ADVENTURE SCIENTISTS

EXPLORE. COLLECT. PROTECT.

CONSERVING BIODIVERSITY: POLLINATORS PROJECT

FIELD SEASON REPORT 2017

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
Entomology

PREPARED BY **MICHELLE TOSHACK**
POLLINATORS PROJECT MANAGER
ADVENTURE SCIENTISTS

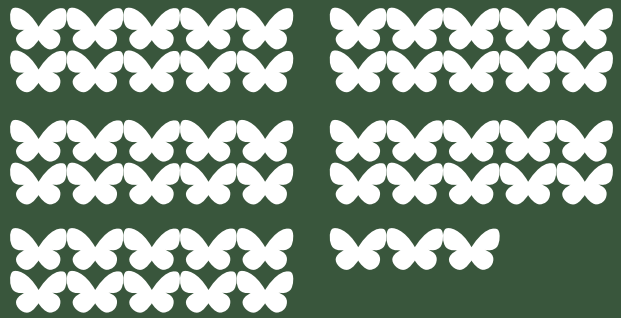
ABSTRACT

The Conserving Biodiversity: Pollinators Project launched a pilot field season in July 2017 to collect baseline data on butterflies and their host plants in remote, subalpine regions on United States Forest Service (USFS) land throughout the western U.S., including Arizona, California, Montana, Utah, and Washington. Volunteer data collectors were trained to use the projects created within the iNaturalist app to record butterfly observations and wildflower phenology (timing of life cycle). In 2017, volunteers accessed 35 remote field sites and collected observations of 526 individual butterflies representing 70 species as well as 676 wildflowers of 126 species. Between July and September they hiked 810 miles with a total elevation gain of 497,380 feet—equal to climbing Mt. Everest 17 times from sea level.

This project contributed baseline data in remote areas that have limited or no data on butterfly diversity.

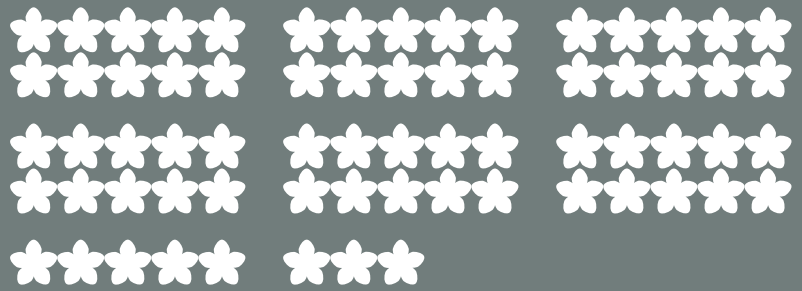
This project contributed baseline data in remote areas that have limited or no data on butterfly diversity. Interesting results include the detection of a variegated fritillary (*Euptoieta claudia*) in the Custer-Gallatin National Forest in western Montana, the fourth iNaturalist record in the state of this species whose normal range is east of the Rockies. We also detected an oreas comma (*Polygonia oreas*), which was one of three existing iNaturalist records in Montana. These detections highlight Adventure Scientists' contribution where there are data gaps and can provide information on potential range shifts for butterfly species.

These data are provided to the USFS for regional management needs. For example, Helena-Lewis and Clark National Forest will utilize these data to "support monitoring efforts of at-risk plant populations or pollinator populations, future restoration projects, and/or influence native plant material collection and seed mixes." In addition, our project partner at the University of Arizona will utilize these data for predictive models of butterfly species under different climate change scenarios for conservation priorities for species that are projected to be in decline. Future work includes adjusting sites and protocols to better serve the management needs of the USFS.



526

volunteer-submitted
observations of butterflies



676

volunteer-submitted
observations of wildflowers

70

butterfly species
identified

94

volunteer crew
members

126

wildflower species
identified

VOLUNTEER KATIE GUETZ COLLECTS DATA ON A WILDFLOWER IN MONTANA DOMINIC OAKES

PROJECT OVERVIEW

Many wild pollinators, including butterflies, are experiencing declines due to habitat loss, pesticides, and climate change (Potts et al. 2010, Goulson et al. 2015). Although some species such as monarchs and honeybees are well studied, the conservation status of many pollinators is unknown. Butterflies and moths (Order Lepidoptera) are an incredibly diverse group of insects, comprising over 160,000 species globally (Merckx et al. 2013). Butterflies serve as important biodiversity indicators for ecosystem health. They also provide food for many organisms, such as migrating birds. Remote

backcountry areas are often considered biodiversity hotspots (Dobrowski and Parks 2016) yet data gaps occur in these remote areas and more information about them is necessary to inform land and wildlife management. The USFS manages 193 million acres, including many high-elevation areas which provide ideal butterfly habitat. Baseline data collection is essential in order to inform management of butterfly species diversity.

In 2017, Adventure Scientists began data collection on butterflies and host plants throughout the western United States. In partnership with Dr. Katy Prudic from the University of Arizona, Adventure Scientists implemented data collection to fill data gaps in high elevation, remote regions. The dataset from the pilot phase can be built upon for better understanding pollinator distributions and management applications throughout the USFS and other remote lands.

FIELD SITES INCLUDE HIGH ELEVATION MEADOWS SUCH AS THIS ONE IN MT BAKER-SNOQUALMIE NATIONAL FOREST SEBASTIAN PARDO

PROJECT DESIGN

Adventure Scientists collaborated with Principal Investigator Katy Prudic from the University of Arizona College of Agriculture and Life Sciences on the Pollinators Project study design. A field protocol was developed with a focus on research-quality data assurance, adequate sample size, and ease of implementation for volunteers. Dr. Prudic co-developed protocols and tested them in the field alongside Adventure Scientists staff. Protocols were based on the methods used in Prudic et al. (2017) and Taron and Ries (2015).

Volunteers adopted field sites to survey multiple times throughout the season during butterfly flight season (July - October, depending on region). A site selection model was developed by Ben Hickson, GIS specialist at the University of Arizona. The site selection model was trained using environmental data and recent climate trends data based on the date and location of previous observations gathered from iNaturalist and Global Biodiversity Information Facility (GBIF). The criteria for site selection included:

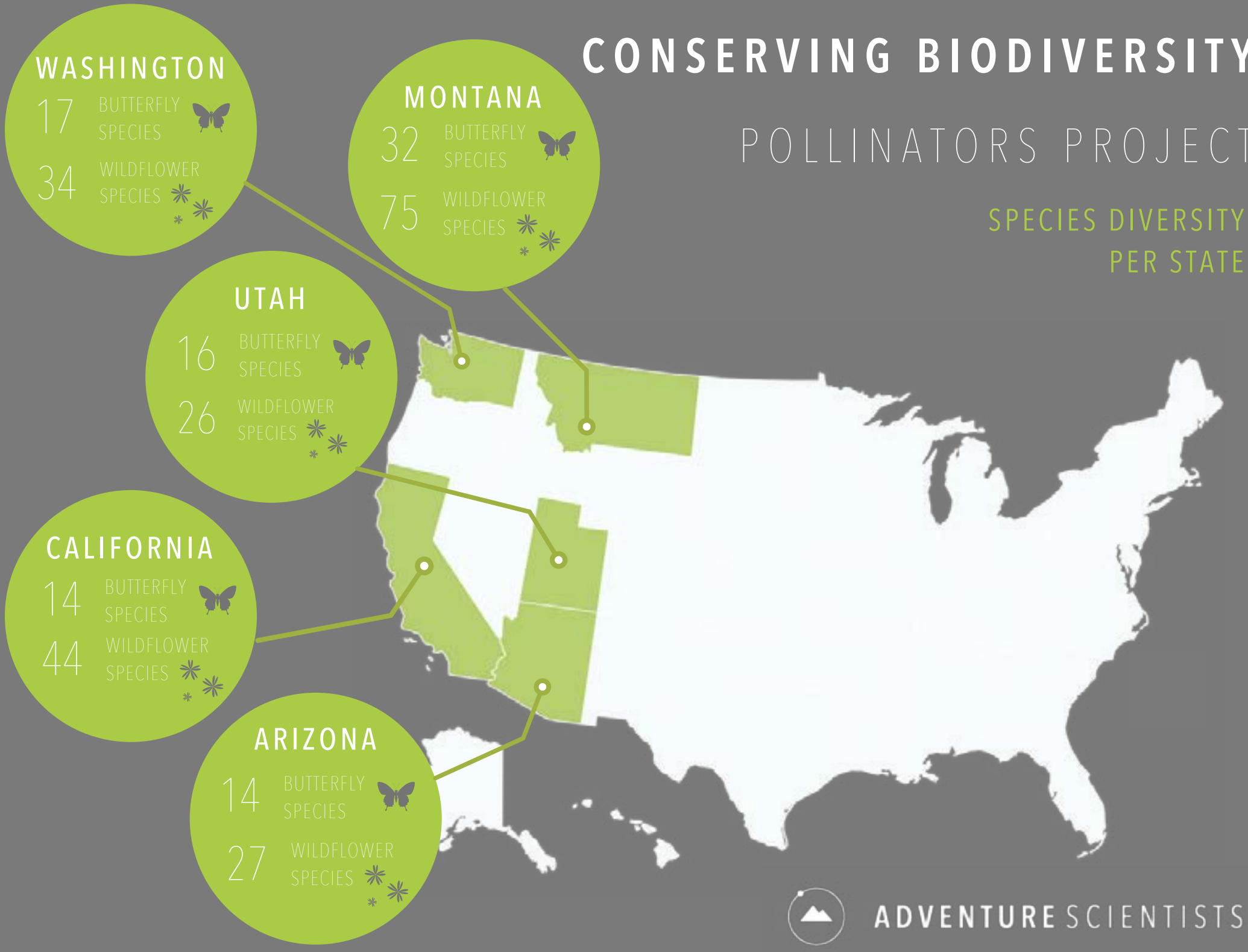
- U.S. Forest Service Land
- Accessible by a trail
- More than 3 miles from a trailhead
- Pairs of sites are at least 2 miles apart
- Above 6,000 ft
- Wildflowers present (i.e. suitable butterfly habitat)
- Less than a 2-hour drive from cities selected for recruitment (Tucson, AZ; San Francisco, CA; Bozeman, MT; Salt Lake City, UT; and Seattle, WA)

From this model, we selected 10 sites per region for Utah, California, and Washington for a total of 30 suitable field sites. The remaining sites were selected by Dr. Prudic, and Adventure Scientists' Project Manager, Michelle Toshack, based on their geographical knowledge of suitable butterfly habitat. Volunteers were encouraged to provide feedback about whether the model-assigned sites were located in suitable butterfly habitat after their first visits to the sites.

CONSERVING BIODIVERSITY

POLLINATORS PROJECT

SPECIES DIVERSITY PER STATE



ADVENTURE SCIENTISTS

A PINE WHITE *(NEOPHASIA MENAPIA)* PERCHES ON VOLUNTEER KATIE GUETZ'S FINGER DOMINIC OAKES

VOLUNTEER MANAGEMENT

The process of volunteer recruitment began in early June 2017. Thirty community members who had previously participated in Adventure Scientists' Gallatin Microplastics Initiative expressed interest in the project, which helped to fill the sites in Montana. In other states, twenty-two volunteers had previously been involved in Adventure Scientists projects. In addition, information about the project was distributed through the Adventure Scientists' newsletter, blog, social media and by

directly contacting 18 organizations who could reach a wide network of potential volunteers (e.g. Native Plant Societies, outdoors groups, etc).

Potential volunteers filled out an application form on our website, which included screening questions such as their level of experience in outdoor settings and whether they have any experience handling insects (experience preferred, but not required). We received 157 applications and we interviewed 108 potential volunteers over the phone. We accepted 100 volunteers into the project.

Twenty-two volunteers had previously been involved in Adventure Scientists projects.

Training for this project followed two methods: in-person field trainings and online training modules. Field training events are beneficial for volunteers to practice protocols in the field, and receive feedback/guidance from Adventure Scientists staff. However, these trainings require staff time and money that wasn't available for all sites in 2017. We saw this as an opportunity to assess the differences in data quality and volunteer retention and therefore tested both training methods in 2017.

Volunteers in Montana, Washington, and Arizona were trained on project in person. Each training entailed a project manager and at least two Adventure Scientists staff members traveling to the designated region to work with volunteers in the field. In-person trainings enabled volunteers to be properly trained on the technology platforms that were selected for data collection (Gaia GPS and iNaturalist).

VOLUNTEER TEAMS UTILIZE MAPS AND GPS APPS TO NAVIGATE TO DESIGNATED FIELD SITES

DOMINIC OAKES

In California and Utah, volunteers were required to take an online training module that we developed internally. This in-depth training module included videos of protocols and a mandatory quiz. The module took between 30 minutes and an hour to complete, and the quiz had to be passed with a 100% score (volunteers could take the quiz as many times as needed).

From a data quality standpoint, the data submitted by those who were trained online was as robust as the data from volunteers who were trained in person, which we assessed based on the percentage of properly submitted data. After the field season we will assess whether training method had an impact on volunteer retention.

The data submitted by those who were trained online was as robust as the data from volunteers who were trained in person, which we assessed based on the percentage of properly submitted data.

Adventure Scientists provided project equipment and written protocols to volunteers. This detailed protocol reminded volunteers before, during, and after their field visits about the use of project equipment and technology, details of catching and handling butterflies, and the details of recording plant phenology data. In their end-of-season surveys, all volunteers expressed that they were provided the necessary training resources to be successful as a volunteer (57% strongly agreed and 43% agreed). Overall, this attention to detail in developing protocols paid off in the reward of high-quality data. Volunteers submitted more than 90% of the data in full accordance with the protocols.

KATIE GUETZ REMOVES A BUTTERFLY FROM THE NET BY HOLDING IT BETWEEN THE HEAD AND THORAX

DOMINIC OAKES

A VOLUNTEER HANDLES A SULPHUR BUTTERFLY USING FORCEPS TO TAKE HIGH-QUALITY PHOTOGRAPHS EMMA BODE

DATA COLLECTION & RESULTS

All volunteers collected data using the iNaturalist app. We chose to use iNaturalist largely due to its machine learning algorithm, which can assist with identification of butterflies and plants. iNaturalist has a community of observers and identifiers who verify the species ID provided by data collectors. We created three separate projects within iNaturalist: "Butterflies," "Plants," and "Site Observations." All of the data is open source and can be viewed on the iNaturalist website, however only trained observers can contribute to the dataset within the three projects created by Adventure Scientists. The data for this project included photos of butterflies

and wildflowers, phenology of the plants (timing of the plant's life cycle), and site information. In total, 94 volunteers submitted 526 observations of butterflies, which were identified to 70 species. For wildflowers, volunteers submitted 676 observations, which were identified to 126 species.

Ninety-two percent of the records have been identified. It was not always possible to ID to species, in which case the observation was identified to genus or family. The three most abundant butterflies observed were orange sulphur (*Colias eurytheme*, 21 detections), mormon fritillary (*Speyeria mormonia,* 20 detections) and western white (*Pontia occidentalis*, 17 detections). Locations of project observations are included on our project website in an interactive format.

"The three most abundant butterflies observed were orange sulphur (*Colias eurytheme*, 21 detections), mormon fritillary (*Speyeria mormonia*, 20 detections) and western white (*Pontia occidentalis*, 17 detections)."

WILDFLOWER DATA IS ENTERED IN INATURALIST AND PROVIDED TO LAND MANAGERS ADVENTURE SCIENTISTS

DATA END-USE

Data on butterflies and their host plants within U.S. Forest Service boundaries are limited in remote regions. Understanding baseline data of pollinators will help inform future management priorities. Coupled with data from future years, data from this project can be utilized in a variety of applications, as described by one such end user:

LOUISE JOHNS

Justina Dumont
Botanist, Helena-Lewis and Clark National Forest

"These data will be used to support decision-making, Forest project planning, and land management strategies to promote biodiversity. These data could potentially support monitoring efforts of at-risk plant populations or pollinator populations, future restoration projects, and/or influence native plant material collection and seed mixes. Projects and planning strategies can be altered based on new information, and the additional data on butterfly species present on the Helena-Lewis and Clark National Forest would provide management opportunities to promote biodiversity."

WHITNEY METZGER MOUNTAIN BIKES TO A REMOTE FIELD SITE AT ROSS PASS, MONTANA

GREGG TREINISH

MICHELLE TOSHACK DEMONSTRATES PROPER NET HANDLING TECHNIQUES ADVENTURE SCIENTISTS

VOLUNTEER EXPERIENCE

In the end-of-season survey, volunteers spoke positively about their engagement with the project, such as:

"This was a great experience overall, giving a new purpose and direction to outings. Being super attuned to butterflies on non-project outings led to a re-discovery of a place I had hiked or run through many times, but now appreciate on a whole new level."

"What makes me most excited about this project is that I understand the power of data and data collection...I am also excited to help in establishing a database that will ultimately impact how our public spaces are managed. As an extensive public land user I am always excited about active ways to give back."

"We went to places [to] which we otherwise would not have gone. We spent a lot of time in the outdoors and it was great to help with scientific research as part of our recreation."

Volunteers requested additional resources about the conservation issues that we are addressing with this project. Forty percent of volunteers requested more scientific journal articles, 25% requested more popular media articles/videos, and 10% requested more Adventure Scientists produced content (blog posts, videos, etc.), reinforcing our understanding that volunteers are likely to become informed ambassadors for the species and places with which they work.

A LARGE MARBLE (*EUCHLOE AUSONIDES*) IS ONE OF THE MANY BUTTERFLIES DETECTED IN THIS STUDY LOUISE JOHNS

CHALLENGES

Time limitation was the biggest challenge we faced during the 2017 field season. Butterfly flight season in the mountains lasts approximately 6-8 weeks at the majority of our field sites, and ideally data-collectors would have been in the field in late June/early July depending on snowmelt. Because of the project's late start date, data collection may have started after peak butterfly activity in some regions. In addition, project permits weren't secured for the state of California, which is required in order to catch and handle insects (this is not required in other states). Volunteers in California photographed butterflies without using nets. As a result,

we received lower-quality photos from California because volunteers were unable to get close-up photos of both sides of the wings (which is often necessary to identify a butterfly to species). Volunteers from other states expressed that catching butterflies is an exciting and engaging activity, which is a major draw of the project. For next season, we plan to work with the state to enable the use of nets.

The project requirements stated that volunteers need to complete a minimum of three site visits within the field season, although many volunteers were unable to do so. When we asked volunteers about the reasons that prevented them from completing the three visits, weather (40%), lack of time (25%), and personal reasons (18%) emerged as the commonly identified barriers. Again, we will adjust our timing for future years to extend the field season.

Species identification on iNaturalist has presented a challenge since many of the observations remained unidentified for longer than we would have liked. An individual observation must be agreed upon by two people to be considered a "research-grade" observation. There are few active iNaturalist members who identify butterflies and plants on iNaturalist. Adventure Scientists' staff contacted the top butterfly observers in iNaturalist and requested them to identify observations for the project. Still many observations were identified by Adventure Scientists' project manager. In the future, we recommend that all project partners reach out to their network of butterfly experts and request that they volunteer for the project's identification needs.

AN ANISE SWALLOWTAIL *(PAPILIO ZELICAON)* OPENS ITS WINGS BEFORE BEING PHOTOGRAPHED AND RELEASED

ADVENTURE SCIENTISTS STAFF HIKE INTO A FIELD SITE FOR DATA COLLECTION

ADVENTURE SCIENTISTS

MOVING FORWARD

We are in the process of developing a Supplemental Project Agreement with the USFS in addition to the master cost-share agreement. We are seeking clarity from the USFS about additional site locations, and how we might adjust our protocols to better serve their management needs. We also are seeking clarity on whether field sites are allowed within wilderness boundaries.

Adventure Scientists has raised funds through philanthropic support for the pilot phases of this project. Adventure Scientists has secured limited funding for the

2018 field season and seeks additional funding if the project is to expand and/or continue beyond July 2018. Adventure Scientists provided 100% of the total 2017 project budget ($86,000) through general operating funds.

We are excited to continue moving forward and addressing the challenges that we faced in 2017 to refine our project for 2018. Future data collection will continue throughout the western United States over a longer field season to ensure high-quality data for management and research needs.

ACKNOWLEDGMENTS

We are so grateful for the enthusiasm and willingness of our trained volunteers. We thank them for participating in this project and providing valuable feedback about how to improve the project for future years. We'd also like to thank the many donor partners of Adventure Scientists without whom this project would not have been possible. The Adventure Scientists team provided tremendous support for getting this project up and running in a short period of time, especially Jessie Kay (Adventurer Coordinator), Nicholas Rustigian (Technology Systems Manager), Gregg Treinish (Founder, Executive Director), Merrill Warren (Development Manager) and Aisling Force (Project Creation Manager). Office assistant Ricky Jones contributed summary stats for this report. Ana Egnew (Assistant Wildlife Program Lead at the USFS) provided support and connections throughout the Forest Service. Celia Whitman at Bioquip Products, Inc. waived shipping fees for butterfly nets. Gaia GPS provided free downloads of their app for navigation purposes to all volunteers. Our corporate sponsors Peak Design, Croakies, Klean Kanteen and CLIF Bar donated cool swag to award to volunteers. Treeline Coffee and Bridger Brewing donated beverages for volunteers.

REFERENCES

Dobrowski, S.Z. and Parks, S.A. 2016. Nature Communications. Climate change velocity underestimates climate change exposure in mountainous regions. 7:12349 DOI: 10.1038/ncomms12349

Goulson, D., Nicholls, E., Botías, C., Rothera, E.L. 2015. Science. Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. Vol. 347, Issue 6229, 1255957 DOI: 10.1126/science.1255957

Merckx, Thomas & Huertas, Blanca & Basset, Yves & Thomas, Jeremy. 2015. A Global Perspective on Conserving Butterflies and Moths and their Habitats. Key Topics in Conservation II. 2. 239-257.

Potts, S., Biesmeijer, J., Kremen, C., Neumann, P., Schweiger, O., Kunin, W.E. 2010. Global pollinator declines: trends, impacts and drivers. Trends in Ecology and Evolution. Vol. 24, Issue 6. 345-353.

Prudic, K.L., McFarland, K.P., Oliver, J.C., Hutchinson, R.A., Long, E.C., Kerr, J.T., Larrivee, M. 2017. eButterfly: Leveraging Massive Online Citizen Science for Butterfly Conservation. Insects 8(53). 1-12. DOI: 10.3390/insects8020053

Taron, D. and L. Ries. 2015. Butterfly Monitoring for Conservation. Butterfly Conservation in North America. 35-57.

PEER-REVIEWED PUBLICATION

Prudic, Kathleen L. et al. 2017. eButterfly: Leveraging Massive Online Citizen Science for Butterfly Conservation. Insects. 2017; 8(2):53.

ADVENTURE SCIENTISTS

PO BOX 1834 | BOZEMAN, MT 59771

406.624.3320 | info@adventurescientists.org

For more information:
www.adventurescientists.org