C. Crowdsourcing and Citizen Science under the American Innovation and Competitiveness Act

This Appendix provides agency-submitted summaries of crowdsourcing and citizen science activities conducted in FY17 and FY18 under the authority provided in the Crowdsourcing and Citizen Science Act and does not include any activities conducted under other authorities.

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C.1 Department of Agriculture (USDA)

C.1.1 4-H Guide for NASA GLOBE Observer Clouds[1]

Lead Sponsoring Agency: National Institute of Food and Agriculture (NIFA)

Project Summary and Goals: The 4-H guide is designed to encourage youth to become citizen scientists by providing opportunities for cloud observation, data collection, and study. The program is geared toward achieving seven objectives for student participants: (1) learn what clouds are and how they form; (2) learn about the different types of clouds; (3) identify the study site, take observations of the sky, and upload data to the GLOBE database; (4) explain why cloud observations are important for understanding our changing Earth system; (5) develop an understanding of the challenge of visually estimating the percentage of cloud cover, gain experience estimating cloud cover, evaluate the accuracy of estimates, and use fractions and percentages; (6) become engaged in the process of science; and (7) become part of a worldwide community of learners and scientists.

Justification for Using Crowdsourcing and Citizen Science: Citizen science is a unique way to actively involve youth in data collection for science research while also teaching the importance of data collection. By participating in a citizen science project, youth can gain exposure to and learn more about a particular project topic. The 4-H Clouds guide is created to introduce youth to citizen science, conduct activities that provide deeper learning about the subject of clouds, and learn more about career opportunities related to the study of clouds and weather.

Status: The project launched in November 2018.

Location: The program will be available across the U.S.

Participation: The project targets U.S. 4-H youth.

Consent: N/A

Submissions: Using a mobile device, youth take images of the sky and collect other data as directed by the Clouds module in the GLOBE Observer mobile app for submission to the GLOBE Data and Information System, hosted at the National Aeronautics and Space Administration (NASA).

Budget and Resources: There is no dedicated budget or funds for this effort. Support for 4-H science education programs was provided by 4-H National Headquarters, NIFA, and USDA. Employees were used to contribute content to the guide, review drafts of the guide, and present at a poster session at a national conference of 4-H professionals. In FY17 and FY18, 0.1 full-time equivalents supported the project. No NIFA resources or funds were used for this project in FY17 or FY18. However, a small team of 4-H educators, supported by NASA GLOBE, attended a meeting at NASA Goddard to learn about GLOBE, use the Clouds module in the GLOBE Observer app, and make recommendations for the use of the app and other GLOBE resources in 4-H nationwide. The lead developer of the guide is a 4-H state specialist at Rutgers.

Partnerships: Federal partners included the Global Learning and Observations to benefit the Environment (GLOBE) Program, which is sponsored by NASA and supported by NSF, NOAA, and the U.S. Department of State. Non-Federal partners included Rutgers University 4-H.

Advancement of Agency Mission: The 4-H guide aligns with NIFA's mission: to "invest in and advance agricultural research, education, and extension to solve societal challenges." This project helps youth

[1] The website for the 4-H Guide for NASA GLOBE Observer Clouds can be viewed at https://observer.globe.gov/.

to learn about a subject area (clouds and weather) that is important to agriculture. It involves youth in science data collection and research and demonstrates how citizen science can contribute to solving societal problems.

Results: NASA scientists use the cloud observations submitted by citizen scientists, in conjunction with data gathered from satellites, to better understand the importance of clouds to our changing earth environment. Rutgers University hosted the guide on their 4-H web site and collect data from participants to gain information on the usage and application of the guide.

Data Availability: Data will be collected by 4-H youth through the Clouds module in the GLOBE Observer app. This data will be available to the public through the GLOBE visualization system on the GLOBE web site: https://vis.globe.gov/clouds.

C.1.2 Boise Multi-Party Monitoring, Boise, ID[2]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The mission of the citizen-led Boise Forest Coalition (BFC) is to provide the Boise National Forest with management recommendations that: 1) Are developed through consensus decisions involving all members of the Coalition; 2) Address natural resource, economic, recreational, and societal needs; 3) Are compatible with Forest Plan direction including implementation of the Forest's Wildlife and Aquatic Conservation Strategies; 4) Are economically realistic; and 5) Promote future collaboration during implementation and monitoring. The Emmett Ranger District is positioned to start implementing a multi-party monitoring strategy involving data collection that could include photo points, surface fuel and overstory forest conditions, wildlife surveys, economic analysis, and recreational use.

Justification for Using Crowdsourcing and Citizen Science: The agency has recently entered into a Good Neighbor Authority (GNA) agreement with the state of Idaho for one of the sale areas on the Emmett Ranger District. Given the state's different management approach and objectives, there has been uncertainty and apprehension from some members of the public with the GNA process, particularly for a project that was developed collaboratively with multiple resource objectives. Implementing a multi-party monitoring strategy would help to build trust between our stakeholders, the state of Idaho, and the USDA Forest Service. It would also provide an opportunity for international students and students from local universities to become engaged in collaboration and citizen science. Having this support could reduce costs, improve National Environmental Policy Act efficiencies, provide implementation monitoring, best management practice monitoring, and forest plan monitoring.

Status: The project started in FY18 and is ongoing.

Location: The project is taking place at the Boise National Forest.

Participation: The project targeted students, conservation groups, timber industry, recreation groups, private citizens, local and State government, other State and Federal land managers.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated USDA budget line item or funding for citizen science and crowdsourcing. In FY18,

[2] The Boise Multi-Party Monitoring project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

funding in the amount of $25,000 was used in support of international forestry students, recruitment, outreach, data sharing, travel transportation, staff and personnel, external projection evaluation, and product development.

Partnerships: Non-Federal partners included Boise Forest Coalition.

Advancement of Agency Mission: The project area is identified in the Boise National Forest forest plan as a high-priority area for restoring vegetation and short-term wildlife habitat, and includes subwatersheds identified as having impaired function based on the nationwide watershed condition classification analysis. The project area includes wildland urban-interface and falls within a priority landscape designated by the Governor of Idaho and approved by the Secretary of Agriculture for forests that are at high risk of insect and disease mortality under Section 8204 of the Agricultural Act of 2014 (i.e., the Farm Bill). The project area is also under contract as a pilot GNA with the state of Idaho to improve efficiency of implementation.

Results: This project would complete implementation and effectiveness monitoring to help inform future forest management decisions, determine the need and effectiveness of project design features, and improve treatment prescriptions/best management practices. Monitoring is often not completed following project implementation due to funding constraints, a lack of resources, and prioritization of projects to attain assigned targets

Data Availability: Results can be posted to the BFC website, the Idaho Forest Restoration Partnership website, as well as potential other open-source locations. Data could also be incorporated into the forest plan monitoring report (posted on BNF website), Forest Service Activity Tracking System, and used for project implementation and compliance inspection.

C.1.3 Científicos en Familia: A Program to Engage Diverse Communities in Citizen Science and Stewardship[3,4]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: Corazón Latino and NorthBay have created a pilot program to engage, train, and empower diverse families, primarily Latino, from the Washington D.C./Virginia/Maryland region to become citizen scientists, applying their acquired knowledge to support the U.S. Forest Service's (USFS) mission, information needs, and restoration efforts. Focus on forest health/human health connections and the relationship between healthy forests and clean water will provide avenues for participating families to become Citizen Science Corps members who can activate to collect meaningful data to meet USFS information needs. The bilingual strategic communications and stakeholder engagement outreach are empowering regional and national audiences using digital tools, social media, traditional media (TV, print, radio) and community outreach (events, workshops, presentations). USFS will generate a citizen science community engagement model for diverse communities that can be adapted, replicated, and scaled throughout the nation. Final deliverables and reporting will include an English/Spanish-language toolkit and project implementation manual.

Justification for Using Crowdsourcing and Citizen Science: Empowering the public to identify natural resource issues, and to be involved in science-based solutions, is a pathway to developing advocates for sustainable public land management. Empowering diverse communities to make informed

[3] The website for the Científicos en Familia: A Program to Engage Diverse Communities in Citizen Science and Stewardship can be viewed at www.corazonlatino.us.

[4] The Científicos en Familia project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

decisions about conservation issues will provide the USFS and other land management agencies with avenues to invite, include, and involve diverse audiences in public engagement activities around land management.

Status: The project started on April 29, 2018, and is ongoing.

Location: The project is located in Washington, D.C. and the George Washington Jefferson National Forest (GWJNF).

Participation: The project targeted semi-rural and urban Hispanic and African American youth and their families, including 4th graders and "Every Kid in Park" program participants. The total number of individuals involved during this period was 47.

Consent: Forty-seven individuals provided consent.

Submissions: Participants were asked to make observations in the iNaturalist app. Observations are defined as geotagged photos of various plants and animals. The data are publicly available and can be used to study biodiversity and invasive species by geographic region across the world.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $25,000 and 0.03 FTEs were used to support salaries and wages for personnel involved in the project, facility rentals, materials, and field trips to the GWJNF.

Partnerships: Non-Federal partners included Corazón Latino and NorthBay.

Advancement of Agency Mission: The pilot program is engaging diverse communities in citizen science activities that meet USFS scientific information needs focused on forest insects and disease; forest health and human health relationships; and water monitoring in the GWJNF. In the GWJNF, the gypsy moth, southern pine beetle, and hemlock woolly adelgid are all major insect pests, while oak decline, dogwood anthracnose, and shoestring root rot are major disease problems. Many of these insects and disease issues are also found in urban/suburban settings. Científicos en Familia is establishing a mechanism for forest health monitoring designed to lead to forest stewardship and restoration of urban/suburban communities and NF lands. Empowering youth and their families to become involved in monitoring activities will also create an informed public that can support sustainable forest management activities.

Results: The first year of the program was aimed at building capacity and trust and fostering environmental stewardship among participants. Participants learned the environmental context for citizen science projects (e.g., what forest health is and why it is important), why citizen science projects are important, and how they can participate using tools like iNaturalist. Participants used iNaturalist to document invasive plant species and document biodiversity in the Washington D.C.-Virginia-Maryland area.

Data Availability: These data are publicly available through iNaturalist and can be used by Federal agencies and partners to advance scientific understanding of regional biodiversity as well as the spread of invasive or non-native species of flora and fauna.

C.1.4 Citizen Science for Rangeland Health: Engaging Ranchers in Science[5]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The Citizen Science for Rangeland Health project intends to monitor resource issues of mutual concern to grazing permittees and the USFS on grazing allotments in the San Juan National Forest. Rangeland managers need data to manage resources sustainably. The USFS and rancher volunteers will work to 1) agree on a resource issue of mutual concern that can be addressed through data collection (spring 2018); 2) decide on a monitoring protocol and locations for answering questions (spring 2018); 3) host training on data collection methods (early summer 2018 and 2019); 4) collect data with data collection coordinators form Colorado State University (CSU), USFS personnel, and ranchers (summers 2018 and 2019); 5) conduct analyses on data in fall of 2018 (preliminary) and 2019; and 6) host several joint-interpretation sessions (fall/winter 2018/2019) with broader group of ranchers and community members.

Justification for Using Crowdsourcing and Citizen Science: Engaging ranchers in citizen science will generate information on important management issues in the area, empower ranchers to be stewards of the resources they manage and to take a more active role in observing land trends. The project adds value by generating data to inform decisions and increasing the efficiency and mutual respect among ranchers and agency staff. At times, USFS and ranchers disagree on assessing rangeland conditions. By agreeing on methods, locations, and jointly collecting, analyzing, and interpreting data, this project engages ranchers and USFS agency staff in building and using a data set for evidence-based decisions. It also provides a framework for enhancing collaboration among ranchers and USFS staff and empowers all parties to engage with data and decisions on the Forest.

Status: The project started in FY18 and is ongoing.

Location: The project is located in the San Juan National Forest in Dolores, CO.

Participation: The project targeted local and regional ranchers, The Rangeland Stewardship Committee, other rural residents and recreationalists, and the Local Future Farmers of America Chapter

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $23,147 was used to support technician salaries and fringe, travel, materials and supplies, rancher stipends, statistical analyses, and printing expenses.

Partnerships: Non-Federal partners included CSU Extension.

Advancement of Agency Mission: Data generated by this citizen science project will provide useful information, help correlate more quantitative monitoring methods with faster methods that ranchers can use, and develop a cohort of individuals who are making formal observations, interpreting data, and applying it in management decisions. The project will address three of USDA's strategic goals for FY14-18: 1) assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving; 2) ensure that national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing water resources; 3) help America promote agricultural production and biotechnology exports as it works to increase food security.

[5] The Citizen Science for Rangeland Health project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Results: Annual utilization measurements provide useful indicators in determining grazing impacts over time. Acquiring this information can be time consuming depending on methodology. Grazing permittees are partners that can assist in collecting and mapping this information on a yearly basis. By collaboratively educating partners to collect this information, it will provide USFS with a more robust data set for making decisions. In addition, the landscape in question currently lacks ecological site descriptions, which are often used to identify desired conditions and objectives during the planning process. An assessment of existing relict sites across the landscape will provide USFS with a better understanding of site potential. Lastly, USFS currently collects vegetation and ground cover data at various permanent transect locations to determine composition and change over time. This is one of the pieces of information used to determine the effects of grazing.

Data Availability: The public will have the opportunity to engage in data interpretation via open meetings. A final report will be made available via the CSU Extension website, the local Conservation District, and the local Forest Service Office. Data will be filed in the 2210 allotment files, and subject to the Freedom of Information Act, per all data collected on USFS land. Data collected in conjunction with USFS personnel will be filed in the respective grazing allotment 2210 file.

C.1.5 Collaborative Investigations at Admiralty Cove[6]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The Tongass National Forest and Douglas Indian Association (DIA), a federally recognized Tribal Government, will work together to document the cultural history of Admiralty Cove on the east side of Admiralty Island National Monument in Southeast Alaska. USFS will fulfill a Heritage Program management goal to complete a comprehensive inventory in an area likely to include archaeological properties with the help of DIA staff and Tribal youth as volunteers. Student volunteers will be paired with elders to collect ethnohistoric information. A field day will enable the same elder/student pairs to spend time in the Cove in the vicinity of the USFS trail and recreation cabin. Students will refine their questions and record additional on-site observations as appropriate. They will assist professional archaeologists and Tribal specialists in conducting an archaeological survey, involving the use of metal detectors, pedestrian transects, and sub-surface probing.

Justification for Using Crowdsourcing and Citizen Science: USFS Heritage Program goals include inventory, site protection, and public outreach. This project will strengthen our relationship with DIA, whose citizens belong to either the Áak'w Kwáan or the T'aaku Kwáan, the two groups of Tlingit whose territory includes the eastern coast of Admiralty Island. The USFS and DIA share the management goals of restoring, sustaining, and enhancing the forest. This project furthers a shared objective that tribes continue their traditional uses of the forest to sustain their cultural identity and continuity. The goal is to identify four Tribal youth who will interact with their elder(s) as mentors and knowledgeable guides. The cross-generational sharing of knowledge is an extremely strong Tlingit value.

Status: The project started on August 10, 2018, and is ongoing.

Location: The project is located in the Tongass National Forest, Admiralty National Monument in Juneau, AK.

Participation: The project targeted Tribal youth and elders for the ethnohistorical research and archaeological inventory phases of the project. An interpretive sign will be designed and installed on

[6] The Collaborative Investigations at Admiralty Cove project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

site aimed at public recreation cabin users. The total number of individuals involved was seven, including four youth and three elders. The total number of volunteer hours was 207.5, 82.5 of which were uncompensated and 125 of which had stipends provided by the Tribe.

Consent: All seven individuals who participated in the project provided consent.

Submissions: Interview planning, digital recordings of interviews, interview catalogues, partial transcriptions, and hands-on assistance at National Records Center including research and document scans.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.11 FTEs and $46,573 supported the project in staff time, project leads and assistants, boat operator, field subsistence for USFS and volunteers, materials (e.g., digital recorders, gloves, tapes, line levels, trowels, bear fence, general camp supplies), stipends for cultural experts/elders.

Partnerships: Non-Federal partners included DIA.

Advancement of Agency Mission: The project advances USDA's mission in four ways. 1) The project enables USDA to meet obligations made under an MOA between the USFS and the Alaska State Historic Preservation Office (SHPO) to mitigate adverse effects to a National Register eligible property. In consultation, USFS and SHPO agreed to mitigation with stipulations addressing interpretive signage; training for staff; research on cultural history and survey for archaeological properties; and appropriate consultation with SHPO through a series of deliverables including site documentation and determinations of eligibility and effect. 2) The project enables USDA to meet USFS Heritage Program goals including inventory, site protection, and public outreach. 3) The project strengthens USFS's relationship with DIA, a federally recognized Tribe with whom the USFS has a government-to-government relationship formalized through a current Memorandum of Understanding. 4) The project promotes shared stewardship.

Results: The project will ensure that the USFS Heritage Program has appropriate information on which to base recommendations for management decisions for future projects in the vicinity of the recreation cabin. This will reduce the cost of future proposals within the survey area particularly for ground disturbing activities like the establishment of replacement outhouses and trail reroutes.

Data Availability: Archaeological data will be shared with the Tribal Council as well as with the Alaska State Office of History and Archeology. Participants will complete the project by designing an interpretive sign that, while protecting sensitive information, will share the results of the research with the public.

C.1.6 Culturally Responsive Citizen Science Development with Forest Inventory Analysis in Interior Alaska[7]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The Forest Inventory and Analysis (FIA) program is a nationwide inventory of forested lands which began in Interior Alaska in 2016. A culturally appropriate method of conducting citizen science in line with local priorities has not been conducted at a broad scale across rural Alaska or Alaska Native communities. FIA crews are based in rural and/or Alaska Native communities for

[7] The Culturally Responsive Citizen Science Development with FIA in Interior Alaska project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

months at a time. The short, intensive period during which employees live in communities limits time to build critical relationships, and collected data may be disconnected from community needs and priorities. A culturally-responsive citizen science approach coupled with typical data collection methods may reduce challenges FIA faces in communities, build partnerships, and increase youth opportunities. This program initiates co-creation of local forest health citizen science projects integrating local knowledge with FIA data. FIA will partner with the Global Learning and Observations to Benefit the Environment (GLOBE) citizen science program through University of Alaska Fairbanks (UAF) to facilitate projects and maintain long-term relationships.

Justification for Using Crowdsourcing and Citizen Science: FIA collects data for use by scientists and managers across the country to undertake locally or regionally relevant research or management decisions. Having local understanding would assist researchers and managers in contextualizing projects or outcomes and provide a more complete perspective. This is especially important in Interior Alaska where change is occurring rapidly and baseline data are often lacking. Enabling communities to participate in determining issues worthy of further citizen-directed research or action as well as co-create and undertake projects is an efficient and cost effective way for USFS and FIA to further our mission and collect wider and more inclusive data/knowledge, while increasing community engagement and ownership of the data and process. Partnering with a thoroughly vetted citizen science and education organization such as GLOBE increases the efficacy of conducting a citizen science project at such a large scale. GLOBE offers a range of environmental monitoring protocols (landcover, soils, phenology, hydrology, wildfire, etc.) that have been peer-reviewed, externally evaluated, and used by youth and communities in over 110 countries since 1995.

Status: The project started in FY18, and is ongoing.

Location: The project is located in Anchorage, Alaska.

Participation: The project targeted local community members including elders, adults, and youth of all ages. Most communities involved are in rural and remote Alaskan areas, not frequently visited by outsiders. In future years, communities will be Alaska Native villages.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $9,250 was used to support travel transportation, staff and personnel, meeting costs, and materials and supplies.

Partnerships: Non-Federal partners included Alaska GLOBE Program and UAF.

Advancement of Agency Mission: This project addresses the first, second, and third strategic goals in the 2015 Integrated Strategy for Youth. 1) Build partnerships to reach all America's youth and engage them in conservation education: Alaska FIA will build a new partnership with GLOBE Alaska to reach youth in rural Alaskan communities with high proportions of Alaska Native students. 2) Develop and nurture opportunities for all youth to engage in conservation service and investigate career opportunities in natural resource management: youth will have personal interaction with FIA employees as they design GLOBE citizen science investigations to further their exposure to Forest Service career opportunities. They will apply the data they collect to a stewardship action project of their own design. 3) Build knowledge about natural resources, conservation, and stewardship of our Nation's forests and grasslands by developing and implementing effective, standards-based, contemporary conservation

education programs that reach all America's youth: youth will engage in a culturally responsive learning model for citizen science developed by the UAF GLOBE program.

Results: FIA is mandated to provide information to assess America's forests on a continuous basis. In 2016, Interior FIA was the last FIA program to be implemented nationally. This effort has the unique opportunity to inform data collection efforts by incorporating locally-identified concerns and co-creating citizen science investigations to address forest health concerns while improving community relationships. This shared customer/public role in project design meets the goal of delivering benefits to the public and excelling as a high-performing agency through exemplary public service. Today, boreal regions are subject to rapid change and current and historical data are critical. Further, a high proportion of communities in the boreal region are rural and indigenous. Citizen science, as an approach to scientific research and engagement, struggles with attracting cultural groups underrepresented in STEM careers. This is often attributed to a mismatch between scientific goals and community concerns. Establishing and evaluating a process for flexible culturally-responsive citizen science with FIA will further engage Alaska Native stakeholders in Forest Service science and scientific research. The strategic partnership with GLOBE Alaska extends data collected by community teams to a global audience, providing data on boreal forest variables for current and future research.

Data Availability: Data collected from community projects will be housed within the GLOBE database which currently houses over 130 million measurements accessible to land managers, scientists, students, and the public at www.globe.gov. FIA data will be available via FIA DataBase, and can be accessed at https://apps.fs.usda.gov/fia/datamart/. FIA data are also available via a landowner report for landowners who have an FIA plot on their land and who request it. FIA data is publically available, however the program is mandated to keep plot location and owner information confidential to comply with Federal privacy legislation and to preserve the integrity of the plot/sample.

C.1.7 Engaging Angler Scientists to Help Prioritize and Monitor the Effectiveness of Stream Reconnection Projects[8]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: This project formalizes a collaboration between Trout Unlimited (TU) and the U.S. Forest Service (USFS) to empower citizen scientists, including TU anglers, college students, and other interested members of the community to 1) conduct road-stream crossing surveys to understand Aquatic Organism Passage (AOP), and 2) conduct brook trout spawning surveys to provide baseline biological data associated with barriers and to monitor the effectiveness of AOP projects and other stream treatments. USFS and TU staff have invested significant resources to assess road-stream crossings for AOP issues.

Justification for Using Crowdsourcing and Citizen Science: This project meets objectives in the 2017 Rise to the Future: National Fish & Aquatic Strategy including Goal 2: Connect People to the Outdoors Through Fishing, Boating, and Other Aquatic Activities. While some national forests have been comprehensively surveyed, many still have significant gaps in the understanding of their aquatic connectivity. Empowering citizen scientists to assist with these surveys will expand USFS capacity to understand AOP across entire forests and to better prioritize stream reconnection projects that benefit brook trout and other aquatic organisms. This project leverages TU's strong grassroots base and regional project staff to develop pilot projects in eastern National Forest lands. By developing resources

[8] The Engaging Angler Scientists to Help Prioritize and Monitor the Effectiveness of Stream Reconnection Projects were conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

and demonstrating the effectiveness of this approach, this project will facilitate and promote expansion of AOP assessment and monitoring to other national forests throughout the eastern U.S. Through these monitoring efforts, volunteers will gain a connection to these watersheds and the efforts to improve them, and may be further engaged in restoration projects.

Status: The project started in FY18, and is ongoing.

Location: The project is located in Pisgah-Nantahala, George Washington-Jefferson, Allegheny, and Huron-Manistee National Forests.

Participation: The project targeted outdoor recreationists, college students, high school students, rural community members.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $24,923 was used to support salaries and wages for personnel involved in the project, travel, equipment, and volunteer expenses.

Partnerships: Non-Federal partners included TU.

Advancement of Agency Mission: This project meets objectives in the 2017 Rise to the Future: National Fish & Aquatic Strategy for the agency including Goal 1: Conserve Fish and Aquatic Resources; Goal 2: Connect People to the Outdoors Through Fishing, Boating, and Other Aquatic Activities; and Goal 4: Deliver and Apply Scientific Research. The project will enhance management decisions regarding brook trout population reconnection on National Forest lands. By increasing the capacity of the USFS to collect useful AOP data, stakeholders can better prioritize specific culverts for restoration, replacement, or further evaluation. In this way, the USFS can focus efforts in identified priority areas, resulting in a more efficient use of limited funding, and a watershed-scale management strategy for the reconnection of aquatic habitat and brook trout populations. Spawning surveys have been shown to be an effective method to monitor population trends in salmonids over time and are more cost effective than other techniques, allowing more populations to be monitored over longer periods of time.

Results: By mapping the distribution of redds (the spawning ground or nest of fish) over time, USFS can identify priority areas for stream treatment projects and document population response to our investments.

Data Availability: Barrier data entered on the mobile application form developed by Southeastern Aquatic Resources Partnership (SARP) is automatically uploaded to their Regional Barrier Inventory. Citizen science-collected data is mapped and used by USFS, TU, state agencies and others in the Southeast to aid in project selection and prioritization. SARP's database is available to the public and can be obtained by contacting SARP. TU will also develop a brook trout spawning survey protocol, resource guide, and database for use by our staff, USFS, and other partners. These resources will be piloted in the Allegheny and Manistee-Huron National Forests and will be designed to be broadly applicable throughout the east.

C.1.8 Engaging Citizen Scientists in Field Research on American Pika, an Indicator Species for Alpine Ecosystem Integrity[9,10]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The American pika, *Ochotona princeps*, is a small, charismatic mammal in western North America that is sensitive to climate-driven variation in temperature, snowpack, and vegetation composition. Extirpation of pika populations and range retraction linked to climate change has been documented in the Great Basin, Southern Utah, and California. The species may be more resilient to climate change in the extensive, high-elevation habitat found in the Southern Rocky Mountains (SRM). However, recent research predicts that pikas may be extirpated from Rocky Mountain National Park (RMNP) during this century under some climate change scenarios. There is a pressing need to assess the species' vulnerability to climate change across the SRM, particularly in National Forests, where the majority of pika habitat in the region is found. The White River National Forest (WRNF) has identified pika as a focal species and aims to determine the status of pika populations as an indicator of alpine ecosystem integrity. The Front Range Pika Project (FRPP) seeks funding to engage citizen scientists in field surveys, to collect data the WRNF needs to determine pika distribution and improve understanding of environmental variables that limit pika distribution using a vetted, peer-reviewed protocol. These data, along with long-term monitoring of occupancy trends, are essential to predicting and tracking the species' response to climate change on the WRNF. In addition, the project will establish capacity for long-term, citizen science monitoring of pika in the WRNF, and advance the Southern Rockies Pika Partnership's (SRPP) research goals.

Justification for Using Crowdsourcing and Citizen Science: This project will be implemented by the FRPP (co-directed by Rocky Mountain Wild and Denver Zoo), in coordination with the SRPP, a partnership collaborating to expand citizen science research on pika in the region. The FRPP has trained over 200 volunteers to collect high quality data since 2010 and has 80 active volunteers. Through expansion of pika citizen science research to the WRNF, the FRPP will enable the WRNF to efficiently determine current pika distribution, and lay the groundwork for long-term monitoring to discern changes in alpine ecosystems and pika distribution occurring as a result of climate change. A trained volunteer cohort will survey multiple areas across the forest using an established, scientifically rigorous protocol.

Status: The project started on August 22, 2018, and is ongoing.

Location: The project is located in White River National Forest in Glenwood Springs, CO.

Participation: The project targeted outdoor recreationists, rural communities surrounding the WRNF, urban communities in the region with a large potential volunteer base, youth, and members of local and regional nonprofit conservation and stewardship organizations. The total number of individuals involved during this period was eight, and the average number of active participants per week was five. The total number of volunteer hours was 90.

Consent: All individuals involved in the project during this period provided consent.

Submissions: Observations, data collection, and images

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[9] The website for the Engaging citizen scientists in field research on American pika, an indicator species for alpine ecosystem integrity can be viewed at www.pikapartners.org.

[10] The Engaging Citizen Scientists in Field Research on American Pika, an Indicator Species for Alpine Ecosystem Integrity project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.08 FTE and $21,334 were used to support salaries, travel, equipment, supplies and materials, training, and webpage development and maintenance related to this project.

Partnerships: Non-Federal partners included Rocky Mountain Wild and the Denver Zoo.

Advancement of Agency Mission: The American pika became a WRNF focal species with the implementation of the 2012 planning rule and replacement of Management Indicator Species with focal species. The WRNF plans to determine the status of American pika populations as an indicator of alpine ecosystem integrity per the 2016 WRNF Monitoring Plan. Pika occupancy surveys are needed to determine current pika distribution and whether distribution patterns on the WRNF are most strongly limited by climate stress, topographic constraints, habitat extent, habitat connectivity, biological interactions, or some combination of these factors.

Results: This study will also establish capacity for long-term monitoring to enable the WRNF to predict and track impacts of climate change on pika and inform potential management actions to improve pika resiliency to climate change. In summary, a WRNF partnership with Rocky Mountain Wild and Denver Zoo through the FRPP will provide vital data to discern the status of pika on the WRNF, provide the opportunity for long-term pika monitoring to increase the WRNF's understanding of climate change effects on this focal species and inform management options.

Data Availability: Data will be open-access on CitSci.org, whose audience includes researchers, managers, educational institutions, and the public. USFS will share project updates and results with volunteers and local communities through presentations at events (including at least two end-of-season volunteer events), newsletters, web pages, social media of partner and participating organizations, and local news outlets. USFS will share results with the Forest Service through a written report to WRNF Reporting in the appropriate Forest Service databases (e.g., Volunteer Services Reporting); NatureWatch, Interpretation, and Conservation Education database; and the Natural Resource Manager among others. USFS will share results with the scientific community through presentations at conferences (e.g., North American Pika Consortium Conference, CitSci 2019); reporting results to the Southern Rockies Pika Partnership; and considering publishing in a scientific journal if results merit publication.

C.1.9 Location of Plants Traditionally Used by American Indian Tribes to Improve Management of Federal Lands on the Four Forest Restoration Initiative[11]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: In a consultation between the USFS and numerous Arizona and New Mexico tribes, tribes requested that the USFS collect information on traditionally-used plants for consideration in the Four Forest Restoration Initiative (4FRI) analysis to develop management protocols that preserve identified plants. This proposal responds to this information need by providing data collected by citizen scientists on the location of hard-to-locate, non-abundant, traditionally-used plants/herbs to 1) 4FRI managers to develop management protocols to ensure long-term sustainability and availability of these resources for tribes; 2) tribal members to be featured in educational materials and utilized as a repository of ecological knowledge for important plant species; and 3) researchers to devise

[11] The Location of Plants Traditionally Used by American Indian Tribes to Improve Management of Federal Lands on the Four Forest Restoration Initiative was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

scientifically-based management and restoration protocols for these culturally important plant species. The 4FRI is the largest Collaborative Forest Landscape Restoration Project in the country influencing the management of 2.4 million acres in central Arizona on the Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests. These data, therefore, have the potential to affect management at a broad geographic scale.

Justification for Using Crowdsourcing and Citizen Science: In government-to-government consultation with local tribes regarding 4FRI, tribal authorities requested that the management of traditionally-used plant species be considered during 4FRI planning to prevent population decline or extirpation during project execution. Spatial data on plant populations will allow the USFS to meet this request, as well as to identify traditional collection areas for which site-specific management protocols will be developed. Locating traditionally-used plants is challenging due to the size of the 4FRI lands and the need for experienced botanists to correctly identify plant species. By harnessing the natural history expertise of local tribes to identify populations of species of interest, USFS can meet the tribes' request with increased efficiency for USDA.

Status: The project started in FY18 and is ongoing.

Location: The project is located in Williams, AZ and Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests.

Participation: The project targeted tribal youth, at-risk youth, underserved communities, tribal communities, and natural resource partners.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $25,000 was used to support Forest Service co-leads' time in facilitating tribal consultation; internal/external training/education for the project; salary for a university partner; stipends and honoraria for speakers and traditional practitioners; mileage and/or vehicle rental for participants and speakers; meeting materials; and space rental.

Partnerships: Non-Federal partners included Northern Arizona University and federally recognized tribes.

Advancement of Agency Mission: This project addresses three of the four management outcomes outlined in the 2015-2020 Forest Service Strategic Plan. Natural resource decision-making is improved through the use of reliable information and applications (outcome 1) by providing USFS land managers with data on the location of traditionally-used plants, thus allowing development of strategies to protect these species during the implementation 4FRI restoration efforts, which includes potentially destructive measures like prescribed burns and mechanical thinning. Additionally, this project will strengthen the partnership between the USFS, Northern Arizona University (NAU), and federally recognized tribes by promoting an exchange of expertise on natural resource management and encouraging future collaborations to scientifically evaluate management and conservation of these species. By protecting culturally, economically, and ecologically important species and sharing distribution information with local tribes, this project will ensure that social, economic, and environmental benefits flow from forest and grassland resources (outcome 2), thus strengthening the engagement of tribal communities with public land management and promoting the connection of these communities with their natural and cultural heritage. Finally, conservation of traditionally-used

plant species promotes forest and grassland ecosystems that are resilient and adaptive in a changing environment (outcome 3), as such species contribute to ecosystem health and function.

Results: This project will add value to resource management by providing spatial data on the location of traditionally used plants on 4FRI lands to USFS land managers. Spatial data on plant populations will allow the USFS to identify traditional collection areas for which site-specific management protocols will be developed.

Data Availability: The data will be open-access for USFS employees, selected researchers, and tribal members through the iNaturalist platform. Obscured location information will be provided to the general public, in order to prevent targeted harvest of these potentially valuable species. Data will be permanently curated on the USFS's Forest ACtivity Tracking System (FACTS) to be shared at the request of land managers, tribes, and researchers.

C.1.10 Monitoring the Status of the Columbia River Gorge Pika Population After the Eagle Creek Fire[12,13]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: Last fall, the Eagle Creek Fire (ECF) burned nearly the entire low-elevation distribution of pikas, small mammals which are important bellwethers to environmental changes, on the Oregon side of the Columbia River Gorge (CRG), prompting widespread public interest in the fate of CRG pikas. Following this event, this project addresses the following goals: 1) leverage an extensive pre-fire distribution dataset to document the extent of changes in CRG pika distribution, following the ECF; 2) engage citizen scientists in conducting pika surveys and collecting additional habitat data; and 3) analyze predictors of pika density and monitor recolonization of disturbed habitat.

Justification for Using Crowdsourcing and Citizen Science: American pikas create an ideal platform for citizen science. In addition to being charismatic, easily identifiable, and residents of beautiful natural areas, pikas have been shown to be vulnerable to environmental changes in some areas. These factors have motivated diverse volunteers to participate in pika watches, from hikers and outdoor enthusiasts to K-12 students and teachers. Cascades Pika Watch (CPW) is a citizen-science initiative supported by the Oregon Zoo, the Point Defiance Zoo and Aquarium, and several leading pika biologists. In the last five years, USFS has trained over 1,000 volunteers to conduct pika surveys throughout the Cascades, including scientifically-selected sites in the continentally unique, low-elevation habitat of the Columbia River Gorge (CRG). USDA's experience is that CPW volunteers enjoy being involved in this project. The active CPW Facebook group has over 500 members who enthusiastically share pika pictures and stories, accessible at: https://www.facebook.com/groups/CascadesPikaWatch/. Post-participation surveys also suggest that this project encourages a sense of stewardship and responsibility among the outdoor enthusiasts as well as a deepened awareness of the complexity of wildlife management and conservation.

Status: The project started in July 2018, and is ongoing.

Location: The project is located in the Columbia River Gorge National Scenic Area of Hood River, OR.

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[12] The website for the Monitoring the status of the Columbia River Gorge (CRG) pika population after the Eagle Creek Fire can be viewed at https://www.oregonzoo.org/cascades-pika-watch.

[13] The Monitoring the Status of the Columbia River Gorge (CRG) Pika Population After the Eagle Creek Fire project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Participation: The project targeted youth groups from historically marginalized communities; outdoor enthusiasts; urban and rural families; and K-12 teachers/students. The total number of individuals involved during this period was 103 volunteers, and the average number of active participants was 71 volunteers per month. The total number of volunteer hours was 868 total.

Consent: All participants involved in the project during this reporting period provided consent.

Submissions: A total of 96 data sheets containing wildlife observations and site data were submitted.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.02 FTE and $26,815 supported the project coordinator and technical advisor, travel for trainers, training events, and cooperator and agency indirect costs.

Partnerships: Federal partners included U.S. Geological Survey Northern Rocky Mtn. Science Center. Non-Federal partners included the Oregon Zoo and Colorado Mesa University.

Advancement of Agency Mission: The pika is currently listed as a Species of Conservation Concern (SCC) in numerous U.S. Forest Service units. Forest Service SCC's are defined as species "for which population viability is a concern, as evidenced by: 1) Significant current or predicted downward trends in population numbers or density. 2) Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution" (Forest Service Manual [FSM] 2670.5.19). Relatively little is known about how CRG pikas might respond to contemporary environmental changes and disturbances caused by wildfire. This knowledge gap may hamper management, given that fires are predicted to increase in both frequency and severity. Through citizen science, CPW provides an early-warning system to inform the USFS about changes in pika populations. In the future, trained CPW volunteers can apply their skills to monitor pikas and other species in areas beyond the CRG, using protocols, apps, and techniques in which they have been trained. Most importantly, this project provides a wealth of data on multiple ecosystem components and fire, across a large area spanning two states, at effectively zero cost to USFS. Cost-efficiencies are created by our existing extensive network of volunteers, and process-efficiencies reflect diverse partners that this project unites towards common, multi-faceted goals.

Results: Experience in this project demonstrates that volunteers can collect high-quality data to inform management. An active social media presence is also being used to spread relevant information to participants and the community. Finally, this effort will ensure a continuous supply of trained citizen scientists for monitoring other species in the future. In addition, to share findings most widely, at least two peer-reviewed publications are anticipated describing both the immediate impact of the ECF on the CRG pika population and the factors underlying short-term declines and subsequent recovery.

Data Availability: Data will be freely available to management agencies following peer-reviewed publication, allowing these agencies (e.g., USFS, USFWS) to make evidence-based decisions on how to manage pikas and their habitat. In addition, results will be shared through presentations to zoo visitors, schools, and through social media.

C.1.11 Neighbors to Nature: Cache Creek Study[14,15]

Lead Sponsoring Agency: USDA Forest Service

[14] The website for the Neighbors to Nature: Cache Creek Study can be viewed at www.naturemappingjh.org.

[15] The Neighbors to Nature: Cache Creek Study was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Project Summary and Goals: This project will expand a partnership between the Forest Service, Friends of Pathways (FOP), Jackson Hole (JH) Wildlife Foundation, and Wildflower Watch through the use of citizen science to better inform land management decisions in the heavily used Cache Creek drainage, directly adjacent to the town of Jackson, Wyoming. The project will engage a youth crew from FOP, citizen scientists/volunteers from the JH Wildlife Nature Mapping program, and existing volunteers from Wildflower Watch to collect, analyze and interpret plant, wildlife, and trail use data. This project will help establish a baseline of observations, as well as an effective and consistent method to gather and process this data over time. Phenological observations such as leaf-out, budding, and flowering of plant species will help monitor the effects of climate change on plant communities with subsequent implications for seasonal recreation use. Approximately ten species of native and invasive plants will be located and monitored by volunteers. Trail counters will be purchased and installed in key locations to observe how the area is being utilized for recreation. Nature Mapping volunteers, as well as the FOP youth crew, will directly observe and report on wildlife movements in the area. Data will then be analyzed by volunteers and provided to the public and the Forest Service to inform future management decisions in the area.

Justification for Using Crowdsourcing and Citizen Science: Aside from informing and improving Forest Service management decisions, much of the value of this collaboration lies in the education of the local community. An educated community is more likely to comply with and support management decisions such as seasonal area or trail closures for wildlife. FOP will engage students in this project through the involvement of their youth crew, who will help install and rotate trail counters and wildlife cameras, as well as upload data into existing databases. This helps students understand data collection standards and the scientific method. Wildflower Watch will engage volunteers through direct monitoring of native and invasive flora and fauna of the forest, getting volunteers outside and participating in rigorous research efforts. Citizen scientists will also be encouraged to participate in data entry, analysis, and interpretation through additional outreach efforts led by the Wildflower Watch team. USFS hopes that participation in this project by the public will create a large community centered on the appreciation of natural resources.

Status: The project started on May 17, 2018, and is ongoing.

Location: The project is located in the Bridger-Teton National Forest (BTNF) Jackson Ranger District in Jackson, WY.

Participation: The project targeted outdoor recreationists, citizen scientists, Teton County Middle School, Teton Science School, the Teton Chapter of the Native Plants Society, Teton Botanical Garden, and the Sierra Club. The total number of individuals involved during this period was 50. Participants were all going out once a week, from mid-June to mid-September into the project study area to record observations. The total number of volunteer hours for this project is 135 hours.

Consent: All of the volunteers have signed volunteer agreements.

Submissions: Participants were asked to collect data on plant phenology, for which roughly 100 observations were collected. Participants were also asked to collect data on wildlife sightings, for which 141 observations were collected. This adds to a total of 241 observations taken.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.05 FTEs and $27,440 were used to support grant administration; staff time; project management; data analysis; stipend for the youth crew; youth crew manager and foreman; web development contractor; and equipment (e.g., wildlife cameras, field guides, lenses, clipboards, printed materials, trail counters).

Partnerships: Non-Federal partners included the JH Wildlife Foundation, Wildflower Watch, and FOP.

Advancement of Agency Mission: From a recreation perspective, this project will add value to local resource management by providing an accurate, scientific view of the plant and wildlife populations in the area, and the associated recreational use patterns. Aside from informing and improving USFS management decisions, much of the value lies in the education of the local community. An educated community is more likely to comply with and support management decisions such as seasonal area or trail closures for wildlife. This directly reduces operating costs for the agency by reducing the number of field patrols and amount of signage that are necessary to maintain closures. Additionally, knowledge of the recreational patterns directly increases efficiency of the USFS unit by informing rangers and trail workers about the areas needing the most attention. From a range perspective, understanding how species composition may be altered in response to climate change will help in predicting community vulnerability to phase or state change within current ecological site descriptions. This could make risk assessments associated with proposed management activities more accurate; thus leading to better informed decisions, improved project design, and increased efficiency.

Results: The USFS Jackson District Trail Assessment was prepared to more effectively manage recreation use by establishing desired conditions for nine geographical areas on the District. The Cache Creek recreation area was further split into four zones to more closely monitor conditions and provide a diverse range of experiences close to town. This project will directly inform recreation managers of existing conditions compared with desired conditions. Additionally, this project aims to initiate citizen science observations of phenology for approximately ten species of flowering plants at Cache Creek, contributing to the greater efforts of the USA National Phenological Network (USANPN).

Data Availability: FOP will integrate trail counter data into an existing database which currently stores three years of trail count data. FOP provides a direct link to this database for managers and the public to see on their website. USFS plans to upload all phenological data to the USANPN database, which is quality assured and open source, to be easily accessed by managers, researchers, and the general public. Wildflower Watch will also keep a backup database of all field collections for use internally at the BTNF and for local partners including researchers, citizen scientists, and school groups. Wildlife data will be composed of observations made anywhere within the project area at any time. The dataset contains data collected since 2009 to the present day. Data going into the NMJH database under casual observations will be shared with the Wyoming Game & Fish Department's Wildlife Observation System to augment State data.

C.1.12 Potomac Highlands Cooperative Weed and Pest Management Area Non-Native Invasive Species Citizen Science Program[16]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: For the last seven years, the Potomac Highlands Cooperative Weed and Pest Management Area (PHCWPMA) has delivered a successful citizen science program for fifth graders at an elementary school in Grant County, West Virginia. After a four-week series of lessons about local non-native invasive species (NNIS) in the classroom, the students apply what they have learned on a day-long field trip to identify, map, and remove NNIS on the Monongahela National Forest. With the support of the CitSci Fund, the PHCWPMA plans to purchase additional educational materials, expand the program to other schools in and around the Monongahela National Forest, and use the latest

[16] The Potomac Highlands Cooperative Weed and Pest Management Area Non-Native Invasive Species Citizen Science Program was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

technology for gathering and sharing NNIS data. Working with teachers, these activities have been correlated with the Next Generation Content Standards and Objectives for the State of West Virginia. The PHCWPMA will continue working with students in Grant County and expand to students in Pocahontas, Fayette, Greenbrier, and Hardy counties by 2019, serving primarily rural and low-income students.

Justification for Using Crowdsourcing and Citizen Science: Currently, a successful version of this program already exists through the PHCWPMA partnership at another elementary school. Expansion of the project to more schools will allow for students to be engaged that come from an area in West Virginia that is primarily rural and low-income. This project creates public engagement and learning/training opportunities in the classroom and field trip into the forest where the students will use what they have learned to identify and be land stewards by removing NNIS.

Status: The project started in FY18, and is ongoing.

Location: The project is located in the Monongahela National Forest in Elkins, WV.

Participation: The project targeted middle school-age students from schools located in or near the Monongahela National Forest. These children reside in rural, low-income regions of West Virginia.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $32,600 was used to support salaries and wages of personnel involved in the project; USFS vehicles; tablets; educational trunks; NNIS identification guides; weeding tools; and protective wear.

Partnerships: Non-Federal partners included Appalachian Forest Heritage Area; AFHA AmeriCorps; and WV Division of Forestry.

Advancement of Agency Mission: The Monongahela National Forest has a target to treat NNIS on over 1,000 acres of National Forest land. The students would directly contribute to this target and improve the forest by recording and voluntarily removing the NNIS on field trips. An important part of reporting to the Forest Service is recording the spatial data of area treated. By using the EDDMapS application, students would provide ArcGIS data to the Forest Service and other interested parties. Having this spatial data will allow for field crews or other volunteers to come in later to finish removal. This recorded data would also provide more information and greater efficiency for the PHCWPMA field crew so that they can better prioritize their efforts based on the location and extent of NNIS populations.

Results: This will improve USFS's data management for NNIS and allow retrieval of spatial data from the website; it qualifies for the USFS's targets for national reporting.

Data Availability: The students will use tablets to collect and store information using the EDDMapS application. The data are accessible by the public, scientists, and other NNIS specialists; such spatial data were not previously available to the Forest Service for the reporting of NNIS treatment and removal. Specifically, they can assist The Nature Conservancy of West Virginia, in partnership with the Monongahela National Forest, in directing their PHCWPMA field crew specializing in weed and pest management to sites that are in need of treatment for NNIS.

C.1.13 Tracking the Vernal Window with a Low-Cost Instrumentation Suite[17]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The vernal window marks the end of winter and the start of the growing season, defined as the time between snowmelt and canopy closure. Weather variability in winter and spring could lengthen the vernal window and impact forest ecosystem functions such as nutrient and water cycling. A changing vernal window could affect economic activities that requires frozen conditions (i.e., winter logging) or snowmelt and soil thaw (i.e., maple sugaring). Additional research is needed to understand how the vernal window responds to changes in snow, soil frost, soil biological activity, and canopy green-up, and could affect forest management and long-term forest health. The goal of this project is to enhance collective understanding of the vernal window by providing New England high schools with low-cost instrumentation to track changes in 1) snow depth, 2) soil frost depth, 3) soil biological activity, and 4) forest canopy green-up. Participants are recruited from the established Community Collaborative Rain Hail and Snow Network (CoCoRaHS) and train students to measure soil frost via the frost tube method, soil biological activity using soda lime base traps, and canopy green-up by observing phenophases.

Justification for Using Crowdsourcing and Citizen Science: Classrooms are an ideal venue for this research because the vernal window coincides with school semesters and engages students in outdoor scientific inquiry. Data will be synthesized in an open-source framework that will allow classrooms to track changes in the vernal window using a lesson plan that meets Next Generation Science Standards.

Status: The project started in FY18, and is ongoing.

Location: The project is located in Durham, NH.

Participation: The project targeted five high school (grades 9-12) classrooms. Two New England teachers have been recruited and three more high schools in New England will be recruited by the end of spring 2018 from a network of teachers in the community.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $24,646 was used to support travel transportation, staff and personnel, and materials and supplies related to the project.

Partnerships: Non-Federal partners included the University of New Hampshire.

Advancement of Agency Mission: The information obtained from this work will help inform the management of Forest Service lands, most notably, the White Mountain National Forest (WMNF) in New Hampshire. A coordinated effort has been underway since 2008 to improve the discussion of climate change in National Environmental Policy Act analysis and decision-making on the WMNF. Winter recreation is important to the regional economy and the management of the WMNF. Increased attention has been going into infrastructure-related issues associated with stream crossings (roads and trails) largely because of the increased frequency of events, such as rain-on-snow that result in major floods. The WMNF is focusing attention to snowmobile trails (400 miles on the WMNF) as many current

[17] The Tracking the Vernal Window with a Low-Cost Instrumentation Suite project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

routes are over wetlands or other water bodies which are no longer reliably freezing. The WMNF is also investing in trail reroutes and better crossing designs on both nordic ski and snowmobile trails across the unit as funding permits. More attention needs to be paid to snow related issues particularly in regards to snowmobiling and cross country skiing, both sports which are not supported by artificial snow making.

Results: Increasing evidence suggests that variability in winter snow and soil frost dynamics exerts important controls on wintertime root and microbial activity and nutrient loss from soils, which in turn affect forest health. More information on the relationships among snow depth, soil frost, and soil CO_2 efflux (a proxy for winter soil biological activity) can help inform our understanding of how winter weather influences forest productivity. Winter conditions, including duration of snowpack and frozen soil, are also important determinants of forest operations planning. Snow and soil frost control winter access for timber harvest, and predictable timing of frozen ground and snowmelt is important for the safety and efficiency of harvest operations. Additionally, sap flow necessary for maple syrup production requires a combination of warm days and freezing nights that is highly seasonal. Weather records show such conditions now occur earlier than in the past and this trend is projected to continue; however, it is unclear whether the season will be shortened or sap yield reduced. Maple producers report that their current ability to adapt to changing weather conditions is largely related to the health of the forest and the ability of producers to adopt new technologies.

Data Availability: Classrooms will follow the existing National Phenology Network Nature's notebook reporting protocols to track three phenophases: breaking leaf buds, leaves, increasing leaf size of trees in outdoor classrooms. Trees will include maple, oak, and poplar, subject to availability on school grounds. Participating classrooms will receive in-class training in the fall and follow-up data analysis sessions in late spring. All data will be uploaded to GoogleSpreadsheets. The research team will perform quality assurance and quality control on the data, and develop scripts to process data into graphs, and made publicly available via a GitHub repository. Researchers and teachers will create a comprehensive Vernal Window Teacher Guide including protocol training slides, datasheets, content presentations, analysis instructions, and a comprehensive equipment list to implement in other classrooms across the Northeastern U.S. Snow depth and phenophase data are available at www.cocorahs.org and www.naturesnotebook.org, respectively. The proposed project will centralize the above vernal window indicators in a single open-access GitHub repository for other educators, managers, researchers, and the general public.

C.2 Department of Commerce (DOC)

C.2.1 Urban Heat Island Mapping Campaign[18]

Lead Sponsoring Agency: National Oceanic and Atmospheric Administration (NOAA)

Project Summary and Goals: On two of the hottest days of summer in 2018 (August 21–23), a NOAA-sponsored team of scientists and volunteer citizen scientists conducted a field campaign to measure and map the urban heat islands of Washington, D.C. and Baltimore, Maryland. The campaign had three main objectives: (1) produce very detailed heat maps of D.C. and Baltimore, quantifying the heat differences across the cities; (2) provide residents and city officials with a resource for assessing the risks from extreme heat and identifying the necessary actions to protect people, property, and

[18] The website for the Urban Heat Island Mapping Campaign can be viewed at https://research.noaa.gov/article/ArtMID/587/ArticleID/2385/High-temperatures-bring-citizen-scientists-to-map-the-hottest-places-in-Baltimore-and-DC.

infrastructure; and (3) improve understanding of the changes in temperature of those urban heat islands through the course of an entire day as a function of different land cover types. Citizen scientist volunteers also participated in a pilot urban heat island mapping campaign, funded by a NOAA Environmental Literacy Grant, in Richmond, VA, on July 13, 2017. Hosted by the Science Museum of Virginia, the mapping effort showed that temperature differences of up to 16°F occurred during the same time of day in different parts of the city. The campaign also found that the orgins of the majority of heat stress-related 911 emergency calls coincided with the locations of the city's heat islands. Thus, city residents and officials are using these findings to begin a new dialog about actions that can be incorporated into the city's long-term master plan to protect its citizens from extreme heat. The full Richmond urban heat island mapping case study can be found at https://toolkit.climate.gov/case-studies/where-do-we-need-shade-mapping-urban-heat-islands-richmond-virginia.

Justification for Using Crowdsourcing and Citizen Science: The decision to utilize a citizen science approach to the Urban Heat Island Mapping Campaign was justified by the scope, design, and nature of the experiment. To achieve the campaigns goals, temperature measurements, taken simultaneously every second all over both cities for three one-hour periods, needed to be collected. This very high-resolution data in both time and space could not have been collected without volunteer drivers. In addition, the experiment needed to be flexible enough to wait for clear, very hot (≥95°F) days, so participants needed to be available in two days notice. Lastly, local citizens want to ensure a high quality of life in the places where they live, work, and play. Thus, local volunteer citizen scientists take ownership of the resulting temperature maps and are likelier to have a vested interest in ensuring that these maps are considered and used by city government officials in their long-range planning.

Status: The project took place between August 20, 2018 and August 23, 2018, and is complete.

Location: The project is located in Washington, D.C. and Baltimore, Maryland.

Participation: The project targeted local citizens from D.C. and Baltimore. The total number of individuals involved during this period was 29, with 9 citizens from D.C. and 20 citizens from Baltimore. The total number of volunteer hours was approximately 85.

Consent: Twenty-nine participants provided consent during this period.

Submissions: Participants were asked to mount thermocouple devices, which were specially designed thermometers in modified PVC pipes, in their front, passenger side windows. These devices measured temperature once per second as well as the precise time of day and precise latitude and longitude location. Participants drove three one-hour traverses through D.C. and Baltimore on selected, very hot days, resulting in the collection of about 75,000 data points throughout both cities.

Resources: A one-time allocation of $30,000 was dedicated in FY17 to cover costs of conducting the Urban Heat Island Mapping Campaign in D.C. and Baltimore. Funds were used to support the work and responsibilities of the principal investigators, including equipment preparation, travel, training workshops, data analysis, and documentation of findings. Less than 0.5 FTEs were needed to support the campaign. Other resources required for the campaign included equipment (e.g., thermocouples, PVC pipes, data loggers, and GPS sensors), specialized software, and LIDAR data.

Partnerships: Non-Federal partners included Portland State University, Science Museum of Virginia, Smithsonian Institution, Baltimore Aquarium, D.C. and Baltimore city governments, and Casey Trees.

Advancement of Agency Mission: NOAA's mission is to share scientific data and information to help the nation plan and respond to environmental hazards. NOAA hosts and maintains the U.S. Climate Resilience Toolkit with the intent to help communities, businesses, and government organizations understand their exposure to climate-related hazards and assess the actions needed to adapt to or

mitigate the consequences of these hazards. The urban heat island mapping campaign contributed to this mission by helping citizens and government officials in D.C. and Baltimore with precisely measuring and mapping their urban heat islands, which can get anywhere from 15°F-20°F hotter than other areas on the hottest days of summer. With a greater understanding of the likelihood and consequences of extreme heat, residents and leaders can properly weigh the risks and identify effective prevention efforts.

Results: NOAA intends to publish the resulting heat maps in the U.S. Climate Resilience Toolkit's Climate Explorer, a web-based mapping and graphing tool. The heat maps will also be shared with the residents and the city governments of D.C. and Baltimore for use in their dialogs and deliberations.

Data Availability: The data will be freely shared with the public in easily accessible and interactive ways for both education and long-term planning purposes.

C.3 Department of Homeland Security (DHS)

C.3.1 FEMA Crowdsourcing Unit and Playbook for Emergency Management

Lead Sponsoring Agency: Federal Emergency Management Agency (FEMA)

Project Summary and Goals: The goal of the project was to develop a playbook outlining how to leverage crowdsourcing networks that support decision making and response during disasters and emergencies for all levels of emergency management. This includes how the agency organizes information required for decision making and the types of crowdsourced data available to support those requirements. Combined with an outline of our Digital Volunteer Network (DVN) partners and the platforms used to share data, the playbook provides a roadmap on how to be successful when operating in the crowdsourcing space.

Justification for Using Crowdsourcing and Citizen Science: Crowdsourcing has evolved to a point where groups of individuals armed with unique skills have self-organized into networks with a mission to leverage data from the crowd to drive positive outcomes. Some networks are well established with well-codified organizational structures and mission sets while others are ad-hoc, organized at time of incident in response to a perceived gap in operations (e.g., the numerous networks organized to identify people in need of rescue during the 2017 hurricane season). This self-organizing of crowdsourcing networks has proven to be an opportunity for emergency managers. Previously, crowdsourcing meant dedicating analytical data and application development capabilities to the effort, which for most emergency managers is either in short supply or non-existent. DVNs facilitate collaboration among thousands of individuals with those precise capabilities. Instead of performing the crowdsourcing, emergency managers can leverage the efforts of DVNs who provide exponentially more robust capabilities than any single emergency management agency could expect to provide. The key is understanding how DVNs operate, why they operate, what their capabilities are, and how to collaborate for mutually beneficial outcomes.

Status: The project started on March 01, 2018, and is ongoing.

Location: The project is located across U.S. states and territories.

Participation: The project targeted FEMA, self-organizing crowdsourcing networks, DNVs, and National Voluntary Organizations Active in Disasters. The total number of active participants during this period was 4.

Consent: All participants for this project provided consent.

Submissions: While FEMA cannot task or ask for deliverables from volunteers, FEMA's crowdsourcing coordinators facilitated a daily coordination call. This call was a collaborative forum of participant volunteers to share activities, data collection methodology, and products across the group. FEMA, among others, used these products to assist in cross-validating official information source and supporting data-driven decision making during Hurricanes Maria, Lane, Florence and National Level Exercise 18.

Budget and Resources: FY17 resources were used for research, planning, and coordination call facilitation. FY18 resources were used for planning, development of a draft Crowdsourcing Playbook, organization of data teams, and coordinators during hurricane preparation and response. A total of 0.2 FTEs supported the program in FY17, and 0.6 FTEs supported the program in FY18.

Partnerships: Federal partners included the U.S. Geological Survey and the Department of Homeland Security. Non-Federal partners included various digital volunteer networks/coordinators.

Advancement of Agency Mission: The unprecedented disaster response requirements experienced during the 2017 hurricane season, particularly in Puerto Rico, led to gaps and delays in gaining critical information necessary to inform operational decision making. As a result, FEMA made the decision to actively participate in ongoing crowdsourcing efforts occurring outside of the Federal Government in order to close these information gaps. Information attained through crowdsourced efforts was used as a placeholder until information obtained through official, vetted sources was available. Crowdsourced information was analyzed and proven highly accurate, nullifying the organizational concern that unofficial information sources were inherently inaccurate. Most recently, FEMA utilized crowdsourcing information for leadership decision making prior to and during the landfall of Hurricane Florence.

Results: Still under development.

Data Availability: Still under development.

C.4 Department of Interior (DOI)

C.4.1 Project eTrout[19]

Lead Sponsoring Agency: U.S. Geological Survey (USGS)

Project Summary and Goals: Virtual reality (VR) platforms provide powerful new opportunities for ecological research and education. The goal of Project eTrout is to engage students in fish biology research using VR and crowdsourcing platforms to generate data for ecological analysis by USGS while achieving educational objectives for participants. The pilot project will take place from 2018 to 2019 and entails 3 steps: (1) USGS researchers collect underwater, 360-video from targeted stream sites in Shenandoah National Park and provide video samples to participating schools; (2) participants watch video samples and collect data on trout abundance, behavior, and habitat use; and (3) USGS summarizes the crowdsourced data and reports results back to participants. This project provides a powerful new link between ecological research and education by enabling fish biology research across large regions while providing students and citizen scientists a new way to experience stream ecosystems. This effort could be expanded to include video collection by visitors to National Forests and National Parks as well as NGO partners at the national and international level.

[19] The website for Project eTrout can be viewed at www.usgs.gov/eTrout. Project eTrout is conducted under the Crowdsourcing and Citizen Science Act as well as the Organic Act of 1879.

Justification for Using Crowdsourcing and Citizen Science: Stream ecosystems are spatially complex and therefore an understanding of stream fishes requires data from many locations. Collection of such spatially-distributed data is not feasible by any single agency or university alone. Instead, stream ecosystems require a collaborative effort across many institutions for analysis at the landscape scale. Moreover, prior efforts in this regard have been criticized for a lack of independently verifiable results. Project eTrout overcomes both of these limitations by using video data collected at a low cost from many locations with empirically verifiable archived records.

Status: The project started in September 2018.

Location: The project takes place in the Eastern United States.

Participation: The project targets students ranging from elementary school to college level. Over 50 schools will be involved with this project beginning in January 2019. Following that, the number of schools involved is expected to increase.

Consent: Consent will be obtained via collaboration with Virginia Tech's Institutional Research Review Board. No personally-identifiable information will be collected.

Submissions: Students and citizen groups will provide data on fish abundance, behavior, and habitat use from 360-degree underwater videos collected by USGS.

Resources: The launch of Project eTrout in FY18 utilized funding from the USGS Ecosystems Mission Area. The total funding in FY18 is $4,500. FTE staffing was used to start organizing the participant network in FY18. Additional funding was used to collect 360-video samples from streams in Shenandoah National Park. A non-Federal partner, Trout Unlimited, contributed in-kind staff support through their Trout In the Classroom program and Virginia Tech Advanced Research Computing Group contributed in-kind support for website hosting and VR website development. Future development of this project will benefit from in-kind support by NGO partners to leverage Federal resources.

Partnerships: Federal partners included the National Park Service. Non-Federal partners included Trout Unlimited and Virginia Tech Advanced Research Computing Group.

Advancement of Agency Mission: A core mission of the USGS is to help America achieve sustainable management and conservation of its biological resources. Specifically a goal of the USGS Ecosystems Mission area is to conduct “cutting-edge research that leads to the protection and restoration of our Nation’s fisheries and aquatic resources.” Project eTrout advances this mission by applying new camera technology in stream ecosystems and crowdsourcing the analysis of large imagery datasets from students and citizen scientists. This project empowers youth as part of a large research team, and enables new spatial analysis of fish abundance, behavior, and habitat use by USGS researchers.

Results: N/A

Data Availability: N/A

C.5 National Aeronautics and Space Administration (NASA)

C.5.1 Backyard Worlds: Planet 9[20,21]

Lead Sponsoring Agency: NASA

Project Summary and Goals: The Backyard Worlds: Planet 9 citizen science project scours data from NASA's Wide Field Infrared Survey Explorer (WISE) mission to search for moving objects, primarily nearby ultracool brown dwarfs. NASA estimates that BackyardWorlds.org will yield more than 1,000 objects that demand publication and that candidates will roughly double the sample of known brown dwarfs cooler than spectral type L5. These discoveries will help NASA understand how planets form and provide analogs to help interpret specta of exoplanet atmospheres. Backyard Worlds: Planet 9 is also the deepest all-sky infrared search for new planets in the solar system, such as the proposed Planet Nine.

Justification for Using Crowdsourcing and Citizen Science: The deepest WISE brown dwarf search prior to this project involved visual inspection of roughly one million images. Thus, NASA recognized that volunteer help with the inspection process would be necessary to go deeper.

Status: The project started on February 14, 2017 and is ongoing.

Location: Participation in the project is available globally through internet access.

Participation: The project targeted the general public. The total number of individuals involved during this period was estimated to be 150,000. However, estimation is based on IP addresses that have accessed the site, so the exact number of participants is difficult to measure. The average number of active participants per day was between 50 and 60. The total number of volunteer hours was 83,000 hours for the classification work on the Zooniverse site alone, plus approximately the same among of time for the effort contributed by the advanced user group on various side projects.

Consent: All participants consented to participate.

Submissions: The project has received roughly 5 million online classifications of image sets from NASA's Wide-Field Infrared Survey Explorer (WISE) mission and Near Earth Asteroid-WISE (NEOWISE) project.

Resources: In FY17 and FY18, the project was supported by NASA's Science Mission Directorate (80%) and NASA's Office of the Chief Scientist/Science Innovation Fund (20%). Extramural funding for FY17 totaled $35,000, and 0.35 internal FTEs supported the project. Extramural funding for FY18 totaled $6,000, and 0.25 internal FTEs supported the project. Both FY17 and FY18 FTEs have gone to support labor for the principal investigator. In addition to providing funding to Zooniverse (zooniverse.org) to develop and use the Zooniverse platform for this project, the project took advantage of a project builder tool Zooniverse has made available at no charge. Additional funding has been used for publication costs and travel.

Partnerships: Non-Federal partners include Zooniverse, American Museum of Natural History, Arizona State University, University of Oklahoma, University of Montreal, UC San Diego, and Bucknell University.

Advancement of Agency Mission: The project addresses NASA's mission to understand the solar system and the universe by finding ultracool brown dwarfs and searching for new planets orbiting the sun.

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[20] The website for the Backyard Worlds: Planet 9 can be viewed at Backyardworlds.org.

[21] The Backyard Worlds: Planet 9 project was conducted under the Crowdsourcing and Citizen Science Act as well as 51 USC § 20112(a).

Results: This project is used to advance scientific understanding and has been cited in a scientific journal publication.

Data Availability: The final list of brown dwarfs discovered by the project will be published in the scientific literature. NASA also plans to create a public archive of potentially useful false positives (e.g., active galactic nuclei, M dwarfs) for use by future astronomers. This archive will be hosted by the NASA/ Infrared Processing & Analysis Center Infrared Science Archive.

C.5.2 Landslide Reporter[22,23]

Lead Sponsoring Agency: NASA

Project Summary and Goals: Historical data on landslide events are vital for landslide hazard and risk assessment and response. However, there is currently a dearth of information at the global scale of when and where landslides occur. Landslide Reporter is a web application that invites citizen scientists to contribute landslides, mudslides, rockfalls, and other events to the NASA Cooperative Open Online Landslide Repository (COOLR) to help build the largest open global landslide catalog. When a citizen scientist finds a landslide in an online news source or sees a landslide in person, they can describe its location, type of landslide, and more details and submit it for review. Their submissions are checked and added to the repository. The COOLR project extends from the NASA Global Landslide Catalog (GLC), an open global catalog of rainfall-triggered landslides compiled by members of the Hydrological Sciences Laboratory at Goddard Space Flight Center since 2007. The goal of Landslide Reporter is to improve the quality and quantity of landslide data globally, to be a tool and resource for local communities to use to monitor and research landslides, and for collective landslide reporting during disasters. Lastly, Landslide Reporter strives to be an educational resource to increase the public's awareness and knowledge about landslides as a hazard.

Justification for Using Crowdsourcing and Citizen Science: Although landslides occur frequently, many landslides go unreported by newspapers or are grouped together with other natural hazards. Thus, people over a wide geographic range are needed to better capture an accurate count of landslides. The massive collection of data from citizen scientists increases the robustness of NASA's global landslide efforts farther than possible with the team at Goddard Space Flight Center alone. NASA's previous methodology for the Global Landslide Catalog (GLC) limited the collection of landslide reports to those found with Google Alerts and by the time availability of scientists and interns in NASA's laboratory. Citizen science enables the amassing of information from many different sources, including local first-hand accounts, reports in non-English languages, and points from other inventories, and lessens the data collection bias. Citizen scientists have a better local understanding of their region, which may result in improved accuracy of the location and details of the landslide. Citizen science also enables more hands to collect reports, leading to a more up-to-date inventory and less reliance on the availability of the landslides team. Lastly, a citizen-aided effort creates more awareness and education about landslides as a natural process and natural/man-made hazard. From the initial findings, citizen scientists are already bringing in new data from areas that have been underreported in the past with great accuracy and detail.

Status: The project started on March 22, 2018 and is ongoing.

Location: The project collects information on a global scale.

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[22] The website for the Landslide Reporter can be viewed at https://landslides.nasa.gov/reporter.

[23] The Landslide Reporter project was conducted under the Crowdsourcing and Citizen Science Act as well as 51 USC § 20111, et seq.

Participation: The project targeted the general public with at least a high school education. The total number of individuals involved during this period was 35, which reflects the total number of participants that have successfully contributed reports. The total number of volunteer hours was 43 hours, assuming each of the 129 submitted landslide reports took an average of 20 minutes to complete.

Consent: All participants are required to agree to the Posting, Privacy, and Takedown Policy before using Landslide Reporter.

Submissions: Citizen scientists are asked to mark where a landslide occurred on a map and fill in information about the date, time, description, type, trigger, fatalities and injuries, and surrounding environment of the landslide. Only the location and source of the event are required to complete the submission. A total of 129 landslide reports have been submitted.

Resources: Total project funding for FY17 and FY18 was approximately $186,000. The funds came from several different sources, but there is not one single funding source specifically designated to support this project. The funding has been acquired through the Presidential Early Career Achievement Award (PECASE), an "Innovation Seedling on Citizen Science" award ($19,000) from NASA Goddard Space Flight Center's Chief Technologist Office, NASA Center for Climate Simulation (NCCS), and the precipitation measurement missions. All resources for this project have been used to support labor (contractor and civil servant labor), including the support received in kind from the system developer partners at NASA as well as the internal group's effort. The FY17 resources were used to develop a first proof-of-concept for this project and back-up documentation for fields to be included. A total of 0.08 FTEs and 0.08 WYEs supported the project in FY17. FTE support and WYE support in FY17 amounted to $10,000 each. The FY18 resources were used to support one full-time contractor to develop the materials supporting this citizen science project. A total of 0.1 FTEs and 1.2 WYEs supported the project in FY18. The FTE contribution was used to manage the project, and the WYE contribution was used to develop the tools using ESRI Citizen Science applications and to support scientific oversight and testing. FTE support amounted to $10,000 and WYE support amounted to $156,000 in FY18.

Partnerships: N/A

Advancement of Agency Mission: Landslide Reporter advances NASA's mission to discover and develop Earth science datasets to better understand the Earth. With the goal to expand the consistency and accuracy of a global open landslide catalog, Landslide Reporter is aiding the discovery of the Earth by helping validate and improve NASA's landslide modeling capabilities. Landslide Reporter also directly aids NASA's response to the 2017–2027 Decadal Survey for Earth Science and Applications from Space, which prioritizes the "forecasting and monitoring of landslides, especially those near population centers." Landslide Reporter fulfills NASA's objective to inspire and engage the public in science by involving the public in contributing data towards NASA's scientific research. In addition to learning about individual landslide events, the public becomes more knowledgeable about landslide hotspots and how landslides occur. The availability of data from Landslide Reporter can be used by citizen scientist landslide experts to conduct investigations. Furthermore, Landslide Reporter supports applications of the Global Precipitation Measurement (GPM) Mission, as COOLR provides validation for NASA's Global Landslide Susceptibility Map and the Landslide Hazard Assessment for Situational Awareness (LHASA) Model, both which use GPM rainfall data for landslide susceptibility and nowcasting.

Results: Data are quality-checked, added to COOLR, and made available to the public. Foremost, COOLR data supports the continued development of the LHASA model, which uses GPM rainfall data to make a nowcast of where landslides are most likely to occur globally. The open data can also be downloaded by anyone for other landslide research.

Data Availability: The data are open to the public for download or referenced from the web application, Landslide Viewer, at https://landslides.nasa.gov/viewer. All information about the project and data are available at https://landslides.nasa.gov.