

AG2PI SEED GRANT - PROJECT FINAL REPORT

PROJECT NAME	GPS collars as precision agriculture tools for managing extensive rangeland production systems
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PROJECT PRINCIPAL INVESTIGATOR	TODAY'S DATE	PROJECT START DATE	DATE OF COMPLETION
Andrew Hess	05/31/2023	12/01/2021	02/28/2023
TEAM MEMBERS (co-PI, co-I, personnel)	COLLABORATORS		
Mr. Scott Huber	Ms. Tracy Shane, Dr. Washington-Allen, Mr. Mike Cox, Dr. Jason Karl		

ACCOMPLISHMENTS

Please provide a short summary of the conclusions (both successes and failures) made from your project. Include a description of how this project will provide benefits to the agricultural genome to phenome community and, possibly, to a broader audience. You should include both qualitative and quantitative details, as necessary, to support your conclusions. Include a short accomplishment statement in non-technical language and do not include names.

The objectives of this study were to use low-cost GPS collars to 1) make land-use management decisions to maintain a healthy ecosystem, 2) track animal behavior, and 3) develop novel trait definitions for individual performance in a rangeland landscape. Initial work with Jason Karl at the University of Idaho provided a means to test the low-cost GPS units he developed for these aims. Using these collars was crucial to understanding how large-scale deployment of GPS collars might work. We deployed the units on 112 individuals, including 57 ewes and 55 lambs, of which 45 were ewe-lamb pairs. These were then used both to gain an understanding of flock movement over time as well as to develop different individual-level traits, including daily distance traveled, time spent near known water sources, time spent on sloped hillside, ewe-lamb distance, among others. These were shown to have moderate repeatabilities, and we are currently working to estimate heritabilities for these traits. We are also exploring ways to integrate raster data collected through satellite imagery.

From what has been collected so far, we are optimistic that there is potential to use these units for genetic selection in environments that are challenging both from the standpoint of animal performance as well as the ability to capture data related to the animal's ability to perform. This is an example of how precision livestock farming tools may be utilized to make genetic improvement. We envision these tools playing an invaluable role in genetic improvement moving forward, particularly with the expected increased emphasis being placed on precision breeding, adaptation to climate change, resilience, and environmental impacts of livestock production.

Products

Please list any products from this project. This may include (but not limited to) publication, concept/white paper, workshop, conference presentation, website, publicly available data or pipelines, etc. Reminder: you are required to make your products available to the broader stakeholder community using standard USDA practices, open source, FAIR, or other models. Metrics may include number of participants or times accessed, etc. Include links to recordings, DOI, etc. when possible. For presentations and posters, provide authors, date, location and presentation title.

ACTIVITY / PRODUCT	DESCRIPTION (include URL, if applicable)	OUTCOME / METRICS
Oral Conference Presentation	<p>Title: GPS collars as precision agriculture tools for managing extensive rangeland production systems</p> <p>Authors: A. Hess, S. Huber, T. Shane, J. Karl, R. Washington-Allen, M. Cox</p> <p>Conference: Thinking Big: Visualizing the Future of AG2PI</p> <p>Date: September 10th, 2022</p> <p>Location: Ames, IA</p>	Presented preliminary data from the project to the AG2P community
Producer-Oriented Article	<p>Using Precision Agriculture Tools to Produce More Sustainable Animals</p> <p>Author: Andrew Hess</p> <p>Journal: Sheep Industry News 2022 Genetics Issue</p>	Discussed the potential benefits of using GPS collars in rangeland environments in an article that was geared towards producers
Oral and Poster Conference Presentation	<p>Title: Using GPS Collars to Measure Rangeland Utilization and Resilience of Livestock</p> <p>Authors: John Bergeron, Scott Huber, Tracy Shane, Jason Karl, Melanie Hess, Robert Washington-Allen, Mike Cox, Andrew Hess</p> <p>Conference: Gordon Research Seminar in Quantitative Genetics and Genomics</p> <p>Date: February 12-17, 2023</p> <p>Location: Ventura, CA</p>	Presented work on trait definitions derived from GPS collar data to the wider genetics and genomics community.
Oral Conference Presentation	<p>Title: Where's Waldo? Describing resilience linked land use behaviors of sheep via GPS collars</p> <p>Authors: John Bergeron, Scott Huber, Tracy Shane, Jason Karl, Melanie Hess, Robert Washington-Allen, Mike Cox, Andrew Hess</p> <p>Conference: AGBT-Ag</p> <p>Date: March 27-29, 2023</p> <p>Location: San Antonio, TX</p>	Presented work on trait definitions derived from GPS collar data to the wider genetics and genomics community.
Poster Conference Presentation	<p>Title: Lessons learned from putting low-cost GPS units on sheep</p> <p>Authors: Andrew Hess, John Bergeron, Scott Huber, Tracy Shane, Jason Karl, Melanie Hess, Robert Washington-Allen, Mike Cox</p> <p>Conference: AG2PI</p>	Will present work outcomes of the project to the AG2PI community

	Date: June 15 & 16, 2023 Location: Kansas City, MO	
Oral Conference Presentation	Title: Repeatability of Rangeland Behavioral and Social Traits Derived from GPS Collars Authors: John Bergeron, Scott Huber, Tracy Shane, Jason Karl, Melanie Hess, Robert Washington-Allen, Mike Cox, Andrew Hess Conference: ASAS Annual Meeting Date: July 16-20, 2023 Location: Albuquerque, NM	Will present work outcomes of the project to the broader animal science community
Data Availability	Github Repository	We are currently working on documentation for data processing and analysis and will make this available with the dataset once the initial paper that is being drafted that uses these data is accepted.

Audience

With whom has this work been targeted to and shared? Please describe how this project and its products have been disseminated to a community of interest. Include any outreach activity or information sharing as well as training or professional development opportunities provided in this project.

The work was presented to the AG2PI community at the AG2PI "Thinking Big" Workshop in October 2022. Additionally, work from this project has been presented at two international conferences (Gordon Research Seminar in Quantitative Genetics and Genomes and AGBT-Ag) and will additionally be presented at the ASAS annual meeting this summer. The data collected as well as a workflow to process and analyze the data will be made publically available via Github.

CONTINUATION OF WORK

Next steps

How do you/your team plan to continue moving this project forward? Include how AG2PI can assist in your forward momentum.

GPS collar data will continue to be collected. We have a trial focused on collecting ewe-lamb pair data as they transition from the Diamond valley floor to the summer allotments planned to kick off in June. This is expected to be an event that will induce stress to the pair, which we expect will provide further insights into the relationships between animals at this critical transition point. The ability to program the new units to collect datapoints at specific times of the day will also allow us to gain a better understanding of the social network of the animals as a whole. We are also using the GPS units alongside vaginal temperature sensors in mature ewes later this summer to integrate thermal sensitivity to animal behavior, and will be relating those data to changes in weight during the data collection period.

AG2PI can assist with forward momentum by continuing support in research focused on the use of precision livestock farming tools.