The Annual Secondary Productivity Cycle in Prince William Sound Measured with the Prince William Sound Plankton Camera

Robert Campbell
Prince William Sound Science Center, rcampbell@pwssc.org
Paul Roberts
Monterey Bay Aquarium Research Institute, plroberts@ucsd.edu
Jules Jaffe
Scripps Institution of Oceanography, jjaffe@ucsd.edu

A novel plankton imager was developed and deployed aboard a profiling mooring in Prince William Sound in 2016 through 2019. The imager consisted of a 12 MP camera and a 0.137X telecentric lens, along with darkfield illumination produced by an in-line ring/condenser lens system. The camera imaged ~325 liters per profile (from ~60 m to surface), and almost 2.5×10^6 images were collected during the three years of deployments. A subset of almost 2×10^4 images was manually identified into 43 unique classes, and a hybrid convolutional neural network classifier was developed and trained to identify the images. Accuracy varied among the different classes, and applying thresholds to the output of the neural network (interpretable as probabilities) improved classification accuracy in non-ambiguous groups to between 80 and 100%. The system documented interannual differences in abundance that corresponded with concentrations estimated from plankton nets. The system also observed high frequency variability in the abundance of several taxa (small blooms lasting days to weeks); intraannual changes in depth distributions (to sub-meter resolution) over the course of the year; and diel migratory behavior in some taxa. Imagery-based estimates of abundance shows promise for rapid, relatively low cost observing of zooplankton biomass, and potentially the extraction of additional information on some individual plankters (e.g. gut fullness, lipid stores).