Harnessing Deep Learning to Assess Coral Reef Health Through Crowd-sourced Efforts

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Coral reefs, which house millions of marine organisms and drive multibillion dollar tourism and fishing industries, have been under severe threat of bleaching due to the warming, acidification, and pollution of the oceans. Efforts are underway to track the extent of coral bleaching, however their reliance on human labor or limitation to benthic cover analysis makes them insufficient in diagnosing the full extent of bleaching. Proposed herein is a deep-learning approach that utilizes convolutional neural networks and crowd-sourced images – collected from governmental, academic, and personal sources – in order to develop a model capable of distinguishing healthy and bleached coral. The researcher sourced hundreds of images from government archives, the Coral Reef Image Bank, and ecological papers and annotated these images to highlight healthy and bleached corals using the Labelbox platform. The Mask R-CNN (Region-based convolutional neural network) algorithm was trained, validated, and tuned to find optimal hyperparameters, on these images within an Amazon Web Services EC2 instance. The model that performed best on the training and validation sets, was tested on an independently-curated set of images and a precision-recall curve was constructed to determine the optimal operation point, or confidence threshold. Training yielded a model with an 85% accuracy in differentiating between healthy and bleached corals in subaquatic images. This deep-learning based model can be implemented in global databases of images from academic explorations and tourist travels in order to track the incidence of bleaching, thereby informing allocations for treatments and preventative measures to preserve our marine ecosystems.

Awards Won:

National Oceanic and Atmospheric Administration - NOAA: Second Award of $500