Do Drones Dream of Electric Sardines?
Exploring the use of Uncrewed Aerial Systems to Survey Coastal Pelagic Species

Melissa N. Liotta¹, Trung Nguyen², Katie Grady³, Kirk Lynn¹

¹California Department of Fish and Wildlife, La Jolla, CA; ²California Department of Fish and Wildlife, Monterey, CA; ³California Department of Fish and Wildlife, Seal Beach, CA

Introduction: Since 2012, the California Department of Fish and Wildlife (CDFW) has conducted the California Coastal Pelagic Species Survey to document and estimate the biomass of Pacific Sardine and Northern Anchovy in nearshore waters. Currently, the survey uses an aircraft with an experienced spotter to locate fish schools, identify species, and estimate biomass. Due to increasing logistical challenges, in 2021 CDFW began exploring the feasibility of using uncrewed aerial systems (UAS) equipped with remote sensing technology and performing advanced image analyses to develop and apply a more repeatable biomass estimate calculation to ensure standardization of long-term datasets.

Goals: 1) Field – Locate and photograph schools of Pacific Sardine and Northern Anchovy; 2) Image Analyses – Use images captured by UAS in the field to calculate surface area and biomass of schools, delineate schools, and identify (ID) individual fish and species.

Methods – Field Deployment
Three field deployments in collaboration with Oceans Unmanned (OU): Sept 27-30, 2021 (Ventura/Oxnard); March 21-23, 2022 (Los Angeles); May 25-26, 2022 (Monterey Bay)

Methods & Results - Image Analyses

Conclusions and Future Research
Use of UAS to survey CPS is a viable test bed for evaluating sensors and developing data collection and processing technologies; however, due to current regulatory and technical constraints it is not possible to solely use UAS for statewide surveys. Therefore, we are exploring how to apply the sensors and image analysis methods used with the UAS for use with a crewed fixed wing aircraft.

Multi-spectral Image Analysis
➢ Color images were created from the Red, Green, Blue, and Near Infrared bands (NIR) of the multispectral sensor (Fig 3A, B). Then an NIR derived mask is applied to the color image that best visualizes the school in order to remove visual noise such as glint. The depth of fish and the surrounding seawater conditions will affect the reflectance in different color bands and how density is assessed (Fig 3C, D).

Artificial Intelligence (AI)
Step 1: Images were spliced into hundreds of small "tiles" (Fig 4A, right) that could be processed by the AI algorithms².

Overall, the performance of both AI algorithms were limited by the small sample size available (20-30 tiles each)². Glare and sunspots presented a challenge and impacted detection, particularly in the DeeplabV3 algorithm (Fig 4C).