

Rocky Mountain Research Station Science You Can Use Bulletin



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A Feather in Their Cap: Using Citizen Monitoring to Track Post-Wildfire Bird Communities in the Arizona Sky Islands

Birders are an especially passionate lot of wildlife enthusiasts, often travelling long distances with expensive spotting scopes to add new species to their “life lists.” This quality of birders has long been harnessed for science, allowing researchers to gather data at a breadth and scale well beyond anything they could accomplish on their own. The longest running “citizen science” effort is the Christmas Bird Count, dating back to Christmas Day,

1900, when Audubon Society ornithologist Frank M. Chapman proposed the idea of counting birds during the holidays (rather than hunt them, so the story goes). Even now, from December 14 through January 5 each year, tens of thousands of volunteers still count birds at specific locations across the United States. Since the outset of this project, many more birding-related citizen science projects have been developed over the decades and recent initiatives

SUMMARY

The Sky Islands of southeastern Arizona, which consist of separate mountain ranges within a desert matrix, are a unique biodiversity hotspot hosting many neotropical bird species that cannot be seen anywhere else in the United States. Residents of this region depend on ecotourism for their livelihood and there is an above-average concentration of citizens skilled at identifying birds by sight and sound. After the Horseshoe Two wildfire in 2011 burned a large portion of the Chiricahua range, the local residents approached RMRS with concerns about effects on the bird populations. RMRS researchers initiated a partnership with a local group, the Friends of Cave Creek Canyon, to assess the feasibility of using a citizen-monitoring program to collect bird population data. By comparing citizen-collected data with that collected by a professional crew, they found that citizen science partnerships can be used for inexpensive and statistically rigorous monitoring, with the added benefit of fostering greater local public involvement in science and conservation. The data collected showed an increase in the overall diversity of bird species found across the landscape. Woodpeckers and flycatchers often become more abundant right after a fire due to the beetle colonization of dead trees. Preliminary results of this study indicate that the buff-breasted flycatcher, a species of concern in the region, has expanded its range to include the recently burned landscapes.



The Sky Islands in Arizona are a biodiversity hotspot, drawing neotropical birds not seen elsewhere in the continental United States. RMRS researchers partnered with citizen scientists to find out what happens to these bird populations following wildfire (photo by J. Sanderlin).

Researchers at Rocky Mountain Research Station partnered with citizen birders to collect data following wildfire within one of the most unique birding locations in the United States, the Madrean Sky Islands in Arizona.

take advantage of our growing global connectivity.

The U.S. Forest Service also has a long history of citizen monitoring projects. Researchers at Rocky Mountain Research Station (RMRS) partnered with citizen birders to collect data following wildfire within one of the most unique birding locations in the United States, the Madrean Sky Islands in Arizona (read more about RMRS avian research in the box below). This area is a “biodiversity hotspot” and has been drawing birders from all over for decades with hopes of seeing neotropical birds that don’t visit anywhere else in the United States. More than 7,000 species of plants and animals, including over half of the bird species in North America, can be found within the Sky Islands. Although the area is sparsely populated, there is an above-average density of resident professional birding guides and experienced amateur birders. RMRS wildlife biologists Jamie

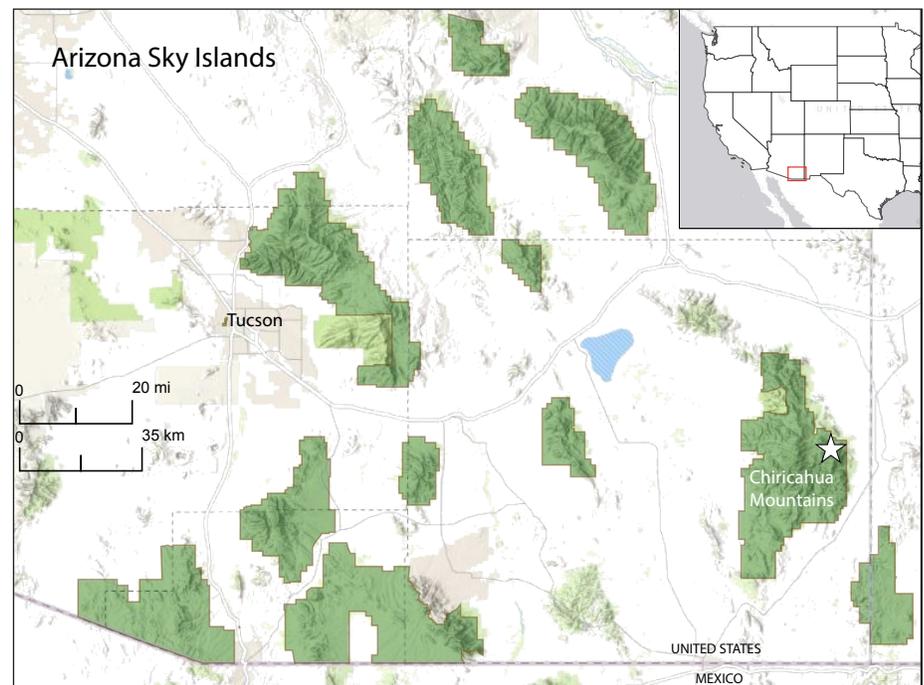
Sanderlin, Joe Ganey, and other colleagues took advantage of this expertise following a wildfire in the Chiricahua Mountains of the Coronado National Forest near Tucson, Arizona, in 2011 and set up a study to determine the feasibility of using data collected by local citizen birders to assess the effects of the wildfires on the local and migratory bird populations.

The uniqueness of the Sky Islands

The concept of a “sky island” originated in 1943 when Natt N. Dodge referred to the Chiricahua Mountains as a “mountain island in a desert sea” in a magazine article. The term was later popularized by nature writer Weldon Heald in his

1967 book *Sky Island*, in which he described a drive from a town in the western Chihuahuan desert to an oak and pine-studded peak in the Chiricahua Mountains, only 35 miles away but 5,600 feet higher in elevation.

The Sky Islands represent the convergence of two different climatic and vegetation zones—the Rocky Mountains and the Sierra Madre Occidental—and steep elevation gradients and isolated habitat islands have resulted in distinct and very biodiverse vegetation, wildlife, arthropod, and associated bird communities. With these unique conditions and proximity to the Mexican border and neotropics, birders visiting



The Coronado National Forest (dark green shaded area) is made up of several mountain ranges. The citizen monitoring effort set up by RMRS was conducted in the Chiricahua Mountains, tucked into the southeast corner of Arizona. The approximate location of Cave Creek Canyon, a popular scenic and birding destination, is shown with a star.



One of the mountain ranges of the Sky Islands—the Chiricahuas—is home to Cave Creek Canyon, often referred to as the “Yosemite of Arizona” because of its stunning rock formations. The area attracts birders from all over due to its rich bird diversity and the opportunity to see neotropical species not usually seen elsewhere (photo by Friends of Cave Creek Canyon).

the Sky Islands may see species that otherwise are unknown or uncommon on U.S. lands, like the Elegant Trogon, Elf Owls, Montezuma Quail, Red-faced Warbler, Arizona Woodpecker, Five-striped Sparrow and many different hummingbird species.

The Sky Island area within the United States and Mexico is made up of over 40 different mountain ranges; RMRS sampled birds and vegetation in five of the higher elevation ranges that fall within the United States as part of the Coronado National Forest in the 1990s. The citizen monitoring effort set up by RMRS scientists Sanderlin and Ganey was conducted in the Chiricahua Mountains, tucked into the southeast corner of Arizona. On the east side of the Chiricahuas is an area known as Cave Creek Canyon, often referred to as the “Yosemite of Arizona” because of its stunning rock formations.

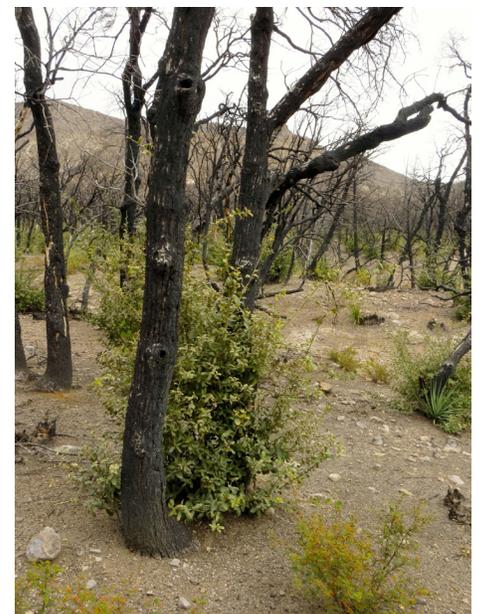
The Horseshoe Two Fire and ecotourism concerns

On May 8, 2011, the Horseshoe Two Fire began in Horseshoe Canyon within the Chiricahua Mountain range on the Douglas Ranger District of the Coronado NF, just south of Cave Creek Canyon. The residents of Portal, an unincorporated community at the mouth of Cave Creek Canyon, were evacuated as the fire spread and threatened the town. It eventually burned over 200,000 acres, including the upper portion of the Cave Creek Canyon watershed. Sanderlin explains, “As with most wildfires, there was a range of fire severities, where some areas burned pretty hot, some more moderately and then some had very low to no fire, but overall this fire covered most of the Chiricahua mountain range.”

Area residents were primarily concerned about their homes while the fire was active, but in the aftermath, were thinking of their

ecotourism livelihoods as well. “The concern of many locals offering lodging or birding tours was that potential visitors would read about the fire and decide not to come because they thought the birds would be gone,” says Sanderlin.

The environmental non-profit [Friends of Cave Creek Canyon](#), a conservation-minded group of local citizens with an interest in the health of the surrounding forest, works closely with the U.S. Forest Service professionals to support the agency’s work and mission in this area. Already aware of an



In 2011, the Horseshoe Two Fire burned over 200,000 acres of the Chiricahua Mountain forests. The fire burned at a range of severities, from no burn to severe (as above, but note the vigorous resprouting of this Madroñal oak woodland), but overall the fire covered most of the mountain range. The local community, which includes many people who run ecotourism operations, were concerned about the fire effects on the bird populations and approached the RMRS in Flagstaff with their concerns, whereupon a citizen monitoring program was initiated (photo by J. Sanderlin).

Avian Research and Monitoring at Rocky Mountain Research Station: Science nested in land management

You have probably heard the phrase ‘canary in a coal mine’, but have you also considered how birds act as harbingers in all kinds of ecosystems? By understanding key avian species and their habitat requirements, land managers are better equipped to make decisions about whole landscapes.

For many years, scientists at the Rocky Mountain Research Station have studied birds to find out how they can provide advance warning for various environmental scenarios. They’ve also studied birds’ various ecosystem roles, which include seed dispersal and foraging on herbivorous insects.

It’s important research. Over the past few decades, Rocky Mountain Research Station studies have enhanced ecosystem knowledge, assisting land managers with land management plans, bird conservation plans and providing support for legal findings.

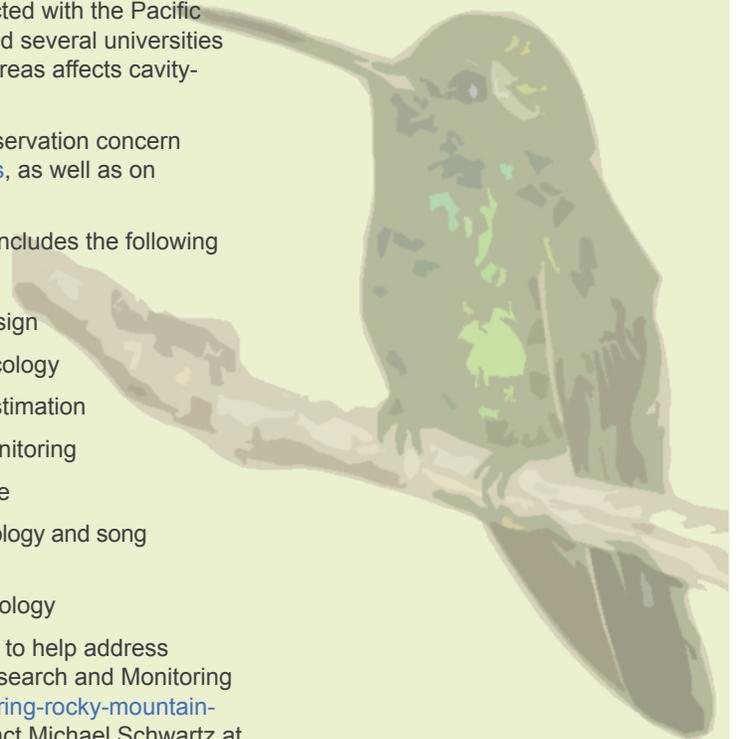
Here are a few examples of Rocky Mountain Research Station avian research:

- When forest managers in the southwestern United States grappled with how to manage forests for goshawks, a team led by research wildlife biologist Richard Reynolds worked with forest managers to study [goshawks and forest disturbance dynamics](#). This work has continued for more than three decades.
- Research wildlife biologist Joe Ganey and his colleagues are at the forefront of Arizona research on [Mexican spotted owls](#), which are listed as a threatened species in the United States and Mexico. This work has continued for more than 25 years.
- Research into [black-backed woodpeckers](#) and other birds that colonize burned areas in the Rocky Mountain Region is being used to understand historic woodpecker nesting habitats and to predict future nesting habitats under different management and climate scenarios.
- Cross-jurisdiction research across large landscapes includes the [Birds and Burn Network](#), a comprehensive series of studies conducted with the Pacific Northwest Research Station, the Nature Conservancy and several universities to understand how fire management in beetle-outbreak areas affects cavity-nesting birds and songbirds.
- Other research related to species or communities of conservation concern include studies on [sage grouse](#) and other [grassland birds](#), as well as on [chipping sparrows](#) and [ferruginous hawks](#).

Rocky Mountain Research Station scientists’ avian research includes the following areas of study:

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|---|--|
| • Nestling, juvenile and adult survival | • Monitoring design |
| • Reproductive ecology | • Community ecology |
| • Genetics and genomics | • Abundance estimation |
| • Single-species management | • Long-term monitoring |
| • Habitat change | • Citizen science |
| • Climate change | • Behavioral ecology and song analysis |
| • Connectivity modeling | • Landscape ecology |

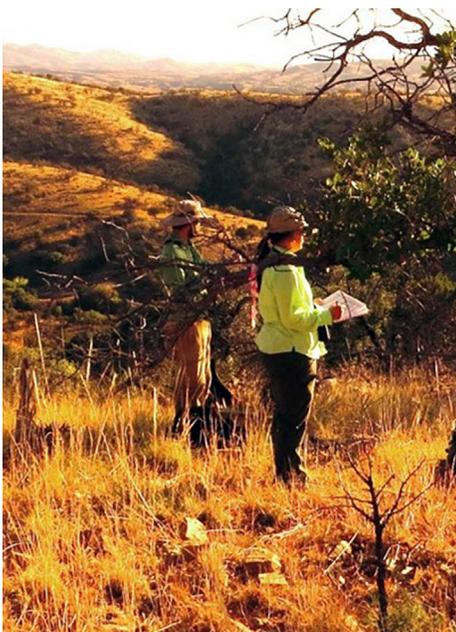
Consider partnering with the RMRS Avian Research Program to help address management challenges. For further information on Avian Research and Monitoring at RMRS visit www.fs.fed.us/rmrs/avian-research-and-monitoring-rocky-mountain-research-station-science-nested-land-management and contact Michael Schwartz at michaelschwartz@fs.fed.us



extensive bird survey that RMRS had undertaken in the Sky Islands in the 1990s, they contacted RMRS scientists after the Horseshoe Two Fire because they wanted to know how the fire would affect the bird communities. Sanderlin and Ganey saw this as an opportunity to engage the local community in collecting scientific data needed to answer this important question that the community had a vested interest in.

When the going gets tough, the tough start sampling

The RMRS researchers used their prior 1990s sampling effort as a jumping off point for developing a citizen monitoring program.



One data quality control (and safety measure) built into the citizen monitoring effort was using double observers, where two people go out together and collect data at the same time/place, standing at a point count station and writing down all the birds that they see or hear, without trying to influence the other person (photo by J. Sanderlin).

Sanderlin explains, “Because we had our protocols already set up from the 90s, and volunteers were very keen on going out there and seeing what birds were there, we decided to do a pilot study in 2012 looking at the same points from the 90s following the same protocol.”

Since the original sampling points were established in the days before GPS technology was widely available, the scientists first had to relocate plots using photographs, written descriptions, and topographical maps. Because the points had been randomly located (as dictated by basic scientific sampling protocols), they were not necessarily convenient to access, and in some cases were downright hazardous. About 100 sampling points were relocated in the Chiricahuas (representing virtually

all of the original points), but, as Sanderlin points out, “A couple of the points we just didn’t even go to because of safety concerns, even for us—many of them were well off trail and in very steep terrain. And then we realized that the fire had created an even bigger set of hazards with downed trees and loose soils.”

The first year of sampling these remote, often off-trail, points was hard on the citizen volunteers. Peg Abbott, a volunteer who was instrumental in coordinating people for Friends of Cave Creek Canyon that year, recalls, “The reality is that the average age around here is at least 65 to 70. We’re a retirement community in the middle of nowhere. So, the available labor pool really was challenged by vertical slopes, and

MANAGEMENT IMPLICATIONS

- Citizen monitoring programs can foster greater local public involvement in science and conservation and be a rewarding experience for the volunteers. The approaches we used can be used to develop similar partnerships in other National Forests.
- Several lessons learned and challenges were identified in the management of this citizen science project. Natural resource managers should be aware of the additional time and resources needed to organize and train volunteers, complete data quality control, and share information with citizen observers. In addition, the researchers found that access to sampling locations for citizen observers was an important consideration which required modifications.
- A long-term monitoring plan that leverages RMRS statistical expertise, an on-the-ground manager’s oversight, and citizen scientists, can be used to assess trends in bird populations following recent wildfires in the Sky Islands on the Coronado NF. The monitoring program can benefit both USFS and the local community by providing information on status of bird communities and their response to disturbance that otherwise would not be available.
- Wildfire in the Sky Island ecosystems appears to be beneficial for bird species such as the buff-breasted flycatcher, which is associated with burned areas. The mosaic patterns created by mixed severity-fire appears to increase the overall diversity of bird species across the landscape.





The citizen observers had a difficult time sampling the randomly located transects in the Chiricahua Mountains in 2012 due to the difficult terrain and burned areas. New 'trail points' were established for the 2013 citizen sampling for easier access; here a hiking trail can be seen in the center of the photo near one of these new points. A follow-up study found that birds detected at these trail points were similar to those at the random transect points, suggesting that these easier access points can be used in further sampling (photo by J. Sanderlin).

scree slopes, and rock. I would say it didn't deter us from getting the work done in 2012, but it did deter us from thinking we could continue to do it on a long-term basis."

Concerned about the longer-term viability of the citizen science monitoring program, RMRS scientists went back to the drawing board after the 2012 season to see if they could put in points that were in the same areas and would capture the necessary information but were safer and easier for the volunteers to access. Joe Ganey explains, "We located some new transects adjacent to the old ones, or as close as we could get them,

that utilized existing roads, and more commonly, trails, so that it was easier and safer for people to navigate them. They still had to walk up steep hills at times, but at least they were on a good trail with good footing and reasonable grades. And we kept the methodology the same, but we altered the number of points that they were supposed to count. That actually worked pretty well—they got a lot more done the second year and were a lot happier." Because the new sampling plots were easier for the citizen observers to navigate, they completed 80 percent more bird counts in 2013 than in 2012, giving the researchers a sizable data set to

"The most important thing is pairing the level of accuracy you might expect of the citizen observers with the questions you are asking."

use in their pre- vs. postfire analysis of bird population trends.

Controlling the quality of the Sky Islands citizen-collected data

When using citizen volunteers to collect data, an important question is, are the data that they collect . . . any good? If a manager or researcher is considering setting up a citizen monitoring program or any monitoring program for that matter, Sanderlin advises, "The most important thing is pairing the level of accuracy you might expect of the citizen observers with the questions you are asking." As with any monitoring program, it is important to understand the level of "noise" you would expect from sampling relative to the "noise" in the ecological system.

Accurately identifying birds takes a considerable amount of skill and experience, unlike, say, grabbing a water sample from a river, and volunteers will naturally vary in their ability level. So, to account for that in the sampling, "Our guidelines had volunteers do different transects each time they went out, so that we could spread different people across places to

account for sampling differences between observers,” says Sanderlin. Another quality control (and safety measure) built into the study was using double observers, where two people go out together and collect data at the same time/place, standing at a point count station and writing down all the birds that they see or hear, without trying to influence the other person.

But how did the citizen effort compare with what a professional



The red-faced warbler is a species of management concern in the Sky Islands. One of the more intangible benefits of a citizen monitoring program is the sense of purpose that it gives to those involved. The volunteer coordinator from Friends of Cave Creek Canyon reported that the citizen birders enjoyed having an excuse to get out and spend a day in the field and feel that they were learning and contributing something to science (photo by Jim and Deva Burns courtesy of Tucson Audubon Society and Associated Press).

birding crew would observe, or, in other words, how accurate was their data? With a background heavy in statistics as well as wildlife biology, Sanderlin can use the information to determine “optimal protocols,” or the minimum effort needed to accurately detect trends, for a long-term bird monitoring plan. The year after the main citizen-monitoring effort, researchers compared the quality of the citizen-collected data by using a professional birding crew to (1) resample the original transects (established in the 1990s) and (2) resample the new, improved sampling points that the citizen observers used in 2013. Comparing the citizen observer and professional technician data using sophisticated statistical techniques has allowed Sanderlin and Ganey to answer some specific questions. First, was there a bias in the citizen-collected data because they were sampling closer to the trails, or were they detecting the same birds as the original randomly located transects? What they found was that the birds detected were similar, giving the green light to continuing to use the easier access points for citizen surveys. Second, was the probability of detecting a given bird similar between the citizens and professionals? The researchers found— not unexpectedly —lower bird detection probabilities in the citizen observer group versus the paid technicians. “This is good to know for designing citizen monitoring studies going forward, because it means that it takes more trips to detect bird species for the

citizen volunteers. This affects the number of surveys that we would build into a monitoring program,” says Sanderlin.

What are the lessons learned from this citizen monitoring program?

There is no question that using citizen monitoring is less expensive than paying for full teams of technicians, and that citizen observers can collect valuable data. “These citizen data are important in our comparison of pre- and postfire bird populations,” says Ganey. “Although we had the paid crews count birds in 2014, that extra year of data that we got from the citizen science effort is very useful in our analysis.” There are a lot of rare birds in the Sky Islands— typically those of highest conservation concern— that are difficult to detect in just one year of sampling.

But, as he points out, there are costs to these programs. “Money for training volunteers would be well spent, to try to get everyone on the same page in terms of identifying the birds and count methodology. Any kind of data quality control you can do along those lines, would also be a worthwhile expenditure.” He also points out the need for a paid volunteer coordinator. “For this project,” he explains, “the Friends of Cave Creek Canyon basically did the onsite coordination themselves, which was extremely helpful to us, but it was a lot of work for them. If you had someone that could be

An intangible benefit of citizen monitoring is the engagement of people in the management of their local natural resources.

there to deal with the logistics of who's going where, when, and any problems that might arise, and answer questions about protocols and data quality, that would all be extremely important."

Also, there is the problem of "using up" the volunteers. Ganey admits, "One of the main barriers to doing this kind of project is that it's a lot easier to motivate people to do hard work if they're getting paid. And when they're not, I think anything you can do to build in rewards would be good, like t-shirts or free gear or even some mileage reimbursement. And we probably didn't do nearly enough of that." Additional outreach presentations before, during, and after sampling would also help with motivation to show how their efforts would be used to answer science questions.

But other than the more obvious benefit of cost savings, an intangible benefit of citizen monitoring is the engagement of people in the management of their local natural resources. Abbott of the Friends of Cave Creek Canyon maintains, "The volunteers got a real sense of purpose from being involved in this project. Part of

being retired is that you still want to contribute to your passion and most of the people in this community are actively looking for a challenge. I think there's a real connection for people that care about where they live. It gives them a great excuse to get out and spend a day in the field but feel that they are learning and contributing something."

So, how did wildfire affect the Sky Island bird communities?

Like many of the recent wildfires that have burned in the Sky Islands, the Horseshoe Two Fire was highly variable in how it burned, with some areas burning very hot, and some mostly untouched. "We weren't really expecting to see much in the way

of species gains or losses across the whole region after the fire, but we did expect to see changes by species in their numbers and where they were found when looking at the local level," explains Ganey. And in fact, their data show that total bird species present in the area were similar for both time periods (prefire versus postfire) across mountain ranges, while local colonization and extinction differed for individual species within the individual mountain ranges.

The fire created a diversity of altered habitats across the landscape, reducing tree densities and basal area across forest types. In general, fire increased the overall diversity of bird



The buff-breasted flycatcher, a species of concern in the region, is one of the birds that has increased locally in abundance since the Horseshoe Two Fire in 2011 (photo by Will Jaremko-Wright).

In general, fire increased the overall diversity of bird species found across the larger landscape.

species found across the larger landscape. Time since fire, scale, and fire severity are all important in the landscape mosaic which influences overall bird diversity. Woodpeckers and flycatchers often become more abundant right after a fire due to the beetle colonization of dead trees. According to Sanderlin, “A species of concern in the region is the buff-breasted flycatcher; when there are fires you usually see more of these and other unique species that are associated with burned landscapes in the area.” Preliminary results indicate that the flycatcher has potentially expanded its range to include recently-burned landscapes.

Bird tour guides key into habitat changes and know that, for example, a high-severity burn area is where they can take people to see woodpeckers, and likewise they would go to low-severity or unburned areas to see species associated with the more mature forest. Birds that responded positively following the Horseshoe Two Fire were more generally associated with cavities for nesting, and open conditions for foraging, such as the Western wood-pewee and the ash-throated flycatcher. Birds that responded negatively were

generally associated with closed forest conditions for nesting, like the Grace’s warbler. But the burned landscape is dynamic and changes rapidly with dead trees falling, new seedling establishment and plant regrowth, and the bird populations respond to changes in foraging and nesting habitats and food sources. This makes birds great ‘indicator’ species for evaluating forest response to disturbance.

What is next for the citizen monitoring program in the Sky Islands?

To track changes in bird communities over time as the forest regenerates from the fire and bird habitats change, the sampling needs to be repeated. The question is, how often? Although the postfire landscape is dynamic, “You’d probably expect to detect changes every five years or so, and that might be the most feasible sort of timeline for recruiting

SCIENCE IN THE SKY ISLANDS

Researchers at RMRS have been conducting ecological research in the Sky Islands for decades. Below is a sampling of research papers involving RMRS published in the last decade, covering topics such as habitats of specific bird species, the vulnerability of wildlife to climate change, and forest dynamics.

Ganey, Joseph L.; Block, William M.; Sanderlin, Jamie S.; Iniguez, Jose M. 2015. Comparative nest-site habitat of painted redstarts and red-faced warblers in the Madrean Sky Islands of southeastern Arizona. *Western North American Naturalist*. 75(3): 291–300. www.fs.fed.us/rm/pubs_journals/2015/rmrs_2015_ganey_j003.pdf

Coe, Sharon J.; Finch, Deborah M.; Friggens, Megan M. 2012. An assessment of climate change and the vulnerability of wildlife in the Sky Islands of the Southwest. Gen. Tech. Rep. RMRS-GTR-273. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 208 p. www.fs.fed.us/rmrs/publications/assessment-climate-change-and-vulnerability-wildlife-sky-islands-southwest

Iniguez, Jose M.; Swetnam, Thomas W.; Baisan, Christopher H. 2016. Fire history and moisture influences on historical forest age structure in the sky islands of southern Arizona, USA. *Journal of Biogeography*. 43: 85–95. www.fs.fed.us/rmrs/publications/fire-history-and-moisture-influences-historical-forest-age-structure-sky-islands

O’Connor, Christopher D.; Lynch, Ann M.; Falk, Donald A.; Swetnam, Thomas W. 2014. Post-fire forest dynamics and climate variability affect spatial and temporal properties of spruce beetle outbreaks on a Sky Island mountain range. *Forest Ecology and Management*. 336: 148–162. www.fs.fed.us/rm/pubs_journals/2015/rmrs_2015_oconnor_c001.pdf

O’Connor, Christopher D.; Falk, Donald A.; Lynch, Ann M.; Swetnam, Thomas W. 2014. Fire severity, size, and climate associations diverge from historical precedent along an ecological gradient in the Pinaleno Mountains, Arizona, USA. *Forest Ecology and Management*. 329: 264–278. www.fs.fed.us/rmrs/publications/fire-severity-size-and-climate-associations-diverge-historical-precedent-along

Photo by J. Sanderlin



volunteers— other obligations make it difficult to do it more often than that,” explains Sanderlin. The area was last sampled in 2014— the researchers have observed some large changes in the vegetation and hope to resample the area next year to detect the shifts they expect to see in the bird communities. Sanderlin says, “I hope that we are successful in securing funding for another round of sampling with the citizen observers and that we can get a long-term partnership in place with them. This would give us more useful data, and they can continue to contribute to ecological research in a meaningful way.”

KEY FINDINGS

- Citizen science partnerships can be used for inexpensive and statistically-rigorous monitoring. An effective citizen-monitoring program should be designed using a question that is appropriate for the level of accuracy you might expect of the citizen observers.
- Three years of data collected at sampling locations were used to evaluate data quality. Specifically, the researchers evaluated differences with avian communities in sampling locations and between citizen and professional bird crew members in both original sampling points and new points established for easier citizen observer access. Bird communities were similar at new and original sampling locations, although citizen observers were less likely to detect some species than professional bird crew members.
- Birds that responded positively following the fire were more generally associated with cavities for nesting, and open conditions for foraging, such as the Western wood-pewee and the ash-throated flycatcher. Birds that responded negatively were generally associated with closed forest conditions for nesting, like the Grace’s warbler.



Iconic bird species found in the Cave Creek area of the Chiricahua Mountains. Clockwise, from top left: yellow-eyed junco, Montezuma quail, elegant trogon, mexican jay, broad-billed hummingbird, and Arizona woodpecker (center) (photos by W. Jaremko-Wright).

WRITER’S PROFILE

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SCIENTIST PROFILES

The following scientists were instrumental in the creation of this Bulletin:



JAMIE SANDERLIN is a Research Wildlife Biologist (Quantitative Vertebrate Ecologist) with the USDA Forest Service's Rocky Mountain Research Station lab in Flagstaff, Arizona. She earned her M.S. degree in Statistics and a Ph.D. in Wildlife Ecology and Management from University of Georgia. Jamie develops innovative analytical applications for several collaborative projects in the realm of quantitative ecology, statistics, and bioinformatics. Her current research includes evaluating fire effects on bird and small mammal communities, sampling design and optimizing resources, developing Bayesian hierarchical models to evaluate wildlife population and community dynamics, citizen science, data integration, and wildlife genomics and bioinformatics. Connect with Jamie at www.fs.fed.us/rmrs/people/jlsanderlin.



JOE GANEY is a Research Wildlife Biologist with the USDA Forest Service's Rocky Mountain Research Station lab in Flagstaff, Arizona. He earned his M.S. degree in Biology and a Ph.D in Zoology from Northern Arizona University. His research has focused on ecology, population dynamics, and habitat relationships of wildlife in forested environments. Joe's current research includes ecology and population dynamics of Mexican spotted owls, factors influencing bird communities in the Sky Islands of southern Arizona, dynamics of snag and log populations in southwestern ponderosa pine and mixed-conifer forests, population dynamics of small mammals in ponderosa pine and mixed-conifer forests, and monitoring methods. Connect with Joe at www.fs.fed.us/rmrs/people/jganey.

FURTHER READING

These references include a sampling of research papers that the RMRS published in the last decade, covering topics such as habitats of specific bird species, the vulnerability of wildlife to climate change, and forest dynamics.

Ganey, J.L.; Iniguez, J.M.; Sanderlin, J.S.; Block, W.M. 2017. Developing a monitoring program for bird populations in the Chiricahua Mountains, Arizona, using citizen observers: Initial stages. Gen. Tech. Rep. RMRS-GTR-368. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 30 p. www.fs.usda.gov/treesearch/pubs/54536

Sanderlin, J.S.; Block, W.M.; Ganey, J.L. 2014. Optimizing study design for multi-species avian monitoring programs. Journal of Applied Ecology. 51: 860–870. www.fs.fed.us/rm/pubs_series/rmrs/gtr/rmrs_gtr368.pdf

Sanderlin, J.S.; Block, W.M.; Ganey, J.L.; Iniguez, J.M.; Cushman, S. 2014. Assessing large-scale effects of wildfire and climate change on avian communities and habitats in the Sky Islands, Arizona. Final Report for U.S. Fish & Wildlife's Desert Landscape Conservation Cooperative. www.fs.fed.us/rmrs/projects/assessing-effects-wildfire-and-climate-change-avian-communities-and-habitats-sky-islands

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