

PANORAMA

SOLUTIONS FOR A HEALTHY PLANET

SOLUTIONS IN FOCUS:

Tech4Nature



Green List
Protected | Conserved Areas

Tech4Nature

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We would like to sincerely thank all solution providers for their contributions and time.

PANORAMA partners



Development partners



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PANORAMA - Solutions for a Healthy Planet

PANORAMA – *Solutions for a Healthy Planet* is a global partnership initiative to facilitate learning from success in conservation. It promotes examples of inspiring solutions that showcase how nature conservation can benefit society. Through a modular case study format, solutions are being dissected into their replicable “*building blocks*” and their broader application is supported through cross-sectoral learning and exchange, relying on online as well as offline mechanisms.

PANORAMA allows practitioners to share and reflect on their experiences, increase recognition for successful work, and to learn with their peers how similar challenges have been addressed around the globe.

IUCN co-leads PANORAMA together with a growing number of partner organizations including GIZ, GRID-Arendal, EcoHealth Alliance, UNDP, ICCROM, ICOMOS, IFOAM - Organics International, OCTO, Rare, UNEP and World Bank.

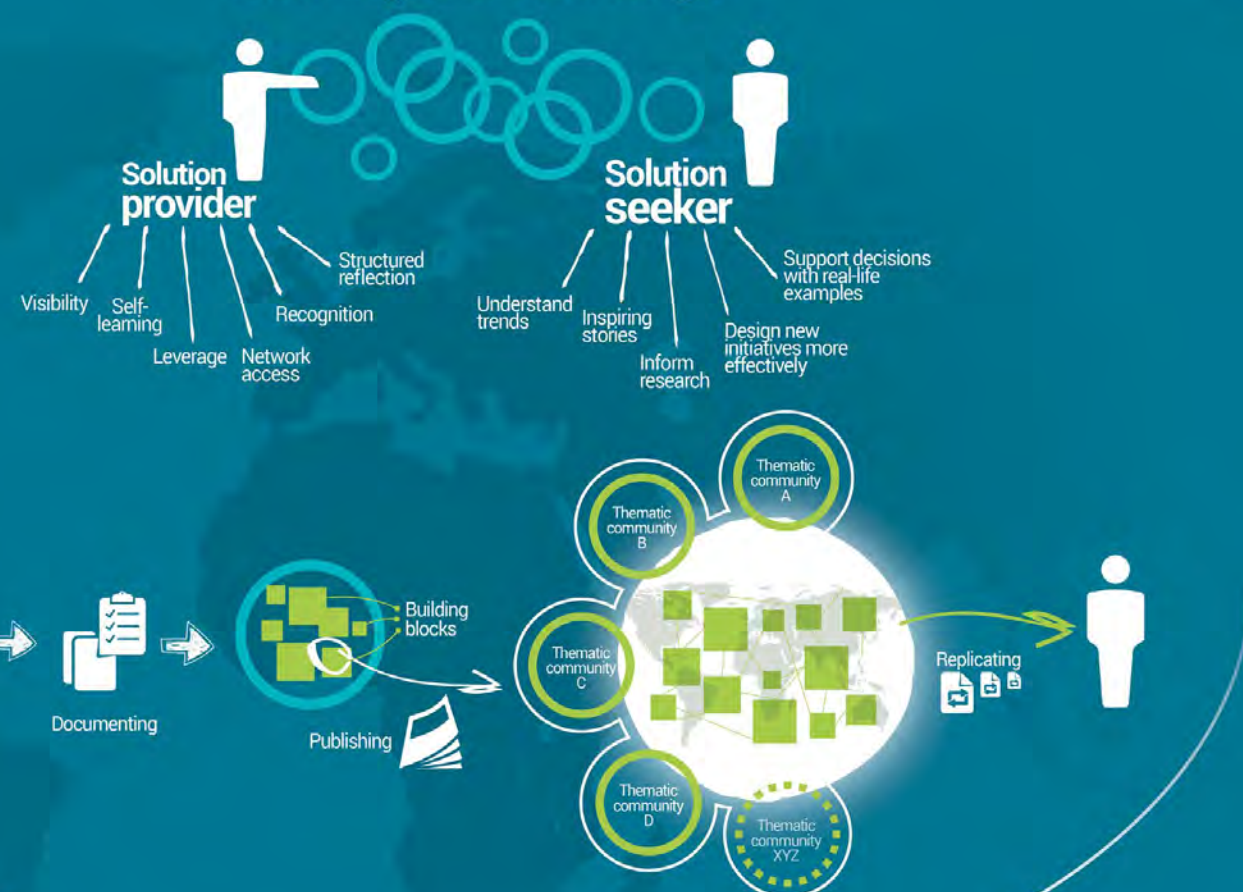
Explore over 1,000 solutions from around the world, including the ones being introduced in this brochure, through the PANORAMA web platform, and submit your own example!

www.panorama.solutions

What if
we could learn
from each other's
success?

PANORAMA
SOLUTIONS FOR A HEALTHY PLANET

Cross-sectoral, global
learning and exchange



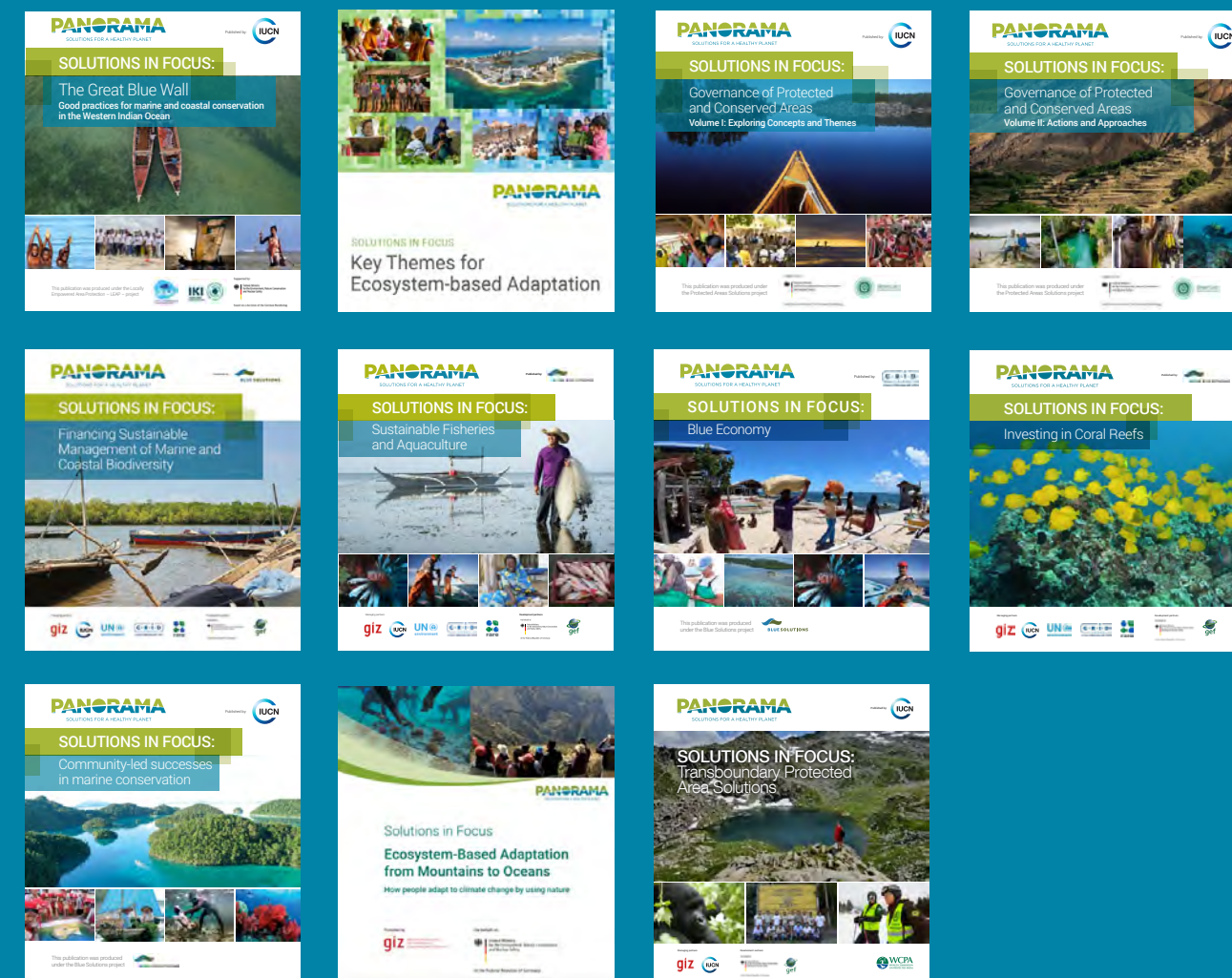
Better decision-making and implementation of
conservation and development activities
by replicating "what works"

The "Solutions in Focus" series

This booklet is part of a series of compilations assembling PANORAMA solution case studies on a defined topic. "Solutions in Focus" zooms in on a topic of interest covered by PANORAMA, allowing to explore common elements and shared learnings across success stories. It is a snapshot of the PANORAMA portfolio at a given time, rather than a representative assembly of selected "best practices" on the issue at hand.

Further "Solution in Focus" booklets:

panorama.solutions/en/resources/publication



What is Tech4Nature?

Tech4Nature is a global partnership to scale up success in nature conservation through digital technology innovation. Created by IUCN and the Huawei TECH4ALL programme, Tech4Nature is designed as an open partnership to apply and promote digital solutions for fair and effective protected and conserved areas.

This growing partnership aims to provide guidance on the appropriate use of technology in area-based conservation and directly involve the ICT industry sector in supporting nature conservation.

At the heart of the Tech4Nature partnership is the IUCN Green List Standard, which describes the steps and processes required to achieve long-term success for people and nature in area-based conservation. It guides and ensures appropriate and responsible deployment of technology in this partnership. In adopting the IUCN Green List Standard, committed sites and their stakeholders build up a profile of positive actions and processes that allow them to set clear conservation objectives and demonstrate progress and successful results.

Tech4Nature aims to enable more than 300 protected areas in over 30 countries worldwide to evaluate their conservation success through the IUCN Green List Standard by 2023. In order to make progress and maintain performance, many sites are using available tools and resources to help make

improvements. This is where technology comes in as a priority enabler. The Tech4Nature partnership addresses key questions around implementation, inclusive participation and improving collaboration, such as:

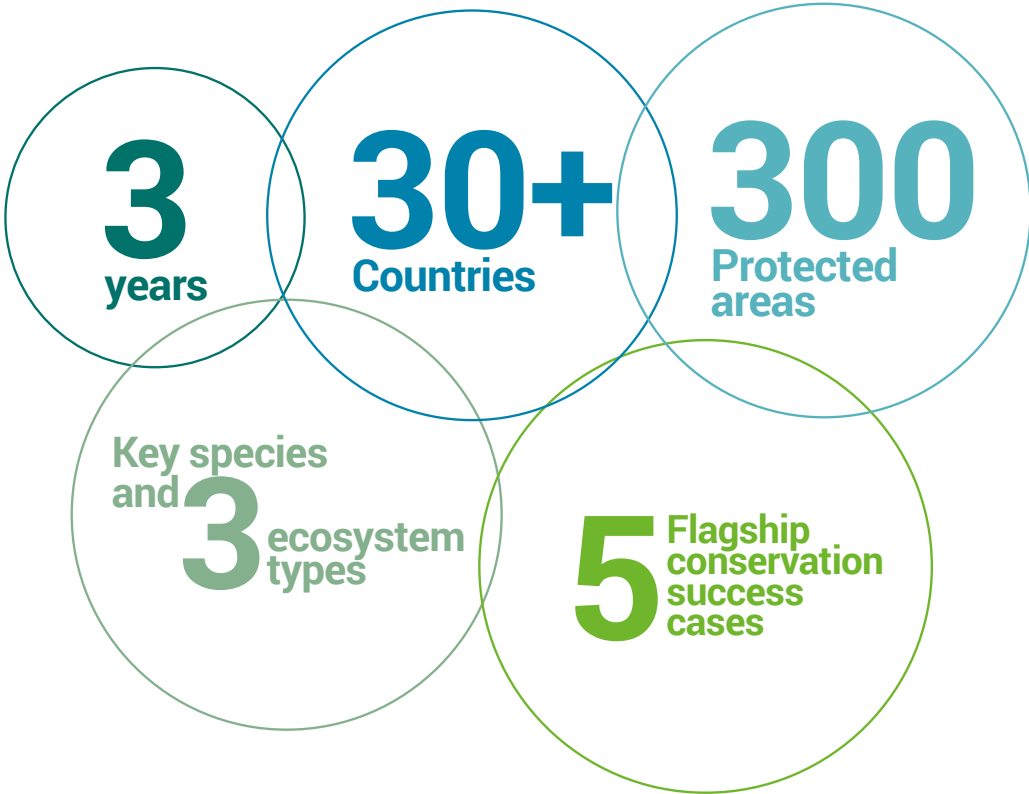
- What are the technologies available that can help frame, set, implement conservation objectives, and enable good monitoring and measures of success? What ideas for new technologies, or adaptations of existing tools, could be harnessed for protected areas?
- Which technologies can best help engage people in participatory processes, rights-based and gender inclusive decision-making?
- How can digital technology help connectivity between experts and practitioners alike, and support improved data management and analytics for decision-making?

In promoting Tech4Nature, IUCN and Huawei identified five flagship protected areas to help pilot the use of ICT for nature conservation using cutting-edge digital technology in different ecosystem types and endangered species.

Participating sites are mentored through the Green List process, and their progress is reviewed, assured and verified. Sites that meet all the criteria of the Standard are awarded Green List certificates, initially valid five years, with continuous improvement expected in order to maintain and prolong this recognition. IUCN's Green List evaluation system will benefit from more advanced digital applications, allowing for the better use of technology to help identify and understand conservation needs, and allow for the remote assessment, review and evaluation of participating nature conservation areas

and sharing of lessons learned among Green List community.

The Tech4Nature partnership is the first time that IUCN engages in a major way with the information and communications technology (ICT) industry, helping bridge their know-how and innovation into the important nature conservation sector, using IUCN standards and safeguards help guide the appropriate use of technology and achieve conservation successes.



Foreword

Throughout human history, innovations in technology have allowed us to develop, surmount challenges, and thrive and connect as societies. The evolution of technology has equally boosted in times of hardship and necessity, and blossomed in periods of peace and prosperity. Technology has driven and helped prosecute conflict, and yet has also secured peace and advanced freedom, and inspired innovation. Technology continues to excite us with its potential, such as electricity-powered coral reef restoration in the Indian Ocean. Yet it can also leave despair from its deleterious impacts, such as the ongoing damage to people and nature caused by chemical defoliants during war.

This paradox relates to our fractured relationship with the natural world. Our global demand for technology equates with an unquenched thirst for the resources and fuel to power its use. Our planet is under enormous pressure from our continued extraction of the earth's resources, and our incessant conversion of ecosystems and wildlife habitat.

Yet many of our technologies can also help vital efforts to safeguard nature, protect and restore ecosystems, reduce carbon emissions, and ensure people can access and benefit from healthy ecosystems and their services. How can we better develop these technologies and ensure fair and generous access to those who would most benefit? How do we support those who would best innovate

and employ technology in the protection and repair of our natural heritage?

This publication offers some compelling case studies in the use of technology for fair and effective nature conservation, from around the world and by people from all sectors of society.

From a practical perspective, technology provides an opportunity for many elements of nature conservation on the ground to become more attainable and to achieve scale. Many technology solutions revolve around generating and accessing more data, faster, and with better connectivity and application. However, there are ethical issues related to privacy and surveillance, and overall access to technology and the data and information that is generated. Technology can be expensive in many cases, and therefore not fairly distributed to those who could most benefit. In fact, the upfront cost of the technology itself is often one of the least expenses, compared with the investment needed in capacity to use it properly, to maintain and upgrade, and to generate and manage knowledge and results. Some of the best technology solutions are those that build on readily available tools and resources, or improve the enabling conditions for better use of technology. For example, through improving digital connectivity and access to mobile network coverage can help the use of basic applications for

nature conservation monitoring, networking, data management and public engagement.

Overall, with the growing application of technology in conservation, IUCN as a union and conservation network leader is identifying the gaps and issues around ethical and responsible use of technology. This is where the concept of “appropriate” technology comes in, to ensure proportionality between the solution deployed, its cost and accessibility, and its purpose and impact on natural values as well as people. IUCN is on a journey with the global community to help define what ‘appropriate’ technology is and to ensure more sustained benefits from the best applications, that do help achieve fair and effective conservation action.

One way to ensure this, used in the Tech4Nature partnership, is through using the IUCN Green List Standard as the guarantee that technology is

linked to successful conservation outcomes and safeguarded rights of local communities. We use the Green List criteria to guide the deployment of technology in several flagship protected and conserved areas. This means we can measure the impact of technology in protected and conserved areas on criteria related to equitable governance, to ensuring local community participation and transparency, to effective planning and management, and to solving conservation challenges.

This publication showcases some of the more successful uses of ‘appropriate’ technology and will hopefully inspire more and better innovation and application of new solutions to the growing biodiversity and climate crises. With your support, diligence, and innovation, technology can be part of the global solution.

James Hardcastle,
Head, IUCN Protected and Conserved Areas

Introduction and roadmap for readers

The story behind this publication

IUCN in its Nature 2030 programme recognises technology as a key enabler for conservation success and as the key to unlock different opportunities and investment for different nature-based solutions and conservation efforts. The Tech4Nature partnership is one way that IUCN is helping build and emphasize the potential opportunities and application of different technologies for conservation impact.

In 2021, Tech4Nature sponsored the ‘Technology for Nature’ category in [2021 Pathfinder Award](#), and building on its success, more case studies and best practices were picked and collected to present in this dedicated ‘Solutions in Focus’ publication.

There is a clear growing momentum and buy-in from the conservation community to use more technology but also to develop and create new ways it can be applied. On this basis, we are building on the positive energy and drive to inspire and help it grow a community of technology providers. Through these successful examples in this publication, we seek to spark optimism, action and hopefully replicability of some of the solutions we’re presenting. This publication presents 22 cases of how technology effectively helps conserve nature, from across 19 different countries.

Key takeaways

These solutions show examples where technology was an enabling factor to:

- Help people to safely and sustainably access and benefit from nature
- Help protect and nurture wildlife and natural values
- Generate impactful knowledge and research into biodiversity conservation
- Monitor different conservation values
- Involve and empower the local community through different conservation activities and projects
- Detect threats to wildlife in and around protected and conserved areas
- Facilitate access to the site and engage with visitors.

Important observations can be extracted from this portfolio: technology use can help solve a wide array of nature conservation challenges more efficiently, and it can be affordable and scalable for different challenges and threats. However, for meaningful, effective and lasting impact, multi-sector collaboration and inclusive engagement of local community are the key to unlocking that success.

It’s becoming more and more evident that there isn’t enough evaluation of the impacts of technologies on both wildlife and people as noted in the latest WILDLABS ‘*The State of Conservation Technology 2021*’ report. Moreover, some of the more pressing constraints such as costs and technical barriers

seem to inequitably affect women and those in the Global South¹.

This points to an underlying need for transparency, inclusivity, responsibility towards those that stand to gain or lose the most from the use of technology. Ensuring suitability and “appropriateness” of the solutions developed is the means by which the technology can go the farthest, have the biggest impact and ensure its long-term sustainability. It is as important to consider the social elements as the technical ones when developing and deploying technology applications.

The importance of multi-sector and multi-stakeholder collaboration in developing technology solutions is clear. This opens an optimistic vision ahead to the future, one that bridges different communities and sectors, creating a future that fosters a culture of collaboration that can open the way to more exciting and innovative solutions and unique partnerships.²

On the technical side, what are the current technological challenges and opportunities ahead?

Looking to deploy technology in natural environments comes with a myriad of challenges,

such as basic data acquisition, the development of standardization systems, network transmission, and AI³ application analysis, because there are a wide range of services and objects to be managed.

There are challenges to ecological sensing capabilities, such as the difficulty of some devices and hardware to adapt to the wild, the difficulty of existing terminal facilities to functioning at very low outdoor temperature and other harsh conditions, or challenges with battery charging. In addition, the equipment itself should not adversely affect the environment and species. Connectivity or data analysis capabilities may be limited, with challenges in transmitting data in real time or where algorithms developed for data analysis are not mature enough to effectively support their application. This can be exacerbated by a lack of technical capacity to use these devices.

The IUCN Nature 2030 Programme laid out some of the potential technologies that can accelerate and facilitate the implementation of its programme and positive impact across the different areas of work as shown in this table:

¹ Speaker, T., O'Donnell, S., Wittemyer, G., Bruyere, B., Loucks, C., Dancer, A., Carter, M., Fegraus, E., Palmer, J., Warren, E., & Solomon, J. (2022). A global community-sourced assessment of the state of conservation technology. *Conservation Biology*, 36, e13871. <https://doi.org/10.1111/cobi.13871>

² idem

³ AI = Artificial intelligence

How we deliver	People	Land	Water	Oceans	Climate
Technology, data and innovation	Blockchain to protect right holders ICT for greater environmental transparency and accountability, and legal education	Innovation in data sensing, big data and AI in conservation knowledge and insights	Innovation in data sensing and machine learning for freshwater species and freshwater ecosystems	Innovation in data sensing and machine learning for marine species and marine and coastal ecosystems	Innovation in data sensing, big data and AI in climate change knowledge and insights

From that table, we see that these technologies pertain to 4 different application objectives:

- Sensing
- Connectivity
- Analysis
- Decision making

According to the WILDLABS ‘*The State of Conservation Technology 2021*’ report, camera traps, GIS/remote sensing, and machine learning/computer vision (artificial intelligence tools) were the most widely used⁴. The 22 solutions in this publication show that a mix of hardware and digital/cloud made up most of the case studies.

A smart ‘*tech-for-nature*’ solution would take advantage of both and how they can complement each other based on technologies such as 4G/5G, ad hoc network, cloud computing, IoT⁵, mobile internet, and big data. These could be used for various goals as comprehensive management, conservation and restoration, resource management, monitoring for research purposes, popular science education, recreation experience, community development and other services.

When designing a technology solution, a broad blueprint is useful to consider which one of the application objectives listed above will best match with your conservation goal, taking one or more approach, such as:

Application objective:

- Multi-dimensional ecological sensing
- Multi-network converged communication
- Intelligence enablement by big data
- Multi-scenario operational support

Conservation goal:

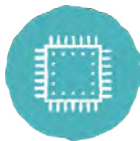
- Protection and restoration
- Monitoring for research purposes
- Resource management
- Recreation experience
- Popular science education
- Community development
- Management and operation

Approaches:

- Data acquisition: Integrated monitoring combining space and aerial remote sensing and IoT on the ground
- Connectivity: Stable, reliable, and continuous network coverage
- Smart analysis: Multi-data smart analysis

How to read this publication?

Flip for tech, flip for conservation, that’s how we intend for it to be read. When looking at the solutions, six broad categories for different conservation challenges emerge. We also broadly identified for each case study whether the technology solution is primarily “hardware or infrastructure” or whether it’s “digital, software, cloud based” or lastly if it’s a mix for both.



HARDWARE



SOFTWARE



MIX

So, if you’re looking at what are the conservation challenges that technology helped resolve, look for each section on the side. And, if you’re looking to see what kind of tech is deployed to help conservation impact, go by the icons next to each solution. We tagged them to make it easier for you to navigate.

Are you interested in developing a technology solution for your conservation challenges? At the end, for more actionable advice, we included a more detailed technology solution architecture to help provide some guidance as well as a quick checklist to make sure the technology is “appropriate”.

4 Speaker, T., O'Donnell, S., Wittemyer, G., Bruyere, B., Loucks, C., Dancer, A., Carter, M., Fegraus, E., Palmer, J., Warren, E., & Solomon, J. (2022). A global community-sourced assessment of the state of conservation technology. *Conservation Biology*, 36, e13871. <https://doi.org/10.1111/cobi.13871>

5 IoT = Internet of things

DISCLAIMER: all of these solutions were taken from the *PANORAMA – Solutions for a Healthy Planet* platform. Wording was very minimally corrected to preserve the integrity of how they were submitted by the original solution providers. Many have been written and contributed by non-native English speakers.



Solutions & inspiring stories

Conservation challenges

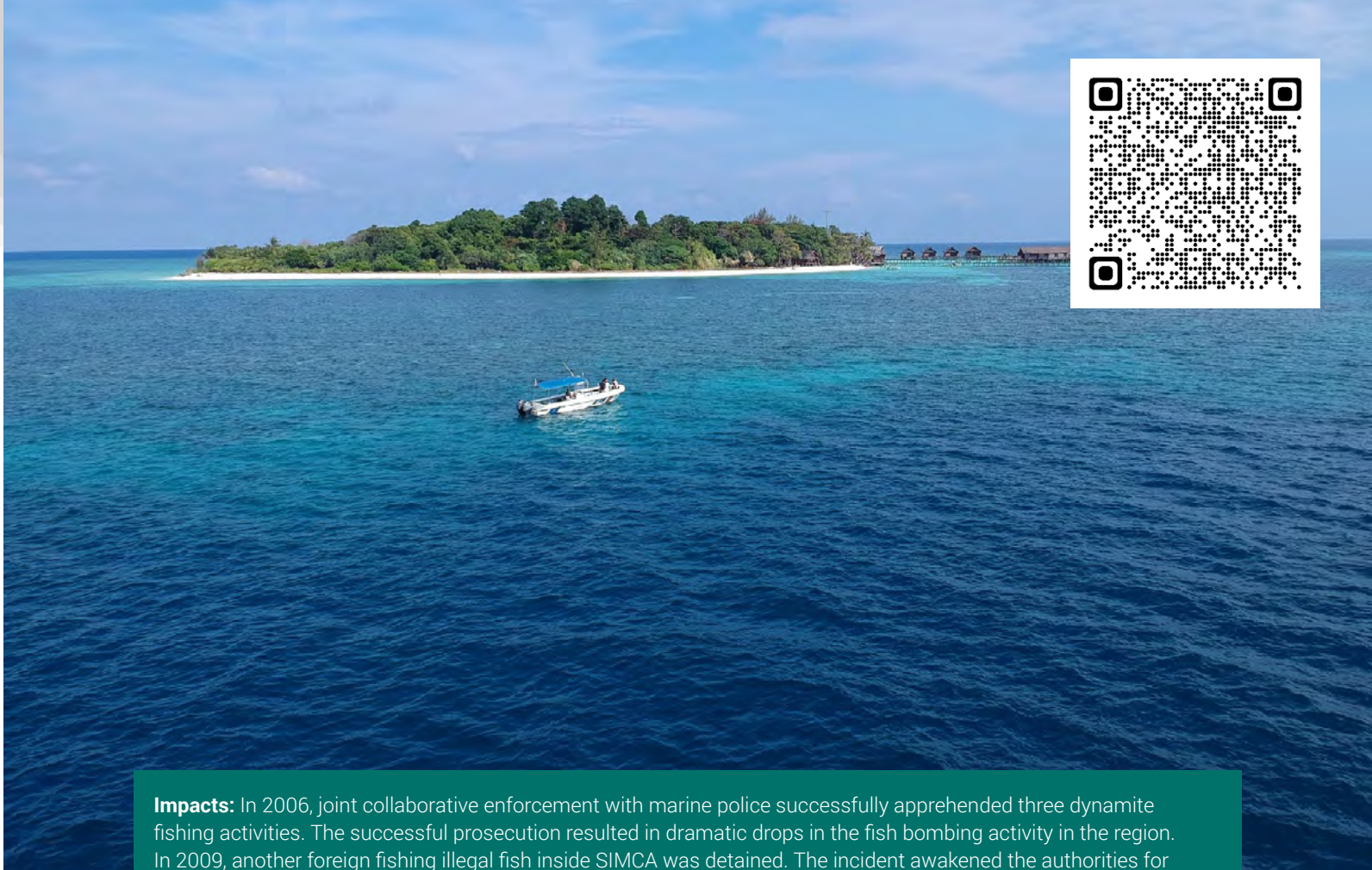
Effective Enforcement Strategy in the Sugud Islands Marine Conservation Area



Solution provider:	Fung Chen Chung, Reef Guardian Sdn Bhd
Type of Tech:	Hardware
Summary:	Through the investment of technologies, the effective enforcement strategy and engagement with the stakeholders in reducing illegal fishing activities within the Sugud Islands Marine Conservation Area (SIMCA) are effective.
Location:	Sugud Islands Marine Conservation Area, Sabah Malaysia
Organisations involved:	Reef Guardian Sdn Bhd, Sabah Wildlife Department



This is an IUCN Green List certified site



Impacts: In 2006, joint collaborative enforcement with marine police successfully apprehended three dynamite fishing activities. The successful prosecution resulted in dramatic drops in the fish bombing activity in the region. In 2009, another foreign fishing illegal fish inside SIMCA was detained. The incident awakened the authorities for more enforcement presence needs to secure Sabah's marine resources. The sea patrol activities assisted by a land-based radar tracking team have reduced illegal fishing to almost zero within SIMCA in the daytime since 2008. The enforcement operation procedure and guideline has been used as an enforcement training module for other agencies in Sabah, Malaysia.

SUCCESS FACTORS:

1. Enforcement guidelines and capacity enhancement
2. Advanced technologies that enhance surveillance
3. Increased awareness and engagement with the local fishing communities
4. Joint collaborative enforcement

Implementing the ArcGIS Protected Area Management Solution for holistic landscape monitoring in the West Lunga ecosystem



HARDWARE



SOFTWARE



MIX

Solution provider: Michael Mole, M.A.P Scientific Services

Type of Tech: Software

Summary: Protected areas are faced with numerous ecological, social, and economic challenges both inside and outside their boundaries. Most of these challenges occur over vast spatial scales and are often magnified by a lack of resources to adequately monitor and respond to challenges. The ArcGIS Protected Area Solution (PAM) is an effective way to address these challenges holistically and at scale. PAM allows users to rapidly configure several workflows for effective area management. M.A.P Scientific Services implemented PAM for the West Lunga Conservation Project (WLCP) in West Lunga National Park, Zambia. The Solution targeted workflows that improve monitoring of the area, these included remote sensing of deforestation and wildfires, law enforcement, wildlife sightings, and community outreach. Outcomes have allowed for improved monitoring and evidence-based management of the protected area that benefits conservation and communities whose livelihoods are intrinsically dependent on the West Lunga ecosystem and its services.

Location: Northwestern, Zambia

Organisations involved: M.A.P Scientific Services, West Lunga Conservation Project, World Wildlife Fund (WWF), Esri, Esri South Africa



Impacts: Eight paper-based workflows were digitised, and a remote sensing workflow was implemented aimed at improving data collection processes, and optimising key initiatives.

- To date:
 - ~25 users have been trained to use customised mobile applications to record:
 - Details on each law enforcement patrol and any incidents that occur during the patrol e.g., poaching, snaring, logging, or signs of illegal activity.
 - Wildlife sightings.
 - Community outreach programs e.g., the location of farmers and their beehives to improve the efficiency of community outreach initiatives aimed at alternative methods of livelihood support.
 - ~180 patrols have been conducted using the solution
 - ~300 patrol incidents have been logged.
 - Two full wildlife ground counts have been conducted using the solution.
 - ~850 wildlife sightings have been recorded on 40 species.
 - The location of ~8 000 beehives have been recorded within the ecosystem.
 - The location and extent of ~15 000 fires were mapped.

On a single secure platform, park management, staff, and their partners can efficiently track data collection and assess their management initiatives in near real time, gaining evidence-based insights for where incidents are taking place, how wildlife populations are changing, whether community initiatives are successful, and what areas are vulnerable to over exploitation, illegal harvesting, and wildfires.

SUCCESS FACTORS:

- ArcGIS Online
- Designing and deploying workflows
- Training and capacity building

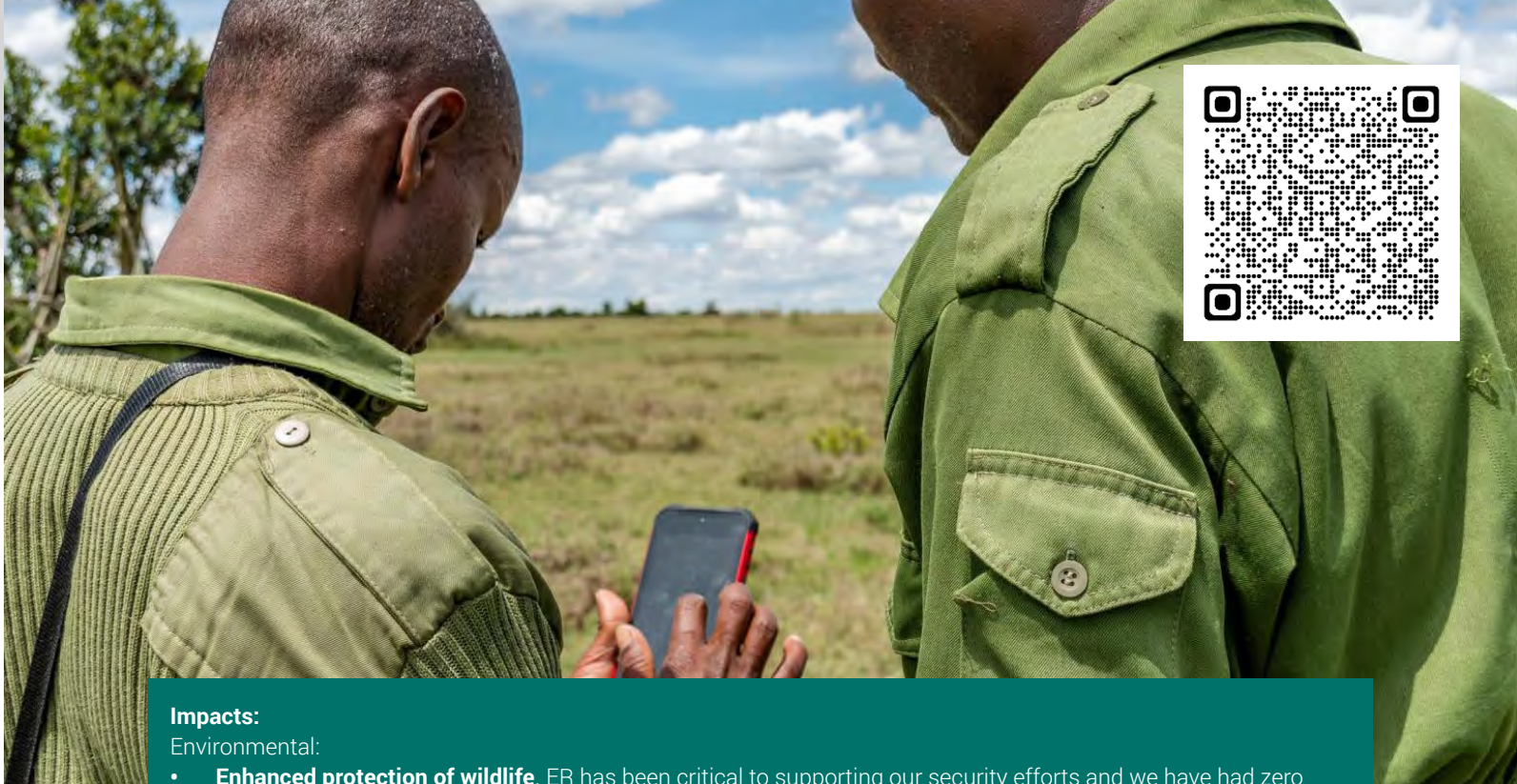
Integrated technology platform to support conservation – protecting wildlife and people



Solution provider:	Kate Terriere, Ol Pejeta Conservancy
Type of Tech:	Software
Summary:	<p>Ol Pejeta is home to the largest population of critically endangered black rhinos in Eastern Africa. Protecting them and other wildlife is a great responsibility, and we utilize technology where it adds value. In 2019 we rolled out EarthRanger (ER), a software platform that collects protected area activity information (the animals and assets being protected, the rangers protecting them, and threats of potential poaching) into a single, integrated, real-time visualized operational platform. It amalgamates data from different sources including animal GPS tracking collars, ranger digital radio systems/vehicle trackers, and ranger recorded observations. ER allows us to see key information in one place, enabling informed and faster conservation-related operational decisions.</p> <p>ER was developed in collaboration with Vulcan Inc. through our Conservation Tech Lab. The Lab acts as a field-based space for technologists and scientists to test and deploy solutions, but also as a centre for collaboration, learning and sharing knowledge.</p>
Location:	Nanyuki, Laikipia, Kenya
Organisations involved:	Ol Pejeta Conservancy, Vulcan Inc.



This is an IUCN Green List certified site



Impacts:

Environmental:

- **Enhanced protection of wildlife.** ER has been critical to supporting our security efforts and we have had zero poaching on the conservancy for 3 years. It also forms part of our ecological monitoring efforts which allow us to protect all wildlife.
- **Evidence-based conservation management planning.** Combining real time and historic data through Tableau analytics has provided richer information to support longer term planning. Appropriate management strategies and approaches are informed by evidence.

Social:

- **Safety and security** for our patrol staff. Switching from analog comms to digital, and trackers on radios and vehicles ensures we know where our rangers are and can respond quickly in the event of an incident in the field, ultimately saving lives.
- **Managing Human Wildlife Conflict** to support the 35,000 people living in communities around the conservancy. ER supports us in being able to respond to reported incidents rapidly and effectively. Data analysis enables us to monitor trends and deploy effective mitigation strategies.

Economic:

- **Operational efficiency.** Effective deployment of 150 field staff ensuring no gaps in ranger patrol coverage.

SUCCESS FACTORS:

1. Integrated (EarthRanger) platform solution design
2. Ranger patrol report design

Using monitoring data to create protected areas and wildlife corridors for saiga conservation



HARDWARE



SOFTWARE



MIX

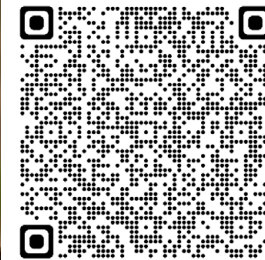
Solution provider: Aleksandra Nikodinovic, Association for the Conservation of Biodiversity of Kazakhstan (ACBK)

Type of Tech: Mix

Summary: The Altyn Dala Conservation Initiative (Altyn Dala) project aims to establish a network of protected areas within the historic boundaries of the Betpak-Dala saiga population to effectively protect saiga, their endangered steppe and semi-desert habitat, and other flagship species including Great bustard and Sociable lapwing. Once completed, this network of protected areas is anticipated to cover 3 to 5 million hectares. To gather data on saiga's migrations and help inform the national authorities on the need to design and establish new protected areas and ecological corridors, the experts are relying on the information collected with the help of satellite collars - as it allows the experts to understand the long-term impacts of infrastructure developments on saiga movements and population recovery.

Location: Yrgyz, Yrgyz District, Aktobe, Kazakhstan

Organisations involved: Association for the Conservation of Biodiversity of Kazakhstan (ACBK), Frankfurt Zoological Society, Royal Society for the Protection of Birds (RSPB), Flora and Fauna International, Government of the Republic of Kazakhstan



Impacts: The saiga (*Saiga tatarica*) is a migratory ungulate that exists in two subspecies and five major populations: three in Kazakhstan, one in Russia and one in Mongolia. More than 2 million existed in the 1950s, but catastrophic declines since the 1990s resulted in only 30,000 remaining, scattered across an immense area. Originally hunted for meat, in the 1990s the population declined dramatically due to ruthless hunting for horns to satisfy demand from countries, where saiga horn is used as traditional medicine. Only hundreds persist in Altyn Dala, where historically the largest population of 1 million thrived, as it was both a calving ground and provided rich summer grazing. Project partners support mobile warden units whose patrols investigate and deter poaching, and monitor the migrating herds. This is combined with law enforcement, public awareness and socio-economic development to make poaching a far less attractive option for rural people. The use of satellite transmitters has highlighted saiga's major migration routes, as well as vitally important calving and wintering areas. By combining this information with the results of biodiversity and socio-economic surveys and overlapping the data with the current protected areas network, the experts could identify new areas for protection.

SUCCESS FACTORS:

1. Satellite tagging
2. Using a flagship species to catalyse policy changes
3. Community outreach

Using Advance Technology and AI for Reef Restoration: Implications of Active Management to declare a Marine Protected Area in Mauritius



HARDWARE



SOFTWARE



MIX

Solution provider: Nadeem Nazurally, EcoMode Society

Type of Tech: Mix

Summary: Coral reefs, known as the blue rainforests, serve as net carbon sinks, help to fix nitrogen, protect against erosion and feed a large portion of the world's population. Due to rapid and significant loss of corals around the Island, active reef restoration is the main focus towards coral recovery and rehabilitation. The restoration site at Pointe-aux-Feuilles covers an area of approximately 2,000 ha (20km²) and is highly visited by tourists and locals. The site is currently not under formal protection, rather as a community conserved area, and requires urgent attention given the amount of biodiversity it contains and its importance in maintaining the ecosystem functions over the place. This solution focuses on technology based-awareness and actions undertaken to restore the reef ecosystems. While education is primordial to create a long-term impact, the use of technology to implement a constant flow of information will ensure the participation of everyone.

Location: Pointe-aux-Feuilles, Mauritius

Organisations involved: EcoMode Society, Mauritius Telecom Foundation, Tech4Nature



13 CLIMATE ACTION



14 LIFE BELOW WATER

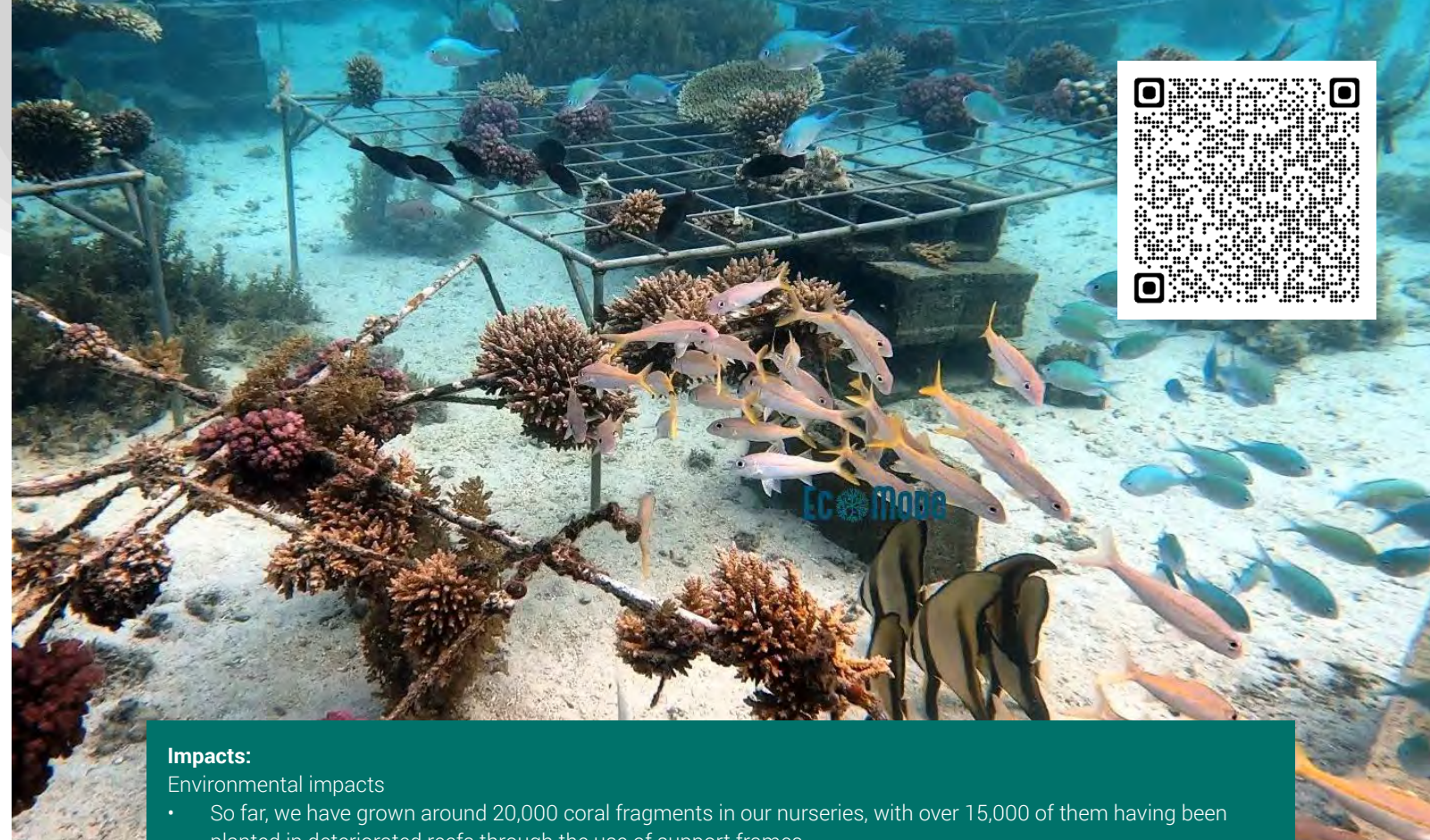


17 PARTNERSHIPS FOR THE GOALS

EcoMode



Tech4Nature

Green List
Protected / Conserved Areas

Impacts:

Environmental impacts

- So far, we have grown around 20,000 coral fragments in our nurseries, with over 15,000 of them having been planted in deteriorated reefs through the use of support frames.
- Creation of an artificial reef using concrete blocks to support natural recruitment and marine life.
- There has been an increase in the marine biodiversity in the nursery area and restoration sites.

Social impacts

- The local community has an improved understanding of the state of conservation targets (species and ecosystems), as well as their vulnerability and resilience.
- Increased awareness of the impact of climate change on coral reefs.
- Participation of local fishermen, especially women, in coral farming activities.

Economic impacts

- More fish for fishermen to catch and eco-tourism activities to support locals

SUCCESS FACTORS:

1. Community engagement and partnerships
2. Interactive technology for conservation

Inspiring story



Coral reef restoration is more important than ever to protect our marine resources and the local economies since coral reefs are increasingly in danger owing to natural and anthropogenic stressors at both a local and global level. Coral colonies are fragmented by strong wave actions and man-made activities like boat anchoring, destructive fishing practices and unsustainable sports activities. The basic principle of coral restoration is to secure broken coral fragments to ensure survival and rejuvenation. Seeing how I could help in coral restoration, this project has allowed me to collect broken coral fragments from the reef, grow them in nurseries until they are mature, and then transplant them in the degraded reef locations.

This project has allowed us all to become involved through the use of technologies. The development of the mobile app has not just been challenging but also engaging in a sense that when we shared with local people, they are more than happy to see live underwater feed on a daily basis.

This project has allowed also fishermen to express their concern on environmental degradation and to established a close link with them to support coral restoration. The underwater cameras and live viewing are allowing us to monitor closely coral growths and integrating education alongside.

Technology and conservation are primordial to help understand what is happening and a way for mother earth to talk to us, to show us the reality underwater and to consider active restoration.

Barcoding Galapagos: Recording and mitigating Covid-19 impacts using key-workers in eco-tourism



HARDWARE



SOFTWARE



MIX

Solution provider:

Jaime Chaves, Barcode Galapagos

Type of Tech:

Hardware

Summary:

The Covid-19 pandemic has impacted the tourism industry in the Galapagos, putting thousands out of work and threatening conservation efforts based on tourism income. In particular, naturalist guides, fishermen, and farmers were hit the hardest, affecting the core of the island economy. This lack of income could also be detrimental to sensitive ecosystems by lifting adequate control and increasing fishing quotas as measures to mitigate this economic collapse. The Galapagos Barcode project's main goal is to directly employ naturalist guides (women and men equally) currently without income, to catalogue the biodiversity of the Galapagos using DNA sequencing technology. By providing infrastructure and scientific training (cash for training), it builds local capacity and resilience, and enhance wildlife and ecosystem conservation, and socio-economic growth.

Location:

Galápagos Islands, Ecuador

Organisations involved: Barcode Galapagos

Impacts: This non-invasive technology is used to catalogue the islands' genetic diversity at the ecosystem level; to identify illegal capture and trafficking of endangered species, and to identify and interfere with invasive species that arrive on ships or by air. The employment of naturalist guides who have lost their livelihoods due to the pandemic are now knowledgeable on barcode techniques, generating new job opportunities in research and technology, thus creating resilience for future uncertain times

SUCCESS FACTORS:

1. Transfer of Technology
2. Clear measurable outcomes

Prey Lang: It's our forest too



HARDWARE



SOFTWARE



MIX

Solution provider: Dimitris Argyriou, Prey Lang - It's our forest too

Type of Tech: Mix

Summary: Prey Lang Community Network (PLCN) is a network of indigenous communities living in and around the Prey Lang forest. Since 2007 PLCN has advocated against illegal logging and large-scale, government-sanctioned land grabbing on their ancestral lands. With an emphasis on peaceful, non-violent actions, PLCN has engaged civil society, indigenous associations, commune and district authorities, NGOs and research institutions in a joint movement for environmental justice and sustainable development. The core of PLCN's work is to patrol the forest, document forest crimes and advocate for the long-term protection of Prey Lang. PLCN helped developing an app for smartphones, making it easy for local patrols to geo-reference, document, and upload information about forest resources, threatened biodiversity, and illegal activities. The data is used to document the importance of the forest to local livelihoods, international biodiversity conservation, and to report illegal activities to the authorities.

Location: Prey Lang Wildlife Sanctuary, Cambodia

Organisations involved: Prey Lang - It's our forest too, Danimission, University of Copenhagen, Peace Bridges Organization, Cambodia Youth Network, Forest & Peoples Organization



DANMISSION



Impacts: Regional and local patrols have been conducted with the participation of hundreds of community members. Illegally felled timber has been burned. Chainsaws and other logging equipment have been confiscated, and reports filed. PLCN's advocacy led to Cambodia's government drafting a sub-decree to gazette Prey Lang as Protected Forest. PLCN has organized consultations from the village to the national level to inform the process. PLCN has communicated the importance of environmental protection effectively at the national and international levels empowered by the use of smartphones. PLCN has been instrumental in slowing forest destruction in Prey Lang forest, the largest primary lowland evergreen forest in Indochina. The effort made by PLCN to preserve the forest habitat has importance for wildlife protection and environmental conservation for the whole region. PLCN promotes the traditional and sustainable tapping of resin trees, which has been shown to generate income and secure livelihoods locally.

The effort made by PLCN to preserve this large vestige of primary rainforest is an important contribution to reduce emissions from deforestation and forest degradation (REDD) in Cambodia and supports national and international policies to mitigate climate change.

SUCCESS FACTORS:

1. Forest monitoring application
2. An innovative partnership

Community camera-trapping: an innovative way of empowering communities through conservation



HARDWARE



SOFTWARE



MIX

Solution provider: Amy Dickman, Lion Landscapes

Type of Tech: Hardware

Summary: One major conservation challenge is ensuring local people recognise meaningful benefits directly from wildlife presence, rather than from the presence of tourists, NGOs etc. Here, we engaged local villagers living adjacent to Ruaha National Park, and employed them to use camera-traps to monitor wildlife on their land. Each image of a wild animal generated points, with more points for more threatened and more conflict-causing species. Every 3 months, these points are translated into additional community benefits, focused on local priority areas of healthcare, education and veterinary care. This has become one of the largest drivers of local development, and is directly incentivising conservation, with villagers taking steps to protect wildlife and habitat. This improves livelihoods while reducing the major threat of conflict, which imperils lions and other species in this critically important area. This has been a successful, scalable solution, which is now being adapted and implemented in other landscapes across East Africa.

Location: Iringa, Tanzania / Luangwa, Lusaka, Zambia

Organisations involved: Lion Landscapes



Impacts: In Tanzania, this programme delivers over \$80,000 worth of community benefits to villagers around Ruaha National Park annually, which has been invested in improving local healthcare, education and veterinary care for livestock. Over 30 local villagers have been employed and gained skills and salaries through the project. The initiative has now been recognised as one of the major drivers of local development, with very important impacts on local health, education and empowerment.

It also has clear environmental impacts: because local people now see tangible, meaningful benefits as a direct result of maintaining wildlife, they have started taking actions to improve conservation. This has included some villages putting local bans on lion and elephant hunts, while others have protected waterholes, protected dens of large carnivores, and similar action.

SUCCESS FACTORS:

1. Monitoring wildlife presence
2. Developing a system to allocate benefits
3. Transparent benefit distribution

Inspiring story



An amazing example of this programme changing attitudes and behaviors recently occurred when pastoralists in the village of Mafuluto found a hyena den while grazing cows. Hyaenas are responsible for more than 80% of depredation events and in the past these dens would normally have been set on fire or snares put around the vicinity. But these days things are different! The pastoralists went straight to the Community Camera Trap Officers in Mafuluto and suggested the put the camera traps near the den to gain more points and more veterinary medicine. Not only do the pastoralists receive benefits directly from wildlife presence on their land but we also get to enjoy beautiful pictures, and show them in the villages to raise awareness and interest in these wonderful animals.

Perovskite solar panels supporting life lasting animal telemetry


HARDWARE


SOFTWARE


MIX

Solution provider:	Bogdan Vykhov, WWF Ukraine
Type of Tech:	Hardware
Summary:	Telemetry collars with flexible perovskite solar panels are created to support the life-lasting monitoring of animals. Collars consist of injecting printed perovskite solar panels covered by transparent epoxide and combined with a GPS fixing chip and LoRa data transmitter. Two innovative collars were put on two European (male and female) bison at Styr hunting enterprise. The GPS coordinates were saved in the EEPROM memory in the collar and transmitted through the LoRaWAN communication protocol to the cloud and created a database. The database provides data to Grafana open-source service, enabling flexible visualizations of forms from multiple data sources. As a result of this, online monitoring of wildlife is established without the need to change the batteries in telemetry collars worn on animals.
Location:	Brody, Lviv, Ukraine
Organisations involved:	WWF Ukraine, Saule S.A.

7

AFFORDABLE AND CLEAN ENERGY



9

INDUSTRY, INNOVATION AND INFRASTRUCTURE



15

LIFE ON LAND



17

PARTNERSHIPS FOR THE GOALS





Impacts: Implementation of life-lasting telemetry collars provide inside of spatial behaviour of animals during their whole life and help to understand the cascade of relationships in ecosystems (day/night, sex, season, habitat preferences). Understanding where is an animal at the exact time allows to improve species management and monitoring, which are the keys to human-wildlife conflict mitigation and poaching prevention. For example, two collared European bison help to locate the flock easily and take measures by administration of managing enterprise for human-wildlife conflict prevention. Telemetry collars fed by flexible perovskite solar panels didn't need battery replacement and animals capturing repeatedly which also save resources and reduce the level of stress.

BUILDING BLOCKS:

1. Integrated telemetry system in wildlife conservation and monitoring
2. Flexible perovskite solar panels in wildlife conservation

Acoustic Monitoring for Improving the Conservation of Critically Endangered Hainan Gibbon



Solution provider:	Yun Xiao, International Union for Conservation of Nature (IUCN)
Type of Tech:	Mix
Summary:	<p>The Hainan gibbon (<i>Nomascus hainanus</i>), one of the most critically endangered species on the IUCN Red List, has only 35 individuals currently living in the National Park of Hainan Tropical Rainforests, Hainan, China. Comprehensive tracking and monitoring are required for better conservation, but because of the difficulty in vivo tracking, acoustic equipment is needed for monitoring.</p> <p>“Tech4Nature” is a global project jointly launched by the International Union for Conservation of Nature (IUCN) and Huawei, aiming to develop more scientific protection measures, combined with the ICT industry, digital technology and IUCN Green List standards, provides technical support for the acoustic monitoring project of Hainan gibbons. To date, full coverage of 5 family groups monitoring has been achieved, automatic identification and real-time back transmission of Hainan gibbon acoustic monitoring have been realized.</p>
Location:	National Park of Hainan Tropical Rainforests, Hainan, China
Organisations involved:	Hainan Institute of National Park, Tech4Nature



- Impacts:**
- Enhance monitoring efficiency: The equipment installed in this project can be activated by the sound of Hainan gibbons, then records the data and transmits back in real time, and can also realize automatic sound recognition, which effectively improves the efficiency of monitoring, and achieves a new stage in Hainan gibbon acoustic monitoring.
 - Assist in biodiversity conservation: The establishment of the cloud database will provide a scientific basis for the discovery of potential solitary or groups of Hainan gibbon, contributing to the biodiversity conservation in Hainan.
 - Contribute to the study of human: Hainan gibbons have a complex acoustic communication system similar to humans, and a stable monogamous or bi-marital mate system. The study of their behaviours based on their acoustic markers can help us better understand the origins of human society, family, language, communication, and the evolution of other behaviours.

SUCCESS FACTORS:

1. Field research
2. Sound recording equipment layout and installation
3. Data quantification and database establishment

Tech-enabled fish species recognition & sorting system to save Atlantic salmon



Solution provider:	Tor Schulstad, Berlevåg Jeger og Fiskerforening
Type of Tech:	Mix
Summary:	<p>This is the story on how Huawei and a local association of hunters and anglers - Berlevåg Jeger-og fiskerforening (BJFF) - developed an automated fish trap with a built-in camera system and AI-software to remove the invading foreign humpback salmon from a river in Berlevåg, a small community, on the northmost tip of Norway, neighbouring the Barents Sea. By preventing the humpback salmon from swimming up the rivers, we eliminate the risk of reproduction and reduce the threat to invasive species in rivers. The Atlantic salmon populations are exposed to variety of threats but the threat from the invasive humpback salmon is the most significant. This is the story on how to save the Atlantic salmon by using technology. The humpback salmon problem is escalating drastically, and as a result, the construction design of the fish trap is prepared to be duplicated and fit into other rivers</p>
Location:	Berlevåg, Troms, Norway
Organisations involved:	Berlevåg Jeger og fiskerforening (BJFF), Huawei



Impacts: The impact of the project is immense for various reasons. First, the solution effectively removes humpback salmon from rivers, which contributes to maintaining the local biological diversity in general and saving the Atlantic salmon in specific. Second, the solution is scalable in a way that it can be applicable in other prone rivers in the arctic region. Third, the solution is cost-efficient compared to other manual capture solutions and liberates the local communities from tiring manual labor. In addition, the system opens for economic gains as the humpback salmon indeed is edible. A possible solution is that local actors may extract the humpback salmon from the traps to sell it on the market.

SUCCESS FACTORS:

- 1. Video capturing and fish recognition module
- 2. Data collection and model re-training
- 3. Automated sorting mechanism

Using camera traps to restore connectivity for wild cats in Central Asia


HARDWARE


SOFTWARE


MIX

Solution provider: Aleksandra Nikodinovic, Ministry of Agriculture and Environment Protection of Turkmenistan

Type of Tech: Mix

Summary: Located in the central part of the Kopetdag Range in the Ahal Province of Turkmenistan and spanning an area of 497 km2, Central Kopet Dag Nature Reserve incorporates two sanctuaries and two natural monuments.

This Reserve is the most important stronghold in Turkmenistan for the conservation of the Persian leopard (*Panthera pardus saxicolor*) and recently the presence of the Pallas cat (*Otocolubus manul*), a relatively rare small wild cat, rediscovered. The Reserve is the gateway between Iran and areas to the north and west into Kazakhstan for the Persian leopard. Since 2018, thanks to the collaboration between protected area staff and international partners, an effort is underway to establish baseline information on all cat species, the status of their important prey (the Urial and Bezoar goat), and to identify threats, including the impacts of the border fence with Iran. Twenty camera traps have been deployed that to date have enabled to identify several Persian leopards as well as record the Pallas cat.

Location: Central Kopet Dag Reserve, Ahal Province, Turkmenistan

Organisations involved: Ministry of Agriculture and Environment Protection of Turkmenistan, Ilbris Foundation, IUCN Species Survival Commission Cat Specialist Group, Center for Large Landscape Conservation, Norwegian Institute for Nature Research, Michael Succow Foundation









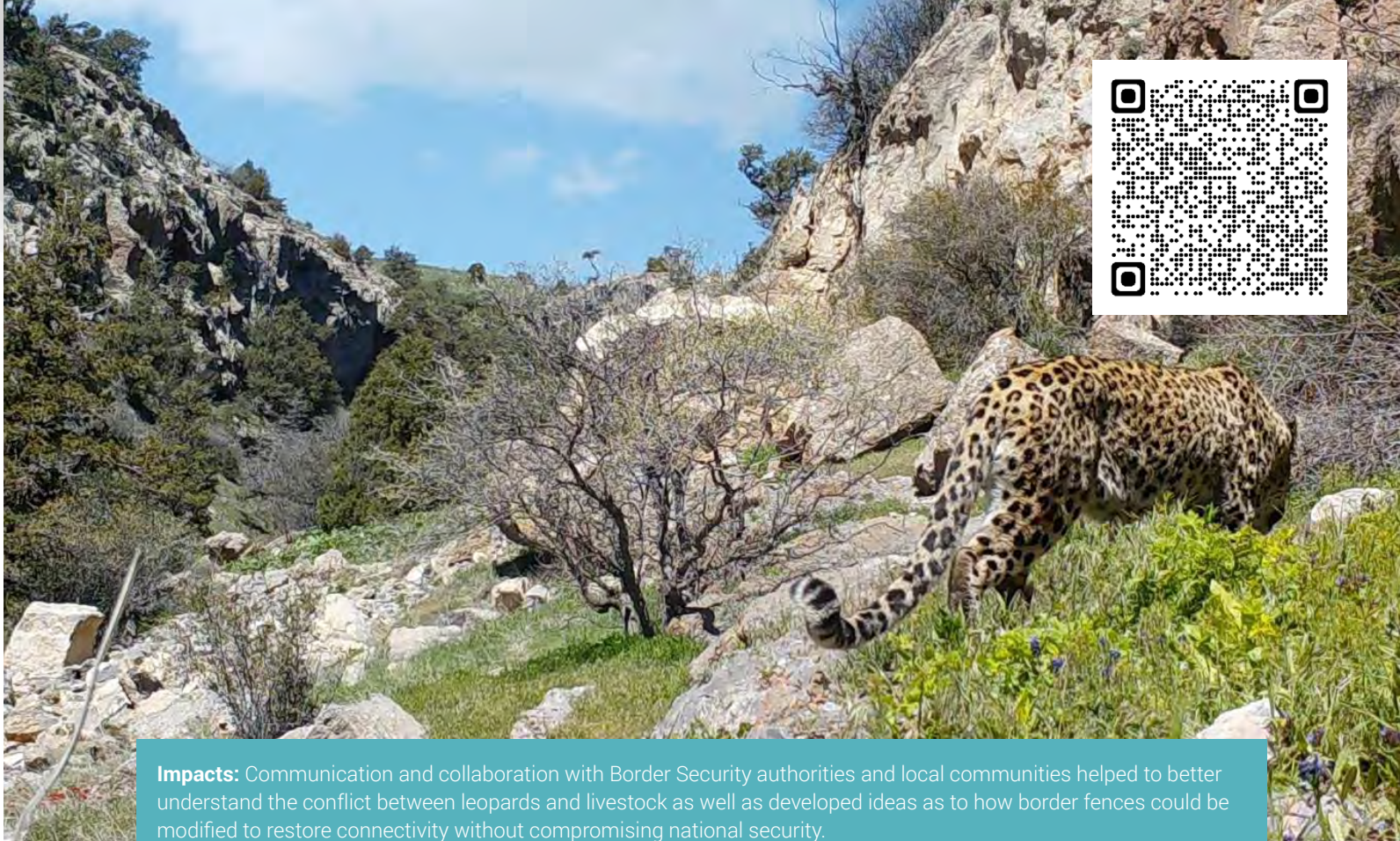












Impacts: Communication and collaboration with Border Security authorities and local communities helped to better understand the conflict between leopards and livestock as well as developed ideas as to how border fences could be modified to restore connectivity without compromising national security. Gathered data and experience have been used to make the case for the inclusion of the Persian leopard under the Convention on the Conservation of Migratory Species of Wild Animals (CMS) Central Asian Mammals Initiative and sealed the commitment of Turkmenistan to join the Convention in January 2021. By joining CMS, the importance of the Reserve as a case study for restoring connectivity became even greater. The important monitoring results have been used for outreach and messaging on the value of protected areas and of protecting species. Several documentaries have been broadcasted on state TV. As a result, there is a greater appreciation for the conservation of wildlife, especially wild cats. Sharing of data and information with conservationists in neighbouring Iran has also showed that Persian leopards cross from Iran into the Reserve in Turkmenistan, albeit severely affected by border fences, and come very close to the country's capital.

SUCCESS FACTORS:

1. Camera traps monitoring
2. Addressing human-wildlife conflict in buffer zone

China Nature Watch - Biodiversity Information Collection and Application



HARDWARE



SOFTWARE



MIX

Solution provider: Chunyue Wei, Shan Shui Conservation Center

Type of Tech: Mix

Summary: Biodiversity baseline data is key to conservation decision-making and practices, yet facing data deficiency and information asymmetry. With the assistance of technology tools, China Nature Watch aims at strengthening the collection of biodiversity data from various sources, especially citizen science, facilitating data applications in land use planning and public participation, and mainstreaming biodiversity conservation. Specifically, technology brings effective solutions to 3 modules:

- Camera trap data management: developing online AI-incorporated data management system to simplify and speed up camera trap data collection and processing.
- Citizen science data visualization: using Microsoft PowerBI to automatically analyse and interactively visualize species records collected by citizen scientists.
- Biodiversity Impact Assessment Tool (BiA): integrating ecological and construction data from multiple data sources to provide instant enquiry of biodiversity impact assessment for construction projects.

Location: People's Republic of China

Organisations involved: Shan Shui Conservation Center, Peking University Center for Nature and Society, Xi'an Jiaotong-Liverpool University, ByteDance Public Welfare, Huawei



北京大学自然保护与社会发展研究中心
Center for Nature and Society



山水自然保护中心
Shan Shui Conservation Center



Xi'an Jiaotong-Liverpool University
西交利物浦大学



Impacts: Technology solutions have optimized biodiversity data workflow and promoted data applications:

- Camera trap data management: The community-based camera trap monitoring assistant app has made data recording easier for 86 local community monitors in charge of camera trap setup/pickup in field. AI image recognition models have processed over 380,000 camera trap images, substituting more than 100 hours of labour. Such acceleration in data collection and processing enables feedback to stakeholders and better conservation decision-making.
- Citizen science data visualization: Through visualizing 2688 records of 22 species collected during six campaigns in 2016-2021 and automatically updating newly collected records, the platform has provided spatial, temporal, and interactive feedbacks to citizen scientist participants and significantly boosted interests in nature watch activities.
- BiA tool: The Nature Watch database maintains biodiversity baseline data collected from multiple data sources including species records (2591 species, 1.35 million records) and protected areas (6 national parks, 474 national protected areas, etc.). Up until now, the BiA tool has provided interactive and visualized biodiversity impact assessment enquiry services to more than 1260 construction project planners and other stakeholders, facilitating biodiversity-friendly decision making.

SUCCESS FACTORS:

1. Workflow analysis, partnership building and overall planning
2. Camera trap data management system
3. Citizen science data visualization platform
4. Biodiversity Impact Assessment Tool (BiA)

Harnessing the power of AI and community centered approaches to monitor Jaguars in the Yucatan Peninsula



Solution provider:	Regina Cervera, C Minds
Type of Tech:	Mix
Summary:	<p>The Yucatan Peninsula, located in the southeast of Mexico, has a great diversity of ecosystems ranging from tropical rainforests to coral reefs, mangroves, dunes, cenotes, and 'ojos de agua', coastal lagoons, caves and subway rivers, among others. It is also home to the most important jaguar population in the country.</p> <p>Tech4Nature Mexico is reinforcing effective monitoring practices for the conservation of the jaguar and its prey, as well as strengthening the understanding of the effects of climate change in priority ecosystems on the north coast of the Yucatan Peninsula through the installation of an integral monitoring system consisting of a network of camera traps and the development of open algorithms to detect and identify jaguars.</p>
Location:	Dzilam de Bravo State Reserve, Dzilam de Bravo Municipality, Yucatán, Mexico
Organisations involved:	C-Minds, Secretaría de Desarrollo Sustentable de Yucatán, Universidad Politécnica de Yucatán, Tech4Nature



Impacts: Nearly 20 camera traps were strategically deployed in three types of ecosystems (mangroves, low deciduous forest and savannah) in areas where signs of presence and/or transit of jaguars and their prey have been identified in close collaboration with the local community and experts from the Secretariat of Sustainable Development.

The system identified 710 photos with vertebrates and identified 49 different species of birds, mammals and reptiles from a database of over 19,700 images.

- Photos currently collected: ~19,700
- Ecosystems covered: 3 (mangroves, jungle and savannah). See Annex 1.
- Land area covered: 19,140 km.
- Number of jaguars identified: 5 (two males, one female and two cubs of unidentified sex)
- Number of photos with identified animals: 710

Number of species detected (video only, acoustic analysis in progress): 49 vertebrates including birds, mammals and reptiles.

The images database has over 5,000 jaguar images that were used to train the algorithm to guarantee accuracy and mitigate potential bias.

This monitoring system and the collaboration with the local community is allowing us to understand the changes in the ecosystem caused by the increased incidence and strength of extreme events and floods caused by climate change and enhancing the protection of endangered species in the area.

SUCCESS FACTORS:

1. Field Research and site characterization
2. Community co-design and engagement
3. Camera traps deployment
4. Algorithm for jaguar detection from camera traps

Inspiring story



The Dzilam State Reserve was declared a natural protected area in January 1989, and a proposed management plan, an annual operating program, and a vigilance body were created, which was unprecedented in the history of conservation in Mexico at that time. However, due to multiple factors, the management program was never published in the Official Gazette of the Government of the State of Yucatan. Since that time, the reserve's management strategies have been based on the principle that caring for nature must go hand in hand with guaranteeing the well-being of its inhabitants.

However, the agricultural strip has grown towards the reserve, causing the displacement of large mammal species, which is possibly the main cause of the mortality and decline of big cat populations, such as the jaguar, because the predators frequently conflict with human interests when they attack domestic animals, particularly livestock.

Juan Castillo grew up in a family of nomads who moved through the jungle long before it was declared a reserve. His family settled near bodies of water and survived by hunting, farming and raising cattle. Juan grew accustomed to the belief that if a jaguar tried to kill the cattle, you had to defend the cattle and kill the jaguar.

As he grew older, he realized that all along, he and his family were the ones invading the jaguar's home and feeding on his food, not the other way around. He removed all his cattle from the reserve, and moved to the city.

Juan raised a family and is now a grandfather. His grandchildren share with him their love for nature and understand that these species are more valuable alive than dead for the survival of the forest, of all the species that live there, and therefore of the people.

Today, Juan is determined to donate his land for conservation, which, despite being within the reserve, belongs to him. He, along with his partner Benjamin, also a former hunter, are top guides, explorers and advocates for the conservation of the jaguar and its prey, as well as the rainforest and the mangroves; they make sure to take care of the camera traps and acoustic monitoring devices (and making sure everyone makes it outside safe and sound) inside the reserve within the Tech4Nature Mexico project.

Nature Collectibles – Collect & Conserve



Solution provider: Roman Eyholzer, Porini Foundation

Type of Tech: Digital

Summary:

IUCN together with the Swiss PORINI Foundation launched NatureCollectibles (NCs), a new and innovative way to make biodiversity assets tradeable. NCs are digital representations of a species connected to a real-world nature conservation project. They are written to Porini's zero-carbon blockchain where they cannot be copied or multiplied, making them unique and tradeable, like a piece of art.

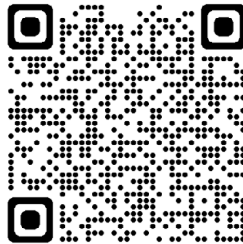
We invited 8 protected and conserved areas (PCAs) from 6 continents to present their work at the first African Protected Areas Congress in Kigali and developed a mobile app where these digital twins can be collected and traded. People can now take part in ongoing conservation action.

We collected over 16'000 USD in the first 2 months and any user can see on the app that 100% of his contribution is sent to the PCA.

In October, we will launch the next collection featuring 8 species from 8 PCAs in Madagascar and over the next 5 years, a total of 512 species in 64 different collections will be added.

Location: Seychelles, Mexico, Colombia, Mongolia, Rwanda, Lebanon, Bermuda, Switzerland

Organisations involved: Porini Foundation, Nature Seychelles, The HBAR Foundation, Apps with Love



SEYCHELLES MAGPIE ROBIN

Species: Copsychus sechellarum

Conservation Actor: Nature Seychelles

Location: Cousin Island Special Reserve, Seychelles

Your support helps nature conservation in Seychelles.

Status: Endangered

Population: 460

Impacts: Protected or conserved areas are traditionally showing their threatened species and natural marvels to tourists, but many PCAs cannot generate sufficient funds to continue their vital conservation work. NatureCollectibles is an innovative and simple way to collect funds for these areas, even if the conservation work is not done for an emblematic species or the PCA cannot be visited by tourists.

Porini Foundation is a specialized charity at the crossroads of nature conservation and blockchain and wants to combine the advantages of both communities. A digital twin of a real-world species which can be traded over a zero-carbon blockchain allows a PCA to collect non-ear-marked funding from naturalists and blockchain collectors to cover basic needs of their conservation work.

Blockchain allows full transparency, so if a collector buys a new card, he can immediately see that his money is accounted for in the PCA-wallet on blockchain. As only the PCA has access to their wallet, this guarantees that 100% of the collected money goes to the PCA.

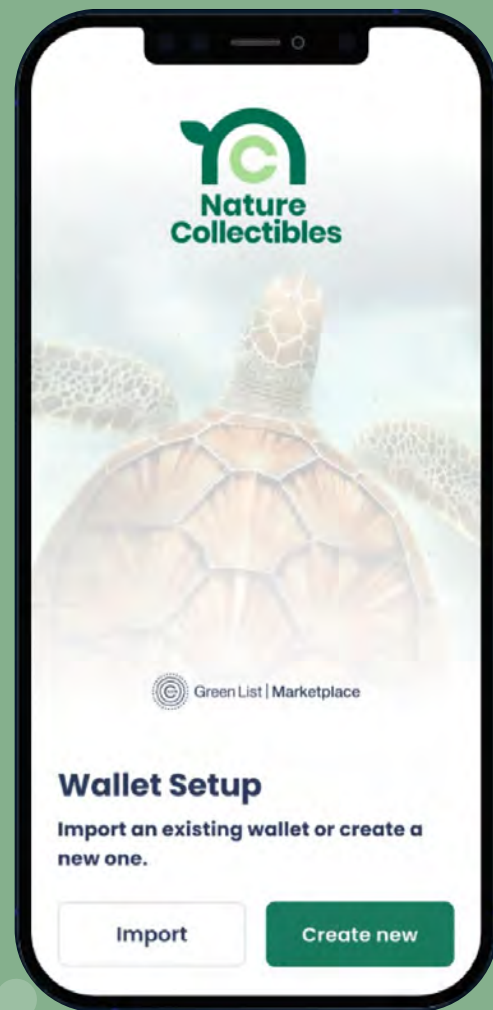
NatureCollectibles is open to all protected areas showing interest and working at the highest standards of biodiversity protection.

New Collections are launched on a regular bases, please get in contact with Porini Foundation for more details on how to participate.

SUCCESS FACTORS:

- 1. Monetarisation of biodiversity assets
- 2. Mobile Application
- 3. Collect&Conserve
- 4. Rangers voices
- 5. Earn your badge
- 6. Transparency

Inspiring story



“We have been talking about how important it is to innovate during the COVID crisis and we are happy to be early adopters of this innovative technology, we named it – Next-Gen Conservation”, says Dr. Nirmal Jivan Shah, CEO Nature Seychelles

Selling a digital twin of a conserved species over the blockchain to naturalists and crypto collectors allows recurrent and non-ear-marked funding for protected and conserved areas, especially as funding for conservation is not always easy and that protected or conserved areas, as the COVID-19 pandemic showed, can quickly lose a great part of their budget and revenue, especially those relying on touristic income.

With NatureCollectibles, IUCN and the Porini Foundation can provide sustainable funding and a robust and innovative financing alternative for conservation work in protected and conserved areas.

By highlighting key conservation species on blockchain, we emphasize the role of the conservation actor and engage with a new audience and new community which can then actively contribute to conservation efforts.

With NatureCollectibles, we can reach:

- naturalists, collecting digital twins and receiving a badge for their efforts,
- the blockchain community, through issuing a non-fungible token which can be collected and traded, gaining value as a nature asset and
- with young people, to learn about protected species as well as the work of the conservation actor.

All this happens in a simple and playful way over a smartphone APP where collecting, trading digital biodiversity assets and learning is fun and supports real work in protected or conserved areas with recurrent and non-earmarked funding.

Digital Recreational Site management system using a dedicated app and web-based backend



Solution provider:	Eoin Hogan, Clare Local Development Company
Type of Tech:	Software
Summary:	<p>Utilising smartphone technology to develop the first dedicated digital outdoor recreational and environmental site management system. It replaces the current general disparate and mainly paper based management systems outdoor recreation sites with an integrated digital system. It ensures that multiple bodies, agencies and community groups who are all involved in managing an outdoors recreational site can use one system. The system is offered on a “freemium” model to community groups and this is subsidised by Government agencies who pay for the system.</p> <p>positive impacts:</p> <ul style="list-style-type: none">- smartphone based transcribing from paper.- Works on android and apple devices and has built in maps so no mobile coverage is needed out in the field- all users of the system are linked to a user ID, so recording can be authenticated- all monitoring reports and remedial actions are stored securely in “the cloud”- geolocating all data allows detailed reporting and enables year on year comparisons (i.e. viewing effects of programs tackling invasive species)
Location:	Ballyvaghan, Drumcreehy, Clare, Ireland
Organisations involved:	Clare Local Development Company, Evolve Technologies



Impacts:

Environmental
Managing a large site with multiple owners
All relevant bodies can use the system to manage their section of a recreational site. With each body using the same system you get a consistent standard of information flow which makes the overall management more efficient and accurate
Biodiversity
The system allows users to log the location of invasive species. It helps with the identification and quantifying the infestation. The basemap will show additional information like watercourses so you can use this to prioritise the addressing of the invasive species – watercourses can spread spores of invasives. Funding has been secured to enhance this element further to manage the invasive species so in addition to the identification and geolocating it will also document the work to eradicate the invasives, it will allow users to record the stages of treatment and manage the progress

Social
The digital system can give you up to date information on the condition of recreational sites (i.e if an issue is reported, the area can be closed and locals and visitors can be guided to an alternative site)

Economic
Economic drivers for rural areas
The trails and outdoor spaces “slow people down” which means they stay longer in an area and spend money which contributes to the local economy. This will only work if the trails and outdoor spaces are in good condition and this is what the system delivers.

SUCCESS FACTORS:

- 1. Partnership
- 2. Innovation

The Positive Effect of Geological Relic Monitoring and Early Warning System on Geological Landform Protection



HARDWARE



SOFTWARE



MIX

Solution provider: Zhang Jiabo, Wudalianchi Administration Committee

Type of Tech: Mix

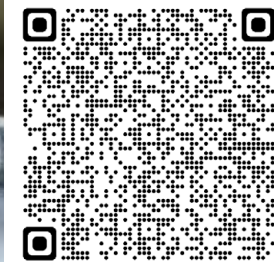
Summary: Wudalianchi is a national park in northeastern China. In recent years, Wudalianchi has gradually attracted people's attention. Now it is not only an ideal learning place for geology scholars, but also a popular holiday resort. It is also an IUCN Green List certified protected area since 2014. Due to the increase of tourists and traffic flow, the protection capacity of the geological relics reached its limits, which also risked visitors' safety. In the past, only some monitoring points were arranged in the densely populated areas of park, which was far from enough to monitor other non-densely populated geological sites and monitor the tourists flow. This solution describes how the management committee of Wudalianchi increases the monitoring capacity by upgrading monitoring system and educating the public. Wudalianchi has developed 12 sightseeing areas. This program has greatly reduced the cost of management and the number of security personnel required, allowing quickly response in face of emergency.

Location: Wudalianchi, Heihe, Heilongjiang, People's Republic of China

Organisations involved: Wudalianchi Administration Committee



This is an IUCN Green List certified site



Impacts:

1. Monitoring system compensates for the lack of staff in charge of monitoring and greatly reduces the cost of management
There are 237 scenic area staff in the park responsible for the maintenance and inspections of geological remains. But only 5 people are in charge of monitoring, far from the requirement of good geological relics protection and monitoring work. With the new monitoring system installed in the park, monitoring staff could check the overall situation of the park sitting in the monitoring center, which is much more efficient compared to the past.
2. Monitoring system allows rapid intervention on the ground
The monitoring and early warning system also allows rapid intervention when there are sudden weather changes (freeze-thaw effect), disasters (earthquakes or volcanic eruptions) or destructions (man-made or caused by extreme weather). Since the important geological sites are monitored, the Management Department could track real-time and inform the security and emergency team on duty quickly in case of disasters. We could also evacuate visitors in a short time when the number of visitors reaches the limit.

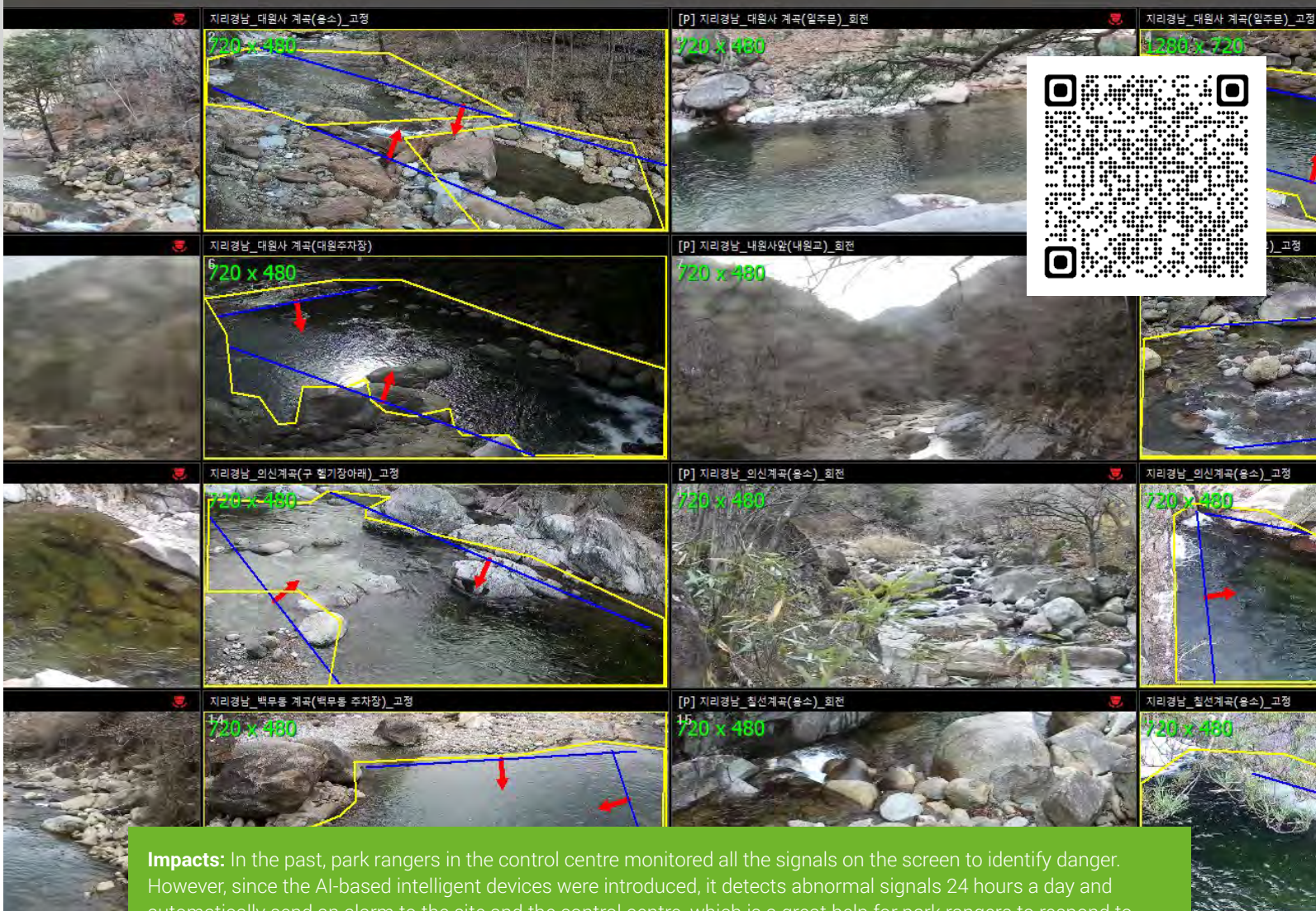
SUCCESS FACTORS:

1. Training staff in monitoring skills
2. Educating the public

The AI-based visitor safety management system of Korean National Parks



Solution provider:	Korea National Parks Service
Type of Tech:	Hardware
Summary:	“Are there any innovative solutions for national park visitors to meet nature without any risk of danger?” The long-standing concerns of Korean park rangers have begun to achieve great results by establishing an AI-based visitor safety management system using the latest technology. This system automatically monitors and analyses the potential safety hazard areas in national parks 24 hours a day by combining measuring equipment such as CCTV, crack gauge, and artificial intelligence. When signs of danger are identified, an alarm is sent to the site where visitors are staying and the control centre in the national park office for follow-up and to prevent the risks in advance. 89 intelligent CCTVs have been installed in 15 national parks since 2020, and 525 automatic and manual crack gauges have been operated in 174 potential rockfall hazard areas of 21 national parks since 2013.
Location:	South Korea
Organisations involved:	Korea National Parks Service



Impacts: In the past, park rangers in the control centre monitored all the signals on the screen to identify danger. However, since the AI-based intelligent devices were introduced, it detects abnormal signals 24 hours a day and automatically send an alarm to the site and the control centre, which is a great help for park rangers to respond to emergencies even in the absence of monitoring staff. Since the introduction of the devices, there have been no casualties due to water play or rockfalls in Korean national parks. Korean National Park Service (KNPS) was awarded the 2020 Prime Minister's Commendation for water safety for these achievements. It is expected that the operation level of the AI-based visitor safety management systems will be improved significantly as data for deep learning is accumulated.

SUCCESS FACTORS:

- 1. AI-based intelligent CCTV
- 2. AI-based crack gauge for rockfall

Inspiring story



When the emergency alarm ring in the control centre, the people who arrive at the site before the 119 are the national park rescue teams. They mobilize several times a day to save someone before they die, and they are willing to go out to protect the visitors even in harsh weather or in situations where their lives are at risk.

Many people were inspired to see them navigating through the wild nature, and in 2021, the drama 'Jirisan' with the motif of the national park rescue team was aired - Jirisan is the first national park in Korea and is certified on the IUCN Green List since 2014.

In the drama, top Korean actors such as Jeon Ji-Hyeon, Ju Ji-hoon, and Seong Dong-il performed the daily life of the national park rescue team, and the beautiful natural scenery became the backdrop for the drama. In the middle of the drama, various safety management systems used by the Korea National Park Service (KNPS) were also introduced, adding to the fun of watching.

Ecosystem threat detection and biodiversity monitoring utilizing acoustic technology



Solution provider:	Todd Hatcher, Rainforest Connection
Type of Tech:	Mix
Summary:	<p>Rainforest Connection (RFCx) has built the connective tissue to make acoustics a scalable worldwide approach to data collection and analysis for conservation. Our platform, including tools for biodiversity analysis and threat detection and a suite of hardware, enables people to understand ecosystem impacts.</p> <p>The RFCx system can be used to:</p> <ul style="list-style-type: none">- Send real-time alerts to people who are able to investigate potential threats.- Find patterns of activity for planned interventions and measure effectiveness of responses.- Accommodate large data sets that can be used for biodiversity monitoring and shared.- Facilitate in-depth, long-term acoustic monitoring.- Evaluate the impacts of different management or conservation activities.- Follow the population dynamics of species over many years.
Location:	Indonesia, Chile, Peru, Philippines, Brazil, Puerto Rico, Romania, Ecuador, Greece, Malaysia and other places
Organisations involved:	Rainforest Connection, Huawei, ARM



Impacts:

- More effective conservation and land management policies and practices
- Education, scientific discovery, and awareness of species presences and biodiversity changes over time, including threatened, vulnerable and endangered species
- A decline in destructive illegal activity in vulnerable ecosystems, including illicit logging, mining, poaching, and land conversion.

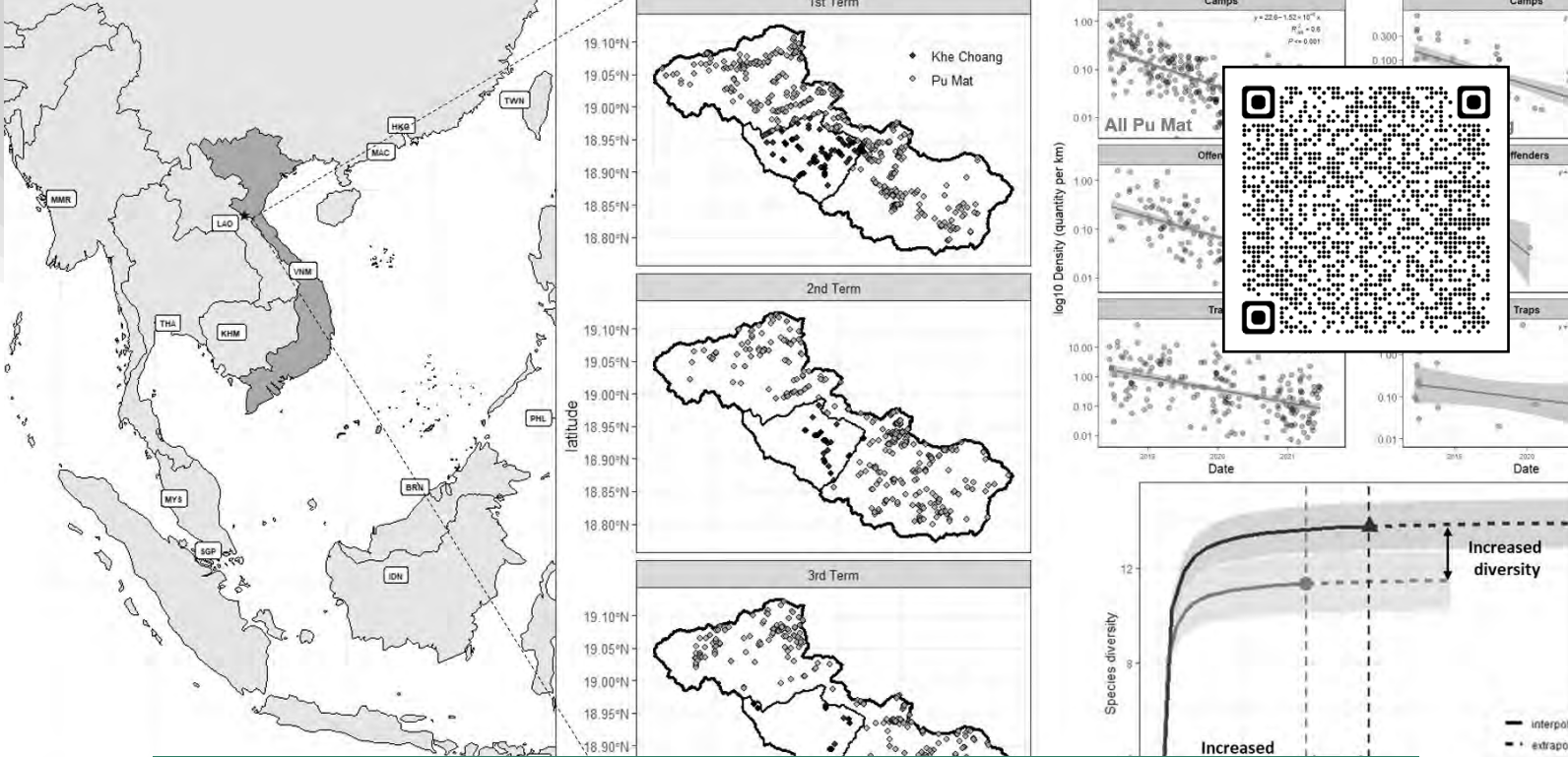
SUCCESS FACTORS:

1. Using Huawei Cloud AI and Tools
2. Applying RFCx Hardware

Intersectoral Collaboration and Conservation Technology Pipelines to Combat Biodiversity Loss in Protected and Conserved Areas of Vietnam



Solution provider:	Russell Gray, Save Vietnam's Wildlife
Type of Tech:	Mix
Summary:	By installing an NGO-based anti-poaching team, and using various anti-poaching technologies in Pu Mat National Park, we were able to effectively maintain spatially explicit records of poaching activities, profiles of offenders, strategically implement automated poaching alert systems, and significantly decreased the number of poachers, traps, and camps within the core zone of the protected area while also substantially mitigating poaching activities throughout the entirety of the park. In doing so, we managed to identify and apply pressure on high-risk poaching areas, create avoidance of poaching in locations where high-priority (Endangered, and Critically Endangered) species were present, maintain a working database of offences and offenders within the protected area to understand more about the social aspects of poaching, and built capacity for all operating rangers in the protected area to use the same methods and technologies themselves.
Location:	Châu Khê, Huyện Con Cuông, Nghệ An, Vietnam
Organisations involved:	Save Vietnam's Wildlife



- Impacts:**
- Illegal firearms confiscated per km travelled in 2018-2019 went from 0.016 to 0.003 in 2019-2020 (79.3% Reduction) to 0.001 from 2020 to the end of 2021 (67.6% Reduction)
 - Traps removed per km travelled in 2018-2019 went from 1.91 to 0.345 in 2019-2020 (81.9% Reduction) to 0.104 from 2020 to the end of 2021 (69.9% Reduction)
 - Illegal encampments removed per km travelled in 2018-2019 went from 0.182 to 0.031 in 2019-2020 (82.9% Reduction) to 0.008 from 2020 to the end of 2021 (74% Reduction)
 - Total number of offenders in the protected area per km travelled went from 0.088 in 2018-2019 to 0.0326 in 2020 (62.9% Reduction) to 0.0075 by the end of 2021 (77% Reduction)
 - For the entire year of 2021 there were zero illegal logging cases recorded in Pu Mat National Park
 - Our successful anti-poaching model is entirely scalable and is now being expanded to four other national parks in Vietnam, with hopes to expand further in the near future.

SUCCESS FACTORS:

1. Anti-poaching team
2. Spatial Reporting and Monitoring Tool (SMART)
3. PoacherCams
4. Systematic Camera Trapping

An innovative automatic location-based real-time alert system to prevent wildlife poisoning using GPS-tagged Griffon vultures has led to better conservation of endangered species in protected areas



Solution provider:	Simon Nemtsov, Israel Nature and Parks Authority
Type of Tech:	Mix
Summary:	<p>Illegal poisoning by disgruntled farmers aiming to kill jackals that supposedly damage crops and livestock is a major threat to wildlife, including Griffon vultures. Poisoned baits are put in carcasses leading to large-scale poisoning events that damage the entire ecosystem. To aid in early detection we innovated an alert system which does automatic analysis in real-time of vultures' location, altitude, body temperature and speed from their GPS-tags. It then does poisoning-likelihood determination whenever the GPS data show behaviour consistent with a vulture descending on a carcass. It then does geo-referencing in poisoning-prone zones and then sends automated Telegram alerts only to relevant regional ranger with exact location. All this in a few seconds, enabling rapid on-the-ground response, preventing potential poisonings. To the best of our knowledge, this the only real-time automatic alert system for finding carcasses based on tagged scavengers operating successfully in the field.</p>
Location:	Israel
Organisations involved:	Israel Nature and Parks Authority



Impacts: Illegal poisoning has caused decline of critically endangered Griffon vultures in recent years. As an important scavenger, preventing their poisoning supports crucial ecosystem services and improves environmental health for wildlife and people, too. Poisoned carcasses harm not only the tagged Griffon vultures but also other threatened species. So, our system has had a very wide positive effect in reducing poisoning events, directly and indirectly through the food chain. The alert system enables fast on-the-ground response and carcass removal. Even when not laced with poison, transferring carcasses from the field to vulture feeding stations reduces food availability to overabundant jackals, reducing their carrying capacity and population size without lethal culling. Reducing jackals lowers human-wildlife conflict and greatly cuts costs of depredation and crop damage. Vultures get the carcasses at controlled sites. This project is a nature-based solution in a literal sense; enabling better management of protected areas based on animals' own behavioural data.

SUCCESS FACTORS:

1. GPS-tagged vultures send out data
2. Advanced loggers receive GPS data
3. Algorithms for likelihood of carcass and need for alert
4. System links to Telegram app for sending alerts to relevant rangers
5. Rangers remove the carcass and deal with poisoning

Tech-enabled fire prevention system to save vital giant panda habitat in tangjiahe national nature reserve (green list) and 165 other important protected area



Solution provider:	CHENG SHUJING, Sichuan Giant Panda Digital Technology Development Co., Ltd
Type of Tech:	Mix
Summary:	Significant conservation impact from technology: the solution uses real-time analysis of satellite images to detect possible fire events. These are rapidly verified and fire events are communicated instantly to rangers in the affected protected areas. Speed is essential. Climate change is making fire more frequent with rapid spreading of events. However there has been a 71% decrease in serious fire events so far in 2021 because of this solution.
Location:	Sichuan, People's Republic of China
Organisations involved:	Sichuan Giant Panda Digital Technology Development Co., Ltd, Huawei, Science and Technology Department of Sichuan Forestry and Grassland Bureau



This is an IUCN Green List certified site



Impacts: Innovation in fire detection for Sichuan and its 166 protected areas. The solution uses satellite image analysis to detect fire events across 8.2 million ha of important habitat for panda. Instant alerts communicated to rangers and who take immediate action. 71% fewer major fire events in 2021 to date.

SUCCESS FACTORS:

- 1. Hot spot CAPTURE module
- 2. Hot spot CHECK module
- 3. FIRE SUBMISSION module

Inspiring story



Five years ago, Wang Jianbo, 31, became an ordinary forest ranger in Huili County, Liangshan Prefecture. Every day, he gets up early in the morning and forms a patrol team with his colleagues. He goes deep into the dense forest until he returns home. They are not only a forest protection team, but also a fire fighting team. On the 80km patrol Road, they not only observe and record the cleaning of natural resources along the way, but also find fire risks and deal with fires, especially in spring every year. The weather in Liangshan is dry and the temperature is high. If you are not careful, a little spark may lead to a surging forest and grassland fire, and the consequences are unimaginable!

In the past, all fire prevention and firefighting work depended on people, and information transmission was often not timely and accurate, so that rear command and front-line operations all depended on experience and luck. In 2021, the forest and grassland fire monitoring immediate reporting system was developed and launched. By creating an integrated digital system of “sky, earth and people”, it has become the intelligent brain and eyes of forest and grassland fire prevention and extinguishing in Sichuan Province.

Like 140000 forest rangers in the province, Wang Jianbo also installed the system on his mobile phone for the first time. In the early morning of March 19, he received a call from the attendant of the fire prevention monitoring centre. The system found that there was a fire hot spot in Hailong village, and asked him to go to verify immediately. Without saying a word, he took the flashlight and mobile phone and hurried out of the door. Because the system has accurately marked the geographical location of the fire hot spot, Wang Jianbo can easily and accurately reach his destination even in such a dark night. Sure enough, there was a fire, but fortunately the fire was not big! He secretly rejoiced, and then shot the on-site video and uploaded it to the system. According to the on-site situation fed back by Wang Jianbo, the headquarters immediately informed the local government to organize a team to fight the fire, and successfully put out the fire before it was white.

With a smile on his tired face, Wang Jianbo said that without this system, the mountains would be completely burned during the day. As a native Liangshan man, he feels honoured to be able to guard the green mountains and grass of his hometown.

Are you looking to develop a technology solution for a conservation challenge?

We hope that these solutions were inspiring enough for you to want to get involved in this space. This is a growing field, where more research, more applications and more results are needed.

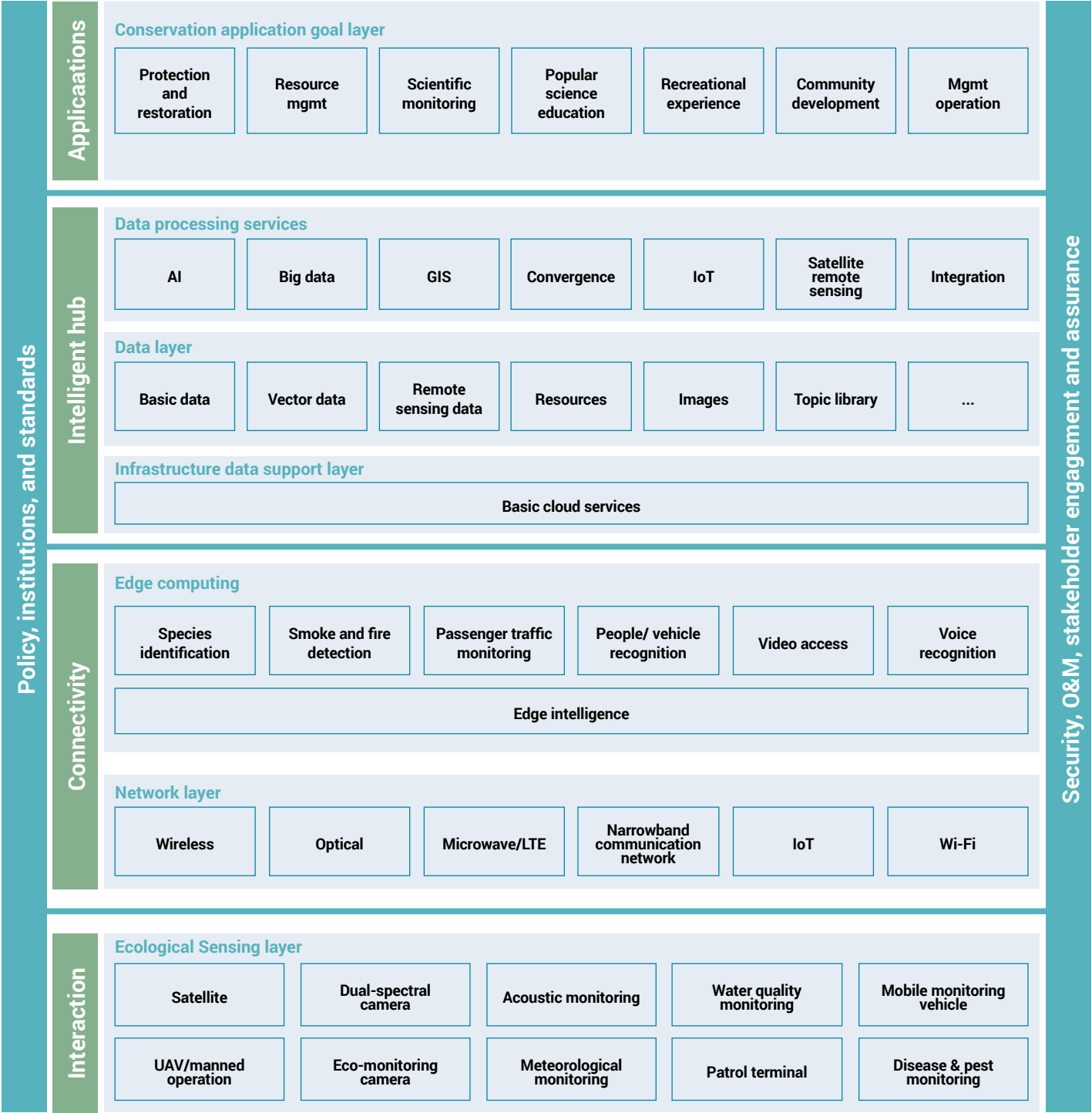
Firstly, it is clear that developing technology solution for conservation impact goes beyond a collection of single smart scenarios. It is an iterative process with lots of considerations to be factored in.

Now, you might be interested in developing a solution for a conservation challenge (we hope you are), so to help guide you some more on this journey, here's a more detailed technical solution architecture and a quick "appropriate" technology checklist, to ensure you're considering all the right technical and social elements when planning, developing and

deploying your tech solution to ensure its success at all stages.

A broad 'tech-for-nature' solution architecture would incorporate "seven horizontal layers and two vertical systems". The seven layers are the ecological sensing layer, network and connectivity layer, edge computing⁶ layer, data layer, infrastructure/ cloud data support layer, data processing platform layer, and the application goal layer. These would be underpinned by two systems, which are: the system of policy, institutions, and standards, and the system of security, operations and maintenance (O&M), stakeholder engagement and assurance. The horizontal layers and vertical systems support each other to achieve trustworthy, controllable, and manageable information systems.

⁶ Edge computing integrates network, computing, and storage capabilities at the edge of the network closer to the data source that have some processing capabilities. It is mainly used for the real-time processing and analysis of local and short-term data. In some remote areas, the network conditions are poor. The time needed to transmit data to the back-end platform impedes the possibility of real-time data processing, this is where edge computing can be particularly useful. It is a supplement to and optimization of cloud computing.



A running theme in this publication was responsible, ethical and appropriate technology. Conservation action and research stands to gain a lot and there is a big focus on different monitoring tools. For instance, camera traps are one of the most widely used technologies for species monitoring, social media enhances communications, connectedness and collaboration. This type of conservation surveillance technology (CSTs) can collect data on people, whether by mistake or design depending on purpose⁷. Which can result in positive impacts, as we saw with the surveillance improving safe access to the protected areas, but it can also have negative impact if data privacy is not protected.

Through the Tech4Nature project, the use of the IUCN Green List Global Standard ensures proportionality and “appropriateness” of the solutions deployed in the different flagship areas where customised technology solutions were developed. Taking inspiration from the principles of Standard for a wider application of “appropriate” technology in, around or outside protected areas, we created an easy 10-step checklist as a quick guide for you for things to consider when developing and implementing your technology solution.

- ☒ Specify the conservation goal you want to achieve and what kind of technology would help achieve it
- ☒ Identify how the technology your using impacts people
- ☒ Identify the different kinds of data it will collect
- ☒ Be an advocate for transparency. Evaluate your solution with the different stakeholders, engage local communities and indigenous peoples, share complete information to achieve consensus on whether the solution is appropriate and proportionate to the conservation goal or not
- ☒ Identify suitable measures to ensure data privacy and analyse potential risks
- ☒ Clarify how the data is going to be measured, used and governed and ensure it follows local laws and regulation
- ☒ Ensure proper communications with different stakeholders throughout the development and implementation of your solution. The more they are involved and engaged from the beginning, the more likely the solution to be successful
- ☒ Identify if you and your team have capacity to deploy, run and maintain the technology. Identify the gaps needed and seek training to improve its operations and management
- ☒ Share results and successes and see how to use them to foster more collaboration and seek more partnerships.
- ☒ Evaluate your results, take note of what worked and what needs to be improved and start again

Have you successfully implemented a technology solution for conservation impact? Don't hesitate to upload it to the [PANORAMA platform!](https://www.panorama.solutions)

www.panorama.solutions

⁷ Sandbrook, C, Clark, D, Toivonen, T, et al. Principles for the socially responsible use of conservation monitoring technology and data. Conservation Science and Practice. 2021; 3:e374. <https://doi.org/10.1111/csp2.374>



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