SUSTAINED EFFORT

COMMUNITY THOUGHTS ON CONSERVATION TECH SUSTAINABILITY

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COMMUNITY THOUGHTS ON CONSERVATION TECH SUSTAINABILITY

Let me start this series with a huge spoiler: you won't find the solution to sustainability in conservation technology here.

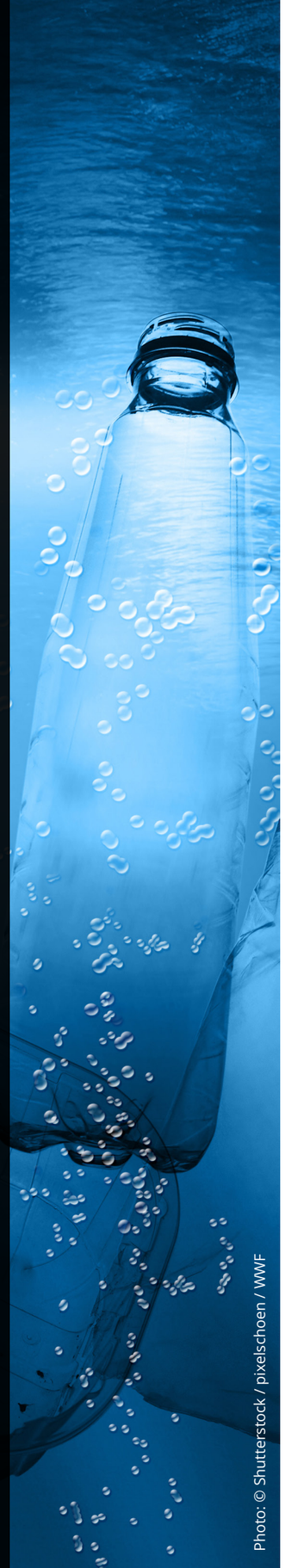
What you will find are ideas. Ways to shape your thoughts around the subject. Stepping stones toward something practical and tangible. Perspectives on why this topic is so difficult to conquer, and starting points from which you can begin untangling your own perspectives on incorporating sustainability into your work.

Sustainability is a web of enormous, complicated challenges that impact every level of conservation technology. Its challenges are built into so many of the systems we deal with every day, and because none of us can be an expert on every system and every layer of conservation technology, both as users or as makers, none of us can hope to untangle that web ourselves. And because those systems are pervasive in our field, it can be difficult to even fully comprehend what it is we don't yet know. In trying to find voices to highlight in this series, I've realized this: we need each other in order to recognize the path forward.

So while you will not find an easy one-size-fits-all solution to sustainability challenges in this series, you will find a reason to be optimistic: we each hold a little piece of the expertise needed to solve those challenges. By accepting what we don't know and seeking spaces like **WILD**LABS where we can fit those puzzle pieces together to reveal the big picture, we still stand a chance of creating meaningful impact. We hope you will read this series, find something within it that speaks to your own challenges, and be inspired to share your puzzle piece with our community.

Ellie Warren

WILDLABS Editorial Lead



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ROB APPLEBY & ELLIE WARREN

1

OUT WITH THE NEW, IN WITH THE OLD

"Using the newest tools that everyone's excited about might be novel and exciting and get all the attention, but in a way, isn't focusing on sustainability and using old tools or thinking outside of the box also just as novel?"

Rob Appleby

Photo: © Sebastian Castañeda / WWF-Peru

Rob Appleby has a bold vision for the future of conservation technology: What if we could learn to see our tools through the lens of sustainability and break free of the mentality that the newest innovation is always best? In this interview between Rob Appleby and Ellie Warren, we discuss the importance of DIY, recycling, and sharing tools in order to make our community more sustainable.

We all love our new tech tools. Experimenting with new innovations (and hopefully finding something that works perfectly for you and your projects' needs) is undeniably one of the coolest things about working in the conservation technology field, and for good reason. In fact, **WILD**LABS wouldn't exist if not for the rapid evolution of tech tools and the constant need to learn new skills, adapt to new features and functions, and find ways to make our technology work as effectively as possible.

But like everything else in the world, new conservation technology comes with a trade-off - a recurring theme in this series. For every new tool we acquire, an old tool becomes obsolete and goes into storage, or to a landfill, replaced by a tool that may work better and check the boxes on all your specific needs, but that inevitably required many unsustainable resources throughout its development and supply chain cycle in order to reach you.

In the quest to find practical and actionable steps that the conservation tech community can take to improve the sustainability of our work, concrete answers were scarce. But Rob Appleby has ideas that every one of us can put into practice right now with our own tech tools, if we're willing to uncouple our work from the inherent coolness of the newest and shiniest gadgets.

What if we made an effort to repair tools that still have potential life left in them? To recycle components from even older tools and give them new life inside of other tools that could use a boost? What if we challenged ourselves to no longer see tools as disposable, but as resources that should be used as efficiently and fully as possible? How would conservation technology as a field change if we adopted that mindset?

"I was digging around at my old university lab," says Rob, "and I kept finding all this old discarded equipment, things like telemetry collars that no one was using. And I thought, these have bits and pieces that could still be recycled and reused, and I actually ended up experimenting with that. I stripped a whole bunch of transmitters out of these old collars, and we ended up using them in test collars that people could try without relying on brand-new tools." The idea sounds simple enough - consider what components inside of obsolete tools could be applied to something new that others (or yourself) can use. If you develop the technical skills to strip tools and understand how components fit together, it's perfectly doable!

"Too often, people have this 'throw it away' mentality about things that aren't even broken. They're easily fixable, or they're just old, or people are bored with using the same old thing and want a change. And I don't think that's a worldview that conservationists should be getting behind," says Rob. "We should be encouraging people to see the long-term value in these tools that can still work perfectly well. And part of that involves encouraging people to share."

Photo: Stephanie O'Donnell

Rob is a big supporter of what shouldn't be a radical idea, but somehow manages to still come across as revolutionary in our consumerism-driven society: giving tools away. "If you're not going to use old camera traps and they'll be sitting in storage forever, why not give them to students to train and learn? Or give them to people who can use them to practice DIYs and repairs themselves." Envisioning the reach of **WILD**LABS' global community, Rob emphasizes just how many tech tools are out there going unused, how many people on a daily basis are looking for tools and components for their work, and how many people with tools to share are already connected through our platform. "We have the community already, we just need to help each other instead of always turning to the solution of buying something straight away."

So how can a community learn to repair and recycle tools for themselves? The idea may be a hard sell; after all, that technical barrier can be intimidating, especially for someone who has never done a teardown or DIYed a tool before. But as someone who taught himself to strip tools and repair them himself, Rob can confidently say that, while it may be intimidating at first, it's an easier skill to acquire than you'd think! "There are really good YouTube tutorials out there to walk you through these things. I watch those regularly for tips and tricks. And learning from teardown videos so you can get the experience of taking things apart and putting them back together, and understanding how everything inside of your tools works together."

And if you're worried about making mistakes, Rob assures potential DIYers that it's all part of the process. "Just struggling to see how well you know your own tools inside and out is going to give you the ability to think about this stuff differently. You'll see that it's all just components and knowing how to use them correctly. If you've got old tools lying around that you're not using, take it apart and try to put it back together. Even if it doesn't go perfectly, you'll learn from the experience, and it'll be a lot less intimidating when you're ready to repair something for real."

And in the near future, Rob can envision a world where we collate our knowledge to teach each other more effectively, bringing that technical barrier down even further for the most tech-challenged among us. "I'd like to eventually put together a list of tools people need to get into

DIYing and repairing things, and steps for tackling common problems with things like camera traps that are relatively easy to dig into and fix. Imagine how much easier it would be if we knew where to get the exact resources we need to fix common problems instead of tossing it into a bin to be replaced by a new model. And once you know how to do it for yourself, you can help others. Spaces like **WILD**LABS already have the ability to connect people and help you find exactly where your unused tools or your skills can make a difference to somebody. So it's much easier with a platform and community like this to build momentum toward actively sharing and swapping than it would've been even a decade ago, when you might never meet somebody who has the same problem or uses the exact same camera trap as you."

Bypassing the need to replace equipment as frequently, or obtain new equipment for testing project concepts or training students and team members to use tools, can go a long way toward making our work more sustainable simply by reducing demand and reliance on the supply chain. And for contentious conservation tech practitioners, this strategy comes with the added benefit of reducing costs.

As Rob explains, "It may not be a huge money-saving venture, but for example, when it comes to things like test collars, say each transmitter you're able to salvage would've cost $200. By salvaging five, you've reduced your footprint quite a bit, and saved $1000 from your budget. That may not be an impressive amount for projects with massive amounts of funding geared toward trying the latest tools available. But if you're like a lot of conservationists who are working with a pretty limited budget and trying to expand the amount of tools you're able to deploy out in the field without running up costs, $1000 can make a big difference."

And this leads our conversation down the path to another (often underrated) aspect of sustainability: the role that funding plays in our reliance on new tools and our less sustainable choices. Planning projects around the latest, most cutting-edge

Photo: Juan Pablo Moreiras/Fauna & Flora International

technology that has all the hype in the world may increase your odds of receiving certain grants and other funding opportunities, and of course, there's no conservation work at all without the funding that keeps the gears well-greased and turning. But truthfully, not every project needs a fleet of brand-new tools, or needs to collect as much data as possible just because innovative features enable us to do so. And while we can't hope to change the entire system of funding and academia and all the considerations that come with it, we could take steps toward shifting perspectives of what is valuable, interesting, and attractive about conservation tech projects.

Looking at our work in the planning stages through the lens of sustainability can help you set realistic expectations and find a comfortable middle ground between what's possible and what's necessary. And because so many projects in our field are already constrained by funding limitations, many of these questions will already feel quite familiar. Are you choosing a new tool because it significantly adds something to your project's chances of success, or to solve a mild inconvenience that doesn't dramatically change your project? How much data do you honestly need to achieve whatever it is you're setting out to do? How many tools minimum will get you there? If you didn't have access to brand-new tools without the exact specifications and features, would your goal still be achievable? And if a new tool is part of your plan because it'll save you time, have you factored in the time it'll take to get over the learning curve of your new tool and use it effectively? What about if your tool malfunctions? If not, would using a familiar tool actually boost your productivity?

It's completely fine if the answer to these questions ends up being that new and innovative tools are the right choice for your project! But keeping an open mind and looking for alternatives when possible means you'll also be open to spotting valuable opportunities to make more sustainable choices, cut costs, and frame your work differently.

Photo: © Subhamoy Bhattacharjee / WWF-US

In the end, many of Rob's ideas boil down to the power of shifting perspectives. "Using the newest tools that everyone's excited about might be novel and exciting and get all the attention, but in a way, isn't focusing on sustainability and using old tools or thinking outside of the box also just as novel? If everyone is building their project around deploying camera traps with all the latest features, doesn't it make your project stand out to say that half your cameras will be recycled or DIYed in some way to lessen your project's footprint?"

So while there will always be new tools that we want to try, and new innovations that will change our field for the better, maybe it's okay to embrace the tried and true occasionally. "It might feel like a very small-scale effort at first," says Rob of exchanging tools and learning to repair what can still be used. "But that doesn't mean it's not important or helpful. We might never feel like we're changing the world - we're just making little changes along the way. But even if you're just making changes to make yourself feel good about being more sustainable, it's worthwhile."

ABOUT THE AUTHORS

ROB APPLEBY

Rob is the co-director of Wild Spy, an Australian based wildlife technology company, and he is currently completing a PhD examining human-dingo conflict on Fraser Island, Queensland. Rob has a strong interest in leveraging the power of technology to help answer tough questions about animal behaviour and to help bring solutions to what can sometimes seem like intractable conflict situations. Rob is keen to explore ways to improve the accessibility and cost-effectiveness of cutting edge technological advances to researchers and conservationists striving to reduce human-wildlife conflict and advance wildlife conservation.

ELLIE WARREN

Ellie Warren is **WILD**LABS' editorial lead. Based in Los Angeles, California, Ellie's favorite part of working with **WILD**LABS is exploring the stories of our conservation technology community and finding ways to highlight why those stories matter. In her spare time, Ellie enjoys podcasts, screenwriting, and looking for squirrels in her neighborhood.

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JACINTA PLUCINSKI & AKIBA

THE ENVIRONMENTALIST'S DILEMMA

OUR SUSTAINABLE TECHNOLOGY JOURNEY

"Sometimes it feels like we're steering the slow-moving Titanic, trying to avoid the environmental disaster iceberg that's clearly on the horizon. But if we focus too much on that, we'll be paralysed. That's where "perfect is the enemy of better" comes in. We know we won't get it perfect the first time out, but we're trying to consistently improve our processes one piece at a time."
Jacinta Plucinski & Akiba

Photo: Jacinta Plucinski & Akiba

Creative thinking can be a conservationist technologist's greatest tool for finding new solutions to pressing challenges. In this article, Jacinta Plucinski and Akiba of Freaklabs discuss how to organise your thoughts around a topic as vast and overwhelming as sustainability in the conservation tech field.

The Enviromentalist's Dilemma is the title of a book by journalist Arno Kopecky. In it, Kopecky discusses the contradiction that whilst humanity's progress overall is trending towards improvement, it is coinciding with environmental degradation on a scale we've never seen. "How do we reconcile this paradox," he asks?

How do we indeed?

Our Conservation Technology Paradox

For us at Freaklabs, we face a similarly stark paradox. We are hardware developers and manufacturers working with ecologists to create tools to help understand, conserve and regenerate the environment. This includes real-time monitoring systems for soil, ABRs modules for camera traps to understand predator/prey behaviour or deter pests, and tracking tags to help first responders locate whales tangled in fishing nets.

These tools are giving us greater understanding and insight into how our world works, enabling us to measure the effectiveness of restoration practices and to increase the impact of our efforts. Yet they rely upon extractive materials, resource-intensive manufacturing processes, and global infrastructure that contributes to the very problem of environmental degradation in the first place.

Materials such as epoxy resin for the PCB is made from petroleum and copper for the electrical traces are mined with a supply chain that's difficult to trace. Water and power-hungry manufacturing processes are used for the PCB fabrication, enclosures, speakers, sensors, cables … the list goes on. Sea or air freight that ships the devices globally rely on petroleum for fuel. And this is before the devices even get into the field, where broken equipment or used batteries start to pile up.

When we contemplate sustainability in conservation technology and stare deeply into the muck, the sheer scale of the problem can be depressing and become paralysing.

It would be easy for us to keep our faces turned towards the light, to focus on the benefits our technology brings – the metrics, the insights, the prevention and the restoration "wins," but without also acknowledging the harmful impacts of what we do, it can quickly turn into unintended greenwashing.

So we end up back to Kopecky's question: how can we, as developers and users of conservation technology, navigate this "moral minefield?"

Photo: © Neil Ever Osborne / WWF-US

Photo: Jacinta Plucinski & Akiba

Our Approach Towards Sustainability with Quotes

Rather than throw up our hands, grab a martini, and watch from the deck as the ship we're all in sinks, we've developed a short step-by-step process, and turned to tried-and-true quotes to keep us focused on the bigger picture. By putting things in perspective like this, we can have hope that our actions towards sustainability make a difference.

1) Sustainability Audit: "Nothing can be Changed until it is Faced" and "Think Global, Act Local."

Our sustainability audit is a process of going through each business element and activity to identify its positive and negative impacts. The audit covers activities such as complete product development, manufacturing, supply chain, operations, field deployments, office activities, and so on.

It began as informal discussions on ways to reduce used batteries in the field, why boxes were often too big for what was being shipped and filled with unrecyclable padding, or how to maximise the life cycle of a product. As we've expanded, we've formalised it into a more structured review that we conduct each year as a way to commit to, and measure, lasting changes.

The audit is a straightforward but overwhelming exercise, and it's easy for us to feel disheartened.

Which is why we rely on the quote "nothing can be changed until it is faced." This is actually a quote by James Baldwin and it keeps us honest. We need to eyeball our impact before we can improve it. We're also mindful that our business is global, with field projects and devices deployed worldwide, so the local actions we take have an impact in many countries. This is why Patrick Gedde's Think Global, Act Local principle along with sustainability has become another business and technology metric, just like time, cost, and expertise.

2) Identify Immediate, Medium and Long-Term Priorities: "Pick Your Battles" and "Divide and Conquer"

When we consider all that needs to be done, "pick your battles" and "divide and conquer" come in.

Within each section of the audit, we identify areas where we can take direct action, where we have influence, or where it's beyond our capability at the moment. We then identify what we can implement with relative ease, what will require procedural or behavioural change or input from others, and what significant changes we need to start building towards for the long term.

One example is printed circuit boards. Previously we were exploring sustainable or biodegradable

printed circuit boards made using alternative materials such as paper, a project we were collaborating on with Jie Qi, a paper engineering expert. Unfortunately, the state of circuit board technology doesn't allow affordable or sustainable solutions at the moment; however, we're still looking for options to test out.

On a different note, we were concerned about shipping packages over long distances, especially for small orders. This both adds cost to end users and creates a horrible carbon footprint. For devices like Boombox, we're now in a position where we can work with fulfilment houses to ship one large batch to them and have them distribute devices regionally. Along with business improvements like lower shipping costs and quicker transit times, it also removes the need for each small package to individually travel by air to its destination.

We also leverage available programs and tools such as B-Corp's free impact assessment or Patagonia's approach to supply chain transparency to help guide us in how we approach larger, more complex issues. We don't want to recreate the wheel, so we look to other organisations to see how they're approaching these issues, and adapt or port over what can work for us. Where there are options, we'll support businesses that have the same commitment to improving their business practises, even if they're more expensive. We're conscious we can't fix everything ourselves, but if we "divide and conquer," we can go further.

3) Implementation: "Perfect is the Enemy of Good Better" and "Anything Worthwhile Takes Time"

Sometimes it feels like we're steering the slow-moving Titanic, trying to avoid the environmental disaster iceberg that's clearly on the horizon. But if we focus too much on that, we'll be paralysed. That's where "perfect is the enemy of better" comes in. We know we won't get it perfect the first time out, but we're trying to consistently improve our processes one piece at a time. It's a game of centimetres (inches for US people) and we just crawl forward centimetre by centimetre until we make progress. It's also why the sustainability audit is so important. It allows us to track our progress and see that, although we may not feel the effects of the changes immediately, it does make a difference in the long run.

Which leads nicely into the final quote, "anything worthwhile takes time." Setting up local manufacturing, a trade-in scheme, migrating to rechargeable batteries, reducing our business carbon footprint, building supply chain transparency, and sourcing from equitable suppliers all requires time and effort that takes years. In some cases, whilst reducing the environmental impact on one hand, an improvement raises social or environmental challenges on the other. For example, local manufacturing takes time, money, and resources to set up as it requires materials, equipment, expertise, training, and so on. Whilst migrating to rechargeable batteries saves on battery waste, in some countries sourcing rechargeable lithium-ion batteries is costly, import is difficult, or they're stolen, which means the equipment can't be used. Making more sustainable decisions often means balancing all these trade-offs between long-term and immediate needs.

Photo: Jacinta Plucinski & Akiba

Photo: Jacinta Plucinski

Activities

Our current focus is on device development and life cycle, logistics, and ewaste. So we've implemented some strategies that aren't necessarily cost or labour efficient, but are more sustainably efficient. These include:

Trade-In Program - The informal product life cycle discussions resulted in us implementing a trade-in upgrade program for our designs. This was trickier than we expected. For Boombox, we standardised on our enclosure and accessories so they could all be reused over the life cycle of the product (unless stomped by an elephant or eaten by a hyena). The hardware upgrade only requires a change in the circuit board, and we roll all the feedback from field deployments and updates into one annual circuit board upgrade.

However, the problem with our enclosures is that the standard screw mounts are made of plastic, so the circuit board can't be removed without threading the mounts. Instead, we have to manually add brass-threaded inserts. To do this, we purchased a special tool that could both heat and install them. Once inserted, it allows the circuit boards to be easily installed or removed multiple times, allowing for simple hardware upgrades over time. To manage receiving the old boards and recycling components, we then invested in desoldering equipment, along with building infrastructure and processes for dealing with and stripping returned boards efficiently. It turned into quite a project!

Batteries - The battery waste discussions resulting from our sustainability audit resulted in us committing to removing disposable batteries from all our internal projects, moving our consulting clients towards rechargeable batteries, and building up the electronics infrastructure to house, manage, measure, and charge lots of batteries, which we've done. We've also added the option to use rechargeable batteries to publicly available devices such as BoomBox. Depending on availability, people are now able to use either option.

Low Inventory - To prevent excess stock and waste, we don't do big production runs, as any unsold inventory becomes scrap in some form. We are trialling batch runs of devices and cautiously increasing the quantities in each batch based on demand, which helps us to be sure that we can sell what we produce. Although we salvage

whatever we can, it's best to make sure we use as much of what we make as possible.

Shipping - We receive many, many packages due to the sheer amount of parts we have to stock to maintain designs. In response, we recycle as much of the packing materials as we can. We have separate boxes to sort our collected packing materials into, with spots for small bubble wrap (popping them is so fun!), big bubble wrap, paper, air cushions, and styrofoam peanuts. When we ship, we choose the packing material that best suits the order and use the recycled materials first before dipping into our own packing material supply.

Packing materials are one of the most wasteful resources we use since they're only used for the duration of a trip and have no real functionality beyond that. With that in mind, we try to manage the packing materials we receive from suppliers efficiently and reuse it as much as possible.

Everything we've discussed here is merely a first step for us. There's much more we can do here to improve our own sustainability and find solutions for others in our field - but the first step is just as important as any other.

We know what we're doing has both a positive and a detrimental impact on the environment. By systematically addressing the detrimental aspects and implementing changes within our means, we're hoping we're headed in the right direction and that all these micro-effects lead to a greater positive environmental impact.

In the words of Lao-Tzu, "the journey of a thousand miles starts with a single step." We've started our journey, and we hope you'll join us along the way.

ABOUT THE AUTHORS

JACINTA PLUCINSKI & AKIBA

Jacinta Plucinski and Akiba run Freaklabs, which develops hardware for wildlife research and environmental conservation. They often perform their work in collaboration with individual researchers, research institutes, conservation organisations, and global organisations including UNESCO, World Bank, The Nature Conservancy, and Bush Heritage Australia. In their free time, they're tending the garden, swimming in the ocean, reading, and writing.

ATTILA STEINEGGER

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HOW CAN TECHNOLOGIES DRIVE SUSTAINABILITY OF THE VOLUNTARY CARBON MARKET?

"Transformation on that scale will not be achieved through incremental steps - it will require the use of new, breakthrough technology that doesn't exist yet. But how can we conceive of and develop this new technology in a way that ensures we get the best system overall, across all sustainability criteria?"

Attila Steinegger

Photo: © Jasper Doest / WWF

Conservation technology is vital to understanding and addressing climate change, perhaps the biggest challenge our planet collectively faces. In this case study from WWF's Attila Steinegger, he discusses how we can make tech-based strategies like carbon credits more effective and sustainable as our ability to understand the natural world evolves.

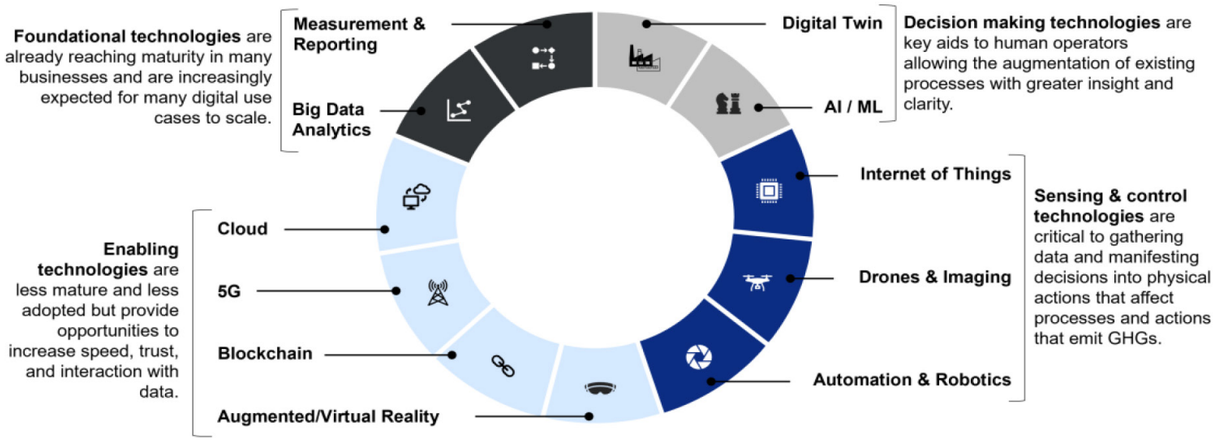
The natural world is deteriorating at rates unparalleled in human history. We are in the midst of the sixth mass extinction and are consequently facing the irreversible loss of plant and animal species, habitats, and vital ecosystems upon which our modern world depends.

Meanwhile, a growing number of countries, cities and businesses are making pledges to get to net-zero emissions, which also leads to an explosion of interest in carbon credits and the voluntary carbon market. McKinsey estimates that annual global demand for carbon credits could reach up to 1.5 to 2.0 gigatons of carbon dioxide (GtCO2) by 2030 and up to 7 to 13 GtCO2 by 2050 (Exhibit 2). Depending on different price scenarios and their underlying drivers, the market size in 2030 could be between $5 billion and $30 billion at the low end and more than $50 billion at the high end (McKinsey).

For those who are not that familiar with carbon credits: A "carbon credit" (also known as a "carbon offset") is an electronic and serialized unit that represents one ton of CO2 equivalent that is reduced, avoided, or sequestered from projects, which can be purchased on the voluntary carbon market. While the voluntary purchase of carbon credits can be an impactful practice, some organizations and experts believe that using carbon credits for carbon neutrality or net zero claims is inappropriate and may be equivalent to greenwashing. For instance, WWF cautions businesses on claiming "carbon/climate neutrality" for either the business or its products, because it could signal that a company's work on climate is done when a company or its products' entire footprint hasn't actually been eliminated (WWF).

In order to provide high quality carbon credits, projects which aim to protect and restore our nature and forests require a feasible monitoring, reporting, and verification process (MRV). However, these MRV activities are time, labor, and cost intensive, and have been shown to be subjective. Therefore, the potential for impact and scale of leveraging advancements of emerging technologies is promising. The World Economic Forum (WEF) presented a diverse set of digital technologies, which can be applied together to deliver decarbonization (see illustration below).

Photo: © iAko R. / WWF-Madagascar



Digital MRV for Forest Projects

Based on this overview, the combination of Sensing & Control Technologies and Decision Making Technologies looks very promising for applying in MVR of forest carbon stock. There are three key aspects that are important for the use of remote sensing in such projects.

One aspect is financial; using available and accessible technology and sensors to lower the cost and upfront capital requirements for forest owners to get certified, especially in low and middle-income countries.

The second aspect is reducing subjectivity in estimating carbon stock and increasing trustworthiness and transparency in the carbon offsetting certification protocols.

And lastly, the solutions need to be scalable due to the urgency of financing forest restoration, especially in tropical regions (ETH). Satellite imagery is increasing in quality and availability and, combined with state-of-the-art deep learning and lidar, promises to soon map every tree on earth and to enable forest above-ground biomass and carbon to be estimated at scale. Compared to current manual estimates, these advancements reduce time and cost and increase transparency and accountability, thus lowering the threshold for forest owners and buyers to enter the market (ETH).

Risk and Limitations of Digital MRV

As already mentioned, technological advancements reduce time and cost and increase transparency and accountability, thus lowering the threshold for forest owners and buyers to enter the voluntary carbon market. Nevertheless, these algorithms risk additionally contributing to a systematic overestimation of carbon stocks, not reducing it, and are not really applicable for small-scale forests, below 10,000 ha (ETH). A recent benchmark study by ETH Zurich shows that all of the available global Above-Ground Biomass (AGB) maps have a tendency to overestimate the ground truth measurements

up to a factor of ten. These are not encouraging results, showing that these maps are far from being accurate enough to be used in remote sensing of forest carbon stock at a small scale (ETH).

This also leads to the conclusion that technology's current state bears the risk of creating misleading

data regarding the impact of conservation projects. As a result, the volume of carbon credits for the voluntary carbon market is increased by low quality carbon credits, which eventually lead to a lower price.

What's next?

Considering the benefits of technologies for digital MRV, it is important that we leverage and scale digital solutions in the MRV process. However, it is also crucial to reduce the mentioned risks and limitations of these technologies. Therefore, it is good to see developments by various organisations like the ForestBench Consortium's effort to create equitable benchmarks for MRV of Nature-Based Solutions with machine learning, which can help to tackle these issues and drive transparency. In addition, some certification bodies of carbon credits are increasingly aware of the technological risks and limitations, and are therefore also working on establishing guidelines and benchmarks to drive transparency and accountability of digital MRV.

What does that mean for Conservationists?

So, what does that mean for the community of restoration and reforestation experts? How could they actively take a step toward driving sustainability with Digital MRV?

1) Get started with Digital MRV - As mentioned earlier, digital technologies can reduce time and cost and increase transparency and accountability in the MRV process. Therefore, it is important to get started and to think about where, when, and how technologies for digital MRV can be applied. To do that, it is crucial to integrate these thoughts into the full process of planning and organizing restoration and reforestation projects; for instance, in a specific monitoring and evaluation (M&E) concept. The use of technologies for digital MRV is usually discussed too late or only when the project has already started. Because of this late start, it is frequently difficult to implement new solutions and tools at a later stage due to issues with availability of financial and personal resources.

Photo: © Jeremy Holden / Fauna & Flora International

2) Make or Buy - Depending on individual requirements for a digital MRV solution, a make-or-buy decision must be made at a certain point. In that case, a short period of research is worthwhile, particularly when it comes to MRV for reforestation and restoration projects, where there are already many potential solutions. One such example of an existing platform is Restor. A global hub for nature restoration, thousands of local communities, NGOs, governments, and businesses share and monitor their projects on the Restor platform.

3) Demand Transparency - Another major action point is demanding transparency from digital MRV and its technology providers. Most providers of digital MRV solutions rely on, among other things, the use of remote sensing data and machine learning algorithms. However, these algorithms are mostly not fully transparent and comprehensible for the users.

To strengthen the sustainability of such solutions, the comparison to a benchmark can be required (e.g. by certification bodies), assessing the accuracy of the algorithms and thus reducing the risk of wrong estimations.

In addition, the technology providers can also be asked to publish the footprint of its solution by creating a holistic view on the entire lifecycle of its product (e.g. use of satellites/drones, platform hosting, data processing, data storage, etc.).

Conclusion & Acknowledgements

Restoration of forests is one of our most important climate mitigation strategies. And by reducing the overestimation of carbon credits, we can allow every man on earth who owns a tree to participate in climate action. Biodiverse and sustainable forestry can provide hope that reaches far beyond the confines of the machine learning community alone (ETH).

I am very thankful for the strong collaboration and insights by ETH Zurich. Special thanks belong to David Dao, Kenza Amara, Gyri Reiersen and the entire ReforesTree-Team for their support and for re-using their work in this article.

ABOUT THE AUTHOR

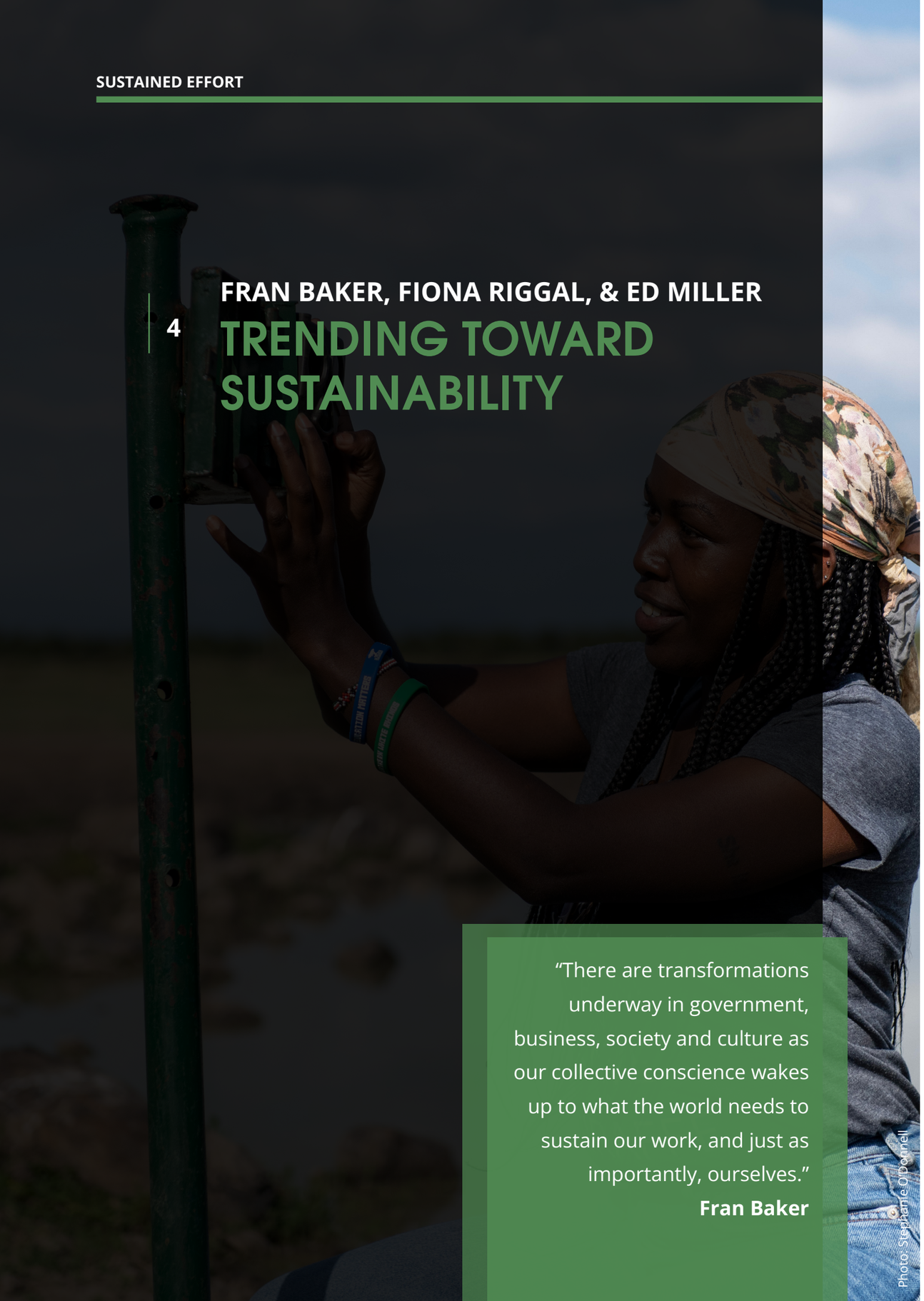
ATTILA STEINEGGER

Attila Steinegger is responsible for digital transformation at WWF. At WWF he is driving digitalisation in the conservation field and pilot emerging conservation technology. Previous to his role at WWF, he used to work for different strategy and technology consulting firms, to drive digital transformation with clients in various industries. He holds a Bachelors in Business Administration from the University of Applied Sciences St. Gallen (Switzerland) and a Masters in Management and Corporate Sustainability from Cranfield University (UK).

Photo: © iAko R. / WWF-Madagascar

FRAN BAKER, FIONA RIGGAL, & ED MILLER

4 TRENDING TOWARD SUSTAINABILITY



"There are transformations underway in government, business, society and culture as our collective conscience wakes up to what the world needs to sustain our work, and just as importantly, ourselves."

Fran Baker

Photo: Stephanie O'Donnell

How are perspectives shifting toward sustainable practices in the tech business world? In this article, experts from Arm discuss how companies that build conservation technology can incorporate sustainability into their mindset of success.

Introduction

Fran Baker

For people working at the 'pointy end' of conservation, you need no introduction to the climate crisis and sustainability issues. Working in a sustainability role at a tech company provides a different perspective on these topics, as my role and that of those on our team is to manage the relationship and tradeoff between the organization's needs and the needs of our greatest stakeholders: this planet and its people.

Businesses (and the people that work for them) don't exist in a vacuum, and are part of the industry we operate in, society we are part of, and planet that we live on. As such, businesses have a responsibility and significant role to play in contributing solutions to some of the world's biggest challenges. The issues of global health, biodiversity loss, climate crisis and inequality are inextricably linked, and even from a purely economic perspective, you cannot have sustainable business on an unsustainable planet. We are motivated by the risks that exist in technological development to both society and the environment, as well as the opportunities for existing and emerging technologies to contribute solutions to the collective challenges we are all facing. It is important to note that technology is not a silver bullet, but a tool that can be used to help address these challenges.

Sustainability considers both planetary and human impacts across different time frames. Meeting the needs of the present without compromising future generations' ability to meet their own needs is the common, though sometimes criticised, Brundtland report definition. This leads to significant difficulties, tensions and tradeoffs. Corporate Sustainability considers these tradeoffs in relation to sustainability issues and their impact on business, and business impacts on sustainability issues for people and planet alike.

Sustainability trends in business

Fiona Riggall

There are good examples of where companies are proactively switching their business models in favour of sustainability as their forward-thinking strategies demonstrate that this is the way to best ensure their continued existence in a low-carbon economic future. The increase in companies voluntarily reporting to CDP (formerly the Carbon Disclosure Project), up 233% since 2015 with 18,700+ companies disclosing in 2022, demonstrates the increasing corporate commitments to publicly respond to climate change, water scarcity and deforestation, and put their efforts out there for all to see.

But moves to be more sustainable are not only being driven by the enlightened - they're also being driven by new legislation such as the Task-Force on Climate Related Financial Disclosure (TCFD), mandating large companies to report on their impact on climate change, and conversely, the impact of climate change on their business models as determined by financial risk assessment. Corporates are also looking to keep pace with their peers and the voluntary standards set by the Science Based Target's Initiative (SBTi) is one way in which best practice is driving ambition across sectors.

The SBTi encourages companies to take more responsibility for all their emissions, measure that impact, and take action to reduce their emissions across all Scopes, including Scope 3 - both

upstream (supply chain) and downstream (how their product is used after it leaves their gates). This means companies can no longer just look at their own operations in a bubble – they have to consider sustainability up and down the value chain. To date, 4,918 companies have committed to the SBTi, including many big players in the tech sector.

Conservation and software challenges

Ed Miller

As a conservation-minded technologist, an Arm employee and a **WILD**LABS member, using technology for the good of the planet is always top of mind for me. However, technology can have negative impacts such as related carbon emissions and e-waste. The negative impacts should be minimized and weighed against the positive to strive for sustainable development.

As a volunteer with a nonprofit, **BearID Project**, I develop machine learning applications to identify individual brown bears in photos and videos. These applications enable researchers to better understand bear populations, which in turn can better inform conservation practices. On the other hand, training and running machine learning models produces greenhouse gasses. While it is difficult to assess the value of protecting a keystone species like brown bears versus the carbon footprint of the applications, we should adopt sustainable practices which continuously evaluate and minimize the impacts of these technology solutions.

Life Cycle Assessment (LCA) is an established methodology for analyzing the environmental impact of each stage of a product or service, from raw materials through manufacturing, distribution, use and disposal. Software should be approached with a similar carbon-aware mindset, considering the impact of development, deployment and use. For example, applications running in the cloud should consider the energy sources of their service provider as well as the resource utilization of the application. Most cloud service providers publish best practice guidance for cost and performance optimization, which often leads to reduction of environmental impact as well. More efficient applications cost less and they use less power. For embedded devices, efficiency should also be considered, but so should upgradeability. Extending the life of the hardware through software updates improves the overall carbon footprint of conservation technology. Software developers can have a significant impact on sustainability by adopting carbon aware programming patterns.

Social Impact

Fran Baker

Sustainability considerations arise at many stages of hardware and software development journeys and come from different perspectives; a materialist approach, for example, might consider the resources required to enable the physical infrastructure of software – from mining, to device production, data centre building and so on. There are also associated social implications of technologies, and consideration for the human and non-human harms in any given deployment is

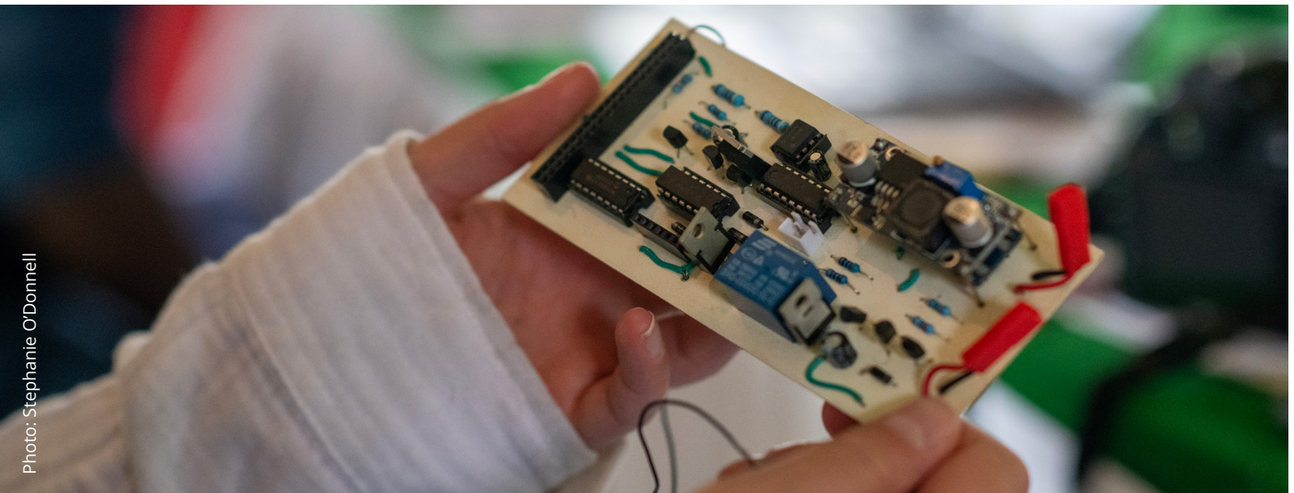


Photo: Stephanie O'Donnell

important, as the impact of software doesn't end with environmental considerations.

In its broadest sense, biodiversity changes can have pervasive effects on the earth's system function, increasing the vulnerability of terrestrial and aquatic systems. Whilst extinction is part of nature, current and projected biodiversity loss rates form the sixth major extinction event in the history of life on earth, and the first driven by effects of human activities (IPBES, 2022). For life on earth to flourish, we must remain within hardwired biophysical limits, which include remaining within acceptable limits of biodiversity loss (Ibid). The relationship between these ecosystems and humanity's ability to survive and thrive are interlinked.

As well as these longer term, existential considerations, responsibility in AI is a key consideration, particularly in the conservation space where there are inequalities of inclusion, access, and power over these technologies. Responsibility in AI in relation to credit scoring, criminal justice, and surveillance is well documented (Zuboff, 2019). Considerations are less obvious and less explored when AI systems and algorithmic impacts fall under the banner of 'AI for Good', and specifically within the conservation space.

With automation of data collection, cleaning and analysis driving a new field of ecological informatics, some scholars within the **WILD**LABS community and beyond consider the ethics of AI in relation to ecological conservation (Adams, 2019) and conservation monitoring technologies (Pritchard et al.,2022), including the Principles for the socially responsible use of conservation monitoring technologies (Sandbrook et al, 2021). This is a welcome shift, though values can be both computationally encoded into conservation monitoring technologies (CMTs), and societally encoded through principles that aim to govern them. Endangered species protection using CMTs, for example, represents an acute case of ethical decisions embedded in AI applications about who or what should be prioritised in a resource-constrained world.

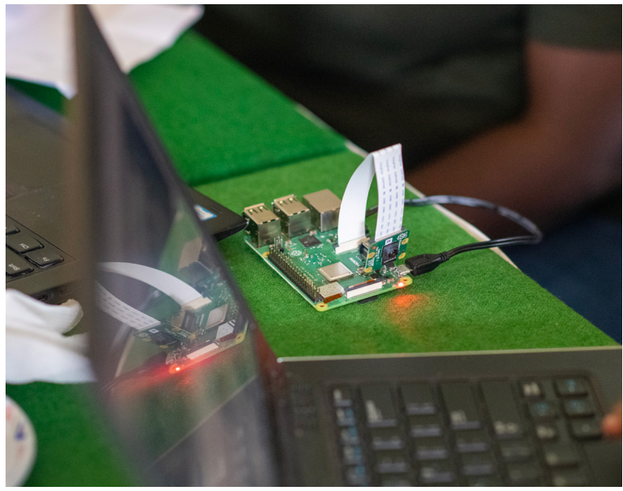


Photo: Stephanie O'Donnell

As readers will likely know well, CMTs have advanced significantly through device capability improvements (e.g., drones), imagery developments (e.g., satellite), data capture capabilities (e.g., remote sensing), and other tools enabling sophisticated data collection, analysis and inference beyond traditional ground and paper-based surveying methods. These tools can be attached (e.g., radio collars) or remote (e.g., camera traps) (Simlai and Sandbrook, 2021) and reflect endangered species' conservation as a microcosm of interrelated sociotechnical challenges associated with AI applications, where outcomes between communities of people and species are directly impacted by their use.

As such, there are significant challenges to regulating or governing a complex sociotechnical system, including potential to reinforce discriminatory social structures that benefit different people, communities and species differently. Therefore, there is a need for a multitude of governance mechanisms at varying levels that are part of AI governance toolkits, particularly for issues that transcend imaginary borders and have impact at a planetary scale.

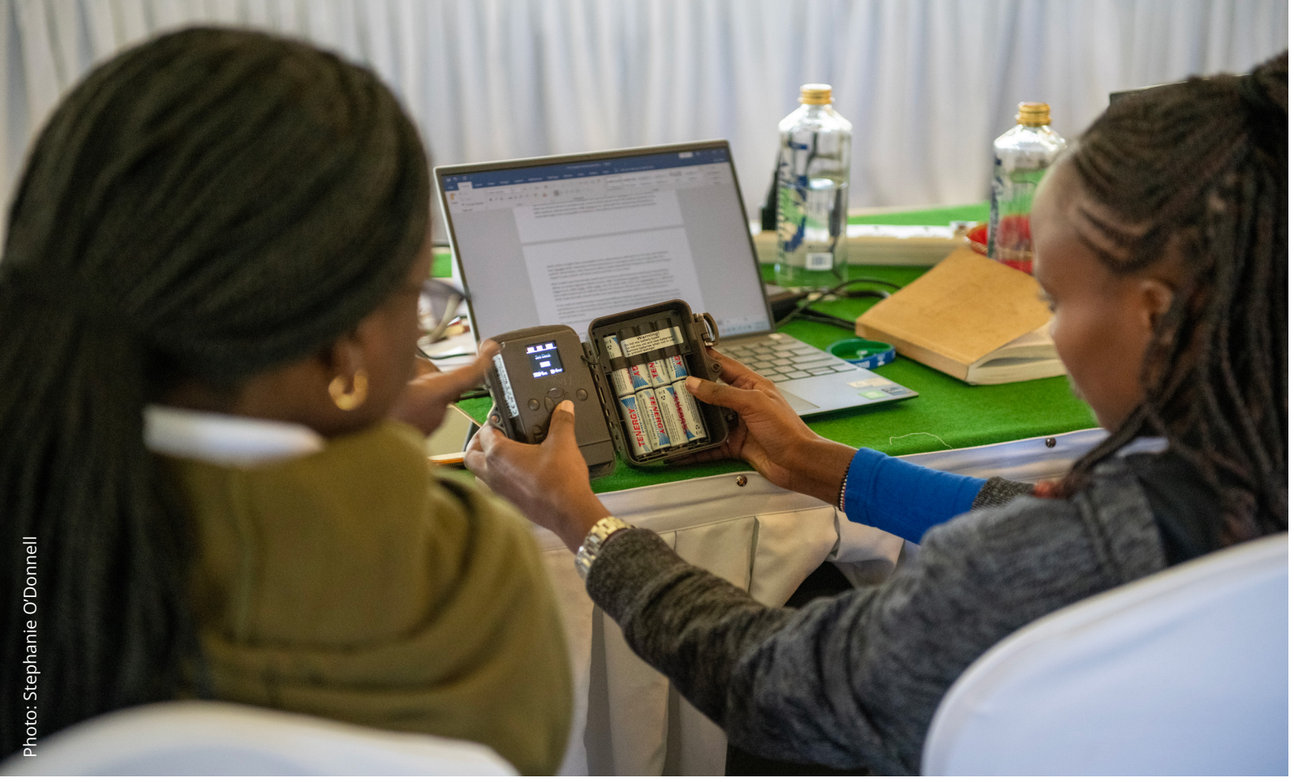


Photo: Stephanie O'Donnell

Arm, Fauna & Flora, and WILDLABS

Fran Baker

Whilst we often see technology portrayed as the saviour to our current and impending challenges, it is irresponsible to continue on our current path in the hope that technological innovation will come to the rescue. That is not guaranteed. Whether driven by impact, innovation or economic incentive, business should and must respond to the pace and scale of the challenge, both inside and outside of their organisations. We must be intentional if we want technology to be a supporting tool in solving some of the world's biggest crises.

But here's the good news: intention is turning into action and showing the way for others to follow, with many examples of this positive change happening within the **WILD**LABS community.

One of the ways in which we have been working to do this ourselves at Arm is through partnering with the problem-holders and bringing together our respective areas of expertise. For many years, Arm has partnered with Fauna & Flora as part of our sustainability approach, supporting a variety of programming. Through this partnership and together with Google, we supported the inception of **WILD**LABS in 2015, which has since grown into the platform you know and love, with programmes designed to bring together conservationists and technologists to innovate solutions to real world issues in conservation and biodiversity.

In 2019, we supported the building and launch of the 'Conservation Tech Lab' at Ol Pejeta Conservancy, designed to research, test, support and develop new technology-based solutions to conservation-challenges around the world, and to bring the prototyping of conservation technologies closer to the action. Next in 2021, we supported **WILD**LABS' groundbreaking State of Conservation Tech research and report, which highlighted where conservation technology currently stands and where innovation is heading next. And in 2022, we supported the first Women In Conservation Technology programme in Kenya, an important step toward training conservation leaders to use technology in their own critical regions.

Sustainable transition trends

Fran Baker

As an optimist working in sustainability, I am definitely seeing the shift in importance across the board. Whilst tipping points such as the Planetary Boundaries represent our hardwired biophysical limits which we much not pass, there are other positive tipping points happening now: The carbon impact of AI is back in the spotlight; e-waste is becoming a focal point in the transition to a circular economy, particularly in the EU, legal cases are being filed against businesses failing to act on environmental commitments; Responsible AI is receiving more welcome attention through recent generative and multimodal AI developments; global backlash against greenwashing and impact washing; and 'conscious quitting' is on the rise as employees choose employers considering sustainability. Likewise, conscious consumption is on the rise, and steps forward in sustainability disclosures alignment and governmental legislations around the world mandating change are resulting in a significant shift in tempo toward positive action.

So, whilst there is a lot of work to do, there are many reasons to be hopeful. There are transformations underway in government, business, society and culture as our collective conscience wakes up to what the world needs to sustain our work, and just as importantly, ourselves. Tech is what we make of it, and considering how it can help us achieve what the world needs, whilst also consciously considering justice in relation to the people tech affects, can help us along our journey to a more just, sustainable and equitable world.

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Fran is Director of Sustainability & Social Impact at Arm, and is currently researching the ethical and societal implication of artificial intelligence at Cambridge University.

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As Director of Sustainability and Climate Impact, Fiona Riggall's role is to minimize Arm's environmental impact with a particular focus on decarbonizing their footprint.

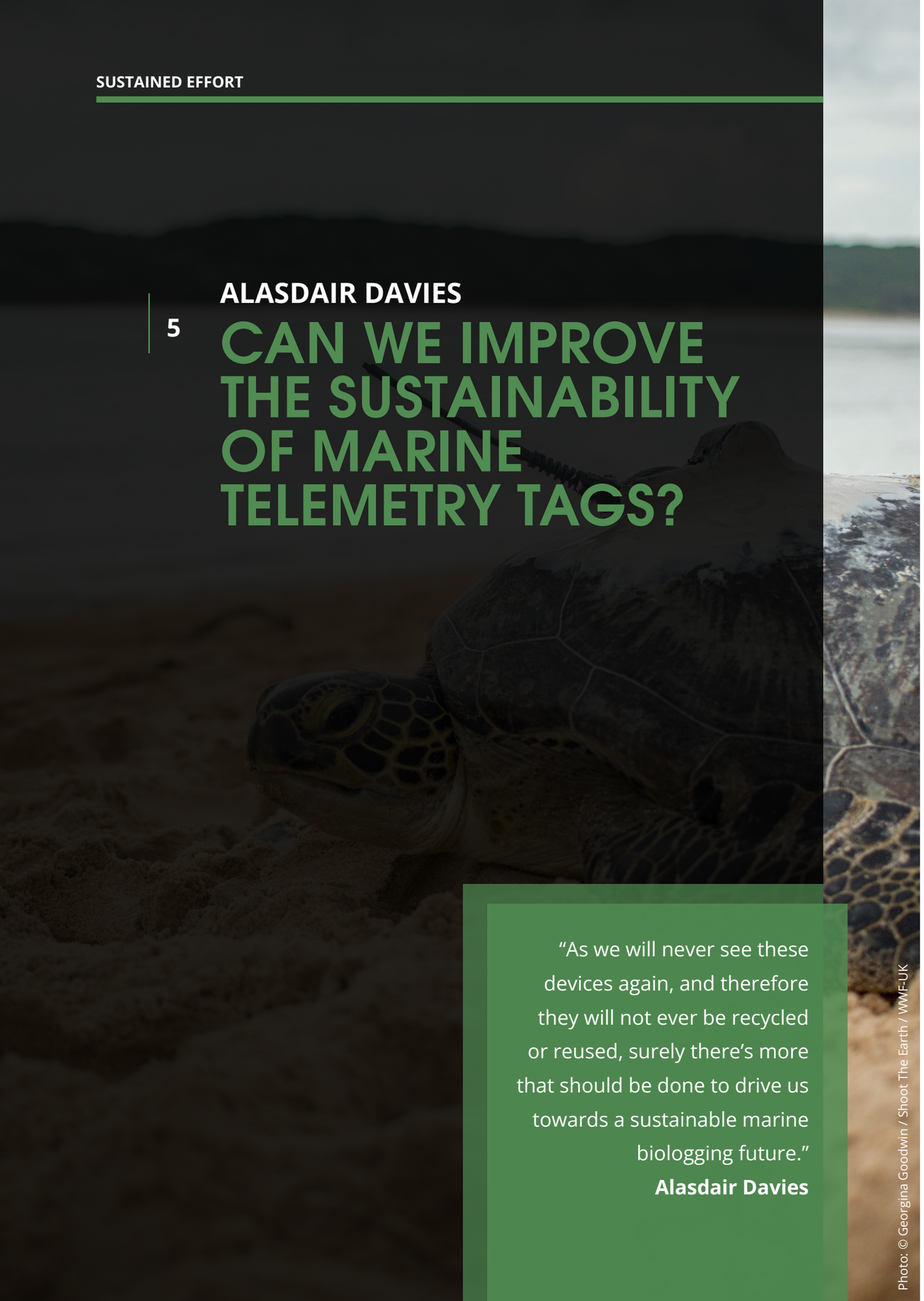
ED MILLER

Ed Miller is a Senior Principal Engineer leading many of the technical engagements with Arm's Strategic Alliances partners.

ALASDAIR DAVIES

5

CAN WE IMPROVE THE SUSTAINABILITY OF MARINE TELEMETRY TAGS?



> "As we will never see these devices again, and therefore they will not ever be recycled or reused, surely there's more that should be done to drive us towards a sustainable marine biologging future."
>
> **Alasdair Davies**

Photo: © Georgina Goodwin / Shoot The Earth / WWF-UK

While all environments present unique challenges to conservation technology, be it humidity, bugs, curious wildlife, thick canopy covers, and much more, marine technology may take the prize for the most challenges to consider during the design process.

I can never help but wonder just what lies in wait for each and every biologger, telemetry tag, or instrument released into the depths of the ocean.

Inside each protective enclosure (often just a few millimetres thick) are delicate electronics, circuitry, and batteries, all of which need to be protected from the harsh saltwater environment, will often need to survive great depths and crushing pressure, and will need to operate for years upon end. Most will never be seen again, attached to the carapace of sea turtles, clamped to dorsal fins of cetaceans, or left to drift on the surface and survive through storms and swells.

There's a classic saying: "hardware is hard." It's true, there's considerable engineering experience needed to design and develop solutions that begin as desk-based prototypes and become devices that can survive in the real world – even more so within the marine environment. It's one of the reasons Arribada focuses on open sourcing complete solutions, from the internal electronics to the enclosure design, meaning years of experience, failure, success, and all the lessons learnt in between can be shared going forward to help others succeed.

Photo: Arribada

When considering what can be done to make the tags we manufacture and deploy more sustainable, the answer is complicated, as are all sustainability issues. From a marine hardware perspective, sustainability is an especially interesting discussion to unpack. Sure, devices on the surface can always ultimately be recovered on beaches or wherever they may come to rest. At that point, recycling, re-use, and recovery are valid options, especially if we're talking about deploying many hundreds, if not thousands of drifting sensors. But for devices that are beneath the waves and attached to animals, what can be done to make those tags more sustainable? As we will never see these devices again, and therefore they will not ever be recycled or reused, surely there's more that should be done to drive us towards a sustainable marine biologging future. To get at the answer, it's probably best to break down the materials, components, and approach to developing and manufacturing solutions for the ocean.

First, let's begin by breaking down the materials used to form a typical telemetry tag and start with the enclosure. For protection from water-ingress, most tags utilise an epoxy resin that is poured into a tool (cavity) in a liquid form to encapsulate the electronics and batteries inside. Epoxy resins (polyepoxides) are usually formed of four parts, a monomeric resin, a hardener, an accelerator and a plasticizer. When mixed together a chemical bond is formed that in turn results in curing, and after a period of time a hard finish. As epoxy resins are essentially thermoset plastic, once bonded, mixed, and cured the process cannot be reversed, meaning it's typically not possible to recycle them.

If properly polymerized (mixed perfectly), an epoxy resin is also inert and will not biodegrade, which is exactly why they are useful to protect electronics inside tags for numerous years. Constant immersion in saltwater shouldn't degrade or break down the epoxy resin enclosure. So what options are available to improve the sustainability of biologging enclosures destined for a life spent permanently in the ocean?

Part bio-based (plant) epoxy resins

Epoxy resins such as EcoPoxy are now available and contain a percentage of plant-based materials, i.e FlowCast contains 20% biobased carbon content. These could be tested and compared against epoxy resins used today to ascertain if they can match the strength and UV resistance needed to become a valid replacement, meaning tag enclosures could be manufactured using part biobased materials. Additionally, epoxy resins can be sourced that are free from volatile organic compounds (VOCs), meaning they won't emit toxic gasses when curing. Switching to different epoxies opens up risk, so there will need to be extensive testing. But if successful, part bio-based epoxies would reduce the quantity of plastic used in each and every biologger manufactured.

Let's next turn to the electronics inside the tag. Over 50 million tonnes of electronic waste ("e-waste") is produced globally every year, so focusing on recyclability and a switch from single-use plastic is key to opening up access to a sustainable future in electronic manufacturing.

One area of development is a move towards sustainable printed circuit boards (PCBs). Considering every biologger has at least one PCB inside, this idea is quite a hot topic. There's plenty of scope to introduce sustainable PCBs into the biologging manufacturing process, and doing so would have a significant positive impact on the sustainability of these tools.

Natural fibre-based recyclable PCB substrates

A number of PCB manufacturers have started to focus on sustainable PCB substrates. One such provider is JIVA, who have developed Soluboard. Instead of using copper and plastic, Soluboard combines natural fibres with a halogen-free polymer, meaning it is equally as flame retardant as standard PCBs and can handle reflowing (replacing electronic components), although I couldn't find any information on the number of layers Soluboard can support at this time. Even if it is a single layer substrate, there's plenty of scope to utilise Soluboard and other recyclable PCB substrates to reduce the percentage of plastic used in manufacturing if incorporated in designs from the start.

Photo: Arribada

Lastly, we have the batteries. Nearly all biologging tags will utilise lithium batteries to pack as much capacity as possible into the limited space and without introducing additional weight. Typically, biologgers utilise primary non-rechargeable cells (Lithium Thionyl Chloride) or rechargeable (Lithium-ion or Lithium polymer). Demand for lithium has skyrocketed, with a prediction that it could triple by 2025 compared to 2020. But an increase in demand also means increased mining and extraction. In Chile, 30 square miles of land have been converted to pump brine to the surface where lithium-rich concentrate is extracted; at the same time, this operation consumes vast quantities of water, parching the local environment, displacing water tables, and disrupting habitat for Andean flamingos. To decrease this demand, we must find alternatives to lithium batteries. So what are the current potential alternatives to lithium batteries in biologgers?

Photo: Arribada

Sodium-ion batteries

One promising solution is the introduction of Sodium-Ion battery technology (Na-ion), offering superior environmental credentials, enhanced safety, and better raw material costs than lithium-ion (Li-ion); however, we're not there yet. Large battery manufacturers are still investing in research to scale lab-based successes and unlock manufacturing at scale, which is no small feat. With the acquisition of Faradion by large industry players (a UK sodium-ion specialist company), it's an evolving space that we will have to watch closely. Of this potential solution, Wood Mackenzie research analyst Max Reid says, "Sodium-ion technology is still in its infancy but represents a viable alternative to Li-ion technologies, depending on how far companies are willing to invest."

It may feel like a drop in the ocean comparing the quantity of batteries used in marine biologgers to, say, the electric vehicle industry, yet the destructive

Photo: © Alam Ramirez / Fauna &Flora

processes to extract lithium remain the same regardless of use. While we are connected to the same extractive industry by our technology's needs and limitations, it is in our interest to support a move to viable sustainable alternatives and more sustainably manufactured biologging tags.

So can we improve the sustainability of marine telemetry tags? Yes, there are several areas where we can push forward, having explored part bio-based epoxy resins, natural-fibre based printed circuit boards, and pointed a finger at sodium-ion batteries (when they become commercially available) as a start.

But for us to really see and understand the coming possibilities will take investment in research by commercial manufacturers, as significant changes like switching to fibre-based printed circuit boards will mean re-testing performance, ensuring quality assurance can be achieved, and confirming modifications to designs are acceptable, all of which takes time, costs money, and requires trust. The same will be true if epoxy resins are changed, or if other sustainable materials and options we haven't yet thought of become possible in the future.

But if successes are shared openly, we can move forward together step by step and create the sustainable future we want to see within the marine biologging community, and through example, throughout the wider conservation technology field.

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Alasdair Davies is a Shuttleworth Foundation Fellow and the founder of the Arribada Initiative. He has over 15 years experience solving conservation challenges in the field through the implementation of conservation technologies. As an advocate of open source hardware and software, Alasdair sees a future where open source technologies and the sharing of knowledge will revolutionize the monitoring of species globally.

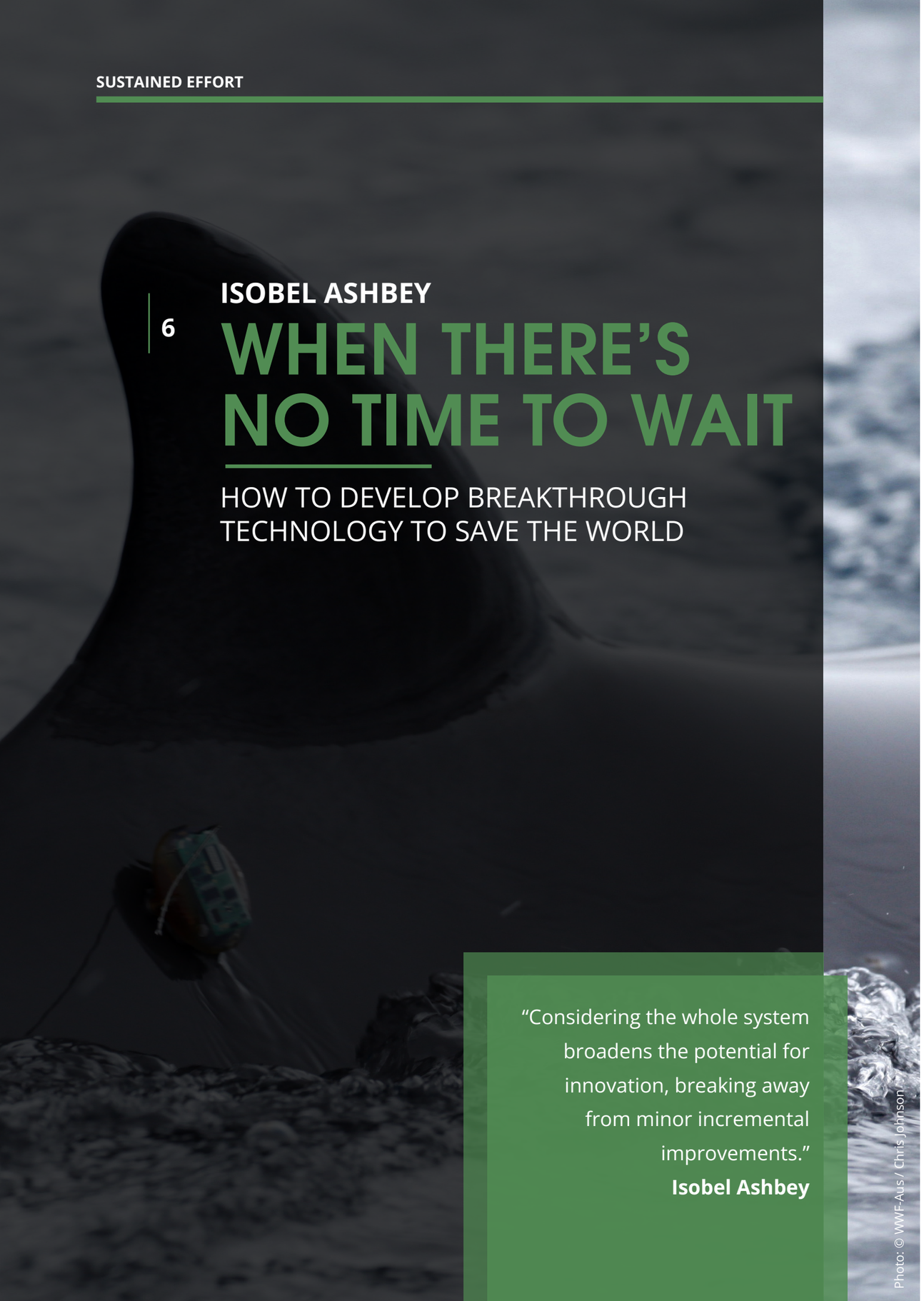
Photo: © Georgina Goodwin / Shoot The Earth / WWF-UK

ISOBEL ASHBEY

6

WHEN THERE'S NO TIME TO WAIT

HOW TO DEVELOP BREAKTHROUGH TECHNOLOGY TO SAVE THE WORLD



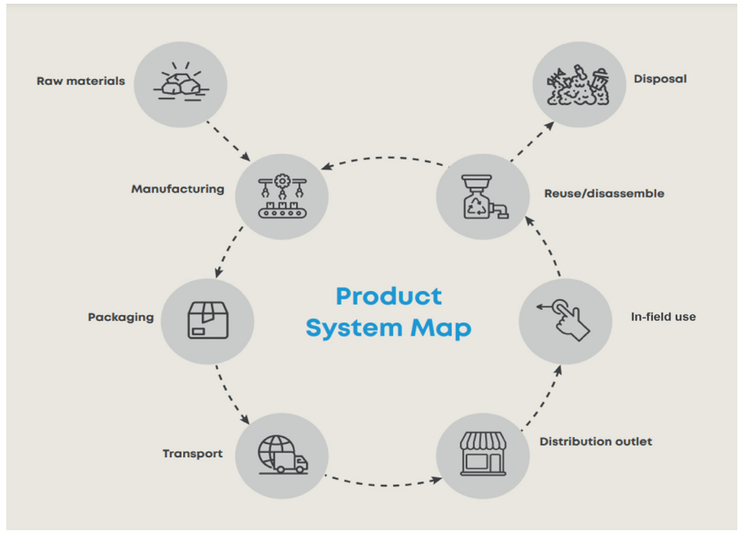
"Considering the whole system broadens the potential for innovation, breaking away from minor incremental improvements."
Isobel Ashbey

Photo: © WWF-Aus / Chris Johnson

Those who work in developing new technologies can often see how sustainability impacts their work long-term, with the supply chain in clearer and starker perspective. But having such a broad perspective of a tool's lifespan can also mean that the right idea can spark impactful change across every level of production. Here, Isobel Ashbey shares Cambridge Consultants' method for thinking of sustainability as a framework that addresses every level of product development.

The conservation and restoration of nature is a huge challenge, and one that will need rapid, transformational action to address. Transformation on that scale will not be achieved through incremental steps - it will require the use of new, breakthrough technology that doesn't exist yet. But how can we conceive of and develop this new technology in a way that ensures we get the best system overall, across all sustainability criteria? At Cambridge Consultants, we follow a process that incorporates whole system mapping into a product discovery framework that is designed for breakthrough innovation.

Sustainable technology development requires innovation across a system's entire value chain, including the supply chain, use, and end of life. Cambridge Consultants' process is customised for each project we work on, but it uses the principles of Whole System Mapping, first developed by Jeremy Faludi, now at TU Delft, and used by dozens of companies and universities around the world. It facilitates innovation by the creation of invaluable visual maps of the product's system. These whole system maps not only capture the flow of materials, energy, money and/or emissions within a product system, but also how individuals and societies both influence and are influenced by the same system.



The whole system map is a visualisation of the flow of materials, energy, money and emissions in a product's system, as well as an illustration of how individuals and societies interact with the product. It helps to shine a light on areas of environmental impact that may otherwise be overlooked, and to provide inspiration for how an entire system – not just one element – may be reimagined.

Four stages to reinvent what's possible

Our framework walks through four stages: Research, Define, Ideate, and Develop.

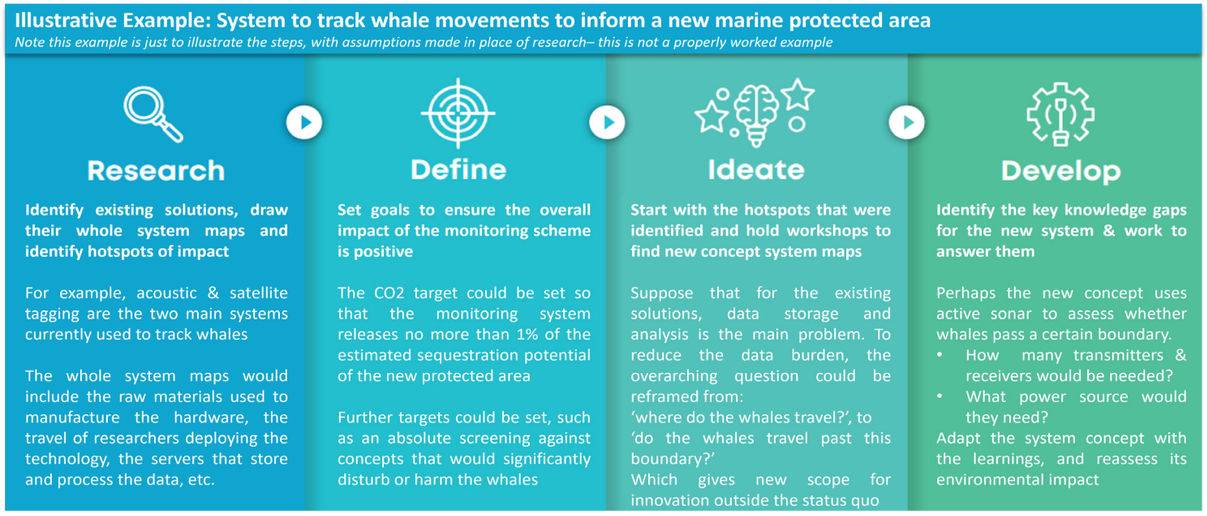
The **Research** step is about understanding why the product is needed and understanding the systems of existing products that meet the same need. Looking at the environmental impact of those existing systems allows you to understand where the hot-spots of negative impact are, which acts as a signpost to where radical innovation could come in.

Define is about setting goals. Zero GHG emissions should always be the target for new systems, but is there an acceptable GHG emissions target for this system that is aligned with 1.5˚C? What other sustainability targets – for example around water use or particulate pollution – should be incorporated? These targets will depend on the specific product need and the comparison to existing systems.

Step 3 is **Ideate** – this is where new system maps are generated to reimagine how the need could be served. Ideation workshops are the ideal environment for radical innovation, where creativity and innovation are unconstrained.

The **Develop** stage follows an iterative process to identify and prioritise key knowledge gaps that represent high risk in the system development. The goal of each learning cycle should be to present an updated system map that incorporates the learnings from the prioritised knowledge gaps. During this stage, the environmental impact of the updated system should be continually updated to understand both its absolute environmental impact and relative evolution versus previous cycles.

Through this iterative process, the level of maturity is increased to a point where product discovery can transition into product execution, when conventional product development processes are suitable for further development.



The path to finding radical new ways to solve a challenge is never fully predictable, but this framework helps to ensure that sustainability is considered at the start and throughout the development process. Considering the whole system broadens the potential for innovation, breaking away from minor incremental improvements.

Unconstrained thinking to find the most sustainable solution

Breaking out of a cycle of incremental improvements to find truly radical new innovations is not easy. Traditional product development processes can be too constrained to allow the freedom required to create breakthrough net zero technologies. Such traditional developments typically begin with drafting a product requirements specification, which is inherently solution-specific. Our approach ensures that implicit assumptions that define and constrain the system map are avoided, allowing unconstrained thinking to find transformative solutions.

Our framework offers the opportunity for finding more sustainable overall solutions to a need, by considering the entire system as one. This goes against the grain of traditional product development processes, where engineers and designers address a problem by breaking it down into pieces. Considering product development initially at the system level provides an opportunity for much greater impact and ensures that all aspects of the system, including end-of-life, are in scope and are the responsibility of the product development team.

High stakes innovation

Cambridge Consultants exists to help organisations find and develop breakthrough innovations when the stakes are high and time is short. The framework we have laid out is an illustration of how to break out from the confines of incremental improvements, and find the sustainable technologies of tomorrow. We hope you'll find these perspectives of use in your own conservation technology development.

This article was adapted from a longer whitepaper which is available for **download here**.

Photo: © WWF-US / James Morgan

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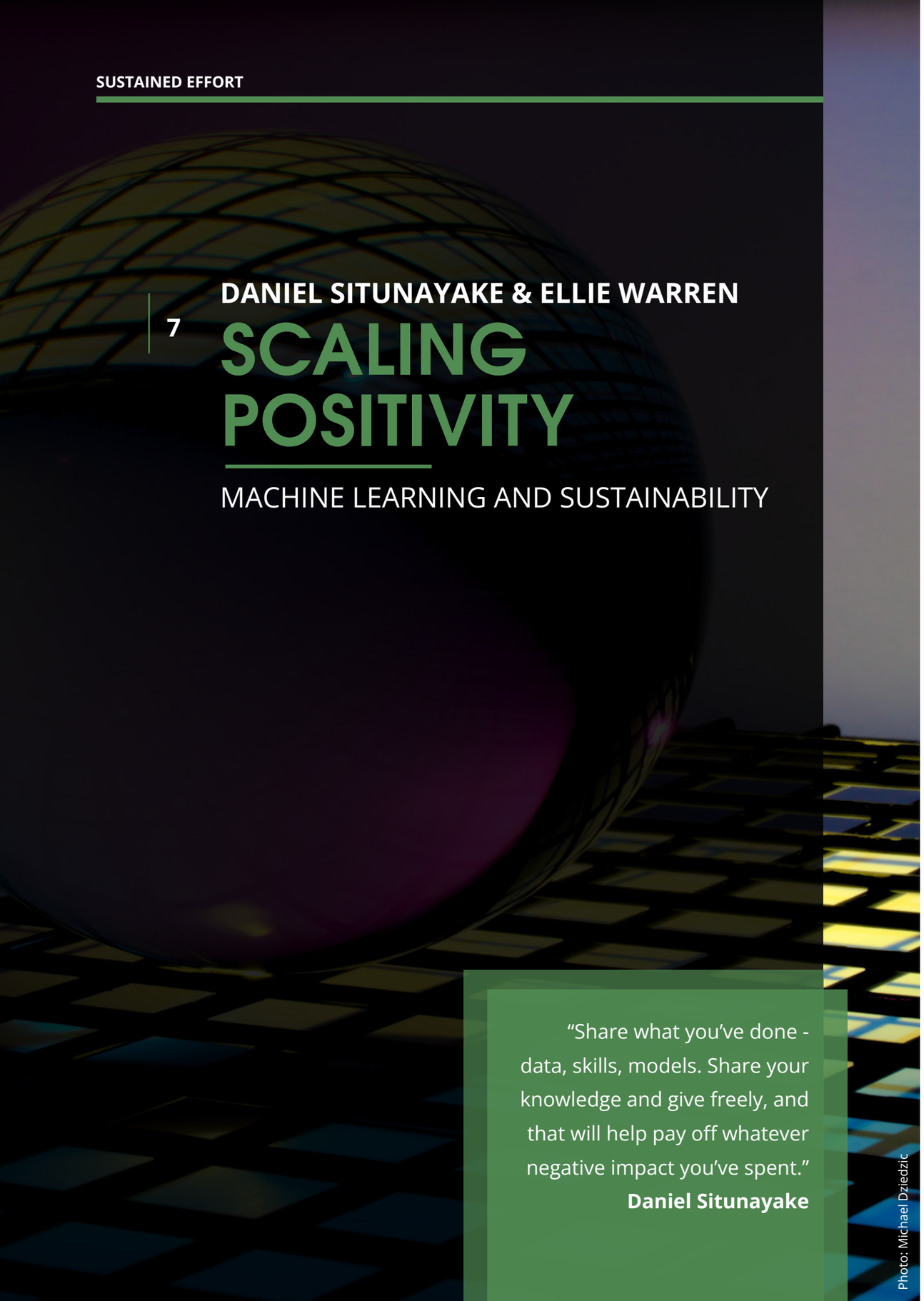
Isobel is the Tech for Good Lead at Cambridge Consultants. She looks for opportunities for CC to collaborate with organisations who are working towards the sustainable development goals and need help with multidisciplinary technology innovation. Her particular focus is biodiversity and conservation technology. Reach out to her on isobel.ashbey@cambridgeconsultants.com

DANIEL SITUNAYAKE & ELLIE WARREN

7

SCALING POSITIVITY

MACHINE LEARNING AND SUSTAINABILITY



"Share what you've done - data, skills, models. Share your knowledge and give freely, and that will help pay off whatever negative impact you've spent."

Daniel Situnayake

Photo: Michael Dziedzic

Every technology comes with a tradeoff in terms of sustainability. What matters is how we achieve the right balance between positive and negative impact. In this interview with Edge Impulse's Daniel Situnayake, we discuss how we can achieve that balance for machine learning tools, and how to maximize technology's potential for good.

There are infinite roads that can lead to each of us making conservation technology a more sustainable field. In our own individual corners of the conservation tech sphere, we can begin by considering how our work - and its inevitable impacts on the environment, big or small - fits into the grand scheme of things.

Some will discover that their most effective role is reducing the amount of batteries used and electronic waste produced; some will strive to lessen their carbon footprint either in terms of travel or shipping equipment; others with the skills to engineer technology will find new, greener ways to innovate. And some, like Daniel Situnayake of Edge Impulse, will build the idea of sustainability directly into their career paths.

From serving as our first-ever Tech Tutors presenter to mentoring conservation tech fellows, Dan is an active and immensely supportive presence in the **WILD**LABS community, and the perfect person to help us explore how the concepts of innovation and sustainability can work together hand-in-hand. While preparing for this interview, the biggest challenge was nailing down just one particular sustainability angle to bring to Dan. Conversations with him are always wide-ranging and full of the unexpected, which is exactly what you'd anticipate from someone's whose career first intersected with conservation technology and sustainability through a very unexpected venture: co-founding an insect agriculture start-up called Tiny Farms. So rather than stick to one topic, we allowed the conversation to roam freely, exploring all the ways sustainability can touch upon a conservation technology career.

And of course, there's no better place to start than with diving into that insect agriculture business. It began with creating open source instructions and kits for creating your own insect agriculture set-up; it eventually grew into a farming operation that used technology like sensors and computer vision to monitor the health of a massive amount of insects.

Dan cites this as his first experience with using technology to understand nature and living creatures. It clearly made an impact with him, as Dan is now one of the driving forces behind Edge Impulse's efforts to innovate embedded machine learning's role in conservation technology's development. And because embedded machine learning has the potential to make data collection and analysis more streamlined and effective, it's

Photo: Stephanie O'Donnell

Photo: © Odair Leal / WWF-Brazil

easy to follow the mental path to how innovations in machine learning can lessen the unsustainable footprint of our work over time.

"This may be a bit of a cliché metaphor, but you can think of data as the new oil," says Dan, "in the sense that we've spent all this money and time and energy tapping into data, but we're not making very efficient use of it. And we're not taking advantage of it enough, given the amount of disruption we've caused by accessing it. But machine learning allows us to make more efficient use of that raw material. If there's energy that we have to produce, this lets us make the most of it."

Dan offers the practical example of how embedded machine learning could help conservationists recognize and fix device failures in the field. "If you can be alerted that something's gone wrong with your tool immediately, someone can go fix that much sooner, which will save you data loss, it might prevent you from needing a new tool or having to extend your project."

And in another example that will appeal to conservationists concerned about the carbon footprint of travel, Dan explains that embedded machine learning could potentially let you monitor for specific environmental conditions remotely. "If you could potentially get some insight on your research from sensors and embedded ML without having to burn a load of fuel and go traipsing around each time to collect data, that's a clear impact on sustainability. And the time saved by machine learning in all these ways is also time that you can use to actively work on solving important conservation problems versus using that time to sit on a plane or spend ages in front of a computer clicking through data."

In this same vein, Dan and his colleagues are supporters of building capacity, another important step toward sustainability in conservation tech. The more accessible these tools are, the more technically skilled people working in their own regions and communities can become. And the more access they have to resources and training, the fewer outsider conservationists have to travel around the globe on planes hauling tools and supplies to places where local conservation leaders are just as capable of making positive changes. Likewise, if embedded machine learning can reduce time spent analyzing data and make data collection more efficient, capacity building

becomes a simpler process, with less team hours, energy, and resources required for success.

But the concept of sustainability is full of contradictions, moral dilemmas, and difficult decisions. If it were more straight-forward, we wouldn't need this series. And like every other type of technology, machine learning comes with its own challenges. According to our State of Conservation Technology research, machine learning is among the tools viewed as having the most potential for innovation. And while it's also perceived as having a significant learning curve in order to use effectively, machine learning is evolving quickly, and new tools like Megadetector and similar automated classifiers are making it easier than ever for conservationists with limited ML skills to apply these tools to their work. And that's great news for all of us! Right?

Yes! But, like all things in conservation technology, there is a tradeoff in terms of sustainability that we must understand in order to use any of our bright and shiny tools - even machine learning - responsibly and efficiently.

Before speaking with Dan, I hadn't given much thought to the footprint of running an AI model, the same way I don't often consider the footprint of, say, using my computer at home. While it's easy to grasp how sustainability ties into conservation work that involves hardware - you've got tools made with unsustainably mined resources and materials like plastic in the mix, the eternal question of recycling and energy sources, and the footprint of the supply chain - for those of us who are not experts, the negative impact of software and tools like machine learning can seem much more ephemeral. Like anything else that requires energy, of course machine learning does have a carbon footprint, even if it feels more intangible than holding a tool made of plastic and metal in your hands.

According to some researchers, training a machine learning model may have the same footprint as somewhere between four and five cars in their lifetimes. That may sound like a lot, but what I've learned throughout the process of creating this series is, when broken down to negative impact


Photo: © James Morgan / WWF-US

alone... everything humans do sounds like a lot, particularly when it comes to technology. But that doesn't mean the energy used to make this technology possible isn't worthwhile.

The fact of the matter is that in order to solve our most pressing conservation issues, we need technology like machine learning, and in using that technology, we must accept that there will always be, somewhere within the many layers of our work, some negative impact. And from there, if we accept that it's our responsibility to reduce that impact wherever we can, we can begin to find the positive balance between the footprint we create and the good we can achieve with technology.

And when it comes to machine learning, that potential for good is high. As Dan explains it, embedded machine learning is one of the conservation tech tools with an excellent return on investment when it comes to minimizing negative impact in the long run, partially because of its ability to put effective tools in the hands of people who can use them most efficiently. And building capacity to make conservation tech more accessible can have a mutually beneficial relationship with the sustainability of machine learning. While machine learning can help reduce the footprint of work in the field and in data analysis overall, empowering more people to use

machine learning tools efficiently and for very specific project needs helps reduce the carbon footprint of training and running huge models.

"Even running a huge model requires this kind of infrastructure that only big companies can afford," says Dan, "and from a practical view, that already limits the positive impact it can make if it's not available to people whose projects might be able to do something meaningful, but don't make a lot of revenue. And as this field has grown, I think a lot of people have seen that this is an opportunity to break the narrative of centralization and relying on massive models that take ages to train on enormous data sets. And instead, by asking what we can do with small, efficient models that inherently require less data and infrastructure to train, and take less energy during that training, people are able to build something that works locally for their project and their community, and delivers value."

As we continually circle back to capacity building in our conversation, it becomes clear that by prioritizing this idea in conservation tech efforts, we have the opportunity to make everything we do significantly more sustainable as quickly as possible. "My philosophy about artificial intelligence, and about machine learning specifically, is that it's a way of taking human insight and domain expertise, and capturing it in software so that it can be deployed at scale. And you can't do a good job of this if you don't have the domain expertise to know what it is you're trying to solve. What we're trying to do at Edge Impulse is build tools that allow the actual domain experts to work on solving what they understand best, instead of having some random person parachuting in who happens to be a technology expert, but doesn't have a clue about the local context. By helping people scale what they can do individually and putting the power of these tools in the hands of people who are already living locally, you're allowing those people to be the ones who solve conservation problems. Access isn't out of reach or solely in the hands of big organizations on the other side of the planet who may have very different ideas of what's needed within local communities and ecosystems."

To close out, Dan offered some inspiration for even the most eco-anxious among us who struggle with the idea that we'll never reach perfection in sustainability. Letting go of that need for perfection is a huge part of moving our field forward toward a more sustainable future, but so is recognizing the importance of what we do, and giving our work the value it deserves.

"I try to think about it in terms of scale," says Dan. "There's a limit to how much damage one person can cause with their footprint. Even if I were to fly around every weekend, there's an upper limit to what my negative impact will be over a lifetime. But there's the opposite end of things, where your potential good impact can scale, and it doesn't have that same limit. If I put my time into a project or a tool that many people can use and benefit from, that good impact can go on into the future. It potentially has no end if people keep using it or helping each other use it. Think about the difference between traveling ten hours to talk to twelve people about technology - probably not going to make a huge difference in the world and could've been done through Zoom - versus traveling that same amount of time to train twelve people to use these tools, who will then train more people, and establish a local knowledge base. If you choose the right things to work on, you can have this long-term positive effect and maximize the benefit of your efforts. And that will outweigh any initial cost. Share what you've done - data, skills, models. Share your knowledge and give freely, and that will help pay off whatever negative impact you've spent."

Photo: Daniel Situnayake

ABOUT THE AUTHORS

DANIEL SITUNAYAKE

Daniel Situnayake is Head of Machine Learning at Edge Impulse, where he leads embedded machine learning R&D. He's coauthor of the book AI at the Edge: Solving Real-World Problems with Embedded Machine Learning, along with TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, the standard textbook on embedded machine learning, and has delivered guest lectures at Harvard, UC Berkeley, and UNIFEI.

Dan previously worked on TensorFlow Lite at Google, and co-founded Tiny Farms, the first US company using automation to produce insect protein at industrial scale. He began his career lecturing in automatic identification and data capture at Birmingham City University.

ELLIE WARREN

Ellie Warren is **WILD**LABS' editorial lead. Based in Los Angeles, California, Ellie's favorite part of working with **WILD**LABS is exploring the stories of our conservation technology community and finding ways to highlight why those stories matter. In her spare time, Ellie enjoys podcasts, screenwriting, and looking for squirrels in her neighborhood.

SOL MILNE

8

CARBON FOOTPRINTS AND CAPACITY

The dual meanings of sustainability in conservation -both environmental impact and project longevity - often go hand-in-hand. Through efficient project design, empowering local conservation leaders and focusing on capacity-building, and making the most of local resources, we can create a long-term positive impact with our work, and just as importantly, reduce the negative impacts of travel and technology. Here, Sol Mline discusses his experiences with both meanings of sustainability, and how uncoupling conservation work from colonial ideals can help us build a more sustainable future for our field.

I love working in this field & count myself extremely lucky to be able to do what I am now. Ironically though, my career in conservation biology has so far been wildly unsustainable. I've traveled around a decent chunk of the world a few times and conducted fieldwork using almost every form of transport available. My carbon footprint probably outweighs any of my friends' who don't even work in the field of conservation. The direct environmental impact of conservation work needs addressing, and there are numerous ways this can be accomplished.

In this article, I will outline a few of the lower hanging fruits that can be addressed directly, to improve the sustainability of our field. But the main focus is a more pervasive theme within conservation fieldwork: colonialism. I believe this is what makes work in this field truly unsustainable in the sense of being unable to continue indefinitely, something that often coincides with environmentally unsustainable work.

Anti-colonialism rings all sorts of alarm bells. It doesn't mean you should go out & overthrow your local governor general. It's simply not building from a system that gives one entity power over another by means of controlling resources and agency to make decisions. When research funding is managed by a body excluding local stakeholders, project aims will naturally lean in favour of the researchers rather than those who the research may impact. This directly impacts the longevity of conservation projects. It feels obvious that unless local stakeholders are involved at onset, initiatives may run out of steam, as the central players may not even be there to stay.

Conservation is an ongoing process and as the needs of local people are dynamic, they must be directly calling the shots to ensure their representation. My experience has shown that people are an intrinsic part of any landscape. No conservation strategy built around a philosophy that excludes people can persist sustainably, in terms of longevity or footprint.

"The few of them that do come to fruition feel much more valuable than the goals developed in isolation, because they are shared."

Sol Milne

Photo: Sol Milne

Photo: Sol Milne

SUSTAINED EFFORT

My specialty is ecological surveying using drones. Drone research is a democratizing tool in conservation, as the skill can be learned with a small initial investment & provide irrefutable evidence of land-use change. Aerial monitoring provides local groups with a powerful means of land-surveying. However, unless local stakeholders can use this tool independently, they will be reliant on outside consultants. While economically useful for drone contractors like me, it means local initiatives are constrained by funding available to hire these specialists.

During my PhD work, I was able to experiment with different drone models, to work out what worked best for the kind of surveying we were doing. The best part was that both myself and the local team I was working with were both starting from scratch. This meant we combined our experience and developed the methods together.

We were lucky to be trained by a local drone specialist who conducts long range drone surveys across Borneo. This was useful for multiple reasons:

We now had a supplier of parts for when the drone inevitably broke in the future. The trainer was a native speaker of Malay and could comprehensively teach skills to the local research assistants, while hiring a local specialist brought in money and promoted his business. Finally, it meant that local professionals were getting involved in conservation research projects. The key methods employed in our research were no longer exclusive to foreign scientists who may not have otherwise interacted with local stakeholders in a meaningful or lasting capacity.

The team of five research assistants who worked with me are now qualified and talented drone pilots, familiar with drone work in forest landscapes. This project's conservation output is still in the works, but this is likely the most lasting current result of this research, locally.

They put these skills to use to this day, working for the Sabah Forestry Department, mostly in the monitoring of concession boundaries. When starting a new project, I try to incorporate this goal, providing training in skills that will provide employment beyond the scope of the work.

To the same point, local research assistants are probably the most under-appreciated demographic in conservation research. When scientists finish fieldwork they often never see them again, even though they might develop great working relationships in the field.

On one occasion, a member of the team I was working with actually saved me from being maimed when I stomped about in the forest and almost trod on a bomb used for killing pigs. These local team members are vital to sustainable conservation work around the world and need all the support to develop their skills and livelihoods that can be provided.

Photo: Sol Milne


Photo: Sol Milne

I'm grateful to be working with a group whose approach is built on respectful engagement. The Cobra Collective uses an approach of community owned solutions: providing capacity building to enable long-term collaboration. The point is to provide tools for local communities, which will serve their own interests and needs. This extends beyond, for example, training in drone surveying, and into the management of the databases and sovereignty in ownership of this information. The community of focus decides what this information is used for, and active collaboration means that cutting-edge techniques are adapted to traditional skills, such as navigation through oral history.

Vitally, consensual decision-making is employed by the group. This means that members formulate decisions together, strengthening the team dynamic and developing trust and skills between the parties involved. It sounds ideal, but this approach is rarely encountered in the field or in the ethos of researchers conducting fieldwork, and needs to be more widely adopted in the future. This is the approach that empowers local communities and fosters the development of lasting, locally sustainable projects.

Drone manufacturers often want you to buy the gaudiest and most expensive kit. More often than not, most aerial surveying projects do not require overly sophisticated drones or cameras. It's important to use networks like **WILD**LABS to talk with experts who have made all possible mistakes already, so that you can build on their experience. Many drone projects have started with big promises and expectations, and an "all the gear but no idea" approach. This was definitely the way I used to see things - the technology is exciting! But drones are expensive, both to the bottom line of the project budget and in terms of human and environmental costs of producing the equipment.

For researchers making a foray into this field, talk to drone experts and run your ideas past them. Simplicity is key in tropical fieldwork, and you most likely won't need a swarm of sentient fixed wings when an old Phantom with a Canon may just do the trick.

Now for the low hanging fruit!

Firstly, expensive conferences in exotic destinations are a lot of fun and fantastic opportunities to develop new projects with interesting researchers. I enjoy these events and they are of great value to early career researchers. However, admission, travel and accommodation are expensive and inaccessible to students with few opportunities for funding. And just as importantly, these events mean researchers studying how to reduce human impacts on nature must extend their carbon footprint to even participate in the conversation.

I like the format that **WILD**LABS has presented for engaging fellow researchers in their work & providing breakout spaces for participants interested in specific areas of conservation. This format should be adopted by other groups, serving as an accessible and low carbon footprint means for direct engagement in research. There will be fewer chances for a drink and dance like at a regular conference, but perhaps this can still be arranged when researchers meet in person after establishing a collaboration!

Secondly, funding opportunities for the training of local researchers are few and far between. This needs prioritisation in conservation research that engages with local researchers and research assistants. In many cases, only participants with higher education are eligible, while many research assistants in developing countries do not have this privilege. I would like to see funding allotted to this more often in new projects, providing lasting skills to local researchers who can carry on conservation work in their own region with less impact.

Thirdly, foreign researchers should make a concerted effort to speak the language in the country they are studying in. This has opened up so many opportunities for me and given me a chance to make lasting connections and friends. This effort demonstrates respect and allows you to convey your meaning more effectively. I cannot express how useful this is, and while it's certainly not easy, it goes very far in developing meaningful connections.

There is plenty of ego in our field, as there is in many others. That's okay, but not at the cost of resources and developing meaningful collaboration. Respectful collaboration is key to subverting this. It prevents us from reinventing the wheel when developing new methods and allows new ideas to flourish. It's the part of this work that I honestly enjoy the most, having conversations about all the beautiful, glittering ideas that could exist when we pool together our knowledge, humor and failures. The few of them that do come to fruition feel much more valuable than the goals developed in isolation, because they are shared.

And ultimately, this is how we can create a more sustainable future of conservation tech: together.

Photo: Sol Milne

Photo: Sol Milne

ABOUT THE AUTHOR

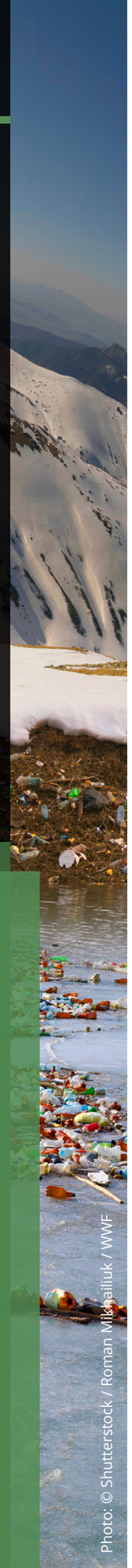
SOL MILNE

Sol is an ecologist, focused on aerial surveying by drone. His background is in landscape ecology, with experience studying the impacts of human land use on orangutan distribution in Borneo, and ghost gear accumulation in tropical marine habitats. Sol is passionate about environmental justice and providing local stakeholders with means to monitor the ecological status of their landscapes.

ELLIE WARREN

9

TEN PERCENT



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> "Because it's true, in the conservation technology field, we are the ones who are supposed to be saving the world. And to do that, we must first save what's left of our optimism. Conserve it like you would an endangered species. Don't burn it out in pursuit of an answer you don't yet have, not when still there's something you can do right now with whatever role and knowledge you already have."
>
> **Ellie Warren**

In this thought piece, **WILD**LABS editor Ellie Warren discusses why sustainability is such a difficult challenge to tackle, and why the enormity of that challenge is the very reason why we should hold onto our optimism.

Photo: © Aaron Gekoski / WWF-US

As I write this, I am thinking about the tower of boxes in the corner of my room. My apartment complex's recycling bin is always full, and so with every online order I make, the boxes pile up, a constant visual reminder of how much unnecessary waste one person can accumulate very quickly and thoughtlessly. Being forced to look at the consequences of your own convenience is a very simple way to understand the negative impact you're having on the environment - I don't know if I'd ever imagined the sheer scale of a landfill until I started to visualize my own pile of trash, multiplied a dozen times, a hundred times, a thousand times - and then realizing that even that vast amount is only a drop in the bucket of how much waste capitalist humans pour into the environment every day.

Throughout creating this series, I have always been thinking about those boxes.

And the plastic coffee cups that wouldn't be there if I'd remembered to bring my reusable cup to the café or hadn't used my phone to order ahead, and the old batteries that have been sitting in a drawer for months because I wasn't sure how to dispose of them, and the old cellphones and laptops that I never took to the special recycling center, and all the other disposable things we all have that will eventually make their way to a landfill, or out to sea, or into some animal's digestive system.

Of course, none of these problems are specific to conservation technology - and that's what this series is meant to be about. The vast majority of us are faced with sustainability challenges and decisions every day, whether we consciously realize it or not. But conservation technology comes with its own extra layer of morality when it comes to thinking about sustainability. We're the ones who are supposed to be saving the planet!

Aren't we?

And because we're trying to understand and save species and habitats that are endangered by the rest of humanity (I say as though we're not all actively part of the same complicated problem), it's difficult to think about how much negative impact our technologies and studies and conferences and fieldwork excursions might be having on the very ecosystems we're trying so hard to protect. Technology offers incredible solutions to conservation problems - we're collecting more data than ever, and in more detail than ever. We're working together to overcome huge challenges like poaching and wildlife crime, we're monitoring endangered species to ensure their survival, building a stronger understanding of climate change impacts habitats, uncovering

secrets about the migrations of sea turtles. Within our community alone, there is someone working on every continent, in every type of ecosystem, with every type of tool, and on every type of problem you can think of. I am constantly overwhelmed by the depth of knowledge that exists within the global network that **WILD**LABS has brought together.

But even with all the knowledge we've built and all we've accomplished through collaboration and dedication, existential crises like climate change and extinction feel overwhelming. Add in the question of sustainability to that - and take a moment to consider how conservation technology could be contributing to negative environmental impacts - and it can seem absolutely insurmountable.

And that's the issue that arose again and again while creating this series. Sustainability in the conservation technology field too often feels insurmountable. It's a problem so enormous, and with so few established paths to address it, that none of us really know where to begin. Some of us don't even know how to think about it - it's mindbogglingly big to consider. We have to use technology to solve the biggest challenges facing our environment. We know that for a fact - it's the entire reason **WILD**LABS exists! But the technologies we rely on require materials that can only be acquired through harmful mining practices, or materials that can't be recycled, or plastics that will end up polluting the seas. They require an energy source - often heaps and heaps of batteries when solutions like solar power aren't practical. They require transport around the world with fossil fuels to reach their deployment destinations, safely packed onto a jet plane or cargo ship in boxes and plastic wrap and styrofoam.

And they require us to operate them, at least until we can build local capacity so more people around the world can access and use these technologies in the communities and ecosystems where they live. And in order for us to build careers in conservation technology, which we have to do in order to put our big solutions into practice and start making a real positive impact - we often have to go through the rigors of academia and all that entails - often fieldwork far from home, traveling back and forth, increasing our carbon footprint to gain experience, and building projects around the newest tools to gain funding. When trying to imagine a more sustainable world in conservation tech, it feels like you have to first imagine an entirely different system from the one we're working within. And that seems.... unlikely. For now, anyway.

Photo: © Ed Marshall

Photo: Juan Pablo Moreiras / Fauna & Flora International

There are so many issues built into sustainability, all piled on top of each other, and not one of us knows how to sort it out. We're all grappling for ideas - biodegradable materials, renewable energy sources, less travel, sourcing materials locally - but our ideas often come with new sets of challenges, or simply can't be achieved yet with the kinds of limited funding that constrains so many ambitious conservation technology ideas. So readers, I'm sorry to report that we have not solved the problem of sustainability. Truthfully, there is no solution. Isn't that awful news?

Now that the existential despair is out of the way, will you give me a moment to put a positive spin on things?

What if it's a good thing that none of us know how to solve the problem of sustainability? What if we accept that we don't have the answer, and that we will never find a perfect fix for any of this? Because really, if someone showed up on **WILD**LABS tomorrow pitching every single step we need to take to fix every lingering problem in conservation tech sustainability... wouldn't that be just as overwhelming? It's like creating a big to-do list: good in theory, but once you see all those tasks piled on top of each other, the reaction quite often boils down to "my god, I'll never finish all that." But if we're creating the to-do list together a bit at a time, we feel less alone, less overwhelmed by expectations, and there's always an opportunity to find a new course of action that will suddenly open up possibilities for rapid positive change. At this moment, because none of us know where this effort will lead us, we still have the ability to think creatively outside of the box. In a world where all the steps are already laid out before us, that kind of thinking too often atrophies, and innovation suffers for it.

One concept came up over and over while discussing sustainability in conservation tech - the idea of keeping a narrow focus and making our own work ten percent better. When we're facing so many urgent crises - habitat destruction, mass extinction, climate change that is already outpacing what we anticipated - ten percent may sound like barely anything at all. And I suppose that's one way to look at it, if you're a "glass half empty" kind of person. Sometimes I am. But at the same time, ten percent IS barely anything at all... so it's doable. Actionable. And because it's barely anything, it's inexcusable to not try.

And I know that saying "if we each do a little, it adds up to a lot" is cliché to the point that some of us don't believe it anymore. As someone who has attended climate conferences and workshops full of inspired, optimistic people who were ready to make a difference right now, only to helplessly watch the world continue to steadily progress down the wrong path, I get it. If it feels like we're not accomplishing much, it's because the challenges ahead of us are enormous and the deck is stacked against meaningful change. There's no way around that reality. So I'm not going to launch into a pep talk about how our community has the ability to make huge changes if we all work together. We absolutely can, and I believe we will, but that's not the point.

Photo: © Michel Gunther / WWF

The real point here is that, if we can't fix everything all at once and these enormous crises are going to continue whether or not we act... why not just act? Even if you feel truly hopeless about the situation, acting can't make it worse. So why not try to be ten percent better? It's easy to do, it makes you feel like you're doing something in the meantime, and it's less overwhelming than being told to immediately change every aspect of how you work in the name of sustainability. Letting go of the idea that you need to fix everything right now is fine! You weren't going to be able to do that anyway, no matter how hard you try! But this is something you can do. Focus on it. Figure out how to make the most of your ten percent.

And in the end, maybe it will add up to a huge change, or maybe it'll add up to a lot of little changes. Either way, it's better than nothing, and it gives each of us a role to play so we don't fall into despair. If you put dozens of conservation technology experts in a room and ask them to create a sustainable future for our field, each one will focus on a different part of the issue - great! It should be wonderful news that none of us are responsible for understanding and fixing it all! If we're all on equal footing of not knowing how to fix it all, then your role - your ten percent - is just as important as anyone else's. And the worst-case scenario, if we all adopt the Ten Percent idea, is that we don't fix everything, but we do make a lot of little changes that ultimately make our field and the world a little better. And by the time someone comes along with a big idea that will create a huge positive impact, we'll be better prepared to tackle it as a team. Doing ten percent better isn't going to stop any of these huge crises in their tracks, but we'll never get to a stage where real change is possible if we don't focus on the little steps first.

Maybe this was a pep talk - a somewhat negative, occasionally meandering pep talk. Partially it's for all of us, but partially it's just a pep talk to myself. Because truthfully, it's hard to talk to a lot of people about sustainability over a long period of time to not only come back with the unfortunate answer that we don't have solutions yet, but to have even more questions and worries as a result. I wanted to be able to write about complex systems like deep-sea mining and how the destruction of those habitats ties back into the technology that we use to protect those habitats, and then tie in all the ways we can start to free our work from those harmful systems - I wanted to share big thoughts and big ideas with you.

But I'm not an expert in these topics yet. It will be a long time before I am an expert. I'm still in the phase of asking questions that lead to more questions. And that's a valuable perspective too, because like I said - none of us have the answers yet. We should all be asking questions that lead us to finding our ten percent goals. And if you try to solve a question like "what can I do with all these batteries?" just to find yourself asking more questions about why certain types aren't recyclable, or why you can't transport certain batteries in certain countries, or why there aren't less destructive ways to get the materials we need for them from the earth, or why solar power isn't always a feasible option to power your camera traps, or why why why....well. At least you've got one question out of the way, and you're onto the next one. Isn't it progress to now know something else that you don't know?

So maybe my ten percent is to keep asking questions and creating spaces on **WILD**LABS where people who might have answers can come together. Spaces where people can share their own ten percents and add them together to create... well, not a solution yet, but a bigger ten percent, at least.

So let yourself - temporarily - be overwhelmed by the problems facing us. Accept that none of us will ever get it exactly right. Come to terms with the fact that this process will involve a lot of questions, and trial and error, and the world may seem like it's not getting better right away. Let yourself be discouraged if that's the emotion that comes to you honestly. And once all that's out of the way, find where you can do ten percent better.

Because it's true, in the conservation technology field, we are the ones who are supposed to be saving the world. And to do that, we must first save what's left of our optimism. Conserve it like you would an endangered species. Don't burn it out in pursuit of an answer you don't yet have, not when still there's something you can do right now with whatever role and knowledge you already have.

And if you're like me... please. Do break down ten percent of those boxes and cram them into the recycling bin. I get it, it looks full. But there's room for ten percent of them, I promise. The tower may not be gone, but it will be quantifiably smaller, and in the end, you'll feel a little better about what's left to be done.

ABOUT THE AUTHOR

ELLIE WARREN

Ellie Warren is **WILD**LABS' editorial lead. Based in Los Angeles, California, Ellie's favorite part of working with **WILD**LABS is exploring the stories of our conservation technology community and finding ways to highlight why those stories matter. In her spare time, Ellie enjoys podcasts, screenwriting, and looking for squirrels in her neighborhood.

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ABOUT **WILD**LABS

It takes a community to create impactful conservation technology applications for real-world use in the field, lab, and beyond.

Collaboration and innovation are at the heart of our work at **WILD**LABS, the launching pad for meeting conservation's biggest challenges with conservation technology's boldest solutions.

The **WILD**LABS Community is the central hub for conservation technology online, connecting **7,000+** conservationists, researchers, field biologists, engineers, developers, and conservation technology experts from around the world. Through our tailored programs and resources, we help conservationists access the tools, resources, and networks needed to create an impact.

Our editorial resources support our global conservation technology community by bringing new voices, perspectives, projects, and organisations into the **WILD**LABS sphere, highlighting the incredible ways that technology (and the people designing and using it!) shapes conservation efforts worldwide, both in our community and beyond.

Visit our platform at wildlabs.net and YouTube channel to learn more about the community, and follow us on Twitter @ **WILD**LABSNET.

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