

CAMinos

Intelligent Trail Camera Annotation

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Biodiversity on the Decline

According to a 2020 <u>WWF report</u> **biodiversity has** <u>declined</u> **68%** worldwide since 1970 and has continued to do so.







What Gets Measured Gets Managed!



Data Collection

Observing wild animals in natural habitat using camera traps

Annotation Bottleneck

Images are manually annotated through volunteer crowdsourcing (Zooniverse)



Complex Process

Analysis Paralysis may be an issue, given the many options provided for volunteers







OUR APPROACH



Simplicity

Improve the annotation experience with a simple user interface



Apply computer vision and deep learning techniques to automate species classifications and counts





Efficiency

Decrease the time it takes for the typical user to annotate species/counts





OUR THOUGHTS...

Technology







Blank Images

Species

Count

Classification and Object Detection



CUSTOMER FIRST

Experience



Intelligent Annotation

FIRST STEPS



SNAPSHOT WISCONSIN

Stakeholders





Researchers

Volunteers

Transforming conservation research and volunteer engagement.



POC: Ryan Bemowski, Chief Data Scientist, Wisconsin Department of Natural Resources

INTRODUCING





ANNOTATION TOOL

A look at CAMinos annotation tool

DATA PIPELINE

WEB/API ENVIRONMENT



MODEL ARCHITECTURE -ENSEMBLE



YOLOv5 - pre-trained on Snapshot Serengeti EfficientNet - pre-trained on ImageNet

THE POWER OF THE ENSEMBLE

	Avg Accuracy Across Tasks*	Capabilities	
YOLOV5	77%	Classification + Object Detection	ENSEMBLE
EFFICIENTNET	82%	Classification	85% Classification + Avg Accuracy Across Tasks Object Detection
MEGADETECTOR	70%	Object Detection	

*Tasks include blank and species classification and animal count (for detection models)

FLEXIBLE MODEL OPTIONS



Stage 1 = Blank Image Classification Stage 2 = Species Classification and Detectior

FLEXIBLE MODEL OPTIONS



Performance by event on unseen test data

* TopC3 = Correct species in top 3 most likely **Runtime measured on AWS G instance with single GPU

MODEL SIZE



ENSEMBLE RESULTS Large Model - Top1

	precision	recall	f1-score	support
bear	0.8712	0.8846	0.8779	130
blank	0.6234	0.9600	0.7559	200
coyote	0.6281	0.8333	0.7163	150
deer	0.9728	0.8468	0.9055	888
elk	0.9255	0.8832	0.9039	197
fox	0.7083	0.7286	0.7183	70
opossum	0.9412	0.6154	0.7442	52
rabbit	0.7619	0.6557	0.7048	122
raccoon	0.8099	0.8235	0.8167	119
turkey	0.7077	0.7302	0.7188	63
wolf	0.7667	0.7302	0.7480	126
accuracy			0.8299	2117
macro avg	0.7924	0.7901	0.7827	2117
weighted avg	0.8538	0.8299	0.8345	2117

ENSEMBLE RESULTS Counts



Count accuracy 78% of the time



A small sample of the results



MODEL INFERENCE

CAMinos is built for ease of use and flexibility for classification and detection on new images.

TESTIMONIAL

"Classifying all photos is tedious and error prone. The classification ensemble, methods, and interface the Berkeley team has produced is definitely going to improve the way our volunteers interact with the program.

By displaying a top 5 prediction with confidence values will help volunteers select the correct species if they have doubt. By including an object detection model, volunteers will be able to better spot animals, even if they need to make a correction. This will...give the volunteers a place to start when there may appear to be nothing in the photo at all.

This system will be able to **fill the gaps** where there is no human time to classify all photos."

- Ryan Bemowski, DNR



POWER of CAMinos



ACKNOWLEDGMENTS



Alberto Todeschini

Professor

Researcher and consultant specializing on artificial intelligence, including deep learning methods for computer vision, natural language processing, and generative adversarial networks.



Fred Nugen

Professor

Specialization in building predictive models of disease, to help physicians engineer new treatment strategies.



Colorado Reed

TA. Advisor

Computer Science Ph.D. student at the Berkeley Artificial Intelligence Research (BAIR) lab advancing fundamental computer vision research through applying unsupervised learning to real-world problems.



Ryan Bemowski

Data Scientist at WDNR Project Advisor. Leads the Snapshot Wisconsin initiative at WDNR.

QUESTIONS?



Access CAMinos at <u>http://54.69.0.194:8080</u>

or docker run --rm -p 5000:5000 -p 8080:8080 jroshanucb/capstone:latest http://localhost:8080