IMAGEin Ecology

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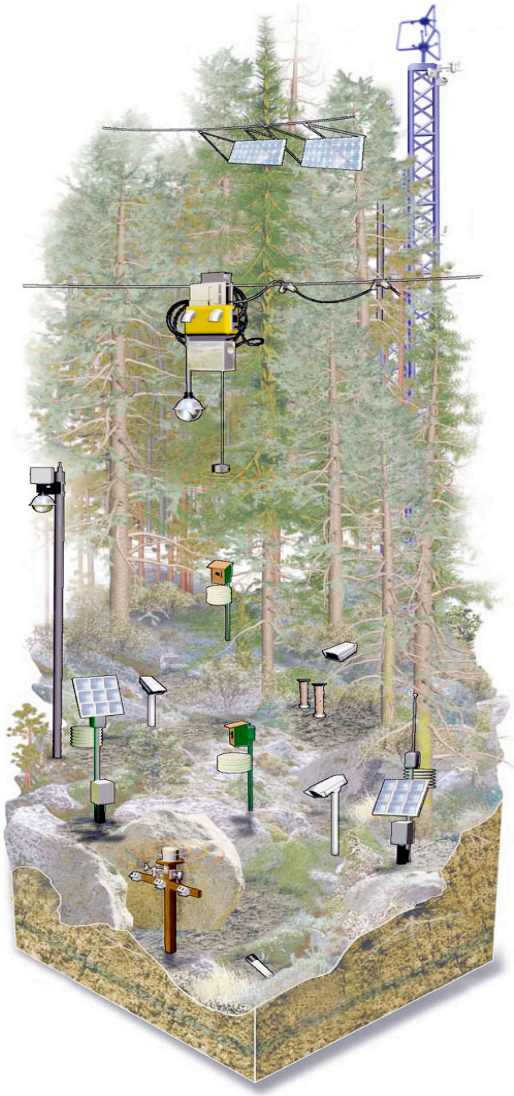
Inferring ecological states through images

- There are questions we can't (easily) answer with traditional sensors
  - What are the CO_2 relations of a plant in the field?
  - Is the flowering and leafing events of different species synchronized with pollinators and herbivores?
  - When do the different stages of the avian breeding cycle occur and what types of behaviors do birds exhibit in these stages?
- Indirect sampling of actual phenomena of interest
  - Color ◊ CO_2
  - Timing of flowering ◊ synchrony of pollinators
  - Egg Count ◊ breeding stage



Overcoming limitations of general vision approaches

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Category Recognition Goal:

Distinguish between many categories, including an “everything else”.

Application Goal:

Distinguish between a few categories, knowing the data collected will only contain those categories on a constrained system.

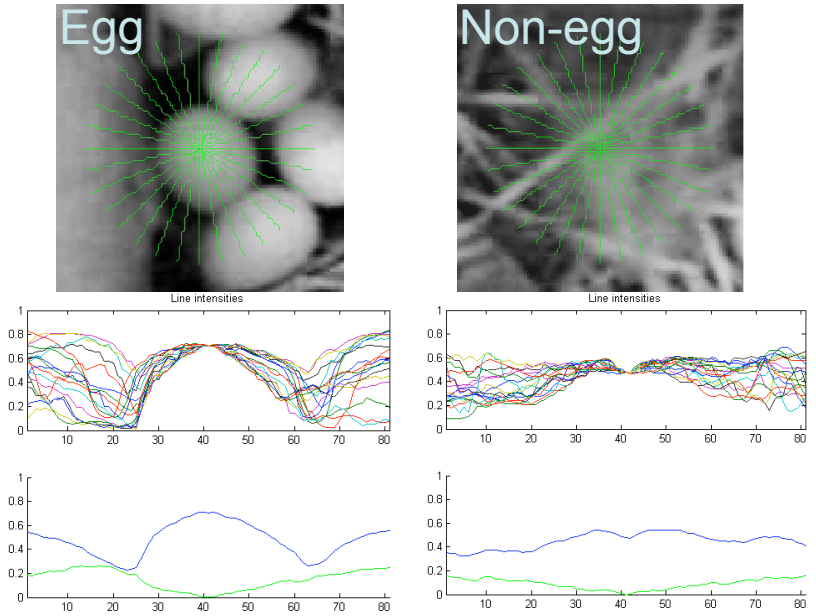
	SIFT Descriptor		Profile Intensity	
	Precisio	Recall	Precisio	Recall
1000+ images	80.61%	53.50%	96.72%	84.14%

Our Approach

-Find an relationship from the problem space into feature/model pairs

-Allow the application to determine the parameters

-Systemically integrate domain knowledge



Generalizable? :

Detecting flowers in meadows

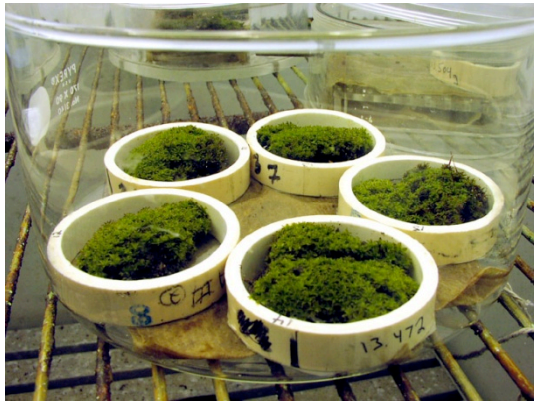
Doing what humans can't do

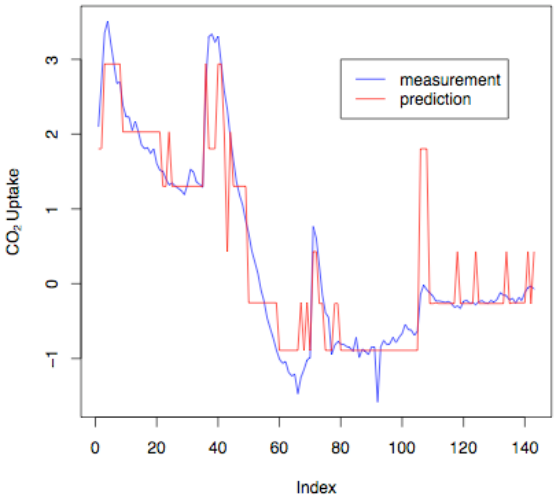
Application Goal:

Determine CO_2 uptake of a drought-tolerant moss in the field.

Using Domain Knowledge:

There is a known correlation between moss color and CO_2 uptake. However, requires a human observer in the field at all times.





Building a model:

1. Extract color based image features
2. Build a regression based model of CO_2 data collected in a laboratory.

Eventually, apply to historical data from existing experiments in the field.

Imagers and interactive sensing

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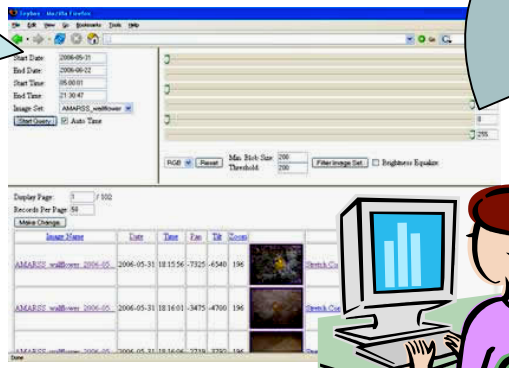
Area of interest

Interactive visualization & image processing



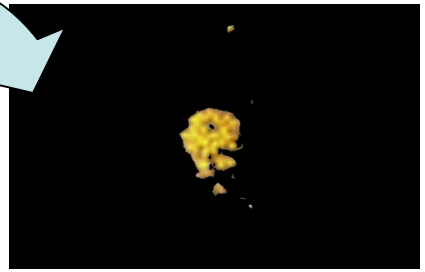
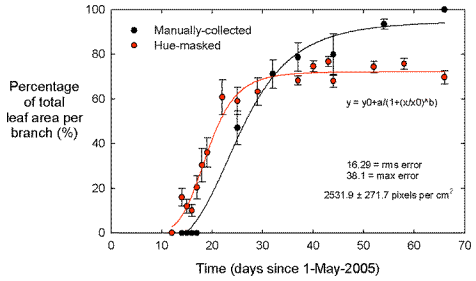
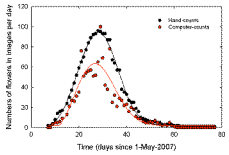


Image Capture

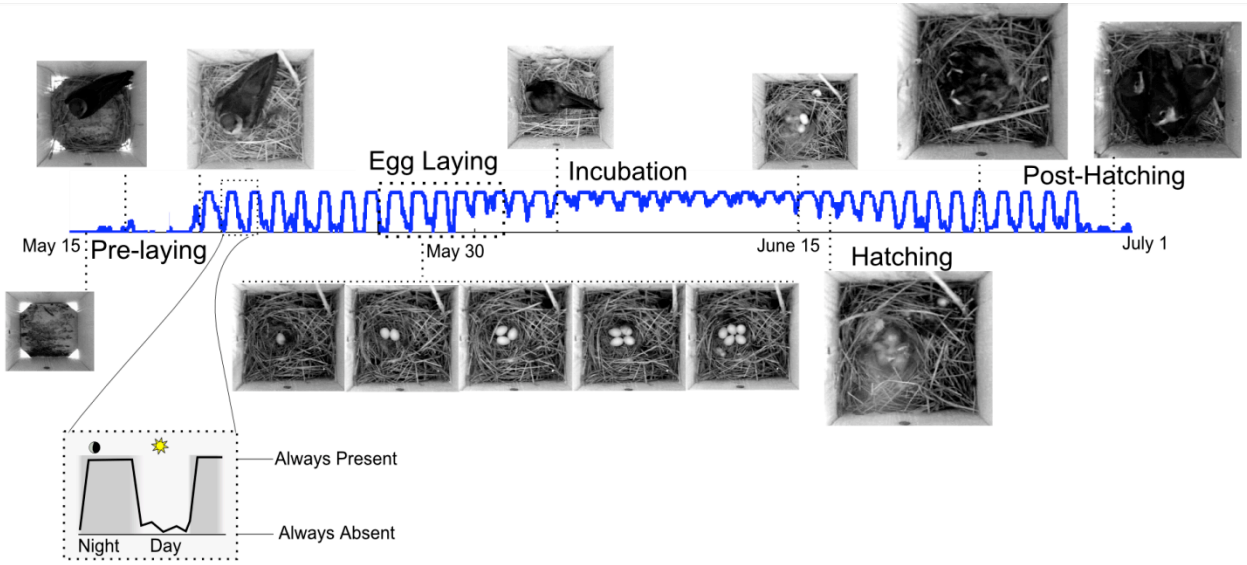


Scientific results



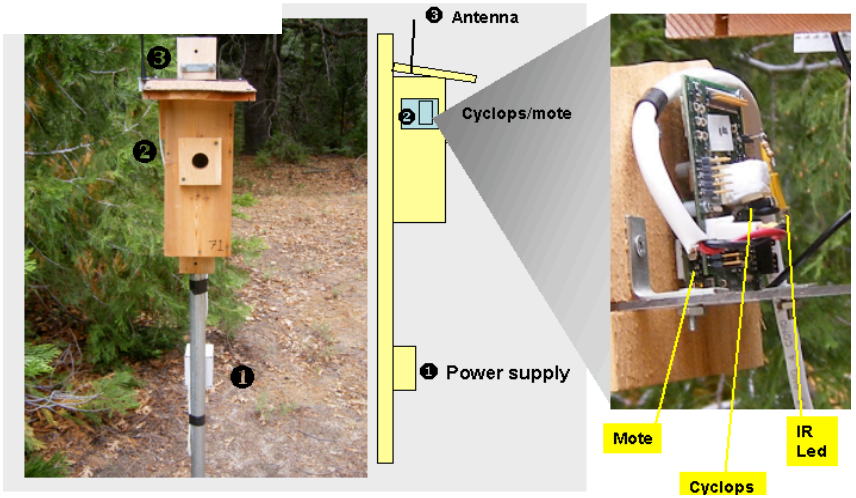
Developing the system

End Goal: Snapshot of nesting cycles.



Characteristics

-Dense Spatial Sampling
- Remote Locations
- Automated Processing

Approach

-Low-power image sensor and radio
- Adaptive Sampling
- Partition computation across a hierarchy of heterogeneous processors