The goal of CENS is to collaboratively develop Embedded Networked Sensing in terms of:

- Technologies (hardware but mostly software)
- Systems (software and statistics)
- Applications (ecological and social)

And to create programmable, distributed, multi-modal, multi-scale observatories to address compelling science and engineering issues.

**The Networked Naturalist**
Mobile phone data collection for citizen science and education
CENS Pilot Campaigns

GarbageWatch
Recycling Practices

HabWatch
Harmful Algal Blooms

What’s Bloomin
Blooming Plants
Leveraging the millions of visitors to our National Parks, we have developed a smart phone + website system to help combat the spread of invasive species, allowing users to geotag invasive observations and NPS officials to obtain up-to-the-minute weed and pest location information.
What’s Invasive! – Lists of weeds

(1) One, Few, or Many is the amount of invasives you see.

(2) Photo on/off and Note on/off to add a photo and notes to your observation.

The phone has automatically selected the appropriate weed list based on your location.
**What’s Invasive! – NPS Pilot Study**

The Santa Monica Mountains National Recreation Area is the nation’s largest urban national park, featuring over 500 miles of recreation trails, all within easy access to a metropolitan region of more than 17 million people.

In May, we handed out 10 Nokia phones to NPS staff …

**TOP 6 INVASIVES!**

- Harding grass
- Perennial pepperwood
- Poison hemlock
- Spanish broom
- Terracina spurge
- Yellow starthistle
New weed distributions and significant advancement of some invasive species had occurred within the 3 years since the original survey.

**Total weeds found in the two-year NPS survey:** 5426.

**Total weeds found using What’s Invasive in two weeks:** 975 = 18%
What’s Invasive! – UCLA Classroom Campus Activities
What's Invasive! – UCLA Classroom Fieldtrip

As part of a UCLA course in California Ecosystems, Professor Philip Rundel wanted to have his students map invasive plants along Topanga Canyon in the Santa Monica Mountains.

He decided to try out the system himself first, and in a couple hours walking down the canyon and concentrating on one invasive species (*Euphorbia terracina*), he mapped 373 locations.
The next weekend, his students were provided with 15 Android cell phones and walking in pairs over shorter sections of the canyon, they mapped a total of 369 locations for the invasive *Arundo donax* (Giant reed) corresponding to 267 new observations (relative to the previous NPS survey) and 102 repeat verification observations.
**BudBurst Mobile** – National Plant Phenology Watch

**Project BudBurst** – National citizen science education campaign

- A CENS Summer Intern project expanded on Project BudBurst to create a user-friendly website to submit and update observations, add geo-tags, and upload photos and comments.
- Participants can view the progress of their own data collection relative to historical data.
- Mobile phone users can submit via SMS, MMS, or e-mail and get regular SMS reminders and updates.
BudBurst Mobile – Keeping track

Phenology stages are available for leaves, flowers, and fruits. You can easily see the plant stages that scientists want you to observe.

Taking a photo of the plant is an easy way to make an observation and serves as validation of your work.

Make notes on your observation, too.
Wisconsin Fast Plants® http://www.fastplants.org/

Fast Plants® are a type of crucifer (the group of plants that includes mustard, radish, cabbage, etc.) that have been bred and selected to have a uniform, short flowering time (14 days) and grow well under in a small indoor space, with little soil, under artificial lights.
Project BudBurst – Classroom / Home Activity

First Flower

Full Flower

day 11

day 13

day 15
Phenology stage icons are the same on the phone as they are on the website.
Next Steps for Advancing Our Mobile Citizen Science

- Data sharing among systems in an environmental network.
- Back-end data analysis for real-time models.

We are working with Invasive.org and other networks to provide easy access to and extensive broadcast of *What’s Invasive!* data sets through automated uploads and data sharing.
Next Steps for Advancing Our Mobile Citizen Science

- Data sharing among systems in an environmental network.
- Back-end data analysis for real-time models.

We are combining Project BudBurst user collected data with using external data sources (local weather) and models to create daily, real-time feedback and predictions of plant events.

Is your plant leafing out?

Growing Degree Days prediction of Spring: March 13th
Sign up, provide your email...

What’s Invasive:

whatsInvasive.com
bit.ly/whatsinvasive

BudBurst Mobile:

bit.ly/mobileBB
bit.ly/mobileBBapp

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