Standardizing the Process of Waterfowl Species Identification using Neural Networks

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Abstract

Waterfowl, including ducks, geese, and swans, are socioeconomically important worldwide and are a subject of constant scientific analysis. From banding operations to the key aspects of adaptive harvest management models, the phenotype - an organism's physical features - is used to evaluate the species' sex and age, information that is then used for a variety of population monitoring studies. Thus, properly evaluating an individual's phenotype is evidently critical for many aspects of waterfowl conservation. The mallard is a Holarctic species, found to the north of both the old and new world, and has been used as food since humanity's early hunting-gathering times. Through time, this ancestral mallard has diverged into various other species by natural movement and isolation from other populations. However, evolution is a long, timely process, so these new species can be considered infants in the scope of evolutionary time. This leads to ancestral trait retention where new species still show much of the same traits as their ancestor. This is caused by a lack of sturdy reproductive barriers and can lead to confounding visual traits used when identifying species. As an example, in a recent study by Lavretsky et. al. (2019), "20% of phenotypically identified mallards (*Anas platyrhynchos*) and black ducks (*Anas rubripes*) were incorrect..." Likewise, 37% of their phenotypically identified hybrids were actually pure-parentals, showing further evidence of the occurrence of phenotypic identification error. Such errors are thought to be due to non-diagnostic traits being chosen, or simple human error. Thus, it is crucial to standardize against identification error for less biased measurements to form more informed ecological decisions.

This study aims to automate phenotypic recognition by using machine learning and computer vision. Convolutional neural networks (CNN) are the standard for image recognition tasks using neural networks. The work presented here is a first step, using a CNN, in creating a system that will identify the chosen species on the field with a high degree of accuracy, with consistency, to support the identification of waterfowl. The system will be trained with a data set from the UTEP Lavretsky Lab, complete with genetically verified species to ensure high quality, pre-labeled images. Preliminary results will be discussed and future work presented.