PERC

PROSPECTUS
DECEMBER 2022

Paradise Valley **Brucellosis Compensation Fund**

Developed by the Property and Environment Research Center

INTRODUCTION

Elk (*Cervus canadensis*) are a keystone species of the Greater Yellowstone Ecosystem, central to maintaining the ecosystem as well as the tourism and hunting economies. Many distinct elk herds occupy the region, which typically spend their summers high in the mountains and migrate outward to lower-elevation winter range on surrounding private working lands. During the winter, elk spend as much as 80 percent of their time on private lands, mostly cattle ranches.

Montana's Paradise Valley, at the northern gateway to Yellowstone National Park, provides critical range for several of the Greater Yellowstone Ecosystem's elk herds (Figure 1). These herds are highly valued by many—including conservationists, hunters, and other outdoor recreationists—but they can bring significant costs and challenges for the landowners in the valley who provide the forage and security for these herds. Chief among these challenges is brucellosis, a disease transmitted from bison (*Bison bison*) to elk to cattle that can have sudden and devastating financial consequences for ranchers.

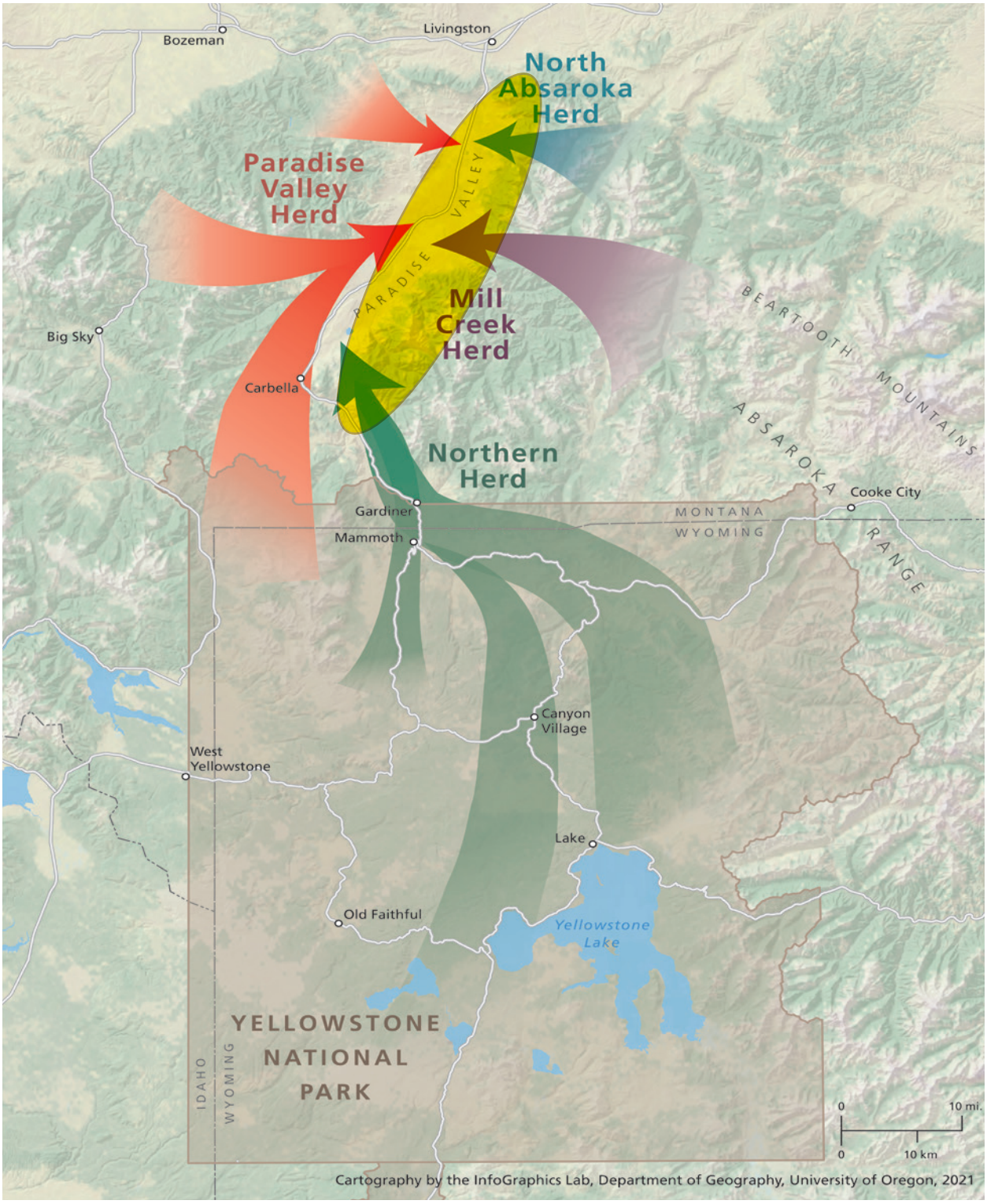
Over the past several years, PERC has worked with Paradise Valley ranchers to better understand the wildlife challenges they face and to develop new tools to address those challenges. In a survey conducted by PERC in 2019, ranchers in the valley identified brucellosis as the most concerning wildlife issue they face.[1] Since then, PERC has helped organize the Paradise Valley Working Lands Group, and PERC researchers have met with landowners and other stakeholders to explore potential solutions to address this challenge.

Brucellosis (aka Contagious Abortion or Bang's disease) was once a nationwide scourge but is now limited to the Greater Yellowstone Ecosystem. Its prevalence in bison and elk and its geographic extent, however, are both increasing. When elk and cattle commingle, there is heightened risk of transmission, which can cause cows to abort their young. A positive case in a cattle herd requires an expensive and lengthy quarantine process in which ranchers have to isolate their entire herd and undergo testing protocols that can last a year or more. Combined with potentially ruinous financial loss and added stress to ranching families and cattle alike, the risk of brucellosis reduces ranchers' willingness to provide vital ungulate habitat and has the potential to undermine the future viability of ranching in the region and the large landscapes it maintains.

Through partnerships and private fundraising, PERC is establishing a Paradise Valley Brucellosis Compensation Fund.[2] The fund, available to cattle ranchers in Paradise Valley, is a three-year pilot project to cover a portion of the costs of mandatory cattle quarantine ranchers incur after a positive brucellosis test. If successful, the fund could be expanded into other areas in the future or lay the groundwork for a more formal financial risk-transfer tool (e.g., a "brucellosis bond") to address brucellosis risks over the long run.[3]

Figure 1

Elk Migrations of Paradise Valley



Map depicts the radio-collared and observational movement of elk to wintering areas in Paradise Valley (yellow shading).

MOTIVATION

Private working landowners in Paradise Valley play a critical role in providing winter and year-round habitat for migratory and resident elk populations.[4] Preserving undeveloped tracts of private land in the Greater Yellowstone Ecosystem is crucial to maintaining the ecosystem's healthy elk herds. If private working lands are not viable, then exurban development (e.g., subdivision) and other land conversions will likely accelerate land-use intensity, making habitat conservation more challenging in the future.

Paradise Valley ranchers provide critical forage and security to elk populations which ultimately benefits the broader ecosystem and other wildlife populations as well. Benefits also accrue to residents, hunters, tourists, and other outdoor recreationists, as well as the businesses that serve them. But sharing one's private land with elk comes with a cost to landowners, particularly for cattle ranchers whose herds can contract brucellosis from infected elk. Consequently, interactions between ranchers and elk can lead to tensions that create challenges to conserving or enhancing wildlife habitat.

Financial risk-transfer tools, such as a compensation fund, offer significant benefits in this context. These tools can help shift some of the costs associated with brucellosis to third-party groups that value wildlife conservation, including abundant elk populations. By sharing the costs of providing critical habitat, this approach can increase landowners' wildlife tolerance, build trust within the community, and help keep working lands working to conserve or enhance habitat and open space.

In December 2019, PERC hosted a landowner forum in Paradise Valley where we discussed the idea of creating a brucellosis risk-transfer tool. Initial feedback was very positive, and from 2020-21 we engaged in detailed discussions with ranchers, agency officials, researchers, conservation groups, and other stakeholders to explore the concept. In January 2022, we presented the details of a three-year pilot compensation fund project at the Paradise Valley Working Lands Group meeting at Chico Hot Springs, where the ranching community overwhelmingly encouraged establishment of the fund.

"If we improve habitat [for elk] we're basically shooting ourselves in the foot because of the increased brucellosis risk."

— Paradise Valley rancher

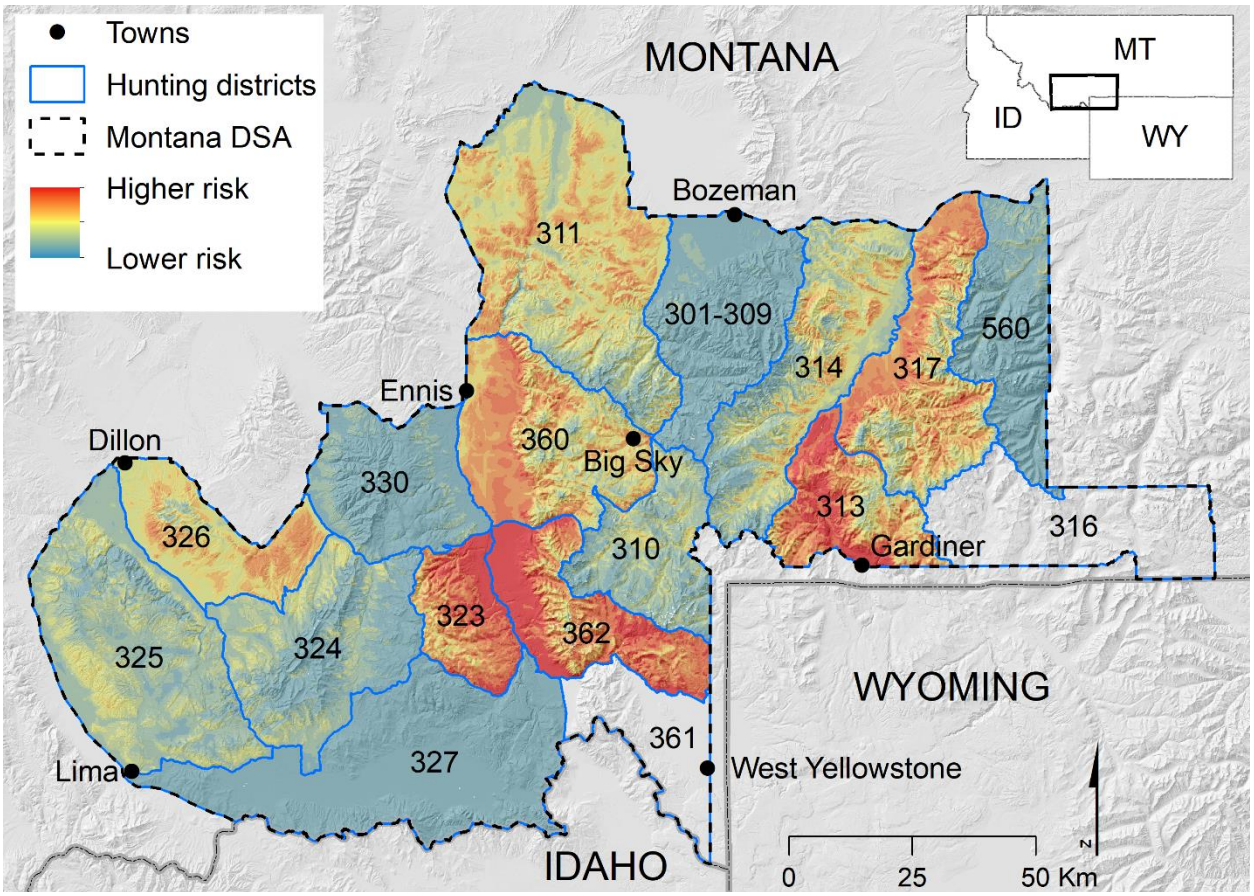
This fund is critical to the future conservation and sustainability of Yellowstone's elk herds because:

- **Based on GPS tracking and remote sensing, ecologists recognize that elk rely heavily on the intact private working lands of Paradise Valley as part of their migration and winter range.**
- **Brucellosis infection rates have increased in elk populations, and researchers believe that without significant intervention the problem is only going to get worse, affecting more cattle.**[5]
- **Reducing the costs of transmission incidents—and thus reducing ranchers' financial exposure to disease risk—will enhance the long-run viability and sustainability of the large, private working lands, which play a critical role in sustaining the region's migration pathways.**
- **There are currently no other financial or insurance mechanisms available to private landowners to address the risk of brucellosis transmission.**

The National Brucellosis Eradication Program, which began in 1954, successfully eliminated brucellosis from most U.S. livestock by the early 2000s—but the Greater Yellowstone Ecosystem and its bison and elk remain the lone epicenter for the disease in the United States.

Figure 2

Paradise Valley Predicted Brucellosis Risk



Map displays the predicted relative risk of brucellosis-induced abortion events by adult female elk during March based on data from 2005-15. It includes the portion of elk hunting districts that fall within the boundary of the Montana designated brucellosis surveillance area (DSA). Hunting districts 313, 314, and 317 encompass Paradise Valley. Nathaniel D. Rayl et al., "Estimating the Risk of Elk-to-Livestock Brucellosis Transmission in Montana," Other Report, Montana Fish, Wildlife and Parks (2018).

Today management of the disease is the responsibility of the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA). In Montana, the Department of Livestock (DOL) and the Department of Fish, Wildlife, and Parks implement USDA brucellosis regulations including development of a brucellosis management plan and establishing designated surveillance areas (DSAs).

Cattle producers inside the Montana DSA, including Paradise Valley (Figure 2), are subject to more stringent testing, monitoring, and management requirements than the rest of the state. In the event of a positive test, all livestock in contact with the positive animal must either be "sold for slaughter" or quarantined on an operator's home ground. Lifting the quarantine involves ongoing testing and strict herd management (see Appendix for more detail). By all accounts, these quarantine requirements create significant financial burdens for ranchers.[6]

THE FUND

The Paradise Valley Brucellosis Compensation Fund was developed based on extensive data collection and modeling by PERC (described in detail in the Appendix) as well as informed by interviews and meetings with Paradise Valley landowners. The three-year pilot project, which will begin January 2023, and run through the end of 2025, has two primary goals:

1. **Provide a financial backstop to help ranchers "weather the storm" of mandatory brucellosis quarantine**
2. **Demonstrate that the costs of brucellosis quarantine can be shared by parties interested in supporting and enhancing elk habitat**

Capitalized at between $100,000 and $150,000, the fund will provide a per head, per month payment to help cover the costs associated with cattle quarantined for brucellosis in Paradise Valley. The fund has been sized and structured with the goal of covering approximately 50-75 percent of ranchers' quarantine costs, with the rancher covering the rest as a cost share to encourage the continued use of best practices. There is no formal enrollment process and no direct financial contribution required from producers to access coverage. Producers must meet a set of eligibility criteria described in the following section. By engaging ranchers in this way, we believe the program will increase tolerance of elk, encouraging landowners to maintain their critical habitat for both livestock and wildlife.

The target amount for the fund was determined based on the coverage objective and target lifespan. It includes an estimated $10,000 to cover costs associated with administering the program which has been designed to minimize such costs by establishing a simple procedural process, relying on state entities for qualification and monitoring, and making payments a simple function of time, number of cattle, and hay price.

The fund is designed to operate for three years, unless it is drawn down before then. At the end of the three-year period, any remaining funds may be rolled over into a new iteration of the fund. This could include evolving the payout structure, expanding to cover other areas in the Greater Yellowstone Ecosystem, or changing the financing structure.

ELIGIBILITY

The following eligibility criteria must be met in order to receive compensation from the Fund:

PRE-INFECTION

1. **Cattle (the only animal covered by this fund) spent a portion of the year in Paradise Valley, defined as hunting districts 313, 314, and 317.**
2. **Producer/herd owner has adhered to applicable rules associated with operating in the Montana DSA (including any required vaccination, testing, or adherence to management plans) prior to the positive test.**
3. **Reasonable methods to prevent livestock from mingling with elk were used prior to the positive test. Fencing of haystacks with appropriate methods for preventing elk access is required.**
4. **There is no evidence of actions undertaken by the Producer/herd owner to intentionally attract elk to locations where cattle were during the season of likely transmission (March to May).**
5. **Producer's cattle become designated an "affected herd" to be quarantined by the Montana DOL.**

POST-DETECTION

6. **As DOL is obligated to keep test information confidential, Producer/herd owner contacts the Paradise Valley Brucellosis Compensation Fund to request compensation.**
7. **Producer/herd owner acknowledges the payout structure and disbursements offered by the Paradise Valley Brucellosis Compensation Fund in writing.**
8. **Producer/herd owner adheres to the "Affected Herd Plan" developed jointly by producer, DOL, and USDA aimed at resolving the quarantine as quickly as possible.**
9. **The Producer's/herd owner's cost of quarantine is not being compensated by a private insurance policy or other compensation mechanism (excluding testing reimbursement from the state).**
10. **Producer/herd owner requests reimbursement for costs from time of DOL quarantine order to the release of quarantine. Claims may be made every 1-to-3 months during the quarantine period and up to two months following lifting of quarantine.**

PAYOUT STRUCTURE

The majority of financial costs related to quarantine are the costs of purchasing additional hay. In normal circumstances, ranchers put up the hay they need to feed their cattle through the winter to green-up when they can put their stock out to pasture. Under quarantine, ranchers are required to hold their cattle in a confined area on their home ground requiring supplemental feeding of cattle that would otherwise be out on pasture.[7]

To help address these unanticipated costs, the Paradise Valley Brucellosis Compensation Fund will make payouts based on the combination of four variables: 1) price of hay, 2) consumption rate, 3) duration of quarantine, and 4) season.

Price of hay x Consumption Rate x Duration x Season

1. Price of Hay

Hay prices vary widely from year-to-year depending on weather, production, quality, and demand. For example:[8]

- 2020 hay crop was an "average year" where hay sold for an estimated $130/ton not including delivery costs.
- 2021 crop averaged $200-$225/ton in the stack. Delivery costs, based on mileage, averaged an additional $20-30/ton.
- 2022 hay prices are similar to 2021 in the stack with delivery costs of $20-40/ton.

Given the wide range of variables affecting hay prices and the need for certainty, the Compensation Fund's rate per ton of hay fed (Index Price) is based on the previous year's average hay price paid in the Paradise Valley (Base Price). The Base Price will be set after conversations with a range of hay producers and buyers and will be agreed at the Paradise Valley Working Lands Group's annual November meeting.

The Compensation Fund's Index Price is set at 75 percent of the Base Price with the intention of capturing the additional costs of hay delivery and price increases likely encountered in procuring hay in the off-season.

For 2023, base price of hay, per ton = $225.00
Compensation Fund index price, per ton (@75%) = $169.00
Index price, per pound = $0.0845

2. Consumption Rate

To calculate a consumption rate for the affected herd, we assume the following Animal Unit Equivalents (AUE) and forage consumption for purposes of reimbursement.[9]

Table 1

Consumption Rate of Affected Herds

Class	AUE	Forage Consumed
Mature cow (approx. 1,000 lbs.) and calf up to 6 months old postpartum	1.00	30 lbs.
Mature cow (approx. 1,000 lbs.), dry	1.00	30 lbs.
Mature bull (>24 months)	1.50	45 lbs.
Two-year old cattle (800-1,000 lbs.)	0.90	27 lbs.
Yearling (600-800 lbs.)	0.70	21 lbs.
Weaned calf (to yearling)	0.60	18 lbs.

3. Duration of Quarantine

Calculated from date Producer's cattle become designated an "affected herd" to end of quarantine with cattle returned to "normal" forage rotations. Months are assumed to be 30 days and payouts will be calculated using a per month, per head rate, rounded to the nearest half-month (15 days).

4. Season

As the primary cost of undergoing quarantine is the cost of additional hay, compensation rates are adjusted to whether quarantine occurs during the "winter" or "non-winter" season, as described below.

Winter *December 16 to April 15*

During the winter, ranchers generally plan feed purchases for their herds, whether quarantined or not. Quarantine, however, imposes other costs in the winter, such as operational changes and feeding cows that would have been sold and thus would otherwise not be on the ranch. Therefore, a fixed $10/head/month payout rate is established during winter months.

Compensation = $10/head in affected herd/month

Non-Winter *April 16 to December 15*

The monthly non-winter compensation rate is as follows:

Index Price x Consumption Rate x 30 days

For 2023 the reimbursement rates, per head for one month are:

Cow (1.0 AUE) w/wo calf:
$0.0845 x 30lbs hay/day x 30 days = $76.05

Mature Bull (1.5 AUE):
$0.0845 x 45lbs hay/day x 30 days = $114.08

Yearling (0.75 AUE):
$0.0845 x 24lbs hay/day x 30 days = $60.84

Two-year old cattle (0.9 AUE):
$0.0845 x 27lbs hay/day x 30 days = $68.45

Weaned calf (0.5 AUE):
$0.0845 x 15lbs hay/day x 30 days = $38.03

The maximum payout for any one incident is half of the initial fund size (e.g., $50,000 for a $100,000 fund) to ensure that the fund is not depleted by a single incident. Payouts may be requested in writing on a monthly basis during quarantine, beginning with the date one month after the quarantine officially begins. Payouts must be requested within two months of the end of quarantine.

FUND SUMMARY

FUND SIZE: $100,000 – $150,000
The initial capital in the fund allocated to brucellosis payouts

PAYOUTS: 75 percent of estimated hay costs
Payments are made based on producer/herd owners meeting eligibility standards and reimbursement calculated on price of hay, herd consumption rate, duration of event, and time of year.

MAX PAYOUT: 50 percent of the initial fund size for any single quarantine event

ANTICIPATED OPERATIONAL PERIOD: Three years, beginning January 2023

The Compensation Fund will treat all communications and transactions with producer/herd owner confidential. The producer/herd owner is responsible for any/all tax reporting and associated payments.

CONCLUSION

Brucellosis is a serious financial risk for cattle ranchers in Paradise Valley and throughout the Greater Yellowstone Ecosystem. Innovative tools are needed to help ensure large, working landscapes continue to provide high-quality elk habitat, winter range, and migration corridors. The Paradise Valley Brucellosis Compensation Fund has the potential to reduce the costs of brucellosis cases and enable others to help shoulder some of the costs of providing elk habitat. If successful, the fund could be expanded to address this and other challenges throughout other areas of the Greater Yellowstone Ecosystem. With the support of many dedicated partners, in collaboration with the ranching community of Paradise Valley, we are excited to launch this innovative fund beginning in January 2023.

If you are interested in partnering with PERC and other conservation and funding partners on the Paradise Valley Brucellosis Compensation Fund, please reach out to Brian Yablonski at brian@perc.org or 406-587-9591.

Endnotes

1. Whitney Tilt, "Elk in Paradise: Conserving Migratory Wildlife and Working Lands in Montana's Paradise Valley," PERC (2020).
2. Current partners include the Greater Yellowstone Coalition, the Rocky Mountain Elk Foundation, the Spruance Foundation II, and Credova. The parameters of the proposed fund may evolve to meet circumstances as they arise before the initial enrollment period.
3. Ben Foster, "A Financial Risk-Transfer Tool for Managing the Costs of Brucellosis to Cattle Ranchers," PERC White Paper (2020).
4. Arthur D. Middleton et al., "The Role of Private Lands in Conserving Yellowstone's Wildlife in the Twenty-First Century," *Wyoming Law Review* (forthcoming 2022).
5. Nathaniel D. Rayl et al., "Elk Migration Influences the Risk of Disease Spillover in the Greater Yellowstone Ecosystem," *Journal of Animal Ecology* 90, no. 5 (2021): 1264-1275.
6. Kari Boroff et al., "Risk Assessment and Management of Brucellosis in the Southern Greater Yellowstone Area (II): Cost-benefit Analysis of Reducing Elk Brucellosis Prevalence," *Preventive Veterinary Medicine* 134, no. 1 (2016): 39-48; Bryan Wilson, "Regional Economic Impacts of Bovine Brucellosis Under New Federal Regulations," University of Wyoming, Department of Agricultural and Applied Economics (August 2011).
7. Gordon estimated that 97 percent of costs were related to feeding during a 12-month quarantine. Jessica L. Gordon, "Ranch-Level Economics of Adult-Booster Vaccination Against Bovine Brucellosis in the Greater Yellowstone Ecosystem," University of Wyoming, Department of Agricultural and Applied Economics (December 2020).
8. Layne Klompien, pers. comm.
9. The animal unit equivalent (AUE) defines forage intake on the basis of a "standard animal," most commonly defined as a grazing ruminant weighing 1,000 pounds, with or without its calf up to 6 months old (Society for Range Management Glossary). AUEs and forage consumption values based on John Lacey, "Forage Consumption Estimated Animal Unit Conversion," Montana State University, MT 911 (1991) and Miranda Meehan et al., "Determining Carrying Capacity and Stocking Rates for Range and Pasture in North Dakota," North Dakota State Extension R1810 (2018).

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PERC

The Property and Environment Research Center (PERC) is the national leader in market solutions for conservation. Through research, law and policy, and innovative applied conservation programs, PERC explores how aligning incentives for environmental stewardship produces sustainable outcomes for land, water, and wildlife. Founded in 1980, PERC is nonprofit, nonpartisan, and proudly based in Bozeman, Montana.

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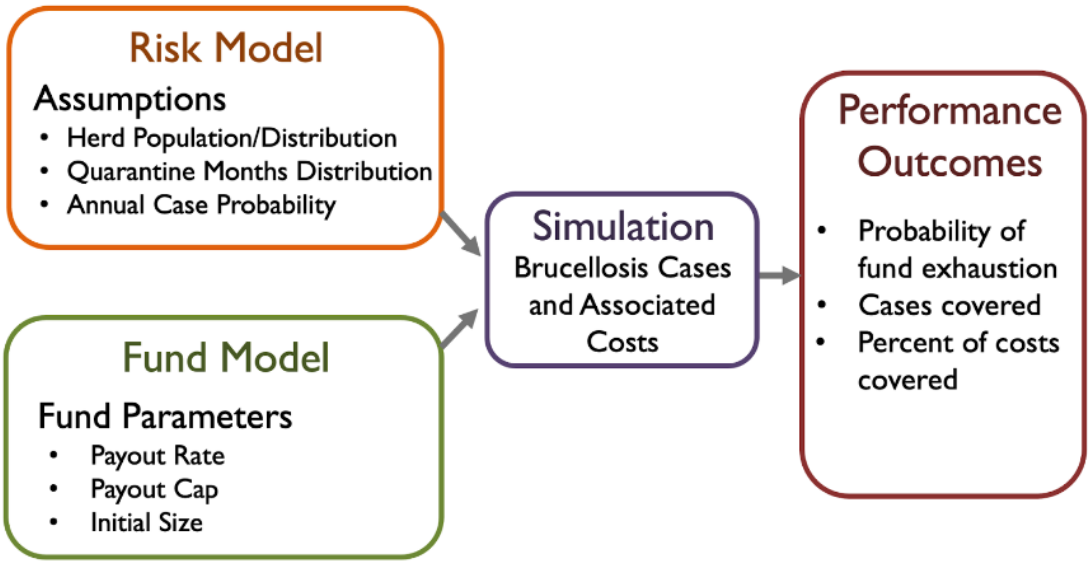
Appendix

Model Detail

To inform the design of the Brucellosis Quarantine Compensation Fund, we developed a simulation model to assess the financial risk of brucellosis to producers in Paradise Valley and to test the performance of possible compensation fund structures. The model simulates quarantine events using data collected on infections and estimates of herd sizes in Paradise Valley and evaluates the performance of various fund specifications (e.g., size and payout structure). Percent costs covered compares actual payouts from the fund against an estimated total real quarantine cost. The exhaustion rate is defined as the probability of the fund being exhausted prior to the end of the three-year period, calculated as the number of simulations where the fund is emptied divided by the overall number of simulations.

Figure A: Model and Outcomes



Simulation Structure

To evaluate fund performance, we use a Monte Carlo process, making random draws from assumed distributions of inputs to develop synthetic outcomes representing possible brucellosis cases in Paradise Valley. We determine the likelihood that a quarantine event will occur each year based on the historical probability of infection using data from USDA. If an event occurs in any given year, we assign a herd size, quarantine length, and quarantine start month from probability distributions of each. We then calculate an estimated total cost of quarantine and apply the fund payout rules to determine compensation from the fund. This payout amount is subtracted from the fund size, and we repeat the process for the next year until the fund is depleted.

Assumptions

The probability distributions were chosen to as closely represent what we know about real world conditions as possible. Herd size is drawn from a probability distribution estimated from a kernel-density estimate using Gaussian kernels. The minimum herd size is 20, the maximum is approximately 1,200, and the average is approximately 270. For quarantine length and start date, we assume a discrete uniform distribution of

outcomes (i.e., an equal probability of each integer outcome in the range) from four to 10 months and November to January for length and start date respectively. These both align broadly with what limited infection data is available. For quarantine length, it is useful to note that while 12-plus months was considered a standard quarantine length in the past, lengths have shortened due to policy changes over time, making any quarantine beyond 10 months unlikely in our estimation.

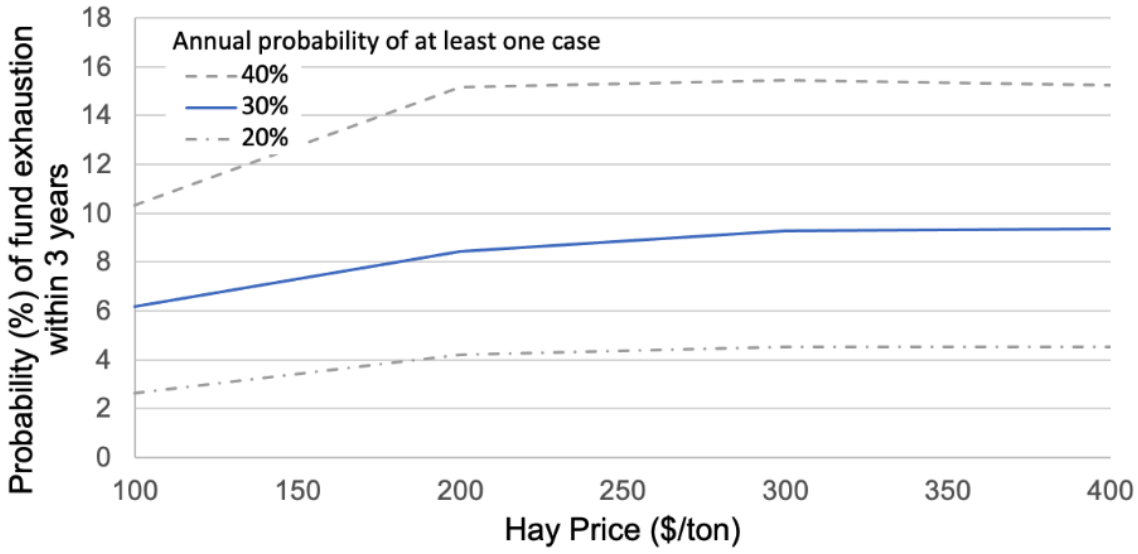
There have been three quarantine events in Paradise Valley over the past 10 years, so we design the fund assuming a 30 percent annual chance of at least one case. There are theoretical reasons that suggest if one case occurs a second or third could occur as well, although that has not happened in practice in Paradise Valley. To capture that possibility, we assume that there is a 6 percent annual chance of at least two cases and a 1 percent chance of three cases occurring. We design the fund parameters using this set of assumptions, but we also perform a "sensitivity" test on the final structure by assessing performance when the probability of at least one case is 20 percent and 40 percent, in addition to the base assumption of 30 percent.

We focused our modeling efforts on a $100,000 fund. Any larger fund would perform "better" in that it would cover more risk for longer.

Results

We estimate the probability of the fund being exhausted by the end of the three-year period to be between 5 and 13 percent. This range is a function of hay price, fund size, and max payout and is sensitive to the assumptions around herd size, quarantine length, quarantine start, and the probability of a positive case. The figure below shows how the exhaustion probability varies with hay price. It also shows exhaustion probabilities at high (40 percent) and low (20 percent) annual case probabilities.

Figure B: Likelihood of Fund Exhaustion



At hay prices that reflect 2012-20 prices (approximately $120/ton), the fund covers roughly 60 percent of estimated actual costs. Approximately 40 percent of events are "max events," meaning the payouts were capped at $50,000. At higher hay prices, risk coverage drops, and "max events" increase due to the higher payout rates associated with those price outcomes. At $400/ton, an extremely high hay price that reflects late 2021 prices, the fund covers approximately 30 percent of costs, and nearly 60 percent of events are "max events."