One Health Institute Pilot Grants Review

Abstract. In 2020, the Colorado State University One Health Institute compiled an outcomes report evaluating ten pilot projects funded by the Office of the Vice President for Research (OVPR) and/or colleges at CSU. Six initial projects were funded in FY15 and four additional awards were supported in FY19. Data were collected from project principal investigators via an electronic survey. Responses were analyzed by the One Health Institute staff to categorize outcomes, lessons learned, and develop recommendations for future One Health research and funding support. We found that 50% of the projects included human, animal, and environmental health components, 30% included two or more One Health components and the remaining 20% focused primarily on only one of these sectors. The projects integrated many areas of research and practice including but not limited to: (1) human or animal biomedical sciences[1]; (2) agriculture, natural sciences, and engineering[2]; and (3) social sciences[3] . The projects generated peer reviewed publications, presentations, posters, and lectures, and other forms of outreach on and off campus. Notably, projects supported the work of 14 masters and doctoral students and 3 postdoctoral fellows. The most often noted positive elements of pilot funding was the opportunity to develop team science and network with collaborators on and off campus. Each of the FY15 pilot projects attempted to secure external funding, with RO1 applications ranging from 5-32 times the initial investment. FY19 project teams are planning to submit grant applications for internal or external funding. Suggestions for future RFP include: a minimum of two years for project completion, inclusion of a minimum number of diverse disciplines, support for students (undergraduate and graduate) and post-doctoral training, and clear alignment with One Health components.

Overview. This report summarizes outcomes from 6 projects awarded to research teams in FY15 and 4 projects awarded in FY19 by the Office of the Vice President for Research (OVPR) and/or colleges at CSU. All four of the FY19 awards requested timeline extensions to complete activities in the 2020 calendar year and the outcomes cannot be directly compared to projects awarded in the earlier funding cycle. Application and award processes for each funding period are summarized below.

Methods. Data were collected using an online survey sent to Principal Investigators (PIs) who received awards either in FY15 or FY19 (Table 1). Funds were awarded in January of 2015 and February of 2019. The survey was distributed in February of 2020. The survey included 25 questions. Respondents were asked nine “Yes” or “No” questions with the rest of the questions being open ended including: 1) if outcomes were completed what were they and why not; 2) project aims; 3) problem or solution being sought; 4) disciplines involved including primary personnel; 4) students involved (major, year in school, role on project); 5) presentations resulting from the research; 6) publications; 7) grants submitted/awarded and funding requested; 8) barriers to successful completion; 9) additional resources that would have supported success; 10) successes of the projects; 11) suggested measures to capture factors contributing to success; other ways projects influenced other work; and 12) most important contribution of the project to the One Health field. (see Attachment 1 for survey questions).

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[1] Community engagement, entomology, epidemiology, health physics, infectious diseases, micro bacteriology, mycobacteriology, nutrition, parasitology, pathology, physiology, public health, toxicology and veterinary medicine

[2] Agriculture, climate change, watershed science, water systems engineering, mechanical engineering, atmospheric science

[3] Community engagement, quantitative and qualitative social science, social and environmental justice

Principal Investigator	Award Title	Time Period	Award amount	Project Goals/approach
Mary Jackson	Development and implementation of a consortium to assess the role of common free-living amoebae in environmental persistence and facilitation of pathogenic organisms	FY15	$100,000	Systematic evaluation of the role of environmental free-living amoebae in the facilitation and persistence of important pathogens of critical concern (*M. bovis, F. tularensis, Y. pestis*).
Liba Pejchar-Goldstein	Human, Wildlife, and Land Health in Residential Ecosystems	FY15	$14,996	Develop research questions to better understand how to sustain ecosystem health and human well-being in an urbanizing world.
Jennifer Barfield	Creating sustainable futures for people, animals and the environment - an interdisciplinary approach to bison reintroduction in Northern Colorado	FY15	$80,091	Develop an interdisciplinary model for species reintroduction that integrates scientific tools for socio-ecological and disease management of Plains Bison.
Marisa Bunning	Examining Food Supply Chains Using a One Health approach	FY15	$15,000	Bring together researchers, extension, producers, and businesses to pilot a project in Routt County to develop systems modeling of their food system based on community goals.
Christie Peebles	Living at the 'EDGE': Translating physiological-metabolic responses of native grassland species to engineer drought resistance in crops.	FY15	$99,988	Develop drought resilient crops for healthy communities by increasing our fundamental knowledge on how plant carbon use- especially sorghum – affects drought resistance.
Michael Lappin	Disease community ecology: Understanding the transmission of Toxoplasma gondii infection in humans, domestic animals, and wildlife	FY15	$15,000	Develop a team of *T. gondii* research collaborators to capitalize on recent analytical serological assay advances to identify the sources of infections.
Amanda McQuade	Colorado Food Project	FY19	$50,000	Support food distribution from Agriculture Experiment Stations to food insecure populations and establish additional relationships to connect faculty, students and staff with research and engagement opportunities.
Greg Ebel	Xenosurveillance in Guatemala: A One Health Study	FY19	$50,000	Pilot a new approach to study the transmission of infectious diseases (vector-borne) between humans or from animals to humans.
Sheryl Magzamen	Cows as Canaries: Impacts of regional air quality on health	FY19	$50,000	Study the effects of air particulates on the region's large dairy cow industry which may serve as an informative sentinel for human health.
Gilbert John	A One Health Approach to the Effects of Legacy Uranium Mining on the Navajo Nation.	FY19	$44,920	Use qualitative methods to document the psychosocial impact of uranium mining on the Sweetwater Chapter community. A community engagement approach informed science communication activities about the health impacts of exposure and a livestock sentinel study.

Table 1 Principal Investigator, award title, date and amount awarded, project goals/approach.

Award criteria

The following criteria were utilized to select the FY15 grantees (released in October of 2014 with a start date of January 2015). Projects fell into one of five categories identified as key One Health priorities for CSU:

1. Disease emergence – including multidrug and antimicrobial resistance, pathogen and host evolution, global health security and outbreak surveillance.

2. Food Safety and Security –certifying supply chain quality and quantity of food ingredients and packaging.

3. Impacts of Environmental Factors on Ecosystem Health.

4. Sustainable agriculture and ecosystem health.

5. Optimizing Global Health by Design (Home, Workplace, Agriculture, New Energy Technology, etc.)

According to the RFP, proposals required:

- More than one department across more than one college approaching a One Health problem with a multi-disciplinary lens. Teams that include private sector, or federal and state partners in the proposal were also encouraged.

- A vision slide that captured the idea, impact, outcomes, and innovative approaches taken that addressed a One Health mission (as perceived at the time). While identifying the proposal with one of the five areas identified above was suggested, it was not required.

- A chart representing anticipated metrics of success, milestones, and timeline.

- Identification of follow on target funding opportunities and intended submission (if known) to a federal funding opportunity, research foundation, or private sector partnership from the work performed.

- Timeline for support was 2 years.

The following criteria were utilized to award the FY19 grants (released on September 14, 2018 with a submission deadline of November 1, 2018):

1. **Focus areas**: Food and Health; Climate and Health; and Urbanization and Health.
2. **Purpose:** solicit projects amongst One Health Scholars and others across campus interested in these areas to stimulate future funding from state or federal funding agencies, industry partners, and private or corporate foundations.
3. **Examples of Projects that qualified** evidence of prior team formation and collaboration across disciplines or campus that aligned with the broad pillars identified above. Inclusion of existing One Health Scholars was encouraged, but not required. Use of resources could include pursuit of extramural opportunities including grant writing, proposal preparation, supplemental subject matter expertise, and pilot data in support of One Health at CSU. Leveraging or cost sharing with other sources of funds was encouraged but not required.
4. **Timeline of support** was one calendar year and the anticipated award date (January 1, 2019) had a small delay with the funding released February 2019. Proposals were reviewed by

intramural reviewers including members of the Council of Research Associate Deans, the One Health Advisory Committee, and staff of the OHI. Funding was available for up to $50,000 with a minimum of no less than $15,000. Faculty support was allowed.

Analysis of the FY15 and FY19 RFPs

The intent and purpose of both the FY15 and FY19 RFPs was to provide pilot funding for interdisciplinary research teams to explore One Health approaches. The funding model in FY15 was a contribution model, wherein each college and the OVPR contributed support. The funding for the FY19 RFP was derived from Research & Scholarship Success Initiative funds. Both RFPs encouraged awardees to establish means of external funding to scale up of the original projects. The FY15 RFP offered up to $120,000 for research and development or up to $15,000 for the exploration of new ideas. The FY19 RFP offered up to $50,000. Since award criteria, amount funded, grant award period and time since grant initiation was substantially different for the two RFPs, some data and outcomes are not comparable between the two mechanisms. However, both RFPs did foster the development of unique research projects, many of which positively influenced the researchers involved to pursue funding and continuously evolve research directions.

Funded Proposals

A total of ten One Health awards were made (6 FY15 awards or $325,075 and 4 FY19 or $194,920 awards. The survey was completed by all 10 recipients: 6 from FY15 and 4 from FY19. All PIs were offered the opportunity to edit a draft report; these responses have been included in this final document.

FINDINGS

Project Completion

Of the FY15 projects, 3 out of 6 considered all outcomes related to the project complete. The 3 projects that did not consider all outcomes complete reported minor ongoing activities. In one case, a manuscript is still in preparation and another is being revised. In the second case, one laboratory experiment was not completed as more funding and time was needed. In the third case, some of the experiments and data analyses were not complete because the student working on the project left and a new student was not recruited to complete analysis.

Of the FY19 projects, none of the 4 PIs considered all outcomes complete. The PIs reported significant progress on the projects aims but needed more time to complete the work.

Some of the reasons for timeline extensions needed by the FY19 researchers include:

- The timing and duration of the award cycle was not optimal in terms of field-based sample collection, sample processing, and community-based activities for some projects.
    - Challenges with field studies related to weather and seasons for optimal sample collection and processing.
    - Challenges with community engaged activities that require the building of trust and allowances for community availability.
- Additional time was required to complete the transport of samples from foreign countries to the US.
- Additional time was required to complete work for publication.

- Projects identified required time to establish connections with researchers, students, participating communities, and likely require additional funding.
- The Covid-19 Pandemic caused research delays for all FY19 research teams.

One Health

The PIs were asked if the projects included components related to human health, animal health, and/or environmental health. These were closed response questions; yes or no. Overall, 80% of the pilot projects included at least two areas of One Health as part of the project design. The projects piloted a variety of One Health approaches by integrating diverse perspectives on health crossing human, animal, and environmental health domains.

Eight of 10 projects included human health, 8 of 10 included animal health, and 7 out of 10 included environmental health. Overall, 5 out of 10 projects included all three One Health areas: human, animal, and environmental health. Three out of 10 projects included two areas of One Health. One project included only human health and 1 project included only environmental health. (Figure I).

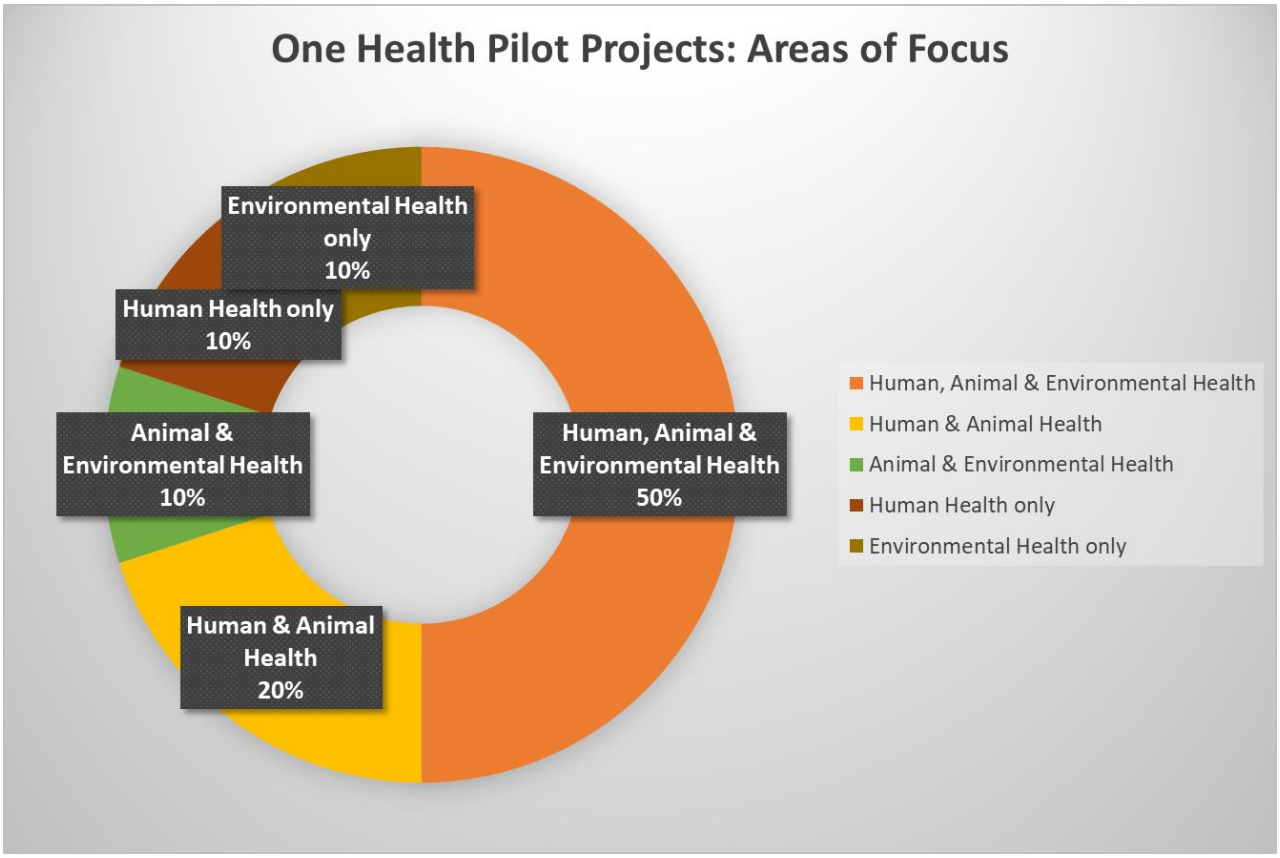

Figure 1: Half of funded projects included all three sectors of "One Health" as focus areas.

Although 50% of the projects reported two or fewer One Health focus areas, other focus areas were considered as future areas of emphasis or acknowledged as part of a larger systemic problem. For example, the *Colorado Food Project* (McQuade PI) addressed food insecurity, which directly impacts human health by distribution of farm fresh produce to food banks. The farm environment and the nutritional value of the produce could be considered an environmental health area of focus in the

future. In the case of the *Cows as Canaries* (Magzamen PI), animal health was the focus, but farmworkers' health was being evaluated as a part of a companion project. The *Xenosurveillance in Guatemala* project (Ebel PI) focused on human and animal health issues. However, the environment in which cohabitation of people and domesticated animals occurs was an important factor noted by the researchers as contributing to vector-borne diseases. The *EDGE Grassland Modeling* project focused on environmental health during the pilot phase. However, the research underscored the need to expand research on climate resilient plants and crops which could potentially intersect with food security and human health issues in a larger research program. Thus, most projects included a broader systems approach that included all components of One Health when considered in a larger context.

The Research Aims and Problem Statements

See Attachment 3 for the research aims per project and overarching problem addressed by each project.

Interdisciplinary Collaboration

Data collected on the research teams was the number of team members per project and the disciplinary background of each investigator per team. Team size ranged from 2 to 14 per project including the PI, Co-Is, postdoctoral fellows and students (Figure 2).

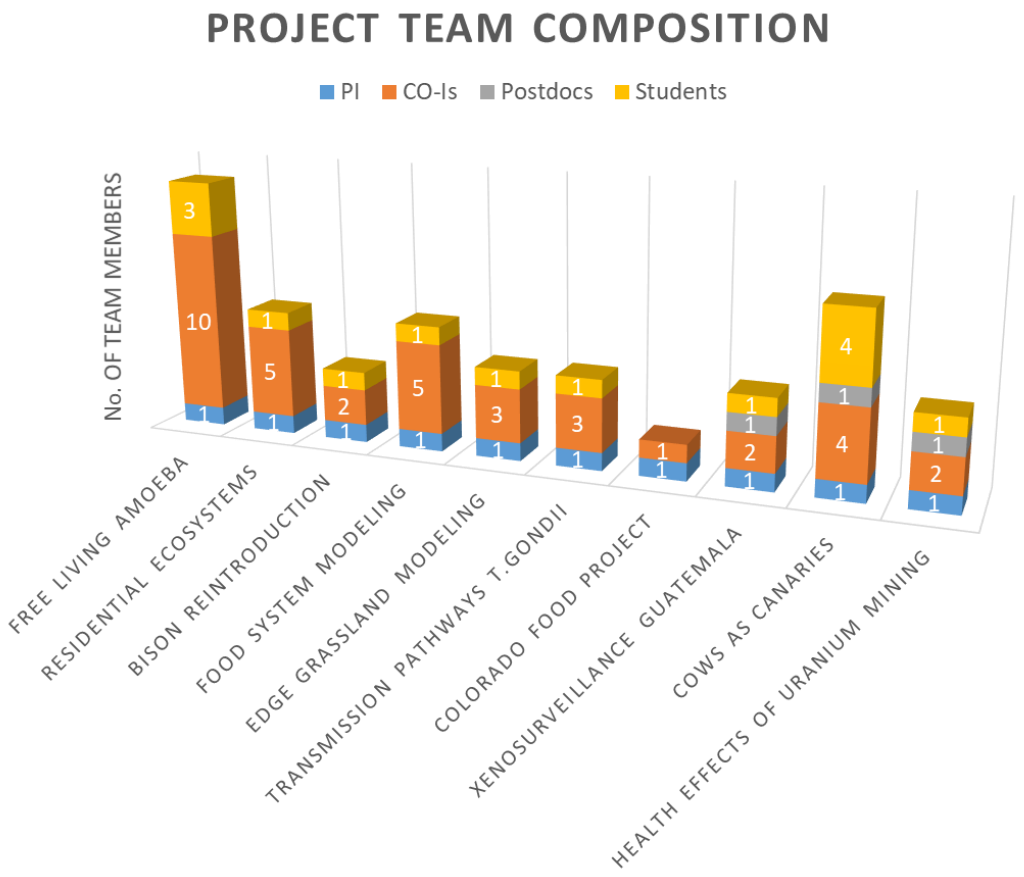

Figure 2: One Health Pilot Projects engaged diverse team participants.

The average team size was 4.7 PI and Co-Is and 6.4 total participants (ie including postdoctoral fellows and graduate students). Team size had less to do with funding amount than the design of the project. Three projects were able to secure research support from postdoctoral fellows, a strategy that leveraged resources and research support to these small-scale projects.

Not all individuals involved in projects were captured in this survey. For example, in the case of the *Food System Modeling* project, one student dedicated time to coordinating the research team and the network of partners involved. In addition to this one student, several veterinary students provided support for workshops hosted by the project that were not included in the total participant count.

Figure 2 does not include networks of advisors and other contributors to each project who provided assistance without being a formal part of the teams. It was not possible with the data available to quantify these networks or map them visually, but according to PIs these networks are a significant consideration for these projects. For example, the *Health Effects of Uranium Mining* project consulted with a number of experts ranging from veterinary expertise to mining remediation contractors. The *Food System Modeling* project had a wide-ranging network of collaborators and stakeholders such as researchers, extension agents, industry partners, producers, students and more. The *Xeonsurveillance in Guatemala* project is dependent upon clinical infrastructure including staff and laboratory space provided by the University of Colorado at the project site in Guatemala.

The research teams included members with varied disciplinary backgrounds. This was part of the criteria outlined by the and a requirement for the research. Table 2 illustrates the range of disciplinary backgrounds per project.

Free Living Amoebae	***Residential Ecosystems***
Mycobacteriology* Epidemiology Immunology Infectious Disease Watershed Science Parasitology Geospatial Technology	Ecology* Conservation Biology Wildlife Disease Psychology Landscape Architecture Conservation Social Science
Bison Reintroduction	***Food System Modeling***
Reproductive Physiology* Ecology Social Science Fish, Wildlife, and Conservation Biology	Food Science* Agricultural Economics Toxicology Veterinary Medicine Extension (Community Engagement)
EDGE Grassland Modeling	***Transmission Pathways T. Gondii***
Chemical and Biological Engineering* Bioagricultural Sciences and Pest Management Horticulture Protemics and Metabolomics	Veterinary Medicine* Clinical Sciences Evolutionary Biology Ecology Parasitology Pathology

Colorado Food Project Cellular & Molecular Biology* Public Health & Medicine Agricultural Science Extension (Community Engagement and Education)	***Xenosurveillance Guatemala*** Entomology & Virology* Public Health Pediatric Infectious Disease Veterinary Medicine Parasitology
Cows as Canaries Environmental Epidemiology* Atmospheric Science Mechanical Engineering Veterinary Medicine Public Health Pathology Social Science (Quantitative)	***Health Effects of Uranium Mining*** Microbiology* Radiological Health Sciences Health Physics Biology & Pathology Social Science (Qualitative) Veterinary Medicine (advisors to project)
Table 2: One Health pilot projects were highly interdisciplinary. * indicates PI Discipline Area; other areas indicate expertise of Co-Is, postdoctoral fellows and graduate students. **Expertise of advisors, industry partners and local organizations is not included in this list.**	

Each of the teams addressed complex problems requiring multiple disciplines and creative research methods to address. The projects integrated many areas of research and practice including but not limited to: (1) human or animal biomedical sciences[4], (2) agriculture, natural sciences, and engineering[5] and (3) social sciences[6].

Student Involvement

The pilot projects included graduate students and postdoctoral researchers. Nine of the ten projects included at least one graduate student, and one project employed four students (Figure 2). Three projects included a postdoctoral researcher. The following examples of student involvement from FY15 and FY 19 projects provide examples of student involvement.

Student Involvement FY15 Projects

Dr. Jackson's *Free Living Amoebae* Project included one MS student in Bio-agricultural Sciences and Pest Management, one MS Pathology student, and a PhD Biology student. Dr. Barfield's *Bison Reintroduction* research included a PhD student in Fish, Wildlife and Conservation Biology. Dr. Pejchar's *Residential Ecosystems* project supported a PhD student to coordinate the working group. The *Food System Modeling* project led by Dr. Bunning included a PhD student from CHHS and a few veterinary students who helped with the workshop. Dr. Lappin's *Transmission Pathways T. Gondii* research included a MS

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[6] Community engagement, quantitative and qualitative social science, social and environmental justice

student in Clinical Sciences who wrote her thesis proving that cats can be infected by ingestion of sporulated oocysts and went on to join the Center for Companion Animal Studies. Dr. Peebles *EDGE Grassland Modeling* project included a Cell and Molecular Biology Masters Student.

Student Involvement FY19 Projects

Dr. Ebel's *Xenosurveillance in Guatemala* team included a postdoctoral fellow and a second year PhD candidate. Dr. John's *Health Effects of Uranium* team includes a Postdoctoral Fellow (Biology and Pathology) who designed research for testing unregulated water and livestock health, and a MS student in Health Physics who is documenting wildlife contact with contaminated water sources. Dr. Magzamen's *Cows as Canaries* research included a first year veterinary DVM student, a DVM completing an MPH, one student in epidemiology and a fourth-year mechanical engineering student who designed the ozone data collection instrument.

The *Colorado Food Project* led by Dr. McQuade, was originally designed to engage One Health Institute (OHI) Scholars, but changes with OHI leadership and direction in 2019 altered this intent. Nevertheless, Dr. McQuade's team developed 5 specific research opportunities to involve graduate students, but timing and geography made student involvement difficult. See Attachment 2 for the list of 5 research opportunities developed by this project.

Presentations and Publications

The FY15 and FY19 projects generated peer reviewed publications, presentations and lectures, and other forms of outreach on and off campus (Table 3).

Type	Quantity
Peer Reviewed Publications	
Published	5
Unpublished manuscripts (under review or in preparation)	3
Non-Peer Reviewed Publications	2
Invited Presentations or Lectures (not at a conference)	24
Conference Presentations	
Presentations	6
Posters	6
Outreach	
External (talk at a local school, business lunch, etc.)	17
On Campus (seminars, etc.)	3

Table 3: Summary of Publications, Presentations, Outreach

Of the FY 15 pilot projects, 3 of 5 resulted in posters, presentations and/or publications. The two projects that did not result in presentations or publications had the goal of building a network and determine research direction, and thus publications were not anticipated. See Attachment 2 a list of Presentations, Publications, and Outreach.

- The *Free Living Amoebae* research resulted in 6 publications.
- The *Transmission Pathways T. Gondii* team presented an EEID abstract with the Johnson Laboratory on the behavioral effects of *T. gondii*. Dr. Scott's research paper proving cats can be infected by ingestion of sporulated oocysts was presented as an abstract and submitted to the

Journal of Veterinary Parasitology. Dr. Lappin's group provides *T. gondii* serological testing for dogs and cats to veterinarians in the U.S.

- The *Bison Reintroduction* team published an article in *Conservation Science and Practice*. This team also did several presentations including a poster at a One Health EcoHealth conference in Australia, a presentation at the Society for the Study of Reproduction in Puerto Rico. Dr. Barfield has since published numerous articles, presentations, guest lectures, and more.

The FY19 pilot projects are still in early stages and publications and presentations are in progress. See Attachment 2 for list.

- The *Health Effects of Uranium* team has presented posters and oral presentations at the Health Physics Society meetings in 2019 and 2020. One Co-I presented this research as a case study for guest lecture in PHBL 540 and GES 450 courses in Fall of 2018. The team intended to present a poster at the One Health Conference hosted by University of Alaska Fairbanks in 2020, but the event was cancelled due to the COVID-19 pandemic. The team plans to use these posters and presentations as inputs for eventual publications once the field research is completed. Publications are anticipated related to the qualitative social science research and the livestock and water research.
- The *Cows as Canaries* team presented their initial analyses at CVMBS Research Day in January of 2020. The DVM student presented as part of CVMBS VSSP poster presentation in August of 2019 as well as the National Veterinary Scholars Symposium in July of 2019. Presentations and publications will follow the completion of data collection in the Fall of 2020.
- The *Xenosurveillance in Guatemala* project presented as panelists at the OHI Seminar on CSU campus in November of 2019. The team anticipates presentations and publications once the samples are processed and the analysis completed.
- The *Colorado Food Project* team presented as part of a panel for the One Health Seminar series in September of 2019. STATE magazine published the article, *Farm to Food Bank: It Takes an Alliance to Relieve Hunger and Education a Community* about Dr. McQuade's work in Winter of 2019.

External Grant Submissions

Each of the FY15 projects submitted internal and extramural grant applications. Dr. Jackson's Free Living Amoebae team received a $600,000 contract from DoD/DARPA, a $500,000 or 5x gain on the initial investment of $100,000. Dr. Pejchar's *Residential Ecosystems* team was awarded a $500,000 EPA grant in 2016 that was unfortunately rescinded. If this award had not been rescinded, this project would have gained $485,000 or 32x on the initial investment of $14,996. Dr. Peebles *EDGE Grassland Modeling* project submitted 3 times to NSF, 1 time to DOE, and 1 time to USDA AFRI. In March 2020, a $11.7 million DOE grant that used data from *EDGE Grassland Modeling* was submitted and the team expects award related information by summer 2020.The FY19 projects are still under implementation but the teams are developing grant proposals currently with plans to secure external funding.

- Dr. Jackson's *Free Living Amoebae* team received $600,000 from DoD/DARPA. (DoD/DARPA 10/01/2015 - 10/31/2016 Contract # W911NF-15-2-0124 PI: Mary C. Jackson; Co-PIs : Richard A. Bowen; Jan E. Leach; William H. Wheat; Mercedes Gonzalez-Juarrero & Bradley R. Borlee "Feral Macrophages:

Dynamics of Free-Living-Amoebae interactions with Pathogens". Dr. Jackson's team submitted numerous other grants ("too many to count") that were not awarded.

- Dr. Lappin's *Transmission Pathways T. Gondii* team submitted a proposal on the Prevalence of antibodies against Toxoplasma gondii sporozoites and tachyzoites in cats and veterinarians to the Morris Animal Foundation for $75,673. Although the funding was not granted, there is a possibility of resubmitting to other donors.

- Dr. Pejchar's *Residential Ecosystems* team was awarded a $500,000 grant from the EPA Star Program that was unfortunately rescinded in 2016 due to the defunding of EPA grant mechanisms under the Trump Administration. Dr. Pejchar commented that the rescinded award hampered the team's enthusiasm and progress surrounding this project.

- Dr. Bunning's *Food System Modeling* team submitted an unsuccessful grant to Colorado Health Foundation in 2016 and one unsuccessful internal grant to SOGES entitled, "Ecosystems Function effect on Food and Health". This project and the work of this research team provided inputs to the eventual funding of Dr. Jablonski's work (FFAR grants) and the inclusion of food systems in SPUR. Animal science hires, Dr. Roades and Dr. Dillon were also influenced by this project in a variety of ways.

- Dr. Barfield's *Bison Reintroduction* team submitted two grants. One was to the National Fish and Wildlife Foundation in 2016 for $242,909 entitled, "Building Bridges for Conservation: Enhancing Grassland Stewardship through Private Landowner Engagement and Ecological Monitoring in the High Plains of Colorado and New Mexico". The other grant that was not awarded was submitted to USDA in 2018 for $1.3 million entitled, "Developing Adaptive Grazing Strategies for Bison and Cattle on Shared Landscapes that Benefit Producers and Conserve Wildlife." Neither grant was awarded.

- Dr. Ebel's *Xeonsurveillance in Guatemala* team is awaiting response on a larger Xenosurveillance NIH R21 submission ($275,000 total direct costs).

- Dr. McQuade's *Colorado Food Project* team has been able to engage with and influence other Research Stations regarding food security programs. The Southwestern Research Center plans to put in an acre of vegetables in partnership with the Sharehouse and the new CSU Ute Mountain Extension Agent this summer. San Luis Valley and Arkansas Valley Research Centers have just been awarded the 2020 Community Champion Award from Care and Share Foodbank. The Agricultural Research, Development and Education Center (ARDEC South) is developing with OHI's support, the ARDEC South Food Security Program. The *Colorado Food Project* had planned to hold a training for Extension Agents who wanted to develop programs that respond to food insecurity in their communities. That training was cancelled due to the COVID-19 pandemic. However, as a result of the pandemic, many parts of Extension and AES have been pivoted to try to address food insecurity in their communities. The team has been able to identify personnel who are able to support those initiatives, in part because of ongoing engagement with this group for over a year. Dr. McQuade and Dr. Serpa consider this to be one of the most successful outcomes of the *Colorado Food Project*. The pandemic accelerated the time frame to reach this outcome.

- Dr. Magzamen's *Cows as Canaries* team is planning to submit a USDA AFRI grant in Spring of 2020.

- Dr. John's *Health Effects of Uranium Mining* team is planning to submit a NIH grant in 2020 and currently reviewing other funding possibilities.

Barriers to Success

Project PIs were asked to comment on the barriers to success for their respective pilot projects. One of the barriers in common across projects was the amount of time of the grant award relative to the time it took to complete the work. The FY19 projects needed more than one year to complete research projects. Three respondents commented on the lack of funding and/or investment available for community-engaged projects stymied efforts for continued funding. The two FY15 projects that had a goal of coordinating a network of stakeholders and collaborators struggled to maintain continuity once the pilot funding had concluded.

Some other illustrative barriers to success are the following:

- The *Residential Ecosystems* research team developed a successful external grant. Unfortunately, the award was rescinded by the agency and the research team lost momentum as a result. This research team needed more support to recover and continue their efforts to pursue other funding.

- The *Free Living Amoebae* project faced some challenges with field studies such as samples and technical hurdles.

- For *EDGE Grassland Modeling,* the pilot funding supported the initial collaboration. Plant studies take time and it can be challenging to sustain effort to get to a publication with the modest amount of funding received. GRA funding in addition to project funding would have helped achieve results to publish. Also, some contingency support when students drop out of the project unexpectedly, would have helped keep the project on track.

- Two of the four projects funded in FY19 had seasonal limitations in terms of when certain types of data can be collected. Date types were both quantitative and qualitative in nature. Seasonal limitations required a longer implementation timeline.

- The *Health Effects of Uranium* team had field research challenges such as securing translators for community-based activities on the Navajo reservation and scheduling activities around other community events. These challenges caused minor timeline delays and changes in activity design.

- The *Xenosurveillance in Guatemala* project experienced delays with FDA approval to ship samples from Guatemala to Colorado.

- The *Colorado Food Project* needed more time to develop policies, practices and programming with Agriculture Experiment Stations (AES) to aid their ability to respond to food insecurity in their communities. Staff turnover presented a problem for projects working with Extension and AES. It was sometimes difficult to communicate with main campus when activities were taking place at remote sites.

- Additional resources and/or support for infrastructure that better identifies, develops, administers, and supports community-engaged research would be helpful for future awards.

Indications of Success, Recommendations for One Health Research and Other Suggestions

Survey respondents were asked to comment on the successes of their respective projects and other suggestions and recommendations. Every PI commented on how the team collaboration and networking

with various collaborators was one of the most important factors for success, and often the goal of these pilot projects. There was also a frequent suggestion to build upon and expand internal and external collaboration to help support long term efforts. Success for many was taking several distinct scientific disciplines and bringing them together in one project. Bringing together an interdisciplinary team is an achievement in and of itself according to respondents, "we built a great team of researchers that submitted another grant together". Respondents considered these projects as authentic examples of team science and integrated One Health approaches. Some respondents explained that one result of the pilot projects was having more concrete research questions to guide future work, "this is a good indicator that we are on the right path". Dr. Peebles team, "was able to gather a large amount of metabolomics data for the EDGE field site and to develop a method for 13C labeling in sorghum." Additionally, with anticipated external funding awards, the teams will leverage the early development work.

Graduate students and postdoctoral fellows had the opportunity to participate in unique research projects leading to presentations and awards. For example, one student was nominated for the NIH student trainee summer award. Postdoctoral fellows participated in unique research projects, which supported their goals to complete postdoctoral expectations. A few projects would have liked more support to include students, postdoctoral fellows and faculty in field research and project coordination. Not all these projects had direct access to students and faculty, but the desire was to create opportunities for students and faculty to collaborate with AES and Extension for community-engaged projects.

PI's provided suggestions on how to measure future One Health projects success. An overarching suggestion was to create an assessment window of five years beyond project lifecycles to allow for presentations, papers and grants to result from the projects. Another suggestion was to find ways to measure different types of engagement. For example, some working groups are still meeting several years after the originally funded projects. In other examples, some researchers have built engagement networks with the City of Fort Collins, producers, businesses, and communities.

Conclusion

Three of 6 FY15 projects were completed. The 3 projects that were still 'open' reported minor incomplete activities. Half of the projects, 50%, included human, animal and environmental health components; 20% included human and animal health; 10% of projects included animal and environmental health and 10% of projects focused on only on human health or environmental health. Overall, 80% of the pilot projects included at least two areas of One Health as part of the project design. The projects integrated many areas of research and practice including but not limited to (in no particular order) the (1) human or animal biomedical sciences[7], (2) agriculture, natural sciences and engineering[8] and (3) social sciences[9] . The pilot projects included students and postdoctoral researchers. The highest number of students on a project was four. Three projects included a postdoctoral researcher. Of the FY 15 pilot projects, 3 of 5 resulted in posters, presentations and/or publications and all of FY19 have

[7] Community engagement, entomology, epidemiology, health physics, infectious diseases, micro bacteriology, mycobacteriology, nutrition, parasitology, pathology, physiology, public health, toxicology, and veterinary medicine

[8] Agriculture, climate change, watershed science, water systems engineering, mechanical engineering, atmospheric science

[9] Community engagement, quantitative and qualitative social science, social and environmental justice

resulted in posters or presentations. Each of the FY15 pilot projects attempted to secure additional funding. Overall return on investment for specific FY15 funded projects ranged from 5 to 32 times the initial support. All the FY19 pilot projects PIs are planning to submit grants for additional support. Two findings for FY15 pilot projects included: (1) inability to secure resources to maintain continuity once the pilot funding had concluded and (2) initial efforts of some teams took directions that resulted in new team formation, or projects that were refocused in other areas. The FY19 projects needed more than one year to complete research projects.

As noted above, the most important factor for success for FY15 and FY19 pilot projects was the opportunity to develop team science and network with various collaborators on and off campus. Second, these pilot projects provide graduate students and postdoctoral fellows with the opportunity to participate in unique research projects leading to presentations and awards. Also as previously noted, a five-year assessment window should be adopted to track project lifecycles and allow for presentations, papers and grants to result from the projects. Finally, measuring different types of engagement would allow for a more comprehensive analysis of these types of pilot projects beyond the standard publication and grant outcomes assessments.

According to respondents, the most important contribution of these pilot projects to the One Health field is that they allowed for intra-CSU collaborations across different departments and colleges, supported team creation and community engagement. The pilots also opened up funding opportunities that were not "typical" for these researchers because they were collaborating in different and unique ways. Collaborative learning about One Health approaches was highlighted as something that should be an integral part of, or goal of, One Health research. One PI remarked that there is the potential for "strong community impact" given the collaborations that enabled the "One Health paradigm (people, animals, and environment)." Another way to express a similar idea was the successful combination of a One Health approach or philosophy with a specific and complex social problem. One PI highlighted that pilot projects can support the pursuit of basic scientific understanding concerning a specific problem first in order to meet the larger goals of One Health.

Lessons Learned

- Some teams were using small amounts of money (under $20K) to investigate big problems. Funding levels should be considered that maximize ability to provide enough money to allow teams to form and succeed.
- The diversity of project topics provides an indication of the importance and/or need to promote and fund additional interdisciplinary research team formation.
- These projects were important to explore interdisciplinary possibilities – each of these projects evolved in ways that the original teams did not expect.
- The FY15 projects would have benefited from more follow up from OVPR and OHI in terms of continuity of working groups, expansion of good ideas to facilitate project continuation.
- Team building, student engagement, and community engagement are three areas that should be considered in future outcomes assessments.
- Projects with a longer timeline have more opportunities to involved students and postdoctoral researchers. These projects allow students and postdocs the opportunity to make unique contributions to research, work with mentors and obtain field experience.
- GRA funding could help stretch funding to meet research timelines.
- Several of the pilot projects highlighted the importance of building networks, hosting meetings and workshops and covering travel expenses to bring key people together. It took over a year in

most cases to reach a point where a specific research project could be designed and launched because the groundwork had to be done first.
- Collaborating across disciplines can bring communication challenges. Some teams had difficulties understanding each other's approaches and recommendations (e.g. field research needs versus laboratory-based activities). Often team members were using very different vocabulary.
- OHI investment in the projects was not universally noted once several years had elapsed.

Recommendations

- The lessons learned can be used to formulate OHI's approach to supporting One Health research.
- OHI and OVPR should continue to support One Health RFPs in the future as they serve as catalysts for interesting and innovative research. The ideal award amount and project timeline should be discussed for future RFPs.
- Create a guide for One Health Research benefits for team formation– for example, these projects tend to reveal opportunities for evolving OH concept integrations (e.g. Dr. Ebel adding environmental research and climate research and researchers).
- It could be useful to develop a system to track the evolution of projects to see if common themes can be identified.
- OHI should provide guidance on how to analyze the areas of One Health from a systems perspective - deliberately, strategically, and thoughtfully.
- OHI has a "birds eye view" of possible One Health research across campus and with off campus networks. OHI can be a partner that fosters One Health research collaboration.
- Long-term metrics should be developed to monitor the progression of a project from pilot to full-fledged project. Future RFPs should require PIs to prepare a final technical report (using a reports template) detailing the results, findings and other research outcomes rather than relying on post-project surveys and staff not involved in the projects to decipher specific research approaches and outcomes. Future RFPs should require descriptions of student and postdoctoral roles that can be updated with a midterm report. The final report should require more detail on student and postdoctoral involvement including feedback from the student and/or postdoctoral fellow about their experience.
- In addition to grants submitted, and consideration of the timescale of an experiment, preliminary data generated, and the complexity of the data should be factored in as metrics for success. Awardees should consider One Health research indicators or considerations as part of their research design so that common factors can be reported on across projects.
- OHI should be a more deliberate partner in these projects such that OHI receives recognition for its support beyond the project period.
- One Health scholarly discussions, seminars and other events should be scheduled to help these networks stay fluid with their work and relationships across campus.
- OHI could play a role in facilitating interdisciplinary meetings or offering suggestions for how to make these interactions successful.

Attachment 1

Survey Questions

1. Do you consider all outcomes related to the project complete?
2. If NO, what were you not able to complete?
3. Why were you not able to complete some of the activities or outcomes?
4. Please describe the Project Aims.
5. Did the project include components related to human health? Y/N
6. Did the project include components related to animal health? Y/N
7. Did the project include components related to environmental health? Y/N
8. Describe the overarching problem and solution(s) being sought.
9. Describe in general terms the disciplines of project CO-Is and other primary personnel (i.e. infectious disease, internal medicine veterinarian, agricultural economics, social sciences, etc.)
10. Were students or trainees involved in the project?
11. If yes, (students were involved), please add name(s), major, year in school/training and role in project.
12. Did the project result in any presentations (including abstracts prepared and/or accepted for presentation?)
13. If yes, please add presentation titles and where presented
14. Did any publications result from the pilot project (including prepared abstract manuscripts, published or not)? If yes, please fill in the information below.
15. Did the project contribute data used in the submission of a larger grant?
16. Were any grant submissions successful?
17. If yes, please list grant(s) awarded and amount received
18. Please list any grant submissions that were not awarded/funded
19. Do you think the pilot project could contribute data for a future submission of a larger grant?
20. What were the barriers to your success with the project or barriers to achieve planned outcomes?
21. Were there resources or support you needed that would have helped to achieve planned outcomes? If so, can you share what would have helped?
22. What were the successes of your project? What does “success” look like for this kind of project? Can you give examples of measures of success that worked for you?
23. Are there ways you would suggest that future one health projects be measured and analyzed to capture different factors for success?
24. Are there other ways this project has influenced other projects, grants, curricula, student projects, community engagement, etc.?

Attachment 2
Publications, Posters, Presentations, and Outreach

Type	Quantity
Peer Reviewed Publications	
Published	5
Unpublished manuscripts (under review or in preparation)	3
Non-Peer Reviewed Publications	2
Invited Presentations or Lectures (not at a conference)	24
Conference Presentations	
Presentations	6
Posters	6
Outreach	
External (talk at a local school, business lunch, etc.)	17
On Campus (seminars, etc.)	3

Chart 4: Summary of Publications, Presentations, Outreach

Dr. Jackson *Free Living Amoebae*

Peer Reviewed Publications

Long, J. J., Jahn, C. E., Sánchez-Hidalgo, A., Wheat, W., Jackson, M., Gonzalez-Juarrero, M., & Leach, J. E. (2018). Interactions of free-living amoebae with rice bacterial pathogens Xanthomonas oryzae pathovars oryzae and oryzicola. *PLOS ONE*, *13*(8), e0202941. https://doi.org/10.1371/journal.pone.0202941

Long, J. J., Luna, E. K., Jackson, M., Wheat, W., Jahn, C. E., & Leach, J. E. (2019). Interactions of free-living amoebae with the rice fungal pathogen, Rhizoctonia solani. *BMC Research Notes*, *12*(1). https://doi.org/10.1186/s13104-019-4802-2

Markman, D. W., Antolin, M. F., Bowen, R. A., Wheat, W. H., Woods, M., Gonzalez-Juarrero, M., & Jackson, M. (2018). Yersinia pestisSurvival and Replication in Potential Ameba Reservoir. *Emerging Infectious Diseases*, *24*(2), 294–302. https://doi.org/10.3201/eid2402.171065

Markman, D. W., Fiero, T. S., Jackson, M., & Antolin, M. F. *Simplex and Multiplex PCR Targeting Clinically Significant Amoebaee*. Unpublished article, Microbiology, Colorado State University.

Martin, K. H., Borlee, G. I., Wheat, W. H., Jackson, M., & Borlee, B. R. *Busting Biofilms: Free-Living Amoebae as a Means to Disrupt Preformed Methicillin-Resistant Staphylococcus Aureus (MRSA) and Mycobacterium Bovis Biofilms.* Unpublished article, Microbiology, Colorado State University.

Sanchez-Hidalgo, A., Obregón-Henao, A., Wheat, W. H., Jackson, M., & Gonzalez-Juarrero, M. (2017). Mycobacterium bovishosted by free-living-amoebae permits their long-term persistence survival outside of host mammalian cells and remain capable of transmitting disease to mice. *Environmental Microbiology*, *19*(10), 4010–4021. https://doi.org/10.1111/1462-2920.13810

Dr. Lappin *Transmission Pathways T. Gondii*

Peer Reviewed Publications

Scott, J., Morris, A., Hawley, J., Scorza, V., Henriksen, M., Hill, D., & Lappin, M. (in press). Evaluating the significance of Toxoplasma gondii sporozoite antibodies in cats: a pilot study. *Journal of Veterinary Parasitology*.

- **Presented as research abstract** and **will be submitted** for consideration as a peer reviewed paper in Journal of Veterinary Parasitology.
- The paper came from Dr. Janelle Scott master's thesis paper proving that cats can be infected by ingestion of sporulated oocysts

Conferences

Johnson, S. K., Calhoun, D., Beldon, M., Lappin, M., VandeWoude, S, Hill, D., & Johnson, P. (n.d.). *Toxoplasma gondii and human behavioral outcomes (Poster)*.

Dr. Barfield *Bison Reintroduction*

Peer Reviewed Publications

Wilkins, K., Pejchar, L., & Garvoille, R. (2019). Ecological and social consequences of bison reintroduction in Colorado. *Conservation Science and Practice*, *1*(2). https://doi.org/10.1111/csp2.9

Invited Presentations

Invited. (2019). Presented at the Society of Environmental Journalists Annual Conference, Fort Collins, CO.

Invited. (2020). Presented at the Department of Biology Research Seminar Series, CSU Pueblo, Pueblo, CO.

Invited Lectures

Adventures with bison in Ram Country. (2018). Presented at the Zoological Medicine Society Symposium.

Applying advances in ART to species conservation. (2019). Presented at the Pacific Coast Reproductive Society Annual Meeting.

Assisted Reproduction as a Tool to Mitigate Disease, Preserve Genetics, and Facilitate Movement of Genetics Across Landscapes for Bison: The Laramie Foothills Bison Conservation Herd. (2017). Presented at the Natural Areas Conference.

Assisted Reproductive Technologies in Bison: From the Bench to the Prairie and Beyond. (2019a). Presented at the "A Celebration of Outstanding Contributions to the Field of Reproductive Physiology" Seminar Series, West Virginia University.

Assisted Reproductive Technologies in Bison: From the Bench to the Prairie and Beyond. (2019b). Presented at the Regis University.

Bison, Brucellosis, and Baby-making. (2019). Presented at the 70th annual American Association for Lab Animal Science National Meeting, Charles C. Hunter Lecture.

Bison Reproduction Program at Colorado State University. (2016). Presented at the Rocky Mountain Buffalo Association.

Breakthroughs Bring Bison Restoration a Bit Closer. (2017). Presented at the George Wright Society Conference on Parks, Protected Areas, and Cultural Sites.

Developing Innovative Solutions for Human-Bison Co-Existence Across North America. (2019). Presented at the 2019 American Bison Society Conference.

From the Bench to the Prairie: Preserving Yellowstone Bison Genetics Using Assisted Reproductive Technologies. (2015). Presented at the University of Northern Colorado, Biology Department Seminar Series.

From the Bench to the Prairie: Preserving Yellowstone Bison Genetics using Assisted Reproductive Technologies. (2015). Presented at the American Association for Laboratory Animal Science, Mile-High Branch.

Panel Speaker on Session Titled: "Public Narratives for Bison Restoration: The NGO Experience." (2016). Presented at the American Bison Society.

Summary of Bison Reproduction Program and Tour of Bison Handling Facilities. (2018). Presented at the CSU Summer Veterinary Scholars.

Using Assisted Reproductive Technologies to Preserve Yellowstone Bison Genetics. (2016). Presented at the Colorado Veterinary Medical Association.

Using Assisted Reproductive Technologies to Preserve Yellowstone Bison Genetics and Mitigate Disease. (2019). Presented at the Bison Ecology course, University of Nebraska, Kearney.

Wildlife Restoration on the Prairies: Ferreting out a Solution. (2019). Presented at the Society of Environmental Journalists Conference.

Conferences

Assessing Consequences of Bison Reintroduction for Birds, Mammals, and Recreationists in Northern Colorado. (2015). Presented at the America's Grasslands Conference 2015 (Poster session).

Assessing the Effects of the Laramie Foothills Bison Reintroduction in Northern Colorado: A Socio-Ecological Approach. (2016). Presented at the North American Congress for Conservation Biology (Symposium, SYM16).

Ecological and social effects of bison reintroduction in northern Colorado. (2018). Presented at the Ecological Society of America Conference (Oral presentation, COS137).

Proposed Research Assessing Consequences of Bison Reintroduction for Grassland Birds and Mammals in Northern Colorado. (2015). Presented at the Front Range Student Ecology Symposium (Poster session).

Outreach

Bison in your Backyard: Preserving an Icon in Northern Colorado Public Spaces. (2016). Presented at the Loveland Mountain Club.

Bison in your Backyard: Preserving an Icon in Northern Colorado Public Spaces. (2016). Presented at the Fort Collins Audubon Society.

Bison in your Backyard: Preserving an Icon in Northern Colorado Public Spaces. (2016). Presented at the Foothills Rotary Club.

Creating the herd: An update on the Laramie Foothills Bison Conservation Herd. (2017). Presented at the Fort Collins Natural Areas, Science behind the Scenery Program.

Guest speaker, Laramie Foothills Bison Conservation Herd Fundraiser. (2019). Presented at the Southern Colorado Chapter of the American Association of Zoo Keepers.

Organize and Present an Interactive Lecture for Regional High School Students on the Bison Reintroduction Event, Conservation Biology, and Science Careers. (2016). Presented at the Front Range Teen Science Café.

Presentation and Tour of Bison Research at the Animal Reproduction and Biotechnology Lab. (2016). Presented at the Local Agribility Chapter.

Preserving an Icon in Northern Colorado Public Spaces. (2017). Presented at the Fort Collins Rotary Club.

"Real-World Expert" on Bison for 2nd Grade STEM program. (2018). Presented at the Shepherdson STEM Elementary.

Science behind the scenery: Creating the herd. (2016). Presented at the Fort Collins Natural Areas Program.

Science on Tap Fort Collins. (2015, November 13). *Dr. Jennifer Barfield: Bison in You Backyard (Science on Tap Fort Collins)* [Video file]. Retrieved from https://www.youtube.com/watch?v=7PttdcbsQTI&feature=youtu.be

Scientific Advisor for Westview Middle School Students. (2017). Presented at the Earth Explorer Scientist.

TEDxCSU. (2016, March 14). *Bison Conservation | Jennifer Barfield | TEDxCSU* [Video file]. Retrieved from https://www.youtube.com/watch?v=NHbZkUsza5w&feature=youtu.be

The Laramie Foothills Bison Conservation Herd. (2016). Presented at the Sertoma Club.

Three years of bison conservation in northern Colorado: An update on the Laramie Foothills Bison Conservation Herd. (2019). Presented at the Science on Tap.

Three years of bison conservation in northern Colorado: The Laramie Foothills Bison Conservation Herd. (2019). Presented at the Poudre Golden Kiwanis Club.

Update on the Laramie Foothills Bison Conservation Herd. (2019). Presented at the City of Fort Collins Land Stewardship and Conservation Board.

Dr. John *and Health Effects of Uranium*

Non-Peer Reviewed Publications

Charley, P.A. (2020, May). Walking in Beauty: A Navajo scientist confronts the legacy of uranium mining. *CSU Source*. Retrieved from https://cvmbs.source.colostate.edu/walking-in-beauty-a-navajo-scientist-confronts-the-legacy-of-uranium-mining-impact/

Invited Presentations or Lectures

Wier, B.A. (2018). *Environment & Health: The Case of Uranium Mining on the Navajo Nation, Traditional Knowledge and Health Communication*. Presented at the PHBL 540 Sustainability & Health Guest Lecturer, Colorado State University, Fort Collins, CO.

Wier, B.A. (2018). *Environmental Health: Urban and Rural Cases: Navajo Nation Uranium Case and Buzzard Point D.C. Air Quality Case*. Presented at the GES 450 One Health Guest Lecturer, Colorado State University, Fort Collins, CO.

Conferences

Charley, P. A., Wier, B. A., Johnson, T. E., & John, G. (2020). *A Pilot Study to Examine Uranium and Arsenic in Livestock near Abandoned Uranium Mines in the Sweetwater Chapter of the Navajo Nation (Oral Presentation)*. Presented at the Health Physics Society Mid-Year Meeting, Bethesda, MD.

Charley, P. A., Wier, B. A., Johnson, T. E., & John, G. (n.d.). *A One Health Approach to Communicating Risks Associated with the Legacy of Uranium Mining in the Sweetwater Chapter of the Navajo Nation (Poster Presentation)*. Presented at the One Health, One Future Conference, University of Alaska Fairbanks, Fairbanks, AK.

Wier, B. A., & Charley, P. A. (2020). *The Process for Fostering Community Engagement in Situations of Actual and Perceived Risks from Uranium Mining (Oral Presentation)*. Presented at the Health Physics Society Mid-Year Meeting, Bethesda, MD.

Wier, B. A., Charley, P. A., Johnson, T. E., & John, G. (2020). *Perception of Risk from Abandoned Uranium Mines in the Sweetwater Chapter of the Navajo Nation (Oral Presentation)*. Presented at the Health Physics Society Mid-Year Meeting, Bethesda, MD.

Wier, B. A., Charley, P. A., Johnson, T. E., & John, G. (2020). *Perception of Risk from Abandoned Uranium Mines in the Sweetwater Chapter of the Navajo Nation (Oral Presentation)*. Presented at the Health Physics Society Mid-Year Meeting, Bethesda, MD.

Wier, B. A., Charley, P. H., Johnson, T. E., & John, G. (2019). *An Innovative Approach to Legacy Uranium Mining Hazard Communication (Poster Presentation)*. Presented at the Health Physics Society Mid-Year Meeting, San Diego, CA.

Dr. McQuade *Colorado Food Project*

Non-Peer Reviewed Publications

Cornelius, C. (2020, February 17). Farm to Food Bank. *CSU System Magazine*. Retrieved from https://magazine.csusystem.edu

Outreach

Farias, A., McQuade, A., Pezzani, A., Amundson, B., Johnson, J., Sbicca, J., & Serpa, M. (2019). *One Health Seminar: Programs to Address Food Insecurity in Colorado*.

Opportunity Reports (Research Opportunities Offered by the Project to Faculty and Students):

1. Consumer survey on local foods in school lunch - Mesa County, CO.
2. Cost analysis of providing healthy foods through food pantries - Mesa County, CO.
3. Database development for outcome assessment - Mesa County, CO.
4. Safety audit of food pantries- Mesa County, CO.
5. Outcome analysis of programming – Cortez, CO

Dr. Magzamen *Cows as Canaries*

Invited Presentations or Lectures

Martinez, Beaupied presented analyses at CVMBS Research Day (January 25, 2020)

Martinez, (2020, December 13) poster presentation for MPH Capstone

Beaupied (2019, August 7) poster presentation for CVMBS VSSP and the National Veterinary Scholars Symposium (July 2019)

Dr. Ebel *Xenosurveillance in Guatemala*

Outreach

Olson, D., Scorza, V., Ebel, G., & Serpa, M. (2019). One Health Seminar: *Expanding a One Health Surveillance System in El Trifinio Region in Southern Guatemala: Syndromic Surveillance and Laboratory Confirmation of Infectious Diseases in Humans and Animals*.

Attachment 3: Project Title, Project Aims and Problems Addressed

Project Title (abbreviated and full titles)	**Project Aims**	**Problem Addressed**
Free Living Amoebae Development and implementation of a consortium to assess the role of common free-living amoebae in environmental persistence and facilitation of pathogenic organisms	Overall project goal: To assess the role of common free---living amoebae in environmental persistence and facilitation of pathogenic organisms. Aim 1: Development of amoebal research models of Mycobacterium bovis and Francisella tularensis. Aim 2: Collection and analysis of environmental soil samples: Isolation of amoebae from potentially highly contaminated environments - Investigate the natural colonization of pathogens by environmental free living amoebae from environmental samples. Aim 3: Creation of public access databases - To link (by geographic parameters, e.g. longitude/latitude etc.) the data that we generate from laboratory-based organism identification techniques (amoebae species, bacterial strains etc.) to the various disease endemic areas from which they were isolated in order to subsequently process our data into geographic parameters that can be used as a resource to benefit healthcare workers and policy decision makers. Aim 4: Conceptual Risk Assessment Model - To integrate the molecular, geophysical, and geographical data ascertained through our studies to develop a conceptual geographic-based model for assessing the risks of exposure as a consequence of the prevalence of various FLA in the ambient environment, their association with mammalian pathogens and the accompanying risks associated with these pathogens	The project aimed to assess the role of free living amoebae in the environmental persistence and transmission of pathogens of environmental, agricultural, and human health interest with a goal to inform risk assessment models and infection control strategies.
Residential Ecosystems	The aim of our "idea flow" group was to identify research questions and approaches to advance the frontier of socio-ecological science at	Residential development is a leading driver of land-use

Human, Wildlife, and Land Health in Residential Ecosystems	the intersection of the natural and built environment and generate practical recommendations for sustainable, healthy communities for wildlife and people.	change globally, with important consequences for land, wildlife, and human health. The design, density, proximity, and integrity of developed areas and surrounding natural ecosystems could all influence a variety of health outcomes. Despite growing interest in the interactions among natural ecosystems, the built environment, and human health, these linkages have been under-explored.
Transmission Pathways T. Gondii Disease community ecology: Understanding the transmission pathways and consequences of Toxoplasma gondii infection in humans, domestic animals, and wildlife	The funded proposal had 5 major specific aims. Aim 1: Develop a team of T. gondii research collaborators via meetings and teleconferences to identify areas for future research with T. gondii. Aim 2: To capitalize on recent analytical serological assay advances to identify the sources of Toxoplasma infections (e.g., oocysts from cats vs. bradyzoites from food) in people and cats. Aim 3: To design experiments to identify the role of T. gondii infection in mediating the risk of vehicle collisions with wildlife. Aim 4: Assemble published and unpublished data collected by project partners to develop a national database of infection, which will form the foundation for subsequent investigations into the roles of environmental conditions, human land use, and biological interactions	People commonly acquire *Toxoplasma gondii* exposure by ingestion of sporulated oocysts passed in cat feces, whether this route is common in cats is unknown Can the infection of cats through T. gondii sporulated oocysts be proved?

	in controlling spatial and temporal patterns of infection. Aim 5: Utilize the information gained in Aims 1 – 4 to generate at least 2 grants for future funding. NOTE: per conversation with PI, the One Health Team, aims 1, 2, 4 and 5 were reached. In collaboration with the USDA team documented that cats can be infected by T. gondii sporulated oocysts, just like people through the validation of a novel enzyme-linked immunosorbent (ELISA) assay for the detection of *T. gondii* sporozoite antibodies in feline sera, and by utilizing the ELISA to investigate the prevalence of sporozoite antibodies in clinically ill and healthy cats.	
Bison Reintroduction Creating Sustainable Futures for People, Animals and the Environment – An interdisciplinary Approach to Bison Reintroduction in Northern Colorado	The goal of this project was to develop an interdisciplinary model for species reintroduction that integrates the scientific tools necessary to address socio-ecological and disease management complexities of plains bison reintroduction in the American West. This model can then be replicated at other species reintroduction sites across the globe. Research objectives include: 1) Establish a genetically diverse, brucellosis-free herd of bison with Yellowstone genetics in northern Larimer County via assisted reproductive technologies; 2) Understand the ecosystem effects of American bison as larger grazers on grassland birds and mammals, as well as land health in northern Larimer County; 3) Document the human health benefits and social effects of bison reintroduction at release sites for protected area visitors and agricultural stakeholders.	There is widespread interest in restoring iconic plains bison across the American West, but only if bison pose minimal risk to livestock and human communities. This project sought to evaluate these risks through interdisciplinary restoration science that focused on understanding the multiple dimensions of landscape recovery – environmental, human and animal health.

Food Systems Modeling Examining Food Supply Chains Using a One Health approach	The goal was to facilitate interaction and collaboration between a variety of stakeholders working on short chain food systems. 1) Support a workshop of 100 people from 3 major groups; extension agents working on short supply chains in their communities, campus-based faculty and students interested in the topic, and producers/processors actually involved in short food chain businesses. 2) Better understand and address health issues created by the convergence of human, animal and environmental systems, a similar strategy is needed to better understand multiple production and pathway influences on food.	The need to develop new ways of collaborating, methods of engaging, and solutions for short chain food systems based on community goals.
EDGE Grassland Modeling Living at the 'EDGE': Translating physiological-metabolic responses of native grassland species to engineer drought resistance in crops.	Develop drought resilient crops for healthy communities by increasing our fundamental knowledge on how plant carbon use- especially sorghum – affects drought resistance.	The need to gain a better understanding of how plants adapt to stresses like drought and how that knowledge can be utilized to improve crops to handle climate change.
Colorado Food Project	Aim 1: Improve human health by expanding the involvement of Colorado Agricultural Experiment Stations in community-based food insecurity work. Aim 2 Link OHI and CSU-wide faculty, students, and staff to opportunities for research and engaged scholarship in improving health through food in rural communities throughout the state.	The lack of regular access to affordable and nutritious food (i.e. food insecurity) impacts the health of approximately 1:10 Coloradans. The solutions to this problem are as vast as the root causes. Universities, governmental entities, and organizations

		are engaged in high levels of research that inform best-practices and shape policies. They are also involved at the practitioner levels of increasing access of nutritious food. CSU engages in all these activities, but there is the potential to do more through research, scholarship, and community-engaged programming to respond to food insecurity in Colorado.
Xenosurveillance in Guatemala Xenosurveillance in Guatemala: A One Health Study	Aim 1: Perform a risk assessment for mosquitoes; Aim 2: Compare xenosurveillance to traditional, syndromic surveillance in an agricultural community in Guatemala	The burden and household transmission dynamics of emerging mosquito borne pathogens in the Trifinio region of Guatemala is unknown. The problem is linked to the difficulty performing disease surveillance in resource poor communities. We are seeking to solve this problem using mosquitos as blood sampling devices and determine if they can become a one health tool to

		improve disease monitoring and diagnosis and taking into account that human beings, animals and arthropods intersect frequently in el Trifinio region of Guatemala
Cows as Canaries Cows as Canaries: Impacts of regional air quality on health	Aim1: Ascertain the relationship between cow health outcomes, production and daily PM2.5, O3 concentrations across the hypothesized gradients of pollutant exposures in Colorado. Aim 2: Investigate the relation between daily PM2.5 and O3 concentrations and levels of inflammatory markers of dairy cows. Aim 3: Quantify spatial gradients of O3 in Colorado through validation of a low-cost, autonomous sensor for O3.	Ozone is a criteria air pollutant with known risks to human populations. However, ozone is generally monitored in densely populated areas, even though ambient levels are higher downwind of major population centers. Livestock animals frequently inhabit areas with high ozone and may serve as a sentinel species to understand health effects of ozone in agricultural regions.
Health Effects of Uranium A One Health Approach to the Effects of Legacy Uranium Mining on the Navajo Nation	The goal is to frame the importance of the psychosocial impacts of the uranium disaster among the Navajo people and collaboratively	The impact of uranium mines on the Navajo people goes beyond physical health. The mental and psychological stress resulting from this

	contribute to the health and well-being of the Sweetwater Chapter community of the Navajo Nation. Aim 1: Determine whether improving and expanding the information/data base about toxic exposures to people, animals, and the natural environment available to Sweetwater will inform the community –level decision making and eventual advocacy for targeted public health interventions. Aim 2: Establish the extent to which mental stress and anxiety is related to perceived and actual risks for toxic exposure as expressed by the community and the individual household level. Through community engagement methods, this project attends to the intersection of social and environmental justice as a critical lens for understanding how individuals and communities experience health depending on access and control over resources, decisions, and stability.	protracted environmental disaster spans generations. Mine site remediation to date has focused on site-specific clean-up rather than individual and community health. There is a need to document perceived risks alongside actual risks of exposure as well as intergenerational trauma and health concerns. The Sweetwater community has expressed the need for accurate risk information within the appropriate cultural context to help the community gain control over decisions and stability that impact their health and well-being. The community is concerned about chronic exposure to unregulated and contaminated (uranium & arsenic) drinking water for human and animal (livestock) health. The team will study the impact of contaminated water on livestock. Livestock are a

		sentinel for human health, which is more complicated to address due to human regulatory standards.