Journal of Extension
www.joe.org

**February 2013**

**Volume 51 Number 1**

**Article Number:**

**1TOT1**

# Mobile Applications for Participatory Science

**Sabrina L. Drill**
Natural Resources Advisor, Los Angeles and Ventura Counties
University of California Cooperative Extension
Los Angeles, California
sldrill@ucdavis.edu

***Abstract:*** *Citizen science, participatory research, and volunteer monitoring all describe research where data are collected by non-professional collaborators. These approaches can allow for research to be conducted at spatial and temporal scales unfeasible for professionals, especially in current budget climates. Mobile computing apps for data collection, training, and analysis can greatly enhance participatory science.*

*This article is part 3 in a series on the use of mobile computing applications for Extension work. The first article discussed mobile applications for Extension, and the second discussed tools for creating mobile applications. A later article in this series will focus on the use of apps for youth education in science and agriculture.*

## Participatory Science

While projects like the National Ecological Observatory Network (NEON) make use of autonomous sensors to collect environmental data, sensing by humans (Goldman et al., 2009) is still the best way to collect certain kinds of data, such as species occurrence (Sullivan et al., 2009). Working with citizen scientists has several advantages. It allows data collection on areal and temporal scales that are difficult to attain by professional researchers (Salmon et al., 2008). Data can be collected synchronously over a wide area, potentially including sites researcher might not have considered. And it facilitates increased investment from participants in research results, as individuals who collect data show an increased level of stewardship (Borisova et al., 2012). In an Extension context, it allows clientele collaborators to gain a deeper understanding of the information they help collect.

Citizen observers can collect data simultaneously at continental, national, or statewide scales during events such as the Great Backyard Bird Count (Bonney et al., 2009) but may also collect data on an ongoing basis over large areas, such as with the Appalachian Trail MEGA Transect (Cohn, 2008) or the international Reef Check program (Gillett et al., 2012). These data are collected at very low cost (Goldman et al., 2009). Volunteer monitors have collected water quality information for decades usually in concert with federal, state, or local environmental protection agencies. With at least 900 groups engaged in water quality monitoring, these activities contribute useful data which may be especially important as professional programs suffer funding cutbacks (Loperfido, Beyer, Just, & Schnoor, 2010).

The Internet has greatly facilitated coordination and management of large-scale participatory projects. Web-based conduits for citizen science allow users to share and analyze the information. This serves to increase scientific literacy and engagement (Bonney et al., 2009; Wiggins & Crowston, 2012) and can empower landowners, even on small residential properties, to take action to better manage the landscape (Cooper, Dickinson, Phillips, & Bonney, 2007). Greater participation in the creation of content and in the collection and analysis of data is part of a general trend to a more interactive Internet, dubbed Web 2.0 (O'Reilly, 2007) with the push towards citizen science, Science 2.0 (Cohn, 2008).

## Mobile Apps for Participatory Research

The use of mobile computing applications (apps) merges Web 2.0 and Science 2.0. Mobile computing devices create unprecedented capacity for members of the public to collect, share, and use data (Drill, 2012a; Shilton et al., 2009). Participants can record observations on site and in real time, data can be processed in "the cloud," and users can have access to their own and to shared data while in the field (Drill, 2012b; Goldman et al., 2009). This interactivity can guide further data collection—for example, if a user documents the location of a particular bird then notices an observation of another species in the area he or she may refocus efforts to look for both species. Apps for

participatory science include INaturalist, Project Noah, and eBird, which collect information about species observations; Project Budburst, a national effort to collect phenological data; OakMapper, which tracks incidences of Sudden Oak Death; and What's Invasive! and I've Got1, which map the distribution of invasive plants and animals. These are examples of coordinated monitoring efforts and effective outreach tools, showing people where and when these phenomena occur and providing them with more information.

These apps primarily attract users who are inherently interested in the topic, but data collection can be further enhanced by the addition of game features, like those in What's Invasive or the FloraCaching feature of Project Budburst, which encourage users to compete to collect more observations. Benefits of using mobile devices for data entry include the fact that certain kinds of data (location, time) are entered automatically, and photos are instantly tagged as they are taken. More complex data can be observed and entered at the same time, rather than recorded for later entry, which cuts down on data entry errors and participant fatigue.

One additional advantage of using mobile apps for citizen science may be the ability to reach new audiences. For youth especially, as exposure to video screens increases, experience of nature decreases—what has been termed "nature deficit disorder (Louv, 2009). Paradoxically, mobile applications could be used as a tool to engage the "net generation" with nature by guiding observations (e.g., Arnold Arnold, 2012). A later article in this series will focus on the use of apps for youth education in science and agriculture.

## Data Quality Control

When engaged in participatory data collection, there are several issues that arise in terms of data quality and management. Data quality can be regulated at the input stage or through review before final recording. Observers may be required to participate in a training prior to data collection, or the instructions may be contained within the app. Mobile apps can enhance this aspect of participatory research (Drill, 2012a), as on-screen prompts clearly guide the users through the data collection process, and illustrations, photos, animations, and videos can be incorporated to guide sample collection and species identification. Trained volunteers can find "refresher" resources built into apps.

While data collected by citizen volunteers can be extremely valuable, researchers should limit their expectations of what they are asked to do—for example, identifying a few easily recognizable indicator species, rather than expecting a comprehensive knowledge of the flora and fauna. Protocols should be very clear, directions easy to follow, and the collected data tested for reliability (Cohn, 2008). Data submitted by volunteers must be managed and reviewed to ensure data quality. This can be a challenging task, and a clear quality control plan should be developed before sharing a data collection app. Data collected by volunteers may not be as accurate as that collected by professional scientists, but evaluation of these data, and refinement of data collection protocols, can improve the quality (Gillett et al., 2012; Loperfido et al., 2010). In addition, volunteer data can be used to direct the use of scant professional resources (Loperfido et al., 2010).

## References

Arnold, G. (2012). Enhancing college students' environmental sensibilities through online nature journaling. *Environmental Education Research*, 18(1), 133-150. doi: 10.1080/13504622.2011.589000.

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen science: A developing tool for expanding science knowledge and scientific literacy. *Bioscience*, 59(11), 977-984. doi: 10.1525/bio.2009.59.11.9.

Borisova, T., Flores-Lagunes, A., Adams, D., Smolden, M., McFarland, M. L., Boellstorf, D. E., & Mahler, B. (2012). Participation in volunteer-driven programs and their Effects on homeowners' landscaping practices. *Journal of Extension* [On-Line], 50(3) Article 3RIB4. Available at: http://www.joe.org/joe/2012june/rb4.php

Cohn, J. P. (2008). Citizen science: Can volunteers do real research? *Bioscience*, 58(3), 192. doi: 10.1641/b580303.

Cooper, C. B., Dickinson, J., Phillips, T., & Bonney, R. (2007). Citizen science as a tool for conservation in residential ecosystems. *Ecology and Society*, 12(2).

Drill, S. (2012a). Mobile applications for Extension. *Journal of Extension* [On-line], 50(5) Article 5TOT1. Available at: http://www.joe.org/joe/2012october/tt1.php

Drill, S. (2012b). Tools for creating mobile applications for Extension. *Journal of Extension* [On-line], 50(6) Article 6TOT1. Available at: http://www.joe.org/joe/2012december/tt1.php

Gillett, D. J., Pondella, D. J., Freiwald, J., Schiff, K. C., Caselle, J. E., Shuman, C., & Weisberg, S. B. (2012). Comparing volunteer and professionally collected monitoring data from the rocky subtidal reefs of Southern California, USA. *Environmental Monitoring and Assessment*, 184(5), 3239-3257. doi: 10.1007/s10661-011-2185-5

Goldman, J., Shilton, K., Burke, J., Estrin, D., Hansen, M., Ramanathan, N., West, R. (2009). Participatory sensing: A citizen powered approach to illuminating the patterns that shape our world (F. a. G. Project, Trans.) *White Paper* (pp. 20). Washington, D.C.: Woodrow Wilson International Center for Scholars.

Loperfido, J. V., Beyer, P., Just, C. L., & Schnoor, J. L. (2010). Uses and biases of volunteer water quality data. *Environmental Science &*

*Technology*, 44(19), 7193-7199. doi: 10.1021/es100164c.

Louv, R. (2009). Do our kids have nature-deficit disorder? *Educational Leadership*, 67(4), 24-30.

O'Reilly, T. (2007). What is Web. 2.0: Design patterns and business models for the next generation of software. *Communications & Strategies* (65), 17-37.

Salmon, T. P., Faber, B., Bender, G., Shaw, D., Kowalski, V. J., & Berentsen, A. (2008). Volunteer researchers: Moving beyond cooperators. *Journal of Extension* [On-line], 46(2) Article 2FEA7. Available at: http://www.joe.org/joe/2008april/a7.php

Shilton, K., Burke, J. A., Estrin, D., Govindan, R., Hansen, M., Kang, J., & Mun, M. (2009, September 25th-27th 2009). *Designing the personal data stream: Enabling participatory privacy in mobile personal sensing*. Paper presented at the 37th Research Conference on Communication, Information, and Internet Policy, Arlington, VA.

Sullivan, B. L., Wood, C. L., Iliff, M. J., Bonney, R. E., Fink, D., & Kelling, S. (2009). eBird: A citizen-based bird observation network in the biological sciences. *Biological Conservation*, 142(10), 2282-2292. doi: 10.1016/j.biocon.2009.05.006.

Wiggins, A., & Crowston, K. (2012, 1/2012). *Goals and tasks: Two typologies of citizen science projects*. Paper presented at the Forty-fifth Hawai'i International Conference on System Science (HICSS-45), Wailea, HI.