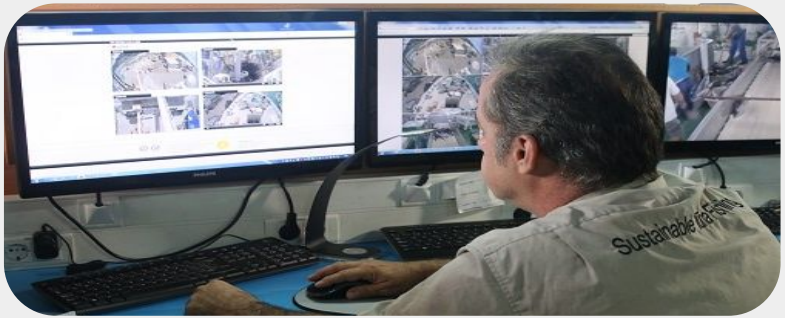
Open-domain Vision with RAG for Ocean Conservation

Sepand Dyanatkar, Angran Li, Alexander Dungate

Tackling Climate Change with AI Workshop 2024

3 billion people depend on healthy oceans

For Example



Review In Fisheries

- Crushingly Expensive
- Too slow for timely fishing data
- Cannot scale

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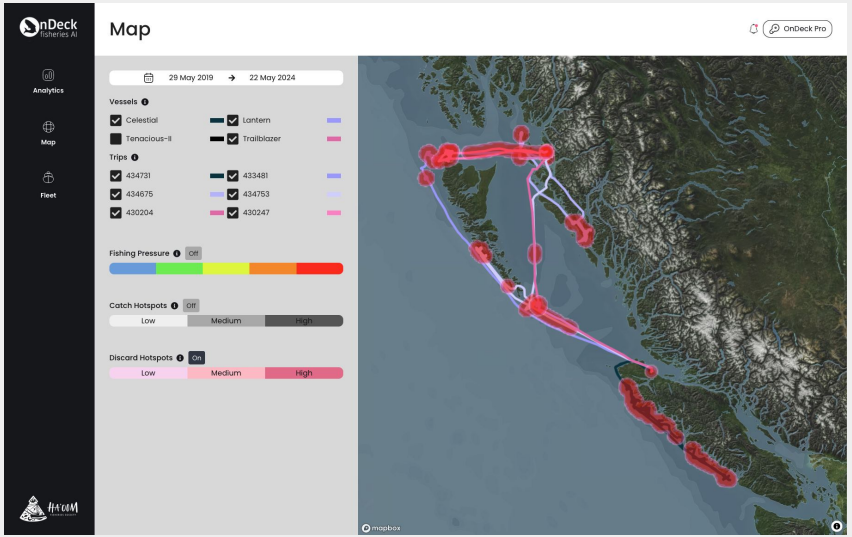
Solved!

[1]



[1] J. Kay and M. Merrifield, "**The Fishnet Open Images Database**" Jun. 16, 2021, doi: 10.48550/arXiv.2106.09178.

Well... Not Quite

Limitations of Top-down Computer Vision

Generalization

- Traditional models struggle with dynamic and diverse environments, even within the same domain.

Long-Tailed Distributions

- Difficulty in identifying rare or unseen species due to imbalanced data. Or entirely missing data.

Limitations of Top-down Computer Vision

Domain Transfer

- Models require retraining or tuning for new environments or conditions.

Decision Provenance

- Explainability is possible only with reverse engineering and not a first-class feature.

Limitations of Top-down Computer Vision

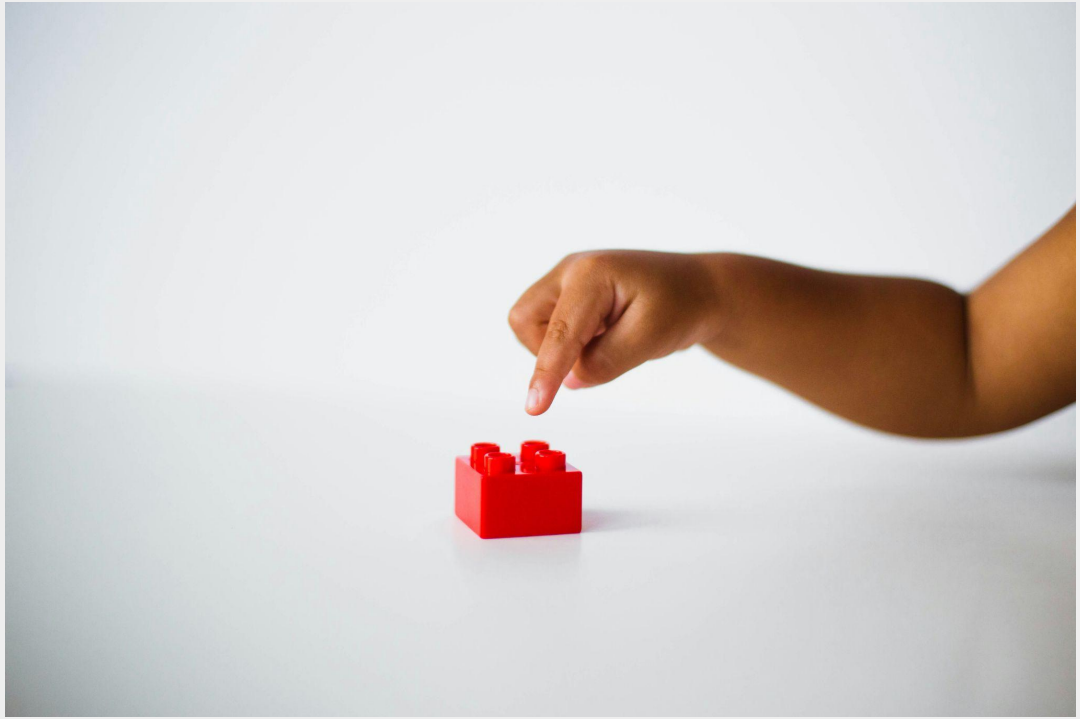
Generalization

Long-Tailed Distributions

Domain Transfer

Decision Provenance

Bottom-Up Learning



Vision Language Models

Self-supervised Pre-training

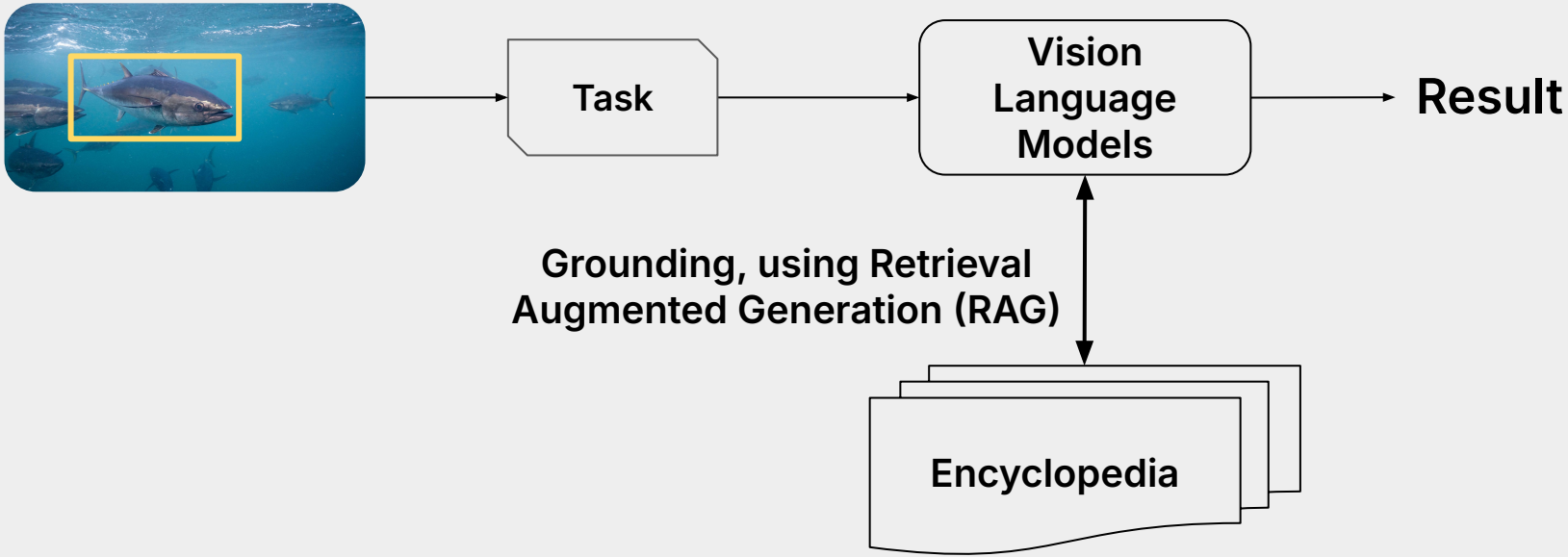
+

Contrastive Learning

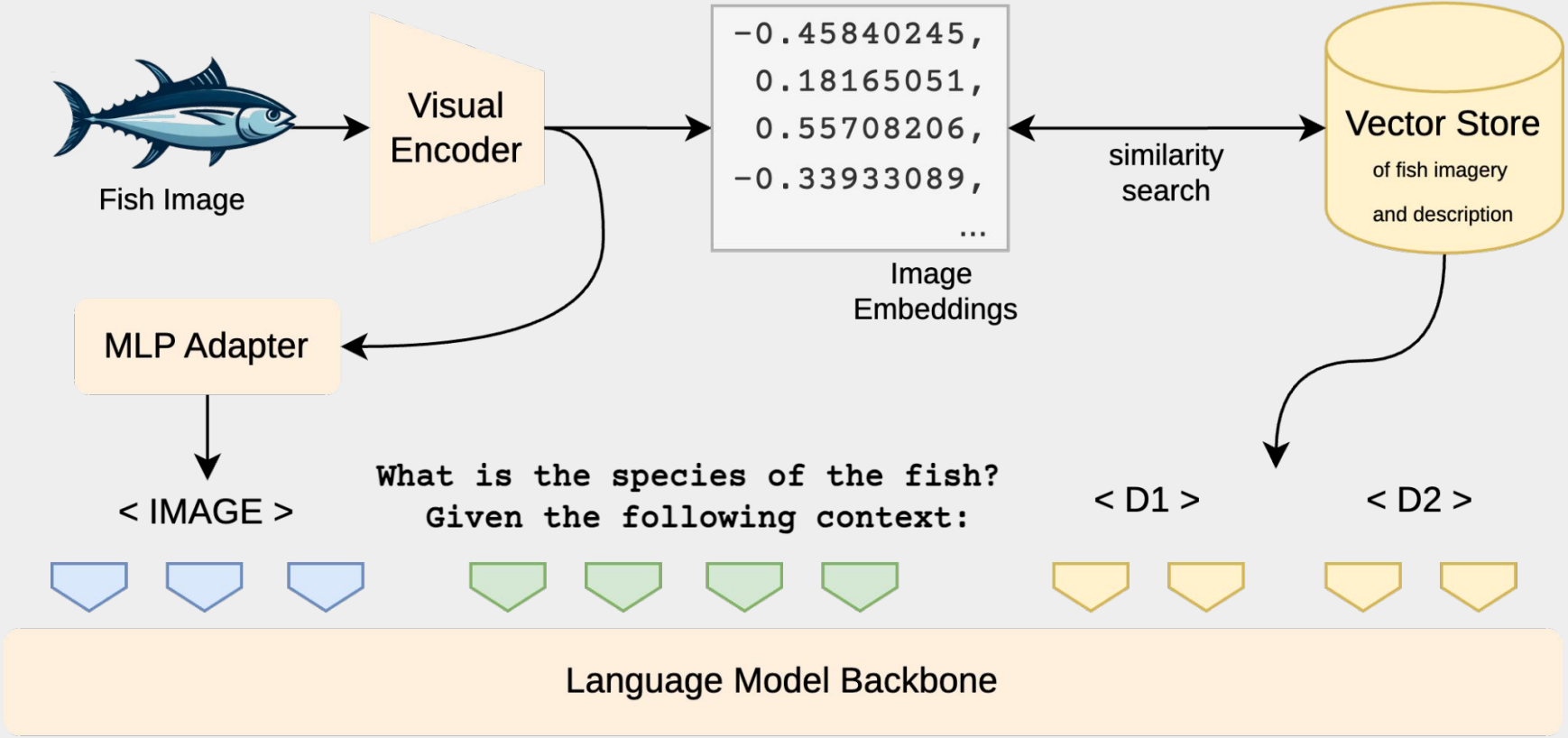
+

Diverse and Varied Training Data

Method


Task
Vision Language Models
Result
Grounding, using Retrieval Augmented Generation (RAG)
Encyclopedia

Architecture

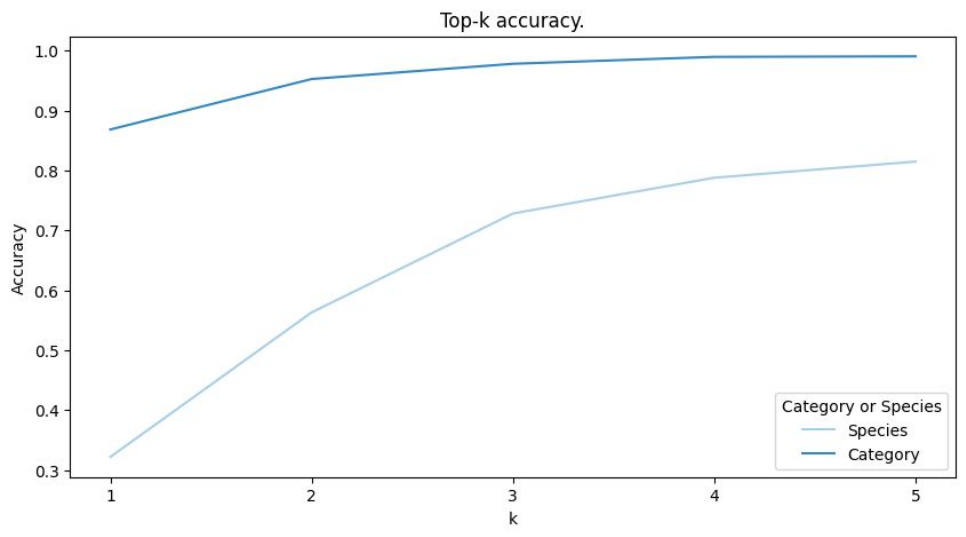


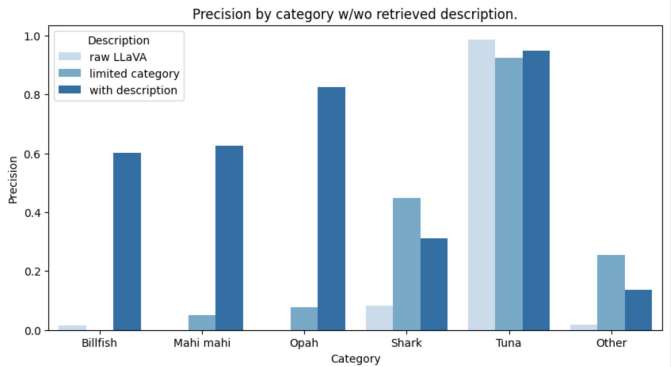
Preliminary Results

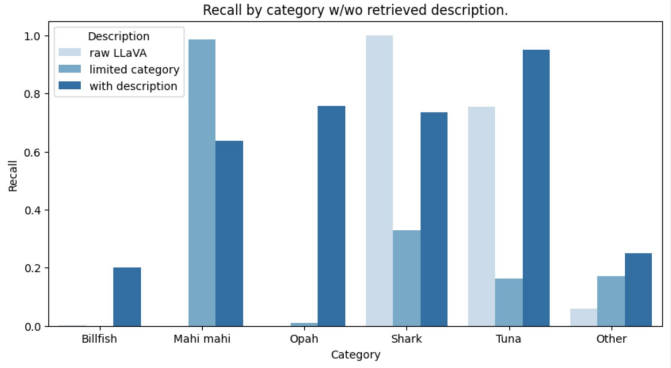
Table 1: Classification accuracy of baseline vs. our VLM-RAG approach on 5 categories. We measure both performance of final prediction (single answer response) and intermediate RAG retrieval.

	Accuracy		
Method	Top-1	Top-2	Top-3
InceptionV3 (Baseline)	0.7501	0.8312	0.9408
VLM-RAG (Ours, Final Prediction)	0.8403	N/A (single answer)	N/A (single answer)
VLM-RAG (Ours, RAG Retrieval)	**0.8684**	**0.9527**	**0.9781**

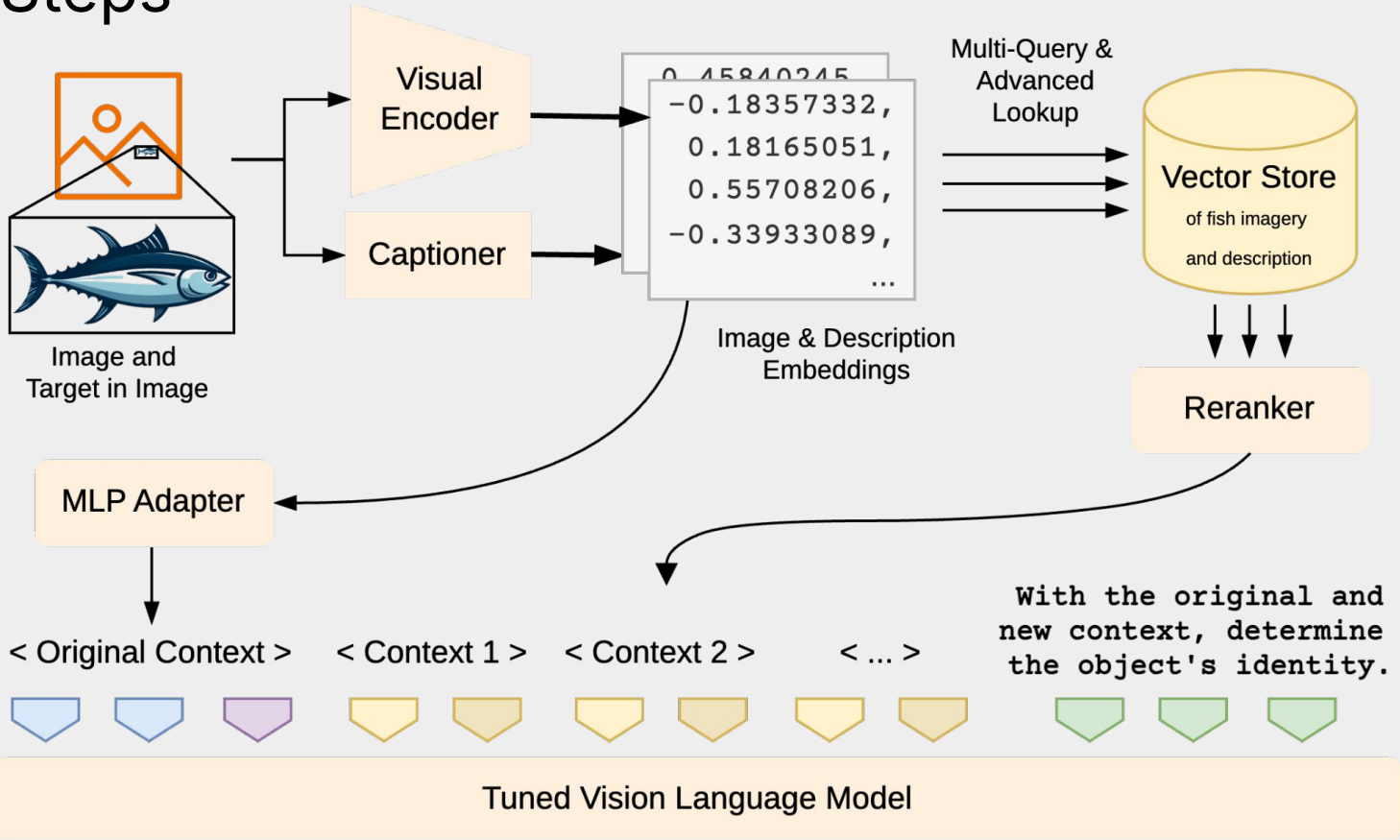
Preliminary Results







Next Steps


Visual Encoder
Captioner
-0.18357332,
0.18165051,
0.55708206,
-0.33933089,
...
Multi-Query & Advanced Lookup
Vector Store
of fish imagery
and description
Image and Target in Image
Image & Description Embeddings
Reranker
MLP Adapter
< Original Context >
< Context 1 >
< Context 2 >
< ... >
With the original and new context, determine the object's identity.
Tuned Vision Language Model

Impact and Conclusion

Accurate, faster and more accessible deployments of marine life monitoring.

=

Significantly more informed and effective responses to changing climates.

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Paper

Our Work

CANADA'S OCEAN SUPERCLUSTER

NATIONAL GEOGRAPHIC

Environmental Defense Fund

OCEAN IMPACT ORGANISATION

SOA SUSTAINABLE OCEAN ALLIANCE

CREATIVE DESTRUCTION LAB

Institute for the Oceans and Fisheries

OCEAN WISE