

The dark side of conservation technology and how we can make it brighter



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Reading time 14 mins

Key Points

- Conservation technology holds the potential to vastly increase conservationists' ability to understand and address critical environmental challenges. However, many technologies lauded as 'game-changing' or 'cutting-edge' fall short of delivering on their promise, causing frustration and difficulties for end users.
- Camera traps, drones, acoustic sensors, tracking and monitoring devices, are expensive, have battery life and memory constraints, connectivity issues, and in the case of drones and tracking collars, can cause harm to wildlife.
- The nature of the data collected (e.g. photos of indigenous people) poses serious questions regarding privacy, consent, and cultural sensitivity.
- Emerging technologies such as artificial intelligence, environmental DNA (eDNA), and networked sensors are promising but present their own set of challenges. The complexity of AI models can be difficult for non-specialists to understand; eDNA requires sophisticated lab equipment and expertise to process and analyse; and networked sensors have considerable resource constraints (e.g. energy, bandwidth, memory, and processing ability).
- Systemic challenges such as competition for limited funding, duplication of efforts, and inadequate capacity building make it more challenging for conservationists to adopt new – and expensive – technologies.
- Translating technological potential into practical, on-the-ground impact will require tools that are simple, cost-effective, accessible, and perform better. Holistic solutions will come from improved technical training, inclusive regulatory and social justice frameworks, and increased collaboration between

industry players.

- In this way, the gap can be bridged between what is expected from conservation technology (it's a tool, not a solution), external barriers (e.g. regulation, governance), end users (i.e. conservationists in the field), and excluded local communities (equally crucial in the conservation conversation).

Looking for highly practical and cost-effective solutions to address the limitations of conservation technology?

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Biodiversity is essential for survival, yet human activities are the leading contributors to its decline. Urbanisation, deforestation, overfishing, and rapidly growing global populations exert enormous pressure on nature's ecosystems – agriculture alone is responsible for **85%** of the 28,000 species at risk of extinction. Conservation technology—such as drones, camera traps, and AI—promises tools and techniques to protect, preserve, and manage our natural resources. However, these technologies often fall short in practice, particularly in remote or critical ecosystems where expectations are highest.

For example, [camera traps](#) are among the most commonly used wildlife monitoring tools in the biodiversity conservation toolkit. They're designed to autonomously and unobtrusively collect data on endangered and invasive species, enable wildlife classification, and identify poaching and illegal logging activities. However, [user frustrations](#) depict a different reality: the cameras are expensive, have a short battery life, are subject to theft and are vulnerable to environmental conditions (e.g. heat and humidity). Furthermore, the volume and speed of data generated are challenging to process – especially in remote locations where connectivity issues can cause bottlenecks in the pipeline.

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Wildlife NGOs typically have limited resources, tight budgets, and operate in a very competitive space to secure funding. It's crucial that the conservation technology they deploy helps them achieve outcomes rather than becoming an expensive line item that doesn't deliver on its promise. In this blog, we'll take a closer look at the limitations of conservation technologies, what can be done to address them, and the emerging technologies that are being lauded as 'game changers'.

What constitutes a conservation

technology, and what are its limitations?

Conservation technology refers to tools, devices, and systems designed to assist in the protection, preservation, and management of natural resources and ecosystems. These technologies have become essential in modern conservation efforts, enabling more precise data collection, monitoring, and intervention – but their limitations impact efficacy and impede widespread adoption.

1. Camera Traps

2. **Acoustic Sensors**: These recorders capture sounds in the environment, such as bird calls or insect activity, allowing scientists to monitor species that are difficult to observe visually.

- Requires significant expertise to analyse and interpret sound data.
- Background noise and environmental factors can affect recording quality.
- High storage and processing requirements due to continuous data collection.
- Conservationists find dealing with the vast amounts of data generated difficult and frustrating. Audio recordings must first be processed to extract relevant sounds (such as wildlife calls) from the background noise. Manually, this is very labour-intensive, and automated tools are often unavailable.

3. **Tracking and Monitoring Devices** (e.g., radio, GPS, and satellite collars): Used to track animals' movement and behaviour, these devices provide invaluable data on migration patterns, habitat use, and social interactions.

- Battery life constraints often require frequent recharging or replacement.
- Potential to cause distress or injury to the animals being tracked.
- Connectivity issues in remote areas can delay or prevent data transmission.
- Size and durability are often challenging to get right.

4. **Drones**: These devices offer a bird's-eye view of conservation areas and are used for aerial surveys, mapping, and monitoring wildlife or habitats.

- High initial costs and maintenance expenses.
- Regulatory restrictions in certain regions.
- Limited flight time due to battery life, requiring frequent recharging or multiple drones for continuous monitoring.
- This technology raises questions regarding consent and cultural sensitivity when capturing images of people.

- The use of drones has been noted to disturb wildlife (particularly animals that are sensitive to sound, such as elephants, and birds which inhabit the airspace in which drones operate).
- Systemic exposure over time may have lasting effects on animal behaviours.

Top 3 emerging technologies that promise to advance conservation

In the first-ever [State of Conservation Technology](#) report published by the World Wildlife Foundation, three emerging technologies with promising trajectories to advance conservation were identified as 'game changers'. These technologies offer new possibilities in the conservation field, addressing some of the limitations of established tools but they introduce their own set of challenges.

1. Artificial Intelligence (AI): AI is being used to analyse vast amounts of data, from identifying species in camera trap images to predicting poaching activities based on patterns in data. By significantly reducing the time required to process data and detecting patterns that are too subtle for human analysts to detect, AI makes it easier to act on insights in real-time.

Challenges:

- Requires large, high-quality datasets for training, which may not always be available.
- The complexity of AI models can make them challenging for non-specialists to understand and trust.

2. Environmental DNA (eDNA) involves collecting samples from the environment (e.g., water, soil) to detect the presence of species based on genetic material left behind. This method allows for non-invasive monitoring of biodiversity and the detection of species that are difficult to observe directly, including those that are rare or elusive. It also allows for the simultaneous monitoring of multiple species.

With regard to overcoming the limitations of legacy conservation technologies, eDNA

reduces the need for physical sightings or captures, which can be labour-intensive and intrusive. It can be used in environments such as lakes and oceans where traditional methods (like camera traps) are impractical.

Challenges:

- It requires sophisticated lab equipment and expertise to process and analyse DNA samples.
- Environmental factors (e.g., water temperature, pH) can affect the quality of eDNA, leading to false negatives or positives.

- Requires a comprehensive reference database.
- Only gathers information on the presence or absence of the target species. It does not provide information on factors such as a species' life stage, reproduction, or fitness.

3. Networked sensors can be deployed across large areas to monitor environmental conditions, wildlife movements, and other ecological parameters in real time, which would be impossible to do manually at the same scale. They are often connected via the Internet of Things (IoT) to central databases and provide continuous, real-time data that can be used to monitor ecosystems with minimal human intervention.

The benefit is that networked sensors can function in remote locations where traditional connectivity is limited. They're also low maintenance; some sensors are designed to operate for years without intervention.

Challenges:

- Initial setup can be complex and costly.
- Data security and privacy concerns, particularly when sensors are deployed on or near indigenous lands.
- Resource constraints: energy, bandwidth, memory, and processing ability requirements are significant.

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According to the WWF report, while AI, eDNA, and networked sensors are seen as highly promising, 'cutting-edge' technologies, they currently rank lower in overall performance compared to more established tools like GIS (geographic information system), remote sensing, and drones. This discrepancy highlights the ongoing challenges in translating technological potential into practical, on-the-ground impact.

Systemic challenges inhibiting the adoption of conservation technologies

The most [pressing challenges](#) affecting the field as a whole are competition for limited funding, duplication of efforts, and inadequate capacity building.

1. **Funding and resource allocation:** Conservation projects often operate on tight budgets, making it difficult to allocate funds for high-tech solutions, especially when these technologies come with high initial costs and ongoing maintenance expenses.
2. **Training and expertise:** There is a significant gap between the availability of

advanced technologies and the expertise needed to use them effectively, especially in developing countries. Many conservationists lack the technical training required to operate these tools or interpret the data they generate.

3. **Regulatory, social justice and ethical concerns:** Regulatory frameworks governing the use of certain technologies, such as remote sensing or AI, can be restrictive and vary widely across regions. [Ethical concerns](#), particularly regarding data privacy and the impact on local communities, further complicate the deployment of these technologies.
4. **Interoperability and integration issues:** Many conservation technologies are developed in silos, leading to compatibility issues when trying to integrate multiple tools or datasets. This lack of standardisation can hinder the effectiveness of conservation efforts.

Conservation tools aren't the same as conservation solutions

One of the critical reasons conservation technology deployment often falls short is that it's mistakenly viewed – and pitched – as a complete solution rather than a set of tools to assist human efforts. Human [intervention and engagement](#) need to be at the heart of protecting biodiversity for conservation to work successfully – and less expensively.

Community engagement: In many cases, Indigenous People and Local Communities ([IPLCs](#)) have been acting as environmental stewards for centuries and have a deep relationship with and understanding of the habitats where they live. However, they often aren't included—nor are their rights protected—in the conservation conversation – leading to conflict instead of collaboration.

- Investing in the training and empowerment of local communities to use and maintain conservation technologies can lead to more sustainable and impactful outcomes.
- Combining modern technology with Indigenous knowledge will create more holistic and effective conservation strategies

Policy and advocacy: Effective conservation requires strong legal frameworks and advocacy to ensure that environmental protections are enforced and that harmful activities are curbed.

- Encourage collaboration between technologists, conservationists, and policymakers to ensure that conservation technologies are designed and deployed to meet the real-world needs of biodiversity protection.

Education and awareness: Raising awareness about the importance of biodiversity and conservation can inspire individuals and communities to take action, from reducing their ecological footprint to supporting conservation initiatives.

While technology alone cannot solve conservation issues, it can help reconnect people with nature. Tools like mobile apps that guide nature walks or virtual reality experiences that showcase endangered habitats can help people appreciate the natural world and motivate them to protect it.

Conservation is a commitment - technology helps us keep it.

Conservation technology holds immense potential to help us preserve our planet's biodiversity. However, to unlock this potential, we must address its limitations, integrate solutions thoughtfully into broader conservation strategies, and remember that technology is a tool—one that must be wielded by informed, committed individuals to make a meaningful impact.

By bridging the gap between technology and human action, we can ensure a brighter future for both our natural world and the generations that will inherit it. [Call us](#) if you're looking for a conservation technology partner who can help co-create the solutions to bridge that gap.

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FAQ's

Why is conservation technology important?

Conservation technology is crucial for monitoring and protecting biodiversity, which is under severe threat from human activities like agriculture. These technologies help gather data and provide insights that can inform conservation strategies. Without them, it would be much harder to track endangered species and manage natural resources effectively.

How do camera traps help in conservation efforts?

Camera traps are used to monitor wildlife, providing critical data on species presence, behaviour, and population trends. They operate autonomously, capturing images and videos without disturbing the animals. However, their effectiveness can be limited by short battery life, environmental conditions, and the challenge of processing large volumes of data.

What are the limitations of using drones in conservation?

Drones are valuable for capturing aerial footage and surveying large areas quickly. However, they are limited by their battery life, susceptibility to weather conditions, and the need for skilled operators. Additionally, they can be intrusive to wildlife, potentially altering animal behaviour.

Which emerging conservation technology shows the most promise?

AI, environmental DNA (eDNA), and networked sensors are among the most promising emerging conservation technologies. These tools offer advanced capabilities like real-time monitoring and species identification from genetic material in the environment. However, they also face challenges such as high costs and the need for specialised expertise.

Why is environmental DNA (eDNA) important in conservation?

Environmental DNA (eDNA) allows conservationists to detect species by analysing genetic material in water, soil, or air samples. It's particularly useful for identifying elusive or rare species without needing to capture or observe them directly. Despite its potential, eDNA analysis requires specialised equipment and expertise, making it less accessible for some conservation projects.

How does AI contribute to conservation?

AI can process large datasets from sources like camera traps, drones, and sensors, identifying species and detecting patterns that humans might miss. This technology can help predict changes in ecosystems and improve decision-making in conservation efforts. However, AI's effectiveness depends on the quality of the data and the algorithms used, and it requires ongoing human oversight.

What are networked sensors in conservation technology?

Networked sensors are devices placed in natural environments to monitor conditions such as temperature, humidity, and animal movements. These sensors can transmit data in real-time, providing valuable insights into ecosystem health. However, they often require reliable power sources and connectivity, which can be challenging in remote areas.

When is conservation technology most effective?

Conservation technology is most effective when it complements traditional conservation methods and is used in environments where it can operate reliably. For instance, technologies like GIS and remote sensing work well in large, open areas where data can be easily collected and analysed. Their effectiveness diminishes in areas with poor connectivity or extreme environmental conditions.

Which conservation technology has the highest performance rating?

According to a World Wildlife Fund survey, GIS and remote sensing, drones, and mobile apps have the highest performance ratings among conservation technologies. These tools are valued for their practicality and reliability in the field. They have proven effective in various conservation projects, despite some limitations.

Why do conservation technologies often fail in remote areas?

Conservation technologies often fail in remote areas due to inadequate power supplies, poor connectivity, and harsh environmental conditions. For example, camera traps and sensors may not function well if their batteries can't be easily recharged or if they're exposed to extreme weather. Additionally, the lack of local expertise can lead to improper use or maintenance of these technologies.

How can conservation technologies impact indigenous communities?

Conservation technologies can negatively impact indigenous communities if they are implemented without proper consultation. These communities may lose access to their lands or face restrictions due to conservation initiatives that prioritise technology over traditional knowledge. Balancing technological interventions with respect for indigenous rights and involvement is essential.

What role do traditional tools play in conservation?

Traditional tools like radios, binoculars, and solar panels continue to play a significant role in conservation, particularly in areas where high-tech solutions may not be practical. These tools are often more durable, cost-effective, and easier to use in the field. They complement advanced technologies, providing a balanced approach to conservation efforts.

Who benefits from conservation technologies?

Conservation technologies benefit a wide range of stakeholders, including conservationists, researchers, and local communities. They help monitor biodiversity, protect endangered species, and manage natural resources more effectively. However, the benefits are maximised when these technologies are accessible, affordable, and used in conjunction with traditional methods.

Why is human oversight critical in using AI for conservation?

Human oversight is crucial when using AI in conservation because AI systems can only be as good as the data they're trained on. Without human involvement, there's a risk of species identification errors or data misinterpretation. AI should be seen as a tool to assist, not replace, human decision-making in

conservation.

What are the systemic challenges in adopting conservation technologies?

Systemic challenges include high costs, lack of technical expertise, and resistance to adopting new methods. Many conservation organisations operate on tight budgets and may struggle to invest in expensive technologies. Additionally, the complexity of some technologies can deter their use, particularly in regions with limited access to training and resources.

Which conservation technology is the most cost-effective?

Mobile apps are often the most cost-effective conservation technology because they can be deployed on existing devices like smartphones and tablets. They provide a wide range of functions, from data collection to species identification, without requiring significant investment in new equipment. Their effectiveness, however, depends on reliable connectivity and user engagement.

How does connectivity affect conservation technology?

Connectivity is critical to the success of conservation technologies, as many tools rely on real-time data transmission. In remote areas with poor connectivity, technologies like networked sensors and camera traps may not function optimally, leading to data loss or delays. Improving connectivity in these regions is essential for maximising the impact of conservation efforts.

What's the difference between conservation tools and conservation solutions?

Conservation tools are technologies that assist in data collection, monitoring, and analysis, but they are not solutions on their own. A conservation solution involves a holistic approach, combining tools with human action, policy, and community engagement to achieve long-term goals. Misidentifying tools as solutions can lead to over-reliance on technology and underestimation of the human effort required.

Who are the main users of conservation technology?

Wildlife NGOs, government agencies, research institutions, and local communities are the main users of conservation technology. These users employ various tools to monitor ecosystems, protect endangered species, and manage natural resources. The effectiveness of these technologies depends on the users' ability to integrate them into broader conservation strategies.

When should conservation technology be deployed?

Conservation technology should be deployed when it aligns with a conservation project's specific goals and when the environment suits its use. It's most effective when combined with traditional conservation methods and local knowledge. Careful planning and consideration of the technology's limitations are essential for successful deployment.

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