A Community Effort to Document Wildlife

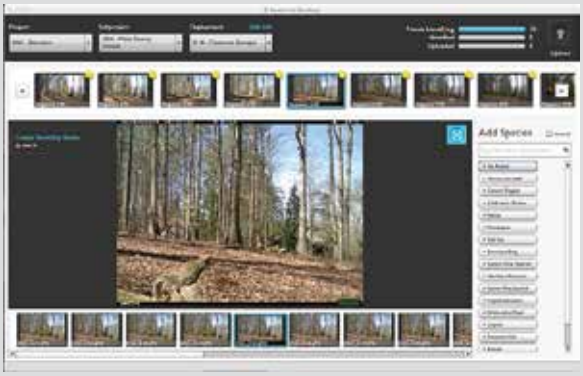
eMAMMAL PROJECT EXPANDS THE IMPACT OF CITIZEN SCIENTISTS

By Roland Kays, Tavis Forrester and William McShea

Outdoorsmen and women love to share their wildlife experiences with friends and colleagues, be it a crazy encounter with an animal, an amazing photo or a harvested trophy animal. Wildlife managers take advantage of this passionate network of observers to gain an understanding of how animal populations are faring.

While state agencies have long used data from harvest reports or sighting logs, these data sets have their limitations because hunter effort and efficacy is difficult to quantify. However, a new approach, which relies on volunteer-run camera traps, has the potential to revolutionize how states monitor wildlife. Camera traps can take thousands of pictures while strapped to a tree for weeks or months at a time. That, combined with the thousands of recreational camera trappers who far outnumber scientific users today, allows researchers to quantify the wildlife community with better precision and over large scales. It also helps connect people to the animals they "capture" in their pictures.

Still, the large troves of wildlife data that camera traps are capable of delivering create a new challenge: data management. As a solution, in 2012, a team from North Carolina, the University of Missouri and the Smithsonian Institution built the eMammal system — a tool that enables volunteers to review their pictures, identify the animals and upload results to a central location. From there, project managers are able to quickly review the images to ensure data quality, check species identification and then archive the records in a curated image database at the Smithsonian. The public portal for the system is the eMammal website where the data can be examined using some basic tools, or exported for more extensive analysis. The best pictures can also be called up, shared and used to illustrate the results of a survey. With a shared metadata structure, images and data can be shared across projects to create a synergy of agency efforts to document wildlife.



Courtesy of Roland Kays

This eMammal desktop tool allows volunteers to examine their camera trap pictures and identify animals. The millions of pictures that camera traps capture are ultimately sent to project leaders who verify data quality.

Getting the Lay of Public Land

To test the effectiveness of camera trap research led by citizen scientists, from 2012 to 2014, we worked with 352 volunteers to survey 32 public lands across six eastern states. The goals of this study were to document how often species were detected at each site and evaluate the effects of recreational use such as hunting and hiking on their populations.

All volunteers used the same sampling plan so that data could be combined and analyzed. First, we used a "stratified-random" study design, which involved placing cameras in randomly selected sites that fit certain criteria. In this case, to allow us to test for effects of hikers on wildlife, we set one camera on the trail, another near the trail — roughly 50 meters away — and a third far from the trail — roughly 200 meters away. We also selected pairs of lands that were near each other but had contrasting regulations about hunting, in that one area permitted hunting and the other didn't. All cameras were set at knee height, without bait, and left in one place for three weeks.

We recruited local volunteers to run the cameras, drawing from hiking groups, naturalist clubs and existing park volunteers. We held a four-hour training session on how to use the cameras, which we provided; a GPS unit, which the volunteers provided; and our software. They did a remarkably good job at operating the cameras, with 94 percent of cameras being set correctly, and most species being identified correctly (Mc-

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Shea et al. 2016). Because we verified all the original images, we were able to correct any misidentified records, creating a "research grade" dataset through the collaboration of citizens and wildlife experts.

In all, we obtained over 175,000 records from about 2,000 locations, providing substantial insight into these wildlife communities. As expected, white-tailed deer (*Odocoileus virginianus*) were the most common wildlife species, followed by gray squirrels (*Sciurus carolinensis*) and raccoons (*Procyon lotor*). Although we photographed a variety of native carnivores such as bobcats (*Lynx rufus*) and coyotes (*Canis latrans*), we were surprised by the lack of domestic cat pictures, given the widespread concern over the effects of this introduced species on native birds and mice. In fact, cameras in half of the sites recorded no cats, and only two sites had more than one cat photographed. Although obviously a problem in some developed areas, our surveys showed that feral cats are not a big conservation concern for most of the larger protected areas in the region. Our statistical models suggest the abundance of coyotes is likely responsible for the low numbers of cats on these public lands (Kays et al. 2015).

Overall, we found that there was little change in how wildlife used particular areas that were also popular among hikers and hunters (Kays et al. 2016). In fact, habitat factors such as housing density and large tracks of forest, rather than recreational use, seemed to influence how and to what extent a species used that site. Interestingly, hunting most strongly influenced coyotes, which were found to have much higher activity in hunted areas than in public lands where hunting was prohibited. Although it's unclear why we got so many more coyote pictures at hunted sites, we think it could be due to an influx of younger animals dispersing into a site to take advantage of territorial vacancies created by hunters or trappers.

This project is one example of how volunteers armed with camera traps, a protocol and an effective data management system can help inform natural resource managers.

Wildlife Across Land Ownership

Our next project was aimed at documenting the distribution of wildlife across public and private lands by surveying the gradient of development that runs from city to country to wildlands. Using a 125-mile radius around Washington D.C. and Raleigh, N.C., we established camera sites across development levels — suburban, exurban, rural and wild — at larger scales based on housing density. We also considered disturbances on smaller scales by dividing cameras across sites that included backyards, small forests, large forests and open developed areas such as golf courses or cemeteries.

Credit: Jeffrey MacMillan

▲ **Citizen scientists participate in wildlife monitoring projects by running camera traps in their local natural areas and sharing their images with wildlife biologists, or just by helping to identify pictures taken by others. This collaboration not only extends the scale of areas that can be monitored, but also helps connect people with their local animals.**

Once again we recruited over 300 volunteers to run cameras, either on their own property or in nearby public spaces. However, this time, we also tested online training material with some volunteers, rather than conducting an in-person training session. The online training proved just as effective, with similarly high approval rates for data collected by citizen scientists.

For these surveys in and around cities we also engaged students to operate the cameras. We worked with middle school teachers to develop curricula around camera trapping, and they collected important data from forests on their school property or near their homes. We also incorporated camera trapping surveys into university classes that included analytical labs where students crunched the numbers to make genuine and unique discoveries about urban wildlife, using eMammal to combine their few survey points with the larger collection of data amassed from hundreds of citizen scientists.

Although we haven't yet completed formal analyses of these city-wide wildlife records, we have discovered a remarkable population of animals living in close proximity to people. Students have used the images and data in their own science projects, and hundreds

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of residents have been surprised to learn how many animals patrol their neighborhoods at night, especially foxes and coyotes. Our standard protocol also will allow a comparison of animal communities across the two cities we surveyed. Expanding this to other cities around the country could provide important insight into how animals are moving into developed areas, and how that movement is changing urban ecology.

Courtesy of Roland Kays

A white-tailed deer wandering on private land stops to look at a camera trap.

Courtesy of Roland Kays

A group of bears walks through a forest in Virginia. Wildlife surveys in spring and summer are useful for documenting breeding patterns, as well as wildlife distribution.

Courtesy of Roland Kays

The unique branching patterns of male deer are evident in this camera trap photo — information that can be used to identify individuals, and in the process, estimate population densities.

Statewide Surveys

The success of these and other citizen science efforts has emboldened researchers to think bigger, scaling up to statewide efforts. Snapshot Wisconsin is a new, ambitious, large-scale program that enlists volunteers to run cameras provided by the project, and also taps into the global "cloud" of animal lovers to help identify photographs through the Zooniverse platform. The North Carolina Wildlife Resources Commission — in collaboration with our eMammal team — will soon launch its own statewide survey called "Candid Creatures" that will use a mix of project and citizen cameras and collect images through the eMammal system. Camera sites will be stratified across a subset of counties in the fall to obtain doe:fawn ratios, and then be distributed more across the state for other wildlife species during the rest of the year.

These large-scale wildlife monitoring projects offer an exciting new chapter in the long history of collaboration between citizens and wildlife managers. By archiving both images and their metadata, these projects collect hard evidence that can be verified, keeping the natural exaggeration of typical hunters' stories in check. At the same time, these efforts help launch a new type of wildlife story, one shared on Facebook and Twitter, as citizens show their friends and family the latest animal "selfie" they may have captured, bragging about the great wildlife with which they share a home. ■

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