Title: Waterfowl Species Monitoring using Neural Networks

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Abstract:

Waterfowl are ubiquitous and as a result, have been very important, from a socioeconomic viewpoint across societies. In order to monitor their population (different species, whether they hybridize or not, to what extent), the phenotype is used to evaluate the species, sex, and age of individuals. Thus, properly evaluating an individual's phenotype is evidently critical for many aspects of waterfowl conservation. However, assessing / identifying species is not easy: for instance, in the case of hybridization, ancestral trait retention caused by a lack of sturdy reproductive barriers can lead to confounding visual traits used for identifying species. A 2013 study by Lavretsky et. al. showed that "20% of phenotypically identified mallards 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 error. Human errors also simply cause misidentifications. As the monitoring of waterfowls is so important in making ecological decisions, it is desirable to achieve a less error-prone identification system.

The goal of this work is exactly this: to develop an automated process for phenotypic recognition of waterfowls. The tool we present today is a mobile app meant to be deployed for park rangers. In the field, rangers can take a picture with their mobile device, which is loaded to the app. The goal is that the tool we built will inform the user not only about the species of the waterfowl in the picture, but also about its age (immature vs. mature), the sex of the animal (male or female), and if it is a male, its plumage phase (i.e., whether it is wearing its breeding plumage).

To do this, we decided to build a use a convolutional neural network (CNN) as it is usually well suited for image recognition. However, we are facing a temporary challenge: in order to train a NN, we need data (a lot, especially given all the dimensions we are expecting to make decisions about) and this data needs to be validated (a true match input/output). Validation in waterfowls is done through genetic analysis, which is hard to do and therefore makes the data sets slim. Our training set is a relatively small dataset of genetically verified species from the UTEP Lavretsky lab, which includes 200 wild mallards, 100 domestic mallards, 250 Mexican ducks, 100 mottled ducks, 100 New Zealand grey ducks, and 350 mallards from New Zealand.

In the presentation, we will demonstrate the app developed by the authors, and discuss how we plan to overcome the issue of genetic vetting of samples as well as the research questions that will derive.