Imagers as Biological Sensors

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Digital Cameras Used as Color and Shape Measurement Devices:

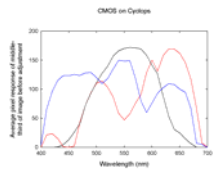
Example High and Low-Resolution Cameras

Both types of imagers have distinct uses with different advantages (power vs. resolution) to both formats.

- **Pan-tilt devices with millions of colors and high resolution**
- **Fixed devices with 256 colors and low resolution**

Calibrations and Algorithm Development

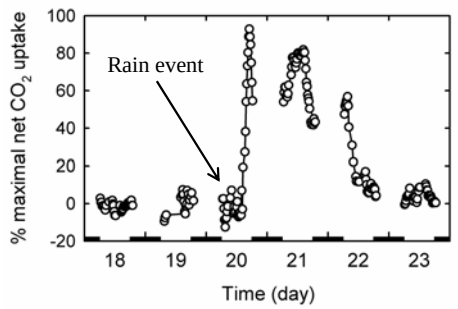
Imagers can be used as shape detectors, color and simple wavelength detectors, and counting devices



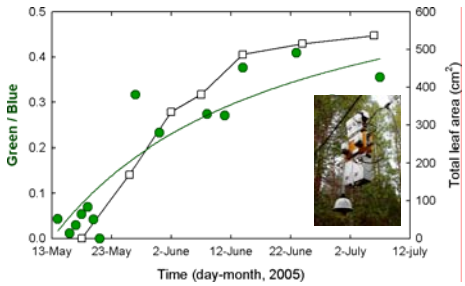
- **Area recognition may be human-assisted or autonomous**
- **Wavelength sensitivities of cameras can be quantified**

Examples of Current Work Using Imagers as Biological Sensors at the James Reserve:

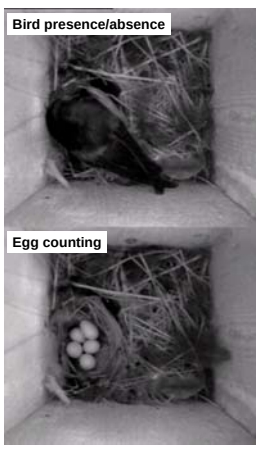
Images as Biological Data

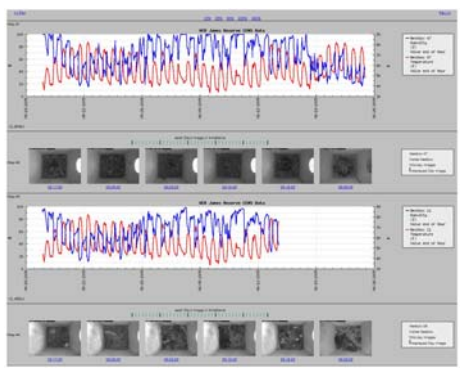


The MossCam Project has collected digital images of *Tortula princeps* at least daily since 2003. Laboratory studies can be used to calibrate these images to indicate field physiological conditions. Using the green:red ratio of field images and otherwise assuming ideal conditions, the total carbon gain for a six day period around a 1.3 mm rain event was about 208 mmol CO_2 m^{-2}, equivalent to 69 days of respiration under dry conditions.



Using the NIMS 1 node to periodically return to set points and capture images of branches of *Rhododendron*, an image chronosequence was created. Simple pixel color ratios (green circles) of the images correlate well with the values of total leaf area production measured by hand in the field (white squares) – such simple but powerful techniques can be incorporated into automated leaf measurements .





A violet-green swallow, *Tachycineta thalassina*,is captured to the left with five soon-to-hatch eggs. Automated image analysis has proven difficult but guided, human-assisted selection of images can be used to rapidly assess variables such as clutch size, days of incubation, number of eggs hatched, and days to fledge. Correlation of nesting events with other sensor data such as temperature and humidity and their simultaneous display helps researchers identify key events in the reproduction of some cavity-nesting birds.