2017-18 ANNUAL REPORT

UVU

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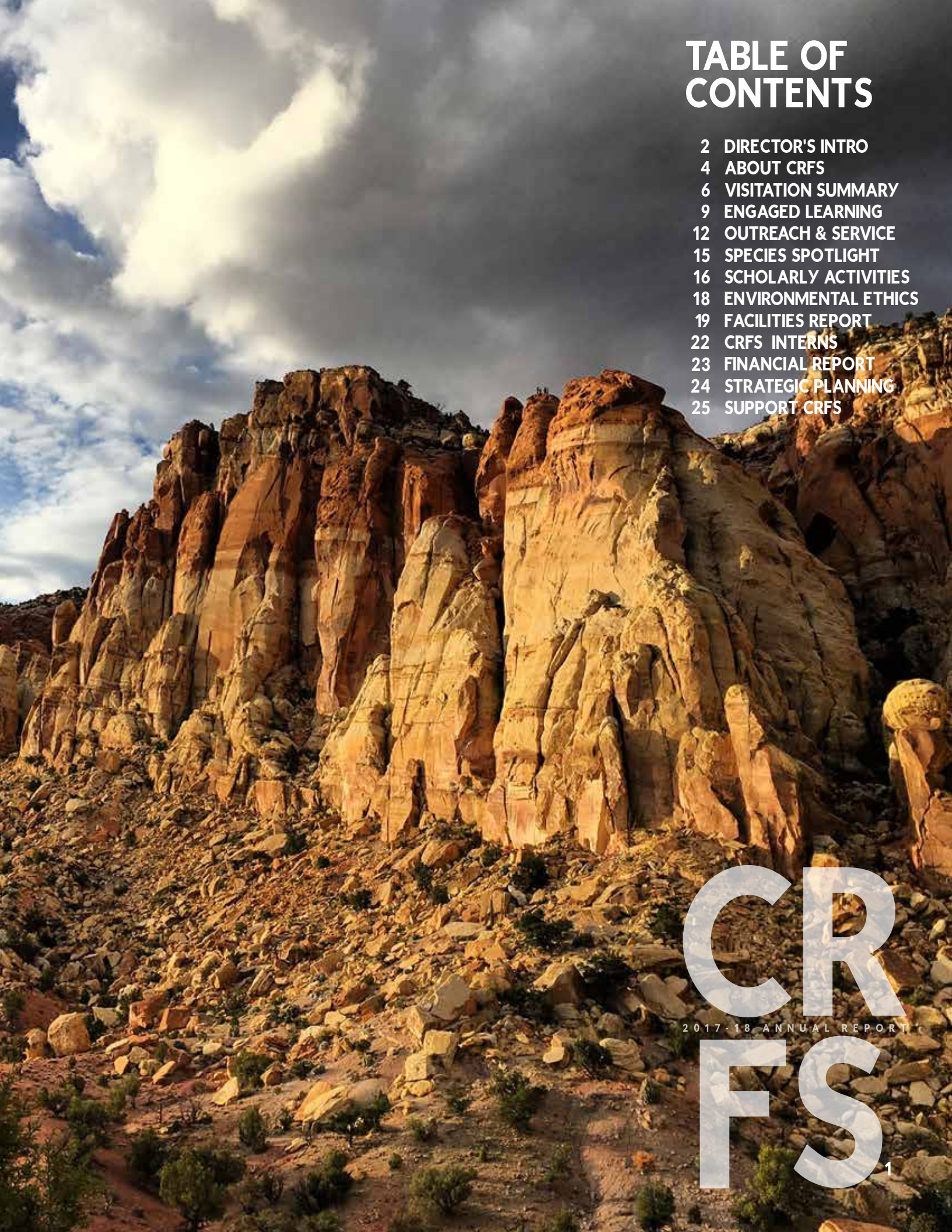


TABLE OF CONTENTS

CRFS

2017-18 ANNUAL REPORT

CAPITOL REEF FIELD STATION

UTAH VALLEY UNIVERSITY

As CRFS approaches its 10th anniversary, I'm given to reflecting on what we've accomplished recently. This year, I'm most proud of our increasing relevance to a wide variety of disciplines. While we often have visitors from several of UVU's colleges and schools, this year we had visitors who represented all eight of UVU's colleges and schools. This means that faculty and staff from programs as varied as the College of Engineering and Technology, College of Health and Public Services, College of Humanities and Social Sciences, College of Science, School of the Arts, School of Education, University College, and the Woodbury School of Business all found ways in which to enrich their curricula through visits to the field station with their students. To me, this means that UVU faculty and staff, regardless

DIRECTOR'S INTRODUCTION

CRFS

2017-18 ANNUAL REPORT

of their discipline, have embraced UVU's model of engaged learning and that CRFS is an excellent venue in which to put aspirations of engaged learning into action. In addition to attracting visitors from all eight of UVU's colleges and schools, we've obtained funding from the National Science Foundation, published a paper highlighting university-national park field station partnerships, and started construction on a new classroom building. From this point of reflection, I'm also looking forward to our next decade of promoting and supporting engaged learning, scholarly activities, and environmental ethics through field studies.

Michael T. Stevens Ph.D.
Director, CRFS

ABOUT CRFS

OUR MISSION

Capitol Reef Field Station, in partnership with Capitol Reef National Park, promotes and supports engaged learning, research, scholarly, and creative activities, and environmental ethics through the exploration of the Colorado Plateau.

OUR PLACE

Beyond the paved roads, our buildings sit atop a mesa in the Pleasant Creek Valley in the heart of Capitol Reef National Park. The field station is surrounded by stunning views of canyon country. The sun rises over the last mountain range in the continental United States to be mapped, the Henry Mountains, and it sets over Boulder Mountain, which was an active volcano tens of millions of years ago and supported small glaciers during the last ice age. At night, casual stargazers and serious astronomers alike can see the Milky Way and abundant constellations against a dark sky that was recently recognized as “gold-tier” by the International Dark-Sky Association. Only 3.5 hours from UVU and the Wasatch Front, our incredible location provides an unparalleled opportunity for place-based learning.

OUR VISION

Our vision is that our visitors leave the field station having learned more than the mere content of their coursework. Far away from many of life’s daily distractions, visitors immerse themselves in educational experiences that focus on the natural world that surrounds them. Practicing conservation encourages all visitors to think about their role in the environment and deepens their understanding of environmental ethics. We hope that every visitor connects with the landscape and develops an appreciation for the natural and cultural legacies of the Colorado Plateau.

OUR HISTORY

From CRFS, visitors can see hundreds of millions of years into the past. The rocky landscapes tell stories of shallow seas, tidal flats, swamps, and sand deserts. More recently, Pleasant Creek has carved its way through the canyon walls to create the oasis that has attracted life for millennia including Paleo-Indian, Desert Archaic, Fremont, and Numic-speaking (Ute and Paiute) people.

More recently, Mormon pioneers began to set the scene that we see today. In 1882, Ephraim Hanks established his ranch in Pleasant Creek Valley, building the first permanent home in what would become Capitol Reef National Park. This same ranch changed hands many times over the years, and had been converted into a tourist destination called Sleeping Rainbow Ranch by the time the national park was created in 1971. The ranch's owner, Lurt Knee, deeded the ranch to the national park in a transaction that included life tenancy. The land was handed over to the park in 1995 with his wife's passing. A few years later, UVU approached the park with the idea of converting the unoccupied site into a field station. It was agreed that a field station would support the missions of each organization, and after years of close collaboration on the project, the idea became a reality. CRFS opened its doors in October 2008.

OUR PARTNERSHIP

The success of CRFS is made possible through the partnership between UVU and Capitol Reef National Park. There are only eight other university-operated field stations located inside US national parks. Our uncommon partnership allows CRFS to provide its visitors with educational experiences that are as remarkable as the landscape in which they occur. CRFS is the property of the National Park Service and is operated by UVU in accordance with our General Agreement with Capitol Reef National Park.

UTAH VALLEY UVU UNIVERSITY

NATIONAL PARK SERVICE

VISITATION SUMMARY

Visitation to CRFS has steadily increased since opening in 2008, and this year was no exception. User days, calculated by multiplying the number of visitors by the number of calendar days they spent at the station, totaled 2,636 (Fig. 1). This represents a 12% increase over the previous fiscal year. Our current use is nearly four times our use in the first complete fiscal year with visitors (2009-10). We credit this substantial increase to our relevance to a variety of disciplines and our ongoing marketing efforts.

Seventy percent of our user days were associated with UVU. The University of Kansas was another substantial source of user days. Groups from American International School of Utah, Northwestern University, and Westminster College visited CRFS for the first time this year (Fig. 2).

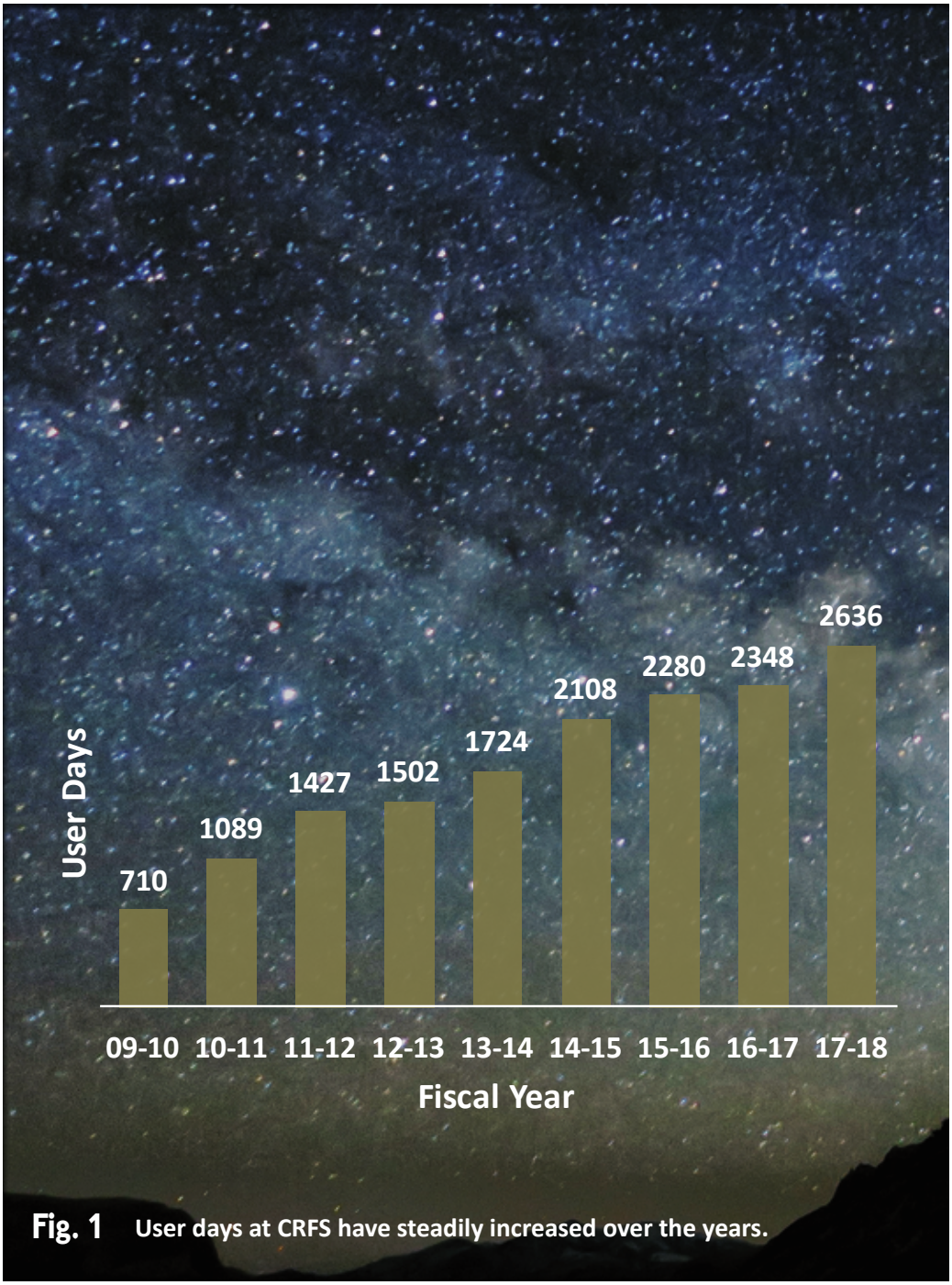


Fig. 1 User days at CRFS have steadily increased over the years.

Visitors from UVU represented all eight of UVU's colleges and schools (Fig. 3). This is excellent evidence that a field-station experience is applicable to many areas of interest. Our top four sources of visitation were the College of Science, College of Humanities & Social Sciences, Professional & Continuing Education, and University College.

During the 2017-18 fiscal year, 644 people (including 545 undergraduates) visited CRFS in 41 groups. The average group size was 16 and the average stay per group was 4 days. Females and males comprised 56% and 44% of visitors, respectively.

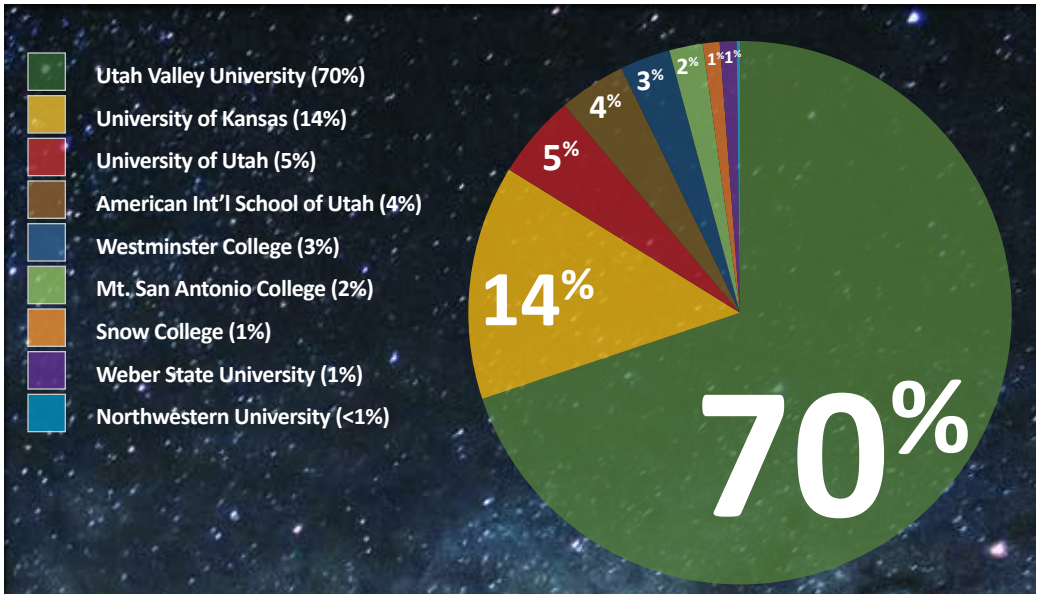


Fig. 2 Percentages of CRFS user days from various institutions.

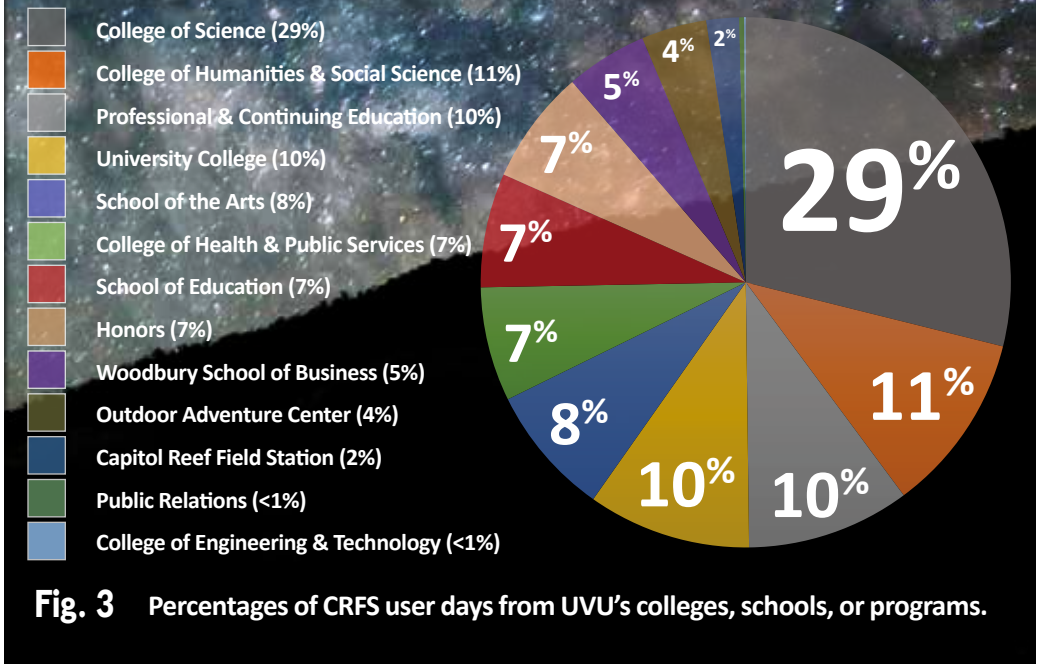


Fig. 3 Percentages of CRFS user days from UVU's colleges, schools, or programs.

VISITATION SUMMARY

UVU CLASSES WHO VISITED CRFS

COLLEGE	COURSE	TITLE
College of Engineering & Technology	DGM 4410	Senior Capstone II: iBeacon Project
College of Health & Public Services	DENT 3045	Dental Hygiene IV Clinical
College of Humanities & Social Sciences	COMM 3115	Environmental Communication
	ENGL 2010	Intermediate Writing
	ENGL 2010/3020	Research Writing
	POLS 1000	Futurescapes Workshop
College of Science	ASTR 1040	Elementary Astronomy
	BIO 202R/GEO 202R	Natural History Excursion
	BOT 4300	Native Trees and Shrubs of Utah
	BOT 4050/4055	Plant Ecology
	GEO 202R	Science Excursion
	GEO 3400/ 3500	Forensic Geology/Geomorphology
	PHYS 425R	Physics for Teachers
	PHYS 1800	Energy You and the Environment
	REC 4400	Natural Resource and Protected Area Management
	ZOOL 3200	Invertebrate Zoology
Honors	HONR 100R	Honors Colloquium
	HONR 100R	Honors Colloquium
School of Education	EDUC 5770	Matter in STEM for Elementary Teachers
School of the Arts	ART 300R	Special Topics in Photography
University College	ELL 2110-2140	English Language Learning
	ESL 1320	English Language Learning

UVU AFFILIATED GROUPS WHO VISITED CRFS

SPONSORING ORGANIZATION	GROUP
Capitol Reef Field Station	Public Star Party
College of Health & Public Services	Public & Community Health
College of Science	Nature to the Classroom
Outdoor Adventure Center	Wilderness First Aid
Professional & Continuing Education	Writer's Workshop
	Writer's Workshop
	Writer's Workshop
Public Relations	Trustee Filming
School of Education	CREATE Lab Training
Woodbury School of Business	Financial Literacy Summer Camp
	Financial Literacy Winter Camp

CLASSES FROM OTHER UNIVERSITIES WHO VISITED CRFS

UNIVERSITY	CLASS
Mt. San Antonio College (Walnut, CA)	Field Geology
Snow College (Ephraim, UT)	Geology Field Studies
University of Kansas (Lawrence, KS)	Geology Field Methods
University of Utah (Salt Lake City, UT)	Parks, Recreation, & Tourism
Weber State University (Ogden, UT)	Bears Ears & Beyond
Westminster College (Salt Lake City, UT)	Westminster Expedition

RESEARCH GROUPS WHO VISITED CRFS

UNIVERSITY	PRINCIPAL INVESTIGATOR
Northwestern University (Chicago, IL)	Matt Wang

OTHER GROUPS WHO VISITED CRFS

SCHOOL	CLASS
American International School of Utah (Murray, UT)	History of the American West

ENGAGED LEARNING

As one of UVU's four core themes, engaged learning is an important part of every student's experience at UVU. It is also central to our mission at the field station where students can have unparalleled engaged-learning experiences. Studying at the field station is more than just hands-on learning; it is a full immersion experience in the Colorado Plateau.

We are extremely proud of the fact that a wide variety of disciplines, from English to geology, are able to find meaningful and unique ways to create engaged-learning experiences at the field station. We regularly survey our visitors, and 99% (n = 484) strongly agreed (87%) or agreed (12%) that their educational experience was enhanced by their field station visit (Fig. 4). Similarly, 96% (n = 479) strongly agreed (90%) or agreed (6%) that the learning environment at the field station is difficult to replicate on campus (Fig. 5). We also found that our students would enthusiastically recommend the field station to others with over 99% (n = 484) encouraging other students who have the opportunity to visit the field station.

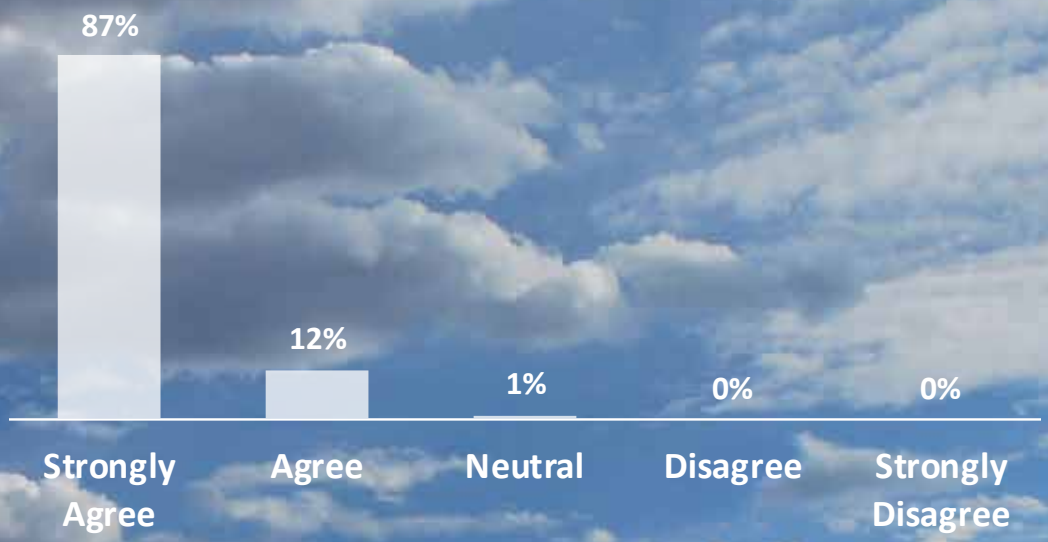


FIG. 4 Ninety-nine percent of our visitors strongly agreed (87%) or agreed (12%) that their educational experience was enhanced by their field station visit (n = 484).

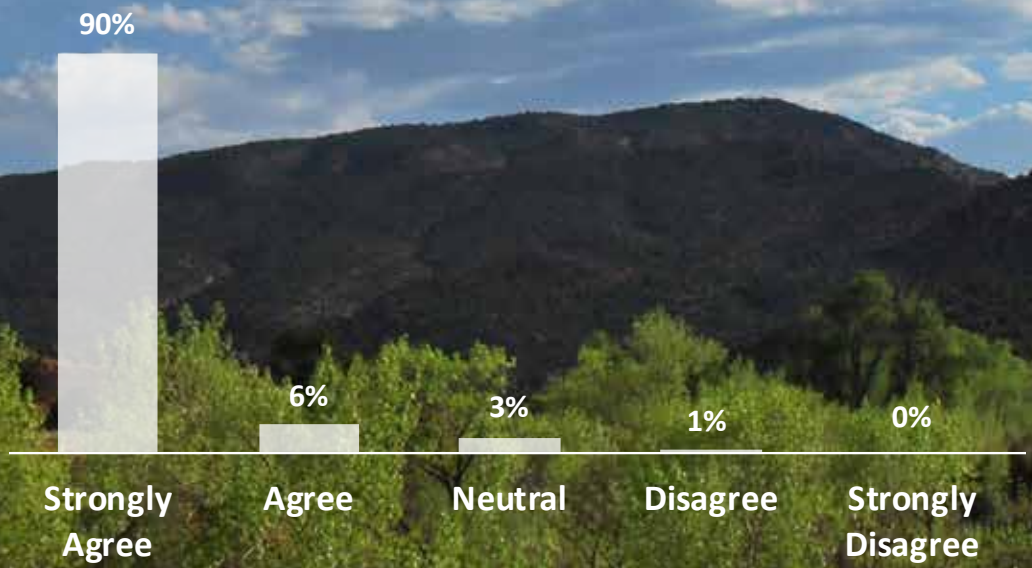


FIG. 5 Ninety-six percent of our visitors strongly agreed (90%) or agreed (6%) that the learning environment at the field station is difficult to replicate on campus (n = 479).

ENGAGED LEARNING

While we have too many groups to highlight in any one report, please read about some of our visitors this year and the unique ways in which they studied and learned at the field station.

UVU SCIENCE EXCURSION

October 19-22, 2017

Patty Garcia of UVU's Earth Science Department took a group of computer science students to the field station where they learned about geology and problem solving. She relates:

"Our primary learning objective was not to turn computer science majors into geologists, but rather to introduce them to problem solving in an unfamiliar terrain. Students had to use creative and innovative methods to solve geology problems during this science excursion. The Capitol Reef Field Station was the perfect integration of a meeting place for group learning, as well as excellent geology right outside the front door.

"Our second learning objective was to appreciate the importance of sustainability in our daily choices concerning how we use water and other resources. Keeping track of how much water we used and how much trash we created during our stay, gave the students a better idea of our impact on the environment. Fully immersing themselves in the beauty and peace of the park will give the students more reason to care about preserving places such as Capitol Reef.

"I believe we accomplished our learning objectives. Everyone turned in a stratigraphy assignment, and I am sure each student will look at geologic rock layers with a new appreciation."

WESTMINSTER COLLEGE WESTMINSTER EXPEDITION

November 18-21, 2017

Westminster College offers a semester-long academic road trip, called the Westminster Expedition, during which students and faculty travel extensively through the American West. During this experience, students study contemporary issues affecting the West while earning credits in history and environmental studies. They stayed at the field station for the first time this year and used their stay as a wrap-up and reflection on their entire experience. Trip leader Dr. Jeff Nichols explains:

"Overall the CRFS was an excellent location for our uses, and the lodging, dining, and conference facilities were just right. We've recommended the place to everyone on campus, and at least one group from Outdoor Leadership is already scheduled to stay there.

"Thanks very much for the accommodations—you have an enviable facility and we'll be back."

UVU FINANCIAL LITERACY
January 20-22, 2018

UVU's Financial Literacy Winter Camp brought twelve Chinese college students from Dalian Maritime University to the field station where they learned about sustainability and the Colorado Plateau. Trip leader, Dr. Rachel Bi summarized the trip as follows:

"Through the three-day experience, students learned a lot about geology, geography, and astronomy. And after three days of outdoor life, students also learned about the value of energy, such as how to save water and electricity. I believe that our visit will make a difference in our living habits in the long run. We appreciate the opportunity provided by UVU Capitol Reef Field Station and look forward to our future visits."

UVU INVERTEBRATE ZOOLOGY
April 13-14, 2018

Dr. Joshua R. Jones took his zoology students to perform macroinvertebrate sampling on Pleasant and Sulphur Creeks, two perennial streams in Capitol Reef National Park. Prior to their visit, he worked with Park Biologist Sandy Borthwick to obtain the necessary permits. Dr. Jones and his students used microscopes at the field station to view larvae and adults of various species that inhabit the park in early spring. They also prepared a simple ordinal-level taxon list based on their findings. He describes their experience in more detail:

"Although our visit to the station was short, it was packed with fun. The students in the course had excellent camaraderie, and energy was high from beginning to end. … The highlights of the trip by far, however, were the visits to, and invertebrate sampling in, Pleasant Creek, Sulfur Creek, and outside the park. One thing students emphasized repeatedly over the duration of the semester was their desire to get out of the classroom to do fieldwork and sampling. Thus our visit to the park represented the crown event of the course. The students earnestly wanted to be out in nature, connecting with it. Such a connection drives them, and is a large reason why they chose their biology-oriented majors. The station provided the perfect venue for such connection. At some point during our visit, each student personally expressed to me a profound appreciation and gratitude for the chance to visit the station."

UVU ELEMENTARY ASTRONOMY
April 14-15, 2018

Dr. Jacqueline Radigan from UVU's Physics Department took a group of students to CRFS to take advantage of our unique night skies. She details the trip:

"I took a small group of ASTR 1040 students to experience the night sky firsthand from the Capitol Reef Field Station (an internationally-recognized dark-sky region). We located constellations in the sky, and used telescopes to look at Jupiter, Saturn, the Orion Nebula, the Ring Nebula, the double star Albireo, and a variety of star clusters. Before sunset, we observed our own star, the Sun, through a solar telescope."

OUTREACH & SERVICE

The presence of the field station in Wayne County facilitates the connection between UVU students, the local community, and the National Park Service. CRFS serves as an important destination not only for university faculty and students but also for visitors from the region. Additionally, several groups this year engaged in service projects such as graffiti removal and invasive species research.

UVU CREATE LAB

October 13-14, 2017

Enhancing K-12 STEM Education

The UVU CREATE (Community Robotics, Education, and Technology Empowerment) Lab, a satellite of Carnegie Mellon University's CREATE Lab, participated in a two-day training at CRFS. The group included K-12 educators from the local community. During their training, they experimented with various ways to use technology to teach STEM (science, technology, engineering, and mathematics) including programming robots and capturing images with high-resolution panoramic cameras. Group leader Dr. Krista Ruggles explains the significance of this training:

"The majority of the participants, being new to these technologies, were enthusiastic about the hands-on experience in such an authentic setting. ... With the push for STEM and 21st-century learning in K-12 classrooms, the partnership with Carnegie Mellon's CREATE Lab has come at the most opportune time. This Lab will support teachers and teacher educators with training and tools available from the lending library to provide meaningful and impactful STEM-focused lessons in our local schools. We are grateful for having an opportunity to utilize the UVU field station to host our initial training."

AMERICAN INTERNATIONAL SCHOOL OF UTAH HISTORY OF THE AMERICAN WEST

February 20-24, 2018

Using the Colorado Plateau as a Classroom for High School Students

A group of eleventh graders from the American International School of Utah visited the field station as part of a course studying the American West. The group attended a rope-tying class, hiked to collect a game camera, and visited a local farm where they were taught sustainable farming techniques by the farm's owner. Group leader Pippa Keene relates their experience:

"Every student became much more aware of the resources they use on a daily basis, and how important water is to the desert environment and the world at large. ... It was great to be able to then go outside to see the American West, and how this specific area has been changed by Western expansion. … I absolutely love watching my students gain confidence, learn in an organic way, make new bonds and friends, cooperate and collaborate with cooking and cleaning, and spend time outside exercising their minds and bodies."

UVU DENTAL HYGIENE
March 1-3, 2018

Dental Hygiene Clinic for Underserved Communities

Second-year dental hygiene students from UVU had the opportunity to visit CRFS while conducting a Free Dental Hygiene Day in the area. They were able to provide free oral hygiene care to patients ranging in age from 1-52 from several counties. Group leader Sandy Wilson shares their experience:

"This experience enriched our students' lives in several ways. They were able to provide service to those who have had a difficult time with access to care. They were able to understand the importance of thinking outside the box when it comes to dental treatment homes. They were motivated and rejuvenated in nature and conservation. We truly feel grateful for this experience and hope that we can bring more students in the future."

UVU ENVIRONMENTAL COMMUNICATION
May 5-8, 2018

Graffiti Removal in Capitol Reef National Park

Dr. Maria Blevins' Environmental Communication class visited the field station in the spring to explore how people communicate about the environment. While at the field station, they were able to meet with Park Archaeologist Julie Howard, who informed them of the problems with vandalism in the park. Afterwards, together with Site Manager Joe Ceradini, they removed graffiti in the Capitol Gorge area of the park. Dr. Blevins relates:

"This service project helped the students learn how to remove graffiti, but the process led to meaningful discussions and exploration of geology, visual communication, and the impact people can leave on the land."

OUTREACH & SERVICE

MT. SAN ANTONIO COLLEGE SPECIAL TOPICS IN FIELD GEOLOGY

May 9-13, 2018

National Park Service Career Panel Discussion and Hands-on Invasive Species Project

Mt. San Antonio College geology students visited CRFS in May as part of a career-preparation program for students interested in environmental careers. They were able to hear from the Park Ecologist Carolyn Livensperger, Park Horticulturist Amanda Snodgrass, and Field Station Site Manager Joe Ceradini, about their respective academic and career paths, current job responsibilities, and work-life balance. The panel made suggestions for internships and higher-education opportunities in the environmental sector. After the career panel, students participated in an invasive grass (cheatgrass) research project in Pleasant Creek Valley, where they helped remove cheatgrass and collect data on variables such as percent cover and distance to ant mounds. Students were also exposed to facets of experimental design and sampling protocols, which are key components of ecological research. Group leader Becca Walker describes the unique opportunity the field station provides for her students:

"CRFS fosters the interdisciplinary learning experience that our community college students are seeking, and the level of academic work in which students engage during their time at the field station is well beyond what they encounter in a typical introductory-level course. Allowing us to visit CRFS and conduct fieldwork in the area is imperative for the recruitment and retention of STEM majors, especially for groups historically underrepresented in STEM. We appreciate the continued support of our field programs at Mt. SAC."

UVU & CAPITOL REEF NATIONAL PARK STAR PARTY

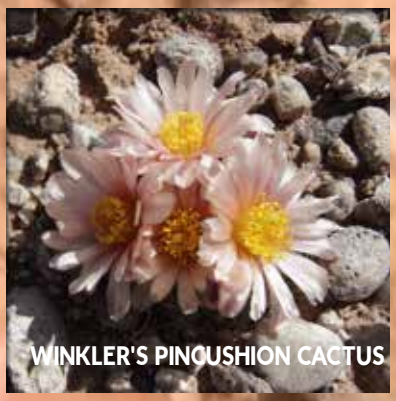
May 18-19, 2018

Public Star Party

This event was held in collaboration with Capitol Reef National Park over two days in May. UVU faculty member Dr. Joe Jensen and CRFS Site Manager Joe Ceradini hosted the Star Party, which was attended by both day visitors and overnight guests. Joe Ceradini says:

"The star party provided an opportunity for the general public to visit and learn about the field station, and experience Capitol Reef's remarkable dark skies from an ideal location, all while UVU astronomer Dr. Joe Jensen provided context and answered our endless space questions. The main response we got from visitors was, when is the next public event and can I sign up now?!"

SPECIES SPOTLIGHT



WINKLER'S PINCUSHION CACTUS

WINKLER'S PINCUSHION CACTUS *(Pediocactus winkleri)*

The desert is a land of extremes. In the summer, desiccating daytime heat transitions to cool nights as the temperature drops as much as 40°F; droughts are often followed by heavy rains and flooding. Plants and animals living in the desert have therefore evolved countless strategies to cope with this variable and harsh environment. The Winkler's pincushion cactus (*Pediocactus winkleri*), for example, has evolved a fascinating desert survival strategy: contractile roots. This pincushion cactus flowers and fruits in the spring. After reproducing, it pulls itself underground or to the ground surface with contracting roots. The cactus remains retracted throughout the summer and winter only to resurface again when conditions are favorable for reproduction in the spring. By retracting underground, the cactus reduces its exposure to extreme heat and cold during the summer and winter. Additionally, Winkler's pincushion cactus can remain below ground for more than a year when drought persists, resurfacing when conditions improve. The ability to capitalize on resources when available, and to avoid unsuitable conditions, allows this species to survive in often unpredictable desert ecosystems.

Winkler's pincushion cactus is endemic to (i.e., only found in) certain desert shrub habitats in south-central Utah. In general, species that are endemic to a small region are at a greater risk of extinction because threats such as habitat degradation are more likely to impact a large proportion of the total population. Winkler's pincushion cactus is threatened by many factors, including disturbance from livestock and off-highway vehicles, climate change, and illegal collection. Due to the combination of its endemism and these threats, the cactus has been listed as threatened under the Endangered Species Act since 1998. To effectively conserve this unique species, we need to conduct research to improve our understanding of its biology, monitor existing populations, and maintain high quality habitat where it can thrive for years to come.

SCHOLARLY ACTIVITIES

At CRFS we are fortunate to be able to support and participate in a wide array of research, scholarly, and creative activities that improve our understanding and appreciation of the Colorado Plateau. This year we highlight work on invasive plants by CRFS itself in collaboration with Capitol Reef National Park, place-based English Language Learning, and two undergraduate independent projects focused on automating data collection and developing a self-guided tour, respectively.

INVASIVE PLANTS

Research and Removal

Joe Ceradini, CRFS Site Manager and Research Associate in the Biology Department, and Carolyn Livensperger, Capitol Reef National Park Ecologist, write about their research collaboration on invasive grass removal and control in Pleasant Creek.

"Invasive plants are among the top threats to ecosystems worldwide and cheatgrass (Bromus tectorum)*, a common invasive grass in North America, is dramatically altering ecosystems throughout the Colorado Plateau and beyond. Invasive plants such as cheatgrass often thrive in disturbed areas, outcompete native plant species, and potentially harm native fauna. The old pastures along Pleasant Creek are heavily invaded with cheatgrass and other non-natives, such as Russian thistle* (Salsola tragus)*. We conducted an experiment on non-chemical cheatgrass removal techniques within these previously disturbed plant communities. We applied different treatments in spring 2018 and will survey plots again in 2019 to assess treatment effectiveness. Additionally, we were able to incorporate CRFS visitors and interns into the project, providing a valuable service project and field experience related to ecological research on the Colorado Plateau. This research will help us to better manage and control this harmful invasive plant within Pleasant Creek Valley and, hopefully, throughout the Colorado Plateau.*

"A second component of this study is to better understand why cheatgrass grows in some places and not in others. If we can better understand what controls cheatgrass growth, we can improve management and prevention practices, and prioritize restoration efforts. For example, we may be able to more accurately predict what portions of Capitol Reef or the Colorado Plateau are most susceptible to cheatgrass invasion and focus prevention efforts on those regions."

ENGLISH LANGUAGE LEARNING

Place-based Eco-pedagogy

Kevin Eyraud, along with other faculty from UVU's Department of English Language Learning, takes students to CRFS in order to provide a real-world context to both language learning and student projects completed over the course of a semester. Furthermore, interviews exploring students' experiences form the basis of Kevin's dissertation research and a forthcoming book chapter. Kevin details the projects and their trips:

"Visiting CRFS as a culminating activity during our language-learning semester highlights in a vivid (and hands-on) manner the competing political, economic, and environmental elements of life in the West that we study in class. Engaging with the varied historical, biological, and geological features of the Colorado Plateau enhances students' learning (and affective) experiences while making observations and working with contextualized college-level content and language. Small teams of students engage with specific topics at the field station and then conduct peer teaching lessons with their cohorts. As examples, one group may be responsible for learning and informing classmates about the geological features of the Colorado Plateau in general and the sedimentary rock layers visible at Capitol Reef in particular. Yet another team explores and then teaches about biological soil and lichen and the surprising and crucial roles these important life forms play in fragile desert ecosystems.

"As a result, students are able to take what they learn before and during the CRFS visit to extend to research topics of their choosing that investigate germane economic and environmental impacts. The research is used to complete substantial and substantive assignments such as a research paper, a reading portfolio, a formal oral presentation, and

a public poster session. The assignments, in conjunction with the CRFS visit, allow students to become 'experts' in their topic and become more conversant about Utah spaces and issues of interest. The truly transformative experiences our students have, in large part due to the trip to Capitol Reef, inform the pedagogical choices we make for the classes. The student voices and opinions in the interviews and subsequent transcriptions play a large role in my dissertation research as well as forming the basis of a chapter in a forthcoming edited book."

TURBIDITY PROJECT

Streamlining Operations through Automation

As part of his undergraduate research project for his computer science degree, David Koch, advised by UVU Professor David Heldenbrand, worked with CRFS to automate data collection during the on-site water treatment process as part of an overall effort to raise awareness of our natural resource use on the Colorado Plateau. UVU student David Koch shares:

"CRFS treats water pumped from a shallow well in Pleasant Creek Valley, where the station is located. Multiple water quality parameters, such as turbidity (clarity), are assessed during the water treatment process. Turbidity data are currently collected manually every 4 hours by the site manager. The manual data collection can be a logistical challenge and also makes it difficult to assess trends. I wanted to automate data collection in order to make the process more efficient, and to provide a more responsive means of troubleshooting problems when they arise. To accomplish this, I developed a software program that integrates with CRFS systems and allows data to be collected and stored as often as every minute. Making the data more easily accessible allows the site manager to compile and analyze it more efficiently and helps reveal patterns and problems in real-time, so we can better understand water quality at the field station. This leads to improved troubleshooting, monitoring, and helps streamline overall operations. Finally, while working on this project I simultaneously gained college credit and acquired hands-on experience within my field of study, which will help advance my career."

iBEACON PROJECT

Integrating Technology and Environmental Education

Arthur Schoenfeld and Leandro Sanchez, UVU undergraduate students in the Digital Media Department, conducted an independent project under the supervision of UVU Associate Professor Michael Harper and in collaboration with CRFS. Arthur and Leandro designed and created a self-guided, interactive tour to enhance visitors' experiences. They said:

"The self-guided tour will be implemented with 'proximity beacons' (iBeacons) placed at strategic locations around the CRFS mesa. We created an application that is activated on visitors' phones when they are close to the iBeacons. The iBeacons activate the application using battery-friendly Bluetooth technology that does not rely on an internet connection. Each beacon provides location-specific information that highlights conservation and design aspects of the field station and the environment of Pleasant Creek and Capitol Reef using text, audio, and pictures.

"The proposed iBeacon proof-of-concept project supports the CRFS mission by promoting environmental ethics and place-based environmental education through a self-guided tour application."

PUBLICATION AND PRESENTATION OF CRFS SCHOLARLY ACTIVITIES

Ceradini JP (2018) Behavioral, demographic, and community responses of small mammals to habitat homogenization by cheatgrass. Biology Department Seminar Series, UVU, Orem, UT.

Kelly A, Stevens MT (2017) Field stations on federal lands. Organization of Biological Field Stations Annual Meeting, University of Minnesota Itasca Biological Station and Laboratories, Lake Itasca, MN.

Kendall E, Bhatt A (2017) Thermospheric airglow perturbations in the upper atmosphere related to hurricanes and thunderstorms. American Geophysical Union Annual Fall Meeting, San Francisco, CA.

Kendall E, Bhatt A, Zhang SR, Coster A (2017) MANGO imager network observations of geomagnetic storm impact on midlatitude 630nm airglow emissions. American Geophysical Union Annual Fall Meeting, San Francisco, CA.

Marstella M*, Vance T*, Walker D*, White A* (2017) Learning sustainability at CRFS. UVU Sustainability Day, Orem, UT.

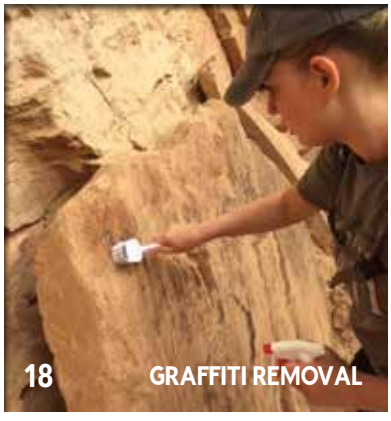
*denotes a UVU student or recent alumna/alumnus

ENVIRONMENTAL ETHICS


FILTRATION SYSTEM


SOLAR PANELS


GRAFFITI REMOVAL


GRAFFITI REMOVAL

We strive to help all of our visitors gain more appreciation for public places and to learn principles of conservation. Regardless of their discipline, all visitors can come to appreciate the Colorado Plateau and leave with a greater desire to protect the environment. This is often an unexpected by-product for visitors who come to study a particular discipline and leave not only with a greater understanding of that discipline but also of conservation and environmental ethics.

We teach our visitors about conservation, and 87% (n = 475) reported learning new ways to conserve. In addition, 97% of visitors (n = 473) strongly agreed (83%) or agreed (14%) that staying at CRFS made them more aware of their personal environmental impact (Fig. 6). Our visitors also leave with a greater appreciation for public lands with 96% (n = 476) strongly agreeing (79%) or agreeing (17%) that they place more value on protected lands such as Capitol Reef National Park because of their stay at CRFS (Fig. 7).

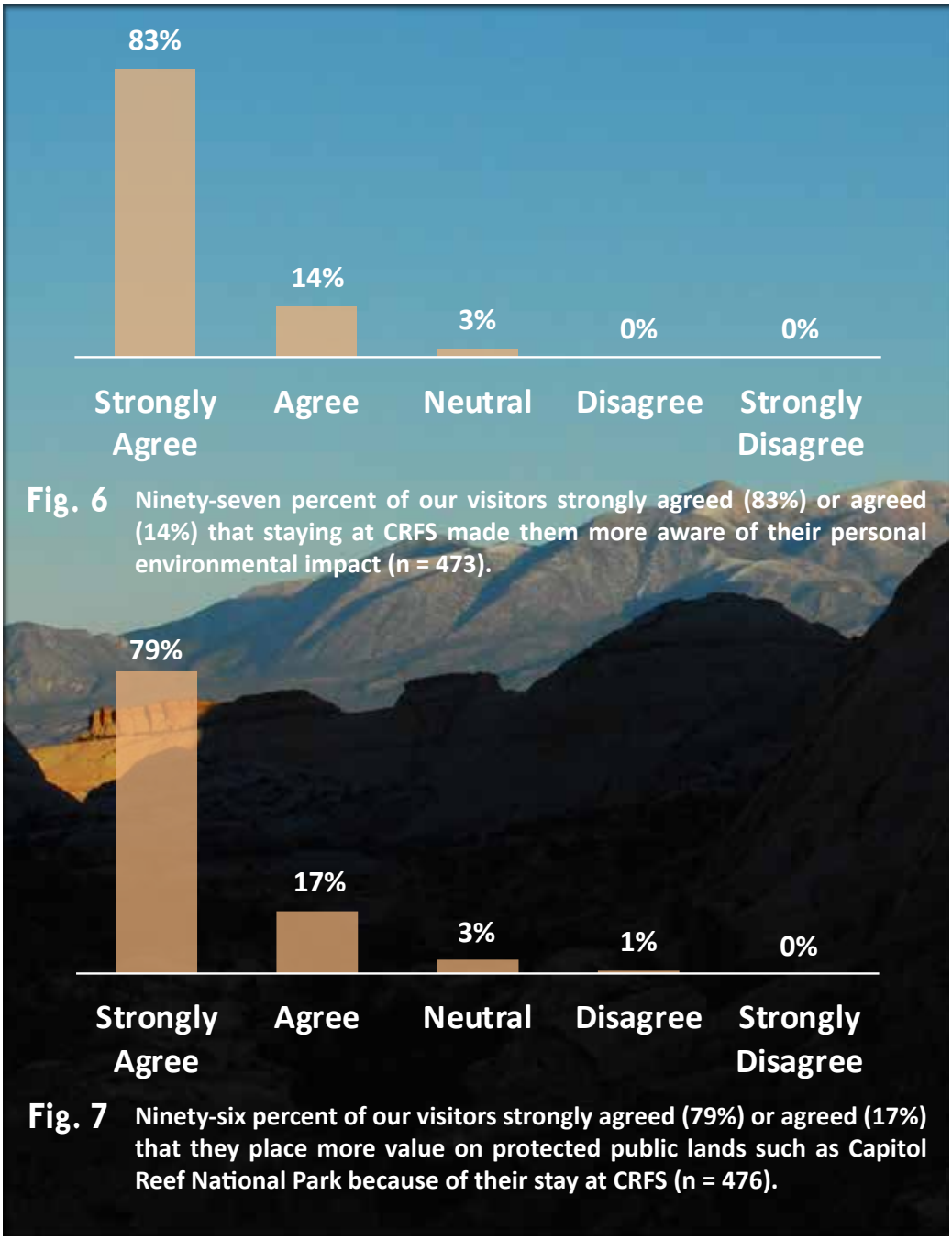


Fig. 6 Ninety-seven percent of our visitors strongly agreed (83%) or agreed (14%) that staying at CRFS made them more aware of their personal environmental impact (n = 473).

Fig. 7 Ninety-six percent of our visitors strongly agreed (79%) or agreed (17%) that they place more value on protected public lands such as Capitol Reef National Park because of their stay at CRFS (n = 476).

FACILITIES REPORT

NEW BUILDING

As user days have increased and user groups have continued to diversify, it has become obvious that our single, multi-purpose room has its limitations. We are excited to announce that construction has begun on a new classroom building, which will feature dedicated space for teaching and learning. It has an expected completion date of spring 2019. The new 1,400 ft^2 building will be situated on the south side of the mesa top between the solar panels and the existing CRFS campus with an east-west orientation. The new building (Fig. 8) will include a classroom with digital projection, whiteboards, sinks, cabinets, and ample work surfaces. The classroom will open onto a covered patio with additional teaching space outside and spectacular views of the Henry Mountains. The building will also feature a telescope storage room with an adjacent observation platform, a space for research instruments, and two restrooms accessible from the outside (Fig. 9). The new building will enhance the field-station experience for all visitors and increase the field station's ability to support the missions of both Capitol Reef National Park and UVU.

Fig. 8 The new classroom building under construction.

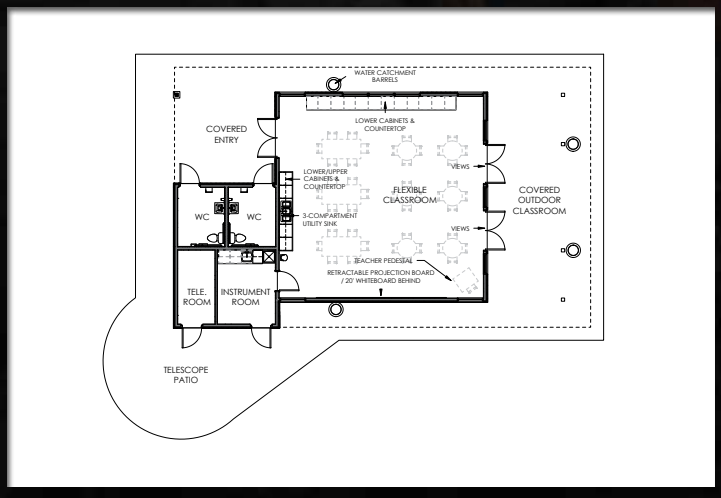


Fig. 9 Floor plan of the new classroom building.

FACILITIES REPORT

OFF-GRID POWER

At CRFS, visitors have the unique experience of knowing where all their electricity comes from. We take advantage of the abundant sunlight and capture solar energy with seventy-two 200-watt panels, which produce up to 14.4 kilowatts of power and also provide shaded parking. Solar energy is stored in a cutting-edge battery bank. Our original lead-acid batteries were replaced with Blue Planet Energy's lithium-ferrous phosphate batteries (Blue Ion 2.0) in fall 2017. The new batteries are more than 95% efficient, require zero maintenance and have virtually no safety risks. Additionally, more than 99% of the energy stored in the Blue Ion batteries is available for use ("depth-of-discharge") as compared to approximately 50% depth-of-discharge for our original lead-acid batteries. Finally, our new batteries contain a more environmentally friendly iron (ferrous) cathode rather than a commonly used and environmentally hazardous cobalt cathode. Four inverters convert the electricity from DC to AC, so it can power our facilities. In the event we lose solar capability, CRFS has a propane-powered backup generator.

DARK-SKY RESOURCE

Of all the awe-inspiring views at the field station, one of the most spectacular is the clear night sky. Capitol Reef National Park and CRFS take special measures to ensure the preservation of this resource, helping to retain the park's designation as an International Dark-Sky Park. To minimize our impact on the nocturnal environment, the field station uses low-wattage external lighting that points downward. All windows are equipped with blinds that are closed at night. Our powerful telescopes give visitors the opportunity to see Saturn's rings or the Andromeda Galaxy, inspiring a deeper appreciation of the natural dark-night sky as a resource worth protecting.

HEATING & COOLING

In the United States, nearly half of the energy used in our homes goes to heating and cooling. Using passive systems can dramatically reduce energy needs. At CRFS, our buildings have been designed to take advantage of natural processes. In the winter, Trombe walls are used to help warm the buildings. These south-facing walls have been painted black and sealed with a pane of glass 4-6 inches from the wall. The sun's radiant energy is captured during the day and slowly conducts inward through the wall, even into the night. For the summer months, these Trombe walls can be covered during the day with a solar shade to prevent heat absorption. To further promote cooling, the building design includes solar chimneys, or "cooling towers." Utilizing the principle of convection, these towers allow warmer air to move up and out of the tower as cooler air filters in, creating a natural current. Without the aid of air conditioning, building temperatures remain surprisingly comfortable throughout the summer. Proper insulation, quality seals around doors and windows, and white roofs that reflect sunlight also help maintain moderate interior temperatures.

ON-SITE WATER TREATMENT

Water at the field station is pumped from a well adjacent to Pleasant Creek, a perennial stream that has supported life in the area for thousands of years. A solar-powered pump brings water to the on-site treatment facility, where it is purified using a membrane-filter system. Treated water is stored in a 10,000-gallon tank for later use. The water treatment system is state-licensed and operated by trained staff. Water is tested regularly and meets or exceeds standards within the state.

WATER CONSERVATION

Visitors have the opportunity to see our on-site water treatment facility, giving them a deeper understanding of where their water comes from. When groups visit our remote desert location, we encourage them to think critically about how they use water, and we teach them water-conservation strategies. All faucets have their flow rate displayed in gallons per minute. Reduced-flow shower heads cut back on the amount of water used, with a flow rate of 1.5 gal/min instead of 2.5 gal/min for a typical shower head. Buttons on the shower heads allow the user to stop the water from flowing while taking time to shampoo, condition, soap up, or shave. In the kitchen, three separate tubs are used to wash, rinse, and sanitize, which allows guests to clean dishes without constantly running the water. Dual-flush kits on toilets allow a partial flush (1 gallon) for liquid waste, and a full-powered (2.25 gallon) flush when it's really needed. Rainwater catchment basins are used to collect precipitation that runs off our roof, which we use for our raised garden beds.

NATURAL LIGHTING

The buildings at the field station were constructed with south-facing windows situated high on the walls. These windows supply ample pleasant light throughout the day while conserving energy. Once the sun is down, we continue to save energy by using energy-efficient bulbs.

RECYCLING AND COMPOST

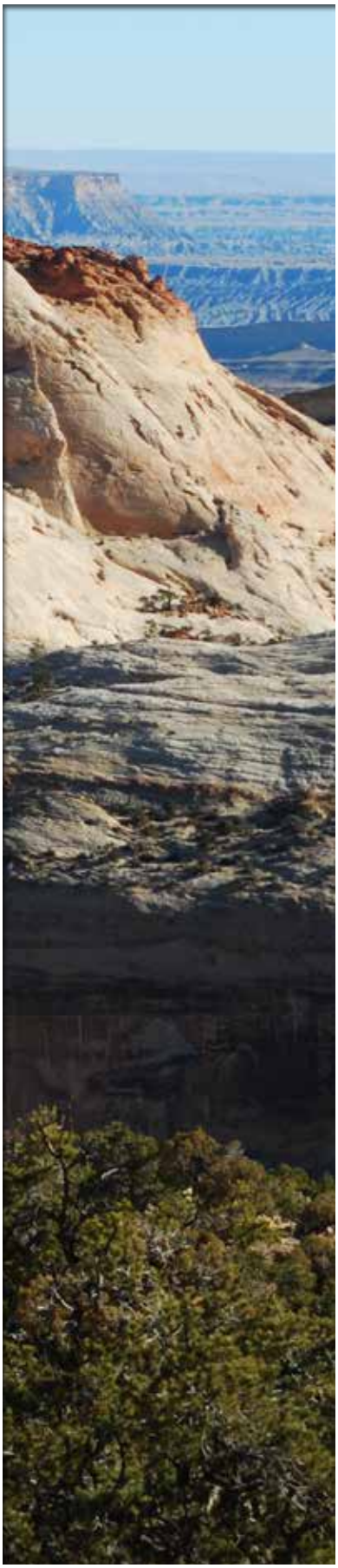
At the field station, visitors are challenged to think about their waste and where it goes. Often, what we consider to be "waste" isn't waste at all! We are able to recycle plastic, tin, aluminum, paper, and glass. We also have a composter to convert fruit and vegetable scraps into nutrient-rich soil for our raised-bed garden. These two methods allow visitors to reduce their environmental impact and significantly decrease the volume of trash they produce.

RAISED BEDS

Two raised garden beds at the field station, installed by intern Sarah Heelis in 2015, help demonstrate the practical applications of composting. Waste from the kitchen is converted into soil and used to grow food on-site, further demonstrating ways to live sustainably.

EROSION CONTROL

Permeable pavement reduces the amount of runoff and subsequent erosion caused by the existence of field station buildings. The interlocking pavers allow precipitation to slowly disperse into the soil, allowing natural ground-water recharge. Permeable pavers also allow topsoil to capture contaminants before runoff re-enters the groundwater.



CRFS INTERNS

ERIN CALL

22 BRET STEIN

NATURAL RESOURCES INTERN

Erin Call

Erin Call, an Integrated Studies major with emphases in Environmental Studies and Geography, worked with the Resources Management and Science Division in Capitol Reef National Park on a variety of projects. She gained hands-on experience with the challenges and rewards of public land management. Erin surveyed extensively for two endemic cactus species listed on the Endangered Species Act, *Pediocactus winkleri* and *Sclerocactus wrightiae*. These cacti are a park management priority and the annual monitoring that Erin assisted with is an essential component of science-based management. Erin's internship also enabled her to gain experience in different ecological subdisciplines as she participated in a diversity of surveys: rare plant surveys in canyons, riparian assessments, native seed collection, breeding bird surveys, tamarisk beetle monitoring, seining for three fish species of conservation concern in Utah, ungulate monitoring, dragonfly larvae collection for a nationwide project on mercury pollution, and archaeological inventories. Her internship directly influenced her career goals and she has now shifted her focus towards science-based land management. Summarizing her experience, Erin says:

"The diversity of this internship made me aware of what the parks do and all the unseen work that goes into keeping our public lands and ecosystems beautiful, inspiring, and pristine."

Erin was also the recipient of the Cordell Roy Scholarship, which is named after a long-time employee of the National Park Service. This scholarship is funded by a generous private endowment from G. Kevin Jones, who is an attorney in the Office of the Solicitor, United States Department of Interior, representing the Utah units of the National Park Service. Cordell Roy also contributed to the endowment.

RIPPLE ROCK NATURE CENTER INTERN

Bret Stein

Bret Stein, an Integrated Studies major, worked as the Ripple Rock Nature Center Intern. He provided science education for hundreds of children and adults visiting Capitol Reef National Park from around the world. Bret conducted interpretation programs on desert ecology and geology for families visiting the Nature Center and swore-in over 500 junior rangers during his internship. Bret is a natural educator, and it shows during his programs. He was able to help kids understand and get excited about the fascinating environment of Capitol Reef by teaching and inspiring kids to appreciate, protect, and learn more about nature. Bret also had the opportunity to work with park employees at the visitor center and to learn from park scientists such as ecologists and archaeologists. Reflecting on his internship, Bret says:

"My time at Capitol Reef National Park has been fourteen of the most worthwhile weeks of my education—I have learned so much. Through my work at the Ripple Rock Nature Center, I hope, and believe, I helped foster a curiosity in, and appreciation of, public lands in many of the kids that visited the park this summer."

FINANCIAL REPORT

This year, the operating funds at CRFS came from three sources: 1) institutional support from UVU ($182,764.10), 2) funds generated by user fees and product sales ($29,407.84), and 3) private donations ($10,219.30) (Fig. 10).

This funding supported the salaries and benefits of the staff ($161,597.73), operations and maintenance ($20,278.58), student internships ($17,687.80), marketing and outreach ($4,095.84), and research ($2,344.78) (Fig. 11).

While UVU generously supports the station, CRFS relies on private donations to fund important programs such as student internships and research. We are seeking donations to help fund our facility expansion and improvement projects. If you value our mission, please make a donation at: www.uvu.edu/give/crfs.html. Contact Jim Murphy at jmurphy@uvu.edu or (801) 863-5511 with questions about a making a donation.

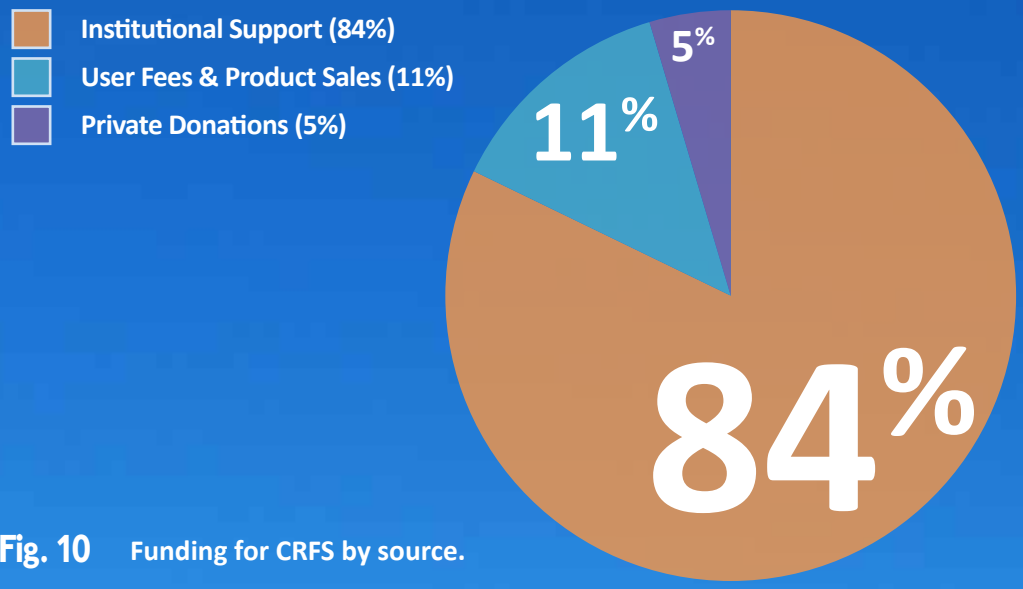


Fig. 10 Funding for CRFS by source.

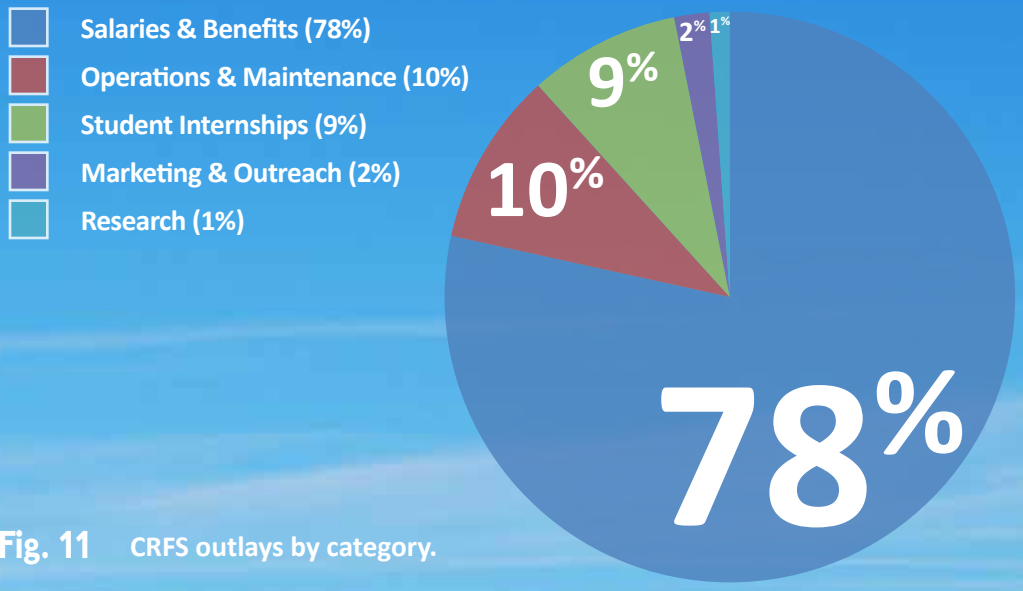


Fig. 11 CRFS outlays by category.

STRATEGIC PLANNING

CRFS staff utilize strategic planning to guide our operations. We have five objectives that direct our decision-making. A summary of our past and future activities related to these objectives is as follows:

1. Promote CRFS as a venue for engaged learning utilized by a variety of disciplines and multiple institutions.

We continue to promote CRFS through a variety of means, including making presentations at New Faculty Orientation and Faculty Convocation. We also redesigned our website to improve navigation and improve the user experience. Our visitation has grown steadily over the last several years and is up this year as well. Our visitors represented a wide array of disciplines from all eight of UVU's colleges and schools. In addition, we hosted visitors from nine different institutions, from California to Chicago.

2. Foster research, scholarly, and creative activities that utilize CRFS as a venue from which to explore the Colorado Plateau.

This year we worked with Capitol Reef National Park staff to identify their research priorities that could be addressed by UVU faculty and students. We also issued a formal call for research proposals in the spring based on the park's research priorities.

3. Develop environmental awareness and engage visitors in sustainable practices to be applied at home.

In addition to teaching resource conservation techniques while groups are at the field station, this year we modified our exit survey to allow us to contact previous visitors to measure continuing impact from their field station visit. This coming year we will begin making those contacts and collect data to assess the lasting impact of field station visits.

4. Continue to collaborate with our National Park Service field-station partners and build relationships with other relevant organizations.

We work diligently to maintain a strong relationship with our partners at Capitol Reef National Park. One of our goals last year was to participate with the park as they developed an artist-in-residence program. We were able to accomplish this when photographer Kit Frost came to campus during Fall 2017 and presented her work as part of the School of the Arts seminar series. She presented to hundreds of students and was well-received. Additional collaborations with the park included an ongoing graffiti removal service project with Park Archaeologist Julie Howard, an invasive plant removal and research project with Park Ecologist Carolyn Livensperger, a public star party, and developing a list of park research priorities to fund through our grant program. We continue to look for opportunities to work closely with the park. Our highest priority this coming year will be to renew our General Agreement with the park.

5. Ensure that CRFS facilities, staffing, and services meet visitor needs.

After a lengthy process, we began construction on our new classroom building this year! It is part of a larger expansion effort that will include a site manager's residence and remodeling of some existing structures.

CAPITOL REEF FIELD STATION MAKES A DIFFERENCE... SO CAN YOU!

Because of the support of our donors, we've begun construction on a classroom building as Phase 1 of an expansion effort that will also include a residence facility for our site manager and needed upgrades to existing structures. These expansions will enhance the field-station experience for all visitors and increase the field station's ability to support the missions of both UVU and Capitol Reef National Park. The budget for the expansion project is approximately $750,000, of which more than half has been raised.

Please visit: www.uvu.edu/give/crfs.html to contribute. Donations are tax-deductible to the extent allowed by law and we will honor your contribution by listing your name in our annual report. Please contact Jim Murphy at jmurphy@uvu.edu or (801) 863-5511 with questions about making a donation.

Thank you to Paul Fenske (UVU Printing Services) for layout and design. Dr. Ethan Sproat (UVU English Department) proofread our report.

Photographs were provided by CRFS staff or trip leaders.

CAPITOL REEF FIELD STATION

UVU UTAH VALLEY UNIVERSITY

For additional information visit: uvu.edu/crfs

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