Final Report:
Assessment of the Northeast Washington Wolf-Livestock Management Program - 2021-2023 Seasons

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Abstract of Executive Summary

This assessment evaluated the effectiveness of the Northeast (NE) Washington Wolf-Livestock Management Program during the 2021-2023 grazing seasons. The program, funded by the Washington State Legislature and administered by the Washington State Department of Agriculture (WSDA), focuses on reducing livestock depredations by wolves through community-based, non-lethal deterrence strategies, including range riding. This evaluation focused on the grantees—Cattle Producers of Washington (CPoW) and the Northeast Washington Wolf-Cattle Collaborative (NEWWCC)—and their ability to meet the range rider program requirements, such as documentation of activities, daily to nearly-daily monitoring (minimum of four days per week), spatial and temporal coverage of range riders, and coordination among all relevant actors. We used mixed-methods research incorporating spatial analysis, document reviews, and qualitative analysis of interviews. We found that CPoW and NEWWCC were implementing their programs effectively and that the programs reflect a strong community-based approach that enhances producer participation.

Program Implementation

During the 2021-2023 grazing seasons, range riders met or exceeded the daily to near-daily monitoring expectations, with an average of 152 rider days– defined as days when a rider visited a producer's operation– compared to the minimum requirement of 88 days. Range riders effectively documented their activities and coordinated their efforts to align with wolf pack presence. In 2023, each rider overlapped with at least two collared wolves, with an average overlap with six collared wolves. Both programs expanded their spatial coverage significantly since the onset of the program, covering portions of up to 13 wolf pack territories by 2023, representing a 117% increase in areas covered.

Community-Based Success

The grassroots structure of the program enhanced participation by and trust among local livestock producers. Participants highlighted the program's flexibility in addressing local needs, which helped foster strong collaboration within the community.

Challenges

Participants reported concerns with achieving consistent daily to near-daily monitoring across the vast and rugged terrain in Northeast Washington, in particular due to a lack of enough range riders to effectively meet the requirement. Participants also reported challenges coordinating and communicating with Washington Department of Fish and Wildlife (WDFW), suggesting a need to improve such efforts.

Conclusion

The NE Washington Wolf-Livestock Management Program, which represents the largest range rider program in the U.S. American West, is a successful community-based approach to foster coexistence between wolves and livestock. While the program has achieved substantial progress in implementing range rider efforts, continued investment, refined administrative processes, improved communication pathways with WDFW, and continued efforts from CPoW and NEWWCC to coordinate their range riding efforts will ensure long-term sustainability and effectiveness.

Executive Summary

The purpose of this assessment was to provide a constructive evaluation of the range rider efforts in Northeast (NE) Washington funded by the NE Washington Wolf-Livestock Management grant program during the 2021-2023 grazing seasons. Specifically, we assessed how well the program grantees–Cattle Producers of Washington (CPoW) and the Northeast Washington Wolf-Cattle Collaborative (NEWWCC)–met requirements of the program as it pertains to their range rider effort and their intent to proactively minimize wolf-livestock conflict. To structure this assessment, we used six questions outlined in the scope of services and grant program requirements. We sought to answer whether grantees: 1) developed a community-based approach, 2) documented and reported activities, 3) met a daily to near-daily monitoring requirement, 4) provided adequate spatial and temporal coverage, 5) demonstrated intent to proactively minimize conflicts, and 6) effectively coordinated efforts.

We engaged with relevant agency representatives and program directors, livestock producers, and range riders from CPoW and NEWWCC from June to November 2024 to obtain data and information relevant to this assessment. We used a mixed-method approach for data collection and analysis. There were three core components: 1) an analysis of the spatial and temporal activities of range riders in relation to livestock and wolves; 2) an analysis of documents (e.g., contracts, log books) relevant to wolf management in NE Washington; and 3) an analysis of interviews conducted with a broad array of actors directly involved in the range riding effort and managing wolf-livestock conflict.

Key Results

Overall, we found that CPoW and NEWWCC effectively implemented their range rider programs through a community-based approach to provide sufficient spatial and temporal coverage while demonstrating the intent to proactively reduce wolf-livestock conflicts.

Community-Based Approach

According to interview participants, the community-based approach of this program is a primary factor in its success. One component of the community-based success is the funding structure, where there is localized decision-making for the distribution of grant funds. Additionally, CPoW and NEWWCC are able to design their programs to fill community niches, meet their participants' needs, and adaptively respond to potential and actual conflicts, which fostered trust and increased participation among livestock producers. Livestock producers appreciated autonomy in selecting range riders who they trust have the necessary skills, knowledge, and integrity, which increased the number of producers willing to use this tool.

Documentation and Reporting

CPoW and NEWWCC documented range rider activities effectively by 2023, implementing GPS tracking of riders and monthly reporting to Washington Department of Fish and Wildlife (WDFW). Though both groups made efforts to adequately document and report their activities during the 2021 and 2022 seasons, they did not achieve this full objective until 2023. In part, this is due to these requests not being codified clearly in their contracts until the 2023 season. Additionally, in 2021 and 2022, NEWWCC attempted to document monthly activities using photo points to document range rider activities before transitioning to GPS tracking in 2023.

Daily to Near-Daily and Spatial and Temporal Coverage

Over all three years, both groups met the daily to near-daily range rider monitoring expectation. CPoW and NEWWCC averaged 152 days per producer (rider days herein) per grazing season, exceeding the minimum threshold of 88 days. Range riders from both groups coordinated their efforts to effectively monitor livestock while providing well-timed preventative coverage in areas where wolf packs were present. Additionally, both NEWWCC and CPoW increased the areas they covered by 117% from 2021-2023. The individual range rider programs covered a total average area of 12,446 mi^2 per year, an area the size of Vancouver Island, British Columbia. Riders covered territories of nine wolf packs in 2021-2022 and 13 in 2023. In 2023, rider overlap with wolf home ranges was substantial; all riders overlapped with at least two collared wolves, with an average overlap with six collared wolves.

Intent for Proactive Conflict Prevention

Both NEWWCC and CPoW carefully considered the design of their range rider efforts and made concerted efforts to make decisions that would result in the most effective programs, demonstrating intent for effective proactive conflict prevention. The program Directors tailored their management approaches to meet local needs and balanced resource constraints with flexible and proactive rider deployment strategies. Range rider efforts focused on both livestock-related (e.g., detecting sick or injured cattle) and wolf-related (e.g., detecting wolf sign) activities and range riders engaged in a suite of actions that likely helped reduce the risk of livestock losses to wolves.

Coordination and Communication

There was positive coordination and communication within programs (e.g., between producers and riders) and with external entities, like the Wildlife Specialist of the Ferry and Stevens counties' sheriff offices, which helped improve program outcomes. Importantly, CPoW and NEWWCC were proactive about improving their relations, communication, and coordination of their two range rider efforts—a critical factor for ensuring well timed and coordinated coverage.

Key Recommendations

Maintain Range Rider Program Successes

- **Continue to Support the Programs**. Based on the successful implementation of the range rider programs by CPoW and NEWWCC, we recommend that the programs continue to be funded. Additionally, if wolf numbers continue to climb and expand their range, we would suggest increasing funding to meet potential demand for more range riders.

- **Maintain Community-Driven Structure.** We recommend maintaining the community-driven model that builds trust and local ownership of deploying conflict prevention strategies (e.g., localized decision-making autonomy). The program design tailored to local conditions enhances participation by livestock producers.

- **Continue to Require GPS Tracking and Monthly Reporting.** Maintaining the requirement to track range rider movement with GPS and monthly reporting to WDFW is

important as a check to help ensure that range riders are meeting daily to near-daily monitoring expectations and that adequate coverage of the landscape is met. Further, several range riders reported appreciating this requirement because they are able to clearly document that they have met all program requirements.

- **Continue to Allow Directors Autonomy and Flexibility in Decision-Making**. We recommend that CPoW and NEWWCC directors and producers continue to have the autonomy to hire their own riders and adapt rider deployment based on real-time response to conflict and need. A key component of livestock producer participation is that CPoW and NEWWCC directors have autonomy and flexibility to design the individual programs and to make important on-the-ground decisions as needed, factors that enhance producer participation and make the program a success.

Increase Resources and Clarify Allocations

- **Increase Program Capacity**. We recommend that funds be increased to meet demand by livestock producers for more range riders. The directors from both NEWWCC and CPoW stated there is increasing demand by livestock producers who would like to enroll in their programs and hire range riders. This is particularly important given wolf populations in Washington State have increased approximately 23% per year since 2008. Moreover, to ensure and enhance quality of range riding while meeting the daily to near-daily monitoring requirements, additional funding for more range riders will be necessary.

- **Allow for Administrative Support**. We suggest allowing for flexibility in the funding allocations in the grants for programs to factor in operational funds and administrative support for tasks such as payroll, general accounting, and grant reporting support. This will help support more efficient and in-depth administrative procedures within each program, thus supporting better reporting, management of range riders, and coordination.

- **Increase Range Rider Compensation**. Effective range riders require a suite of knowledge and skills. Yet, given the seasonality and uncertainty of the job, it is a challenge to recruit and retain quality range riders. To recruit and maintain range riders over multiple seasons, we recommend that range rider compensation is increased to help retain riders who have developed significant skill sets. Maintaining a pool of skilled range riders would help increase sustainability of the programs into the future.

- **Clarify Eligibility for Grant Funds.** We recommend the grant advisory board clarify eligibility for grant awardees by developing and providing clear evaluation criteria related to, for example, if an NGO must be composed of several producers or if an individual can qualify. Clarifying such criteria will improve the overall program by ensuring applicants design effective programs and that NE Washington has well placed and coordinated range rider programs.

- **Improve Invoice Processing Time.** We recommend that WSDA reduce invoice processing times to address the concern raised by NEWWCC and CPoW participants that there are often significant delays in paying riders and, at times, program Directors must find outside sources of funds (e.g., loans) to ensure timely compensation.

Maintain and Enhance Coordination and Communication

- **Perceptions of WDFW.** We recommend that effort be taken to improve communication between WDFW and livestock producers, particularly as wolf numbers continue to expand. For example, program participants expressed a desire for more clarity around expectations for lethal control of wolves when livestock depredations occur, and more timely responses to producers that report wolf conflict and livestock losses. Livestock producers expressed the sentiment that participating in the program and meeting the daily to near-daily expectation was hard work. They felt that this represented a good faith effort on their part and, from their perspective, that WDFW could respond more consistently in cases when lethal control actions are perceived warranted by livestock producers.

- **Consider Creation of a Regular Forum for Stakeholders.** We recommend that a new forum be established to enhance communication and coordination among all program participants at the regional scale in NE Washington; in particular with NEWWCC and CPoW participants, the county sheriff offices' Wildlife Specialist, and representatives from WDFW and WSDA. We strongly recommend this forum be facilitated by a third party for it to be effective. This forum could be convened at the beginning and end of each annual grazing season to help clarify or update any wolf management policies, strategize improved coverage, and address any challenges. Such a forum may facilitate collective learning, improve trust and communication, and improve range rider practices.

- **Retain the Wildlife Specialist Position with Ferry and Stevens County Sheriff Offices**. This trusted "local anchor" serves as a vital liaison between producers and agencies and is a central figure that supports the extensive coordination and communication efforts amongst relevant actors in NE Washington.

- **Strengthen CPoW and NEWWCC Communication and Relationships**. Given the importance of the two individual programs in filling community niches and ensuring the intent to proactively prevent wolf-livestock conflict by producers and range riders, coordination of their efforts is crucial to the success of the overall program. While CPoW and NEWWCC worked to improve their coordination during the 2021-2023 grazing seasons, we suggest they continue to identify further opportunities to enhance their coordination of rider deployment and landscape coverage.

- **Consider Pre-Season Range Rider Training.** Since several range riders expressed wishing they had received additional training prior to starting, we recommend that CPoW and NEWWCC consider riders take part in a formal, one-time training in addition to training provided by each NGO. Doing so would provide an opportunity for riders across NGOs to learn from one another and ensure they are operating with the same fundamental knowledge and skill sets needed to carry out their activities in a coordinated manner. For example, training can standardize tasks already done by NEWWCC and CPoW, such as how to identify wolf sign and other predator sign, assess livestock herd health conditions, and how to best document and report activities to meet administrative program requirements.

Background Information

Summary of the Northeast Washington Wolf-Livestock Management Program

The Washington State Legislature provides funding to support a community-based approach to reduce livestock depredations by wolves. The program encourages the use of a suite of non-lethal conflict prevention tools, in particular range riding. These funds cover efforts in four Washington counties (Okanogan, Ferry, Stevens, and Pend Oreille) where wolves have significantly expanded in numbers and range over the past decade. The Washington State Department of Agriculture (WSDA) oversees the distribution of these funds. The first grants were distributed beginning in 2017. A four-member advisory board of community members local to these counties advises the WSDA on the distribution of these grant funds, which may be used only for the deployment of non-lethal deterrence resources. The advisory board reviews community grant applications and selects annual grantees. Requirements for grantees include that they must be nonprofit community-based organizations that have advisory boards comprised of personnel from relevant agencies including, but not limited to, the United States Forest Service or the Washington Department of Fish and Wildlife (WDFW). Once grantees are awarded funds, the directors of the community-based non-profits then oversee the use of the funds within their organizations to support range riding programs for the communities they serve. The Northeast Washington Wolf-Cattle Collaborative (NEWWCC) became a registered 501(c)(3) nonprofit organization in 2017 and received their first grant from WSDA that same year. The Cattle Producers of Washington (CPoW) was already an established 501(c)(3) and received their first grant from WSDA in 2018.

Purpose of Assessment

The purpose of this assessment was to provide a constructive evaluation of the range rider efforts in Northeast (NE) Washington that were part of the NE Washington Wolf-Livestock Management grant program during the 2021-2023 seasons. Specifically, we assessed how well the program grantees - Cattle Producers of Washington (CPoW) and the Northeast Washington Wolf-Cattle Collaborative (NEWWCC) - met requirements of the grant program as it pertains to their range rider effort and the primary goal of proactively minimizing wolf-livestock conflict. It should be noted that this assessment does not evaluate the functional effectiveness of range riding efforts because we lacked data on livestock losses and an appropriate “control” area (e.g., area with wolves and cattle but no range riders) to compare range riding efforts. Rather, our purpose was to evaluate if CPoW and NEWWCC met the expectations of the grant program in the four counties of NE Washington from 2021-2023. Our report evaluates how well CPoW and NEWWCC deployed proactive and preventative deterrence methods, with an emphasis on range riding, with the intent to reduce the likelihood of cattle being injured or killed by wolves. We did not evaluate whether there was a reduction in injuries and cattle depredation.

Our approach to producing a constructive assessment reflects our professional interests and experience in finding solutions that help maintain rural livelihoods, wolf populations, and public acceptance of wolves in states like Washington and beyond. We conducted this assessment with a spirit of collaboration and used evaluation methods that generated mutual understanding among our research team and key actors engaged in wolf-livestock conflict mitigation in NE Washington.

Summary of Evaluation Team Experience

All members of this evaluation team have experience in managing, monitoring, and evaluating programs and prevention tools in the field of human-carnivore conflict and coexistence. Additionally, all members have direct field-level and policy experience in research, conservation, and management of wolf-livestock conflict mitigation. As NGO workers, federal wildlife research scientists, and academic researchers, this team brings a diversity of experiences for understanding how people, wolves, and livestock interact. Perhaps most importantly, several members have been immersed in developing, managing, and evaluating range rider projects in the State of Washington, as well as Montana, Oregon, New Mexico, Arizona, and Colorado. Below, we highlight relevant experience from team members in research, evaluation, and management methods. See *Appendix A* for more details on the qualifications of individual team members.

Range Riding Framework For Evaluation

Range riding is a general term to describe the use of human presence to deter carnivores from livestock and to implement other strategies for assisting producers whose livestock may be at risk of depredation. A range rider monitoring livestock can reduce the risk of livestock depredations by detecting sick, injured, or isolated animals that may be vulnerable to wolves so that management actions can be taken. Moreover, range riders can detect the presence of wolves near livestock, locate depredated livestock, and alert producers in order to report depredations. This information can help range riders, livestock producers, and wildlife managers understand where depredation events are unfolding and facilitate the successful implementation of management actions to consider (Parks and Messmer, 2016). In general, range riding can help deter wolves, locate livestock, check herd health, identify signs of wolf and other carnivore presence, and, in some cases, move cattle or haze wolves (Parks and Messmer, 2016).

Range riding has been used to reduce livestock losses to carnivores including wolves (Boitani, 2003). Researchers have found that the spatial distributions of predator and prey species vary with human activity levels (Hebblewhite et al., 2005; Muhly et al., 2011). In certain cases, prey species were more prevalent in areas with high human activity, whereas predator species, including wolves, avoided such areas—hence the justification for increasing herd supervision rates by using range riders (Wells et al., 2019). While this may appear to be a straightforward and pragmatic proposition in terms of livestock husbandry, the effective use of range riders can be influenced by social, ecological, economic, and cultural factors across space and time. In places like the U.S. American West, range riding efforts have been used more frequently over the past decade as wolf and other carnivore populations have increased and expanded their range.

Range rider activities can vary daily according to the needs identified; thus, evaluation of the practice is challenging. While the effective use of range riding is context-specific, based on our team's direct experience in managing and investigating range rider programs for nearly twenty years, we have found that several core components are important for understanding and evaluating a range rider effort.

In particular, we used the *Range Rider Framework to Guide Evaluation* (Figure 1; adapted from Wilson et al. 2017) as an *a priori* framework for identifying and evaluating

relevant components of the NE Washington Wolf-Livestock Management Program. This framework details the core stakeholders, wolf-related factors, and livestock-related factors that should be considered during an evaluation. This heuristic helped guide our assessment to understand how well core stakeholders from CPoW and NEWWCC coordinated efforts to generate an understanding of wolf-and livestock-related factors and, in turn, how well they addressed those factors that were context specific to NE Washington. For example, by assessing if range riders met the daily to near-daily expectation of livestock herd supervision and understanding what activities they conducted, we can learn to what extent range riders observed livestock, detected sick, injured, or lost livestock, and observed wolf sign and activity.

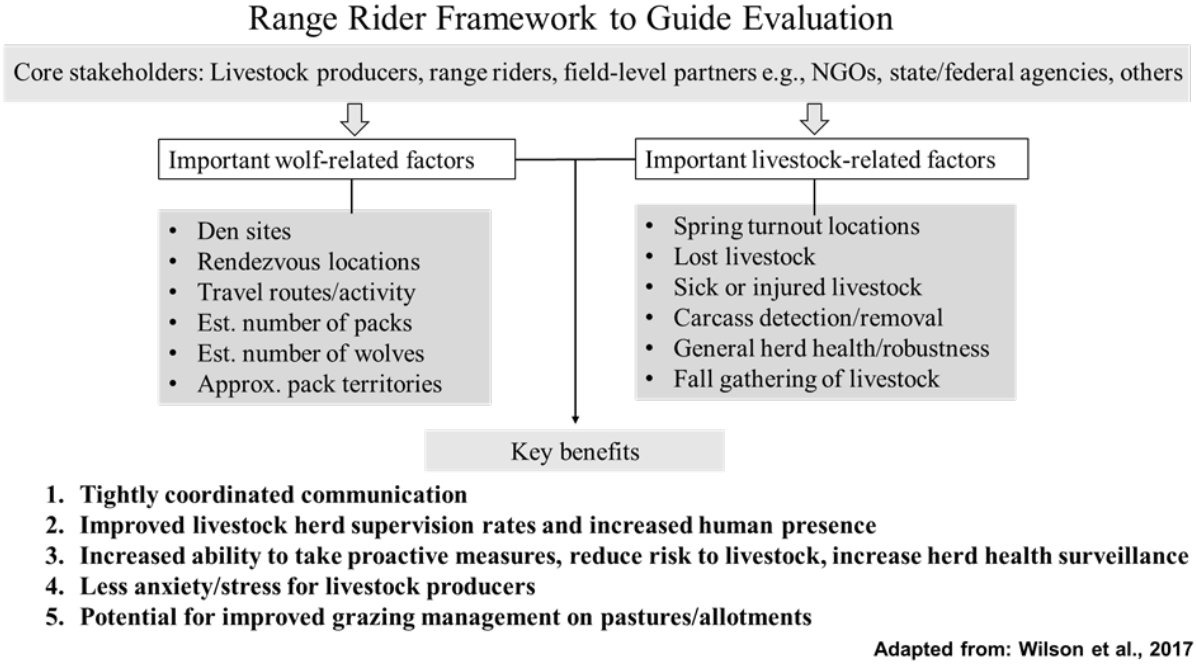

Figure 1. A range rider framework that we used as a heuristic to guide the *a priori* aspects of this evaluation. It is adapted from Wilson et al. (2017).

When using such a framework to identify evaluation criteria, it is important to incorporate the effort of program participants and context-specific factors given that both social and ecological contexts vary greatly across programs. For example, terrain ruggedness, amount of forested cover, accessibility to pastures/allotments, and behavior of nearby wolf packs and other predators vary greatly, as does individual range rider pay, training, background, and understanding of livestock behavior - amongst other considerations. While we could not measure these types of factors directly, in our evaluation we generally considered how they can influence the ability of a range rider to attend to a given herd.

Assessment Approach

We used the widely accepted goal-achievement program evaluation model to guide our assessment approach (Jung et al., 2021; Mickwitz, 2003). The goal-achievement model helps researchers assess whether the results and outcomes of a program align with the *a priori* stated goals of a given initiative (Mickwitz, 2003). We first evaluated if the stated goals of the program, identified by the scope of services for this assessment and the requirements outlined in the grant

program for grantees, were manifested in efforts of the two grant recipients during 2021-2023. Secondly, we evaluated if our *a priori* goals of range riding were achieved within the site-specific contexts of the two grant recipients' program areas, based on the context-specific factors detailed in the Range Rider Framework to Guide Evaluation and the knowledge of the experts on our team.

We used the following questions derived from the scope of services for this assessment and the requirements outlined in the grant program:

1. Was a community-based approach effectively developed to provide assistance with non-lethal management methods to reduce livestock depredations by wolves?

2. Did range riders document their activities with GPS track logs and provide written descriptions of their efforts to WDFW on a monthly basis?

3. Did range riders visit areas with cattle daily to near-daily?

4. Were there coordinated wolf-livestock conflict deterrence efforts, both temporally and spatially, therefore providing well-timed and placed preventative coverage on the landscape?

5. Was the performance of recipients based on the intent of conducting proactive deterrence activities with the goal to reduce the likelihood of cattle being injured or killed by wolves?

6. Did grantees collaborate with other grantees of the program and other entities who provided prevention efforts?

Methods

We collected both quantitative and qualitative data to assess if the overall program and range riding goals were successfully achieved. Given the complexity of evaluating community-based programs, triangulation of data helps avoid bias inherent in each approach and to enhance validity. Thus, the integration of both quantitative and qualitative research is recommended to provide a comprehensive assessment (Granner & Sharpe, 2004).

Our mixed-method data collection and analysis approach includes three components: 1) an analysis of the spatial and temporal activities of range riders in relation to livestock and wolves; 2) an analysis of documents (e.g., contracts, log books) relevant to wolf management in NE Washington; and 3) an analysis of interviews conducted with a broad array of stakeholders directly involved in the range riding effort and managing wolf-livestock conflict. We received ethical approval for research methods from Colorado State University's Institutional Review Board (protocol # 5917).

Spatial and Temporal Analysis of Range Rider Monitoring and Landscape Coverage

We conducted an analysis in NE Washington (Figure 2) to examine whether range rider efforts by CPoW and NEWWCC were targeted in a spatially and temporally efficient manner.

This analysis focuses on whether range riders were deployed in areas where wolves were present and whether range riders met the daily to near-daily expectation of a minimum of four days per week.

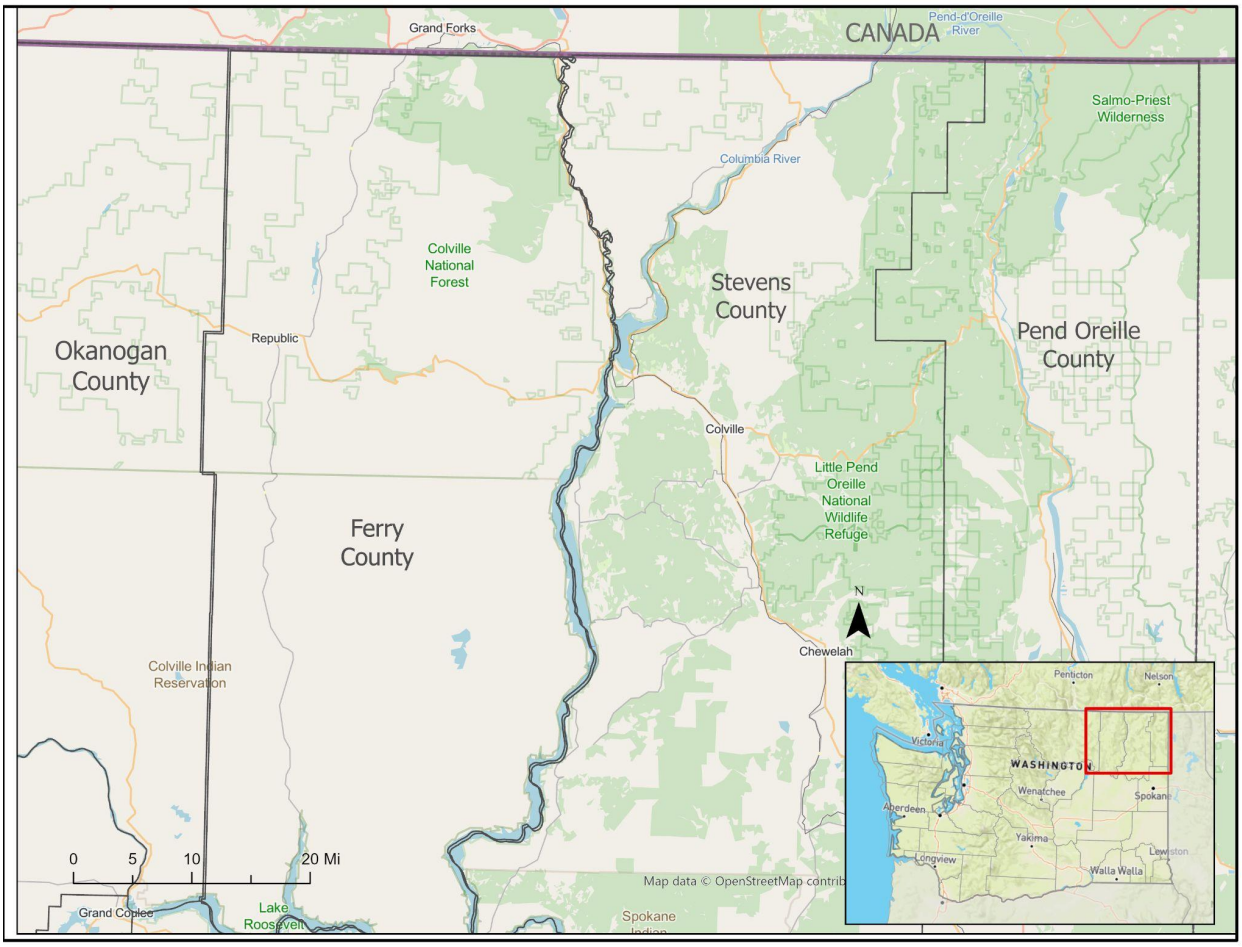

Figure 2. Location of range rider study area in NE Washington in Okanogan, Ferry, Stevens, and Pend Oreille counties. Sources: ESRI, OpenStreetMap, Mapbox.

Data Collection

We used publicly available wolf home ranges and WDFW location data on collared wolves to evaluate coverage. We downloaded 2021-2023 wolf pack home ranges from WDFW (https://hub.arcgis.com/datasets/wdfw::wolf-pack-polygons-all-years/about, data accessed: 1 August 2024). These home ranges consisted of minimum convex polygons (MCPs), which create a polygon of the total area contained within global positioning system (GPS) locations of individual wolves in each pack. We then used WDFW data on annual wolf pack size and linked that data to each home range. We also obtained location data for individual wolves monitored with GPS collars from 2021-2023 by WDFW (GPS collar models Vectronics and Telonics). These data consisted of a total of 35,109 GPS locations from 35 collared individuals from 13 packs in Eastern Washington. Sampling intervals for GPS collars varied from 30 minutes to 13 hours. Importantly, only a fraction (<50%) of all wolves in the study area were collared.

We worked with NEWWCC and CPoW to gather data on range rider locations by year and livestock operations covered by each program. We collected GPS locations and tracks from CPoW and NEWWCC range riders between 2021-2023 (n = ~897,000). For NEWWCC, we also used invoice data that reported which operations riders visited. We grouped range riders by the producer or producers whose herds they cover, as these were the units for each contract. Producer names were removed from figures per our confidentiality agreement with the range rider groups.

Temporal Coverage

The units of measure were the number of days a rider was present at a livestock producer's operation (rider days herein). Rider days are cumulative, meaning if two riders were present during a single day, we counted that as two rider days. A single producer may have multiple allotments that are used throughout the summer, or multiple producers can have livestock grazing on the same allotment, therefore allotment information was merged to the producer level. We used data provided by the range rider groups to identify range riders and the corresponding operation(s).

We calculated a minimum "near-daily" threshold by considering a typical grazing season from June 1st to November 1st (153 days), then calculated the number of days needed to visit a producers' herd as four days per week, as defined in the Wolf-livestock Interaction Protocol (2020), to meet the threshold.

Spatial Coverage

We evaluated spatial coverage of the range rider programs using overlap metrics and visualizations, described below.

Overlap metrics. We used several overlap metrics to evaluate spatial coverage of range riding efforts in relation to wolf activity. These included: 1) descriptive statistics such as number of wolves, wolf packs, and total areas covered by the programs; 2) overlap between range riders and wolves using rider GPS points and publicly available maps of wolf home ranges; and 3) overlap between range riders and wolves using range rider GPS points and WDFW location data from GPS collared wolves.

To estimate spatial coverage of riders, we first removed all rider GPS points taken while en route to grazing operations to reduce the overestimation of their spatial coverage. We then used the remaining points to create minimum convex polygons (MCPs) for each of the riders, which approximated the associated spatial coverage of the rider. We overlapped rider MCPs with publicly available wolf MCPs to approximate the coverage of each program each year.

We then evaluated overlap through a more precise statistical method called the Bhattacharyya coefficient, or the ratio of overlap between activity areas for range riders and wolves. For this analysis, we used range rider and wolf GPS points only from 2023 to calculate a home range estimator, the autocorrelated kernel density estimates (AKDEs; Fleming et al., 2015; Fleming & Calabrese, 2017), using the ctmm package (Calabrese et al., 2016). We then used these data to create a pairwise comparison of spatial overlap (Tilberg & Dixon, 2022; Winner et al., 2018) between each rider and the target wolf using the overlap function in the ctmm package

(Calabrese et al., 2016). We considered a target wolf to be the collared wolf with the largest spatial overlap with a given rider. We calculated how many collared wolves each rider covered (minimum of 0.10 overlap) and summary statistics of the overlaps.

Visualizations. We used three types of visualizations to display spatial overlap between range rider and wolf activity, including: 1) heatmaps, which delineate areas of high concentration of rider and wolf activity and 2) distance, the distance between an individual rider and the closest collared wolf, displayed over time.

We created heatmaps in the statistical software R using the packages ggmap (Kahle & Wickham, 2013). We used GPS location data from wolves, CPoW riders, and NEWWCC riders to create separate maps for each. After removing en route range rider points as described above, we created heatmaps using the stat_density2d function with a kernel bandwidth of 0.35 for all GPS locations.

Lastly, we used the distance function in the ctmm package (Calabrese et al., 2016) to visualize the distance between an individual rider and the closest collared wolf. This visualization estimates how often a given rider and wolf come into proximity with each other. Distance data were displayed over time across the summer season for the three riders with the most overlap.

Thematic Analysis of Documents and Key Informant Interviews

We used existing documents and key informant interviews to serve as the core sources of information for our qualitative analysis.

Document Analysis

We collected documents that provided information relevant to the overall NE Washington Wolf-Livestock Management Program as well as the two individual programs, CPoW and NEWWCC. We evaluated these data using a document analysis approach, which is a systematic procedure for analyzing pre-existing data that were produced absent of a researcher's intervention (Creswell & Gutterman, 2019).

The following documents were included in our analysis:

- WDFW annual wolf reports for 2021, 2022, and 2023
- WDFW Wolf Livestock Interaction Protocol 2020
- The ENGROSSED SUBSTITUTE SENATE BILL 5187 (biennial funding appropriation)
- The MOU between WDFW and WSDA from 2021
- The program 'call for proposals' for 2021, 2022, and 2023
- CPoW and NEWWCC program applications for 2021 and 2023
- CPoW and NEWWCC summary and annual reports for 2021 and 2023
- Grant agreement contracts for 2021
- The grant review board recommendations on applications for 2021
- WDFW comments on NEWWCC's and CPoW's applications for 2021 and 2023
- The 2022 supplemental budget request
- The 2022 supplemental funds contract and fund statement of work for NEWWCC
- Range rider logbooks

Key Informant Interview Analysis

From June to September 2024, we conducted interviews with 37 key informants from CPoW and NEWWCC, including program directors, livestock producers, and range riders, and personnel from state and federal agencies that were involved in the range rider program throughout the 2021, 2022, 2023 seasons (Table 1). We recruited participants using a combination of emails and phone calls. Before conducting interviews, we provided a written consent form and a verbal explanation of their rights as participants, including confirmation that we would ensure confidentiality and anonymity. We only began the interview after receiving verbal consent.

Table 1. Interview participant categories and numbers of interviews conducted.

Type of key informant	**Number of interviews**
Livestock producers	6
Range riders	19*
Directors of CPoW and NEWWCC	2
Board members from CPoW and NEWWCC	2
County sheriff offices' Wildlife Specialist	1
Personnel from Washington Dept. of Agriculture	1
Personnel from Washington Dept. of Fish and Wildlife	3
Personnel from United States Forest Service	2
Grant advisory board members	1

** Of the 19 range riders, 4 were also livestock producers riding their own allotments.*

We recorded interviews and focus group discussions and transcribed these into written documents using Otter.ai transcription service (otter.ai: https://otter.ai/). We then analyzed the transcriptions using inductive thematic content analysis, a foundational qualitative analysis method that allowed for identification of the meaningful topics, ideas, and patterns inherent in the data, relevant to the goals articulated by the scope of service (Saldaña, 2016). In the perceptions of the quality of coordination and communication efforts section below, we counted the number of times we coded for relevant themes from that part of the interview analysis to provide descriptive statistics on how often relevant groups and entities were discussed and on the perceived quality of those coordination and communication efforts with each entity. We similarly provide descriptive statistics in the range rider effort section below, where we averaged how often range riders reported engaging in a suite of range rider activities that are important for a proactive approach for minimizing wolf-livestock conflict. Qualitative analysis was conducted in the Dedoose software program (Dedoose Version 9.0.107).

Results

Our results include sections based on the six framing questions identified by the scope of services for this assessment and the requirements outlined in the grant program for grantees. We organized our quantitative and qualitative results under section headers that represent the following assessment questions:

1. Was a community-based approach to provide assistance with non-lethal management methods to reduce livestock depredations by wolves effectively developed?

2. Did range riders document their activities with GPS track logs and provide written descriptions of their efforts to WDFW on a monthly basis?

3. Did range riders visit areas with cattle daily to near-daily?

4. Were there coordinated wolf-livestock conflict deterrence efforts, both temporally and spatially, therefore providing well-timed and placed preventative coverage on the landscape?

5. Was the performance of recipients based on the intent of conducting proactive deterrence activities with the goal to reduce the likelihood of cattle being injured or killed by wolves?

6. Did grantees communicate and coordinate with other grantees of the program and other entities who provided prevention efforts?

1. Community-Based Approach

Government officials, board members, and NEWWCC and CPoW participants collectively felt that the most important reasons the programs were successful were that they were community-based and funded through a community-driven grant program. The community-based aspect, and the fact that funds are sent to WSDA then allocated by a board of local community decision-makers who approve grantees, has led to increased acceptance for and support of range riding by producers in NE Washington. Livestock producers also indicated that this community-based structure increased their willingness to engage in other preventative measures to proactively reduce wolf-livestock conflict.

These positive perceptions of the programs should be viewed as a key metric of success in this region. Moreover, based on the extensive numbers of livestock producers and range riders engaged in the programs, this represents the largest riding effort carried out in the U.S. American West to date - evidence that the program has been effective at cultivating participation by local livestock producers and range riders.

The design of the overall program has allowed for relevant public agencies to rely on community expertise to further enhance livestock protection strategies and for community members to work collaboratively to solve issues and support each other at the local level.

A WSDA participant shared: *"I sort of believe that the design of this program is genius, because I'm in Olympia, we're Department of Ag, and we don't make the funding decisions. The way the money is divvied up and who gets funded… it's the locals that are making the funding decisions, it's your neighbor, it's your conservation district board members… this is the key element of this program that's really genius and really sacred, and we need to keep it that way."*

One of the range rider program directors shared: *"It's amazing to watch people start working together. Just having that coordination, that community, feels really good… the people they want to hire tend to care about, not so much about wolves, as just making it work for the agricultural community, and that, in turn, I mean people in the West Side don't get it, but that, in turn, helps the wolves, and I've tried to get that across."*

In another example, a conservation district board member said: "*I think that's probably the other positive that I've seen with range riding… they're doing stuff now, not just to check the box. They're trying to actually solve the problem, which is a huge positive."*

Program participants noted two particularly important components of the community-based program structure they believe have led to success: 1) CPoW and NEWWCC are able to fill different community niches in NE Washington, expanding overall program participation among diverse producers with varying needs and preferences, and 2) there is sufficient autonomy and flexibility for grantees to design the individual programs and make important on-the-ground decisions as needed.

Filling Community Niches

An important aspect regarding flexibility and autonomy is that the directors of NEWWCC and CPoW have the ability to make decisions about how their range riding programs function in order to prevent wolf-livestock conflicts and meet the needs of the communities they serve. This allows these individual programs to fill different community niches and attract different community members, allowing producers the choice to work with the program they prefer, which increases the coverage in the region. One producer stated: *"by having two groups, everybody gets a chance to pick what they want."*

A government official stated that: *"I feel like CPoW fills a niche that others can't and don't… not all cattlemen in Washington are one type, they all have opinions and they all have alliances. And so, I think CPoW is equally as important as NEWWCC in terms of the stakeholders that they serve. They're all serving sort of… different varieties and different types of people, and I think that they're fulfilling that area really really well."*

Flexible Decision-Making

Another key facet of flexibility and autonomy that participants appreciate is the degree of autonomy producers have to work with program directors to hire their own range riders, thus ensuring they have trust in the riders' skills and integrity. Importantly, several participants reported that this decision-making autonomy has increased the number of producers that are willing to engage with the overall program and employ range riders on their allotments.

Some of the producer and rider participants shared:

- *"I believe that if you're riding for somebody, then you should ride for the brand. If they're not neighbors and they don't work for me, then I don't want them on our place. I mean, how many people do you let play with your savings account?"*

- *"Producers got to find a Range Rider that they trust… if the producer has a Rider pushed on them with no trust, you're done, and then the program fails."*

2. Documentation of Activities

We found that NEWWCC and CPoW met grant program objectives by regularly documenting their activities with GPS track logs and providing written descriptions of their efforts to WDFW on a monthly basis for the 2023 season. Though both groups made efforts to adequately document and report their activities during the 2021 and 2022 seasons, they did not achieve this full objective until 2023. In part, this is due to these requests not being codified clearly in their grant contracts until the 2023 season. Additionally, in 2021 and 2022, NEWWCC attempted to document monthly activities using photo points to document range rider activities before transitioning to GPS tracking in 2023.

3. Meeting the Daily to Near-Daily Expectation

Wolves are adaptive, smart, and able to detect when livestock are most vulnerable; thus, deploying riders on a daily to near-daily basis may logically be a good indicator of how effective a range rider program is (Fowler et al. 2019). As defined by the Wolf-livestock Interaction Protocol by WDFW (2020, pg. 9),

> "Near daily is generally 4-5 days per week, but allows the rider or riders to remain adaptable to the situation and needs. Range riding presence depends on the number of people assigned to areas, and individuals' time may be allotted to priority areas or specific times of day. Provided resources are available, the intent of this expectation implies that there will be an adequate number of range riders to allow all portions of grazing allotments with livestock presence to be checked on a near-daily basis during times of concurrent overlap with wolf activity. With location-based range rider data, WDFW can determine the extent to which this expectation is being met. Having an exact definition of "near daily" in the protocol may not accurately reflect the dynamic nature of a range rider's job or priority areas."

Range riders from NEWWCC and CPoW exceeded the daily to near-daily expectation that was defined in WDFW's Wolf-livestock Interaction Protocol (2020) (Figure 3). In total, riders accumulated 6,151 days over the three years, with a mean of 152 rider days per producer for each summer grazing season, which exceeds the minimum threshold of 88 days.

NEWWCC riders monitored for 3,324 days over the three years. In 2021, riders worked a total of 1,212 days; the mean number of days per producer was 230 (range 116-406). In 2022, that number was 1,113 days with a mean of 170 days (range 115-289). In 2023, that number rose to 1,334 total days, with a mean effort of 192 days per producer (range 128-259).

CPoW riders monitored for 2,827 days over the three years. In 2021, riders worked a total of 556 days; the mean number of rider days per producer was 133 (range 87-174). In 2022, that number was 1,007 days with a mean of 143 days (range 56-274). The producer with 56 rider days is an outlier because they had a shortened grazing season on an allotment. In 2023, that number rose to 1,264 total days, with a mean of 162 rider days per producer (range 14.3-283). One producer only needed a rider for one month, hence the low minimum range for CPoW in 2023. Notably, the mean number of rider days increased over the three-year period, suggesting CPoW has improved temporal coverage over time.

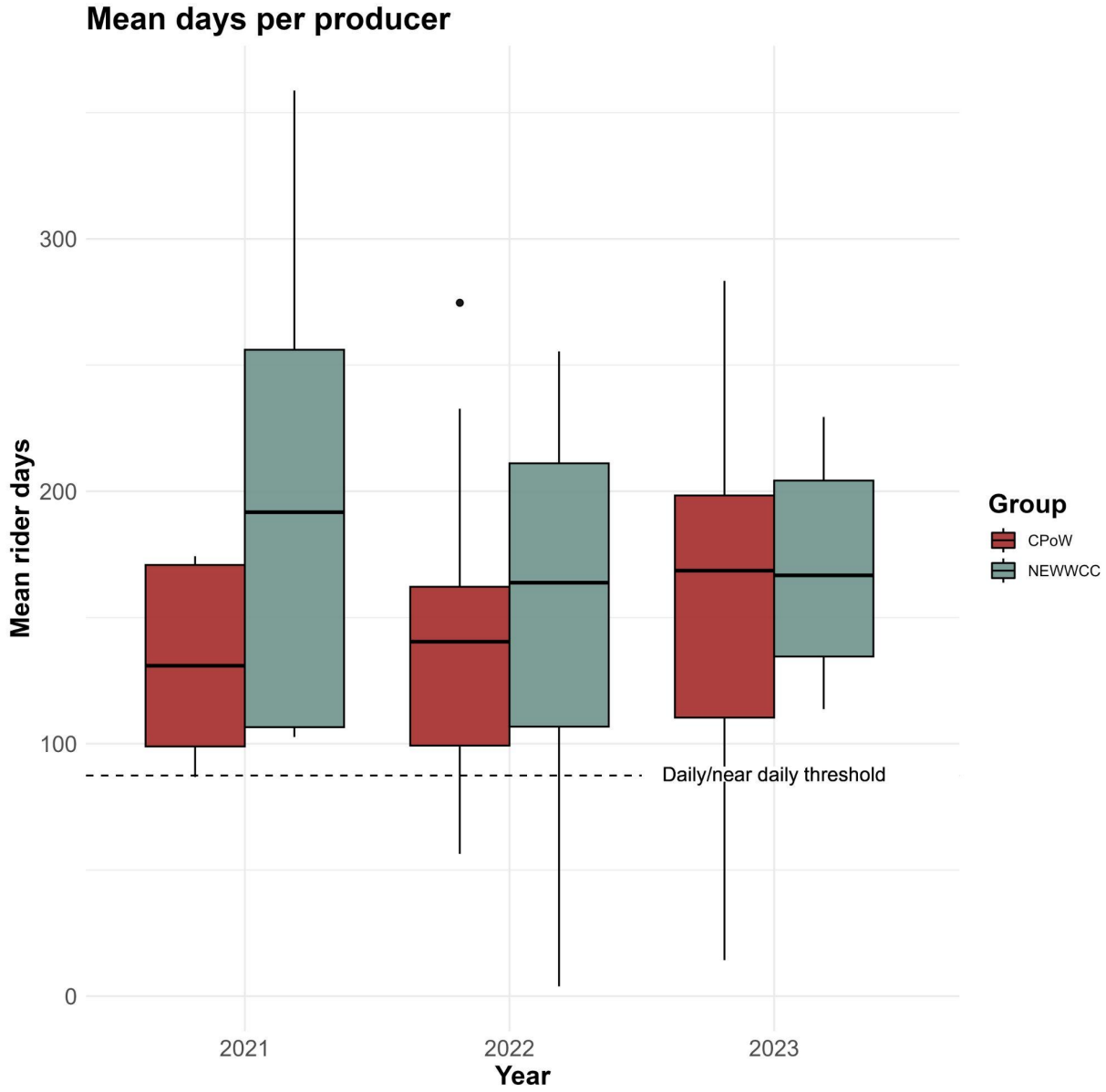

Figure 3. Temporal coverage of producers' operations from 2021-2023. Rider days are the number of days a rider spent at a producer's operation. Boxes represent the range of days for each group, the black center line is the median number of days, and the vertical black lines are the maximum and minimum data points. The dotted line is the daily to near-daily threshold. Red represents CPoW and teal represents NEWWCC.

Participant Perspectives on Daily to Near-Daily Expectations

Though the directors and participants of CPoW and NEWWCC have identified where and when to deploy riders to be most effective, the pressure to be on all allotments daily to near-daily, regardless of the conflict context at any given time, complicates these decisions.

While participants described the importance of daily to near-daily in proactively preventing conflict, most participants shared the perspective that it is not feasible to achieve as currently defined, enforced, and, most importantly, funded. Many shared that there are substantial costs and trade-offs associated with prioritizing achieving daily to near-daily on every allotment for every producer. For example, many described that prioritizing daily to near-daily can reduce the quality of work and the time that riders can spend on allotment as they try to cover multiple pastures, herds, or producers regardless of risk or observed need.

Participants shared that daily to near-daily is feasible for smaller allotments and most critical when there is active conflict or increased risk for conflict. The primary challenge described was the perception that there are simply not enough resources, both financial and number of riders, at this time to maintain a daily to near-daily expectation for every allotment in NE Washington.

Several participants shared:

- *"The daily, near-daily is tough. I mean, if a person could do it, you'd want to be there in every allotment daily, but it's not going to happen with the amount of people that we have, it's impossible."*

- *"How do you negotiate… if [name redacted for anonymity] needs more riding, but you can only afford so much, so you'd have to pull from [name redacted for anonymity] to do that. How do you make those decisions?"*

- *"Daily, near-daily is pretty important when you're really having trouble. But this idea of daily, near-daily everywhere a cow and a wolf can come together will break us all. There's no way to be held to that criteria."*

- *"I think it's the more people, more eyes that are out there, the more apt you are to see the problem or to be in the right place at the right time and intervene. And that happens with daily or near-daily. That's what is really irritating about one rider per allotment on 30,000 acres, it's a joke…even if you achieve daily or near-daily with one person per day, it's just random."*

4. Spatial and Temporal Coverage of Range Riders

Human presence has shown to be an effective deterrent for wolves, thus understanding whether range riders were active where wolves were active is a good indicator that their activity was likely reducing interactions with livestock. We found that NEWWCC and CPoW range riders tended to be in places where collared wolves and livestock were both present, suggesting that their presence was well-timed and well-targeted on the landscape—reducing the likelihood of wolf depredation on livestock.

Overlap Metrics

We found that range riders were present in the home range of nine wolf packs in 2021 and 2022, and 13 packs in 2023. In total, the individual programs covered a total of 31 active wolf pack territories from 2021-2023. In 2023, the 13 packs covered by the programs included a total of 85 wolves, while there were 50 wolves in 2022 and 51 wolves in 2021 (Figure 4). Note, these numbers include packs that were active multiple years (unique packs = 14), and often CPoW and NEWWCC were working within the same pack's territory. There were a minimum of 186 wolves over those three years.

Collectively, the range rider programs covered a total average area of 12,446 mi^2 per year according to rider MCPs. The area that the range rider programs covered increased by 117% over three years, from 7,594 mi^2 in 2021 to 16,504 mi^2 in 2023. CPoW and NEWWCC covered a substantial area within wolf packs' MCP home range over the three years. CPoW covered 2,848.5 mi^2 of active wolf home ranges in 2021 and 1980.9 mi^2 in 2022. This number rose four-fold in 2023, when CPoW covered 7,239.4 mi^2 of active wolf home ranges. NEWWCC riders covered 1,052.5 mi^2 of active wolf home ranges in 2021, 1,226.6 mi^2 in 2022, and, like CPoW, increased substantially to 5,223.8 mi^2 in 2023 (Figures 4 and 5).

In 2023, rider overlap with wolf home ranges was substantial, according to the Bhattacharyya coefficient overlap metric of AKDE ranges for individual riders and wolves. All riders overlapped with at least two collared wolves, with an average overlap with six collared wolves. It is important to note that our measure of overlap is likely conservative because not all wolves had GPS radio collars, thus it is likely that overlap with wolves was greater than what we report here. We were unable to calculate overlap during 2021 and 2022 because GPS tracking by NEWWCC was only used in 2023, but we speculate that overlap was similar in the first two years.

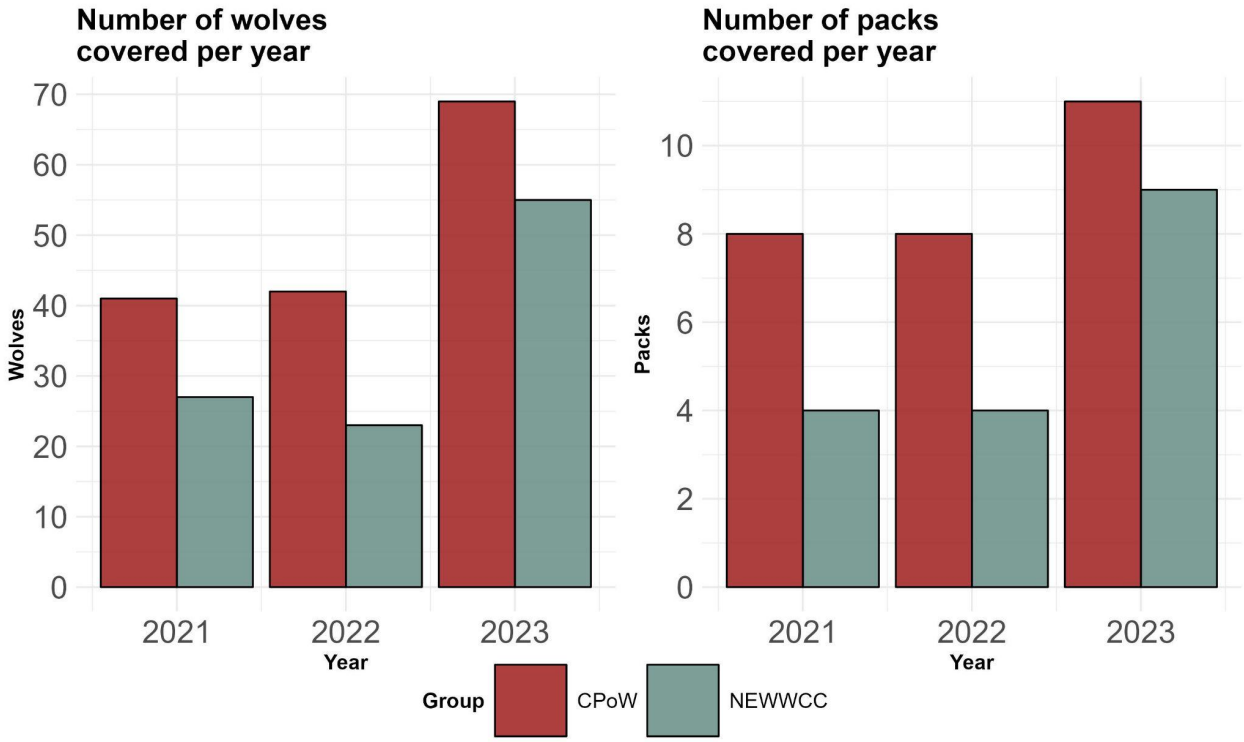

Figure 4. Number of GPS-collared wolves and number of known wolf packs covered by CPoW and NEWWCC range riders from 2021-2023. Red represents CPoW and teal represents NEWWCC. Note that some packs and wolves were covered by both programs.

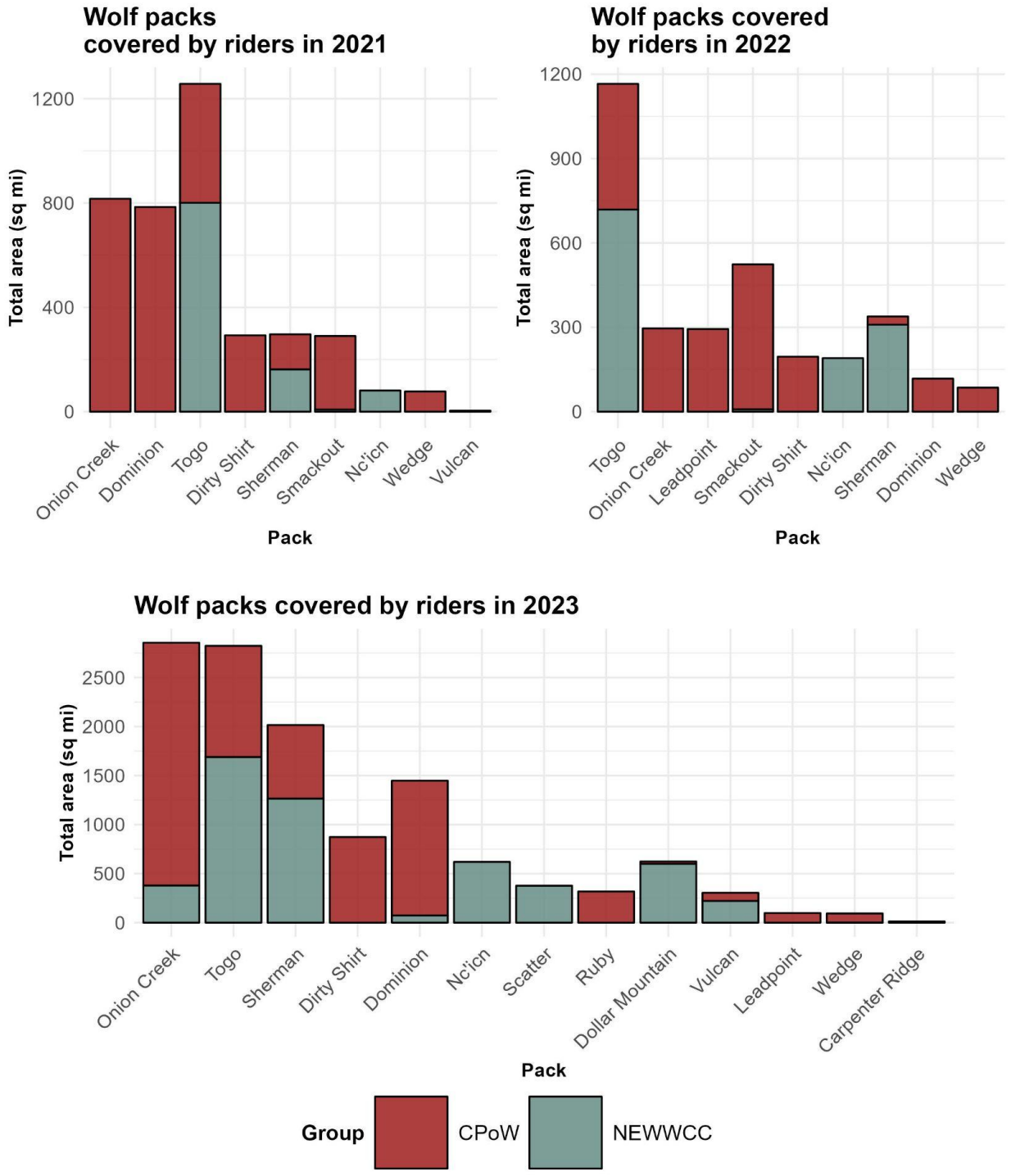

Figure 5. The total area (sq mi) of known wolf packs covered by the range riders from CPoW and NEWWCC from 2021-2023. Spatial coverage of range riders and wolf packs calculated using Minimum Convex Polygons (MCPs). Red represents CPoW and teal represents NEWWCC.

Visualizations

Heatmaps displayed considerable overlap between GPS locations of range riders and collared wolves from 2021-2023 (Figure 6). The distance between range riders and wolves is another indicator of whether range riders were in areas of high potential for interaction. For the three riders with the most coverage of any wolf pack, two riders had eight total locations within 0.62 miles (1.0 kilometer) of wolves (Figure 7).

Overall, these results suggest that riders were in an appropriate area to mitigate potential conflicts between wolves and livestock. Importantly, riders do not necessarily target areas of wolf activity but rather where cattle are concentrated. However, we did not have livestock location data for any operation and made the assumption that range rider GPS locations represented the producer and herds of interest. Moreover, there are uncollared wolves within the study area for which no location data are available. Nonetheless, overlap between riders and collared wolves is suggestive of the persistent possibility of interactions between wolves and cattle.

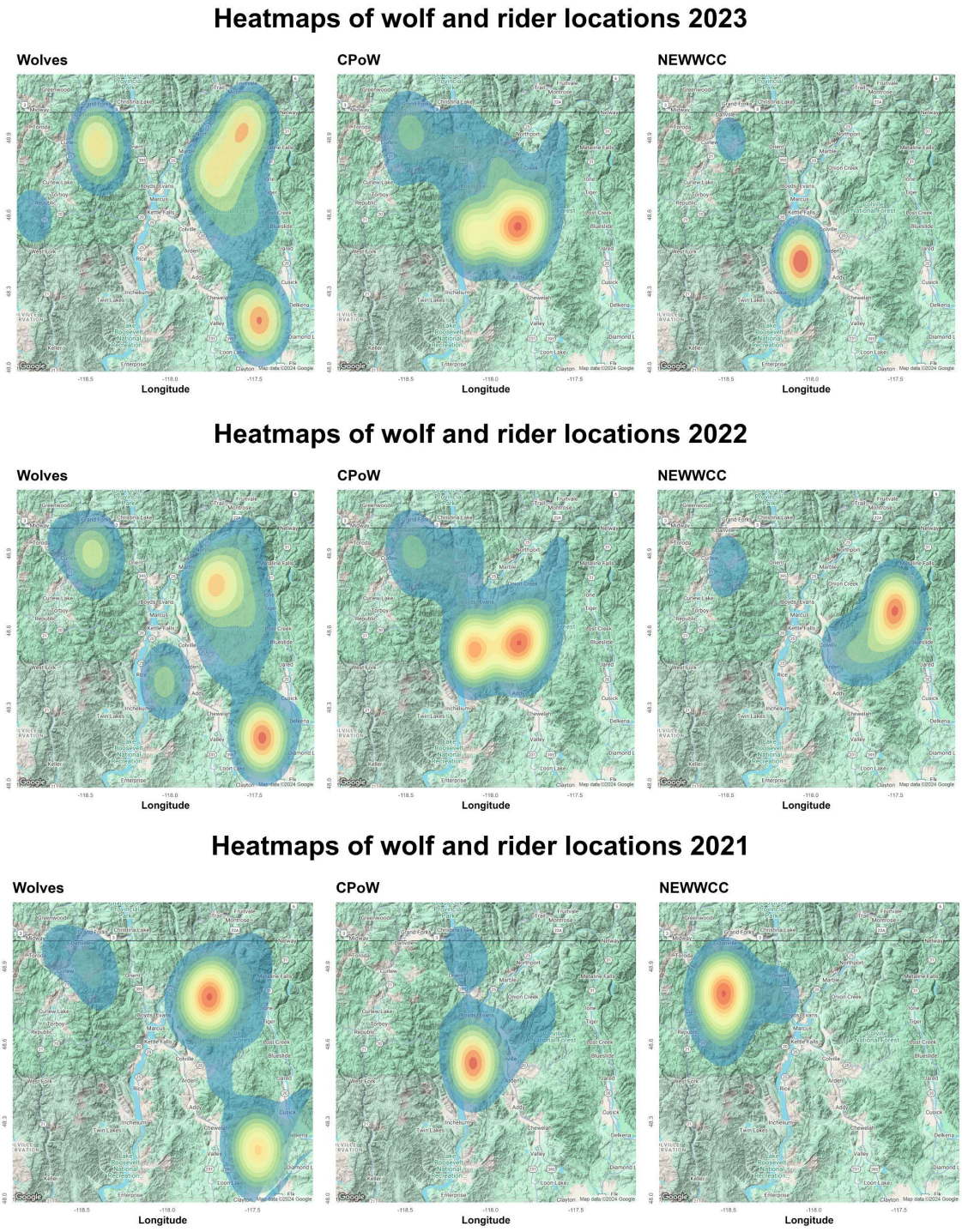

Figure 6. Heatmaps of GPS locations of range riders and collared wolves from 2021-2023. Red areas show a higher concentration of locations, while blue are lower concentrations. Heat maps were created using a kernel bandwidth of 0.35. Note there are likely additional, uncollared wolves moving through the study area.

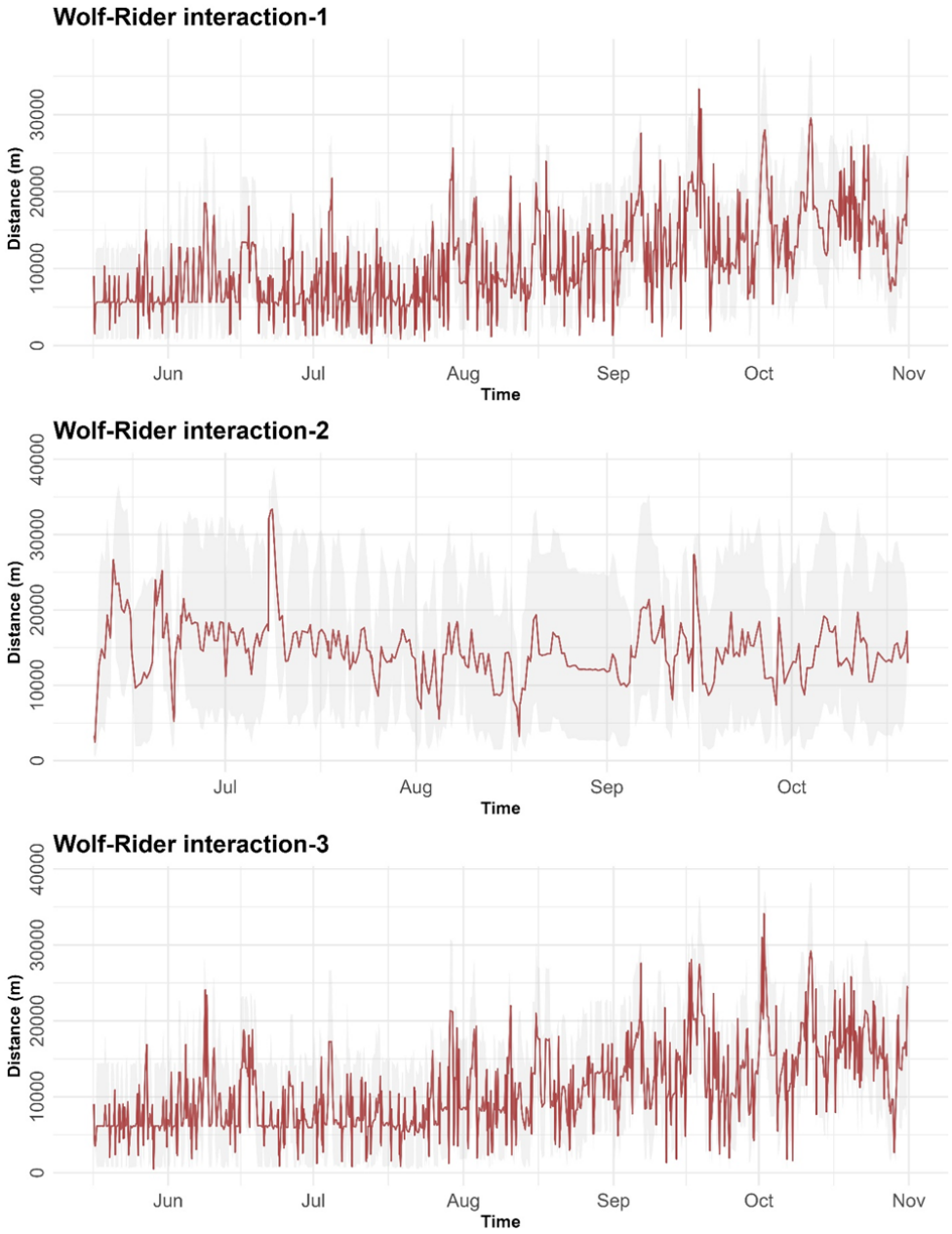

Figure 7. Interactions (time x distance) between the three riders with the most coverage of the closest GPS-collared wolf. The red lines represent the distance at each point in time between the rider and the wolf and the gray area is the confidence interval around the distance estimate.

5. Intent to Proactively Reduce Wolf-Livestock Conflict

We found that CPoW and NEWWCC made a concerted effort to carry out their range riding programs and activities with the intention of being proactive. Proactive efforts are important because they have the potential to minimize negative interactions between wolves and livestock that lead to economic impacts to ranchers, which may have indirect benefits on reduced lethal control actions on wolves and social strife between stakeholder groups (Brown, 2011). We

report two result types that demonstrate intent to proactively minimize wolf-livestock conflict, including range rider efforts and program design.

Range Rider Efforts

We assessed, on average, how often the range riders we interviewed completed important range rider activities while on range using activities from our *a priori* framework and knowledge, where average time represents how often the typical range rider engaged in the activity, from not at all to every time they rode, during the 2023 season. This demonstrates *intent* as these activities can help minimize livestock losses and can result in management actions to address conflict situations.

Of the various important activities that range riders should engage in, there are three activities we expect effective riders to use regularly (i.e., daily to near-daily): looking for carnivore sign and activity; looking for herd sign and activity; and observing cattle directly. The NE Washington range riders we interviewed reported engaging in these important activities, on average, every time they rode (Table 2).

The fact that the riders we spoke with conducted these activities each time they rode demonstrates clear intent to be proactive in preventing wolf-livestock conflict. It is particularly noteworthy that, on average, riders reported directly observing cattle 97% of the time they rode. Due to landscape conditions, riders may not be able to observe cattle directly every ride, despite efforts. Direct observation primarily includes assessing herd condition and behavior (normal, stressed, mothers separated from calves, etc.) and signs of injury.

Table 2. Percent time riders reported engaging in regular or as needed range rider activity, averaged across all range rider participants (n = 13)

Range Rider Activities	**Average percent time range riders reported engaging in regular or as needed activities**
Activities to be Completed Regularly	
Looking for wolf sign and activity	100%
Looking for herd sign and activity	100%
Observing cattle directly	97%
Activities to be Completed "As Needed"	
Communicating with the producer	85%
Operation-scale management	82%
Checking and placing field cameras	74%
Night riding	42%*
Hazing wolves	25%*
Carcass detection and sanitation	17%*
Managing or doctoring sick or injured cattle	14%*
Deploying other conflict reduction strategies	12%*
Sleeping in the herd overnight	1%*

*Note: these percentages are generally low as need for them is infrequent and should not be interpreted as neglect of duty or inattention by range riders.

There are other important range rider activities that should be conducted on an "as needed" basis (e.g., detecting sick or injured cattle). For these activities, conducting the activity every ride is not realistic, practical, nor advantageous. Moreover, several of these activities only occur when there are active conflict situations (e.g., hazing wolves).

The "as needed" activities that were performed most frequently (range 74%-85% of the time) included communicating with the producer, checking and placing field cameras, pre-season scouting, and other forms of operation-scale management (e.g., putting out salt, fixing fences, checking water tanks, etc.) (Table 2). The frequency by which riders communicate with their producer is dependent upon the preference of the producer. Some producers may want daily

updates, but many prefer that riders only communicate when a concern or issue arises. Similarly, riders and their associated producers will have a system for checking and placing game cameras and for whether producers prefer if their riders engage in management. For the latter, not all producers prefer their riders carry out such activities, but some will ask riders to perform relevant activities that help them "herd" cattle into predictable areas where they can be more efficiently monitored.

Additional activities that were conducted only when necessary (range 1%-42% of the time) included: night riding, which can be dangerous and typically only performed when the potential for conflict is high; hazing wolves, which is usually only needed when riders detect wolves in/around livestock or in the act of chasing or attacking livestock; deploying other conflict reduction strategies like fladry, fox lights, or rag boxes; carcass detection and removal (when feasible); managing or doctoring sick or injured cattle; and sleeping in the herd overnight, which is usually only done when wolf activity is high (Table 2).

Lastly, another important activity that the majority (n= 11) of the range riders reported doing was pre-season scouting. Pre-season scouting includes activities that support proactive efforts, such as gauging pre-turnout predator activity and behavior. Additionally, this allows range riders to assess water and forage conditions and clear roads and repair fences, which ensures rider access to livestock when they start for the season, and improves knowledge of where livestock may be concentrated on the landscape.

Program Design

CPoW and NEWWCC directors demonstrated their intent to deploy range riders to proactively minimize wolf-livestock conflict in a safe and effective manner through the careful consideration they gave to their program design. Additionally, their program designs allowed for adaptive management and flexibility to respond to potential and actual conflicts.

The primary design approaches that differed between the two programs include: 1) whether to pair or use single riders and 2) whether to hire producers to range ride their own allotments. Two additional approaches that participants reflected on as particularly important for an effective proactive program included: 1) the primary mode of travel riders are encouraged to use and 2) how to decide when and where to deploy riders. Below we expand our findings on these four program design components of proactive conflict minimization.

Perspectives on pairing riders. NEWWCC requires and pays their riders to ride in pairs while CPoW does not, though CPoW will allow riders to split the pay if they choose to ride in pairs. While both approaches allow for a successful range riding program, there are important benefits and trade-offs to consider. Our analysis of the tradeoffs between pairing-up or not is that, up to the time of this assessment, there is no clear evidence about whether pairing-up either increases or decreases the effectiveness of proactive efforts. Thus, leaving this to the discretion of the program directors, who understand the community-niche they fill, is appropriate.

Some participants in favor of pairing riders perceived that, by being able to work together, a team of riders can be more effective and efficient, suggesting *"you don't see everything by yourself"* and that *"if there was only one of us here, we'd only be seeing half of*

what we're seeing right now." Several NEWWCC riders shared that pairing riders is also an important safety concern, especially while on horseback, as rough and remote terrain, and unpredictable weather makes range riding inherently dangerous.

> The NEWWCC program director shared how the decision to pair riders was made, while also noting a trade-off: *"One of our riders… had an accident… She got airlifted out… and we just didn't want to go through that again or have anybody die out there. So, the board of directors decided that we would ride in teams. Sounds like a good idea, problem with it is it costs a lot, it doubles the cost."*
>
> One rider shared their experience with a serious injury incurred while riding: *"I would be dead or in a wheelchair, because I was stuck on the horse [and] I could not get off, if he [the rider partner] wouldn't have been with me, it's kind of personal for me, but I can't imagine… if my horse would have taken off, I would not have been able to stop her, control her."*

Participants that were not in favor of pairing riders, some of whom had worked in pairs in the past and some of whom had not, described the primary trade-offs as including increased costs, impracticality and inefficiency, and the risk of "box-checking" with no real benefit. Moreover, there is potential that pairing riders may limit the amount of ground riders can cover and, therefore, the coverage of potential wolf-livestock interaction areas.

For example, two participants expressed:

- *"I think pairs would be wonderful, but I don't know that the budget could ever handle anything like that."*

- *"Is it practical? No, because we have such a vast area to cover, and there's so few of us that pairing up is a huge waste… We have four allotments we have to cover, and we have X amount of people. Unless it's an extreme situation, pairing up is not practical at all."*

Perspectives on hiring producers to ride. Hiring personnel that can be effective from day one is critical for maintaining a proactive wolf conflict minimization program. One commonly discussed solution to the problem of hiring effective personnel is the idea of hiring livestock producers as range riders. NEWWCC will hire producers, or producer family members, as range riders to ride their own allotments while CPoW will not. Based on our analysis of this program and prior knowledge about range riding, we do not believe this decision will directly influence rider effectiveness, so long as riders have the necessary skills, training, and knowledge to complete the job.

Some participants believed a benefit to hiring producers is that these individuals know their allotments and cattle better than someone unfamiliar with the operation and range, and can therefore be more effective. This familiarity and knowledge may enhance riders' ability to more efficiently move on the landscape and identify if cattle are acting stressed or abnormally and, thus, to respond to potential or actual conflicts.

One producer/rider said *"There's nobody who knows that allotment better and nobody who knows if there's something wrong with the cattle better."*

Another producer/rider shared: *"I know my range. I know where the cows are going to be. I can be efficient and get to them when it's 105º like it has been… I know where the water sources are, I know if this cow is normally just, you know, crazy or if there's stress. I know that I've got marker cows that will live in [location redacted for anonymity] until there's too much pressure, and then she'll move out. I can read that."*

A potential trade-off shared by some of our participants is that producers should not be hired to ride their own allotments because it is already the producers responsibility to be out on allotment checking on their herd. Additionally, some suggested that a producer working as a rider may spend time doing tasks that would not typically fall under a range rider's purview given they may see other "producer" tasks that need to be completed while they are out.

One rider explained this perception saying: *"Producers have producer stuff to do, I've got range riding stuff, that's a good way to say it… There's some overlap there, yeah sure, there's times when they could be a range rider, but I think sometimes that line is pretty blurry to be honest, so I would probably say I'm not a fan."*

Perspectives on the effectiveness of various modes of travel. The mode of travel riders use is important to consider because it may influence the effectiveness of being proactive. Modes that are typically considered successful include horseback and motorized vehicles such as trucks and ATVs. Both NEWWCC and CPoW allow their producers and riders flexibility to choose the travel mode they see best for their riding, and many riders use more than one over the course of a week. Our findings suggest that allowing for flexibility in using a combination of these modes of travel depending on the situation and the preference and ability of each rider is beneficial to the overall program because this allows them to decide which approach will be most proactive in a given context.

Riders who used horses explained that they are effective for being able to more easily see wolf tracks, hear wolves, observe sign, and detect injured cattle or find carcasses. Being on horseback also allows riders to access more areas (e.g., off roads), particularly in dense brush and diverse terrain. Additionally, horses themselves can alert a rider to their environment and potential presence of wolves or livestock carcasses.

On this note, some participants indicated:

- *"...because when you move slower, you hear more, you see more."*
- *"I always ride… I want my hearing, I want my smell, I want all of that. And my horse to tell me what's happening."*
- *"Going out on horseback kind of gave that advantage, if there was anything dead out there, it was a lot easier to find it… going through and hitting all the cattle trails on a horse is a little bit better."*

For motorized vehicles, key benefits described include that riders can cover more ground, especially on large allotments, and that vehicles are better in some conditions.

On this note, some participants shared:

- *"...you can definitely cover more country motorized."*

- *"I do have a side by side too. When it was 100º I will use that for a couple hours in the afternoon."*

- *"...it's too muddy to take a horse… he [the rider] knows some of that country, and he can drive across it, and he can get out there and he can see it, and if he took the horse, the horse is getting stuck in the mud."*

Perspectives on deciding where and when to deploy riders. One of the most important decisions range riding programs need to make to ensure well-timed and placed proactive efforts is when and where range riders should move on the landscape. There are two main decisions that CPoW and NEWWCC make each field season. First for the season, CPoW and NEWWCC Directors decide which producers will get riders and how many they will have, and second, individual riders, in coordination with the program director and the producer they ride for, decide each ride how they will move on the landscape to respond to various potential and actual conflicts. Both of these support a proactive approach by accounting for where cattle are over the grazing season and how to adaptively adjust rider efforts as wolf pressure on cattle changes over time.

Through discussions with directors, producers, and riders from both programs we learned there is not one "right" way to make such decisions, rather, there are several factors that must be considered, each with their own benefits and trade-offs. For example, which producers get a rider (and how many) may be based on known wolf presence, past wolf conflict, allotment size, or cattle numbers. For both programs, it was important to have the ability to be flexible in these choices to maintain a proactive effort.

When focusing on wolf presence, there are three factors to weigh. The first is to consider historic wolf conflict consistently observed in a grazing area. The second is high wolf numbers that may increase the risk of depredation - though increased wolf presence does not necessarily guarantee increased conflict. The third is to respond to known livestock depredation events by moving riders to these locations in order to avoid additional conflict. The benefit of this approach is that riders, in some cases, may be prepared to prevent additional depredation events through other strategies, such as hazing, and will more quickly find injured livestock or livestock that have been chased by wolves.

> One rider shared: *"We focus on the ones [livestock] that are in the danger areas, mostly. I mean, that's where it's going to happen, if it happens. And so that's our goal, focus on those areas."*

However, there are several trade-offs with focusing on wolf activity regardless of allotment while riding. For example, moving riders to different locations or allotments to follow

wolf activity may not be effective since riders who are moved will be unfamiliar with the allotment terrain and the behavior and temperament of the herd, which may reduce their productivity.

Many participants suggested that deploying riders to focus on cattle presence and activity is also effective. Key benefits of this approach include that individual riders become familiar with their herd, allotment, wolves, and producer, enhancing their ability to quickly identify issues, communicate with the producer, and adapt their behavior towards an effective solution. A trade-off of this approach is that maintaining riders on one allotment and with one producer may decrease their ability to respond to conflict on other allotments when needed (e.g., when conflict increases in one area and riders need to be shuffled).

Regardless of the primary approach taken, it is important for producers and riders to maintain flexibility to adaptively respond to a given context. NEWWCC and CPoW participants used a combination of these factors when deciding where and when to deploy riders. One rider shared: *"We try to concentrate on the areas that we know the cattle are in, primarily, and then secondary is to go where we know that the wolves have been."*

6. Communication and Coordination Effort

We found that there was extensive coordination and communication across grantee programs and with relevant groups and entities during the 2021-2023 target assessment years. There were two primary types of coordination and communication efforts: 1) within the individual programs and 2) with external groups and entities. Within the individual programs, these efforts took place between: NEWWCC and CPoW; directors of these programs and their participating producers and range riders; producers and other producers; range riders and other range riders, and producers and their riders.

Coordination also included external groups and entities, including: the Wildlife Specialist from the Stevens and Ferry Counties' Sheriff Offices; Washington State Department of Agriculture (WSDA); Washington Department of Fish and Wildlife (WDFW); U.S. Forest Service; local conservation districts; and the Washington Wolf Advisory Group (WAG).

During the thematic analysis of interview data, we coded for each time participants described various coordination and communication efforts between these individuals, groups, and entities. Participants described the terms 'coordination' and 'communication' a total of 240 times. The most commonly described efforts were between the directors of NEWWCC and CPoW and their riders and producers; between producers and their riders; with the sheriff offices' Wildlife Specialist; and with WDFW (Table 3).

Table 3. The percentage that the terms coordination and communication were mentioned by participants within or between each program, group, or entity out of the total number of times those efforts were mentioned (n= 240).

Entity	**Percentage out of 240 mentions**
Within the Programs	
Between producers and riders	21.7% (n= 52)
Between directors and riders	15.8% (n= 38)
Between directors and producers	8.8% (n= 21)
Between NEWWCC & CPoW	6.3% (n= 15)
Between riders and riders	5% (n= 12)
Between Programs and External Entities and Groups	
Washington Department of Fish and Wildlife	23% (n= 55)
Wildlife Specialist; Stevens and Ferry Counties' Sheriff Offices	12.1% (n= 29)
Washington State Department of Agriculture	4.2% (n= 10)
U.S. Forest Service	2.5% (n= 6)
NW Conservation Districts	0.4% (n= 1)
Washington Wolf Advisory Group (WAG)	0.4% (n= 1)

While analyzing interview participants' discussions of coordination and communication amongst the relevant individuals, groups, and entities, we coded for the perceived quality of these efforts. We found that there were two types of perceived quality: 1) the perception that existing communication and coordination is positive and 2) the perception that communication and coordination needs improvement. We analyzed the percentage breakdown that each group was described as either type 1, *positively perceived coordination and communication* or type 2, *coordination and communication needs improvement* (Figure 8).

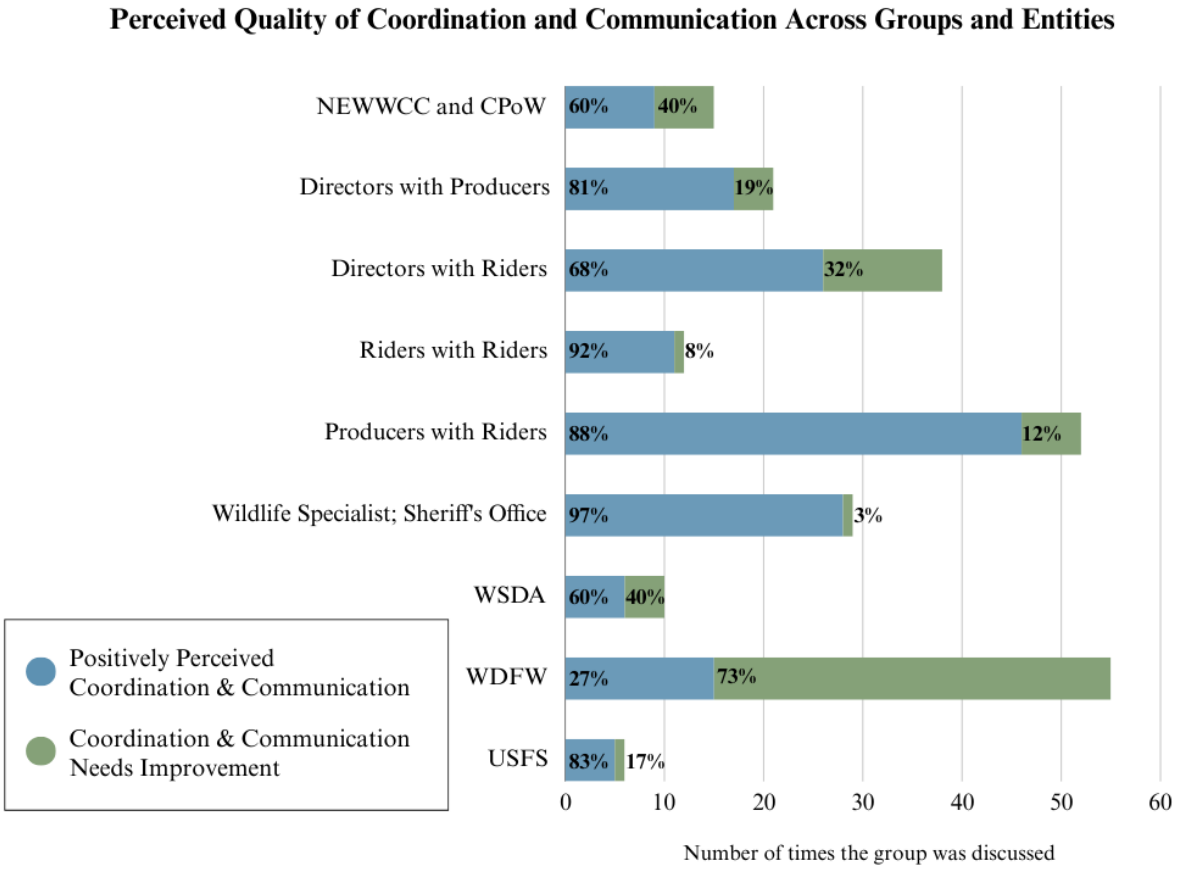

Figure 8. The percentage by which efforts of each group were described as either type 1, positively perceived coordination and communication (percentage reported on the blue portion of the bar) or type 2, coordination and communication needs improvement (percentage reported on the green portion of the bar), out of the total number of times that group was mentioned (each bar adds up to 100% of the times that group was discussed).

Positively Perceived Coordination and Communication

Six groups had highly positively perceived coordination and communication, with a range of 68%-97% of mentions coded as positive across the six groups (Figure 8). The most typical efforts described as positively perceived communication and coordination were those happening amongst individuals within each program, namely between riders and other riders; producers and their riders; and the individual program directors and their producers and their riders. This type of internal coordination and communication is critical for ensuring the success of these programs and, in turn, efforts to reduce wolf-livestock conflict. Therefore, it should be seen as a key metric of success that interview participants described the wide variety of coordination and communication efforts occurring within programs as highly positive.

For external groups, there were positively reported communication and coordination efforts with USFS and the Wildlife Specialist of the Stevens and Ferry County sheriff's offices. Those participants that discussed USFS positively shared they are easy to work with, particularly

for producers with Forest Service allotments and riders that need to ride or camp on forest service land.

The Wildlife Specialist employed by the sheriff offices serves a critical role in NE Washington as a connecting figure that facilitates communication and coordination throughout the region. Participants described the Wildlife Specialist as reliable and trustworthy and appreciated that he delivered timely and clear information to directors and producers. Participants shared that they appreciated having a "local anchor" to support their conflict prevention efforts, that they can come to this individual with concerns or issues, and that can help them communicate with the relevant agencies (e.g., WDFW and WSDA).

> For example, one producer said "*my first step would be to [call the Wildlife Specialist], not to the [WDFW] conflict guy*".
>
> Another participant stated: "*our riders are talking to him…He's sort of the trusted messenger.*"

Moderately Perceived Positive Coordination and Communication

Two entities had moderately perceived positive coordination and communication, with both entities having 60% of their mentions described as positive and 40% indicating there is room for improved coordination and communication efforts (Figure 8). These include efforts between NEWWCC and CPoW and of the individual programs with WSDA. For the communication and coordination efforts between NEWWCC and CPoW, participants described a history of tension and competition between these groups. However, most interviewees discussed that participants of these programs, namely the directors, have worked to improve relations and coordinate efforts to increase spatial coverage within the NE Washington region in the 2021-2023 seasons. The program directors continue to work towards improving coordination and communication, which we see as a success in continuing to advance the range riding programs and proactively prevent wolf-livestock conflict.

> One of the grant board members shared: *"The first go around, when we funded those guys, it was a little bit of a rocky back and forth. And then to [Director's name redacted for anonymity] credit, he kind of went to [Director's name redacted for anonymity] and was like, 'hey, you know what, we gotta not fight each other, we got to work together.' And they did. And so the next go around, basically we just split the funding down the middle between CPoW and NEWWCC and that went really good."*

For the WSDA, positive perceptions of communication and coordination included the perception that this entity delivers trusted information, they are flexible, and timely in addressing concerns and issues. Those that discussed that there is room to improve efforts primarily noted the department is new to being involved in wildlife issues and so there is a gap in their knowledge of the program, for example *"we have to sit back and say, department of AG is department of AG. And they're learning. It hasn't been that long, and they're not wildlife people, but they really are doing a good job."*

Coordination and Communication Needs Improvement

The only coordination and communication efforts consistently described as needing improvement (73% of mentions) were those between the participants of both programs with WDFW (Figure 8). Participants discussed a history of tension and discord with WDFW staff and with prior WDFW range riders that has damaged the trust and relationships NEWWCC and CPoW producers have with WDFW personnel. This has led to some program participants being uncomfortable with communicating and coordinating with WDFW personnel directly. Some of the participants that described attempts to directly connect with WDFW personnel stated concerns such as being unable to get in contact with a representative (particularly during necessary times like reporting a conflict or depredation) or perceiving a lack of transparency and clarity with WDFW policies and how decisions are made.

Some example points include:

- *"[Name redacted for anonymity] took over… she would not ever call you back, if you'd set up a meeting you'd get there and then she'd call and tell you, 'Oh, I'm tied up here'. It was a very poor experience."*

- *"Communication I think is probably the worst problem that we have with the game department."*

- *"...we can call into the game department, and they can give us updates, but that's a pain. It's hard to get a hold of them and they don't respond well. It's just, it's not worth it."*

- *"The communication is not good between Fish and Game and the producers, and it's not good between Fish and Game and the range riders. Like, they definitely seem to be kind of off in their own world, and we're all expected to jump through these hoops, which happens, but then Fish and Game can drop the ball, and then it's like this whole thing is fruitless. So if there's a policy change, I think it needs to be with them to make sure that they're actually doing their due diligence…to actually get us the information we need so that we can do our jobs effectively."*

It is important to note that we only heard from program participants on this issue and thus are not able to share the complementary perspectives from WDFW personnel on their perspectives of coordination and communication efforts with NEWWCC and CPoW participants. Additionally, we did learn that there are efforts led by WDFW, including a regular virtual check-in meeting during grazing seasons with invitations to the program directors and various other relevant stakeholders (e.g., USFS and WSDA personnel).

Program Recommendations and Considerations

Overall, we found that CPoW and NEWWCC effectively implemented their range rider programs through a community-based approach to provide sufficient spatial and temporal coverage while demonstrating the intent to proactively reduce wolf-livestock conflicts. Below, we provide several recommendations based on our identification of the successful elements of the programs and areas for improvement. Our recommendations are based on our own professional experience with range riding and the perspectives of those we interviewed. Our recommendations fall into three categories including: 1) program design, 2) funding, 3) communication and coordination.

Program Design

We recommend maintaining the current structure of the program, in particular the community-driven model and the degree of flexibility and autonomy afforded to the program directors. The community-driven model of this program has built trust, local ownership of deploying conflict prevention strategies, and has enhanced participation by livestock producers.

The program director's autonomy and flexibility in making design and operational decisions have improved community acceptance of range riding and contributed to the success of these programs. We recommend that decisions, such as hiring range riders, whether to ride in pairs, deployment strategies for riders, and whether to hire producers as riders, should remain under the program's authority. This approach allows programs to adapt to unique community needs, ultimately enhancing coverage and effectiveness of range riding in NE Washington.

We recommend maintaining the 2023 standard for GPS tracking of range rider activity and monthly reporting to WDFW. GPS tracking offers multiple advantages from a programmatic standpoint. First, it effectively documents compliance with contractual obligations such as meeting the daily to near-daily requirement. From a programmatic standpoint, this ensures transparency between the range rider groups and state agencies and several range riders reported appreciating this requirement because they are able to clearly document that they have met all program requirements. Further, GPS points provide opportunity for a data-driven evaluation of whether range riding can alter the spatiotemporal patterns of wolves when combined with GPS collars on those wolves.

We recommend that CPoW and NEWWCC consider having their new riders take part in a formal range riding training, in addition to the training provided by each NGO. This would allow riders to learn from one another and help ensure that all riders are operating with consistent fundamental knowledge and skill sets. This will help increase trust between riders and increase effective coordination of their efforts. For example, training can standardize tasks already done by NEWWCC and CPoW, such as how to identify wolf sign and other predator sign, assess livestock herd health conditions, and how to best document and report activities to meet administrative program requirements.

We recommend that range riders record the behavior of wolves when they encounter them. Recording wolf behavior could be used as a future indicator for determining individual rider and overall range rider program effectiveness and if new procedures need to be implemented to adapt

to wolf behavior. For example, if wolves become more comfortable around riders over time, noting this could indicate a need for riders to diversify their approaches and activities.

Funding

We recommend retaining the current funding distribution model where funds are sent to WSDA then distributed to a local board of community decision-makers to approve grantees. Additionally, we recommend that increased funds are allocated to this program, particularly given: 1) the wolf population has increased on average 23% per year since 2008 (WDFW, 2024); and 2) WDFW's policies require daily to near-daily range riding efforts in herds facing repeat wolf conflict to qualify for various wolf management activities.

The daily to near-daily requirement is important for ensuring proactive wolf-livestock conflict prevention efforts (Fowler et al. 2019). While the groups are complying with this requirement, the scale of operations, allotments, and wolf movements makes ensuring high quality range riding difficult. Increasing funding can facilitate hiring more riders and shift from just meeting requirements to providing higher quality conflict mitigation.

Further, directors from both NEWWCC and CPoW highlighted a growing demand among livestock producers in Northeast Washington to enroll in their programs and deploy range riders on their allotments, a demand that exceeds current funding levels. Increased funds could also allow for funding to be allocated to operational needs and administrative support for the individual programs, further enhancing their efficiency and effectiveness.

We recommend that range rider pay should increase. Effective range riders require a suite of knowledge and skills. Yet, given the seasonality and uncertainty of the job, it is a challenge to recruit and retain quality range riders. To recruit and maintain range riders over multiple seasons, we recommend that range rider compensation is increased to help retain riders who have developed significant skill sets. Maintaining a pool of skilled range riders would help increase sustainability of the programs into the future.

The programs face several challenges in hiring and paying their range riders related to biennial budget processing aligning with fiscal years and the WSDA invoicing process. These challenges have resulted in both NEWWCC and CPoW requiring outside funding sources (e.g., loan) to pay riders on time before WDSA funds come available, which is administratively taxing for both directors and riders. To address the first challenge, we suggest exploring options to align the grant funding cycle with the grazing season to provide greater continuity. For example, options could include exploring the feasibility of fiscal adjustments that allow grants to span partial fiscal years to align with grazing seasons, or establishing a bridge funding mechanism that ensures uninterrupted support during the transition between fiscal years. This could involve setting aside a portion of funds from the first fiscal year to cover the start of the grazing season in May of the second year until the new grant cycle begins in July.

We also suggest streamlining the invoice processing workflow within WSDA and/or establishing a fast-track system for rider payments to prioritize their compensation to address the concern across program participants about the delays in paying range riders. These changes should focus on process enhancements that do not require legislative adjustments but can

significantly improve payment speed and rider satisfaction, potentially considering existing software platforms that expedite payments.

We recommend allowing for flexibility in the funding allocations in the grants for programs to factor in operational funds and administrative support for tasks such as payroll, general accounting, and grant reporting support. This will help support more efficient and in-depth administrative procedures within each program, thus supporting better reporting, management of range riders, and coordination.

We recommend the grant advisory board clarify eligibility for grant awardees by developing and providing clear evaluation criteria related to, for example, if an NGO must be composed of several producers or if an individual can qualify. Clarifying such criteria will improve the overall program by ensuring applicants design effective programs and that NE Washington has well placed and coordinated range rider programs.

Coordination and Communication

We recommend retaining the Wildlife Specialist position, housed with the Ferry and Stevens county sheriff offices, as this individual was widely perceived as beneficial. Participants viewed this trusted "local anchor" as a vital liaison between producers and agencies (e.g., WSDA and WDFW) and is a central figure that supports the extensive coordination and communication efforts amongst relevant actors in NE Washington.

We recommend that CPoW and NEWWCC continue to make concerted efforts to strengthen their relations and coordinate their rider deployment. While interview participants noted clear improvements in the relationships and coordination since the inception of the program in 2017, given the importance of the two programs in filling community niches and ensuring the intent to proactively prevent wolf-livestock conflict by producers and range riders, coordination of their efforts is crucial to the success of the overall program. Thus, we suggest program directors continue to identify further opportunities to enhance their coordination of rider deployment and landscape coverage.

We recommend that effort be taken to improve communication between WDFW and livestock producers, particularly as wolf numbers continue to expand. For example, program participants expressed a desire for more clarity around expectations for lethal control of wolves when livestock depredations occur, and more timely responses to producers that report wolf conflict and livestock losses. Livestock producers expressed the sentiment that participating in the program and meeting the daily to near-daily expectation was hard work. They felt that this represented a good faith effort on their part and from their perspective, that WDFW could respond more consistently in cases when lethal control actions are perceived warranted by livestock producers.

Finally, we recommend that a new forum be established to enhance communication and coordination among all program participants at the regional scale in NE Washington, in particular with NEWWCC and CPoW participants, the sheriff offices' Wildlife Specialist, and representatives from WDFW and WSDA. We recommend this forum be facilitated by a third party to be effective. This forum could be convened at the beginning and end of each annual

grazing season to help clarify or update any wolf management policies, strategize improved coverage, and address any challenges. Such a forum may facilitate collective learning, improve trust, and improve range rider practices.

Conclusions

The Northeast Washington Wolf-Livestock Management Program has demonstrated success during the 2021-2023 grazing seasons. Both CPoW and NEWWCC effectively met program requirements and carried out their respective efforts in a proactive and timely manner.

The community-based structure of the program enhanced participation and trust among local producers and range riders, with over 6,151 rider days recorded during the study period. Participants highlighted the program's flexibility in addressing local needs and fostering strong collaboration within the community. To ensure the continued success and long-term sustainability of the NE Washington Wolf-Livestock Management Program, we recommend maintaining its current structure while exploring opportunities for increased financial investment. Allocating additional funding would support the expansion of range rider teams, further enhancing spatial and temporal coverage across northeast Washington. Strengthened coordination between CPoW, NEWWCC, and WDFW, alongside improved administrative processes, will also be critical for future success. The broad support among local producers for these programs highlights their value as a trusted and effective tool for conflict prevention.

Range riders met or exceeded daily to near-daily monitoring expectations, with an average of 152 rider days during grazing seasons from 2021-2023, surpassing expectations of a minimum of four days per week during the summer grazing season. Range riders effectively documented their activities and coordinated their efforts to align with wolf pack presence. In 2023, rider overlap with wolf home ranges was substantial; all riders overlapped with at least two collared wolves, with an average overlap with six collared wolves. Both programs expanded their spatial coverage significantly, covering portions of up to 13 wolf pack territories by 2023 representing a 117% increase in areas covered during assessment years. This success underscores the importance of maintaining the program’s community-driven structure, flexibility, and autonomy, which have been key to its widespread acceptance and operational, on-the-ground achievements in NE Washington.

The NE Washington Wolf-Livestock Management Program is a successful community-based approach that helps foster coexistence between wolves and livestock. While the program has achieved substantial progress in implementing range rider efforts, continued investment, refined administrative processes, and strengthened coordination between CPoW and NEWWCC and with WDFW will ensure long-term sustainability and effectiveness. With ongoing support and investment, this program can continue to serve as a model of community-based wolf-livestock management that balances the needs of livestock producers and supports healthy wolf populations.

References

Boitani, L. (2003). Wolf conservation and recovery. In: Mech LD, Boitani L (eds) Wolves: behavior, ecology, and conservation. The University of Chicago Press, Chicago, pp 317–340.

Brown, Peter Douglas. (2011). Wolves and Livestock: A review of tools to deter livestock predation and a case study of a proactive wolf conflict mitigation program developed in the Blackfoot Valley, Montana. *Graduate Student Theses, Dissertations, & Professional Papers*. 1193. https://scholarworks.umt.edu/etd/1193

Calabrese, J. M., Fleming, C. H., & Gurarie, E. (2016). ctmm: an R package for analyzing animal relocation data as a continuous-time stochastic process. *Methods in Ecology and Evolution*, *7*(9), 1124–1132.

Creswell, J. W., & Guetterman, T. C. (2019). Educational research: Planning, conducting, and evaluating quantitative and qualitative research. Pearson Higher Ed: New York.

Dedoose Version ***9.0.107***, cloud application for managing, analyzing, and presenting qualitative and mixed method research data ***(2023)***. Los Angeles, CA: SocioCultural Research Consultants, LLC www.dedoose.com.

Granner, M. L. & Sharpe, P. A. (2004). Evaluating community coalition characteristics and functioning: A summary of measurement tools. *Health Education Research, 19*(5), 514-532.

Hebblewhite, M., White, C.A., Nietvelt, C.G., McKenzie, J.A., Hurd, T.E., Fryxell, J.M., Bayley, S.E., & Paquet, P.C. (2005). Human activity mediates a trophic cascade caused by wolves. *Ecology, 86*, 2135–2144.

Fleming, C. H., & Calabrese, J. M. (2017). A new kernel density estimator for accurate home-range and species-range area estimation. *Methods in Ecology and Evolution, 8*(5), 571–579. https://doi.org/https://doi.org/10.1111/2041-210X.12673

Fleming, C. H., Fagan, W. F., Mueller, T., Olson, K. A., Leimgruber, P., & Calabrese, J. M. (2015). Rigorous home range estimation with movement data: A new autocorrelated kernel density estimator. *Ecology, 96*(5), 1182–1188. https://doi.org/https://doi.org/10.1890/14-2010.1

Fowler, N.L., Belant, J.L. & BEyer, D.E. (2019). Non-linear relationships between human activities and wolf-livestock depredations. *Biological Conservation, 236*, 385-392. https://doi.org/10.1016/j.biocon.2019.05.048

Kahle, D. J., & Wickham, H. (2013). ggmap: spatial visualization with ggplot2. *The R Journal, 5*(1), 144.

Jung, G. K., Oh, J., Jung, Y., Sun, J., Kong, H. & Lee, U. (2021). "Good enough!": Flexible goal achievement with margin-based outcome evaluation. In CHI Conference on Human Factors in Computing Systems (CHI '21), May 8–13, 2021, Yokohama, Japan. ACM, New York, NY, USA, 15 pages. https://doi.org/10.1145/3411764.3445608

Mickwitz, P. (2003). A framework for evaluating environmental policy instruments: Context and key concepts. *European Evaluation Society, 9*(4), 415-436.

Muhly TB, Semeniuk C, Massolo A, Hickman L, & Musiani, M. (2011). Human activity helps prey win the predator-prey space race. *PLoS ONE 6*(3):e17050.

Nordli, K., Wabakken, P., Eriksen, A., Sand, H., Wikenros, C., Maartmann, E., & Zimmermann, B. (2023). Spatial and temporal cohesion of parents and offspring in a social large carnivore. Animal Behaviour, 197, 155–167. https://doi.org/https://doi.org/10.1016/j.anbehav.2022.12.006

Oliveira, T., Treves, A., Lopez-Bao, J. V. & Krofel, M. (2021). The contribution of LIFE program to mitigating damages caused by large carnivores in Europe. *Global Ecology and Conservation, 31*, e01815.

Otter.ai. https://otter.ai/

Parks, M., & Messmer, T. (2016). Participant perceptions of Range Rider Programs operating to mitigate wolf–livestock conflicts in the western United States. Wildlife Society Bulletin, 40(3), 514–524. https://doi.org/https://doi.org/10.1002/wsb.671

R Core Team. (2022). R: A Language and Environment for Statistical Computing.

Saldaña, J. (2016). The coding manual for qualitative researchers. Sage Publications Ltd.

Tilberg, M., & Dixon, P. M. (2022). Statistical inference for the utilization distribution overlap index (UDOI). *Methods in Ecology and Evolution, 13*(5), 1082–1092. https://doi.org/https://doi.org/10.1111/2041-210X.13813

Washington Department of Fish and Wildlife. (2020). Wolf-livestock interaction protocol. Accessed 11/16/2024. https://wdfw.wa.gov/species-habitats/at-risk/species-recovery/gray-wolf/conflict-prevention

Washington Department of Fish and Wildlife. (2020). 2021-2023 wolf pack home ranges. Accessed 8/1/2024. https://hub.arcgis.com/datasets/wdfw::wolf-pack-polygons-all-years/about

Washington Department of Fish and Wildlife, Confederated Tribes of the Colville Reservation, Spokane Tribe of Indians, Yakama Nation, Swinomish Indian Tribal Community, and U.S. Fish and Wildlife Service. (2022). Washington Gray Wolf Conservation and Management 2021 Annual Report. Washington Department of Fish and Wildlife, Ellensburg, WA, USA.

Washington Department of Fish and Wildlife, Confederated Tribes of the Colville Reservation, Spokane Tribe of Indians, Yakama Nation, Swinomish Indian Tribal Community, and U.S. Fish and Wildlife Service. (2023). Washington Gray Wolf Conservation and Management 2022 Annual Report. Washington Department of Fish and Wildlife, Ellensburg, WA, USA.

Washington Department of Fish and Wildlife, Confederated Tribes of the Colville Reservation, Spokane Tribe of Indians, Yakama Nation, Swinomish Indian Tribal Community, and U.S. Fish and Wildlife Service. (2024). Washington Gray Wolf Conservation and Management 2023 Annual Report. Washington Department of Fish and Wildlife, Ellensburg, WA, USA.

Wells, S.L., McNew, L.B., Tyers, D.B., Van Manen, F.T., & Thompson, D.J. (2019). Grizzly bear depredation on grazing allotments in the Yellowstone Ecosystem. *J Wild Mng. 83*, 556–566.

Wilson, S.M., Bradley, E.H., Neudecker, G.A. (2017). Learning to live with wolves through community-based conservation: A case study in the Blackfoot Valley of Montana. *Hum-Wild Inter, 11*, 245–257.

Winner, K., Noonan, M. J., Fleming, C. H., Olson, K. A., Mueller, T., Sheldon, D. & Calabrese, J. M. (2018). Statistical inference for home range overlap. *Methods in Ecology and Evolution, 9*(7), 1679–1691. https://doi.org/https://doi.org/10.1111/2041-210X.13027

Appendix A – Qualifications of Evaluation Team Members

Dr. Mireille Gonzalez (project co-lead / project manager)

CSU Center for Human-Carnivore Coexistence - Co-Director & Research Associate - 2023-Present

- Co-director and research associate for the CSU Center for Human-Carnivore Coexistence (CHCC). The CHCC, an academic institution housed at Colorado State University, is focused on integrating transformative science, education, and outreach to reduce conflict and facilitate coexistence between humans and carnivores.
- As Co-Director, manages the CHCC's diverse programs across education, research, and outreach efforts.
- As research associate, conducts research exploring social contexts of human-carnivore conflict including wolves in the American west, leopards in India, and jaguar and puma in Brazil. Current research includes investigating Colorado ranchers' perspectives about non-lethal livestock protection approaches in order to understand motivations and barriers for implementing approaches.
- Leads community outreach and education events about reducing direct conflict between wolves and livestock and between people about wolves.

Colorado Conflict Reduction Group - Program Manager - 2021-Present

- Coordinates monthly meetings and annual workshops amongst the diverse actors engaged in wolf conflict reduction in Colorado, including agency representatives from Colorado Parks and Wildlife, Colorado Department of Agriculture, and USDA Wildlife Services; academic researchers; representatives from environmental NGOs such as Defenders of Wildlife, the Western Landowners Alliance, and the Rocky Mountain Wolf Project; and Colorado producer representatives.
- Leads the Wolf Conflict Reduction Fund committee. The effort includes soliciting donations in order to provide funds to producers to implement non-lethal livestock protection approaches to minimize conflict with wolves in Colorado.
- Leads a subcommittee of the key actors in Colorado who will develop and define range riding programs and trainings for the state (see actors listed above).

Program Evaluation Experience

- Engaged in several program evaluations, including:
    - working with Colorado Parks and Wildlife on an NSF funded research program to assess social outcomes (e.g., increased acceptance of management decisions, reduced social conflict) of their stakeholder and public engagement process for developing the Wolf Restoration and Management Plan;
    - evaluating the CHCC's outreach efforts such as rancher workshops and public educational events;
    - evaluating the impact of a conservation voluntourism and citizen science program on participants perceptions toward the environment and science.

Social Conflict Researcher and Mediator

- Experienced conflict mediator, trained in facilitation and stakeholder engagement design by the Center for Public Deliberation during a two-year period as a Senior Associate.

- Conducts social-psychological research on the drivers of social conflict about wolves by bringing in theory from conflict and peace-building fields to identify conflict reconciliation interventions.
- Runs social conflict reduction events including bringing urban wolf advocates together with livestock producers and rural community members to build common ground.

Dr. Seth Wilson (project co-lead)

Blackfoot Challenge - 2006-present

Developed and managed the first range rider efforts in Western Montana for the Blackfoot Challenge, 2006-2015.

- Recruited, hired, and trained range riders within a community-based framework.
- Worked directly in the field with range riders to develop the overall program.
- Worked closely with state/federal wildlife managers and livestock producers to develop an overarching range rider protocol. Methods that were developed included:
    - VHF telemetry use (privacy, environmental ethics/wolves, etc.)
    - Livestock herd health surveillance metrics
    - Prevention tool metrics
    - Human presence and herd supervision rate metrics
    - Overall monitoring of wolves and livestock at the landscape-scale
- Developed communication protocols for working with livestock producers/partners.
- Reviewed and edited Annual Range Rider Reports and bi-weekly range rider reports.
- Evaluated annual performance of range riders through journal/log reviews, interviews.
- Evaluated effectiveness of range rider prevention efforts with confirmed and suspected livestock depredation spatial data provided by MT Fish, Wildlife and Parks.
- Communicated field season results to approx. 150 interested parties.
- Published article describing range rider effort in *Human-Wildlife Interactions* in 2017.
- As Executive Dir. of the Blackfoot Challenge, 2019-pres. supervise 11 employees, including the Wildlife Program Coordinator; support/evaluate current range rider efforts.

Montana Livestock Loss Board - Member and Chair - 2013-2020

- As a gubernatorial appointee and Chair of the Livestock Loss Board, provided leadership and oversight of the program that provides compensation for livestock losses to grizzly bears, wolves, and mountain lion.
- Provided oversight and helped develop the Prevention Loss Grant Program, a competitive grants program that includes range riders for funding.
- Developed prevention loss application for grant applicants and eligibility criteria.
- Reviewed all grant applications for possible award of state funds.
- Conducted a spatial analysis published in the *Journal of Wildlife Management* in 2018 with MT FWP of livestock to establish a chronicity index of wolf-livestock conflict hotspots in Montana to guide prospective applicants in areas with the greatest need.

People and Carnivores - 2011-2015

- As a co-founder of the NGO, People and Carnivores, helped develop and extend range rider efforts to other landscapes of Montana (Big Hole Valley, Granite Co., Madison Valley) and Northeast Washington at the invitation of Conservation Northwest.

- Developed first "Range Rider Rendezvous" meetings to share lessons and improve collective professional practices for range riders and partners in MT and WA.

Rae Nickerson (doctoral candidate)
Utah State University – Doctoral Student – 2021-present

- PhD student on the Conflict on Working Lands Conservation Innovation Grant (CIG) researching the effectiveness of range riding at reducing direct and indirect livestock losses associated with wolf and grizzly bear conflict.
- Works directly with producers and range riders to collect data from over 15 ranches across the west (Washington, Oregon, Montana, New Mexico, and Arizona). Methods and metrics include conducting interviews, analyzing rider logs/forms, spatial analysis of predator and rider location data, camera trap deployment to capture predator and cattle behavior/activity, collaring cows with VHF and monitoring rider use of telemetry, and analysis of cow hair samples for cortisol and thyroid function.
- Lives and works with producers and range riders in the field and works to build trust and relationships in order to coproduce an understanding of range rider effectiveness.
- Communicates and partners with state and federal wildlife agencies, tribes, NGOs, and various rider cooperatives.
- Organizes and facilitates workshops west-wide on wolf-livestock conflict focused on actionable solutions using range riding as a nonlethal-tool

Colorado State University – Masters Student – 2019-2022

- Master's research included qualitative and quantitative methods to identify what motivates wolf depredation reporting by livestock producers and what an ideal compensation program would look like (including support with nonlethal tools like range riding).

Relevant Experience

- Member of the Conflict Reduction Consortium, Western Landowners Alliance
- Worked with livestock producers across the west to identify policy needs for improving access to various nonlethal tools including range riding
- Attended range rider clinics that included low stress livestock handling with Hilary Anderson in Tom Miner Basin with Western Sustainability Exchange and Whit Hibbard with Western Landowners Alliance at the Hanson Ranch, California.
- Seasonal employee with the Washington Department of Fish and Wildlife:
    - worked with producers to implement deterrent measures to reduce wolf-livestock interactions and depredations (fladry, hazing, etc.);
    - trapped problem wolves around the Colville, Chewelah, and Kettle areas and conducted depredation investigations;
    - assisted range riders with monitoring allotments/riding.
- CSA Intern with the Mexican Wolf Program (U.S. Fish and Wildlife Service) responding to wolf-livestock conflict, trapping and monitoring wolf activity and population, and participating in a large, interagency management team.

Technician with the Oregon Department of Fish and Wildlife trapping and monitoring wolf populations and assisting with DNA identification.Conservation Northwest Intern - wrote a Grey Wolf Sensing Report for the southern recovery zone of the South Cascades in Washington State

Matthew Hyde (doctoral candidate during first half of assessment, PhD graduate in second half)
Colorado State University – Doctoral Student – 2021-present

- PhD Candidate and Graduate Research Assistant for the Center for Human Carnivore Coexistence
- Conducts interdisciplinary research evaluating the local and landscape-level efficacy of nonlethal strategies to reduce livestock depredation from large carnivores in the Western United States and Colombia.
- Collaborates with the Conservation Innovation Grant "Conflict on Working Lands" with a network of NGOs, USDA Wildlife Services and ranchers.
- Liaisons with ranchers to co-produce relevant research questions and collaborative processes of data interpretation.

Panthera Colombia – 2018-2021

- South American Corridor Partnerships lead
- Managed three projects (~$350,000 annually) for big cat conservation, with a regional scope of four countries (Brazil, Peru, Colombia, Chile) and a team of 4-9 researchers.
- Implemented anti-predator strategies and conservation agreements in 18 livestock ranches with a total 52,000 hectares (128,000 acres).
- Designed and supervised five camera trap studies, totaling over 7,000 trap/nights in three countries.
- Developed relationships and liaised with international partners, regional and national governments and local non-profits to create and implement projects in Colombia, Chile, Peru and Brazil.

Mexican National Forestry Commission and Peace Corps – NRM Specialist/Project Coordinator – 2014-2017

- Implemented and expanded a community-based monitoring network for medium and large mammals in the states of Jalisco and Nayarit. The monitoring network identified 4 endangered species including jaguars, 2 threatened species and 26 other species.
- Contributed to Mexico's National Strategy for Biodiversity Mainstreaming in the Forest Sector 2016-2022, specifically in monitoring and evaluation of biodiversity in conservation programs through the integration of a community-based adaptation of the national methodology.
- Created the qualifying model for Payments for Ecosystem Services for communities in Mexico according to 15 criteria defined by the Forestry Commission. Through habitat parameters and GIS models, delineated a jaguar conservation corridor in Western Jalisco together with the Alianza Nacional para la Conservación del Jaguar.

Cole Purdy (doctoral candidate)
Colorado State University – Graduate Student – 2022-present

- PhD Candidate and Graduate Research Assistant for the Center for Human Carnivore Coexistence
- Conducts social and ecological research about human-wildlife conflicts, including related wolf reintroduction in Colorado.

- Deep experience with qualitative analysis methods (the portion of the assessment he contributed to).

Dr. Julie Young

USU Department of Wildland Resources - Associate Professor - 2010-Present

- Associate professor in the Department of Fish, Wildlife, and Conservation Biology at Utah State University.
- Director, Berryman Institute for Wildlife Damage Reduction, Utah State University.
- Conducts research on carnivore and beaver ecology with an emphasis on animal behavior and mitigation strategies for human wildlife conflict.
- Served as head of US delegation on international humane trapping standards (2011-2013)
- Recently completed a 3-year project funded by USDA-NRCS that involved a variety of NGOs and state management agencies. This work focused on implementing and monitoring range riding across many western states and resulted in an additional 22 million becoming available for a diversity of states through NRCS.

USDA-Wildlife Services-National Wildlife Research Center- Supervisory Research Wildlife Biologist - 2010-2021

- Created tools and technology for USDA-APHIS-Wildlife Services to reduce conflict between carnivores and people.

Dr. Stewart Breck

USDA-Wildlife Services-National Wildlife Research Center- 2001-Present

- Research Wildlife Ecologist responsible for developing and evaluating tools and techniques for reducing human-carnivore conflict. This work is conducted throughout the U.S. and includes a variety of carnivores in diverse systems.
- Recently evaluated a range riding program that resulted from new Congressional funding for Wildlife Services aimed specifically at nonlethal wolf and grizzly bear management.
- Recently completed a 3-year project funded by USDA-NRCS that involved a variety of NGOs and state management agencies. This work focused on implementing and monitoring range riding across many western states. Our work resulted in an additional 22 million becoming available for a diversity of states through NRCS.

CSU Center for Human-Carnivore Coexistence - Director - 2021-Present

- Co-founder and a current external leader to help facilitate collaboration and integration of agency and academic approaches for reducing conflict by predators, including wolves in the western United States.

IUCN Bear Specialist Group - Human-Bear Conflict Specialist Team 2018-Present

Member assisting partners across the globe to enhance coexistence with multiple bear species.

Dr. Kevin Crooks

CSU Center for Human-Carnivore Coexistence - Director - 2021-Present

- Director of CSU Center for Human-Carnivore Coexistence (CHCC).

- As Director, works with other scientists, students, and external partners to design, implement, and evaluate conflict reduction approaches to reduce livestock depredation by predators, including wolves in the western United States.

CSU Department of Fish, Wildlife, and Conservation Biology - Professor - 2003-Present

- Professor in the Department of Fish, Wildlife, and Conservation Biology at Colorado State University.
- Adopts an interdisciplinary approach to evaluate conflict and coexistence between humans and carnivores.
- Published over 195 peer-reviewed publications in a diversity of outlets, cited over 18,000 times with an h (Hirsch) index = 60 (Google Scholar, accessed 3/4/2024).