2023

UNDERGRADUATE RESEARCH FORUM AND SHOWCACE

April 4, 2023

THE OHIO STATE UNIVERSITY
LIMA

PURPOSE

The **Lima Campus Undergraduate Research Forum** is designed to showcase the research performed by our students on the Lima campus. Lima students also present their research at the Denman Undergraduate Research Forum, the Spring Undergraduate Research Festival and at many discipline-specific events. This year, we also present the other branches of Academic Enrichment – Honors, Service Learning, and Global Studies at our Research Forum and ShowcAcE.

THANK YOU

We thank the Dean's Office for supporting the Lima Campus Forum.

2023 UNDERGRADUATE RESEARCH AND MENTORING COMMITTEE

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The Ohio State University at Lima Undergraduate Research
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ABSTRACTS

Leah Beraki
Research Advisor: Ryan W. Norris

Reconciling evolutionary history with taxonomy in the root rats and bamboo rats in the subfamily Rhizomyinae (family Spalacidae)

Root rats and bamboo rats in the subfamily Rhizomyinae (family Spalacidae) are subterranean herbivorous rodents that are distributed in eastern Asia and the Horn of Africa. These rodents are burrow-dwelling and undergo allopatric speciation due to their limited ability to move between patches of soil. Recent taxonomies recognize 6 species in the subfamily; however, more species are present. Past researchers have named as many as 48 forms. We evaluated all of the subfamily's recognized species in the genera *Tachyoryctes* (2 species), *Rhizomys* (3 species), and *Cannomys* (1 species). I assembled a large dataset of the cytochrome b gene from all Rhizomyinae individuals available in Genbank (n=87) along with representatives of each species of zokor (subfamily Myospalacinae) for use as outgroups. I mapped the localities for each sample. I aligned the data and constructed phylogenetic trees using the programs PAUP*4.0a and BEAST. I evaluated the different taxonomic hypotheses with regard to monophyly, genetic distance, divergence time, and formal species delimitation analysis. We conclude that the current taxonomy fails to reflect the real species diversity.

Royce Glass
Research Advisor: Robin K. Bagley

Surveying fly parasitoid species associated with the redheaded pine sawfly

Understanding the origin of, and mechanisms that create, diversity in the living world is a major goal of evolutionary biologists. One potentially under-explored area of evolutionary biology is what role, if any, parasitism, a form of symbiosis where one organism benefits while the other is harmed, can play in generating biodiversity. One group where we may be able to investigate this are *Neodiprion* sawflies, which are attacked by a wide range of parasitoid (lethal parasitic) insects. These parasitoids lay their eggs on or inside of sawfly larvae, and then consume them from the inside out after the host larva pupates. Since the sawflies are agricultural pests, some information has been compiled on their parasitoids in hopes of discovering a means of biological control, but the majority of this work focuses on the wasp parasitoids. Comparatively less work has examined their fly parasites (Order Diptera, Family Tachinidae), and it is uncertain how many or which species attack *Neodiprion*. Here we report the results of an initial survey of tachinid flies reared from *Neodiprion* sawfly colonies. Several putative species have been found on the basis of morphological differences. Future work will seek to identify these specimens to the genus or species level, facilitating future investigations of their ecology and evolutionary history.

Akansh Mani
Research Advisor: Ryan W. Norris

Geographic Distribution and Predicted Habitat Suitability for High Elevation Rodents in Northern Pakistan

The purpose of this study was to investigate the geographic distribution and predicted habitat suitability for high elevation rodents in Northern Pakistan. This area represents the site where the world's three tallest mountain ranges meet and where 3 of the world's 6 major biogeographic realms converge. Due to the topological variability, the region contains a variety of habitats. The four main taxa that were studied were the woodland mice (*Apodemus*), burrowing voles (*Hyperacrius*), mountain voles (*Alticola*), and field and juniper voles (*Microtus*). *Apodemus* are found mostly in forested habitat, *Hyperacrius* in alpine meadows, *Alticola* in rocky areas, and *Microtus* in grassy regions and barren hillsides. I obtained locality information for specimens from the Woods and Kilpatrick 1990s expeditions using georeferenced specimens in the Florida Museum's Mammalogy Collection database. I created a comma-separated values input file, which I imported into the R package, Wallace. Ecological niche modeling was used to create habitat suitability projections, which were compared across these rodents to better understand the degree of overlap and how these animals are partitioning the landscape.

Arshia Mani
Research Advisor: Zachery Beres

Evaluating the Effectiveness of DNA Extraction from Older and Younger Seeds of *Conyza canadensis*

An overreliance of herbicides in agricultural systems across the Midwestern United States contributes to the intense selection upon agricultural weeds present within these systems. Glyphosate, commercially sold as Roundup®, is the number one herbicide used worldwide. More than 40 weed species have evolved resistance to glyphosate through various mechanisms. The first broadleaf species to evolve resistance to glyphosate was *Conyza canadensis* (horseweed) in 2001 in Delaware, USA. Within horseweed, a proline to serine point mutation at position 106 (Pro-106-Ser) was recently documented in highly resistant plants for the first time in the United States. While this point mutation is found in at least 13 other species, the origin, or potentially multiple origins, of this mutation within horseweed remains a mystery. DNA sequencing of fresh leaf tissue is preferred; however, horseweed seeds only remain viable for ~3 years within the seed bank or slightly longer in cold storage. To begin investigating this larger problem, we collected seeds from maternal plants around the Ohio State Lima campus and surrounding agricultural fields in fall of 2022. Using these seeds and older seeds collected in 2015 from Iowa, we attempted to extract DNA using a CTAB protocol. The quantity and quality of DNA extracted from these younger and older seeds was assessed using a NanoDrop Spectrophotometer and gel electrophoresis. These analyses are currently ongoing and will be presented with the poster. Establishing whether we can extract high quality DNA from older seeds will be an important first step in understanding the origination of the Pro-106-Ser mutation within horseweed. Once a reliable method is determined, older samples from various regions around the United States could be assessed. Understanding this relatively new mutation within horseweed will have direct implications on management of these noxious weeds in Ohio and across the Midwestern United States.

Fatima Mohammed
Research Advisor: Ryan W. Norris

Evaluating the geographic distribution and the evolutionary history of field and juniper voles (genus *Microtus*) in Northern Pakistan through molecular phylogenetics

High-elevation mountain ranges restrict gene flow and can drive allopatric speciation of mammal species. Voles are small rodents akin to hamsters but are morphologically distinct, with shorter eyes, ears, and a rounder head. Voles in the genus *Microtus* inhabit many habitats across Eurasia and North America. Prior to my study, only a single species of *Microtus* vole, *M. yuldaschi*, was found in Pakistan. We sequenced the mitochondrial cytochrome b gene for 37 individuals and constructed a phylogenetic tree. We recovered *Microtus* belonging to 3 separate radiations. We found a total of 9 individuals related to the Transcaspian vole, *M. transcaspicus*. We found 6 individuals related to the Afghan vole, *M. afghanus*. Finally, we identified 19 individuals related to the Juniper vole, *M. yuldaschi*. Within-taxon genetic diversity and population structuring varied, ranging from the M. aghanus lineage, which shows high levels of genetic diversity and population structuring both within Pakistan and across its overall range to *M. yuldaschi*, which exhibits low levels of genetic diversity across its range.

Waseq Mohammed
Research Advisor: Robin K. Bagley

Mirroring divergence? Evaluating speciation of parasitic wasps alongside their sawfly hosts

A major goal of evolutionary biology is to understand what generated our current biodiversity and how new species form, especially within hyper-diverse groups such as plant-feeding insects and parasitoid wasps. One thing thought to generate new insect species is shifts to new host plants. Because insects spend their entire life cycle closely associated with their host plant, any changes to their host are likely to require adaptations to maximize their performance on the new host. These adaptations may directly promote the development of new species. This is an example of ecological speciation, where adaptation to divergent environments produces reproductive isolation as a by-product. Because parasites are also closely associated with their hosts (typically other insects), they may "follow" the ecological divergence of their hosts, forming new groups specializing on each diverging host species. In this way, divergence in host insects could also result in divergence of their parasites. One system where this may be occurring, but has not yet been tested, are *Neodiprion* sawflies. *Perilampus hyalinus,* a parasite of the redheaded pine sawfly, *Neodiprion lecontei*, is one species where this sequential divergence may occur. This parasite is proposed to be a generalist that attacks many host insects, although no molecular work has confirmed this hypothesis. Here we take a first step towards addressing this question by sequencing the barcoding region of the mitochondrial COI gene for 26 specimens of *P. hyalinus* reared from a geographically- and ecologically-diverse set of *N. lecontei* colonies. We find little evidence of population structure within the specimens at this gene.

Rocco Salajcik
Research Advisor: Ryan W. Norris

Revisiting the Forest Refugia Versus Riverine Barriers Hypotheses as Drivers of Genetic Differentiation in the Forest Dwelling Mice of West Africa

The West African rainforests are considered a biodiversity hotspot; this is believed to be driven by speciation caused by climate oscillations. During the Pleistocene, it is believed that the rainforest receded during times of drought. There are two hypotheses on how exactly the rainforest reshaped. One hypothesis suggests that the rainforest stayed as one, creating just one large forest refugium. The other hypothesis suggests that the rainforest broke into two forest refugia, which would create two distinct forests patches (north and south) with unsuitable habitat separating them. If the single forest refugium theory were to be correct, speciation would likely occur along the west and east sides of riverine barriers. If the two forest refugium theory were to be correct, evidence of speciation should be present in the north and south parts of the rainforest. This research is based off, and an extension of, a previous thesis (Bauer 2019) that focused on the evolutionary history of a group of rodents found in the rainforests of west Africa, the *Hybomys* division. The goal of this research is to combine newly generated genetic data (cytochrome b) and data from a previous study (Pradhan et al. 2021) with the genetic data from Bauer's thesis. We conducted a phylogenetic analysis and retested the hypotheses presented in Bauer's thesis.

Marie Walton
Research Advisor: Robin K. Bagley

Lepidopteran Diversity in a Restored Prairie

Although much is known about plant succession in prairie habitats, information on invertebrate succession is not widely available. Tracking developmental change in a restored prairie requires baseline estimates of insect species present upon establishment of the site. In this study, I sampled lepidopteran (butterflies and moths) species in a recently burned prairie restoration on The Ohio State Lima campus to discover the community composition present in early succession, and to evaluate if any prairie specialists were present. To sample lepidopteran diversity in the Tecumseh Interpretive Natural Area, four methods were employed: one malaise trap, one light trap, four bucket traps, and weekly aerial netting. A plant survey was also employed for 4 sites in the prairie. Diversity metrics for lepidopterans and plants sampled were calculated using R software.

Although a relatively small amount of plant diversity was found at the prairie, the habitat supports a diverse community of lepidopterans, with 13 families and 48 species. This community is primarily made up of generalists, but does include two specialists. The findings support the hypothesis that there are currently more generalist species of lepidopterans in the restored prairie than there are specialist species. Out of 48 species found, only two were known to be prairie specialist species. This is likely due to a combination of the prairie's young age and recent total burn. Plants displayed low diversity, but a larger sampling effort should be pursued. Continuing to monitor for changes in populations of butterflies and moths present in the prairie is an inexpensive and straightforward way to monitor changes in the environment. As the prairie matures, the species composition will change along with plant succession. Tracking changes in lepidopteran biodiversity is an important task for new scientists to take on as we advance what is known about insect succession in prairie ecosystems.

Carter Welch
Research Advisor: Zachery Beres

Assessing the Habitat, Water Quality, and Macroinvertebrate Biodiversity of The Lost Creek on the Ohio State Lima Campus

The Lost Creek flows through the northern portion of the Ohio State Lima campus adjacent to the Tecumseh Interpretative Nature Preserve. This creek joins with the Maumee River to ultimately flow into Lake Erie. Monitoring local aquatic habitats improves understanding of local biodiversity and informs future restoration efforts. Two portions of the Lost Creek were evaluated using 150-yard stretches from November 2022 through March 2023. The first site ("Bridge Site") runs under N Mumaugh Road and includes the bridge and adjacent oil pipe. The second site ("Natural Site") is largely wooded and surrounded by the Tecumseh Prairie and Ohio State Lima farmland. The general health of these two sites was evaluated using the Citizen's Qualitative Habitat Index (CQHEI), chemical analyses, and macroinvertebrate biodiversity. The Natural Site scored higher than the Bridge Site across all measures. The high-quality riffles, pools, substrate, and riparian area found in the Natural Site scored well using the CQHEI (61), while the heavily modified habitat found in the Bridge Site scored lower (41). The two sites scored similar in several chemical analyses. Notably, the Natural Site did show increased orthophosphate compared to the Bridge Site [0.40 vs. 0.13 mg/L PO4, respectively; t-test ($p = 0.820731$)] and nitrate [5.87 vs. 4.4 mg/L NO3-, respectively; t-test ($p = 0.713687$)], but these differences were not statistically significant. Both nutrients are especially important in aquatic ecosystems. Assessments of macroinvertebrate biodiversity for both sites are still ongoing. Current analyses suggest that the Natural Site represents a healthier section of the Lost Creek compared to the Bridge Site though additional testing is needed. This data will allow future research opportunities to monitor biodiversity changes and habitat alterations. Future remediation efforts and continued monitoring of the Lost Creek are important to understand local impacts of freshwater habitats on downstream areas such as Lake Erie.

Macy Wiktorowski
Research Advisor: Robin K. Bagley

Evaluating mite abundance and diversity on the Ohio State Lima campus

Biodiversity is an essential part of functioning ecosystems that help to support all life on Earth. While it is known there are many species on Earth, the exact number is unknown, as are the relative ratios of diversity between groups. One group that has traditionally been thought to be a candidate for the largest insect order are beetles. These insects are large and charismatic, making detection and formal species descriptions relatively simple. However, other, less-charismatic groups of organisms with smaller bodies are harder to find and may appear to have similar morphologies to the naked eye. Consequently, these groups are under-described. A good example of this phenomenon are parasitic wasps. Their small size and the relative lack of information on their ecology made historical investigation and formal description challenging. Recent work, however, suggests that parasitic wasps actually far outnumber beetles, highlighting the importance of closely evaluating groups. One group of organisms with similar issues are mites, a poorly-defined taxon of parasitic arachnids. It has been proposed that mites could be highly specialized, with most species of animals and plants having their own unique infecting mite, but little ecological or molecular data is available to support or refute this idea. Here we describe the beginning stages of a project explicitly evaluating this hypothesis. We collected insects using a passive Malaise trap in the Tecumseh Interpretive Nature Preserve. The collected insects were evaluated for the presence of external mites by visual investigation, and internal mites using molecular barcoding, with the goal of identifying what mites attack which hosts, and how diverse these attacking mites are. Although this work is still in progress, thus far external mite abundance was low and their diversity seems limited, refuting the hypothesis of high mite diversity.

Mike Altstaetter
Research Advisor: John Hellmann

"Your Advertising is Just Dandy!": Gender as Performance in Arthur Penn's *Bonnie and Clyde*

As 1967's *Bonnie and Clyde* spotlights the most well-known and romanticized criminal couple in history, created in a decade that heralded a change in sexual politics between men and women, one would assume the film would feature subversive sexuality and gender, but, as this research reveals, the film actually reaffirms traditional gender roles and law-abiding behavior! Noting how our two protagonists struggle with achieving the ideal gender performance, reject and/or be found lacking of it, and finally accomplish it in the end (Clyde's hard-won battle over his impotence intertwined with Bonnie's slow regression back into traditional womanhood), Penn's *Bonnie and Clyde* reasserts traditional gender roles and performance. This upholding of society's expected gender performance goes hand-in-hand with the upholding of society's expected law-abiding citizenship, and the couple's infamous punishment for failing to perform it.

Jenny Hibbard
Research Advisor: Tina Schneider

Women of Ohio State Lima

The research study, "Women of Ohio State Lima," explores campus life of Ohio State Lima's female faculty, staff, and student body during the second wave of feminism in the 1960s and 1970s. Despite the changing cultural norms, newspaper clippings, student-published articles, and photographs in Ohio State Lima's archives all show traditional gender divisions of labor. The female students on campus are captured taking on the roles of the planners, decorators, and volunteers. The representation of women emphasized how their role on campus was seen either as the support for the working man, or the housewife-in-training. Further research will focus on the lack of individuality women possessed and how this continues to be an issue today.

Garret Martin
Research Advisor: Sabine Jeschonnek

Finding optimal angles for long-distance cannon fire using Euler's Method

Cannon fire has been utilized in battle for centuries and has been improved upon drastically over that time. Cannons have become more precise and powerful, and because of this, ammunition that can be fired from the cannon can reach greater heights. Without any air resistance, 45 degrees is the optimal angle for firing long distances. Reaching higher altitudes poses the intriguing question what the optimal angle to reach maximum range is: air resistance plays a role, and, as altitude increases, the density of the air decreases. I investigate if the optimal angle remains the same even with increased altitude.

Calculating this analytically would take far too long, due to the constant changes in air density, and the interplay of horizontal and vertical velocity components, so I have to calculate it numerically. I did this by utilizing Euler's Method. Euler's Method allows the program to solve ordinary differential equations as long as there is a given initial value. Since I know the angle of the cannon, the velocity of the cannonball leaving the barrel, and the air density at ground level, I am able to apply Euler's method, as these are my initial given values. By applying the method, I was able to calculate the flight path of a cannonball in a realistic scenario. I will present my results for the optimal angle to reach maximum range including air resistance calculated with varying air density.

Agapé Anderson, Ariba Fatima, Grace A. Wagar
Research Advisor: Fábio Leite

Evaluation of individual differences in spatial and cognitive abilities within the general population, artists, and athletes

Broadly, we are interested in individual differences in spatial and cognitive abilities. Spatial and cognitive abilities have been focal points of many studies (e.g., Hedge, Powell, & Sumner, 2018; Leite, 2009). The purpose of this study is to examine the relationship between spatial and cognitive abilities and athletic and artistic inclinations. After reviewing tasks that have been reported to be robust and time-effective methods, we selected three cognitive tasks (viz., mental rotation, Stroop interference, and matrix reasoning) to measure participants' performance and adapted two inventories to group participants by their level of expertise (fluency) in athletics and art, exploring individual differences. Participants have volunteered to participate from Psych 1100 classes for approximately 45 minutes. Following our pilot data collection in Autumn 2022, we changed the mental rotation task and continue to collect data in Spring 2023. The involvement of all participants is tested through. We predict that there will be some observable differences among more or less athletically-inclined individuals and more or less artistically-inclined individuals. For example, more athletically-inclined individuals are expected to have an advantage in mental rotation. On the other hand, more artistically-inclined individuals may have an advantage in reasoning and mental rotation. We will continue to examine how these advantages, if present, may also be observed in subgroups with differing levels of fluency in the arts and athletics.

Hedge, C., Powell, G., & Sumner, P. (2018). The reliability paradox: Why robust cognitive tasks do not produce reliable individual differences. 50(3), 1166-1186. Https://link-springer-com.proxy.lib.ohio-state.edu/article/10.3758/s13428-017-0935-1

Leite, F. P. (2009). Should IQ, perceptual speed, or both be used to explain response time? *The American Journal of Psychology*, 122(4), 517–526. http://www.jstor.org/stable/27784426

Lauren Chatman-Wright
Research Advisor: Virginia Tompkins

How Race and Gender Impact Children's Narrative Comprehension

There is a lack of research examining the connection between race, gender, and in-group membership and how this affects pre-readers' story comprehension. The purpose of this study was to explore whether the race and/or gender of story characters (and whether characters are from the same vs. different groups) influences pre-readers' story comprehension. To accomplish these comparisons, preschoolers (i.e., 3- to 5-year-olds) were randomly assigned to one of four stories that were identical except for the race and gender of the story characters such that some children were read a story that matched their own race and/or gender and some were not. Children were asked 12 yes/no questions at the completion of the story to assess story comprehension. Data collection is ongoing, but thus far 102 children have participated (Mage = 4.35 years), including 48% females, 74% White, and 26% Black or Biracial preschoolers. We examined the main effect of race (whether the child's race matches the character's race), the main effect of gender (whether the child's gender matches the character's race), and the interaction between race and gender. Preliminary results show a trend toward better comprehension when the character gender matches the child's gender, but poorer comprehension when the character race matches the child's race; however, results are not statistically significant. There is also a trend towards an interaction in which children do most poorly on story comprehension if the character race matches the child's race but is of a different gender. These results suggest that gender and race of characters (and whether these characteristics match the child's) exert contradictory influences on young children's comprehension of stories. Results will be discussed in the context of children's identification with and preference for people of their ingroups (race and gender) at this age.

Kirsten Flora and Mackenzie Peterman
Research Advisor: Patrick Carroll

The Antecedents and Mechanisms of System-Justifying Tendencies

As we see political beliefs become more polarized in the United States, it becomes increasingly important to understand the potential causes of this phenomena. To wit, we examined personality traits that could facilitate these rigid and extreme beliefs. System justification theory posits that people from all segments of society express a need to view their societal system as fair and just—even when it oppresses them. There appears to be dispositional antecedents or causes related to system justifying tendencies. Our study looks at the big 5 personality traits as well as chronic self-control and their relationships to system justifying tendencies. For our study, we had 142 (Female = 55) Mturk workers complete a survey that measured system-justifying tendencies (Jost and Thompson, 2000), Chronic self-control tendencies (Tangey, Baumeister, & Boone, 2004), and big 5 personality traits (Gosling, Rentfrow, & Swann, 2003). We supported the hypothesis that those who are higher in neuroticism will be higher in system justifying-tendencies. However, we also supported the hypothesis that the relationship between neuroticism and system-justifying tendencies would be mediated by chronic self-control with our results. Our study aims to extend past work on personality antecedents of system-justifying tendencies.

Isabella M. Torsell
Research Advisor: Joseph P. Green

A Principal Components Analysis of the Binghamton Hypnotic Attitudes Scale

In 2017, Lynn, Evans, and Russ advanced a 10-item measure of motivation and readiness to engage in hypnosis, expressed openness and acceptance of hypnotic experiences, and a willingness to experience hypnosis without opposing or resisting suggestions. Bradford and Green (2018) reported adequate reliability across the items and positive correlations between the scale and other measures commonly found to correlate with hypnotizability. Recently, the scale authors added items to the *Binghamton Hypnosis Attitudes Scale* (BHAS), making it a 17-item measure. In this investigation, *N*=290 undergraduate students completed an online administration of the BHAS along with a number of other personality scales in exchange for course/extra credit. We conducted a series of principal components analyses to examine the relationship among the BHAS items and determine the number of underlying components measured by the scale. We identified problems with 5 of the items (e.g., failed to correlate with other items above $r = .3$; low component loading; or poorly worded). The retained items showed high reliability (i.e., Cronbach alpha=.95). We obtained a single underlying component - which we labeled *Openness and Motivation Towards Hypnosis* - that captured 66.28% of the variance across the items. We found no gender differences on total scale scores or across individual items. Largely in line with predictions, we obtained positive correlations between the 12-item version of the BHAS and measures of absorption, expectancy (to be hypnotized), and dissociation; moreover, we observed non-significant associations with measures of emotional intelligence, various attachment styles, and attitudes about Covid. We discuss the next steps to validate the modified scale as a unique measure of hypnotizability.

Samantha Robertson
Research Advisor: Carmen Cupples

Nature Relatedness and Wellbeing in Older Adults in Northwest Ohio

Background: Research indicates that interaction with the natural environment facilitates positive wellbeing. Studies from a wide range of disciplines confirm that contact with the natural environment has the potential to affect mental and physical health including, lower rates of anxiety and depression, improved immune system functioning and blood glucose levels, and overall positive functional health status. While research on the role of nature relatedness on the overall well-being of urban-dwelling older adults does exist, there remains a clear gap on research with older adults living in rural areas. Informed by Bronfenbrenner's Theory of Human Ecology, this study examines the effects of spending time in nature on the psychosocial wellbeing of older adults in two rural Ohio counties.

Methods: Using convenience sampling methods, this study enrolled non-institutionalized older adults (50 years and over) residing in Northwest Ohio. The data was collected through an online survey hosted on OSU Qualtrics in November-December 2022. Open and closed-ended questions were used and asked about participants' characteristics, interaction with nature, and physical and mental health.

Results: A total of 73 responses were received but 6 responses were omitted from analysis due to being outside the study age-range (N=67). The average respondent was 63.84 years old (M= 63.84, SD= 7.09) and lived in a mean household of 2.09 members. Approximately 48% of the respondents reported an annual household income of above $91,000 and approximately 61% identified as female. Preliminary analysis indicates that on average, participants spent 22.35 hours in nature each month with the most common outdoor activities listed as hiking, gardening, and walking. Participants did identify challenges to spending time in nature including physical mobility, time, and the weather. Approximately 92% rated their mental health as either good or very good, and 71.7% rated their

physical health as good or very good. An emerging and unexpected finding from qualitative responses was around spirituality. Participants described a spiritual connection and specifically mentioned God and their relationship to God as integral to their connection with the natural environment.

Discussion: As the World Health Organization's Age Friendly Movement continues to gain momentum in rural areas, and as we are grappling with the long-term change in the climate, there is need for more studies on the well-being of older Americans as they navigate their natural environment.

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