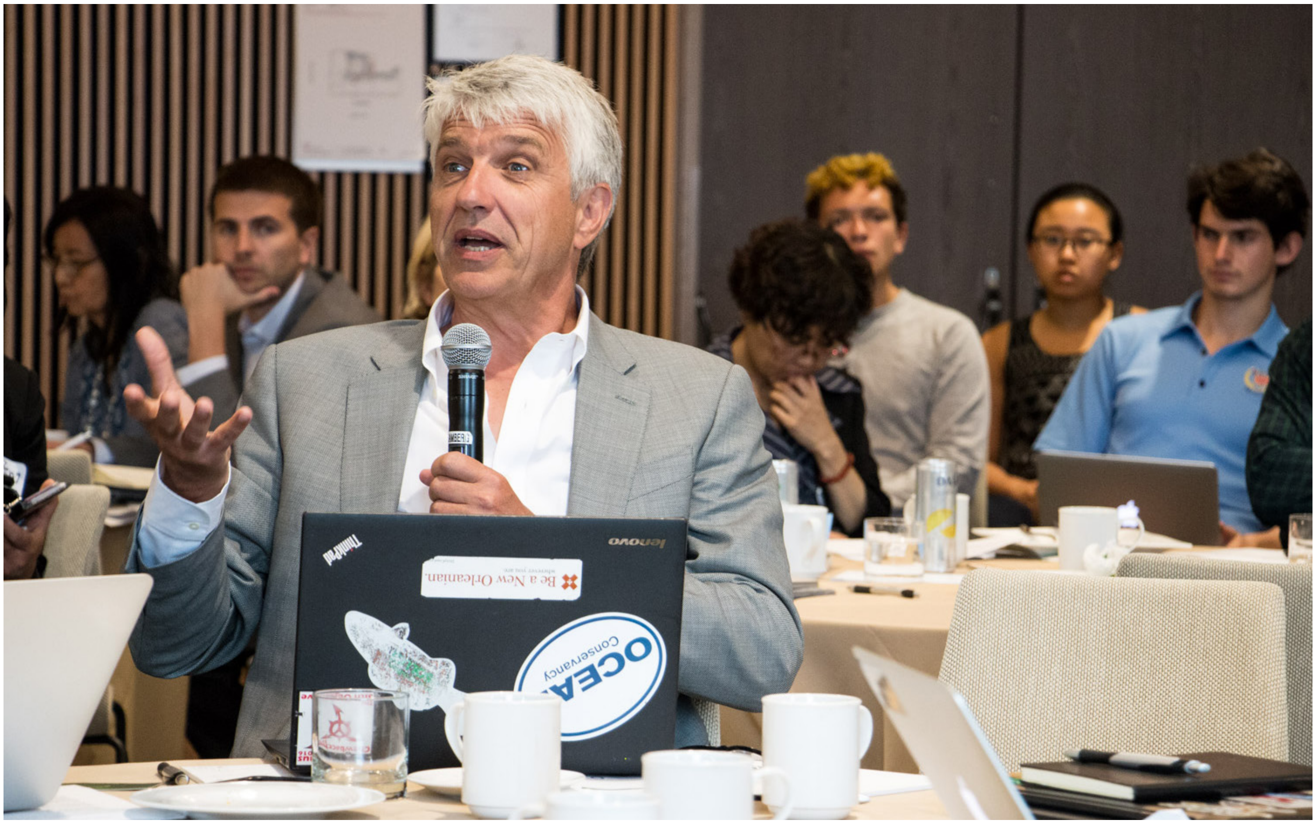
6 **Finding the Plastics "Super Sites" Throughout the Ocean**

It has been recently estimated that 19 billion pounds of plastic waste is deposited in our oceans every year, and that this quantity is on track to double by 2025. This waste accumulates in specific sites in the ocean – often at depths far below the surface – corresponding to convergence zones, sea-bed topography, and ocean layer boundaries. Prior to targeted removal or tracking back to their source, a smart system is needed to find these accumulation sites. An autonomous vehicle would be useful to collect micro-plastic samples in high-risk areas at various depths. Modeling ocean dynamics will allow for smart navigation to likely accumulation sites and support mapping and assessment of the site. By using technology such as particle imaging, Rahman Spectroscopy and chemometric analysis, we will evaluate the size and composition of the plastic. These sites will then be used to characterize volumes and pathways of ocean plastic pollution and aid the development of targeted remediation and prevention approaches.

7 **Wildlife Machine Learning Identification Service**

Wildlife data taken from sensors in the field, mostly from camera traps, are currently siloed around the world and are not being efficiently used to inform science and conservation decisions. We want to create a machine learning-based tool that enables efficient data management, archiving and analysis of what is in the data source (image, audio file, etc.) and provide conservation and scientific results in a useful format. Our vision is to create the tools and services needed to break down data silos and encourage an open approach to wildlife data. This service and accompanying solutions are part of a larger strategy and effort to secure the world's wildlife populations.

A number of additional concepts and solutions using AI related technologies were discussed and are being further scoped and evaluated. These include hosting grand challenge AI and robotic themed events, developing land-based robotics for conservation solutions, human-wildlife conflict, fostering an open design sensor approach for conservation, and embedding AI in dynamic modeling systems.

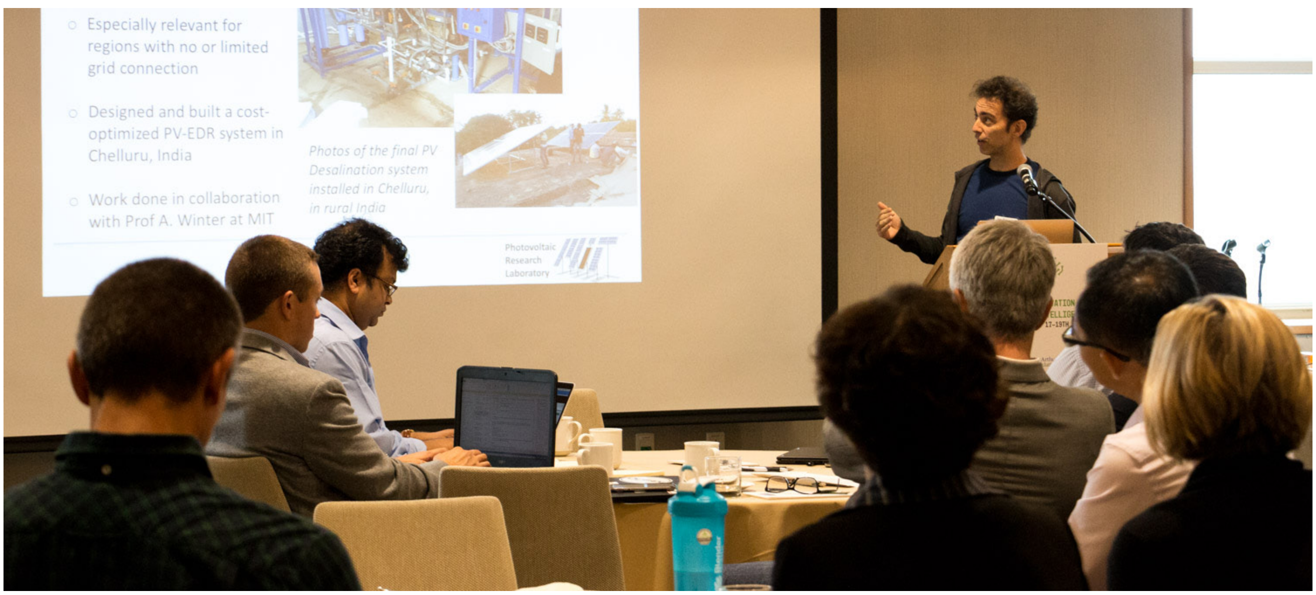


3. AI for Conservation

Creating the Space for Continued Progress

In addition to identifying specific conservation projects that can utilize AI technologies, workshop participants considered whether there is a need to have a more open and dedicated space – that can provide information, standards, tools, and services – to enable the uptake of AI related technologies into conservation projects. This discussion is still in its infancy and we are looking to include additional key partners from the technology sector, university and NGO conservation communities.

NEXT STEPS



Each of the above mentioned steps will be further evaluated and have a work plan put into place to get them started.

Each project will differ in the resources, partners, and research required to complete a pilot effort. Each pilot will include sustainability and scaling up scenarios to ensure wider adoption, when and if appropriate. We are delighted that all attendees were enthusiastic not only in their participation in the workshop itself, but in their interest in further collaboration to pursue specific projects as well as the overall objectives of the event.

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