Assessing East African coral reef associated fish diversity using underwater video census (UVC) and machine learning.

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Coral reefs are biodiversity hotspots providing essential ecosystem services and supporting fisheries vital to Kenyan and Tanzanian livelihoods. However, they face threats from climate change and anthropogenic activities such as pollution and unsustainable fishing practices. These threats are likely to affect fish communities and endanger local fisheries resources. In order to develop effective management strategies, it is important to monitor these changes over time. We plan to conduct underwater video censuses (UVC) and compare current diversity data with historical data to document possible fish community changes in fished and non-fished areas. During SCUBA diving surveys, 50 m video transects were recorded using a GoPro at depths of 5 m and 10 m on several reefs along the coast of Kenya in March 2023. Similar transects are planned for February 2025 in Tanzania. The videos will be visually analysed and compared with historical count data.

Human video analysis, however, is time consuming and requires a high degree of expertise. In an attempt to counter these shortcomings, we will equally develop a machine learning approach to East African fish identification. Extracted still images will serve as raw data, undergoing pre-processing steps such as normalisation and redundancy removal. To create a labelled dataset, manual labelling will be conducted using Roboflow software. We will utilise YOLOv8, a state-of-the-art object detection model balancing precision and speed, to identify fish species. Labelled data will be exported in the YOLO format, containing class IDs and normalised bounding box coordinates. Semi-automatic labelling will iteratively improve model performance by refining predictions and retraining with expanded datasets. The model will further be finetuned using data augmentation techniques, cross-validation, transfer learning, and hyperparameter optimisation. The finalised model will facilitate fish abundance extraction, enabling robust correlations with environmental variables. The results obtained by both methods will be compared with each other as well as with the results of an eDNA approach developed in parallel with the goal to determine the optimal monitoring tool(s) for East African fish diversity monitoring.

Keywords
Coral Reef Ecology, Fish Community Monitoring, East African Fisheries, Machine Learning, Underwater Imagery.