# WALLFLWR – A Conservation X Labs Product

# An AI Model Marketplace for Conservation Scientists

Conservationists are often late adopters of technology that can significantly increase the efficiency and efficacy of their scientific work. The barriers to emerging technology adoption often include cost, lack of technical expertise, and limited understanding of relevant technological applications to specific fields of conservation science. Further, conservationists often take a reactionary approach to technology adoption, waiting to apply technologies developed for other purposes to their fields of study. We see a proactive approach in which conservationists develop technologies specifically for their use cases as a more effective way to bring emerging technologies into conservation science. If appropriately designed and implemented, one emerging technology that would significantly enhance conservation work is artificial intelligence (AI). Broad access to AI-enhanced conservation tools and devices has the potential to help conservation science practitioners make huge advances in a number of areas.

**Track Relevance: AI Driven Innovation via Data & Model-Sharing.** We propose a project that will converge the fields of wildlife conservation, one health, product engineering, and computer science. We plan to develop a custom AI-model marketplace (i.e. a model commons) that gives application experts (e.g. those charged with monitoring wildlife) access to AI-enabled tools currently limited to technology experts. The marketplace will have a particular focus towards “edge” models optimized for enabling automated real-time environmental monitoring on devices in the field, such as trail cameras. However, it will also capitalize on, and include the existing work of, our partners that focus on systems that rely on large specialized processes including robust classifiers/detectors, individual re-identification, and specialized datasets. Datasets from non-AI-enabled devices in the field would also benefit from our marketplace by inference off-device -- either through cloud-based or personal computing workstation analyses.

Within our marketplace, either an existing AI-model will be available, or a custom model can be created without the user requiring any machine learning or computer science expertise. If a new model is necessary, our marketplace queries publicly available datasets (e.g. the Global Biodiversity Information Facility -- GBIF, the Labeled Information Library of Alexandria -- LILA, etc.) to find relevant training data for those user-defined insights. It then trains the AI model using a robust animal detector and transfer learning. Finally, it automatically sends the model to the AI-enabled device in the field. The device will then use that model to deliver user-defined insights. Since the users only need to define the insights they are interested in recording, the marketplace helps make AI more accessible to conservation scientists without having to learn advanced computer programming or deep learning techniques themselves.

**Convergence research.** Our proposal is to develop the conservation science AI-model marketplace to advance AI, conservation, and one health research. For conservation scientists, the models shared within the marketplace will provide additional AI capabilities to devices monitoring wildlife and biodiversity in remote locations. The marketplace will allow users to define research insights they would like their devices to deliver (e.g. is the animal the device just detected diseased?) Similarly, the marketplace will enable one health researchers to identify research insights associated with bio surveillance to help understand the threats and demography of endangered species at scale.

Understanding the limitations of a common AI-model pipeline to generate models capable of running on low-power devices will be an essential area of research as we design hardware devices specifically to run AI models. Communicating these limitations to non-experts will be an area of active and consistent investigation. As new model frameworks, on-device learning techniques, hardware, and compression techniques emerge we hope to be able to extend capabilities into areas previously not possible for on-device inference. These include areas such as multi-spectral/thermal imaging for disease and physiological monitoring, cross-species pose detection (e.g. for behavior and physiological monitoring), and individual re-identification.

We also plan to keep a large database of publicly available images, and as data is polled as part of the marketplace development and use, we will feed results (both new data and additional metadata such as bounding boxes) back into the database. This will, in turn, extend the capacity and capabilities of the rest of the marketplace users to generate novel research questions or deploy in different scenarios.

**Proposal Team and Potential Partnerships**. Our convergence research team brings together: leading researchers in computer vision at the California Institute of Technology’s Computational Vision Laboratory; conservation scientists utilizing AI and citizen science from the non-profit organization WildMe; and practitioners in environmental conservation, international development, and product engineering at Conservation X Labs. We plan to bring a robust coalition of partners from current and past collaborations as well as reach out to parties that serve as:

* potential conservation science AI-model marketplace end-users (e.g. individual field scientists, conservation organizations with field operations, one health practitioners, governments at the national, state, & municipal levels, and university researchers);
* AI, machine vision, and data manipulation thought leaders (e.g. university researchers at Cornell, Carnegie Mellon, Arizona State, Harvard, and Massachusetts Institute of Technology);
* data contributors (e.g. GBIF, LILA, and WildLife Insights); and
* technical and engineering partners (e.g. Duke University, Georgetown University, Google, and Microsoft).

**Deliverables.** We see three significant deliverables at the end of the Convergence Accelerator program: the AI-model Marketplace for Conservation Science; a prototype hardware device capable of running small image and acoustic machine learning models that enable wildlife monitoring in remote locations; and, data and metadata sets relevant to trained models. Our conservation science AI-model marketplace will present existing work on species detection in a new approachable way that will help solve new problems by advancing and powering community approaches. Understanding the location of species in near real-time alone is useful in a number of scenarios, for example, during an invasive species outbreak or discovery of endangered species during NEPA Environmental Impact Assessments. Further, by increasing accessibility to two historically disparate fields of hardware and AI, for an application that is historically underfunded (wildlife/disease monitoring) - we lower the collective barrier for use cases and scenarios that may otherwise be financially infeasible.

However, the marketplace also allows further, less explored possibilities, utilizing community and shared development. Beyond species identification, feature detection models such as sex, life stage, and pregnancy, give invaluable insights to the health of populations that are otherwise costly and time-consuming. Other model types, such as pose detection may be able to begin to detect behavior or detect issues such as lameness in herd animals, where early intervention is important. Finally, there has been some preliminary research around disease monitoring through thermal and/or multispectral imagery - although fundamental research is still required, the rise of thermography for disease detection in veterinarian medicine suggests these techniques will become more widespread.