Teton County Wildlife-Vehicle Collision Database Summary Report

May 2019 – April 2021
(Two Year Summary)

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On the Cover:

Newly constructed wildlife underpass built under US Highway 89 South (Hwy 89S) as part of a larger mitigation project.

Photo: Renee Seidler

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Introduction

Jackson Hole Wildlife Foundation (JHWF) has collected wildlife-vehicle collision (WVC) data since the organization's inception in 1993. These data are collected as carcass reports from trained citizen scientists. In 2003, Biota Consulting summarized JHWF's data (Biota Research and Consulting, Inc 2003) and then in 2011 Huijser et al. wrote a comprehensive report using these data for specific sections of highway within Teton County. However, neither of these efforts comprehensively incorporated all datasets available, e.g., WYDOT crash data, or all major roadways in Teton County, WY. That same year, JHWF began developing a comprehensive WVC database for Teton County, WY with assistance from the Teton Science Schools' Teton Research Institute (TSS-TRI). The goal was to collate and standardize WVC data from citizens, Wyoming Game and Fish Department (WGFD) reports of roadside carcasses and crash reports from Wyoming Department of Transportation (WYDOT) so that these data could be viewed and utilized in a comprehensive manner. Wildlife-vehicle collision data are the summation of both carcass and crash data.

JHWF's WVC database serves as a WVC data hub for use by town and county planners, wildlife managers, land managers, elected officials, transportation planners, scientific researchers and others. The database tool facilitates scientifically-based decision making regarding WVC mitigation and transportation management.

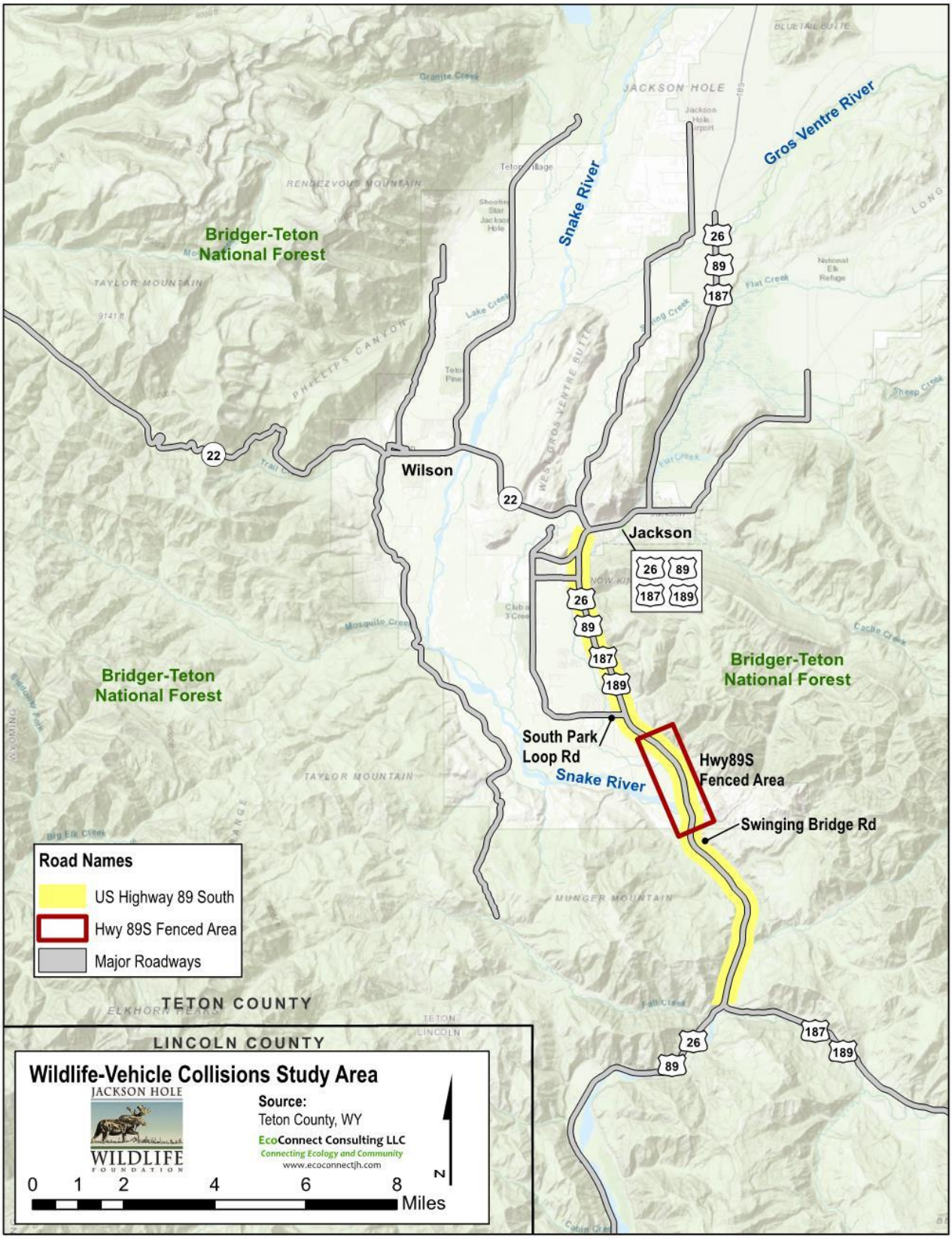
In 2015, JHWF began creating reports summarizing these data for use by government agencies and other partners. These reports focused on southern Teton County, WY (Figure 1) as Grand Teton National Park maintains its own database. Data were also collected for roads in the Alta area and Togwotee Pass. These summaries have influenced many management actions for wildlife protection along roadways in Teton County including:

- a collaborative signage program between JHWF, Wyoming Game and Fish Department, Teton County, and Wyoming Department of Transportation (WYDOT) to increase awareness near WVC hotspots;
- the creation of a County-wide plan to mitigate WVC and increase landscape permeability across roads (Huijser, et al. 2018);
- in 2019, the overwhelming public support for Special Purpose Excise Tax funding for WVC mitigation projects; and
- the use of WVC data to inform and design several wildlife crossing structures and fencing projects with WYDOT, including South Highway 89 and the Snake River Bridge Project at the intersection of Highways 22 and 390.

Each of these progressive efforts aimed to reduce WVCs in Teton County. Nonetheless, the greatest protection for wildlife that allows safe movement across roadways, particularly within the context of continually increasing automobile traffic and widening roadways, has been the installation of well-designed and accurately placed wildlife crossing structures with accompanying funnel fencing (86% effective; Huijser, et al. 2009). Appendix A contains background information on mitigation efforts employed in Teton County.

Through past efforts and JHWF's partnership with WYDOT and Teton County, wildlife underpasses and associated fencing have been implemented or are under construction including the ongoing US Highway 89 South (Hwy 89S) expansion project south of Jackson and at the upcoming Snake River Bridge project that includes the realignment of the Highway 390 and Highway 22 intersection in Wilson. With the use of JHWF's Wildlife-Vehicle Collision Database, both of these projects have presented an opportunity to examine the effects of WVC mitigation efforts on the number of WVCs reported annually within Teton County. Preliminary analysis of a section of the Hwy 89S expansion project has been included in this report.

Figure 1. Study Area



Methods

Wildlife-Vehicle Collision Data Processing and Sources

The WVC database was updated annually using an automated process. This process stored all WVCs in a Structured Query Language (SQL) database where it could be accessed in ArcMap (https://www.esri.com/en-us/arcgis/about-arcgis/overview), via a Spatial Database Engine (SDE) connection, and in Program R (https://www.r-project.org/), via a remote database connection. The SQL database allowed all raw data to be stored in one place. Using saved queries, these data were formatted and combined into one large database. This database was run through an iterative loop in Program R that identified duplicates based on distance (<0.25 mi) from other observations, sample date and species. For example, if two mule deer were reported on the same day 0.20 miles from each other, the reports were flagged as possible duplicates and reviewed by a trained biologist. Annual observations were added to the SQL database and queried to identify, assess and eliminate duplicates.

WYDOT maintains spatial datasets for all major travel routes in Wyoming. These spatial datasets used linear-referenced system (LRS) geometry containing route and measurement attributes. Before raw WVC data were queried in a SQL database, each observation was joined to the nearest WYDOT LRS route using the "Locate Feature Along Route" tool in ArcMap.

When duplicates were identified in Program R, optimal observations were selected based on the data source. Table 1 indicates the ranking of the data sources included in the JHWF WVC database. If duplicate observations were found in multiple data sources, the record from the source with the highest rank (lowest number) was retained. The rankings were based on relative spatial accuracy and species sex/age identification.

Table 1. Data Source Ranking and applicable years.

DATA SOURCE	Source Rank
Jackson Hole Wildlife Foundation Nature Mapping Observations (2010-2021)	1
Jackson Hole Wildlife Foundation Roadkill Hotline (2012)	2
Wyoming Game and Fish Department Wildlife Observation System (2014-2021)	2
Wyoming Department of Transportation Crash Data (1994-2021)	3
Wyoming Department of Transportation Carcass Pick-Up Data (1999-2021)	4
Jackson Hole Wildlife Foundation Roadkill Hotline, Other Data Sources (1990-2009)	5
Wyoming Game and Fish Department Wildlife Observation System (1976-2013)	6

Important Caveats of the Database

- No records were included within Grand Teton National Park at the Park's request. The Park maintains a separate database.
- The database combined a mix of data collected by different means with different accuracies.
- Some observers were trained biologists while others were not (e.g., volunteers).
- Annually, there was a large effort to remove potential duplicates among different sources.
- Date/time was not a record of actual time of death, but rather the observation time of the dead animal.
- The database was likely heavily biased by ungulates. These were the species that WYDOT picked up and that caused WVCs large enough to call the authorities. Ungulates are also more readily observed by citizen scientists.

- This database was likely a significant underestimate of WVC occurrences in Teton County, WY even for ungulates. Many WVC events go unreported or animals are hit and die out of sight from roads (*C. Riginos, pers. commun.*).
- The database was likely biased by larger roads (more observers and higher traffic volumes).
- Documentation and interest have improved in recent years. These data were likely biased by year. WYDOT has collected data since 1990, but other groups started later. WYDOT's documentation has also improved in recent years.
- WVC numbers were likely influenced by winter conditions; higher collision rates likely occurred during more severe winters when ungulates were concentrated close to roads.

WVC Hot Spot Mapping

Hotspots were identified using the Kernel Density tool in ArcMap 10.6. The colors represent the probability density of WVCs occurring based on the search radius.

For the purposes of these WVC data, a WVC year was May 1 – April 30 (e.g., 2020-2021: May 1, 2020-April 30, 2021). This year better represented the seasonal trends associated with WVCs than a calendar year. Data used for raster creation included the previous 10 years of WVC data inclusive of WVC years 2011-2012 through 2020-2021 (i.e., May 1, 2011 – April 30, 2021). These 10 years of WVC data correspond to the report's figures and "WVC Summary Table - Count of WVC Species by Year" found in Appendix B.

Two raster layers were created for each of four analyses: all species recorded, moose, mule deer and elk. The coarse resolution layer, which appears smoother by generalizing hotspots, identifies searches for WVCs within 300 m of each 50 m pixel (stretch symbology using 3 standard deviations). This course resolution layer was used in this report's maps. The finer resolution layer identified WVCs within 100 m of each 50 m pixel resulting in a more precise hotspot depiction and, while not included in this report, were created for the JHWF Team and may prove useful for future management decisions. These raster layers were clipped to 100m on either side of major roadways in southern Teton County, WY using the Extract by Mask tool in ArcMap. Major roadways were chosen based on traffic levels or where future roadway projects were proposed (e.g., South Park Loop). WVCs reported on roadways outside of those depicted were not represented in these figures.

Roadway Names

The study area and major roadways are depicted in Figure 1.

While the highway from the center of Jackson south to Hoback Junction is a component of Highways 26, 89, 187 and 189, the section of this roadway from the intersection with Highway 22 to Hoback Junction is commonly referred to as "US Highway 89 South" (Hwy 89S) and is therefore referred to as such in this report. In Figures 4, 5, 7 & 9 "South 89" data refers to WVCs reported on this section of US Highway 89 South.

Broadway/ Refuge data are for WVCs reported north of the Hwy 22 on Highway 89/ Broadway and onto the Refuge Rd.

WY22 data are from the intersection with Highway South 89 west to the Teton County line.

WY 390 data are from the intersection with Hwy 22 north to the Grand Teton National Park boundary.

Results

2019-2021 Data Update

There were 220 total reported WVCs in Teton County during May 2019 – April 2020 and 165 reported WVCs in Teton County during May 2020 – April 2021 (Figure 2). The 2019-2021 three-year average (~217) was down from the previous high mark (~274), which occurred during the previous three years (2016-2018; Figure 3). This high 2016-2018 average was heavily influenced by the 2016-2017 winter, which was very severe and may have caused many animals to concentrate near roads. The number of reported WVCs in May 2020 – April 2021 was also down from the ten-year average of 234 WVCs per year.

Since the 2011-2012 WVC year, the dataset has been heavily weighted by ungulate species. Elk represented 16%, moose 7% and mule deer 67% of the total WVCs reported. Other species represented approximately 1% of the WVCs counted during these ten years. They included coyote, North American porcupine, red fox, striped skunk and white-tailed deer. In 2020-2021, there were 19 striped skunk WVCs reported out of 35 total for the ten-year period. The remaining species each represented less than 1% of the ten-year dataset (Appendix B).

Figure 2. Total Annual WVCs in Teton County, WY

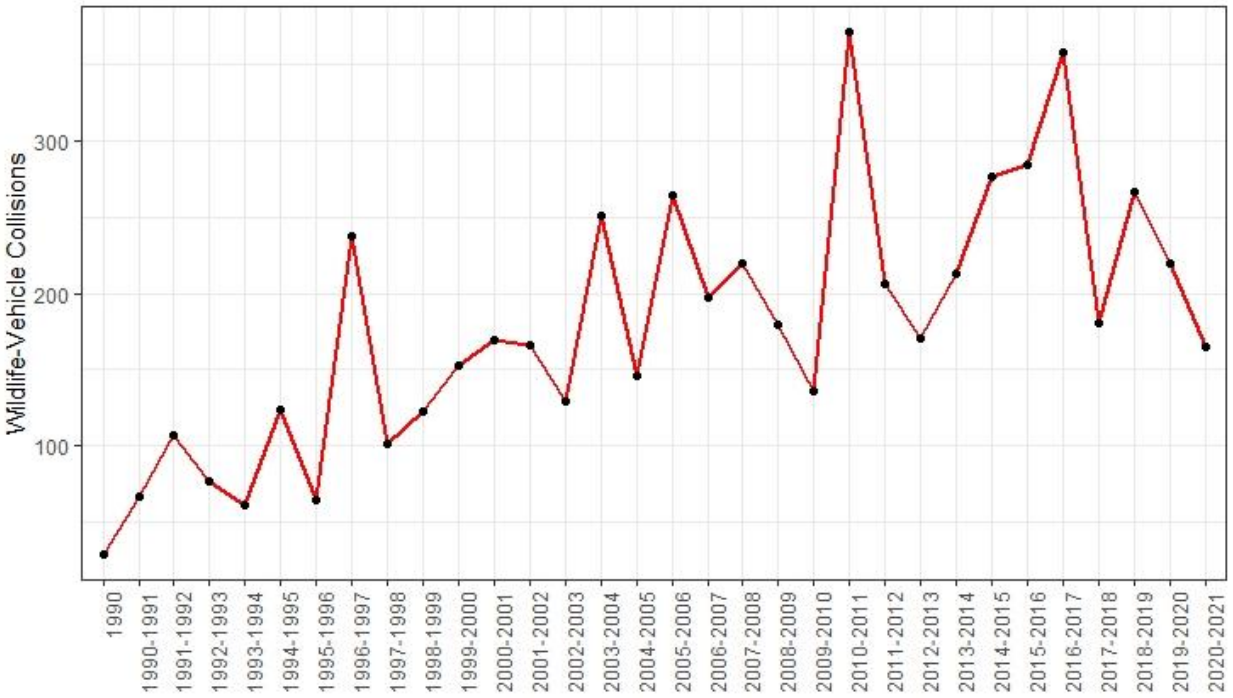
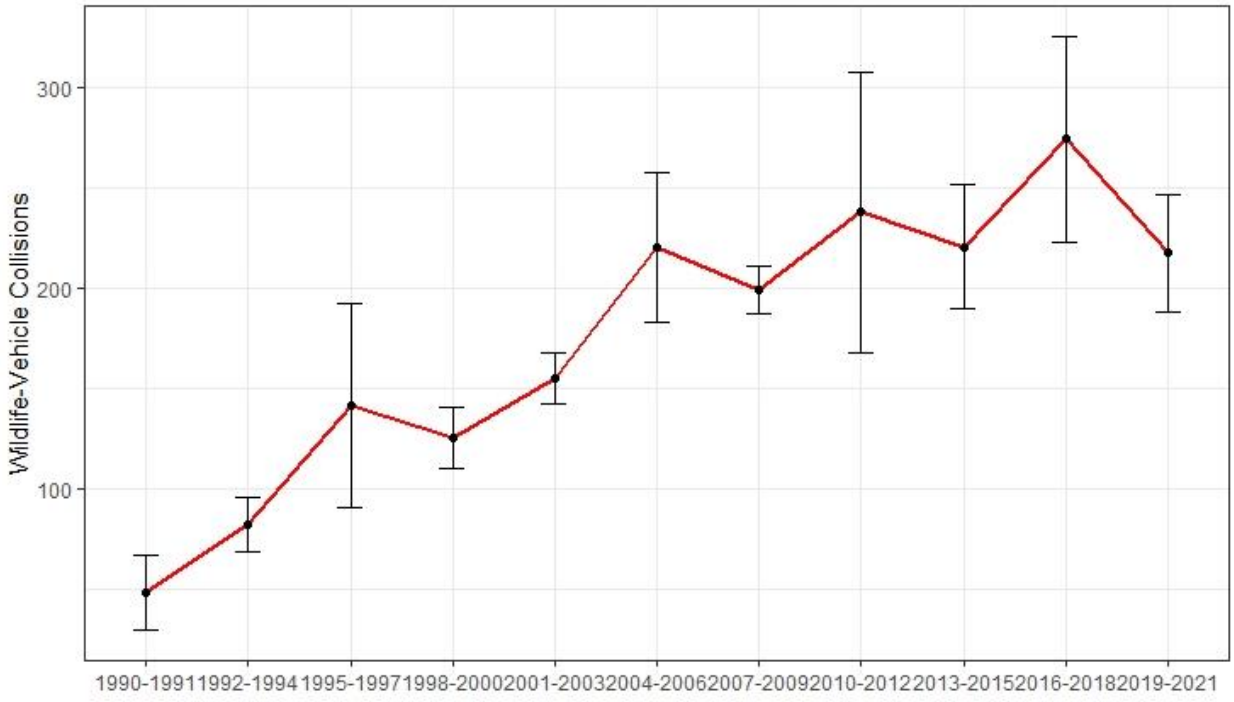


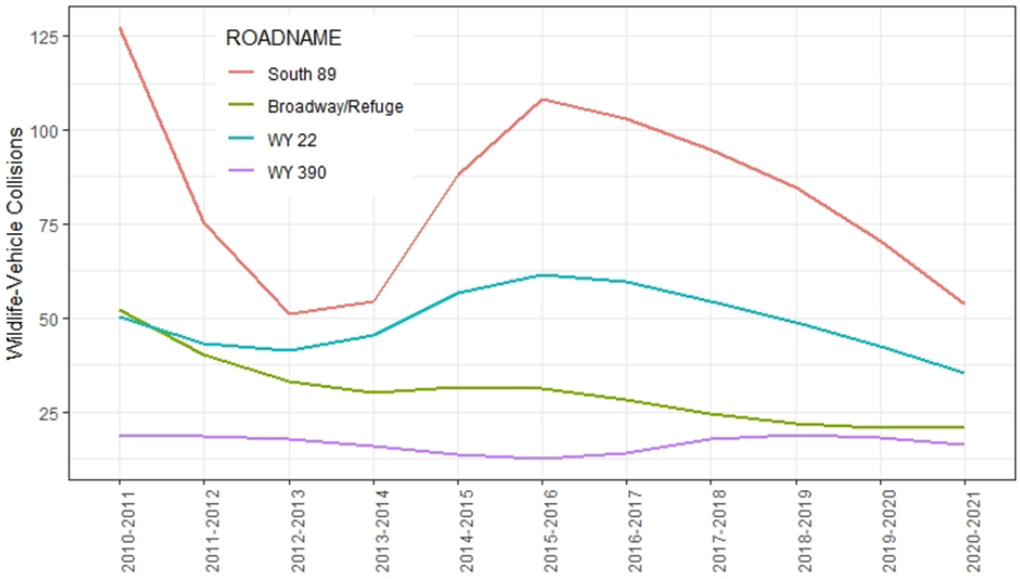
Figure 3. Three-year averages of total annual WVCs in Teton County, WY



Highway Trends

Since a high in 2015-2016, WVCs reported continued to trend downward or remain stable on state and federal highways in Teton County (Figure 4).

Figure 4. Total Annual WVCs by Major Highway in Teton County, WY 2010-2021



Elk

There were 47 elk WVCs reported in Teton County during May 2019 – April 2020 and 37 reported in May 2020 – April 2021. 2019-2020 was higher than the ten-year average of 38 reported WVCs per year while 2020-2021 was approximately the same as the average. In 2019-2020, WY 22 had the highest elk WVC count since 2016-2017 while in 2020-2021, elk WVC counts on WY 22 and WY 390 decreased (Figure 5, Figure 6).

Figure 5. Annual Elk WVCs by Major Roadway in Teton County, WY 2010-2021

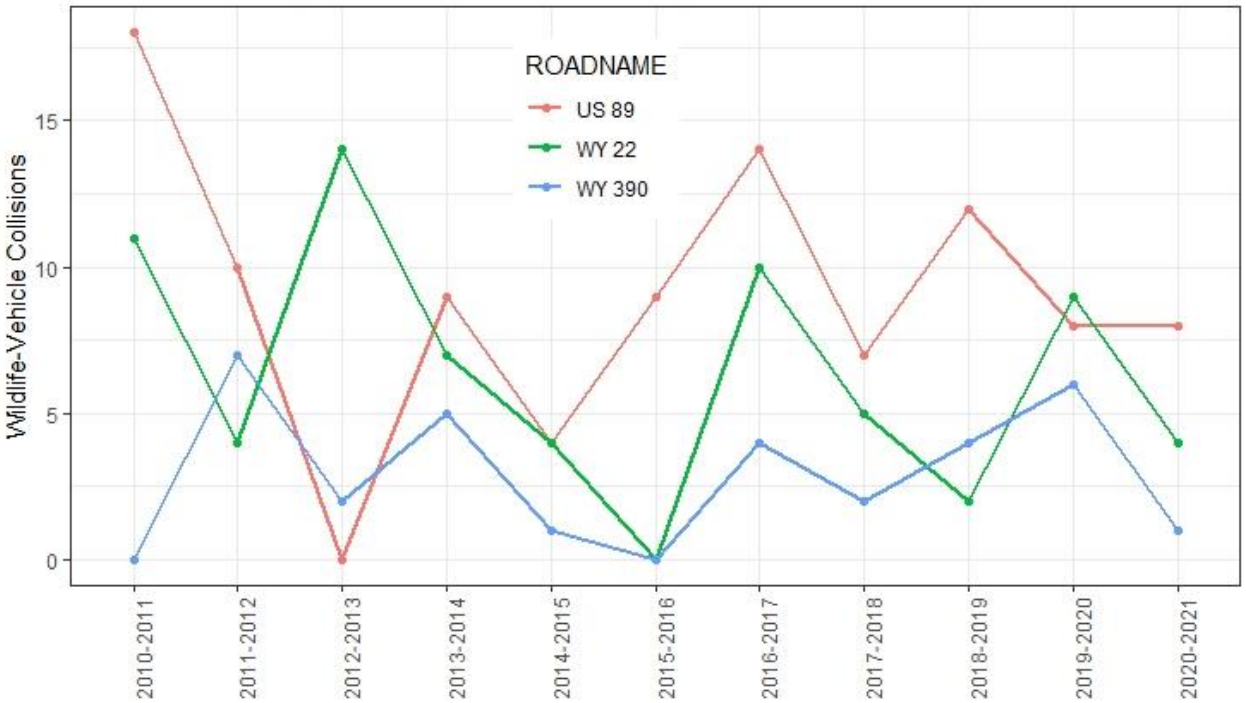


Figure 6. Elk-Vehicle Collision Hotspots (May 2011-April 2021)

Moose

There were 14 moose WVCs reported in Teton County during May 2019 – April 2020 and 10 reported during May 2020 – April 2021. These years were both lower than the ten-year average of 16 reported WVCs annually. Nine moose WVCs were reported on WY 22 in 2019-2020 and 4 were reported on WY 22 in 2020-2021. Since 2012, moose WVC counts on WY 22 peaked in 2017-2018 and have steadily declined since then (Figure 7 & Figure 8).

Figure 7. Annual Moose WVCs by Major Roadway in Teton County, WY 2010-2021

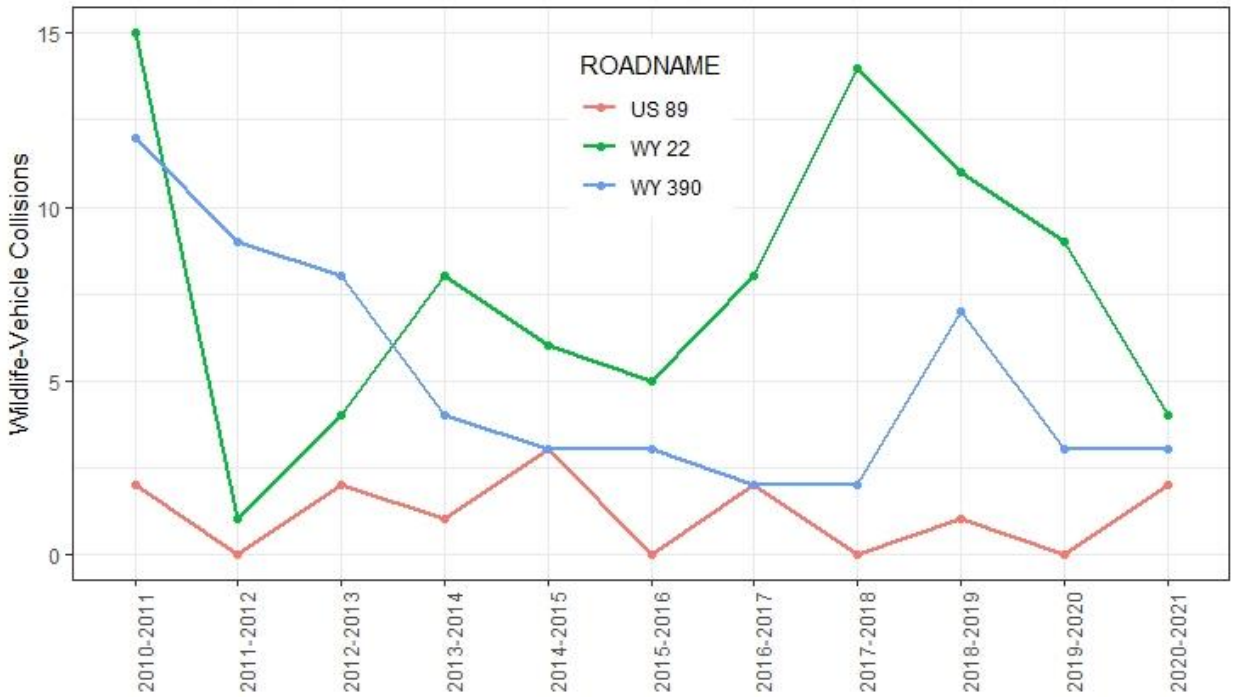
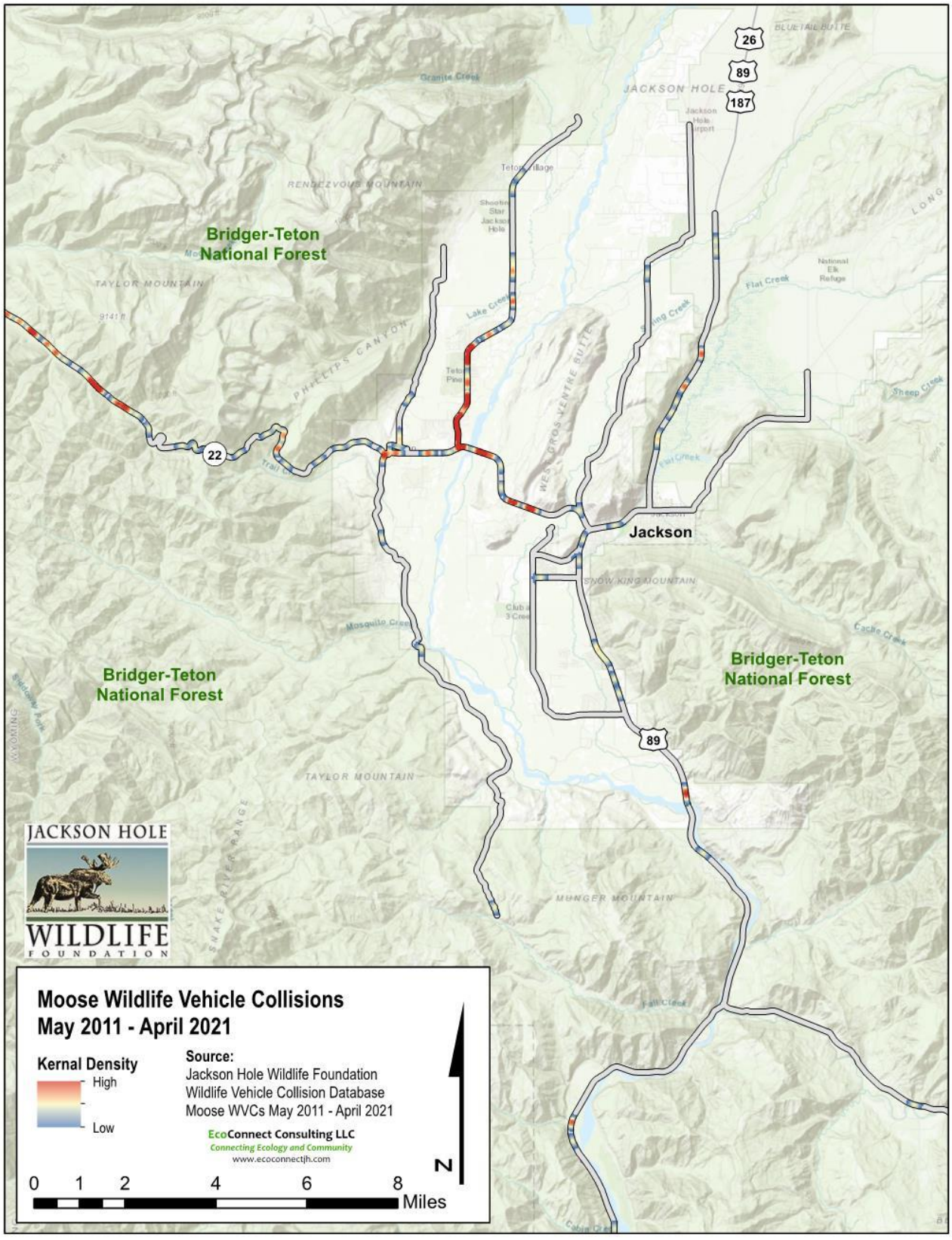


Figure 8. Moose-Vehicle Collision Hotspots (May 2011-April 2021)



Mule Deer

There were 132 mule deer WVCs reported in Teton County during May 2019 – April 2020 and 86 mule deer WVCs reported in May 2020-April 2021. These years were both under the ten-year average of 157 reported WVCs per year.

In 2020-2021, there were approximately 33 mule deer WVCs reported on US 189/US 191/US 26/US 89 (US89) from the center of Jackson to Hoback Junction, which comprised 38% of the total mule deer WVCs reported in the County (Figure 9). Mule deer WVC counts on this stretch of highway over the last ten years represented between 30-52% (40% average) of the total mule deer WVCs reported in Teton County, WY (Figure 10).

Figure 9. Annual Mule Deer WVCs by Major Roadway in Teton County, WY 2010-2021

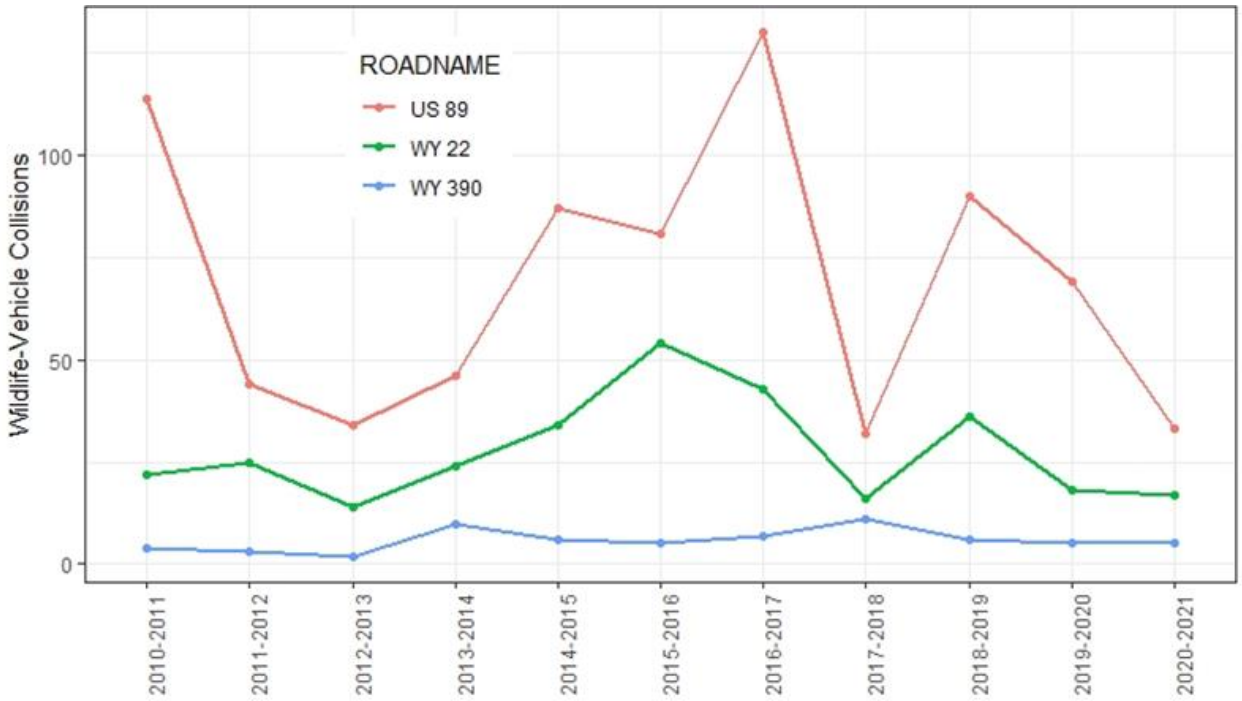
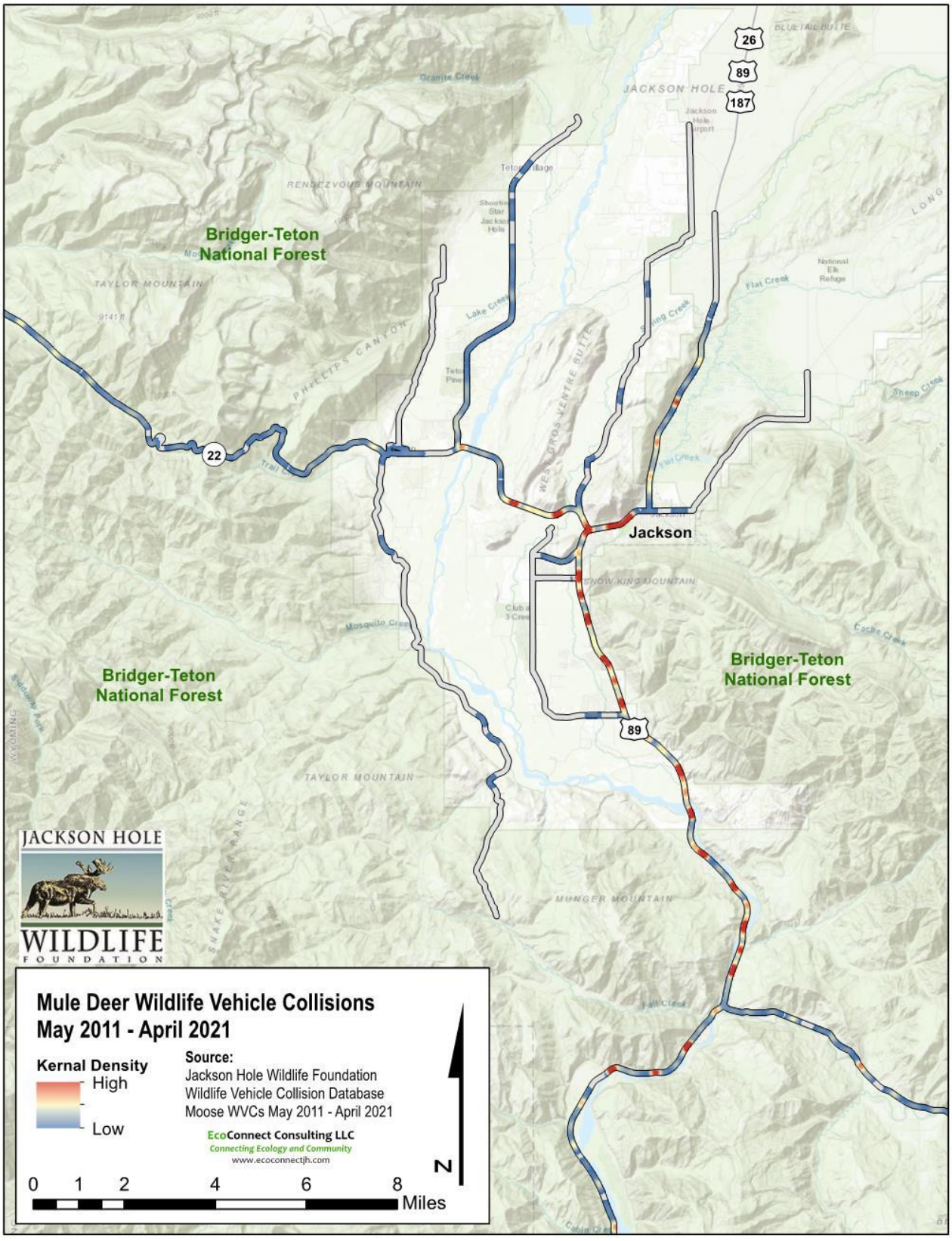


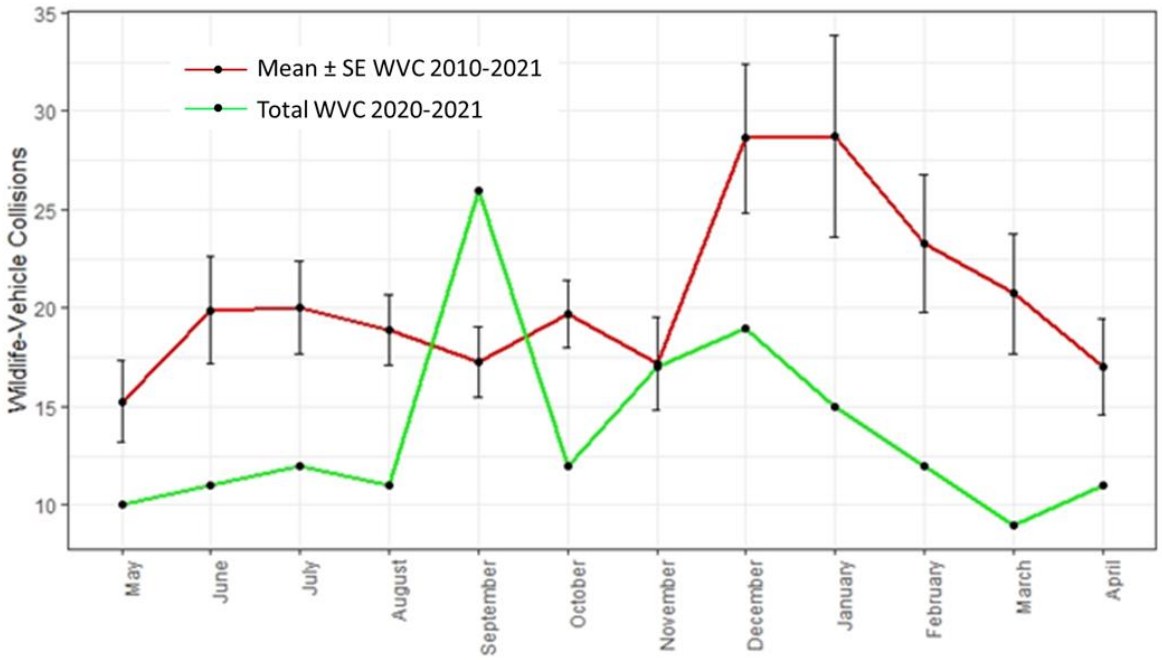
Figure 10. Mule Deer-Vehicle Collision Hotspots (May 2011-April 2021)



Seasonal Trends

WVC numbers in 2020-2021 followed a similar monthly trend as the previous 10 years (2010-2021) except for September 2020 which showed a spike in WVCs in excess of the monthly mean for September. During the previous ten-year period, December and January had the highest WVC counts. Except for September 2020, this trend was similar in 2020-2021. However, throughout 2020-2021, except for September, the total WVCs reported were generally lower than previous years.

Figure 11. Seasonal Trends of WVCs in Teton County, WY 2010-2021

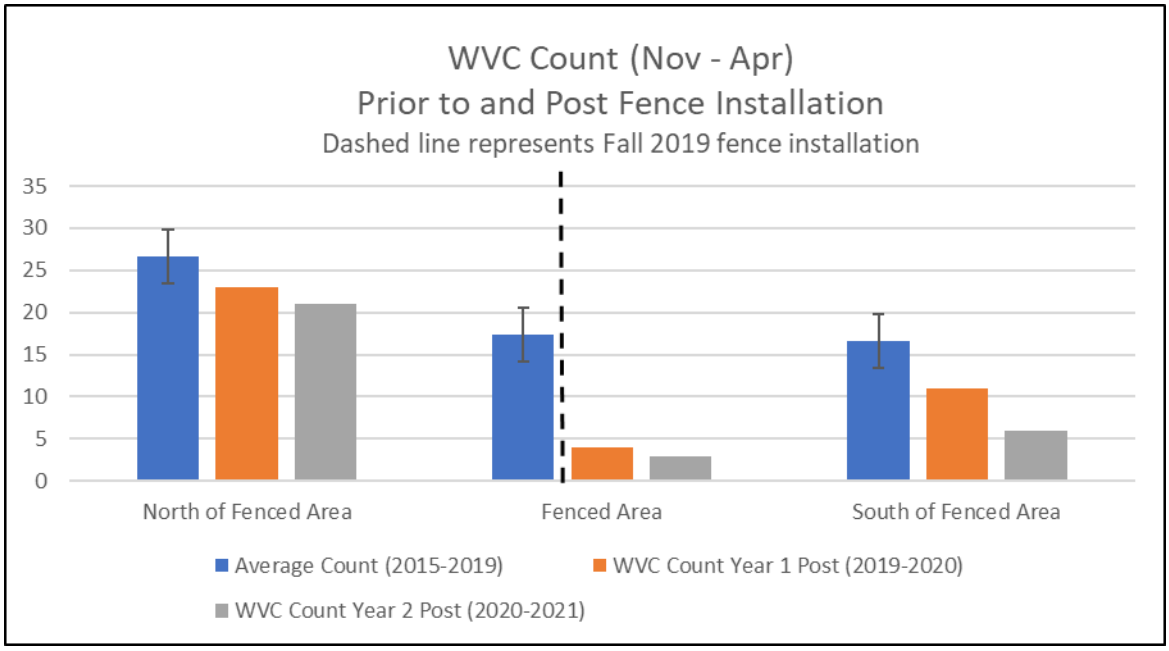


US Highway 89 South Mitigation

WVC mitigation, including wildlife fencing and crossing structures, has been implemented along a stretch of highway south of Jackson. Even though the Hwy 89S project has not been completed, WVC counts in the fencing project (Figure 1) area between South Park Loop Road and Swinging Bridge Road indicate that the mitigation may already be successful. Dr. Hannah Specht from the University of Montana has found that "The most important insight is that there were 30% fewer collisions between vehicles and large animals (elk, deer, moose) between Hoback and Jackson in just the first winter (2019-2020) that the underpass and fencing were installed (with the fencing extending only ~30% of the distance)" (Specht 2022). Specht estimated that this 2019-2020 reduction in WVCs represented approximately $200,000 in cost savings to the community in only one year.

Based on 2019-2021 collision data within this mitigated highway section, an average of 17 ungulate WVCs per year were reported during the five years prior to fence installation (WVC years 2015-2019). In WVC year one post fence installation (2019-2020), four WVCs were counted while in year two post installation (2020-2021) three WVCs were recorded (Figure 12). In unfenced areas to the north and south of the fenced area (north to the intersection with WY 22 and south to Hoback Junction), WVC counts in years one and two post fence installation were less than the average of the previous five years but were not as reduced as in the fenced area.

Figure 12. WVC Count Prior to and Post Fence Installation on a section of US Highway 89 South



Discussion

Summary for Teton County, Wyoming

Wildlife-vehicle collision observations are typically underreported. Conservative estimates suggest that wildlife-vehicle collisions are 2-4 times higher than what is reported (*C. Riginos, pers. commun.*). Some animals are injured but able to move away from the roadway before dying or succumbing to their injuries, undetected. Furthermore, carcass persistence is low for smaller species, such as birds and small mammals, and it is difficult to see smaller carcasses while driving (Guinard et al. 2012; Teixeira et al. 2013). Therefore, small carcasses are rarely reported to databases like ours. Even large-bodied animal carcasses can disappear from roadways. Scavengers can drag them substantial distances and carcasses in the lanes of traffic can be removed by agency personnel or concerned citizens who may not report them. Our data are incidental and primarily collected by citizen scientists, so these numbers should be considered a minimum count and it should be assumed that the true numbers are significantly higher.

During May 2019 – April 2020 a total of 220 WVCs were recorded. However, given the vast underreporting of WVCs, even when rigorous survey efforts are undertaken, the actual number of WVCs were likely 440-880 or 2x to 4x higher (Guinard et al. 2012; Slater 2002; Teixeira et al. 2013). Likewise, during the May 2020-April 2021 reporting year, 165 WVCs were recorded. Given the underreporting multipliers, the actual number of WVCs for 2020-2021 likely ranged between 330 and 660.

Trends

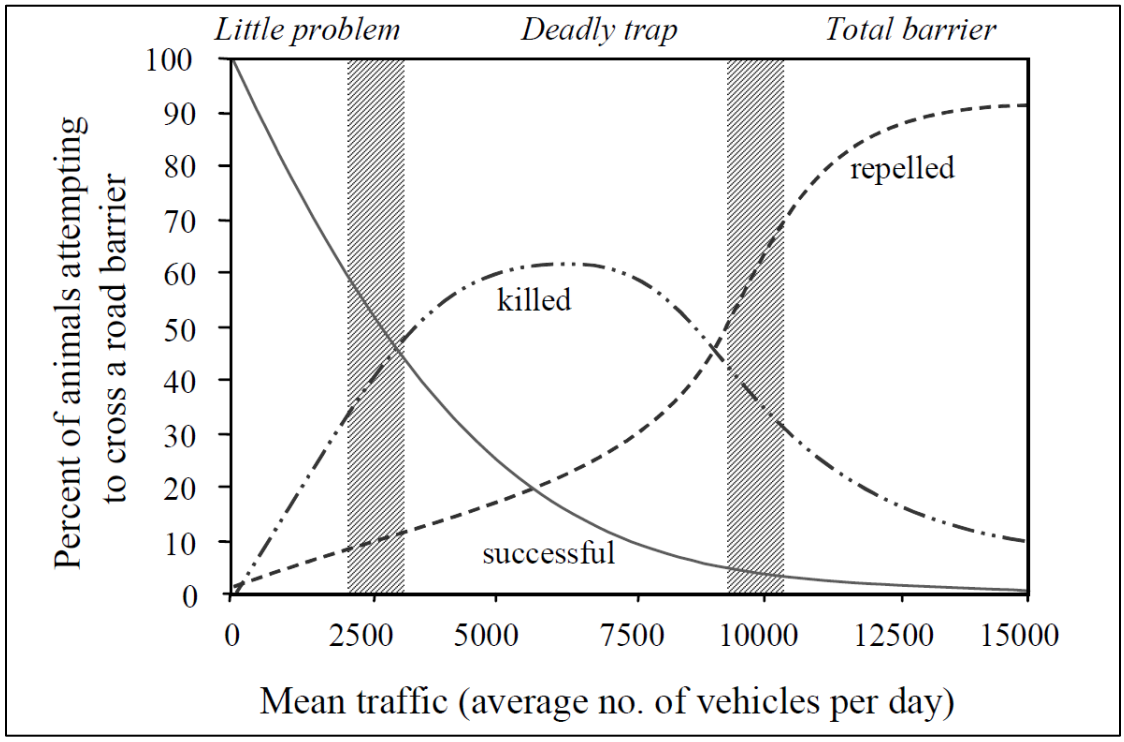
Since 1990 (Figure 2), when roadkill data collection efforts began in Teton County, the number of reported WVCs has steadily increased; however, the last three-year average (2019-2021) WVC rate has decreased (Figure 3). The reason for this decrease is unknown and could be due to a combination of factors.

Data from the South Highway 89 project indicate that the completed wildlife underpasses and fencing have reduced WVCs along this section of road. Once the rest of the project is completed, we expect a further reduction in WVCs. During the COVID-19 pandemic in 2020 and 2021, traffic patterns across the United States were altered as a result of shelter-in-place orders and other restrictions implemented to slow the spread of the novel coronavirus (Plumer and Popovich 2020). The Town of Jackson implemented a stay-at-home order on March 28, 2020 (Arnold 2020). Interestingly, March and April of 2020 saw lower WVC reports than the same months in previous years. We do not have data to demonstrate that this reduction in WVCs was directly caused by reduced traffic numbers. Furthermore, during the 2020-2021 pandemic years (and continuing to present) Teton County, Grand Teton National Park and Yellowstone National Park have seen record numbers of visitors (Grand Teton National Park 2022), potentially leading to animals being repelled from roads due to the impediment high traffic levels create (Figure 13; Riginos, et al. 2018; Seiler 2003). While the 2020-2021 monthly WVC counts were mostly below the ten-year average (Figure 11), except for September 2020, this trend may not continue through the 2021-2022 reporting year. If we continue to see reduced WVC trends on busy roads, it would be prudent to assess habitat connectivity across roads.

While it is difficult to pick out trends in the species-specific data, it is important to continue collecting WVC data in Teton County. Long-term datasets are valuable for assessing trends over time. For instance, in 2016-2017, mule deer WVC counts peaked in Teton County, WY, with 265 mule deer WVCs reported that year. In 2019-2020, only half that number (132) were reported. In 2020-2021, only 86 mule deer WVCs were reported equating to 32% of those reported in 2016-2017. Is this downward trend a result of mitigation efforts, driver

awareness, weather, management decisions or increased traffic density? Questions such as these cannot be answered without the benefit of a long-term dataset.

Figure 13. Conceptual model on the effect of traffic volume on the percentage of animals that successfully cross a road, are repelled by traffic noise and vehicle movement, or get killed as they attempt to cross. Adapted from Seiler 2003.



While wildlife crossing structures have proven to be one of the most effective means of lessening wildlife-vehicle collisions and increasing habitat permeability (Huijser, et al. 2009), these mitigation strategies are not possible on all roadways. Increased awareness by individual drivers is an important variable particularly as traffic volume and roadway width continue to increase in Teton County. It is the Jackson Hole Wildlife Foundation's goal to implement education and awareness campaigns that facilitate the heightened awareness and behavioral changes needed for drivers to reduce wildlife-vehicle collisions.

Suggested Citation

Jackson Hole Wildlife Foundation. 2022. Teton County Wildlife-Vehicle Collision Database Summary Report (2019-2021). Jackson, WY.

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Dr. Hannah Specht, *Where does the chicken cross the road? Thoughts on the things we wouldn't know without your help.* JHWF March 1, 2022 blog provided the initial data analysis on US Highway 89 South mitigation project.

Data were generously contributed by the dedicated citizen scientists of Nature Mapping Jackson Hole, WYDOT and WGFD.

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Appendix A: Overview of Wildlife Mitigation on Teton County Wyoming Roads

Signs

Signs have been effective in reducing WVC in cases when other types of mitigation are not practical or possible. However, there has been variability in the effectiveness of signs based on the type and utilization of the sign being used. Permanent static signs (yellow diamond with Deer Crossing and/or an image of a deer) have been found to be less effective than moveable enhanced signs (Beckmann, et al. 2010). Effectiveness has typically been measured as driver speed reduction rather than WVC reduction because in most cases WVC data was not rigorously collected before and after signage was implemented (Sullivan, et al. 2004). Enhanced signs are most effective when they possess "larger-than-typical sizes and fonts and include flashing lights, bright flagging, and reflective backing" (Hardy, et al. 2006). It is also important that the sign(s) be located as close to WVC hotspots as possible and that they are activated during seasonal and daily movements (migration periods and crepuscular hours, (Hardy, et al. 2006). Al-Ghamdi and Algadhi (2004) found that motorists are likely to reduce speed for about 500 m before an enhanced sign and 500m after passing the sign. Similarly, a survey of motorists in Australia found that motorists are more likely to respond to signs possessing evidence of WVCs (e.g., year-to-date number of carcasses found; Blacker and Jones 2013). This Australian study also found that motorists are unlikely to respond to signage that exists in areas where evidence of the problem does not exist (e.g., where carcasses are removed from the road, a displayed year-to-date number could help improve motorist response; Blacker and Jones 2013). Blacker and Jones acknowledged that what motorists *think* they would do and what they *actually* do may not be congruent. Multiple studies have emphasized the importance of using wildlife signs during times of heightened WVC risk (Hardy, et al. 2006; Sullivan, et al. 2004).

Ultimately, to be effective, signs must be reliable, legible, and attention-catching; effectiveness may increase if signs are used sparingly and strategically. When enhanced signs were displayed to traffic during ungulate migration season in Utah, a 50% reduction in speeding vehicles was documented as well as an estimated 50% reduction in WVCs (Sullivan, et al. 2004). Although enhanced signs have been shown to influence speed reduction and estimated WVC occurrence, the effect was often ephemeral. Sullivan et al. demonstrated effectiveness of enhanced signs in slowing motorist speed in the first year of their study but the effect was reduced in the second year of the study (2004). Some studies demonstrate a 0% effectiveness of novel, enhanced signs on WVC reduction (Rogers 2004). Well placed, seasonal warning signs can have an impact on motorist behavior and reduce WVCs by 26% on average (Huijser, et al. 2009) but even the most strategic and dynamic signs do not compare to the 86% effectiveness of crossing structures with fencing (Huijser, et al. 2009). It should be noted that while signs can be effective in reducing WVCs, they do little to ensure the permeability of the landscape for animal movement (Huijser, et al. 2009).

Since 2006 JHWF has been working with WYDOT and Teton County to implement signage in the form of dynamic message signs (DMS; large signs with the ability to display different messages) and fixed radar signs (signs that display a motorist's speed and the speed limit). The signs have been positioned strategically near WVC hotspots. To maintain effectiveness, WYDOT has moved the DMS and changed the messages periodically according to JHWF and WGFD recommendations. JHWF also worked with transportation partners to lower speed limits in areas where WVCs were frequent, such as near the intersection of Highways WY 390 and WY 22. Some of the fixed radar signs were programmed to display the night-time speed limit after dusk.

Crossing Structures

Crossing structures with fencing are the most effective form of mitigation for WVCs with an 86% effectiveness rate (Huijser, et al. 2009). Importantly, crossing structures with fencing are also the only type of WVC mitigation

that maintains or increases landscape permeability for large mammals. However, not all crossing structures are suitable for every species. There is variability in species' willingness to use crossing structures depending on the type and size of structure and the amount of human use near or on the structure (Clevenger and Waltho 2000). Overpasses are ideal for species that prefer large, open spaces with good visibility, such as moose, grizzly bears, bighorn sheep and pronghorn. However, these species may not approach multi-use structures that accommodate human passage as well. In Banff National Park, large carnivore use of underpasses decreased with increasing human use and increased with increasing distance from the nearest town (Clevenger and Waltho 2000). Alternatively, ungulate use of underpasses was more strongly correlated with structural and landscape factors (openness and width) than with human use. Ungulate use of underpasses was negatively correlated with underpass openness and width. Underpasses with large openings can be used by species such as deer and cougars (Clevenger and Huijser 2011). If dimensions are sufficient (40-foot width and 15-foot height), some species, such as moose, grizzly bears and bighorn sheep may adapt to using underpasses (Clevenger and Huijser 2011). Pronghorn require even larger dimensions but have been infrequently documented using underpasses that are large enough (Seidler et al. 2018).

Crossing structures have been planned (Teton County Wildlife Crossing Master Plan; Huijser, et al. 2018), partially funded and are beginning to be built in Teton County. These include barrier fence near Togwotee Pass, the highway expansion project and associated wildlife mitigation on Hwy 89S mentioned earlier in this report and the wildlife crossings and fences that will be built at Highways 22 and 390. Further mitigations are being considered that could utilize the $10 million Special Purpose Excise Tax money being accrued to help fund these projects (Figure 14).

Figure 14. Teton County's plan for wildlife crossing structures at Highways 22 and 390.

(found at: https://www.tetoncountywy.gov/2203/Wildlife-Crossings)

Education Campaign

Many efforts have been made in Teton County to reduce wildlife-vehicle collisions including the purchase and installation of special signs, outreach via websites, printed brochures, public service announcements via radio, work to create plans and build wildlife crossing structures, amongst others, but wildlife-vehicle collisions are still a problem. While these are all valid and effective ways to reduce wildlife-vehicle collisions, they do not reach all audiences and/or are not feasible across all circumstances.

A social media marketing campaign tailored to target locals, commuters and visitors that drive our roads can change driver behaviors and reduce wildlife-vehicle collisions. In October 2021, JHWF created a digital media and Google campaign with support from Google and Teton Conservation District. Ads have been displayed on Google, Facebook and Instagram (Figure 15).

In mid-May, 2022, the campaign link had received 195 clicks, 10,970 impressions, and reached 4,527 viewers. Results of a survey (137 respondents) to determine the effectiveness of the ads and tailor them for greatest reach show that we are reaching 53% of the surveyed individuals and that an ad that shows a roadside carcass is most impactful at catching attention and changing respondent's driving behaviors (Figure 16).

Figure 15. Two examples of digital ads that were displayed on Facebook.

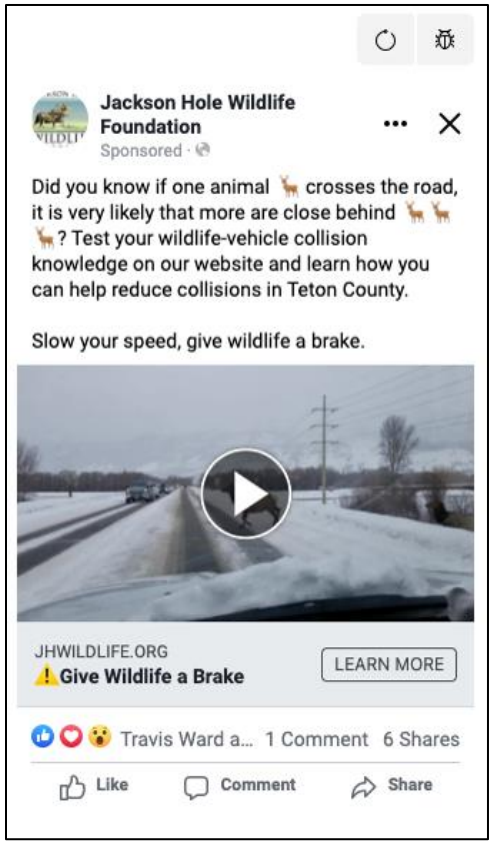
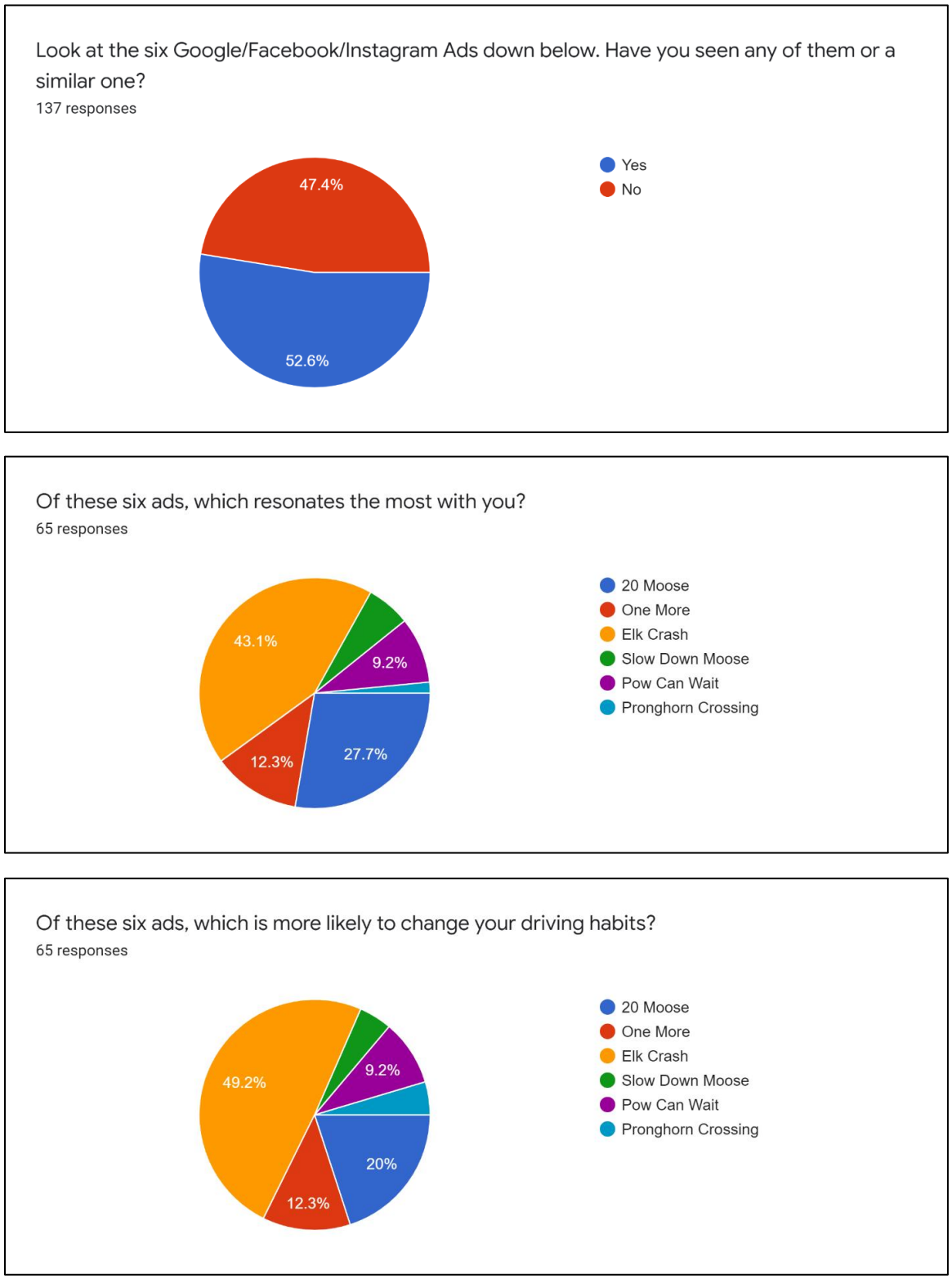


Figure 16. Three responses from people surveyed about the digital campaign.



Appendix B: WVC Summary Table - Count of WVC Species 2011-2021

SPECIES	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	Total
American Marten	1							1			**2**
American Mink	1										**1**
American Robin					1						**1**
Bighorn Sheep						4					**4**
Black Bear		1	1		1	2		1	2		**8**
Black-billed Magpie		1	1					1			**3**
Boreal Toad						1					**1**
Common Raven	1			1							**2**
Coyote	1	1	1		3	2		2	1	1	**12**
Elk	37	36	46	29	25	46	49	34	47	37	**386**
Gray Wolf		1		1							**2**
Great Horned Owl	1		1		4					2	**8**
Grizzly Bear					1	1			1		**3**
Least Chipmunk					2						**2**
Long-tailed Weasel						1		1			**2**
Moose	14	18	15	13	12	18	20	28	14	10	**162**
Mountain Bluebird				1				1			**2**
Mountain Lion	1						1			1	**3**
Mule Deer	137	99	134	217	223	265	105	179	132	86	**1577**
North American Badger								2	2	1	**5**
North American Porcupine	4	5	4	2	4	4		3	1	2	**29**
Northern Goshawk			1								**1**
Northern Raccoon	5	3	4	6	4	1	1	5	6		**35**
Pronghorn			1				1				**2**
Red Fox	1	1	1	1		2	2	2	3	3	**16**
Red Squirrel					1					1	**2**
Rough-legged Hawk			1								**1**
Ruffed Grouse				1							**1**
Short-tailed Weasel		1									**1**
Snowshoe Hare		1									**1**
Striped Skunk		1		4		6		2	3	19	**35**
Tiger Salamander								1			**1**
Wandering Gartersnake					1		1	2	1		**5**
Weasel					1						**1**
Western Tanager									2		**2**
White-tailed Deer	2	2	2		1	4	1	2	5	1	**20**
Yellow-bellied Marmot				1		1				1	**3**
Grand Total	**206**	**171**	**213**	**277**	**284**	**358**	**181**	**267**	**220**	**165**	**2342**