Applicant: **Traill, Lochran**
Organisation: **University of Leeds**
Funding Sought: **£0.00**

DIR31IN\1205

AI-enabled camera systems to mitigate human wildlife conflict in Zimbabwe

Human wildlife conflict (HWC) is an ongoing problem where human communities live alongside wildlife in Zimbabwe. These already marginalised villagers regularly lose crops and livestock to wild animals. Innovative approaches that reduce the impacts of HWC may be welcome in this context. We will develop/test innovative, off-the-grid camera systems that have built-in machine learning to identify multiple 'problem wildlife' species, and deter conflict through real-time warning messages, and real-time audio/visual repellers. Stakeholders will co-develop field experiments in south-eastern Zimbabwe.

PRIMARY APPLICANT DETAILS

Title	Dr
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Surname	Traill
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Address	[redacted]

OTHER DETAILS

Title	Mrs
Name	Vicky
Surname	Normington
Organisation	University of Leeds
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Email (Work)	[redacted]
Address	[redacted]

Title	Mr
Name	John
Surname	Carney
Organisation	University of Leeds
Tel	**N/A (tel:N/A)**
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Address	[redacted]

DIR31IN\1205

AI-enabled camera systems to mitigate human wildlife conflict in Zimbabwe

Section 1 - Contact Details

PRIMARY APPLICANT DETAILS

Title	Dr
Name	Lochran
Surname	Traill
Organisation	University of Leeds
Tel (Work)	[redacted]
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Address	[redacted]

OTHER DETAILS

Title	Mrs
Name	Vicky
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Organisation	University of Leeds
Tel (Work)	NA
Email (Work)	[redacted]
Address	[redacted]

Title	Mr
Name	John
Surname	Carney
Organisation	University of Leeds
Tel	N/A
Email (Work)	[redacted]
Address	[redacted]

GMS ORGANISATION

Type	Other
Name	University of Leeds
Phone (Work)	
Email	
Address	

Type	Organisation
Name	University of Leeds

Section 2 - Project Summary, Ecosystems, Approaches and Threats

Q3. Project Title

AI-enabled camera systems to mitigate human wildlife conflict in Zimbabwe

Please attach a cover letter as a PDF document.

cover.letter.darwin
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pdf 97.97 KB

Q4a. Is this a resubmission of a previously unsuccessful application?

⊙ No

Q5. Key Ecosystems, Approaches and Threats

Please select up to 3 biomes that are of focus, up to 3 conservation actions that characterise your approach, and up to 3 threats to biodiversity you intend to address, from dropdown lists.

Biome 1

Savannas and grasslands

Biome 2

Intensive land-use systems

Biome 3

No Response

Conservation Action 1

Livelihood, Economic & Moral Incentives

Conservation Action 2

Species Management

Conservation Action 3

Research & Monitoring

Threat 1
Agriculture & aquaculture (incl. plantations)
Threat 2
Biological resource use (hunting, gathering, logging, fishing)
Threat 3
Other threats

Q6. Summary of project

Please provide a brief non-technical summary of your project: the problem/need it is trying to address, its aims, and the key activities you plan on undertaking.

Human wildlife conflict (HWC) is an ongoing problem where human communities live alongside wildlife in Zimbabwe. These already marginalised villagers regularly lose crops and livestock to wild animals. Innovative approaches that reduce the impacts of HWC may be welcome in this context. We will develop/test innovative, off-the-grid camera systems that have built-in machine learning to identify multiple 'problem wildlife' species, and deter conflict through real-time warning messages, and real-time audio/visual repellers. Stakeholders will co-develop field experiments in south-eastern Zimbabwe.

Section 3 - Dates & Budget Summary

Q7. Country(ies)

Which eligible country(ies) will your project be working in?

Country 1	Zimbabwe	**Country 2**	*No Response*
Country 3	*No Response*	**Country 4**	*No Response*

Do you require more fields?

⦿ No

Q8. Project dates

Start date:	End date:	Duration (e.g. 1 year, 8 months):
01 April 2025	31 March 2027	2 years

Q9. Budget Summary

Darwin Initiative Funding Request	2025/26	2026/27	Total request

(1 Apr - 31 Mar) £	£116,063.00	£80,309.00	196,372.00

Q10. Do you have proposed matched funding arrangements?

⊙ Yes

Please ensure you clearly outline your matched funding arrangement in the budget.

Q11. If you have a significant amount of unconfirmed matched funding, please clarify how you will fund the project if you don't manage to secure this?

No Response

Q12. Have you received, applied for, or plan to apply for any other UK Government funding for your proposed project or a similar project?

⊙ No

Section 4 - Darwin Objectives and Conventions

Q13. Problem the project is trying to address

Please describe the problem your project is trying to address in terms of biodiversity and its relationship with multi-dimensional poverty.

Human wildlife conflict (HWC) is a challenge in Africa. HWC is defined here as the situation where wild animals pose a direct threat to human life and livelihood, and as a consequence of that, those wild animals may be persecuted or killed. Conservation scientists have a duty to their fellow human beings, and to wildlife species, and so they (biologists) need effective and cost-efficient approaches that mitigate HWC.

African people living alongside Protected Areas (PAs), may incur substantial costs because of wildlife conservation, and typically see very few benefits [1]. Costs include the loss of life or injury, or the loss of family income if a breadwinner is killed or injured through HWC [2]. Or families may lose income through employment when adults are forced to guard crops or livestock instead of working [3]. Children may fall behind in school if they spend the night guarding crops [3]. Further costs include loss of valuable food crops or livestock, and opportunity costs.

In southern Africa, HWC may occur in regions where paradoxically, conservationists focus much of their effort; namely transfrontier conservation areas. A key component of transfrontier conservation is the facilitation of corridors, allowing wildlife migration. But the encouragement of wildlife dispersal invariably brings about conflict between wildlife and the resident marginalised human communities.

One such example is the Great Limpopo Transfrontier Park (GLTP), where wildlife corridors are encouraged between Gonarezhou National Park (Zimbabwe), Limpopo National Park (Mozambique) and Kruger National Park (South Africa) - see attached map. But the concerns of subsistence farmers living in these corridors, such as the Sengwe region in Zimbabwe have to an extent, been overlooked [4,5]. These communities, and indeed all rural communities that border Gonarezhou NP incur losses through ongoing HWC [6].

Eviction of people from wildlife corridors, or from communal lands bordering National Parks is not an option, so the challenge is quite simply; how do conservationists promote the welfare of already marginalised human communities in the region and facilitate wildlife conservation at the same time?

Community based conservation schemes, and compensation schemes do exist in the Sengwe corridor, and other communal lands bordering GNP [6] - some are CAMPFIRE areas. But there is a need for innovative approaches that may help villagers, and wildlife authorities detect or deter wild animals that may raid crops or livestock.

There has been no effort in the areas affected by HWC outside of GNP (or the GLTP) to trial Artificial Intelligence (AI) enabled technology that detects possible problem animals, and to deter those animals - in real time [see 7]. The applicants have been encouraged by collaborators in GNP to test AI-enabled systems in areas outside the park where multiple species are involved in HWC, in particular new off-the-grid technology developed by project partners.

The project is core to the Zimbabwe National Biodiversity Strategies and Action Plan, which details the need for technology transfer through 'expertise locally and in the global biodiversity fraternity …'.

Q14. Biodiversity Conventions, Treaties and Agreements

Q14a. Your project must support the commitments of one or more of the agreements listed below. Please indicate which agreement(s) will be supported.

- ☑ Convention on Biological Diversity (CBD)
- ☑ Global Goals for Sustainable Development (SDGs)

Q14b. National and International Policy Alignment

Using evidence where available, please detail how your project will contribute to national policy (including NBSAPs, NDCs, NAPs etc.) and in turn international biodiversity and development conventions, treaties and agreements that the country is a signatory of.

One aspect of our project is the transfer of leading technology and expertise to stakeholders in Zimbabwe. Access to technology, and the transfer of that technology is important to the goals of the UN CBD, which Zimbabwe has ratified. Indeed, the convention explicitly encourages the 'sharing of information and cooperation in technology development and transfer among countries and with …, indigenous and local communities, research institutions and NGOs.'

Under the UN CBD, the Zimbabwe NBSAP emphasises technology transfer, and mitigation of wildlife conflict, and thus species' conservation and human upliftment.

Regards technology, the Zimbabwe NBSAP highlights the strategic use of technology to conserve biological diversity, and capacity building around innovative technology. Indeed, the preamble to the Zimbabwe NBSAP states the need for 'research, technology, and innovations … to protect the environment, conserve and sustainably use biodiversity and ecosystems …'. The Zimbabwe NBSAP moreover specifies the need for technology transfer through 'expertise locally and in the global biodiversity fraternity …', and emphasises capacity building.

The Zimbabwe NBSAP further lists, as a strategic objectives; 1) the need to understand and address the drivers of biodiversity loss across the country, 2) a reduction of direct pressures on biodiversity, and 3) community empowerment. One driver of species' range retraction and loss in Zimbabwe is retributive killing following conflict, and large mammals are particularly vulnerable to this. The mitigation of conflict is a core NBSAP objective that reduces direct pressure on wildlife species, and benefits human welfare. By prioritising capacity building and technology transfer through this project, we will further empower communities to manage wildlife

on their own terms.

Our project is further relevant to Global Goals for Sustainable Development (notably life on land and life below water), and our work feeds directly into the HWC mitigation goals.

Section 5 - Method, Innovation, Capability & Capacity

Q15. Methodology

Describe the methods and approach you will use to achieve your intended Outcome and contribute towards your Impact. Provide information on:

- **how you have reflected on and incorporated evidence and lessons learnt from past and present similar activities and projects in the design of this project.**
- **the specific approach you are using, supported by evidence that it will be effective, and justifying why you expect it will be successful in this context.**
- **how you will undertake the work (activities, materials and methods).**
- **what the main activities will be and where these will take place.**
- **how you will manage the work (governance, roles and responsibilities, project management tools, risks etc.).**

Here we propose a programme that co-develops (with communities) the field testing of AI-enabled camera systems that detect multiple wildlife species that may cause wildlife conflict (and provide real-time alert messages, and real-time audio/visual repellers). The technology is innovative. Communities and other stakeholders will be engaged throughout, and training provided.

The use of machine learning within conservation is not new, but real time alerts, and an off-the-grid system to detect multiple species is novel. Moreover, the application in Zimbabwean conservation is novel. The project will run over 24 months and will consist of four phases:

Phase 1 (Year 1). Machine learning (ML) models will be trained to identify the multiple wildlife species involved in wildlife conflict in the study area (elephant, leopard, lion, hyaena etc). This will be done through project partners in the Netherlands, and will include a field component, whereby off-the-shelf camera traps are placed in Gonarezhou National Park (GNP), and the Sengwe region to obtain images of wild animals, and dominant habitats typical which will be used to validate the models. ML models will be tested for false-positive/false-negative identification of species, based on images sourced on site. This phase includes employment of Zimbabwean consultant, and securing research and ethics permits. Communities and all stakeholders engaged.

Phase 2 (Year 1). Here 10-20 AI-enabled cameras, configured to identify 'problem animals' will be field tested in GNP and at boundary communal lands. Testing will include ML models in the field, and animal response to audio repellers configured to AI-cameras (from images on cameras). Communities will advise on practical issues, such as camera height above ground, aspect, artificial structures etc. Community surveys will identify core HWC areas, and methods in place to mitigate conflict. Training of staff and community members initiated.

Phase 3 (Year 2). Testing of AI-enabled camera systems in (pre-selected) communal lands neighbouring GNP, working with communities. Peak conflict months with crop raiders are January-June. Images on problem animal response to repellents analysed. Effectiveness of early warning messages tested. Social surveys and workshops run to help interpret initial findings.

Phase 4 (Year 2). Continued data collection, with trials on 'phased distance' of AI-enabled camera/repeller systems to crops. Stakeholder engagement and social survey on project findings, for example on benefits/pitfalls of AI-camera systems compared to in-person guarding of crops (and other approaches used). Closing workshops on key findings. Full training completed. Targeted placement of camera systems in communities working with

community leaders.

A phased approach allows for problem solving interventions to occur before the technology is rolled out. And this also allows for communities to be involved at all steps.

Lead Applicant oversee the project, apply for permits, manage the budget, travel to field sites (every quarter) and engage in M&E. Gonarezhou Conservation Trust will facilitate consultant fieldwork and support community engagement. Social scientist at Witwatersrand University will advise on community engagement and surveys. Toledo Zoo will provide education material. Technology partners will co-develop all methods, assist with field set-up and lead training. Sapienza Museum Network will match funds.

Q16. Innovation

Please specifically outline how your approach or project is innovative.

Is it the application of a proven approach in a distinctly different geography/issue/stakeholder (novel to the area), or in a different sector (novel to the sector), or an unproven approach in any sector (novel to the world)?

The project is innovative, because off-the-grid AI-enabled camera systems that allow real time alerts and repellers have not been tested in these settings.

The camera systems here are different to AI algorithms of camera traps images, such as through Mbaza AI, which identify species from images uploaded from field cameras. Our camera system includes an embedded micro-computer that retrieves and identifies species-of-interest via an AI-algorithm – in the field and in real-time. Where a detected animal is a species that may be a crop raider, for example, then the camera systems can then either alert villagers, or trigger an audio or visual repeller. Our project is innovative too because we will co-develop system set up and rollout with communities, adapting to their feedback. And our project is innovative because it applies to multiple wildlife species (that may raid crops or kill livestock).

The project partners (HtP) have played a leading role in bringing AI-enabled technology to conservation [see 1]. The Zimbabwe based consultant, and the lead applicant have track records in mammal conservation in Africa. Project staff are experts in community based conservation. The project will build on community outreach programmes already in place through Gonarezhou Conservation Trust.

The approach is certainly novel to the Zimbabwean conservation effort. Other than capacity building, our project will generate substantial interest within Zimbabwe and facilitate uptake. We feel that this technology is inevitable in African community based conservation, and we are assisting that process.

Q17. Capability and Capacity

How will the project support the strengthening of capability and capacity of identified local and national partners, and stakeholders during its lifetime at organisational or individual levels? Please provide details of what form this will take, who will benefit (noting any Gender Equality and Social Inclusion (GESI) considerations), and the post-project value to the country.

While a principal aim of our project is proof-of-concept regards the usefulness of AI-enabled technology to mitigate HWC (which can be scaled across Africa), an overall objective is the development of on-the-ground capacity in the GLTP. Ultimately, we want to develop the technical capacity and uptake in remote regions for the monitoring of 'problem wildlife', and the real-time prevention of conflict between those animals and rural farmers. Our project will train personnel at Gonarezhou National Park, and in the Chiredzi District of the CAMPFIRE programme (includes Sengwe Communal Lands). We will work through Community Extension Officers based at GNP to identify key personnel within the CAMPFIRE regions, and we will target 50/50 gender splits for training. The consultant has experience working in CAMPFIRE regions.

Our partner field consultant, GNP field staff, CAMPFIRE representatives (and villagers) will be trained at all steps of the AI-camera system process, from field set up and monitoring to data interpretation. Their feedback - and those of villagers affected by HWC - will be incorporated to facilitate post-project continuity.

We plan to establish a working group on conservation technology in Zimbabwe (the lead applicant has pioneered this for hippopotamus in Zimbabwe). That will compliment workshops that we hope to run in the GLTP region (and at the University of Zimbabwe and Dept of National Parks and Wildlife Management), which will raise awareness and uptake. We also plan regional knowledge sharing.

If necessary, please provide supporting documentation e.g. maps, diagrams, references etc., as a PDF using the File Upload below:

References.map
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pdf 171.41 KB

Section 6 - GESI, Awareness, Change Expected & Exit Strategy

Q18. Gender Equality and Social Inclusion (GESI)

All applicants must consider whether and how their project will contribute to promoting equality between persons of different gender and social characteristics. Please include reference to the GESI context in which your project seeks to work. Explain your understanding of how individuals may be disadvantaged or excluded from equal participation within the context of your project, and how you seek to address this. You should consider how your project will proactively contribute to ensuring individuals achieve equitable outcomes and how you will ensure meaningful participation for all those engaged.

The University of Leeds is committed to equality of opportunity for all people, regardless of gender or background. Our work explicitly aims to improve knowledge and capacity in a developing nation, and we do not anticipate that our work will increase gender inequality.

We are mindful of more traditional societal roles in rural parts of Zimbabwe, and we will work toward mitigating this through 50/50 split participation in workshops and training where possible. We will further encourage participation across all age, and ethnic groups.

Also, we will ensure that stakeholder engagement around system set up and roll out, maintains gender equity. This will ensure that all people and views are represented, and that is full and equal access to information around our project, and AI-enabled technology more generally.

We are aware of work done in Zimbabwean communal lands that show some differences in views (by gender) on resource management (Sundstrom et al 2020, Conservation Letters), and we will ensure equity in community outreach to account for those differences. We are also aware that stakeholder engagement (that accounts for gender) may facilitate training or employment opportunities for women that may not have been available to them otherwise (Nabane and Matzke 1997 Society and Natural Resources). We will be mindful of that and will ensure 50/50 splits in stakeholder outreach, and training.

Q19. Change expected

Detail the expected changes and benefits to both biodiversity and multi-dimensional poverty reduction, and links between them, that this work will deliver. You should identify what will change and who exactly will benefit a) in the short-term (i.e. during the lifetime of the project) and b) in the long-term (after the project has ended).

Short term change

A proof-of-concept trial of a novel technology in a remote, rugged landscape typical to conservation in southern Africa. This will build on the advances already made by the project partners in AI-enabled camera systems across Africa. This will involve stakeholders as co-developers.

A test of the efficacy of AI-enabled camera systems in identifying species-of-interest across various landscapes in the GLTP, accounting for diel, and the likelihood of false-positive/false-negative identifications.

Trial the robustness of AI-enabled camera systems in a National Park and surrounding Communal Lands. This includes for example possible damage by elephant or primates. Stakeholders will be included.

Raised awareness of AI conservation technology in Zimbabwe. This will be done by knowledge-sharing through the AI conservation technology network that we will initiate, and results of our field trials will be published and circulated through regional networks. These networks will include all stakeholders, including remote communities who may be left out of recent advances in technology. Through workshops, people from these communities may further express concerns or preferences re the application of such technology.

Capacity building through training of field technicians in GNP and rural district council members in neighbouring CAMPFIRE areas, mostly the Sengwe Communal Lands.

Short term capacity for regional practitioners to use AI-enabled camera systems, and to repel 'problem animals' in real time through audio or visual repellers, or through early warning text messages to wildlife authorities or villagers.

Local capacity developed through working with Zimbabwean consultant, who will help run the field programme, and will receive training on all aspects of AI-enabled technology.

Long term change

Long term local capacity and knowledge around AI-enabled conservation technology.

Possible increased uptake of AI-enabled technology across Zimbabwe, and maybe across southern Africa where wildlife comes into conflict with people through crop raiding or the killing of livestock. This uptake will facilitate further 'lessons learned' on the usefulness of AI-enabled technology in the encouraging of human wildlife coexistence.

Increased capacity across the GLTP, in particular in the Zimbabwe region of the GLTP.

Increased local capacity to opportunistically use AI-camera systems to monitor wildlife species that may be of interest for other reasons. For example the technology may be used to monitor endangered or cryptic species, both within National Parks, and across conservation corridors.

Q20. Pathway to change

Please outline your project's expected pathway to change. This should be an overview of the overall project logic and outline <u>why and how</u> you expect your Outputs to contribute towards your overall Outcome and, in the longer term, your expected Impact.

Our pathway and theory of change is simple and as follows:

1) If an effective, robust and affordable approach to mitigating wildlife conflict in remote conservation areas in Africa can be achieved through AI-enabled cameras (and co-developed with villagers), and

2) If AI-enabled technology works as either an early warning system, or an effective repellent (through audio or visual signals triggered by AI-cameras), and
3) If that technology either complements existing direct methods to prevent conflict, such as crop guarding, bomas or bonfires, or even it surpasses established approaches, then
4) we imagine that there will be uptake of AI-enabled camera systems as one approach to prevent or lessen the impacts of crop raiding and livestock killing by wildlife. And
5) we imagine then that of AI-enabled camera systems and repellers will make a contribution toward African conservation and human welfare, as other approaches have, in their small ways.

We anticipate that our work will be of great interest to African conservation scientists broadly, and within the GLTP. Our work may also be useful to practitioners working within community based conservation schemes across Africa, in particular people working to mitigate wildlife conflict.

Q21. Sustainable benefits and scaling potential

Q21a. How will the project reach a point where benefits can be sustained post-funding? How will the required knowledge and skills remain available to sustain the benefits? How will you ensure your data and evidence will be accessible to others?

We anticipate that the awareness raised through our project, as well as the training and workshops will facilitate ongoing work around AI-enabled camera systems. We will also work with experts at Toledo Zoo in the United States to develop education material for the project.

Moreover, the local and regional collaborations built will facilitate ongoing research and roll-out around AI-based conservation technology. We recognise that Zimbabwe may lack some capacity around AI-technology at present, but we do feel that our work will at the very least raise awareness on this lack of capacity, and prompt both Universities and conservation organisations to increase local capacity.

Our ML models will be made open-source, and all camera systems left in the region to allow ongoing work.

Moreover, all findings will be published (in the peer reviewed literature and popular science articles), and the lessons learned can be scaled across the region.

Q21b. If your approach works, what potential is there for scaling the approach further? Refer to Scalable Approaches (Landscape, Replication, System Change, Capacitation) in the guidance. What might prevent scaling, and how could this be addressed?

Our proposed project faces many challenges, but we feel that the use of AI-enabled technology is inevitable in African conservation. And the challenges faced by conservation scientists in Zimbabwe are typical to the challenges across much of sub-Saharan Africa. It is for those reasons that our project has potential.

We will grapple with the challenges of working in remote conservation areas, and the methods that we develop will be scalable across Africa, including within transfrontier conservations areas. The lessons that we learn, and the approaches that we disseminate may be applied by conservationists in different regions, with different conservation challenges.

Our work will in particular have capacity scaling, in that we will work hard to raise awareness of the lack of AI-technology and know-how in many southern African states, and the need to increase that through technology acquisition and further training, such as at Zimbabwean Universities.

Section 7 - Risk Management

Q22. Risk Management

Please outline the 7 key risks to achievement of your Project Outcome and how these risks will be managed and mitigated, referring to the Risk Guidance. This should include at least one Fiduciary, two Safeguarding, and one Delivery Chain Risk.

Risk Description	Impact	Prob.	Gross Risk	Mitigation	Residual Risk
Fiduciary (financial): funds not used for intended purposes or not accounted for (fraud, corruption, mishandling or misappropriated). There is some risk that funds may not be used for purposes outlined in the proposal.	minor	unlikely	moderate	Leeds University has strict auditing in place, and vendors for payment will be checked. Partners also have strict auditing in place. Payment will only be to GCT, the consultant and HtP.	moderate
Safeguarding: risk of sexual exploitation abuse and harassment (SEAH), or unintended harm to beneficiaries, the public, implementing partners, and staff. Unlikely that field work will cause unintended harm. Field consultant employed through project vetted, and training will occur. All policies made clear to staff and collaborators, Gonarezhou Trust has own policies on these matters, as does Hack the Planet (Netherlands).	moderate	unlikely	moderate	Leeds University has strict policies in place re exploitation, and human welfare. Consultant will receive training on safeguarding. All field work will go through required ethics protocols.	moderate
Safeguarding: risks to health, safety and security (HSS) of beneficiaries, the public. Implementing partners, and staff. All possible risks outlined for risk assessment. Consultant fully trained. Partners made aware of all possible risks at outset.	moderate	unlikely	major	All personnel have African field experience. Lead applicant and consultant have extensive experience in Zimbabwe. Rangers will accompany staff in the field. All risk assessment before travel.	moderate

Delivery Chain: the overall risk associated with your delivery model. Risk to field sampling material (cameras) through theft, animal damage, fire or high winds.	moderate	possible	moderate	Part of our 'proof of concept' field approach is the documentation of damage to cameras and the mitigation of this through various approaches. Our findings will be published.	moderate
Risk 5 Political unrest risk.	minor	unlikely	moderate	This is beyond our control, and the risk is low as general elections do not occur in Zimbabwe again until 2028. Zimbabwe is a relatively peaceful country and crime rates are low.	moderate
Risk 6 Permit permission risks.	minor	unlikely	major	There is minor risk that a permit through the Zimbabwe Research Council will not be provided. But the risk is low and Gonarezhou Conservation Trust will assist with the process.	moderate
Risk 7 Support withdrawal. Minor risk that partner (Gonarezhou Conservation Trust) may withdraw support.	moderate	unlikely	moderate	This is unlikely, but as a mitigation, the lead applicant will alert other conservation NGOs in the region to the project, with possible transfer of project and equipment if required.	moderate

Q23. Project sensitivities

Please indicate whether there are sensitivities associated with this project that need to be considered if details are published (detailed species location data that would increase threats, political sensitivities, prosecutions for illegal activities, security of staff etc.).

⦿ Yes

Please provide brief details.

When testing cameras in Gonarezhou National Park, there is risk that images of black rhinoceros (Diceros bicornis) may form part of the data. Black rhino have been re-released to the Park, and reside within an Intensive Protection Zone. These camera images will be incidental and will not be published. These will be required for ML model training, but no images will be published and the species will not be mentioned in papers published. There is knowledge within Zimbabwe of the presence of black rhino in the Park, but we will delete any data that provide information on animal location.

Section 8 - Workplan

Q24. Workplan

Provide a project workplan that shows the key milestones in project activities.

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Section 9 - Monitoring and Evaluation

Q25. Monitoring and evaluation (M&E)

Describe how the performance of the project will be monitored and evaluated, making reference to who is responsible for the project's M&E. How will the project robustly evaluate the innovation to support its future application?

Our work is to some extent, proof-of-concept. The rationale behind our work is that if we can develop a field-based approach to mitigating wildlife conflict (or at least reducing the amount of conflict) through AI-enabled camera systems in a remote conservation area in Zimbabwe, and if our system is robust (after testing), and all stakeholders approve, then AI-enabled camera systems may be scalable across other transfrontier conservation areas in southern Africa.

Our field approach will be structured as four phases, with each phase being evaluated on conclusion, and before progression to the next phase. So, M&E is built into the project at each of the phases of the project. These are:

Phase 1 includes the training of machine learning (ML) models and validation. This will be done working with collaborators in the Netherlands (Hack the Planet). While some this will be done online, the field component will include the use of off-the-shelf camera traps placed in Gonarezhou National Park (GNP), and the Sengwe region to obtain images of wild animals and livestock typical to the region. This stage will also include employment of a Zimbabwean consultant, securing research and ethics permits, community outreach and stakeholder engagement. The lead applicant will review outcomes here. Once concluded, this will feed into the next phase:

Phase 2 includes the testing of AI-enabled cameras, configured to identify 'problem animals' in the field. This will mostly be done in GNP and bordering communal lands. Community feedback will be taken into account, and training will occur. The lead applicant, and collaborators will visit the field sites and evaluate project progress. On conclusion of satisfactory progress, the project will continue onto the next phase:

Phase 3 involves targeted testing of AI-enabled camera systems in communal lands. This will be done in consultation with the community outreach officer at GCT, with community leaders and villagers. Community interviews will occur and animal response to repellents analysed. The lead applicant will visit the sites over this period, and work closely with project partners and the consultant The success of this phase will influence possible long-term uptake of the technology in these regions, and community interviews and feedback will be part of Phase 4. So this Phase will merge into Phase 4, and monitoring and evaluation will be embedded into Phase 3 will enable long term uptake.

Total project budget for M&E (£) **(this may include Staff and Travel and Subsistence Costs)**	[redacted]
Total project budget for M&E (%) **(this may include Staff and Travel and Subsistence Costs)**	[redacted]
Number of days planned for M&E	[redacted]

Section 10 - Logical Framework & Standard Indicators

Q26a. Logical Framework (logframe)

Darwin Initiative projects will be required to monitor and report against their progress towards their Outputs and Outcome. This section sets out the expected Outputs and Outcome of your project, how you expect to measure progress against these and how we can verify this.

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Impact:

AI-enabled camera systems can help villagers in Zimbabwe mitigate conflict with wildlife. This has scaling potential across the region.

Outcome:

Off the grid, AI-enabled camera systems are being used to detect, deter and warn villagers in communities bordering Gonarezhou NP about wildlife that may bring about conflict.

Project Outputs
Output 1: Techniques established for AI-enabled detection and deterrence of 'problem animals' in communal areas neighbouring Protected Areas. This includes the Sengwe corridor of the Great Limpopo Transfrontier Park (GLTP).
Output 2: Capacity building on AI-enabled camera systems in Zimbabwe and the GLTP.
Output 3: Off the grid, AI-enabled camera systems with early warning, or repeller ability are demonstrated to be an effective tool to warn villagers about 'problem animals', and/or deter problem animals.
Output 4: *No Response*
Output 5: *No Response*

Do you require more Output fields?
It is advised to have less than 6 Outputs since this level of detail can be provided at the activity level.

⦿ No

Activities

Each activity is numbered according to the Output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1.

1.1 Community and stakeholder outreach on needs re HWC mitigation
1.2 Machine Learning models trained to identify species involved in HWC in the Sengwe corridor and other communal lands bordering GNP
1.3 Images from commercial camera traps across GNP used to validate ML model identification of key problem animals, testing for false-positive and false-negative id.
1.4 Community and stakeholder outreach and feedback on camera system and repeller set up
1.5 Configuration of AI enabled camera to detect problem animals and send early warning message in real time
1.6 Configuration of AI enabled camera to detect problem animals and trigger audio and/or visual repeller
1.7 Testing in the field of optimal height, aspect etc of camera trap system, with stakeholder feedback
1.8 Testing of AI camera capacity to detect problem animals in the field (within GNP)
1.9 Tests of the response of problem animals to repellers – based on real time recorded images of these events (within GNP)
1.10 Roll out of camera systems in pre-identified villages where HWC occurs, with stakeholder involvement
1.11 Data collection through images recorded to test for problem animal response
1.12 Social surveys of villagers (with gender parity) to record views on the effectiveness of approach versus in-place approaches (such as bomas)
1.13 Documentation of all costs involved, and on all findings
1.14 Results made public through workshops in the Sengwe region and other communal lands
1.15 Results made public more broadly through workshops in Zimbabwe, and through publication of research papers

2.1 Working group on AI-based technology established in Zimbabwe
2.2 Zimbabwean consultant trained in all aspects of AI-enabled camera systems and repellers
2.3 Training of GNP staff and CAMPFIRE staff on AI-camera system use, with gender parity

3.1 Stakeholders across communities made aware of the results of the project and implications (and feedback sought)
3.2 Workshops in the GLTP, at Zim Parks headquarters and University of Zimbabwe to make all stakeholders aware of the technology, and project findings
3.3 All ML models made open source, and reports and papers published on findings and community perspectives

Q26b. Standard Indicators

Standard Indicator Ref & Wording	Project Output or Outcome this links to	Target number by project end	Provide disaggregated targets here
e.g. DI-A01: Number of people in eligible countries who have completed structured and relevant training	**e.g. Output indicator 3.4 / Output 3**	**e.g. 60**	**e.g. 30 non-indigenous women; 30 non-indigenous men**
DI-A01: Number of people in eligible countries who have completed structured and relevant training	output 2 / indicators 2.1 and 2.2	20	10 indigenous women, 10 indigenous men

DI-A03: Number of local or national organisations with enhanced capability and capacity	output 2	5	Includes indigenous male and female representatives
DI-C01: Number of best practice guides and knowledge products published and endorsed	output 3	10	Target audiences principally indigenous
DI-C10: Number of decision-makers attending briefing events	output 1 / indicators 1.5, 1.7, 1.8, 1.9	25-50	Almost all indigenous, with effort at gender parity
DI-D03a: Number of people with Sustainable Livelihoods created or protected	output 1 / indicator 1.4	Potentially over 50	All indigenous
DI-D04a: Number of people with improved food security	output 1 / indicator 1.4	Potentially over 50	All indigenous
DI-A04: Number of people reporting that they are applying new capabilities 6+ months after training	output 2	20+	10 indigenous women, 10 indigenous men+
DI-D04e: Number of people with improved security	output 1 / indicator 1.4	Potentially over 50	All indigenous
No Response	*No Response*	*No Response*	*No Response*
No Response	*No Response*	*No Response*	*No Response*
No Response	*No Response*	*No Response*	*No Response*
No Response	*No Response*	*No Response*	*No Response*
No Response	*No Response*	*No Response*	*No Response*

If you cannot identify three Standard Indicators you can report against, please justify this here.

Not applicable

Section 11 - Budget and Funding

Q27. Budget

Please complete the appropriate Excel spreadsheet, which provides the Budget for this application. Some of the questions earlier and below refer to the information in this spreadsheet.

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18/10/2024
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Q28. Alignment with other funding and activities

This question aims to help us understand how familiar you are with other work in the geographic/thematic area, and how this proposed project will build on or align with this to avoid any risks of duplicating or conflicting activities.

Q28a. Is this new work or does it build on existing/past activities (delivered by anyone and funded through any source)?

⦿ Development of existing/past activities

Please give details.

The work does build on an existing project, undertaken by the lead applicant and project partners; using technology in hippo conservation. That work is underway as a pilot study (until end 2025), and does include ML recognition of hippo. The pilot project is partly funded by Toledo Zoo, which will provide in-kind support to this project.

There is no overlap here because human hippo conflict is insignificant in the study area, and the existing hippo project does not engage with human conflict, or work outside the National Park. The hippo project generated discussions around HWC with Gonarezhou Trust, and the ideas here were generated in part through those talks.

The proposal outlined here will focus on the multiple wildlife species that do cause conflict in the region, in particular elephant, leopard, lion and hyaena.

Our field approach remains novel and innovative.

Q28b. Are you aware of any current or future plans for work in the geographic/thematic area to the proposed project?

⦿ No

Q29. Value for Money

Please demonstrate why your project is good value for money in terms of impact and cost-effectiveness of each pound spend (economy, efficiency, effectiveness and equity). Why is it the best feasible project for the amount of money to be spent? Please make sure you read the guidance documents, before answering this question.

Through training and workshops we will increase capacity and knowledge on the use of AI-enabled technology in conflict mitigation in Zimbabwe. We recognise that while Zimbabwe may lack some capacity at present, our work will alert Zimbabwean authorities to this.

Our approach will embed community views and concerns (across age and gender), and the findings will be of great interest to all people involved in wildlife conflict mitigation. There is substantial opportunity to scale the technology across the region, and across areas where similar conflict occurs (for example in Asia). All field approaches will be published and all ML models will be made open source.

Because the results of this project will be published, so the reach and impact of the work will extend beyond the study site.

Q30. Capital items

If you plan to purchase capital items with Darwin funding, please indicate what you anticipate will happen to the items following project end. If you are requesting more than 10% capital costs, please provide your justification here.

There are no capital items however we will be purchasing AI-enabled camera systems developed in the Netherlands for this project. That includes the repeller systems (audio sirens and visual warning systems). All equipment will remain with the Community Outreach team at Gonarezhou Conservation Trust in Zimbabwe.

Section 12 - Safeguarding & Ethics

Q31. Safeguarding

All projects funded under the Biodiversity Challenge Funds must ensure proactive action is taken to promote the welfare and protect all individuals involved in the project (staff, implementing partners, the public and beneficiaries) from harm. In order to provide assurance of this, projects are required to have specific procedures and policies in operation.

Please outline how your project will ensure:

(a) beneficiaries, the public, implementing partners, and staff are made aware of your safeguarding commitment and how they can confidentially raise a concern,

(b) safeguarding issues are investigated, recorded and what disciplinary procedures are in place when allegations and complaints are upheld,

(c) you will ensure project partners also meet these standards and policies.

Indicate which minimum standard protocol your project follows and how you meet those minimum standards, i.e. CAPSEAH, CHS, IASC MOS-PSEA. If your approach is currently limited or in the early stages of development, please clearly set out your plans to address this.

The Lead Partner (University of Leeds) policies regards Safeguarding, Code of Conduct, Health and Safety and Whistleblowing have been uploaded.

All partners and project staff will be made aware of all Lead Partner Safeguarding, Code of Conduct, and Health and Safety Policies. These will be made explicit at Contract stage.

Lochran will be supported by various internal teams with the University of Leeds who specialise in Health and Safety and Safeguarding.

Defra recommend you appoint a safeguarding focal point to ensure the project's PSEAH work is taken forward. This can be a separate member of staff or a current member of staff who spends a proportionate amount of time for safeguarding and PSEAH activities. Please name this individual here - this person should also be included in your overall staff list at Q34 and in your budget.

[redacted]

Q32. Ethics

Outline your approach to meeting the key principles of good ethical practice, as outlined in the guidance.

The main ethical concerns around this project are: photographic images of people taken by off-the-shelf cameras (used to validate ML models), and the potential for benefit sharing and capacity building to not

materialise as promised. There may also be potential for community interests, and traditional knowledge systems to be overlooked.

To mitigate these concerns, we will first of all ensure all ethical obligations of research, as outlined by the Zimbabwe Research Council are met. We will further seek human ethics approval through the University of Leeds, and part of that process will emphasise informed consent by communities where the technology is trialled. Informed consent will be attained through workshops with communities, where they will be told that cameras tested in areas where conflict occurs may take images of people, although these images will not be saved.

Moreover, capacity building will be in place from the beginning of the trial, and stakeholders will be engaged. Their views on the technology itself, and the optimal use of the technology – that for example compliments traditional approaches to HWC – will be incorporated into the field programme.

Communities will be engaged from the outset, following the IUCN SSC HWC guidelines.

Section 13 - British Embassy or High Commission Engagement

Q33. British embassy or high commission engagement

It is important for UK Government representatives to understand if UK funding might be spent in the project country/ies. Please indicate if you have contacted the relevant British embassy or high commission to discuss the project and attach details of any advice you have received from them.

⦿ Yes

Please attach evidence of request or advice if received.

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Section 14 - Project Staff

Q34. Project staff

Please identify the core staff (identified in the budget), their role and what % of their time they will be working on the project.

Name (First name, surname)	Role	% time on project	1 Page CV or job description attached?
Lochran Traill	**Project Leader**	10	Checked
Sibusiso Khumalo	Wildlife conflict field consultant	40	Checked
Wayne Twine	Social Science advisor	10	Checked
Bob Mandinyenya	Ecology and community advisor (Gonarezhou Conservation Trust)	5	Checked

Do you require more fields?

⦿ No

Please provide 1 page CVs (or job description if yet to be recruited) for the project staff listed above as a combined PDF.

Staff.CV.merged
17/10/2024
14:00:56
pdf 374.97 KB

Have you attached all project staff CVs?

⦿ Yes

Section 15 - Project Partners

Q35. Project Partners

Please list all the Project Partners (including the Lead Organisation who will administer the grant and coordinate delivery of the project), clearly setting out their roles and responsibilities in the project including the extent of their engagement so far.

Lead Organisation name:	University of Leeds
Website address:	https://www.leeds.ac.uk/
Why is this organisation the Lead Organisation, and what value to they bring to the project?	Leeds University is a leading research intense University in the United Kingdom, and emphasises high quality research with global societal impact. The School of Biology at Leeds University has successfully managed a number of past Biodiversity Challenge Funds.
(including roles, responsibilities and capabilities and capacity):	The School of Biology at Leeds will be responsible for managing all funds, and will also oversee due diligence, risk assessments and ethics permits. The Lead Applicant is based at Leeds University, and will be ably supported by the School of Biology with project oversight.
International/In-country Partner	⦿ In-country
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from the Lead Organisation?	⦿ Yes

Do you have partners involved in the project?

⦿ Yes

1. Partner Name:	Gonarezhou Conservation Trust
Website address:	https://gonarezhou.org/
What value does this Partner bring to the project? **(including roles, responsibilities and capabilities and capacity):**	Gonarezhou Conservation Trust is a joint-managed agreement between Zimbabwe National Parks and Wildlife and Frankfurt Zoological Society. The Trust manages Gonarezhou National Park and is actively involved in community outreach and facilitating wildlife dispersal, where possible in the Greater Limpopo Transfrontier Conservation Area. The Trust is an ideal partner and base for the project. They have indicated areas outside of the Park where conflict is high, and they will provide access to region-wide data on villages affected by HWC, and species that are the main perpetrators of crop damage or livestock killing. Gonarezhou Conservation Trust will allow full access to the Park, will assist with permits and will provide guidance and feedback where required (through their ecology and community outreach teams). The Trust will allow use of vehicles and accommodation (for the consultant when on-site, and the lead applicant and partners), and vehicles can be used in communal lands.
International/In-country Partner	⦿ International
Allocated budget:	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this partner?	⦿ Yes

2. Partner Name:	Hack the Planet
Website address:	https://www.hack-the-planet.io/
What value does this Partner bring to the project? **(including roles, responsibilities and capabilities and capacity):**	Hack-the-Planet (HtP) are a non-profit Dutch engineering company, embedded within Q42, which 'builds digital products that make people's lives smarter, better and more fun.' The HtP team are at the forefront of AI-enabled technology, and have pioneered some of this technology already in Africa, for example AI-enabled alert systems to detect elephant in Gabon (see Whytock et al 2024 MEE, 14: 867–874). The HtP team presently collaborate with the Lead Applicant on a project on hippo and technology, and they have been involved in idea development for this project, along with practitioners based at Gonarezhou NP. HtP will sub-contract their expertise, and develop technology for the project, working with the lead applicant, Zimbabwean consultant, communities and the team at Gonarezhou.

International/In-country Partner	⦿ International
Allocated budget:	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this partner?	⦿ No
If no, please provide details	Time constraints. HtP have provided a budget for this project and are fully aware and supportive of the work. They presently collaborate with the lead applicant. Email confirmation can be arranged if necessary.

3. Partner Name:	Sapienza Museum Network
Website address:	https://www.uniroma1.it/en/pagina/museums
What value does this Partner bring to the project? **(including roles, responsibilities and capabilities and capacity):**	The Sapienza Museum Network facilitates and supports funding around Natural History. The network recently (2021) secured funds from the Italian Agency for Cooperation and Development to promote sustainable resource use and conservation in Mozambique. Given the role of Mozambique in the Great Limpopo Transfrontier Park, the Museum Network is happy to allocate some funds to this project, with a possible view of extending the work further in the region.
International/In-country Partner	⦿ International
Allocated budget:	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this partner?	⦿ Yes

4. Partner Name:	*No Response*
Website address:	*No Response*
What value does this Partner bring to the project? **(including roles, responsibilities and capabilities and capacity):**	*No Response*
International/In-country Partner	○ International ○ In-country
Allocated budget:	*No Response*

Please provide a combined PDF of all Letters of Support for all project partners or explain why this has not been included.

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partners.support
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pdf 781.2 KB

Section 16 - Lead Partner Track Record

Q36. Lead Organisation Capability and Capacity

Has your organisation been awarded Biodiversity Challenge Funds (Darwin Initiative, Darwin Plus or Illegal Wildlife Trade Challenge Fund) funding before (for the purposes of this question, being a partner does not count)?

⦿ Yes

Please provide details of the most recent awards (up to 6 examples).

Reference No	Project Leader	Title
23-021	Dr Keith Hamer	Promoting biodiversity in sustainable oil-palm landscapes for West African smallholders
EIDPS036	Dr Jon Lovett	Planning wildlife corridors for La Primavera Biosphere Reserve, Mexico (Karina Aguilar Vizcaino Fellowship)
EIDPR114	Dr William Hughes	Assessing and conserving critical pollinator communities in Bermuda
EIDPO015	Dr Simon Goodman	Building capacity and Integrating Disease Surveillance with Conservation Management for Galpagos Fauna
15-024	Dr Simon Goodman	Quantification and Elimination of Threats to the Caspian Seal
No Response	*No Response*	*No Response*

Have you provided the requested signed audited/independently examined accounts?

⦿ Yes

Section 17 - Certification

Q36. Certification

If this section is incomplete the entire application will be rejected.

Please note if you do not upload the relevant materials below your application may be ineligible.

On behalf of the

Trustees

of

University of Leeds

I apply for a grant of

£196,372.00

I certify that, to the best of our knowledge and belief, the statements made by us in this application are true and the information provided is correct. I am aware that this application form will form the basis of the project schedule should this application be successful.

(This form should be signed by an individual authorised by the applicant institution to submit applications and sign contracts on their behalf.)

- **I have enclosed CVs for key project personnel, a cover letter, letters of support, a budget, logframe, theory of change, Safeguarding and associated policies, and project workplan.**
- **Our last two sets of signed audited/independently verified accounts and annual report (or other financial evidence – see Finance Guidance) are also enclosed.**

Checked

Name	John Carney
Position in the organisation	Deputy Faculty Research Manager - Biological Sciences
Signature (please upload e-signature)	PDF Signature.png 18/10/2024 15:27:39 jpg 4.4 KB
Date	18 October 2024

Please attach the requested signed audited/independently examined accounts.

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Annual_report_and_accounts_2022_23 (4)
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Please upload the Lead Organisation's Safeguarding Policy, Whistleblowing Policy and Code of Conduct as a PDF. Optionally you can also upload your Health, Safety and/or Security policy or Security Plan here.

safeguarding_policy
15/10/2024
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pdf 93.45 KB

Fieldwork_Guidance
15/10/2024
12:01:20
pdf 588.85 KB

Health and Safety Policy 2022
15/10/2024
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Dignity-and-respect
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whistleblowing_procedure
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Section 18 - Submission Checklist

Checklist for submission

I have read the Guidance**, including the "Darwin Initiative Guidance", "Monitoring Evaluation and Learning Guidance", "Standard Indicator Guidance", "Risk Guidance", and "Finance Guidance".**	Checked
I have read, and can meet, the current Terms and Conditions **for this fund.**	Checked
I have provided actual start and end dates **for the project.**	Checked
I have provided the budget based on UK government financial years **i.e. 1 April – 31 March and in GBP.**	Checked
I have checked that the budget is complete**, correctly adds up and I have included the correct final total at the start of the application.**	Checked
The application has been signed by a suitably authorised individual **(clear electronic or scanned signatures are acceptable).**	Checked
I have attached the below documents to my application: • **a** cover letter from the Lead Organisation.	Checked
• **a** completed logframe **as a PDF using the template provided.**	Checked
• **a 1 page** Theory of Change **as a PDF which includes the key elements listed in the guidance.**	Checked
• **a** budget **(which meets the requirements above) using the template provided.**	Checked
• **a signed** copy of the last 2 annual report and accounts **for the Lead Organisation (or other financial evidence – see Finance Guidance), or provided an explanation if not**	Checked
• **a completed** workplan **as a PDF using the template provided.**	Checked
• **a copy of the** Lead Organisation's Safeguarding Policy, Whistleblowing Policy and Code of Conduct **(Question 31).**	Checked

• **a copy of the Lead Organisation's** Health, Safety and/or Security policy or Security Plan **(Question 31)**	Checked
• **1 page CV or job description for all the Project Staff identified at Question 34, including the Project Leader, or provided an explanation of why not, combined into a single PDF.**	Checked
• **a** letter of support from the Lead Organisation and partner(s) identified at Question 35, or an explanation of why not, as a single PDF.	Checked
I have been in contact with the FCDO **in the project country(ies) and have included any evidence of this. If not, I have provided an explanation of why not.**	Checked
The additional supporting evidence is in line with the requested evidence, amounts to a maximum of 5 sides of A4, and is combined as a single PDF.	Checked
(If copying and pasting into Flexi-Grant) I have checked that all the responses have been successfully copied into the online application form.	Checked
I have checked the Darwin website **immediately prior to submission to ensure there are no late updates.**	Checked
I have read and understood the Privacy Notice on the Darwin Initiative website**.**	Checked

We would like to keep in touch!

Please check this box if you would be happy for the lead applicant (Flexi-Grant Account Holder) and project leader (if different) to be added to our mailing list. Through our mailing list we share updates on upcoming and current application rounds under the Biodiversity Challenge Funds. We also provide occasional updates on other UK Government activities related to biodiversity conservation and share our regular newsletter. You are free to unsubscribe at any time.

Checked

Data protection and use of personal data

Information supplied in the application form, including personal data, will be used by Defra as set out in the Privacy Notice, available from the Forms and Guidance Portal**.**
This Privacy Notice must be provided to all individuals whose personal data is supplied in the application form. Some information may be used when publicising the Darwin Initiative including project details (usually title, lead organisation, project leader, location, and total grant value).

Project Title: AI-enabled camera systems to mitigate human wildlife conflict in Zimbabwe

Project Summary	**SMART Indicators (including disaggregated targets)**	**Means of Verification**	**Important Assumptions**
Impact: AI-enabled camera systems can help villagers in Zimbabwe mitigate conflict with wildlife. This has scaling potential across the region. (Max 30 words)			
Outcome: (Max 30 words) Off the grid, AI-enabled camera systems are being used to detect, deter and warn villagers in communities bordering Gonarezhou NP about wildlife that may bring about conflict.	0.1 The use of off the grid, AI enabled camera systems to detect 'problem animals' in remote field sites has been tested and challenges identified (with community feedback) 0.2 The effectiveness of AI-enabled camera systems, with real time audio and visual repellers has been ably tested and challenges identified (with community feedback) 0.3 The effectiveness of AI-enabled camera systems to alert villagers - in real time – to the presence of 'problem animals' field tested. 0.4 Design of a robust camera system set up tested in consultation with stakeholders and made public through reports and workshops. 0.5 Zimbabwean conservationists and community representatives in the region	0.1 Report on the reliability of AI-enabled camera systems to detect multiple species that may be crop raiders or livestock killers (verified with non-AI camera images) 0.2 Report on the reliability of AI-enabled camera systems to warn villagers in real time of the presence of 'problem animals', and of repellers systems to deter 'problem animals' 0.3 Report on the reliability and robustness of AI-enabled camera systems to withstand trying field condition, and on placement in the landscape 0.4 All outcomes of stakeholder engagement made public, including stakeholder views on camera system set-up and placement and effectiveness	0.1 That AI-enabled camera systems may be more effective than traditional, simple approaches such as crop guarding or cattle fence bomas. 0.2 That there will be uptake amongst community outreach personnel and communities in the region 0.3 That there will be uptake by Zimbabwean and African conservation practitioners and academics, in particular those working in transfrontier conservation 0.4 That all stakeholders consider the approach to be useful and worthy of uptake

	trained on the use of camera systems (with gender parity) 0.6 Zimbabwean academics and conservation scientists made aware of the application technology through workshops and working groups. 0.7 Off the grid, AI-enabled camera systems used to mitigate HWC in the communities neighbouring GNP, in particular the Sengwe corridor region		
Outputs: 1 Techniques established for AI-enabled detection and deterrence of 'problem animals' in communal areas neighbouring Protected Areas. This includes the Sengwe corridor of the Great Limpopo Transfrontier Park (GLTP).	1.1 development of AI-enabled camera systems and field set-up that is robust in the field 1.2 development and validation of AI-enabled camera systems to detect multiple species involved in wildlife conflict, and send real time early warning messages 1.3 development and testing of 'problem animal' response to real time audio and visual repellers in the field 1.4 rollout of camera systems in villages in communal lands that experience conflict with crop raiders (eg elephant and hippo) and livestock killers (eg lion, hyaena etc).	1.1 quarterly progress reports 1.2 workshop minutes and reports 1.3 video footage of animal response to audio and visual repellers configured to camera systems 1.4 ML models validated in the region made open-source 1.4 final reports and paper on results of all work	1.1 that AI-enabled camera systems and set up can tolerate the environmental conditions in the region, including potential for animal damage and vandalism 1.2 that all 'problem animals' can be accurately identified 1.3 that the field approaches developed are robust and scalable

	1.5 training of GNP staff and community members in the set up and use of AI-enabled camera systems (with gender parity) 1.6 education material developed – in collaboration with Toledo Zoo - and made available to schools in the region. 1.7 workshops run within GNP, and across communities outside of the Park with focus on Sengwe corridor. These will allow for feedback and ensure all members in communities are informed 1.8 results of project communicated to conservation scientists and academics across Zimbabwe, and the GLTP region through working groups and a workshop 1.9 results communicated to biologists at Zimbabwean Universities through a workshop. 1.10 at least one paper submitted to an international journal on the many lessons learnt through our work		
2. capacity building on AI-enabled camera systems in Zimbabwe and the GLTP	2.1 training of a Zimbabwean consultant on all aspects of AI-enabled camera systems	2.1 workshop minutes and reports 2.2 quarterly reports on progress, which will include details on	2.1 that there is adequate interest in the work for future uptake

	2.2 training of GCT staff and community representatives on AI-enabled camera system set up, monitoring, and maintenance as well as image data analysis and repeller configuration. Here targets around gender representation will be met. 2.3 awareness of off the grid, AI-enabled camera systems among all stakeholders in the transfrontier region, including Zimbabwean scientists	indicator targets (female technicians trained etc)	2.2 that trained personnel will continue with monitoring based on AI-enabled cameras 2.3 that all workshops and training events are well attended
3. Off the grid, AI-enabled camera systems with early warning, or repeller ability are demonstrated to be an effective tool to warn villagers about 'problem animals', and/or deter problem animals.	3.1 results of the effectiveness of AI-enabled cameras made public across the region.	3.1 project reports and paper documenting outcomes. 3.2 All positive aspects - and all challenges of the technology will be made explicit	3.1 that stakeholder interest and engagement will be high
Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1. Each activity should start on a new line and be no more than approximately 25 words.) 1.1 Community and stakeholder outreach on needs re HWC mitigation 1.2 Machine Learning models trained to identify species involved in HWC in the Sengwe corridor and other communal lands bordering GNP 1.3 Images from commercial camera traps across GNP used to validate ML model identification of key problem animals, testing for false-positive and false-negative id. 1.4 Community and stakeholder outreach and feedback on camera system and repeller set up 1.5 Configuration of AI enabled camera to detect problem animals and send early warning message in real time 1.6 Configuration of AI enabled camera to detect problem animals and trigger audio and/or visual repeller 1.7 Testing in the field of optimal height, aspect etc of camera trap system, with stakeholder feedback 1.8 Testing of AI camera capacity to detect problem animals in the field (within GNP) 1.9 Tests of the response of problem animals to repellers – based on real time recorded images of these events (within GNP) 1.10 Roll out of camera systems in pre-identified villages where HWC occurs, with stakeholder involvement 1.11 Data collection through images recorded to test for problem animal response			

Project Title: AI-enabled camera systems to mitigate human wildlife conflict in Zimbabwe

1.12 Social surveys of villagers (with gender parity) to record views on the effectiveness of approach versus in-place approaches (such as bomas)
1.13 Documentation of all costs involved, and on all findings
1.14 Results made public through workshops in the Sengwe region and other communal lands
1.15 Results made public more broadly through workshops in Zimbabwe, and through publication of research papers

2.1 working group on AI-based technology established in Zimbabwe
2.2 Zimbabwean consultant trained in all aspects of AI-enabled camera systems and repellers
2.3 training of GNP staff and CAMPFIRE staff on AI-camera system use, with gender parity

3.1 stakeholders across communities made aware of the results of the project and implications (and feedback sought)
3.2 workshops in the GLTP, at Zim Parks headquarters and University of Zimbabwe to make all stakeholders aware of the technology, and project findings
3.3 all ML models made open source, and reports and papers published on findings and community perspectives