

Wyoming Game and Fish Department Migration Corridor Threat Evaluation

Sublette Pronghorn

Regional personnel made a recommendation to identify or pursue designation of the migration corridor based on the information provided in this report. Corridors that are high risk due to known threats will be moved forward in the designation process. If conditions change, this threat evaluation can be updated and the corridor’s status may be changed through the process as outlined in the Migration Corridor Executive Order 2020-01.

WGFD Corridor Identification-Designation Department Recommendation: [Pursue the Designation Process](#)

Date: February 21, 2024

Range of distance collared individuals migrated: 6 to 165 miles

Longest migration distance: 165 miles

This herd is over 75% migratory

Counties that overlap the corridor: Fremont, Lincoln, Sublette, Sweetwater and Teton

Methods for data analysis: Brownian Bridge Movement Model for Stopovers and 300 m Line Buffer for High, Medium and Low Corridor footprints. Please see Appendix of Methods for more information

Number of individuals: 415

Number of Sequences: 806

Years completed: 2002 to 2022

Acreage Table: *Please fill in acres and (percent of total) within the corridor for each use level, by land ownership.*

	BLM	USFS	OSLI	WGFC	Private	Other*	Total
Low Use	1,061,879 (62%)	143,245 (8%)	70,567 (4%)	1,920 (.1%)	339,201 (20%)	96,468 (5%)	1,713,280
Medium Use	233,044 (61%)	63,629 (17%)	15,296 (4%)	1,043 (.2%)	48,442 (12%)	18,368 (5%)	379,822
High Use	60,039 (46%)	38,515 (30%)	4,243 (3%)	122 (<.1%)	20,397 (16%)	7,078 (5%)	130,394
Stopovers within High Use	42,151 (59%)	10,560 (15%)	2,688 (4%)	26 (<.1%)	11,610 (16%)	5,037 (7%)	72,071
Stopovers within Other Use	325,953 (70%)	28,487 (6%)	21,478 (5%)	723 (.1%)	70,752 (15%)	20,198 (4%)	467,592
Bottlenecks	3,014 (16%)	8,301 (43%)	633 (3%)	0 (0%)	6,477 (33%)	1,018 (5%)	19,443

**Other includes National Park Service, Bureau of Reclamation, USFWS Refuges, etc.*

Threats:

Consider existing and potential (10 years) threats and indicate Yes or No if they exist or potentially exist in the corridor. Indicating 'yes' to a potential threat would capture discussed or planned projects or proximal development affecting the corridor. Your narrative below should explain if these threats or protections exist throughout the corridor or in an area that only influences a portion of the herd.

	Existing	Future
Subdivision or suburban sprawl	Yes	Yes
Fence impacts (all fence conditions or not wildlife-friendly design)	Yes	Yes
Road impacts (state, county or other improved)	Yes	Yes
Oil or gas wells or APDs	Yes	Yes
Wind	No	Yes
Solar	Yes	Yes
Mining - coal, trona, bentonite, gravel	Yes	Yes
Transmission lines, compressor stations or pipelines	Yes	Yes
Other energy or resource extraction	Yes	Yes
Human recreation during migration (motorized)	No	No
Human recreation during migration (non-motorized)	No	No
Wildfire threat due to cheatgrass invasion of sagebrush ecosystem	No	Yes
Closed canopy or late succession reducing herbaceous forage	Yes	Yes
Other: habitat impacts from wild horses	Yes	Yes

Protections:

	Existing	Future
Wilderness, WSA, ACEC, SMA or NPS land	Yes	Yes
Specific county zoning protections that overlap corridor	No	No
Conservation easements	Yes	Yes
NSO, CSU, or other lease land use plans from RMPs, Forest Plans, etc	Yes	Yes
USDA habitat leases (G-CRP)	No	Yes
Projects in development to mitigate threats	Yes	Yes
Other: federally designated migration corridor, Path of the Pronghorn	Yes	Yes

Narrative: Include a description of the corridor and explain answers or justify determination. Also, please submit maps along with this application. At least one map is needed for this entire corridor showing land ownership.

The Sublette Pronghorn herd is one of the largest antelope populations in the world. Individuals migrate up to 165 miles between winter and summer ranges across private, state and federal lands. The public land jurisdictions include Office of State Lands and Investments, three Bureau of Land Management (BLM) field offices, U.S. Forest Service, National Park Service and United States Fish and Wildlife Service lands in addition to Wyoming Game and Fish Commission lands. Private working lands are an important component of the land ownership, and the Wyoming Game and Fish Department (Department) has a long history of supporting multiple use along with wildlife management on these private lands. The northernmost portion of the herd hosts

antelope that summer in Grand Teton National Park, the National Elk Refuge and Jackson Hole and can winter as far south as Interstate 80 near Rock Springs. Other distinct summer ranges include the Bondurant Basin, Upper Green River Basin and Waterdog Lakes on USFS land, and sagebrush steppe habitat throughout the Upper Green River Basin in the vicinity of the communities of Pinedale, Big Piney, Kemmerer, Farson, Green River and Rock Springs. Pronghorn in this herd unit are comprised of several sub-herds, and over the last 20 years movement data has been collected for a wide variety of projects. Please see Appendix of Methods for more detailed information about the research data analysis.

GPS Collar Studies conducted in the Sublette Pronghorn herd that contributed to the corridor delineation

Years	Project	Objective
2002-2003	Kemmerer	Fences and roads as barriers
2003-2004	Grand Teton NP	Jackson Hole movements
2005-2010	Pinedale Anticline	Effects of natural gas development
2009-2017	Pinedale Anticline 2	Effects of natural gas development
2010-2013	Grand Teton NP 2	Jackson Hole movements
2012-2013	Jack Morrow Hills	Movement in the Red Desert
2017-2018	I-80	Influence of climate and I-80
2018-2020	Sweetwater Solar	Effects of solar energy development
2020-2024	Distribution Gaps	Fill in areas between previous studies

This is one of the most extensive and data-rich GPS collar datasets available for antelope in the world. Because of the very large and diverse landscape inhabited by Sublette antelope, various threats to and protections for maintaining functionality of the corridor have been identified and discussed below.

Threats:

There are several significant threats to maintaining the functionality of the Sublette antelope herd’s seasonal movements. One of the most pressing threats is habitat loss associated with the expansion of suburban development and general expansion of the human population into native habitats. Subdivisions and associated disturbance from roads, fences, pets and humans have already affected the functionality of the corridor in some areas, and demand for more development continues to be a pressing concern. Recently, the influx of people relocating to western Wyoming has greatly increased, likely fueled by the COVID-19 pandemic and the increased ability for employees to telework away from urban centers. As of 2021, the total population of Sublette County has increased 78% since 1990 and 46% since 2000 (U.S. Census Bureau 2021). Demand for additional residential development and changes to county zoning to accommodate this demand has occurred throughout the corridor. While private land is not the dominant land ownership throughout the corridor, the impacts associated with this population expansion are predominantly focused in these areas. Development can disrupt migratory behavior and significantly impact the functionality of the corridor by animals increasing speed of movement, reducing time in stopovers or shifting use of stopovers (Wyckoff et al. 2018). The area directly west of the town of Pinedale is an example of how residential development severed a historic bottleneck. A busy roadway, numerous new buildings and impermeable fences have nearly eliminated use of this area.

Another significant threat includes energy development, both oil and gas and more recently renewable energy such as solar and wind. In the Pinedale Anticline Project Area (PAPA) adjacent to the Jonah Field, Sawyer et al. (2019) demonstrated that antelope both avoid energy infrastructure and spend considerably less time in

traditional winter ranges once habitat fragmentation occurs due to development. Additional fragmentation and active disturbance on winter and migratory habitats therefore further reduces effective available habitat and potentially compromises the herd's ability to move around during and recover after severe winters. In the LaBarge and Moxa Arch energy developments GPS collar data has only recently been collected and impacts are less understood. Planned projects (e.g., Normally Pressured Lance) will require managers to site future development in locations and during times of the year to mitigate the impacts of energy development and maintain functionality of the corridor. Disturbance thresholds associated with the sage grouse executive order in core areas would likely ensure disturbance densities do not impede migratory movements. More recently, solar energy developments have been constructed in the southern portion of the proposed corridor near Green River and along the Gateway West Transmission Line. Solar development and their associated chain link perimeter fences create a complete movement barrier to migrating antelope (Sawyer et al. 2022). It is reasonable to expect leasing on public land and the federal mineral estate to continue, even if the corridor is designated.

Additional threats to the Sublette antelope migration corridor include highways, secondary roads and fences. Vehicle collisions are a direct source of mortality, but roads also have impacts to fitness levels of individuals who are unable to efficiently cross due to right-of-way fences, snow loading or traffic volume. Also, some of the busiest stretches of road in Wyoming, such as U.S. Hwy 26-89-191 in Teton County, have or are approaching traffic levels that have functionally fragmented some habitats for this herd. Woven wire and chain link fences create complete movement barriers and significantly impact the ability of antelope to move between seasonal ranges particularly during winter. Disturbance from increased recreation such as off-road vehicles, mountain biking and antler hunting during critical times of the year may impact the functionality of the migration corridor for antelope, but there is little science or data at this time on these disturbances. Concern about recreation impacts is most likely focused in bottlenecks and will be evaluated in more detail through Biological Risk and Opportunity Assessment, if corridor designation is pursued. Lastly, there are impacts to the available forage resources from wild horses, particularly within the southern third of the corridor.

Protections:

Within the Sublette antelope herd, protections and proactive conservation measures have been implemented with a goal of maintaining the connectivity and functionality of important habitats. While the majority of land occupied by the Sublette antelope during migration is managed by the BLM, the north end of the corridor is dominated by lands managed by the USFS and GTNP with a small amount overlapping the National Elk Refuge. In 2008, the USFS designated the first federally protected migration corridor, The Path of the Pronghorn, through the Upper Green River and Gros Ventre River drainages, with a Forest Plan amendment. This act created a framework for land management decisions to be consistent with the functionality of the corridor within the mapped footprint occurring on USFS lands. In the southwest portion of the herd unit, Seedskaadee National Wildlife Refuge overlaps a small portion of the corridor. Other existing land management circumstances contribute to current and long-term protections in areas that overlap the corridor, including the Gros Ventre Wilderness on USFS lands and several Wilderness Study Areas managed by the BLM.

Additional wildlife seasonal ranges provide some level of seasonal disturbance protections for portions of the herd. Pronghorn crucial winter ranges (39,682 acres) afford some protection on the high use portions of the corridor in the context of land use decisions on public land from November 15 to April 30. There is overlap between the antelope migration corridor and crucial winter range in the central and southern portions of the herd as well as overlap with mule deer crucial winter range on the Mesa and Ryegrass, between Big Piney and

Kemmerer and in the Golden Triangle areas. The Sublette mule deer migration corridor has some overlap with the high use areas of the antelope migration corridor (21,386 acres) on the Mesa and areas north and west of Pinedale towards Bondurant which would have some overlap with the spring and fall seasonal use periods. Lastly, sage-grouse core area overlaps the high use areas of the antelope corridor in several places including the area north of Kemmerer, the Ryegrass, the Mesa and areas north of Rock Springs through the Golden Triangle (86,615 acres) which are currently afforded some protections through the Sage Grouse Executive Order (SGEO), particularly in areas near leks. These restrictions on disturbance and development are associated with nesting habitat from March 15-June 30 and winter habitat from December 1-March 14.

Additional wildlife protections within the Sublette Pronghorn corridor

Description	Category from WGFC Mitigation Policy	Protections
Big Game Crucial Habitat	Vital	Activities should be avoided between November 15-April 30
Sage-Grouse Core Population Areas	Vital	<i>Surface Occupancy</i> -No surface occupancy within 0.6 miles of the perimeter of occupied Greater sage-grouse leks. Seasonal Use - Activities should be avoided from March 15 to June 30 outside of the 0.6 mile perimeter of an occupied lek.
Sage-Grouse Non-Core Habitat		<i>Surface Occupancy</i> - No surface occupancy within 0.25 miles of the perimeter of occupied Greater sage-grouse leks in non-core areas. Seasonal Use - Activities should be avoided from March 15 to June 30 outside of the 0.25 mile perimeter of an occupied lek and within 2 miles from the perimeter of the occupied lek
Sage-Grouse Winter Concentration Areas		Activities should be avoided December 1 to March 14

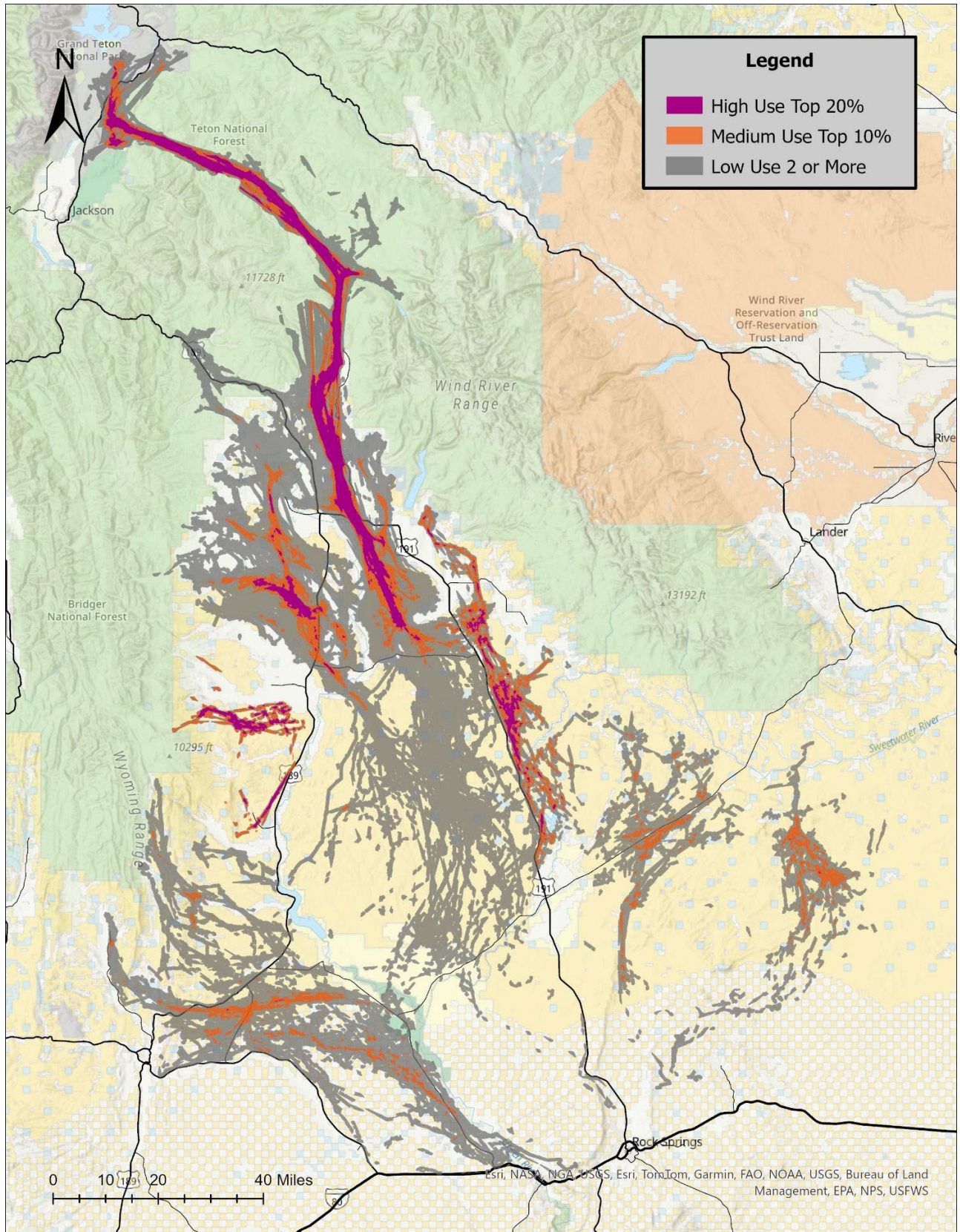
Private landowners have contributed significantly to the functionality of the corridor by voluntarily placing conservation easements on tens of thousands of acres within the corridor. Typically these deed restrictions maintain significant areas of open space indefinitely, even if the parcel is sold in the future. Also, landowners have voluntarily participated in cheatgrass and other noxious weed management efforts, implemented habitat enhancements to improve forage quality and modified hundreds of miles of wildlife friendly fence.

Many public land management efforts have also been implemented including removal of net wire fence near Kemmerer and Boulder, spraying tens of thousands of acres of cheatgrass, particularly along the west slope of the Wind River Range across all land ownerships, implementing sagebrush habitat enhancements associated with the Sublette Mule Deer and Wyoming Range Mule Deer habitat projects on BLM and a variety of mitigation projects tied to the Pinedale Anticline and Jonah gas fields. The construction of the Trappers Point highway crossing project significantly improved survival of individuals migrating across Highway 191 northwest of Pinedale through construction of two overpasses and six underpasses with associated wildlife proof fencing to funnel animals to these structures. Other highway crossing projects have been implemented on Wyoming Highways 28 near Farson, 351 south of Pinedale and 9 underpasses associated with the Dry Piney project north of LaBarge. These included the installation of paired gates to be left open during migration seasons and

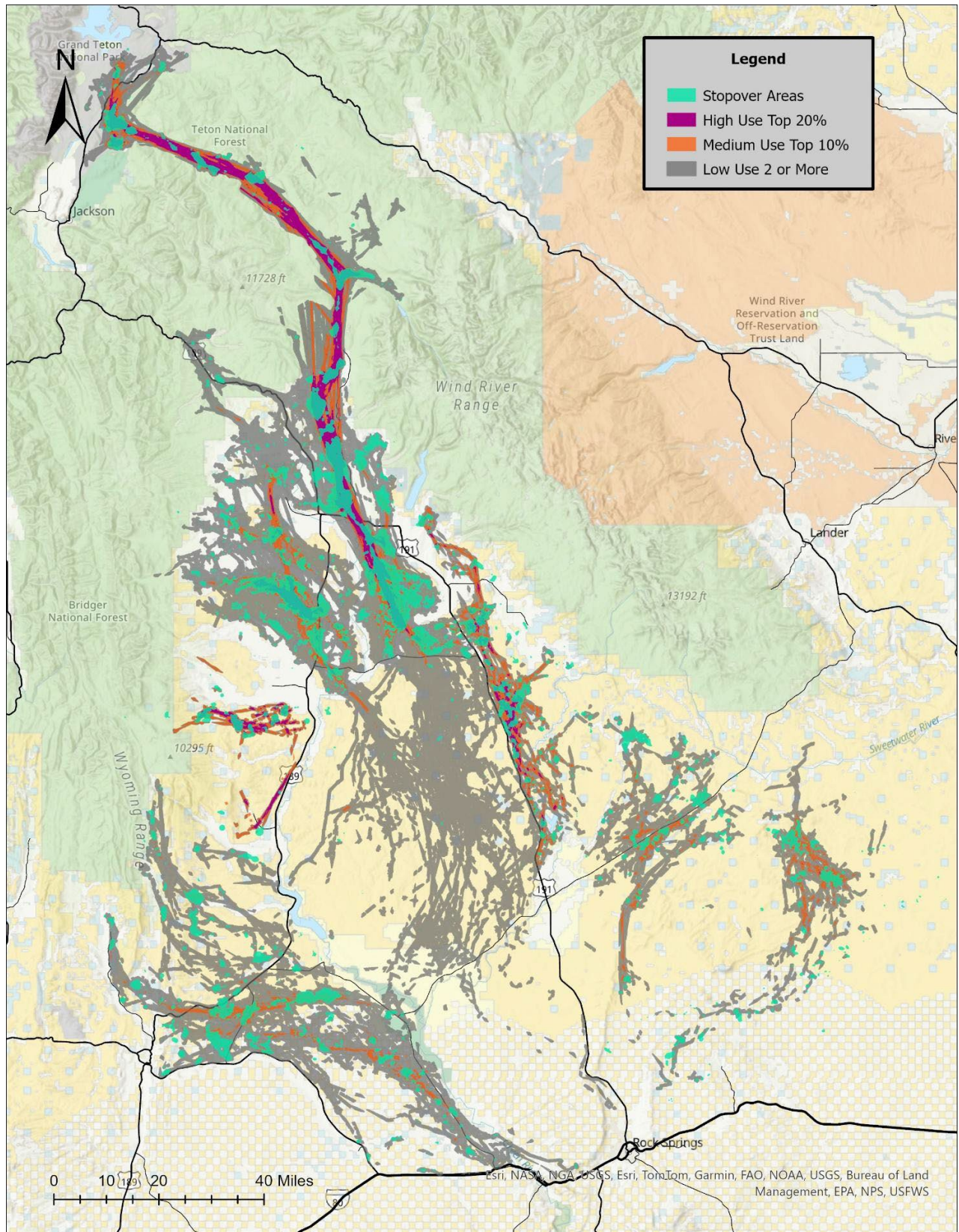
modifying the associated right-of-way fences to increase permeability and therefore access to winter ranges on either side of the roadways.

Future conservation opportunities through federal programs including the Wyoming-USDA Big Game Pilot program, federal initiatives, and willing landowners will be explored as opportunities arise. Additionally, funds have been secured to manage cheatgrass on a landscape scale, contracts are already in place for dozens of miles of fence modifications, NEPA processes are complete or nearly complete to mechanically and chemically enhance over ten thousand acres of sagebrush used by antelope within the Kemmerer and Pinedale BLM Field Offices, and several potential conservation easements are currently in various stages of planning and completion. All of these management actions have potential to positively affect and/or protect the functionality of the corridor for many years into the future.

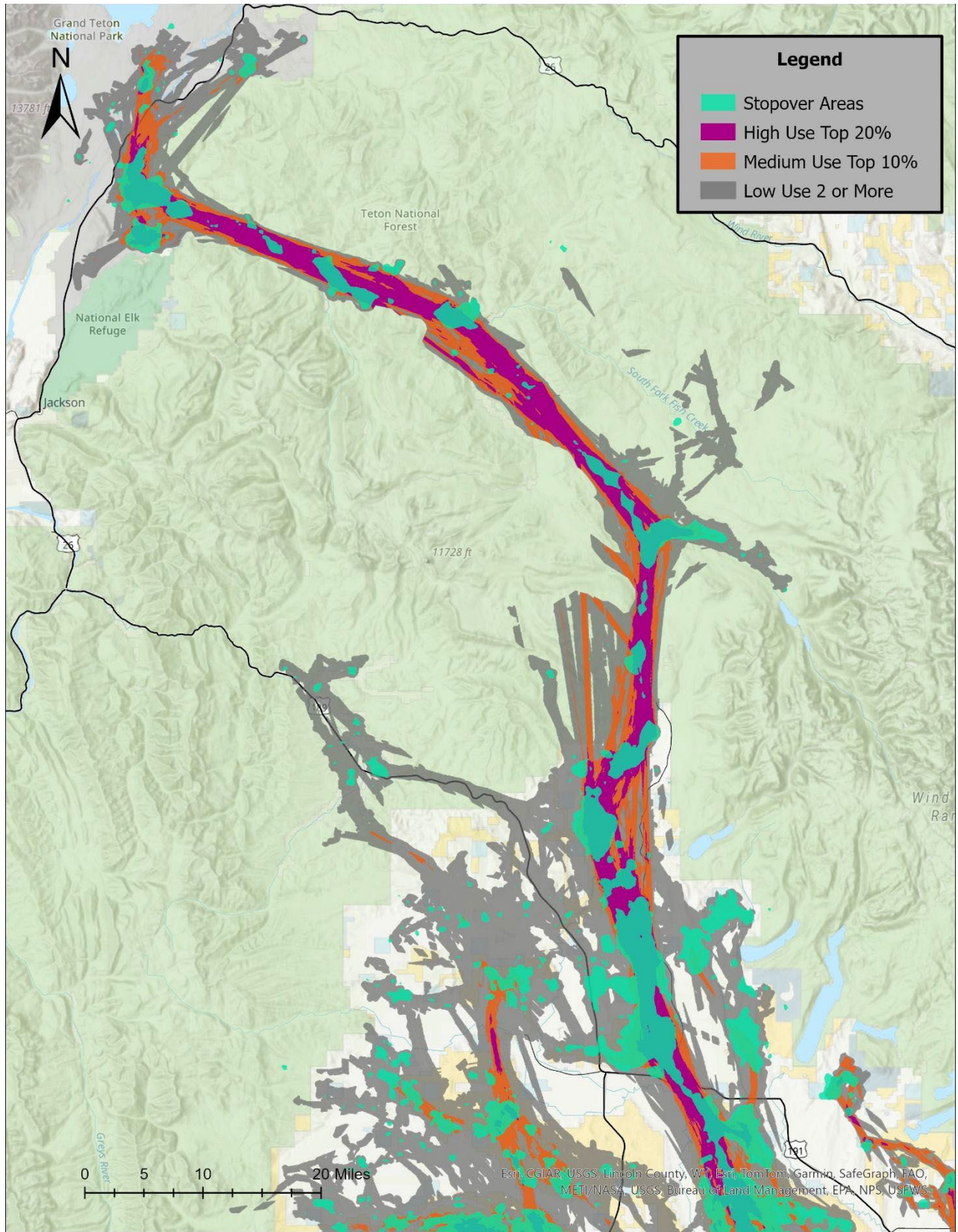
In summary, the known current and potential threats pose a high risk to the functionality of the Sublette Pronghorn migration corridor. The existing trend of suburban expansion and demand for renewable energy resources are the most concerning threats to the functionality of the corridor. In addition, the recent population reductions due to disease (*Mycoplasma bovis*) and harsh conditions during the 2022-23 winter especially highlighted the importance of permeable corridors, as animals that migrated further south generally experienced increased survival versus animals on the more northerly winter ranges. For these reasons, the Department recommends pursuing the designation process as outlined in the Wyoming Executive Order 2020-1.



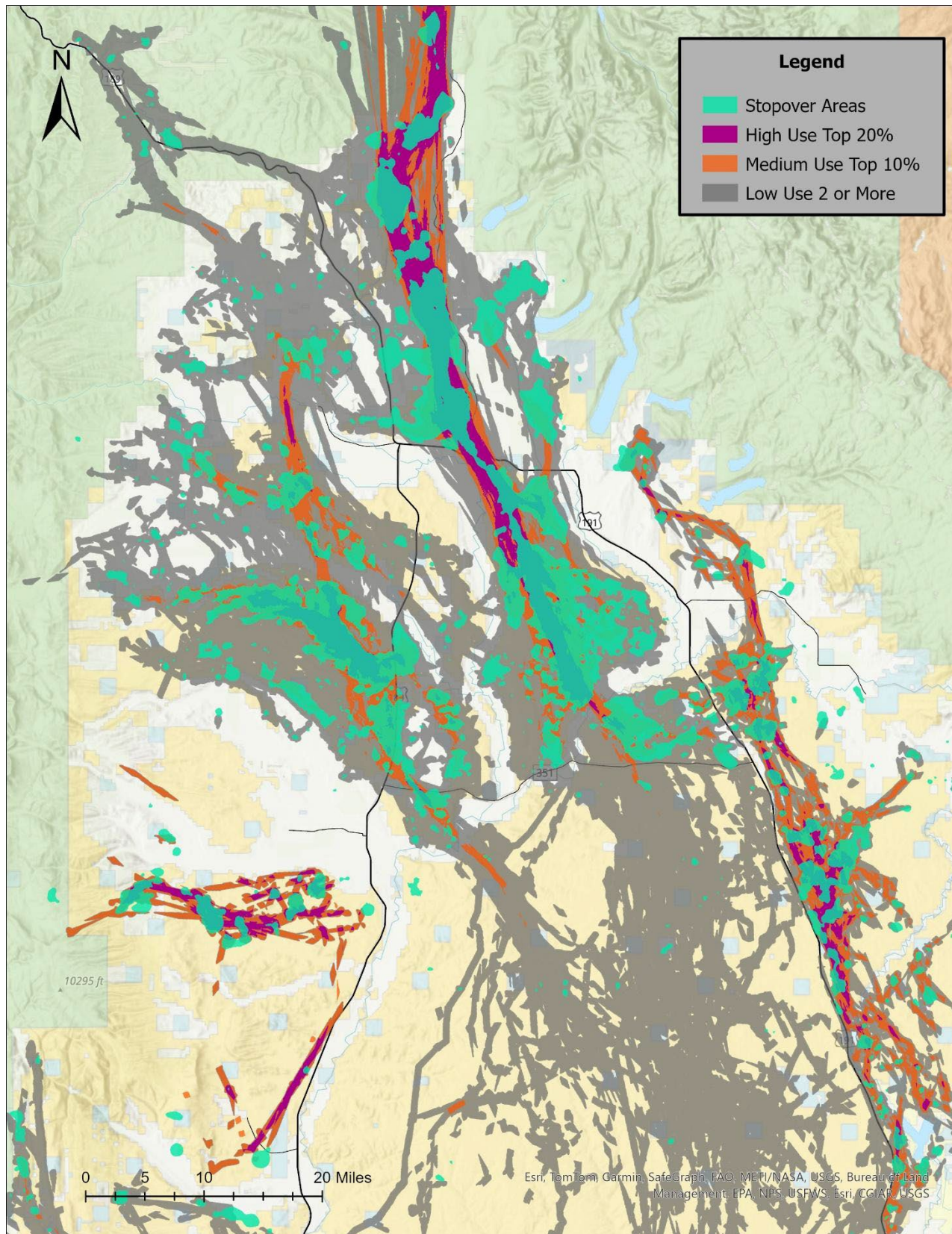
Entire Sublette Pronghorn Migration Corridor



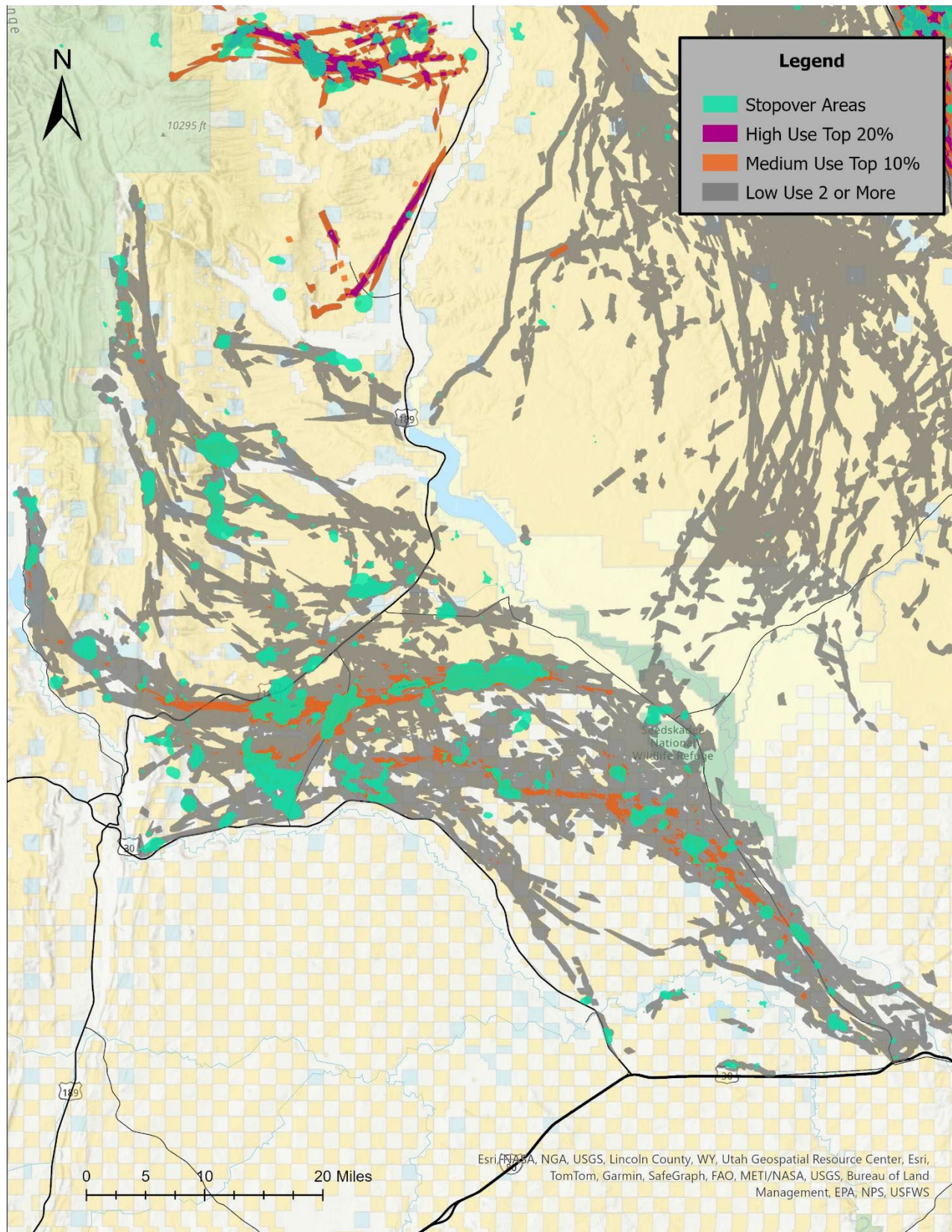
Entire Sublette Pronghorn Migration Corridor with Stopovers



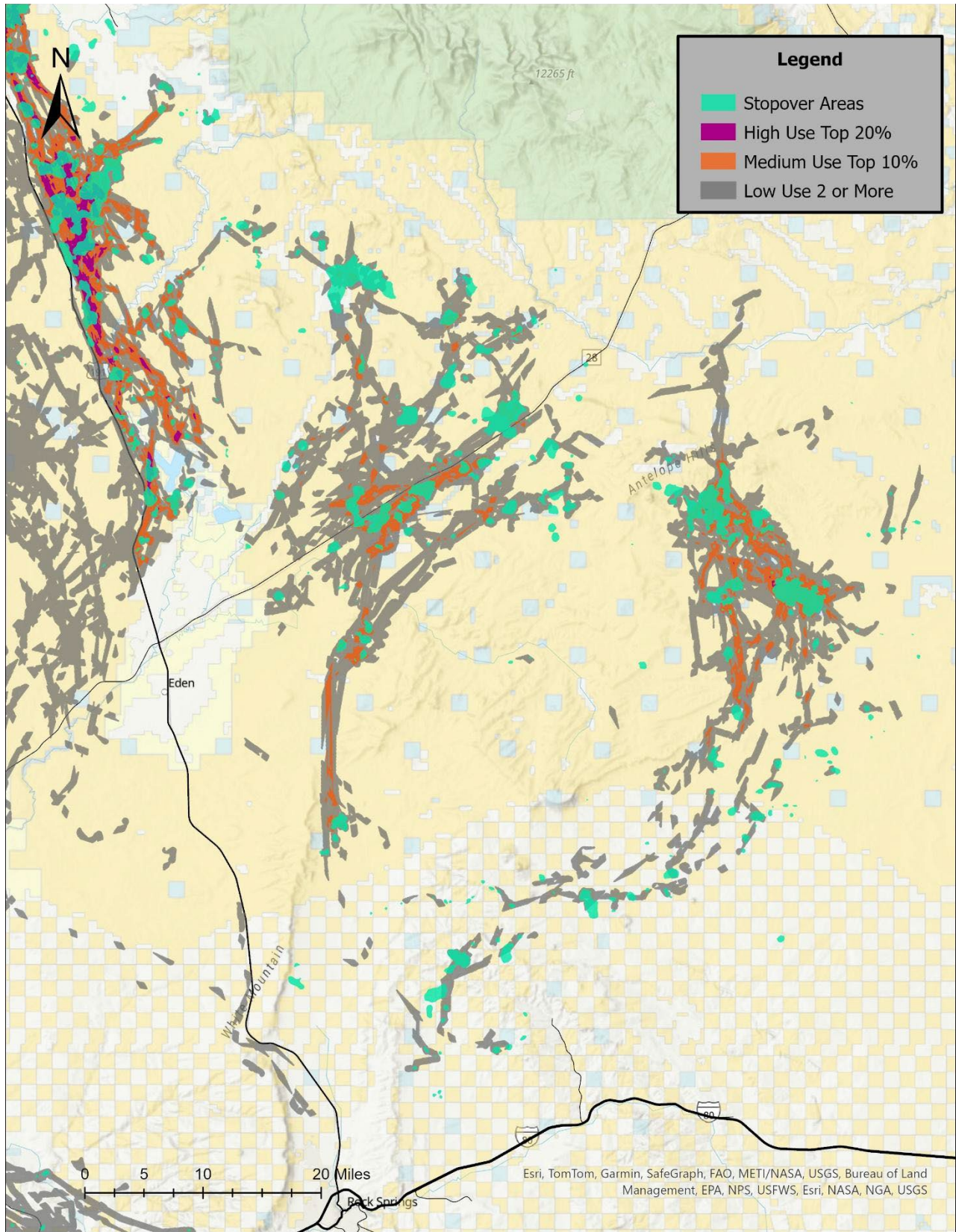
North section of Sublette Pronghorn Migration Corridor



Central section of the Sublette Pronghorn Migration Corridor



Southwest section of the Sublette Pronghorn Migration Corridor



Southeast section of the Sublette Pronghorn Migration Corridor

Literature Cited

Merkle, J.A., J. Gage, H. Sawyer, B. Lowrey, and M.J. Kauffman. 2022. Migration Mapper: Identifying movement corridors and seasonal range for large mammal conservation. *Methods in Ecology and Evolution* 13: 2397-2403.

Merkle, J.A., B. Lowrey, C.F. Wallace, L.E. Hall, L. Wilde, M.J. Kauffman, and H. Sawyer. 2023. Conserving habitat for migratory ungulates: how wide is a migration corridor? *Journal of Applied Ecology* 60(9): 1763-1770.

Sawyer, H., M.J. Kauffman, R.M. Nielson, and J.S. Horne. 2009. Identifying and prioritizing ungulate migration routes for landscape-level conservation. *Ecological Applications* 19 (8): 2016-2025.

Sawyer, H., Korfonta, N. M., Kauffman, M. J., Robb, B.S., Telander, A. C., and Mattson, T. 2022. Trade-offs between utility-scale solar development and ungulates on western rangelands. *Frontiers in Ecology and the Environment* 20(6): 345-351, doi:10.1002/fee.2498

United State Census Bureau. "Sublette County, Wyoming population by year, race and more." *USA Facts* Accessed September 13, 2023. <https://usafacts.org/data/topics/people-society/population-and-demographics/our-changing-population/state/wyoming/county/sublette-county/>.

Wyckoff, T. B., H. Sawyer, S. E. Albeke, S. L. Garman, and M. J. Kauffman. 2018. Evaluating the influence of energy and residential development on the migratory behavior of mule deer. *Ecosphere* 9(2):e02113. 10.1002/ecs2.2113

Appendix of Methods

In order to provide a better understanding of the data analysis that was completed for this migration corridor, this Appendix provides a summary of the methods used. Significant contributions have been provided by Dr. Jerod Merkle, Assistant Professor, Knobloch Professor in Migration Ecology and Conservation, University of Wyoming, who completed the data analysis for the Wyoming Game and Fish Department for this corridor.

Line Buffer and Brownian Bridge Movement Model (BBMM) analysis:

In the past, designated migration corridors were delineated with the BBMM for both corridors and stopovers (Sawyer et al. 2009). However, more recently, the line buffer analysis method was developed, tested by researchers with GPS collar data and published in a peer reviewed journal (Merkle et al. 2023). BBMM is a complex statistical model designed to account for uncertainty in movement between GPS fixes. BBMMs can produce highly variable corridor widths and non-contiguous corridors that do not fully connect seasonal ranges. These issues are magnified when there is a wide variety of fix rates on collars, such as in the Sublette Antelope herd data. To resolve these limitations, the line buffer method was developed to simplify the approach and allow for a stronger focus on the amount of space required by animals to migrate. The line buffer method simply applies a buffer to the straight line that connects successive GPS locations. Buffer widths can be determined based on the species and herd, depending on field-based knowledge of the needs of the migratory herd. For this herd we buffered each line by 300 meters (i.e., 300 m on each side of the line) which creates a functional corridor width of 600 meters (1,969 feet) for each movement sequence. BBMM is still the best scientific analysis method for identifying stopovers, and thus the BBMM method was used to delineate stopovers for the Sublette antelope herd.

Overall Sample Size:

The Sublette Antelope herd is one of the most data-rich ungulate populations in the world, with nine different GPS collar studies completed from 2002 to 2022. All of these available data were included in this migration corridor analysis. The original dataset included 613 individuals with functioning collars that lived for at least a few months during 2002 to 2022. Individuals had to survive long enough to migrate and had to show migratory behavior to be included in the final analysis. The final sample size for the Sublette Antelope corridors was 415 individuals representing 806 migration sequences. Based on a combination of field knowledge and the assessment of the GPS collar data across the herd unit, we estimate that > 75% of this herd displays migratory movements.

GPS Collar Studies conducted in the Sublette Pronghorn herd that contributed to the corridor delineation

Years	Project	Objective
2002-2003	Kemmerer	Fences and roads as barriers
2003-2004	Grand Teton NP	Jackson Hole movements
2005-2010	Pinedale Anticline	Effects of natural gas development
2009-2017	Pinedale Anticline 2	Effects of natural gas development
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2012-2013	Jack Morrow Hills	Movement in the Red Desert
2017-2018	I-80	Influence of climate and I-80
2018-2020	Sweetwater Solar	Effects of solar energy development
2020-2024	Distribution Gaps	Fill in areas between previous studies

Defining Migration:

To isolate sequences of individuals displaying migratory behavior, we used the following definition of migration: movements in spring or fall between distinct summer or winter seasonal ranges. In some cases, antelope made significant movements during winter. Those movements were not included unless they were connected (sometimes through a stopover site) to a spring or fall migration. Net Squared Displacement (NSD) graphs were created for each collared individual for each year, and only data from the migration periods are used for the migration corridor analysis. These graphs demonstrate the distance the individual traveled away from winter range, displayed over the timeframe of one year. The zone where this distance changes rapidly in the spring and fall is the period of migration, highlighted in blue and purple in Figure 1. Figure 1 shows a classic migratory movement sequence, Figure 2 shows a nomadic antelope movement sequence and Figure 3 is a resident antelope movement sequence.

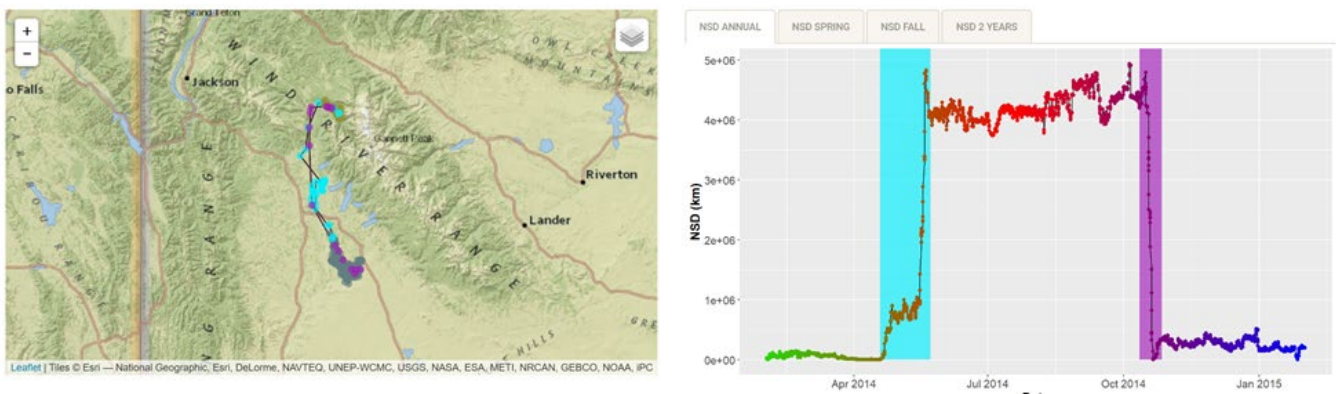


Figure 1. Example movement and net squared displacement graph of a migratory antelope from the Sublette herd. Light blue represents the spring migration sequence and purple represents the fall migration; the light blue and purple symbology on the movement map correspond to the Net Squared Displacement figure.

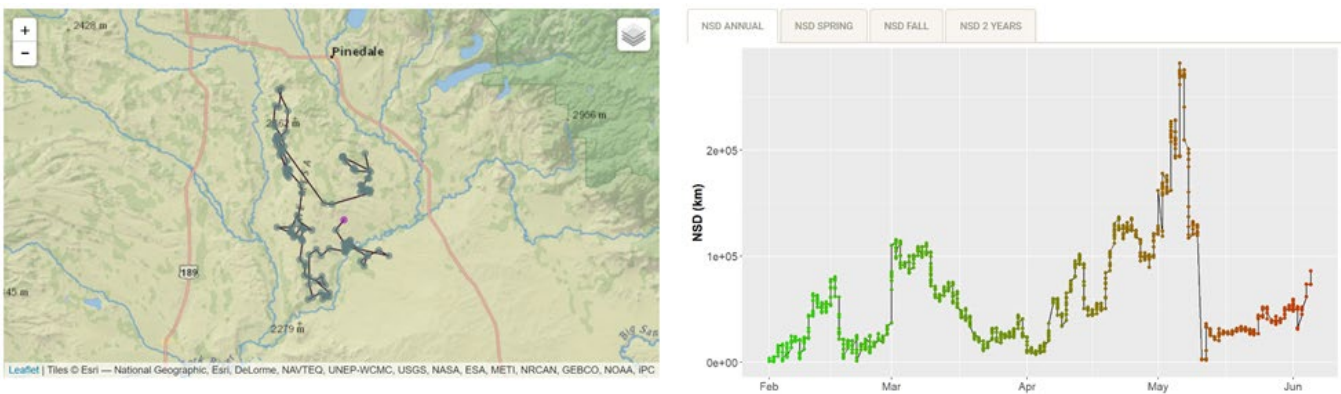


Figure 2. Example movement and Net Squared Displacement graph of a non-migratory nomadic antelope from the Sublette herd that was NOT included in the Sublette migration corridor analysis.

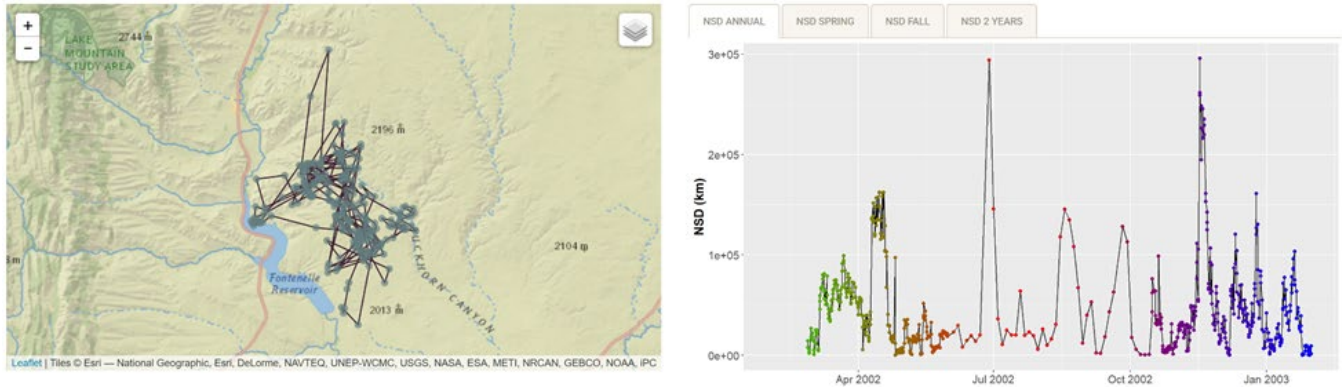


Figure 3. Example movement and Net Squared Displacement graph of a non-migratory resident antelope from the Sublette herd that was NOT included in the Sublette migration corridor analysis.

Sampling bias and subherds:

The sampling effort across the Sublette Antelope herd has not been uniform over time. For example, there have been over 150 individuals captured on the Mesa, whereas only about 50 individuals have been captured in the Southwest part of the herd. Ignoring such inconsistencies can bias migration corridors and stopovers towards areas where collaring effort was higher. To minimize potential sampling bias, the Sublette herd unit was divided into seven distinct subherds (see map-based definitions below). Line buffer and BBMM analyses were conducted separately for each of these subherds, and then merged to create final stopovers and corridors. Individuals that were captured in, or migrated through, each of these subherd areas were assigned to their respective subherd. There was generally little overlap (<2% of individuals) in animal movements between subherds, except in one situation. Most individuals from the North subherd were also found to be in the NE subherd. Thus, individuals that were identified as being in the North subherd were removed from the NE subherd.

Subherd definitions:

- Southwest: West of Green River, North of Interstate 80, South of LaBarge Creek
- Southeast: East of Highway 191, South of Big sandy reservoir
- Northwest: North of North Piney Creek, West of Green River
- Northeast: East of Green River, West of Highway 191 up to trappers point (The Mesa)
- West: South of North Piney Creek, North of LaBarge Creek, and West of Highway 189
- East: East of Highway 191, South of Pinedale, north of Big sandy reservoir, West of little sandy creek
- North: Individuals that migrate north of Upper green

Stopovers:

Stopovers are typically calculated as the top 10% of the area of use within the migration footprint (i.e., low use corridor). The area of use at the subherd level is calculated as the average of the area of use of all individuals in the subherd using the BBMM analysis (see Merkle et al. 2022 for details). In conducting this first analysis of

antelope migration data, it became clear that antelope migration routes are much more spread out and have less overlap than mule deer, resulting in a rather large low-use footprint relative to the area of the high-use corridor. Thus, after careful examination of the location and size of stopovers using different cut-offs, a value of 5% (instead of 10%) was used. This reduced the area of the stopover polygon by half and provided a more realistic representation of what regional biologists observe for this herd.

High-Medium-Low Corridor delineation:

High, medium and low use polygons are mapped to help managers understand the relative use of different parts of the corridor. These corridors are based on 'stacking' up each individual's migration footprints within each subherd, and then calculating the percent of the subherd migrating through (or using) an area of the landscape (see Merkle et al. 2022 for details). Once high, medium, and low use polygons are created for each subherd, they are merged to create the final high, medium, and low use polygons. For the high use corridor, at least 20% of the collared individuals in that subherd have to overlap in their migration footprint polygons. For medium use, at least 10% of the collared individuals' polygons have to overlap. For low use, at least two collared individuals have to overlap in their migration footprints. These distinctions give managers an indication of the proportion of the subherd that use an area during migration or the areas that have high concentrations of migrating animals. Low use areas are not necessarily used by less individuals, but the individuals that use the area are more distributed and less concentrated to major migration habitat areas.

Edits made to maps after initial analysis:

After the initial public review of the maps, several editing processes occurred in order to make the polygons more logically usable on the ground: 1) Disconnected island polygons of the mapped corridor that were less than 100 acres in size were deleted; 2) Islands (holes) polygons of unmapped corridors within the corridor less than .7 acres in size were filled (i.e., absorbed into and become part of the corridor); 3) Stopovers less than 5 acres were deleted; 4) Polygons of the mapped corridor falling outside the Sublette Antelope herd unit in the Carter Lease Herd unit were deleted; and 5) Mapped corridor that lay grossly outside of known antelope movement areas, which were due to long fix rates, in the Upper Green/Gros Ventre were corrected.