MONTANANS' PERSPECTIVES ON WOLVES AND WOLF MANAGEMENT IN MONTANA: QUANTATIVE HUMAN DIMENSIONS SURVEY SUMMARY

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EXECUTIVE SUMMARY

Following the 2011-12 and 2016-17 wolf hunting/trapping seasons, Montana Fish, Wildlife & Parks (FWP) conducted surveys of resident Montanans to better understand their views regarding wolves and wolf management in Montana. Survey findings in 2017 revealed that tolerance for wolves on the Montana landscape was relatively low, although comparing the 2017 and 2012 survey data revealed a shift toward more tolerance for wolves over time, more so among general Montana households than resident deer & elk license holders, resident wolf license holders, or private landowners. Results also showed continued tolerance for wolf hunting in Montana across all four groups. In contrast, tolerance of wolf trapping varied substantially; while license holders (deer/elk and wolf) and landowners were very tolerant of wolf trapping, nearly half of the general population were intolerant of wolf trapping in the state. These survey results spoke to the contentious nature of wolf management in Montana, and the importance of continued efforts to involve the public in wolf-related outreach and education, wolf management decisions, and season setting processes.

In 2023 we replicated the 2012 and 2017 human dimensions wolf surveys, maintaining the approximate 5-year interval between efforts. Replication of this survey in 2023 represented an opportunity to analyze and report results regarding Montanans' attitudes and views about wolves and wolf management over the first decade of regulated hunting and trapping of wolves in the contiguous United States. Similar longitudinal datasets do not exist in many other jurisdictions, even though others face similar public controversy surrounding wolves and wolf management. Implementation of the 2023 survey presented an opportunity for more in-depth analyses of trends and among-group differences to inform wildlife managers and decision makers.

As was done in 2012 and 2017, we surveyed four distinct populations of Montana's resident adults in 2023: general residents, resident deer and/or elk license holders (hereafter "deer/elk hunters"), resident wolf license holders, including wolf trappers (hereafter "wolf hunters"), and resident private landowners with at least 160 acres in rural parts of the state (hereafter "landowners"). We maintained survey question wording used in 2012 and 2017 wherever possible, and used careful weighting procedures to generate accurate population estimates for each of these groups across all years. We achieved 33-40% response rates across these survey populations, giving us a total of n=9,203 responses and yielding sampling errors of $\pm$0.5% for wolf hunters to $\pm$3.7% for general residents. See the methods section below for details on all sampling, weighting, and estimating procedures.

Results from this survey show that general residents' attitudes toward wolves have become increasingly positive over the past 10 years, but their support for hunting and lethal control also remains high. For example, over the past ten years, the proportion of general residents who report being tolerant or very tolerant of wolves has increased from 40% in 2012 to 50% in 2017 and to 74% in 2023. At the same time, a majority of general residents continue to support wolf hunting (58%) and find it acceptable or very acceptable to lethally control wolves, even as a conflict prevention measure (62%). Across the state, attitudes toward wolves are improving, but people remain unwilling to accept even minimal impacts from the species. The exception to this pattern is that support for wolf trapping is comparatively low and has declined slightly over the past years; nearly half (49%) of general residents are now intolerant or very intolerant of wolf trapping whereas 36% reported being tolerant or

very tolerant. In contrast to general residents, deer/elk hunters and wolf hunters as well as landowners have more negative attitudes toward wolves and are more supportive of hunting, lethal control, and trapping. Among these groups, deer/elk hunters tend to have the most favorable attitudes toward wolves whereas landowners have more negative attitudes and wolf hunters have strongly negative attitudes. On average, satisfaction with wolf management is neither high nor low for all groups; average confidence in FWP is also around the midpoint for deer/elk hunters and general residents, but lower for landowners and wolf hunters. These and other survey results reveal the complicated, nuanced, and contentious nature of wolf management in Montana.

A few highlights of results include:

- **Tolerance of wolves has increased** for the general population of MT residents, deer/elk hunters, and landowners
    - Wolf hunters' tolerance remains low (mean = 2.0/1-5pt scale)
    - General population is now tolerant (mean = 3.9/1-5pt scale); deer/elk hunters are above the mid-point (mean = 3.4/1-5pt scale); landowners are up to 2.5 from 1.7 in 2012
    - In 2023, 74% of the general public were tolerant or very tolerant of wolves on the MT landscape, up from 41% in 2012 and 50% in 2017.
- **Satisfaction with wolf hunting regulations has decreased slightly for the general population,** but remained generally stable around the midpoint (mean = 3.0/1-5pt scale) since 2012 for deer/elk hunters, and landowners
    - In 2023, 41% of the general population was satisfied or very satisfied with Montana's wolf hunting regulations, down slightly from 43% in 2012. In 2023, 33% of the general population was dissatisfied or very dissatisfied, up from 25% in 2012.
    - Wolf hunters' satisfaction with wolf hunting regulations has increased to mean = 3.9/1-5pt scale in 2023 from 2.9 in 2012
- **Satisfaction with wolf trapping regulations is low for the general population**
    - Satisfaction with wolf *trapping* regulations (mean = 2.6-3.5 across all groups) is lower than satisfaction with wolf *hunting* regulations (mean = 3.0-3.9 across all groups), but has remained generally stable from 2017 to 2023. In 2023, 31% of the general population was satisfied or very satisfied with Montana's wolf trapping regulations, about the same as it was in 2017 (30%); in 2023, 44% of the general population was dissatisfied or very dissatisfied with wolf trapping regulations; 26% were neither satisfied nor dissatisfied.

- **All groups remain somewhat to very tolerant of wolf hunting** (e.g., gen pop mean = 3.5/1-5pt scale – the lowest of all groups), although tolerance has decreased among the general population
    - Since 2012, tolerance of wolf hunting has decreased some for MT general population, remained stable for deer/elk hunters and landowners, and increased some for wolf hunters
    - In 2023, 58% of the general population were tolerant or very tolerant of wolf hunting, down from 71% in 2012
- **There have been decreases in tolerance for wolf trapping** 2017-2023, where:
    - Deer/elk, wolf hunter, and landowners all remain tolerant or very tolerant of wolf trapping
    - General population is down to mean = 2.7/1-5pt scale; in 2023, 36% of the general population was tolerant or very tolerant of wolf trapping, down slightly from 40% in 2017. In 2023, 49% of the general population were intolerant or very intolerant of wolf trapping, up slightly from 46% in 2017
- **Overall, bag limits and season length are about "just right" to a plurality or slight majority of the general population, deer/elk license holders, and landowners.**
    - In 2023, most wolf hunters think the season is too short or much too short (66%) and bag limits allow too few or way too few wolves (63%)
- **Satisfaction with wolf management remains unchanged** since 2017 – all groups hover around or just below 3.0/1-5pt scale
    - In 2023, 33% of the general population was satisfied or very satisfied with wolf management in MT, up slightly from 31% in 2017. In 2023, 31% of the general population was dissatisfied or very dissatisfied with wolf management, about the same as in 2017 (32%).
    - Confidence in FWP has waned slightly, particularly for landowners and wolf hunters – and is now at or below the midpoint of 3.0/1-5pt scale for all groups
- **Since 2012, smaller proportion of people have purchased wolf licenses**
    - Down to 1% of general population in 2023 from 4% in 2012; down to 5% of deer/elk hunters in 2023 from 17% in 2012.
- **Nearly ubiquitous improvement in attitude/belief statements about wolves for all groups** from 2017-2023 (e.g., wolves important, *don't* pose risk, enjoy knowing exist)
    - General population had and continues to have more favorable views on wolves than all other groups; General population is most favorable to wolves, followed

by deer/elk hunters, followed by landowners, followed by wolf hunters – this pattern is consistent.

- **Most people still think wolves should be controlled across all scenarios** (e.g., wolves sighted near development, threaten pets or livestock, etc.)
    - For example, in 2023, 52% of the general populations said wolf populations should be controlled when they are sighted near human development, 55% when they threaten big game, 68% when they threaten pets, and 76% when they threaten livestock.
    - However, these proportion have decreased for all groups in nearly all scenarios since 2017
- **General population supports preventative non-lethal actions to prevent conflict, but they also support a wide range of lethal control:**
    - In 2023 (the first year we asked this question), 63% of the general population found acceptable or very acceptable "preventative lethal actions"
    - Only slightly more people (65%) found acceptable or very acceptable lethal removal after wolves have attacked livestock, or lethal removal as a last resort (65%)
    - Other groups overwhelmingly support all control measures across all scenarios
- **Wildlife Value Orientation** types have shifted within all groups – this pattern is consistent across studies from 2005, 2012, 2017, 2018, and 2023
    - In the general population, there are now:
        - Fewer distanced – now 4% (down from 7% in 2012)
        - More mutualists – now 30% (up from 21%)
        - More pluralists – now 34% (up from 29%)
        - Fewer utilitarians – now 33% (down from 43%)
- **Many people report at least some interaction with wolves** (i.e., 56% of general population; larger proportions of all other groups)
    - Overall, the general population rates their interactions with wolves as slightly positively (3.5/1-5pt scale; 52% saying positive or very positive; 17% saying negative or very negative)
- **Slight agreement across all groups (e.g., 52% of general population) that hunting wolves will make them more wary of humans**

- More ambiguity and disagreement about whether NOT hunting wolves will make them more comfortable around humans (e.g., 38% of general population)

- **Fewer people in all groups "oppose" wolves, more people "conditionally support" them**
    - In 2023, 17% of the general population "opposed" wolves, down from 30% in 2017
    - "Conditional support" grew to 56% in 2023, up from 43% in 2017
    - 24% of the general population fell into the "advocate" quadrant of the attitude-acceptability framework (same as in 2017)
    - 1% of the general population fell into the "tolerate" quadrant (up from 0.1% in 2017)

METHODS

SAMPLING

The sampling frame (i.e., the people we attempted to survey) for the 2023 survey effort included four populations:

- the general population of adult residents of Montana ("GenPop");
- adult resident deer/elk license holders ("deer/elk hunters");
- adult resident wolf license holders ("wolf hunters"); and
- adult resident landowners with ≥160acres of land ("land")

These populations are "overlapping" meaning that people can belong to one, two, three, or all four groups. We conducted sampling for the 2023 survey for each of these groups using methods similar to those used for the 2012 and 2017 surveys to allow analysis of within-group change over time. Additionally, we included questions on each survey instrument to allow respondents to self-identify as members of every group. For example, a respondent drawn as a wolf hunter could self-identify as a landowner and/or as a deer/elk hunter. This sampling approach affords statistical comparisons between and among groups, something not possible in 2012 or 2017.

GENERAL POPULATION SAMPLE

The University of Montana (UM) Human Dimensions Lab drew the GenPop sample in partnership with the UM Bureau of Business and Economic Research (BBER) using a stratified, random sampling design. We randomly selected adults from within occupied dwellings listed in the U.S. Postal Service Deliver Sequence File using the most recent birthday method. BBER facilitated the sample purchase from Dynata, Inc., a reputable survey sampling firm. The sample was stratified by: (i) the top 20 census tracts with the most American Indian adult residents (to inform population estimates with data from these areas despite expected higher non-response); (ii) the counties defined by the U.S. Office of Management and Budget (2023) as core statistical areas (i.e., either metropolitan or micropolitan statistical areas); and (iii) all remaining counties

and census tracts (i.e., rural areas, to inform population estimation with data from these areas despite low proportions of population). In other words, we oversampled rural areas and areas with higher American Indian populations to collect enough data from people in these areas to inform overall population estimation; below we discuss weighting of these data to correct for this oversampling and other factors. The total size of the study population was N=850,123 Montana resident adults (U.S. Census Bureau, 2023). We randomly selected an initial sample of n=5,000 addresses in the 3 strata as described in Table 1.

Table 1 General Population sampling strata definitions

TOTAL GENPOP INITIAL SAMPLE ADDRESSES (n=5,000)			
Stratum number:	**Stratum 1**	**Stratum 2**	**Stratum 3**
Description:	**American Indian Oversample Tracts**	**Metro and Micro Statistical Areas Counties**	**Rural Counties**
n (addresses):	500	3,250	1,250
Definition:	Census tract 9402, Glacier County	Missoula County	All Montana tracts and counties minus those in stratum 1 and 2
	Census tract 9401, Blaine County	Cascade County	
	Census tract 9402, Blaine County	Yellowstone County	
	Census tract 9403, Hill County	Stillwater County	
	Census tract 9404, Rosebud County	Carbon County	
	Census tract 9404, Big Horn County	Flathead County	
	Census tract 9406, Big Horn County	Lewis and Clark County	
	Census tract 9400.02 Roosevelt County	Jefferson County	
	Census tract 9407, Big Horn County	Butte-Silver Bow County	
	Census tract 9404, Glacier County	Gallatin County	
	Census tract 9400.01 Roosevelt County		
	Census tract 9405, Big Horn County		
	Census tract 1, Big Horn County		
	Census tract 9404, Lake County		

	Census tract 9407, Lake County		

DEER/ELK LICENSE HOLDER SAMPLE
Montana Department of Fish, Wildlife and Parks (FWP) drew the deer and elk hunter sample using a simple random sample design. FWP randomly selected adults from their complete list of all Montana residents who had purchased any deer and/or elk license for the 2022 hunting season (n=1,500)

WOLF LICENSE HOLDER SAMPLE
FWP drew the wolf hunter sample using a simple random sample design. FWP randomly selected adults from their complete list of all Montana residents who had purchased any wolf hunting or trapping license for the 2022 hunting season (n=1,000).

LANDOWNER SAMPLE
The UM Human Dimensions Lab drew the landowner sample in partnership with FWP using the MT Cadastral Data available through the Montana State Library (2023). To begin, FWP selected all records from the MT Cadastral Data with Montana-based mailing addresses who owned at least 160 acres across all parcels associated with that mailing address. In many instances, a single person/entity owned multiple parcels; to avoid drawing the same person multiple times, FWP "dissolved" (a spatial analysis operation that merges records, summing attributes such as acreage) parcels with identical mailing addresses and owner name. From this population UM drew an initial simple random sample of n=2,500.

FINAL SAMPLES
Duplication across sampling procedures was possible because sample frame populations were overlapping. In other words, someone drawn for the GenPop sample could have also been drawn for the deer/elk hunter sample. To ensure the overall sample (i.e., all four samples combined) was drawn *without replacement* (an important distinction for population estimate calculations), we cross-referenced the landowner and GenPop samples for duplicate names and removed those with identical names and similar mailing addresses (i.e., identical first, last, and middle names with a P.O. Box and a street address in the same city, but not identical names if the addresses were in different cities), as well as those with identical mailing addresses and slightly different names (e.g., John Doe and Doe Excavation at the same mailing address). We found, removed, and replaced 16 landowners in the initial sample who were duplicates from the GenPop sample. We checked for duplication again among the 16 replacements and found none. Next, we repeated this process for: the wolf hunters where we found and replaced 10 duplicates; and the deer/elk hunters where we found and replaced 8 more duplicates. We checked all replacement samples for duplication one final time and found none. The final sample was n=10,000 unique adult Montana residents, consisting of n=5,000 GenPop, n=2,500 landowners, n=1,500 deer/elk hunters, and n=1,000 wolf hunters.

SURVEY ADMINISTRATION & DATA ENTRY

FWP oversaw the administration of all four surveys and data entry. Surveys were mailed to all respondents addresses in early summer 2023; undeliverable surveys were marked as such; one follow-up mailing was conducted to all non-respondents approximately four weeks after the initial mailing; and a second follow-up mailing was conducted to non-respondents of the GenPop survey another four weeks later. FWP's Human Dimensions Program Supervisor oversaw the administration of all four surveys as well as completion of data entry for these surveys. Initial mailings of all four surveys were sent out in late spring of 2023. Tracking databases were used by FWP to monitor survey response rates, including keeping tallies of undeliverable surveys. A follow-up mailing to nonrespondents for each of the four surveys was sent out approximately four weeks after the initial mailing of the surveys. A second follow-up mailing to nonrespondents for the GenPop survey was sent out in late summer of 2023 to further boost the response rate for this specific survey population. The Human Dimensions Program Supervisor developed data coding manuals and oversaw data entry work for each survey. Data entry was completed by an experienced temporary staff member who had previously been employed by the agency during the past three years to do similar work. Quantitative and qualitative data were entered for each survey using Microsoft Excel. FWP's Human Dimensions Program Supervisor performed data entry consistency checks, ensured the data entered had the correct data type, and ensured the data entered followed the desired coding manual formatting rules. Once data entry work was completed, the finalized Excel files for each survey were converted to a Statistical Package for the Social Sciences (SPSS) data file format and sent to the University of Montana for analysis.

Following collection and data entry appropriate UM added data labels as well as composite variables and flags to facilitate analysis. Missing values for the weighting variables -- necessary for comparison to the 2020 Census counts and 2023 Montana Department of Fish, Wildlife and Parks counts for the current numbers of elk and/or deer hunters, and wolf hunters -- were imputed using the multiple imputation method (Berglund & Heeringa, 2014; Rubin, 1987).

WEIGHTING

We used survey weights to generate all estimates presented in this report. Survey weights improve the accuracy of estimates and help to ensure that the survey is representative of the study population (Kish & Frankel, 1974; Rao et al., 2010). BBER calculated all weights used to generate survey results in partnership with the UM Human Dimensions Lab using three statistical software packages: IBM SPSS Statistics Version 28, SAS Version 9.4, and Statistics Canada's G-EST Version 2.03. We calculated weights using a three-step process widely accepted in the survey research literature and described below (Haziza & Beaumont, 2017; Battaglia et al., 2016; Haziza & Lesage, 2016; Valliant et al., 2013; Valliant & Dever, 2018).

In step one, we calculated a base weight to account for different selection probabilities among respondents in each of the three sampling strata (see Sampling section above). For example, someone living in a rural area had a higher likelihood of being included in the sample than someone in an urban area due to our oversampling design; this first weighting step accounted for these different probabilities.

In step two, we modified the base weight to adjust for non-response (Valliant & Dever, 2018; Haziza & Lesage, 2016; Battaglia et al., 2016; Brick 2013; Kreuter & Olson, 2013; Olson 2013; Valliant et al., 2013). This step is needed to account for the fact that some members of the sample did not respond to the survey, making the base weight alone (calculated in step 1) insufficient to produce accurate population estimates. When survey respondents differ from nonrespondents with respect to survey topics, selection or nonresponse bias can skew population estimates. To mitigate the possibility of a nonrandom relationship between respondent characteristics and answers to survey questions, we first grouped respondents and nonrespondents into classes with equal propensity to respond (Valliant & Dever, 2018). Then, to correct for nonresponse, we multiplied the base weights (calculated in step 1) by the inverse of the mean response rate within each class (Haziza & Lesage, 2016; Haziza & Beaumont, 2017; Valliant & Dever, 2018).

To estimate response propensity for each member of the sample, we built a logistic regression predicting response (dichotomous variable where 1=response, 0=no response) using a variety of independent variables (Table 2) obtained from FWP license database, Montana cadastral data, the US Census Bureau, and Dynata, Inc., the vendor from which we bought the address-based sample (Kreuter & Olson, 2013; Olson, 2013; U.S. Office of Management and Budget, 2023). This model predicted response propensity very well, with a Nagelkerke R Square of 0.828 and an overall confusion matrix accuracy of 94.7%.

Table 2 Independent variables used in the response propensity model (weighting procedures, step 2)

Variable Name	**Description**	**Source**
Mailing	Responded after 1st mailing	BBER
	Responded after 2nd mailing	BBER
	Responded after 3rd mailing	BBER
Sampling strata	American Indian oversample	BBER
	Urban Montana counties	BBER
	Rural Montana counties	BBER
POBOX_FLAG	Address is a P.O. Box	Dynata, Inc.
	Address is not a P.O. Box	Dynata, Inc.
DEL_TYPE	A-Residential Curb	Dynata, Inc.
	B-Residential NDCBU	Dynata, Inc.
	C-Residential Central	Dynata, Inc.
	D-Residential Other	Dynata, Inc.
	E-Other	Dynata, Inc.
PCT_HISP	% adults in census tract	Dynata, Inc.
PCT_BLACK	% adults in census tract	Dynata, Inc.
PCT_ASIAN	% adults in census tract	Dynata, Inc.
PCT_WHITE	% adults in census tract	Dynata, Inc.
PCT_AM_IND	% adults in census tract	Dynata, Inc.
MEDIAN_INC	Households in census tract	Dynata, Inc.
ETECH	A = African American	Dynata, Inc.

	B = Southeast Asian	Dynata, Inc.
	C = South Asian	Dynata, Inc.
	D = Central Asian	Dynata, Inc.
	E = Mediterranean	Dynata, Inc.
	F = Native American	Dynata, Inc.
	G = Scandinavian	Dynata, Inc.
	H = Polynesian	Dynata, Inc.
	I = Middle Eastern	Dynata, Inc.
	J = Jewish	Dynata, Inc.
	K = Western European	Dynata, Inc.
	L = Eastern European	Dynata, Inc.
	M = Caribbean Non-Hispanic	Dynata, Inc.
	N = East Asian	Dynata, Inc.
	O = Hispanic	Dynata, Inc.
	Z = Uncoded	Dynata, Inc.
Hunting_license	Individual at address has a Montana hunting license	Montana Department of Fish, Wildlife and Parks
	No individual at address has a Montana hunting license	Montana Department of Fish, Wildlife and Parks
Fishing_license	Individual at address has a Montana fishing license	Montana Department of Fish, Wildlife and Parks
	No individual at address has a Montana fishing license	Montana Department of Fish, Wildlife and Parks
Percent BA + by county	% of adults with at least a Bachelor's degree by county	U.S. Census Bureau
Total acres	Number of acres owned in Montana by a person residing at the address (160 or more, else 0)	Montana Cadastral data
Sex	1 = male	Dynata, Inc.
	2 = female	Dynata, Inc.
Age	Ages 18+	Dynata, Inc.

In step three, we calibrated the non-response-adjusted weight to population control totals derived from the 2020 U.S. Census count for the population of persons age 18 in Montana (N = 850,123) as well as from hunting license counts provided by FWP (Haziza & Beaumont, 2017; Lavellee & Beaumont, 2016; Valliant et al., 2013; Sarndal, 2007; Kalton & Flores-Cervantes, 2003). We conducted survey weight calibration using the Gest-Calibration module of the Generalize Estimation System version 2.003 (2019) using sampling strata: age, sex, number of deer and/or elk license holders, and number of wolf license holders.

We used the final, weighted household survey data to estimate the population proportions required to merge all four surveys in this study into one dataset representative of the adult, resident Montana population. These proportion estimates are presented in Table 3. Note that

because categories 5 and 6 were small, we combined categories 5-7 for use in weighting responses.

Table 3 Total size and population proportions for each combined survey weighting category

Combined survey weighting category	**%**	**N**
1. GenPop only	76.3%	648,740
2. Landowner only	6.4%	54,312
3. Deer/Elk only	15.0%	127,367
4. Landowner & Deer/Elk	0.9%	7,487
5. Wolf hunter	0.01%	59
6. Landowner & Wolf hunter	0.01%	48
7. Deer/Elk hunter & Wolf hunter	0.6%	4,988
8. Landowner, Deer/Elk hunter, Wolf hunter	0.8%	7,122
TOTAL	**100%**	**850,123**

We followed the same three-step weighting procedure for the combined survey dataset (i.e., combined data for all four survey populations) as described above for the household survey dataset. In step one, we calculated a base weight to account for uneven selection probabilities. In other words, a landowner who was also a deer/elk hunter had a higher likelihood of being sampled for this survey than a general resident who did not own land or hunt deer, elk, or wolves; this first weighting step accounted for these different probabilities. In step two, we modified the base weight to adjust for survey non-response. In step three, we calibrated the nonresponse-adjusted weight to population controls derived from the 2020 U.S. Census count for the population of adult residents of Montana and from hunting license counts from FWP. We used the Gest-Calibration module of Generalized Estimation System version 2.003 (2019) using sampling strata: combined survey design (base) weight, age, sex, number of deer and/or elk license holders, number of wolf license holders, and urban/rural residence.

WEIGHTS FOR LONGITUDINAL ANALYSES

Some survey items we measured in 2023 were also measured in 2017; other 2023 survey items were asked in both 2017 and 2012. To allow longitudinal comparisons, we calculated weights for the 2012 and 2017 datasets using a two-step procedure that accounted for selection probabilities and calibrated to population controls for age and sex derived from the 2012 and 2017 American Community Survey 1-year estimate for the population of adult residents of Montana (N=785,015 for 2012; N=820,598 for 2017), and for deer/elk license purchasing from the FWP automated license database system for hunting seasons 2011 and 2016 (N=137,262 for 2011; N=146,948 for 2016). The estimates we produced with these weights differ slightly from previous results found in FWP Research Summaries for these past survey efforts that did not weight estimates (2012) or weight them as completely (2017); estimates provided here for all survey years are as accurate as possible given current best practices for weighting survey data and are the most useful for understanding change over time.

COMPOSITE MEASURE METHODS

In addition to estimating basic means and frequencies for each question on the survey, we calculated two composite measures: wildlife value orientations and attitude-acceptability typologies. Methods for these calculations are provided here:

WILDLIFE VALUE ORIENTATION METHODS

We estimated wildlife value orientation proportions using procedures developed at Colorado State University from the 2017 and 2023 survey data (Teel et al., 2005). To do so, we calculated the average of responses to survey items/questions that fell into one of the following belief dimensions: mutualistic, caring, hunting, or utilitarian. Some survey items were reverse coded to standardize directionality. We then combined these four dimensions to create two value orientations (i.e., hunting + utilitarian = utilitarianism; caring + mutualistic = mutualism). Each survey respondent was then assigned a wildlife value orientation category based on their joint scores on these two orientations, such that:

- those with high (above the mid-point on the scale) utilitarianism and low (below the mid-point on the scale) mutualism scores were categorized as "**utilitarians**;"
- those with low utilitarianism and high mutualism scores were categorized as "**mutualists**;"
- those with low utilitarianism and low mutualism scores were categorized as "**distanced**;" and
- those with high utilitarianism and high mutualism scores were categorized as "**pluralists**."

We then used survey weights to estimate the proportions of these groups within each survey response group (i.e., GenPop, landowners, deer/elk hunters, and wolf hunters).

ATTITUDE-ACCEPTABILITY TYPOLOGY METHODS

We estimated attitude-acceptability typology proportions using procedures from Metcalf et al., (2024) from the 2017 and 2023 survey data. To do so, we calculated the average of responses to survey items/questions that collectively measured attitudes toward wolves and, separately, acceptability of impacts from wolves. We then assigned each survey respondent to one of four groups based on their joint attitude-acceptability scores, such that:

- those with high (above the mid-point on the scale) attitude and low (below the mid-point) acceptability scores were categorized as "**conditionally support**;"
- those with high attitude and high acceptability scores were categorized as "**advocate**;"
- those with low attitude and low acceptability scores were categorized as "**opposed**;" and
- those with low attitude and high acceptability scores were categorized as "**tolerate**."

We then used survey weights to estimate the proportions of these groups within each survey response group (i.e., GenPop, landowners, deer/elk hunters, and wolf hunters).

ANALYSIS

We conducted all analysis with the R statistical program 4.3.2 using the *survey* package which allows accurate estimates of sampling errors under complex sampling designs.

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RESULTS

RESPONSE RATE & SAMPLING ERRORS

Response rates for each sample were calculated using the American Association for Public Opinion Research calculation 6 where the numerator consists of complete and partial (i.e., one or more survey questions were skipped) responses and the denominator is equal to the initial sample minus any undeliverable. Responses, initial samples, undeliverables, response rates, and associated sampling errors at the 95% confidence interval are shown in Table 4.

Table 4 Initial sample sizes, the number of undeliverable records, responses (final sample size), response rates, and sampling errors at the 95% confidence interval for the full survey sample and each survey response group

GROUP	INITIAL SAMPLE	UNDELIVERABLE	RESPONSES	RESPONSE RATE	SAMPLING ERROR [95% CI]
GenPop	5,000	1,156	1,249	32.5%	±3.7%
Landowner	2,500	189	926	32.8%	±1.2%
Deer/Elk hunter	1,500	35	480	36.4%	±2.5%
Wolf hunter	1,000	27	354	40.1%	±0.5%
TOTAL	**10,000**	**1,500**	**3,009**	**30.1%**	**±3.7%**

Response rates and final sample sizes for each survey response group (i.e., GenPop, landowners, deer/elk hunters, and wolf hunters) from the 2012 and 2017 survey efforts are provided in Table 4 based on FWP reporting. Also shown in Table 5 are sampling errors that we estimated based on responses and known populations for each survey response group (i.e., GenPop, landowners, deer/elk hunters, and wolf hunters) at both points in time.

Table 5 Sample sizes, response rates, and sampling errors at the 95% confidence interval for each survey response group in 2012 and 2017

	2012			2017		
GROUP	**SAMPLE SIZE**	**RESPONSE RATE**	**SAMPLING ERROR [95% CI]**	**SAMPLE SIZE**	**RESPONSE RATE**	**SAMPLING ERROR [95% CI]**
GenPop	465	37%	±5.9%	412	34%	±6.0%
Landowner	720	49%	±3.6%	718	50%	±3.6%
Deer/Elk hunter	656	45%	±3.8%	599	42%	±4.0%
Wolf hunter	541	56%	±4.1%	487	50%	±4.4%

MEANS & FREQUENCIES

Below we present figures summarizing population estimates for each survey response group (i.e., GenPop, landowners, deer/elk hunters, and wolf hunters) to every survey question. Most estimates are provided on two figures. First, we provide bar graphs showing mean scores for each group across all years available with 95% confidence interval standard error bars. These figures allow easier interpretation of central tendencies, change over time, and group comparisons. Second, we provide bar graphs showing the percent within each group providing each response option across all years available. For example, the % of the GenPop that would respond with a "1" to a question vs a "2" vs a "3," etc. This granular detail allows readers to see the distribution of the population behind every mean score. Importantly, each estimate provided in the following figures is a *population estimate* using the weighting described above, not simply the number of survey respondents providing each answer.

We order these figures as follows: questions asked in 2012, 2017, and 2023; followed by questions asked in 2017 and 2023 but not in 2012; and finally those questions only asked in 2023.

2012-2017-2023

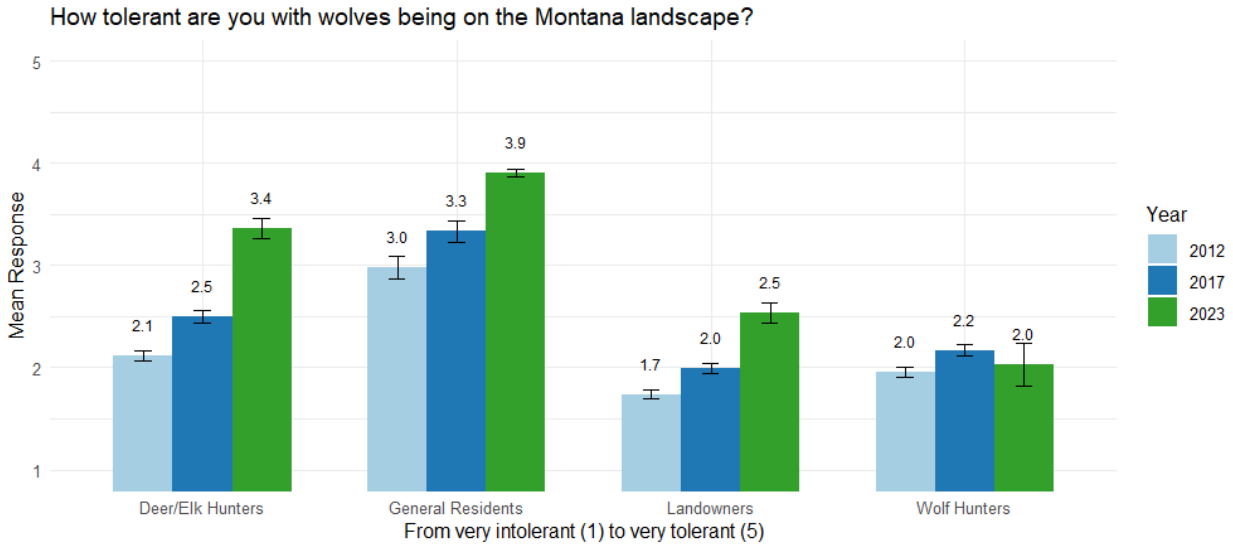

Figure 1 Tolerance means

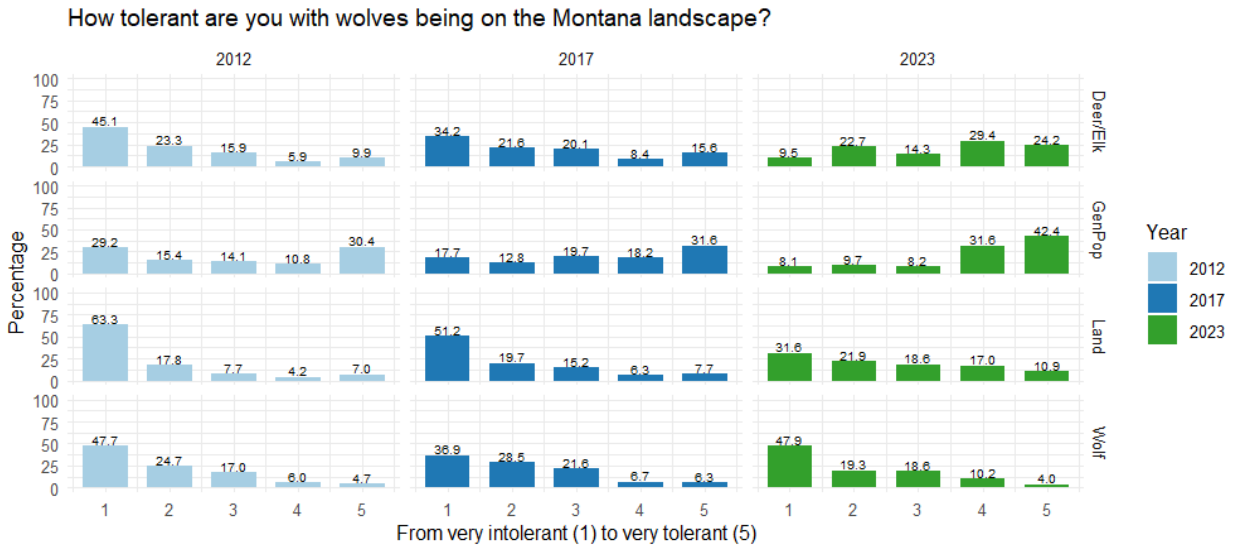

Figure 2 Tolerance frequencies

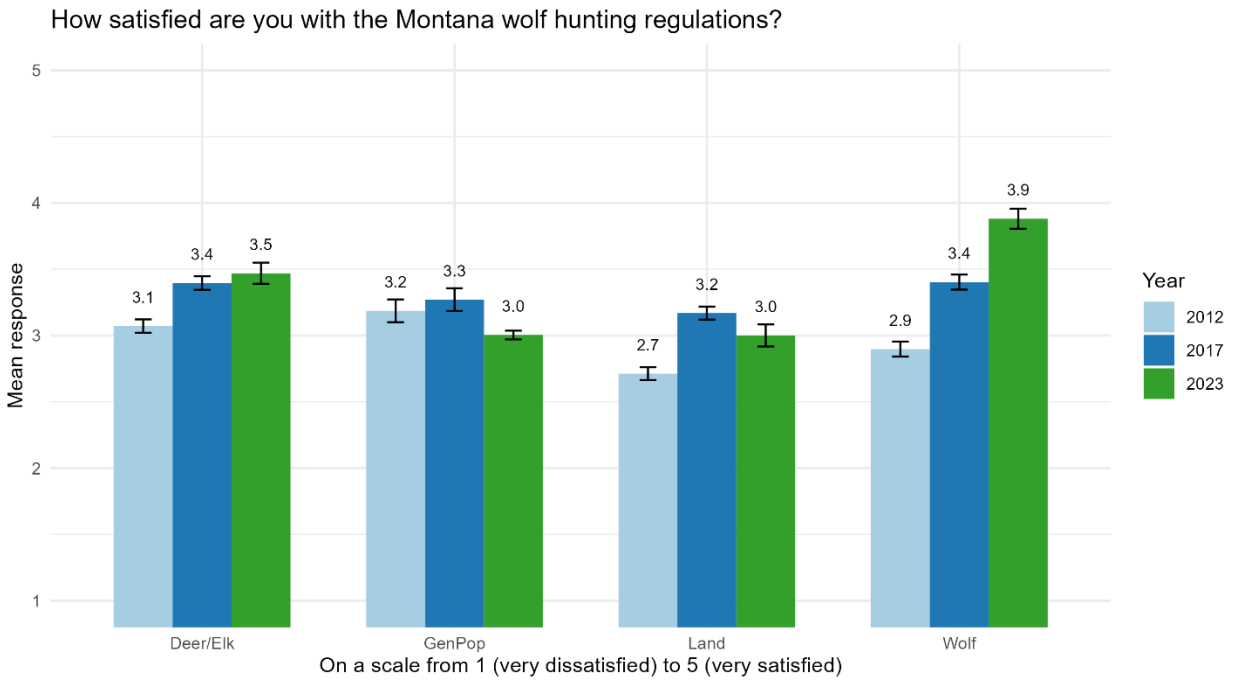

Figure 3 Wolf hunting regulation satisfaction means

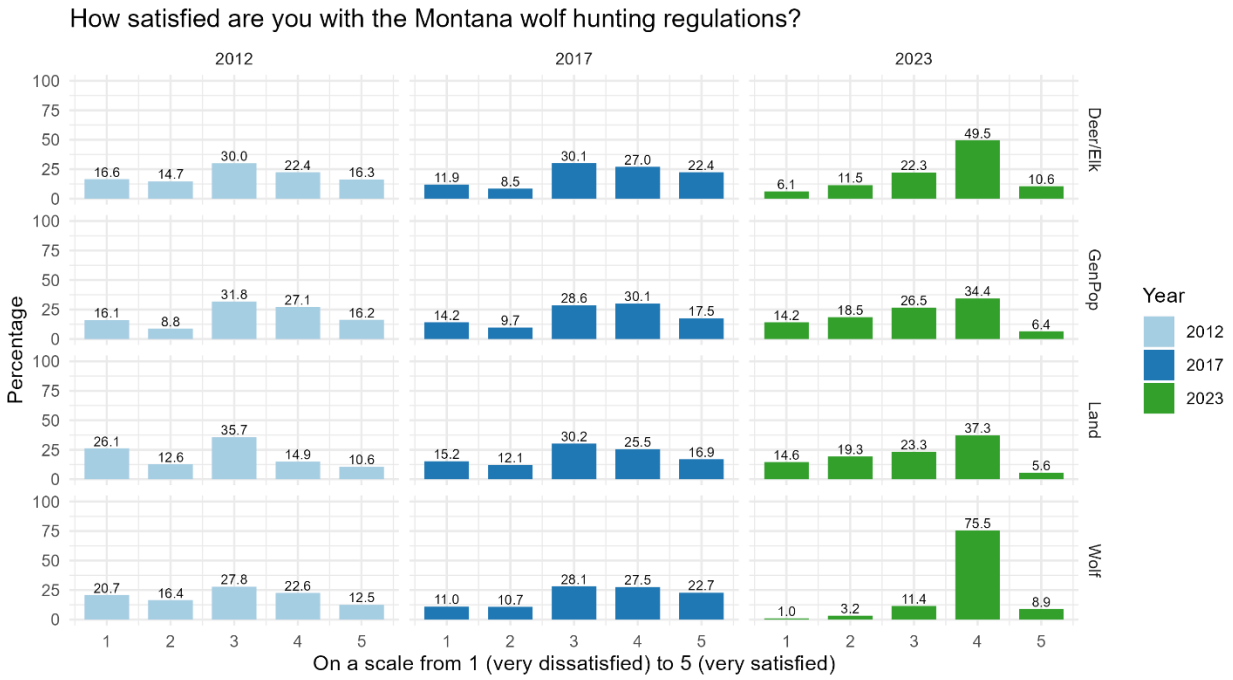

Figure 4 Wolf hunting regulation satisfaction frequencies

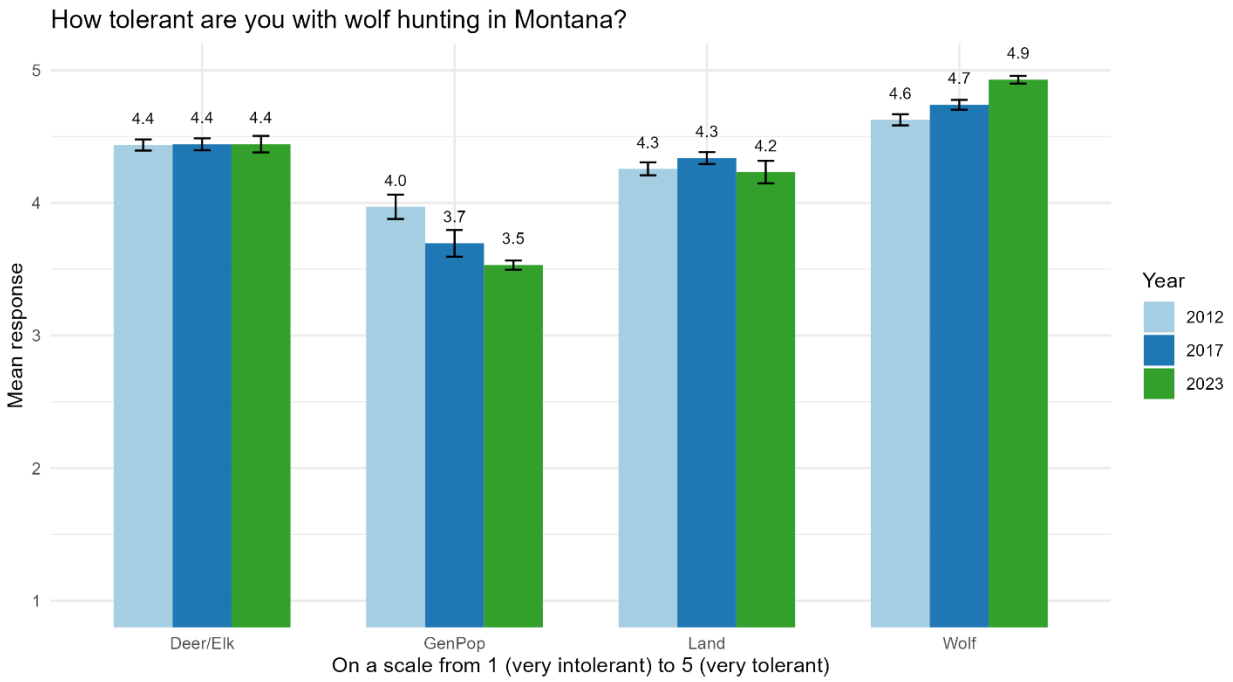

Figure 5 Hunting tolerance means

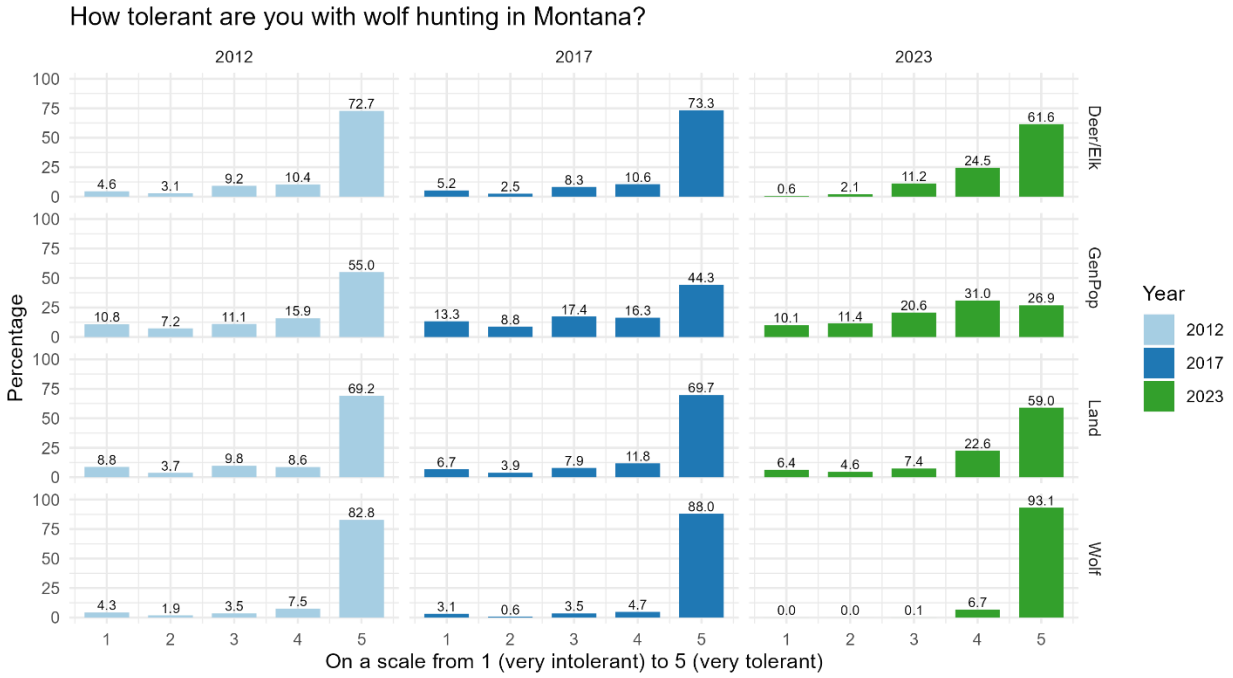

Figure 6 Hunting tolerance frequencies

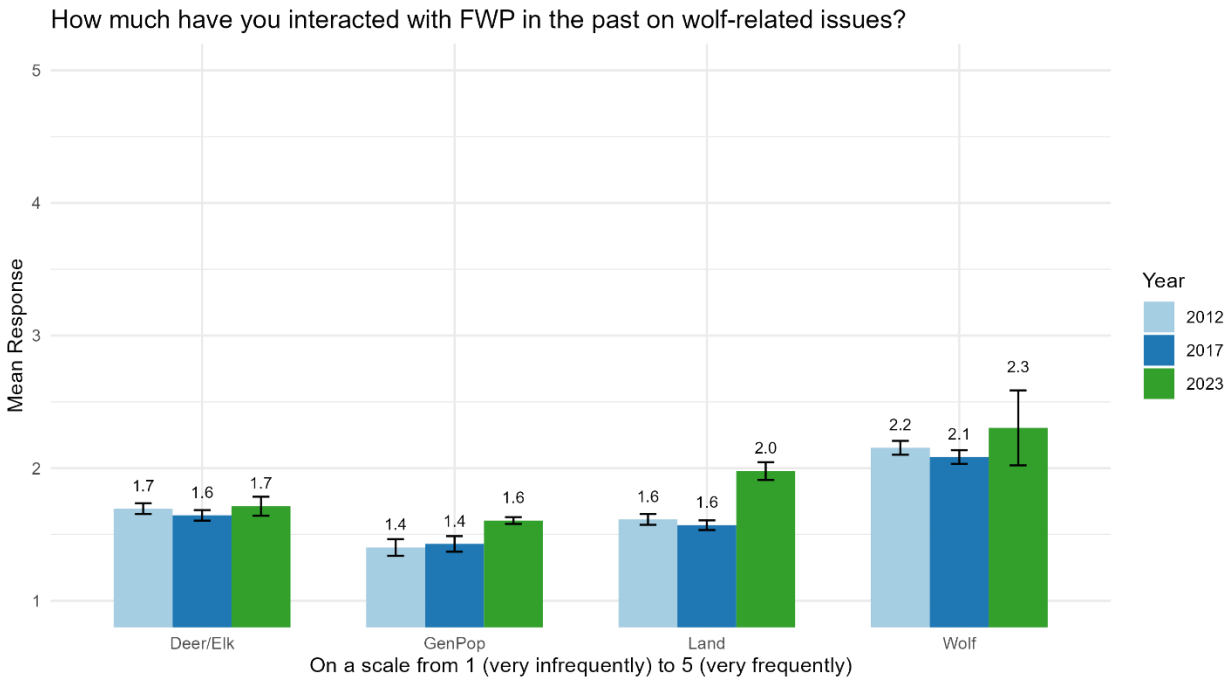

Figure 7 Interact with FWP means

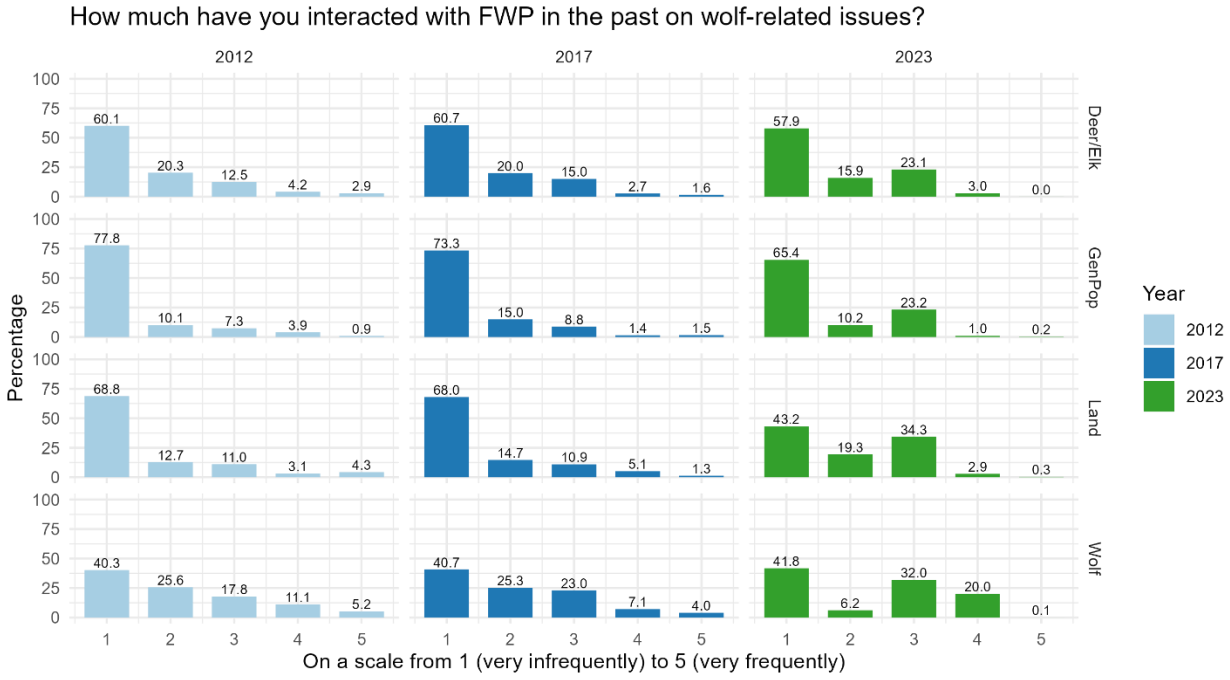

Figure 8 Interact with FWP frequencies

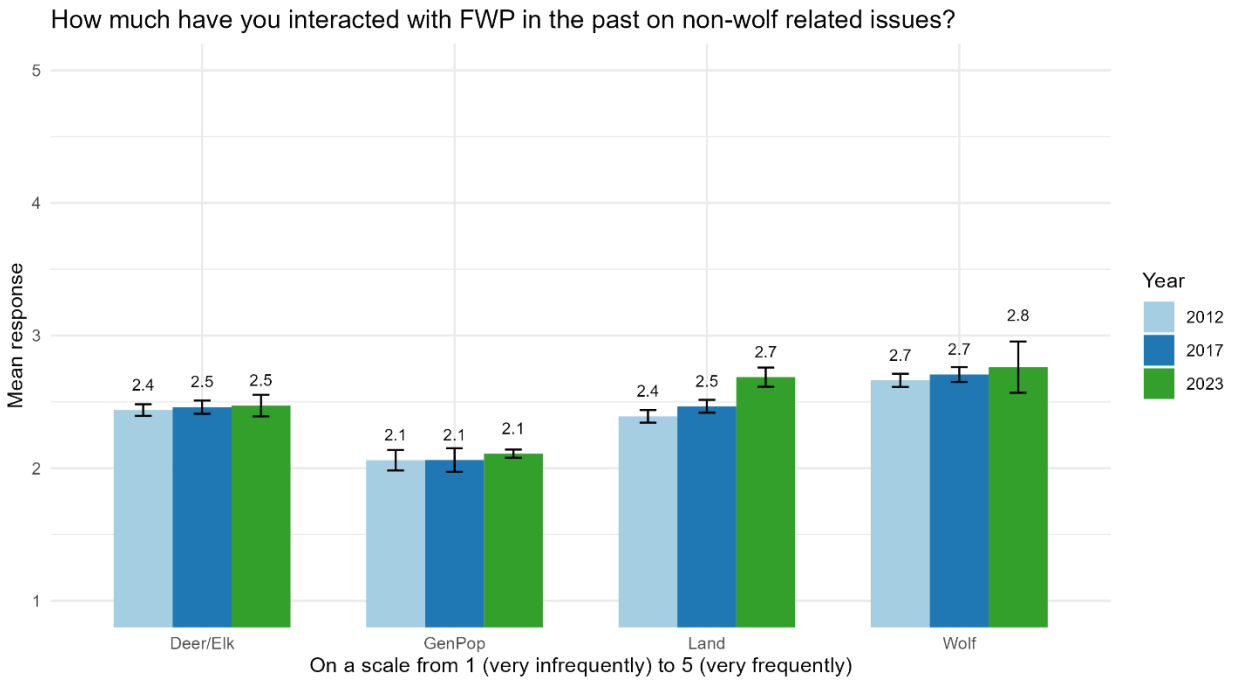

Figure 9 Interact with FWP (non wolf) means

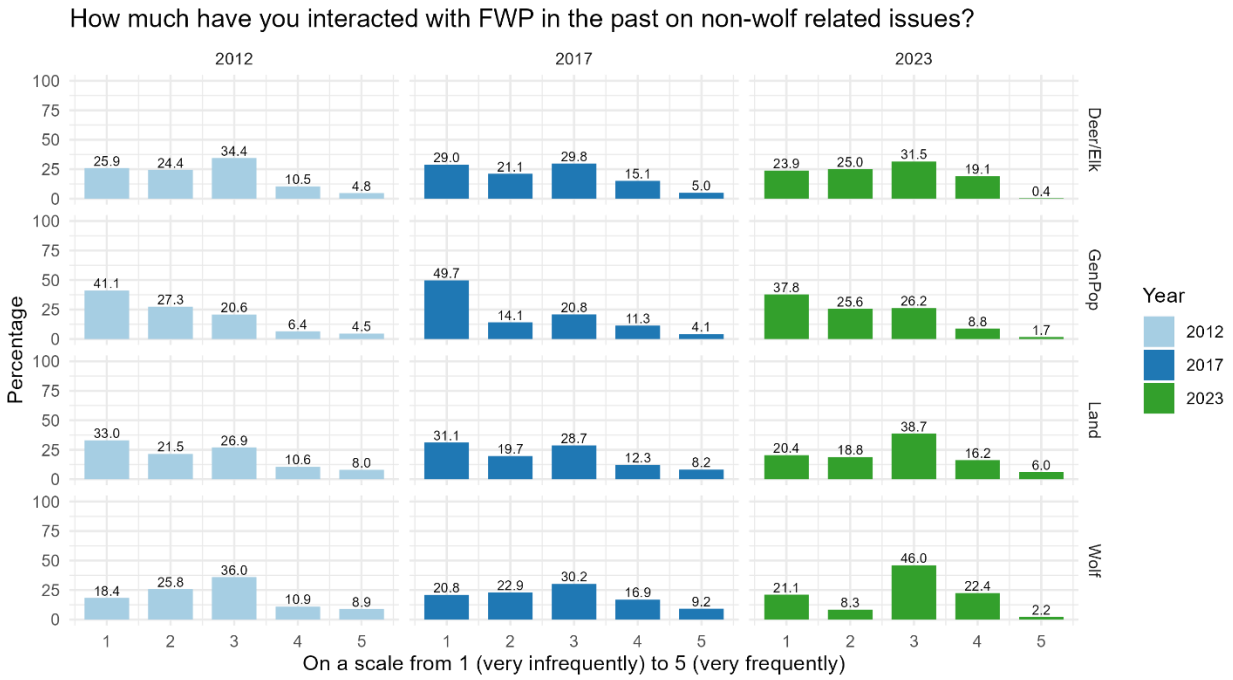

Figure 10 Interact with FWP (non wolf) frequencies

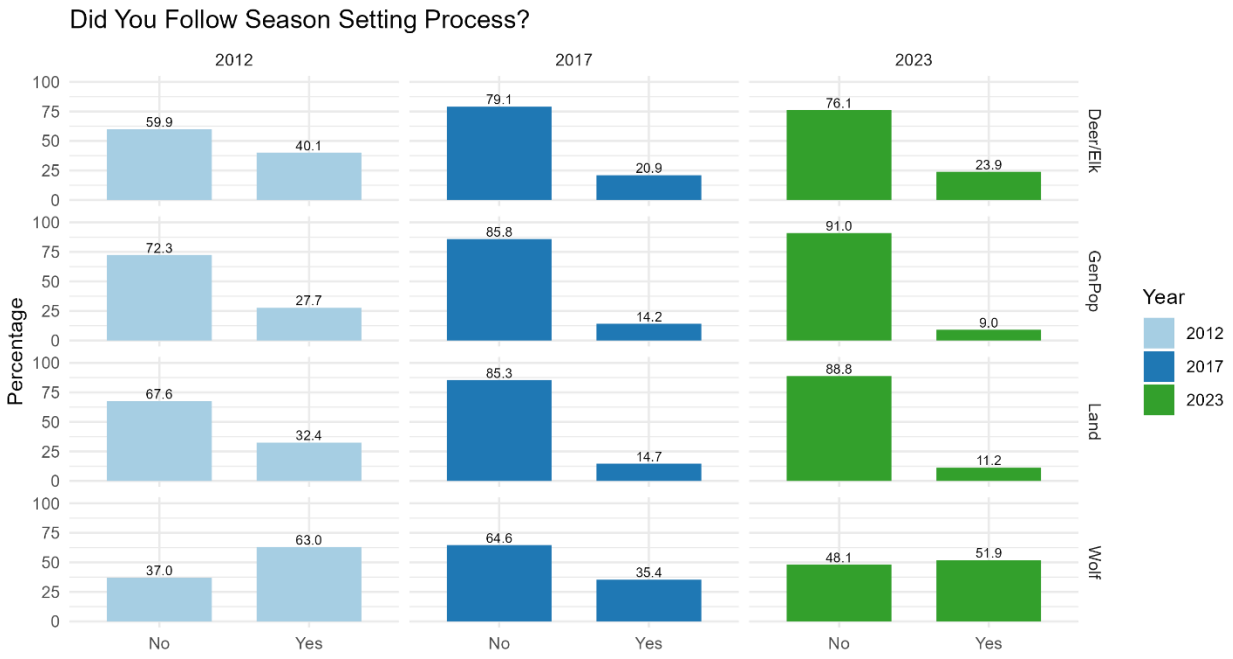

Figure 11 Follow season setting means

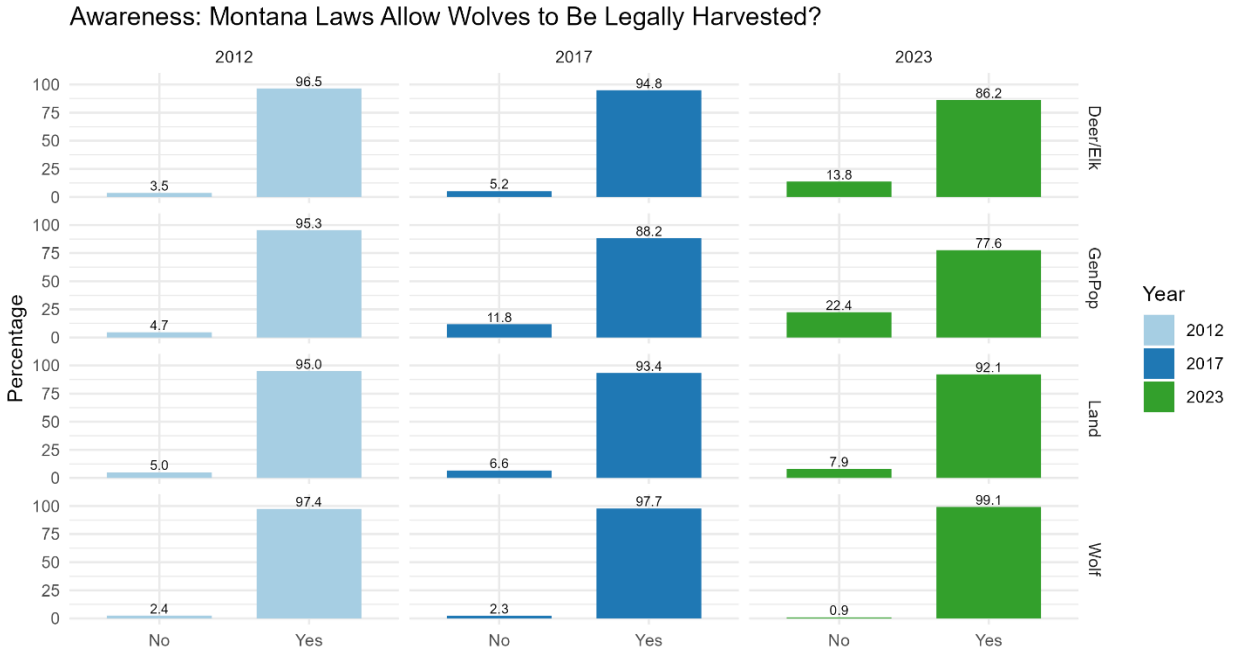

Figure 12 Follow season setting frequencies

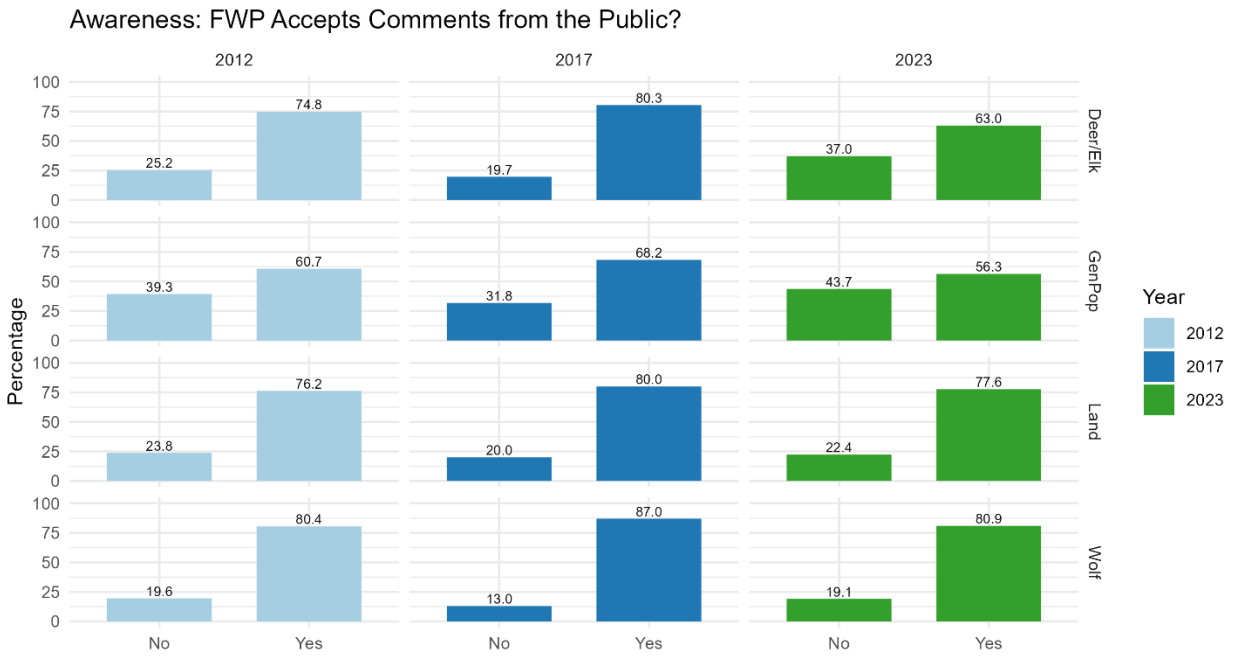

Figure 13 Aware FWP accepts comments means

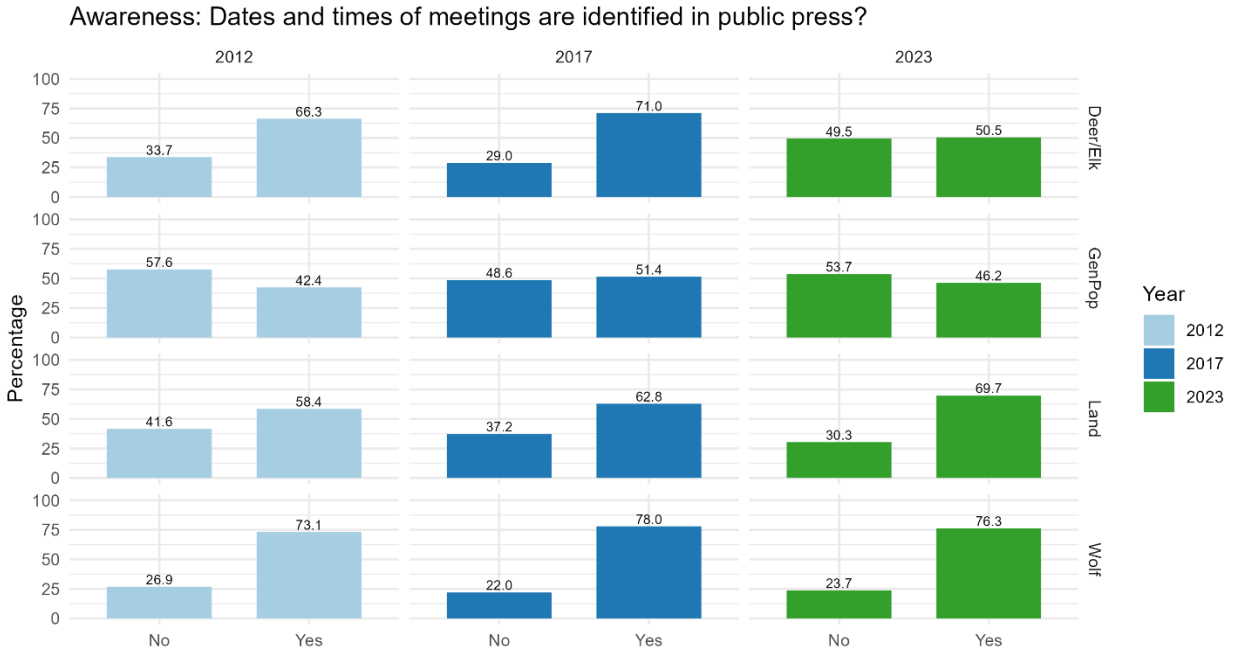

Figure 14 Aware FWP accepts comments frequencies

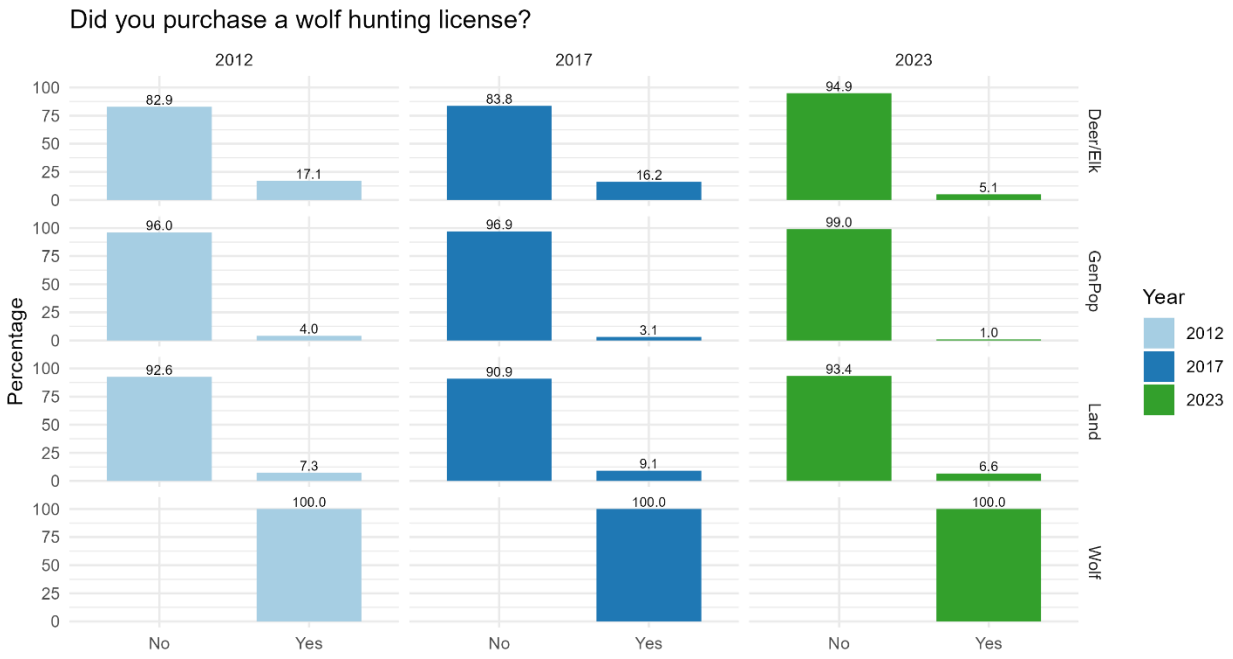

Figure 15 Purchase wolf license frequencies

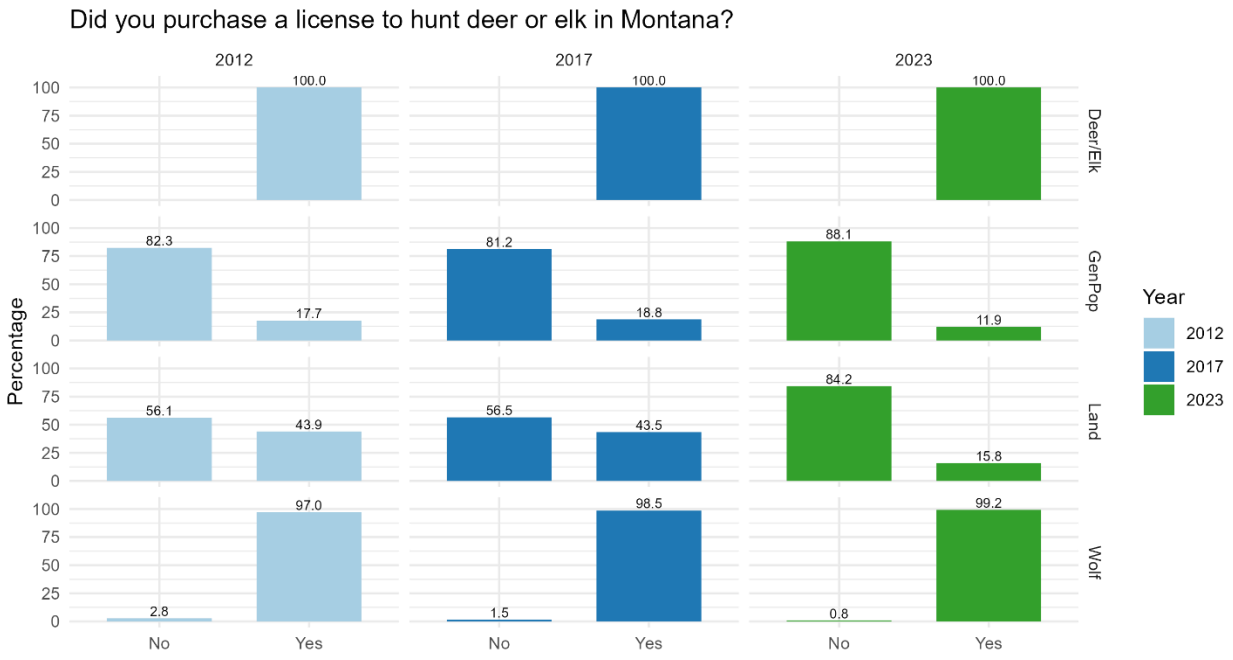

Figure 16 Purchase deer/elk license frequencies

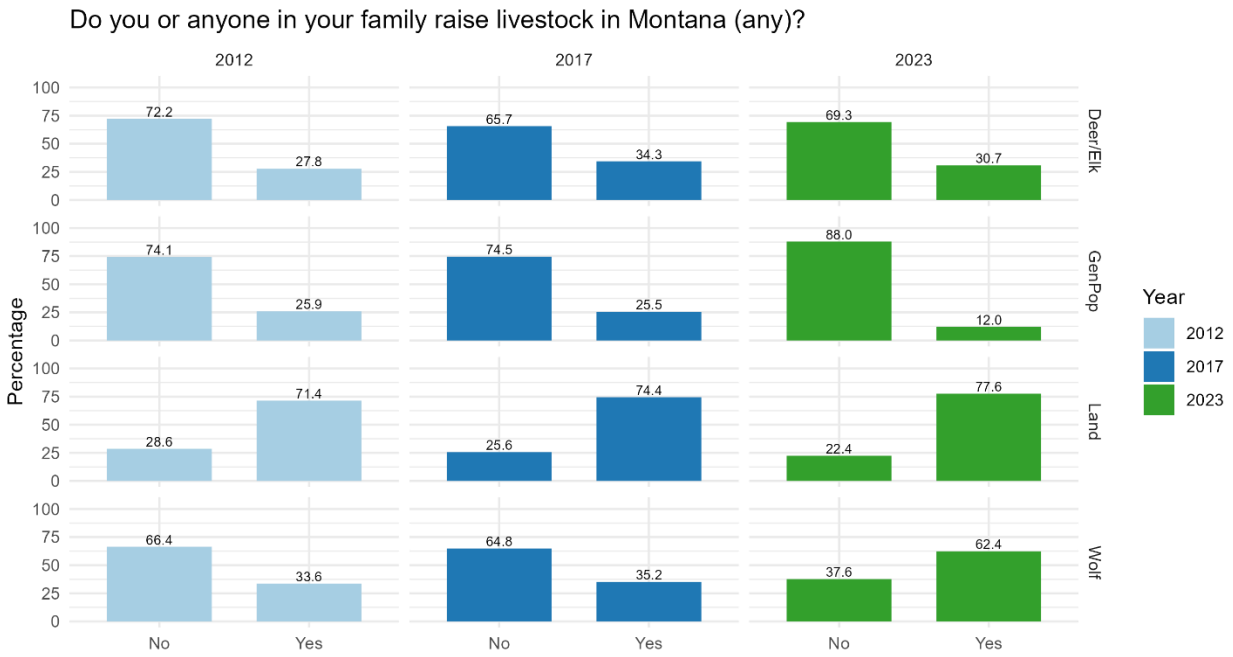

Figure 17 Raise livestock frequencies

2017-2023

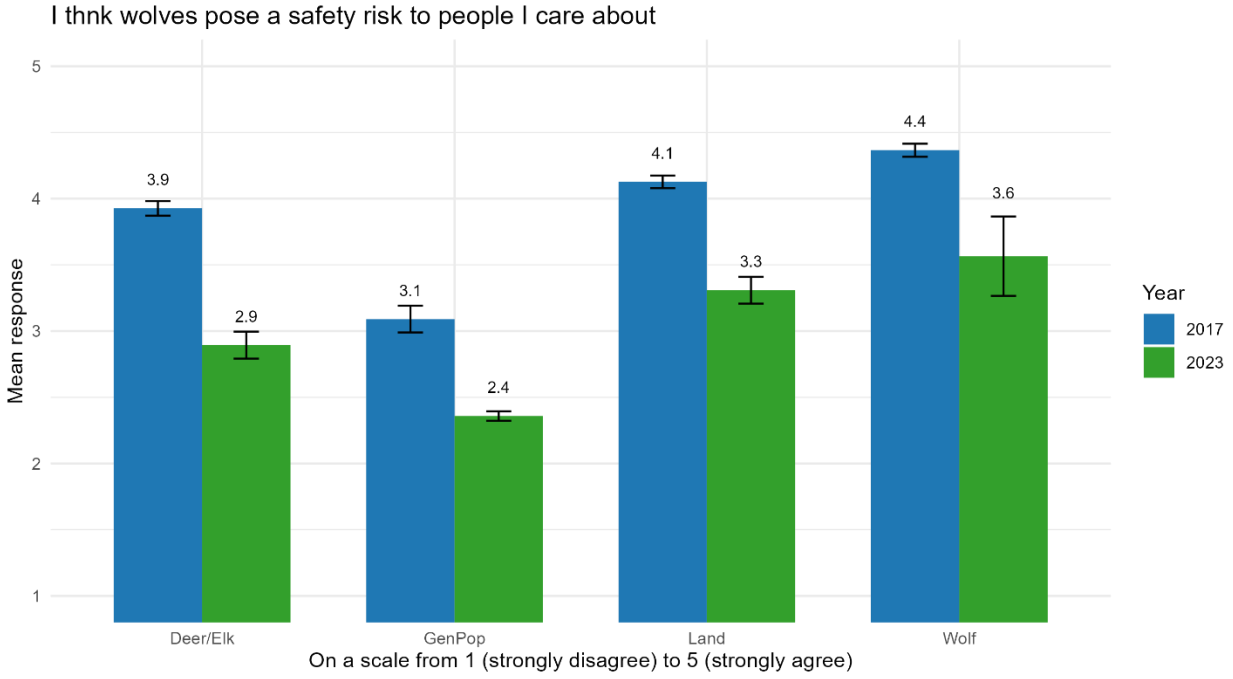

Figure 18 Wolfs pose safety risk means

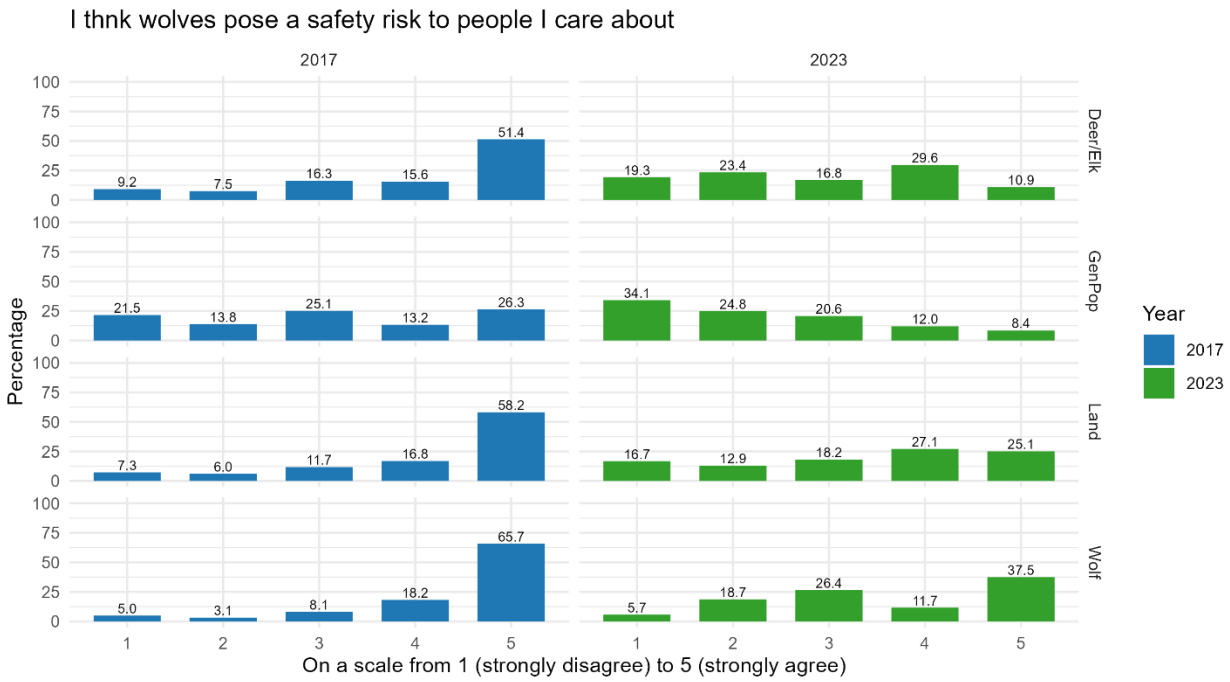

Figure 19 Wolves pose safety risk frequencies

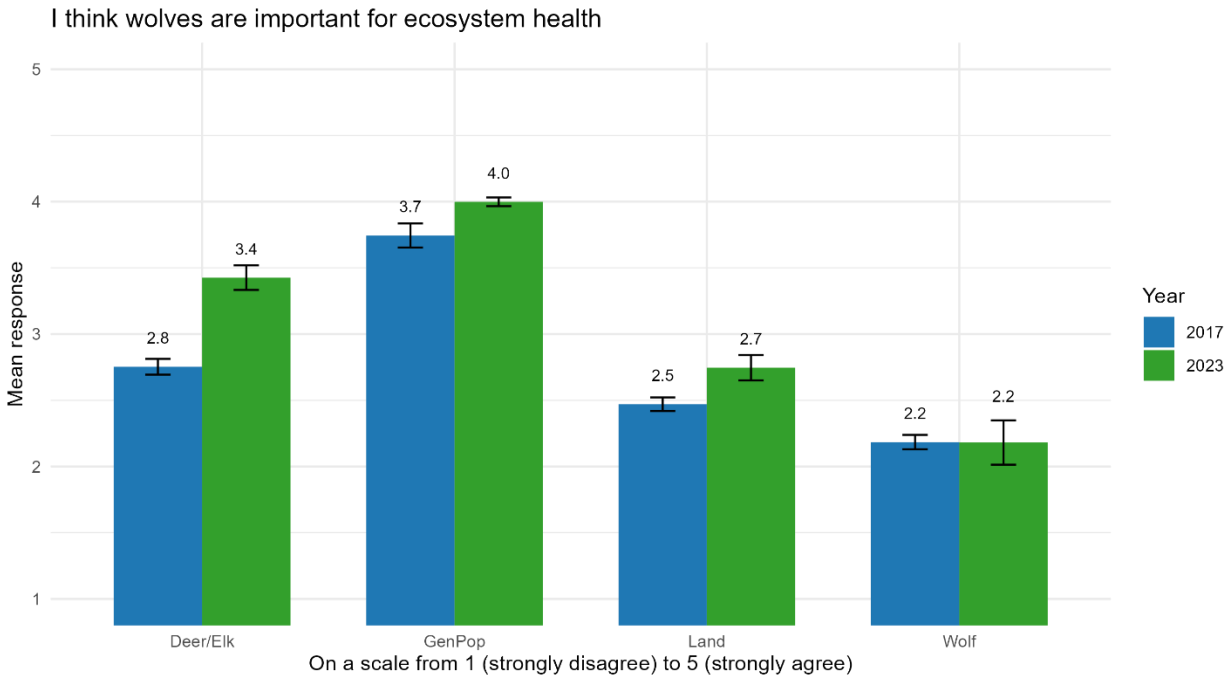

Figure 20 Wolves important to ecosystem means

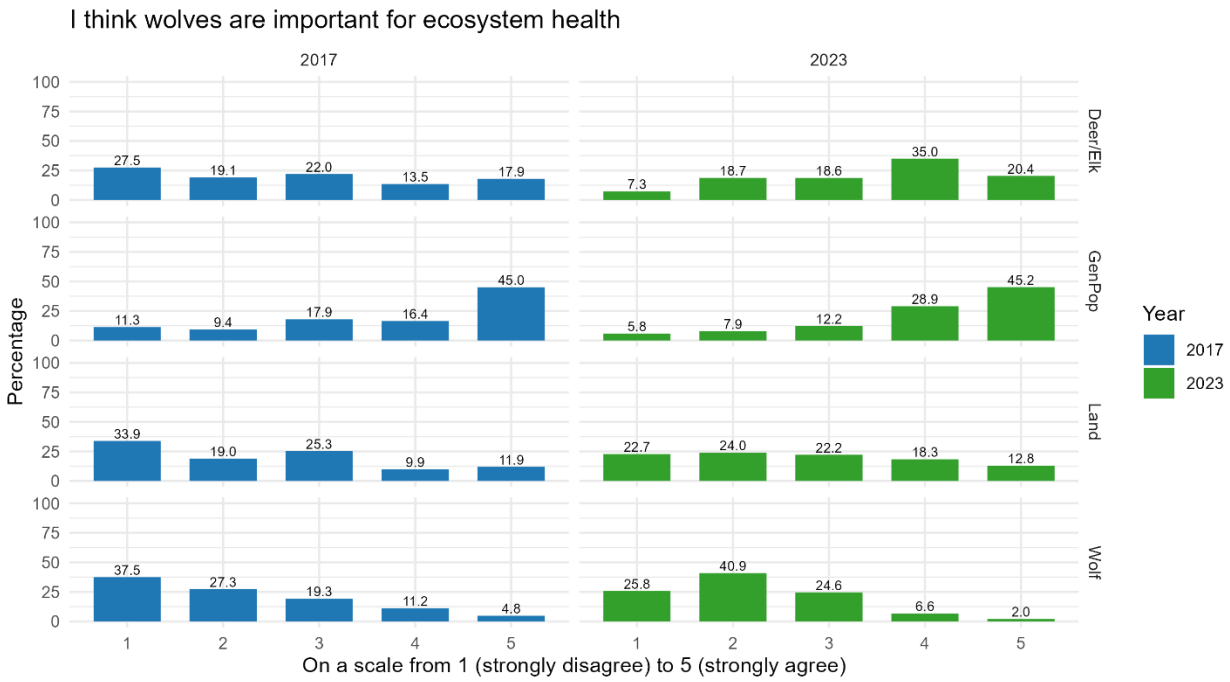

Figure 21 Wolves important for ecosystem frequencies

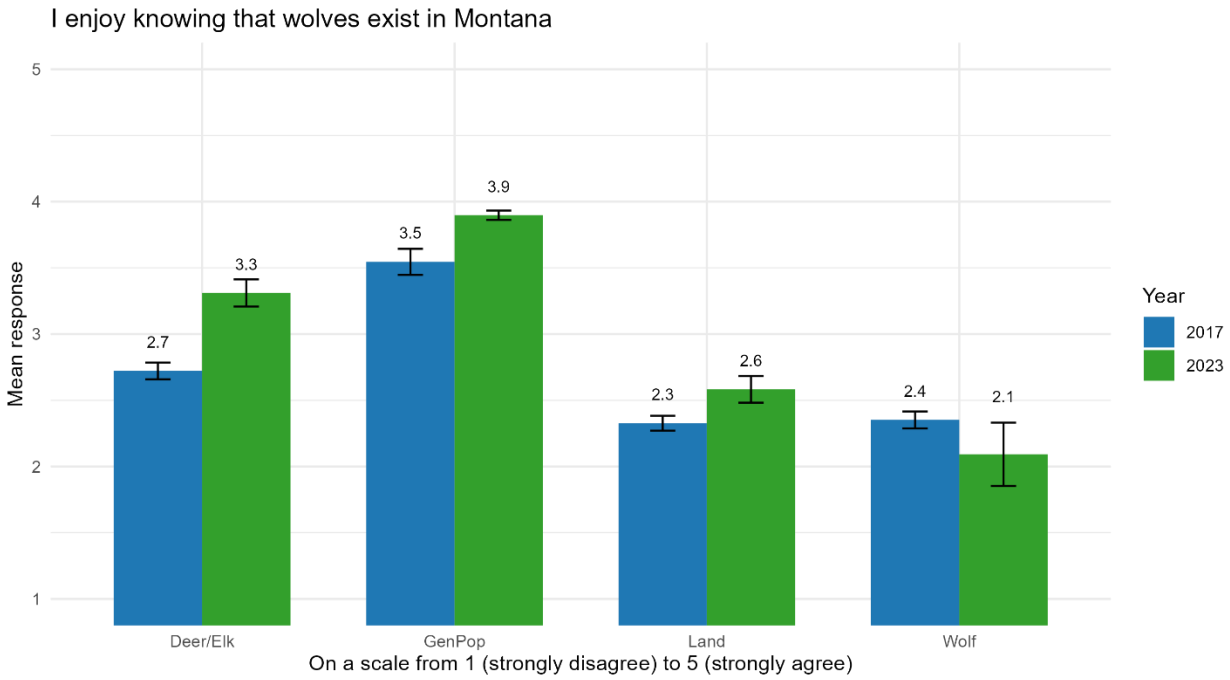

Figure 22 Enjoy knowing wolves exist means

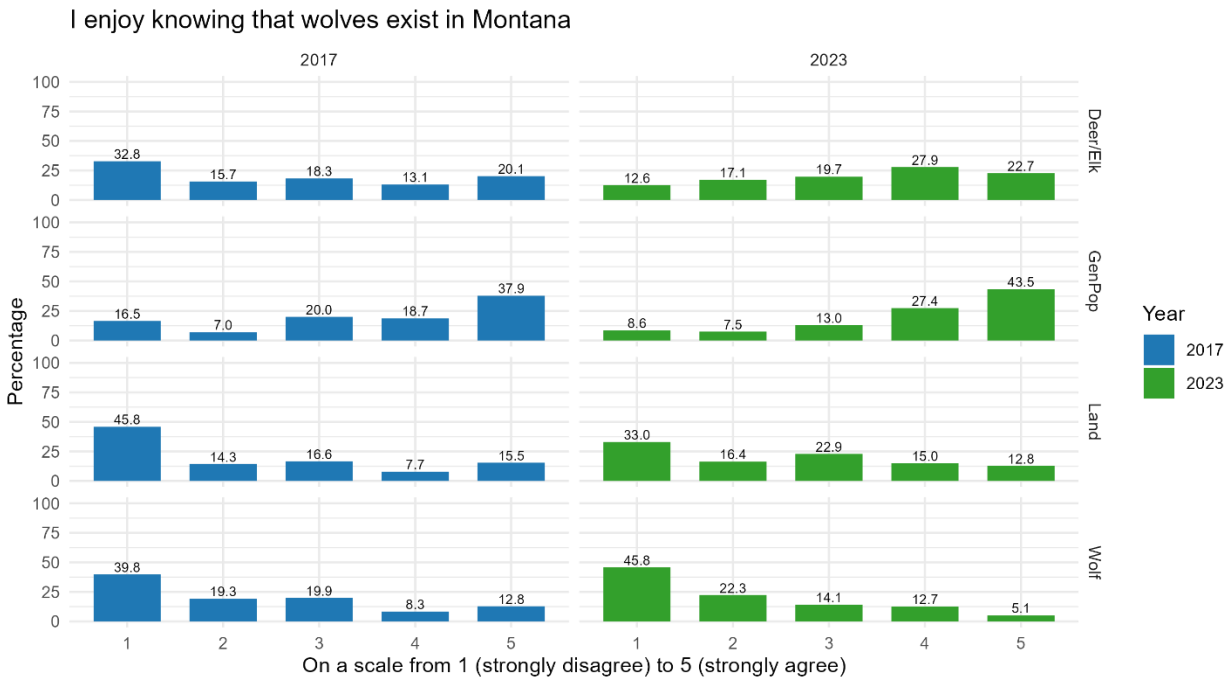

Figure 23 Enjoy knowing wolves exist frequencies

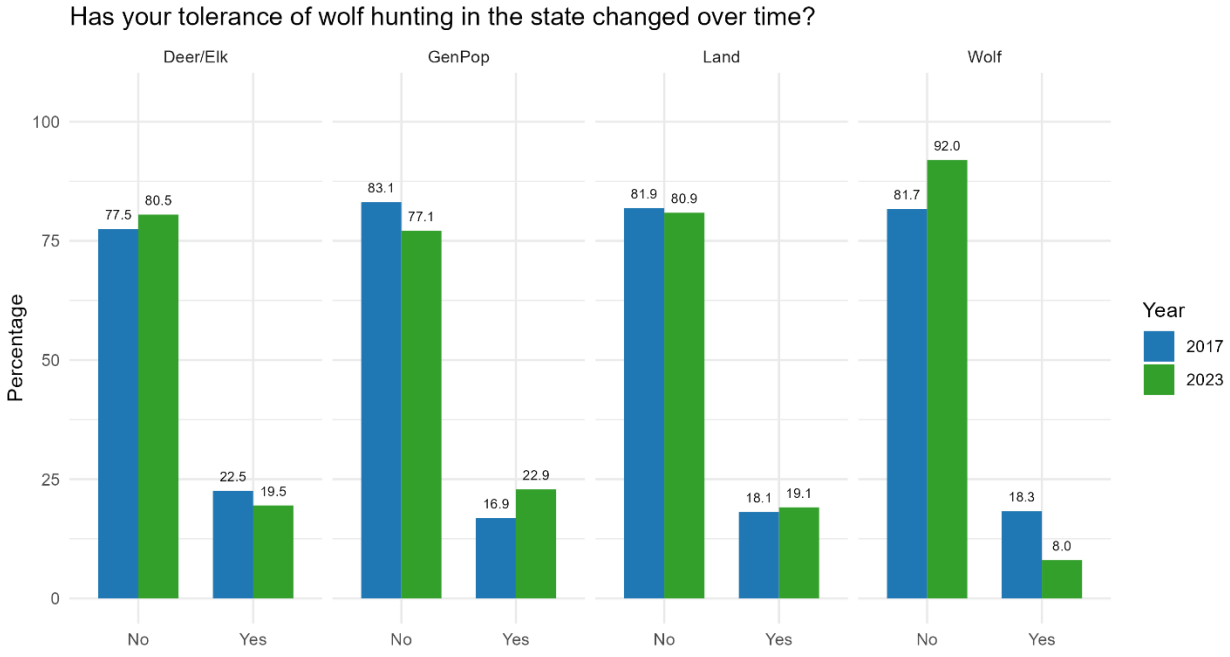

Figure 24 Self-reported change in tolerance of wolf hunting frequencies

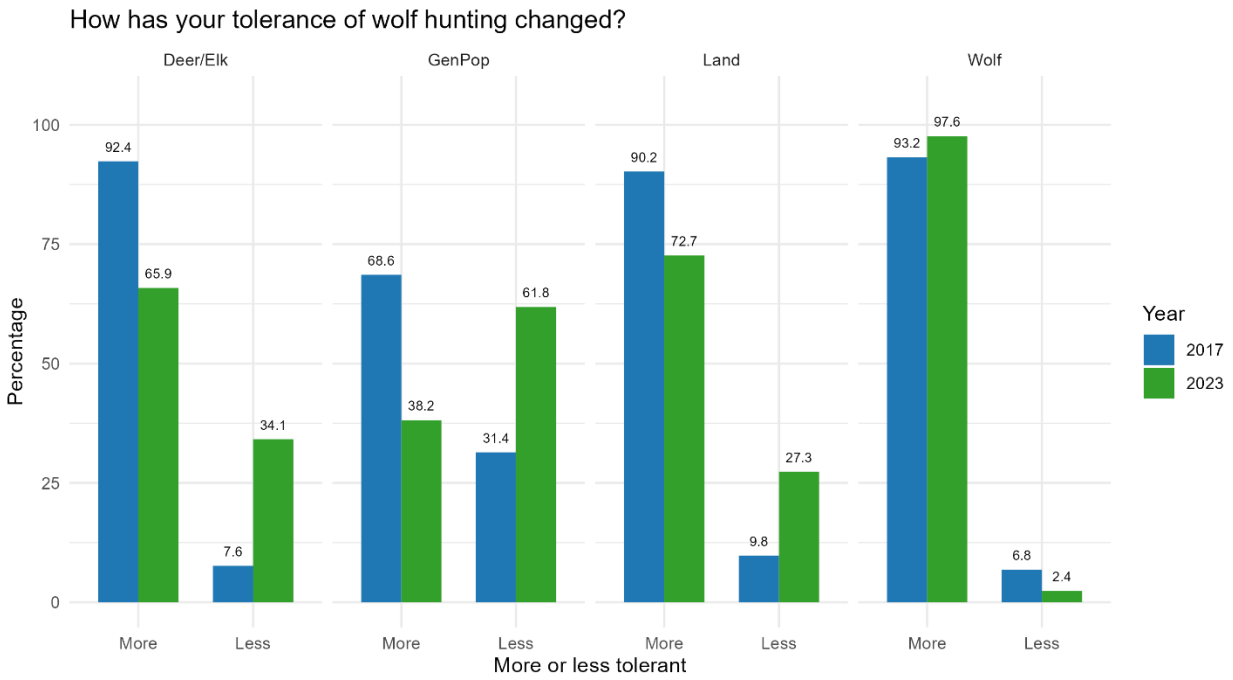

Figure 25 Self-reported change in tolerance of wolf hunting directionality frequencies

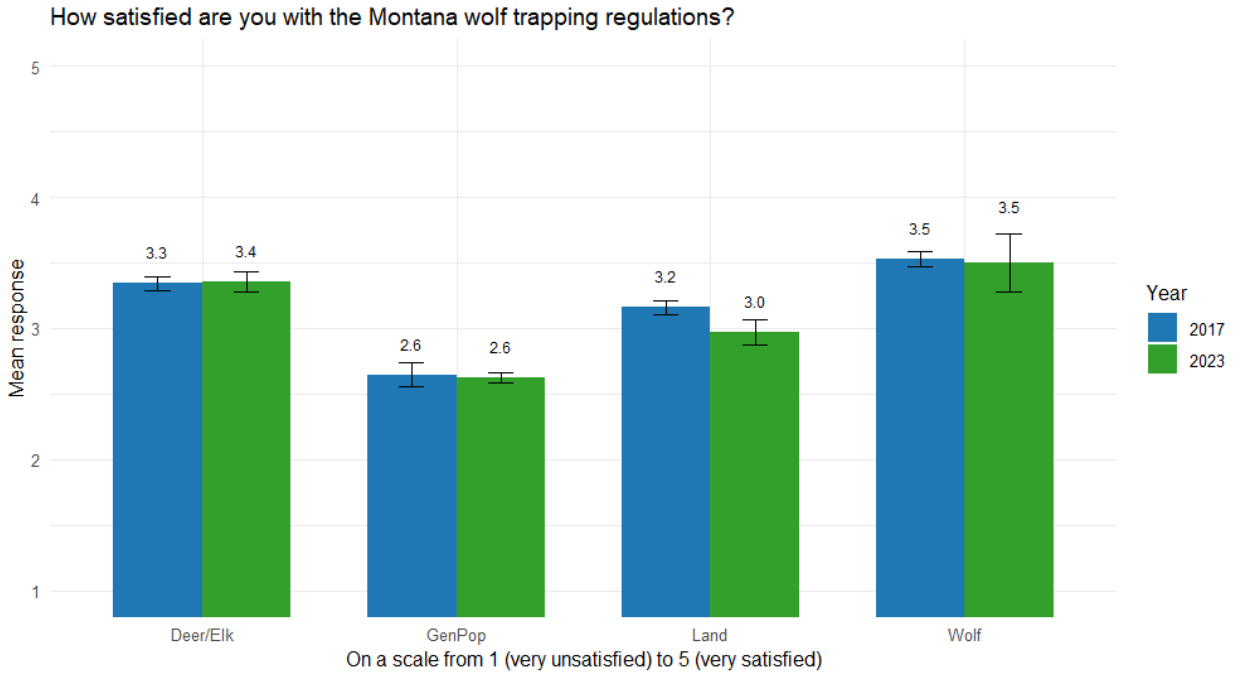

Figure 26 Figure 26 Satisfaction with wolf trapping regulations means

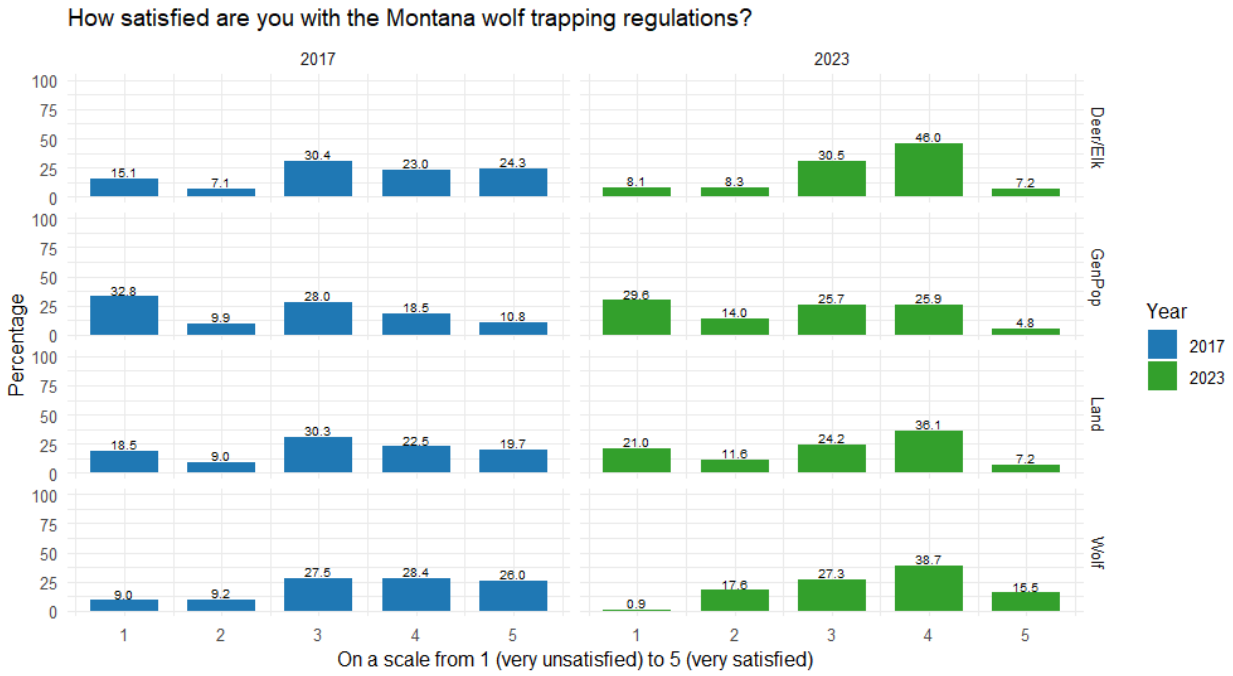

Figure 27 Satisfaction with wolf trapping regulations frequencies

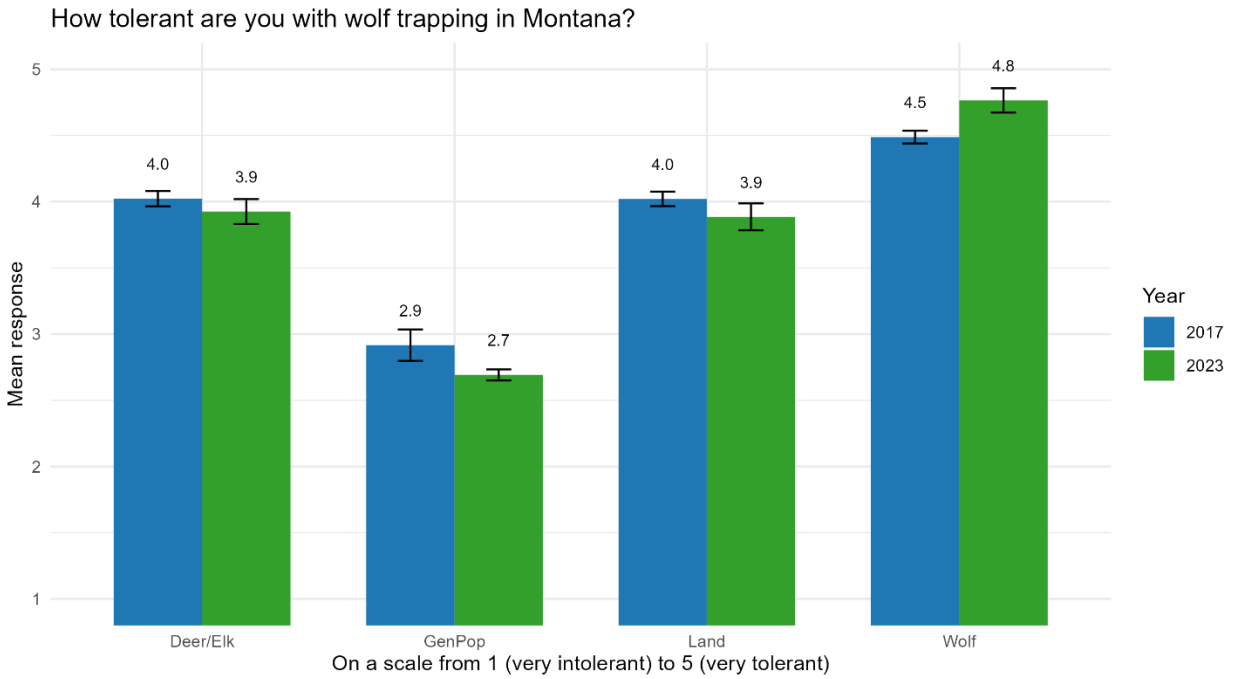

Figure 28 Tolerance with wolf trapping means

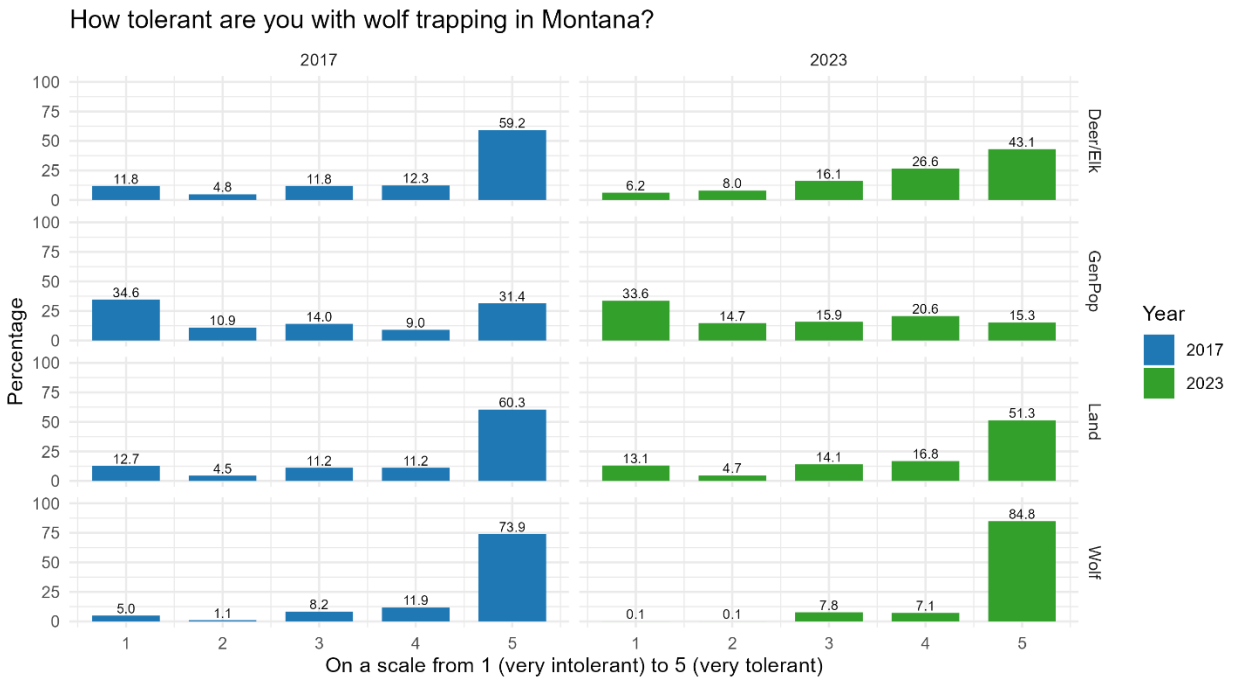

Figure 29 Tolerance with wolf trapping frequencies

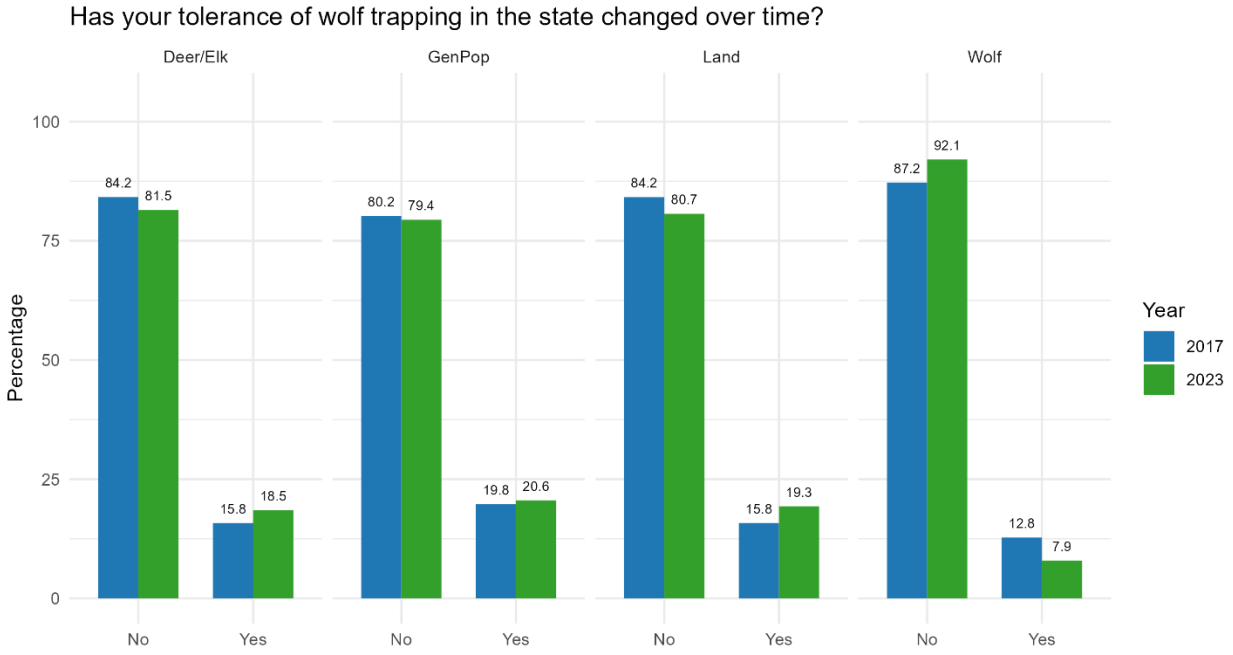

Figure 30 Self-reported change in tolerance for wolf trapping frequencies

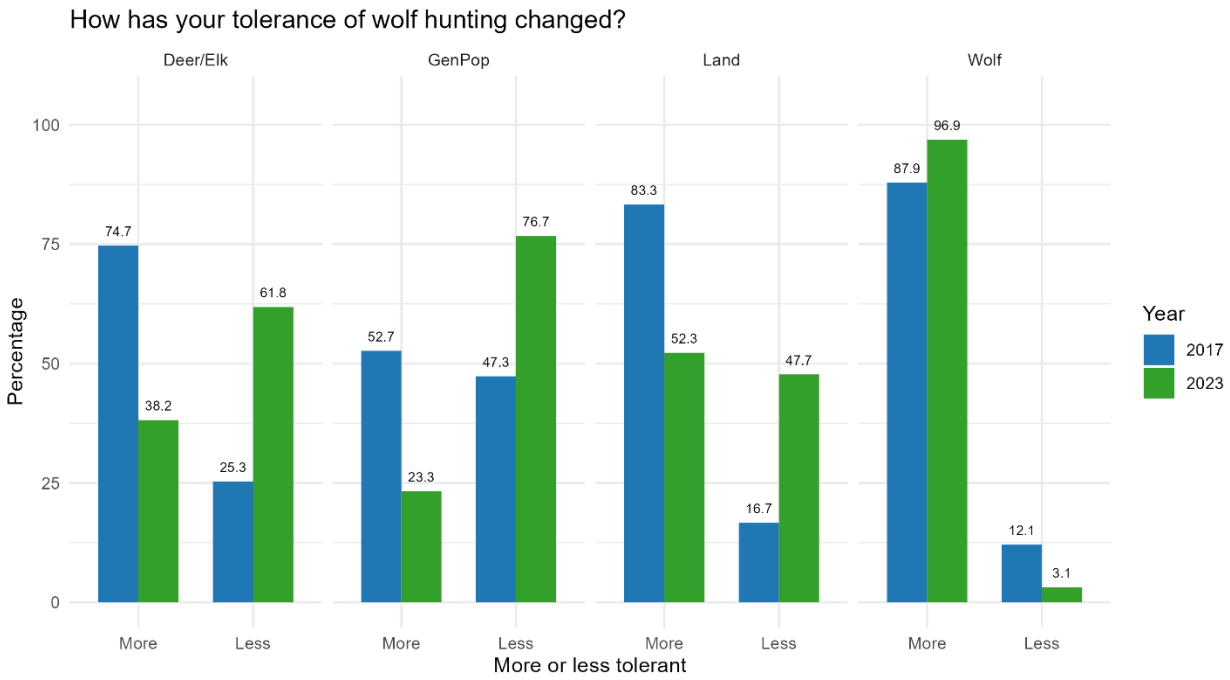

Figure 31 Self-reported change in tolerance for wolf trapping directionality frequencies

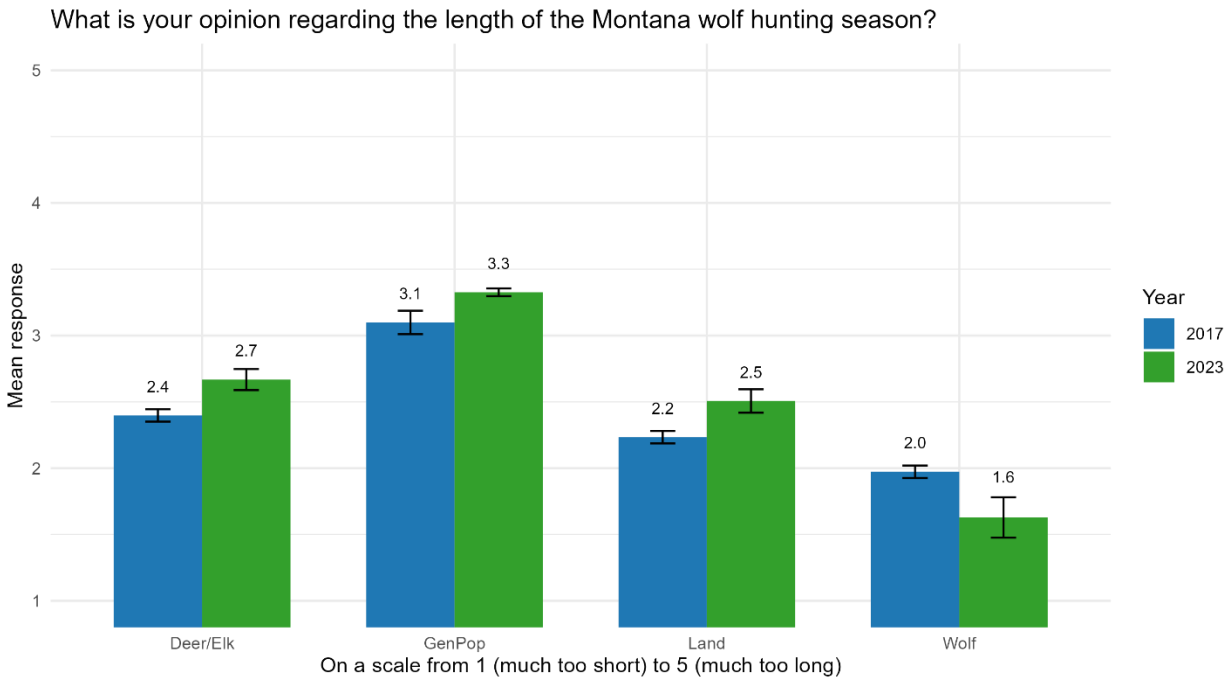

Figure 32 Wolf hunting season length means

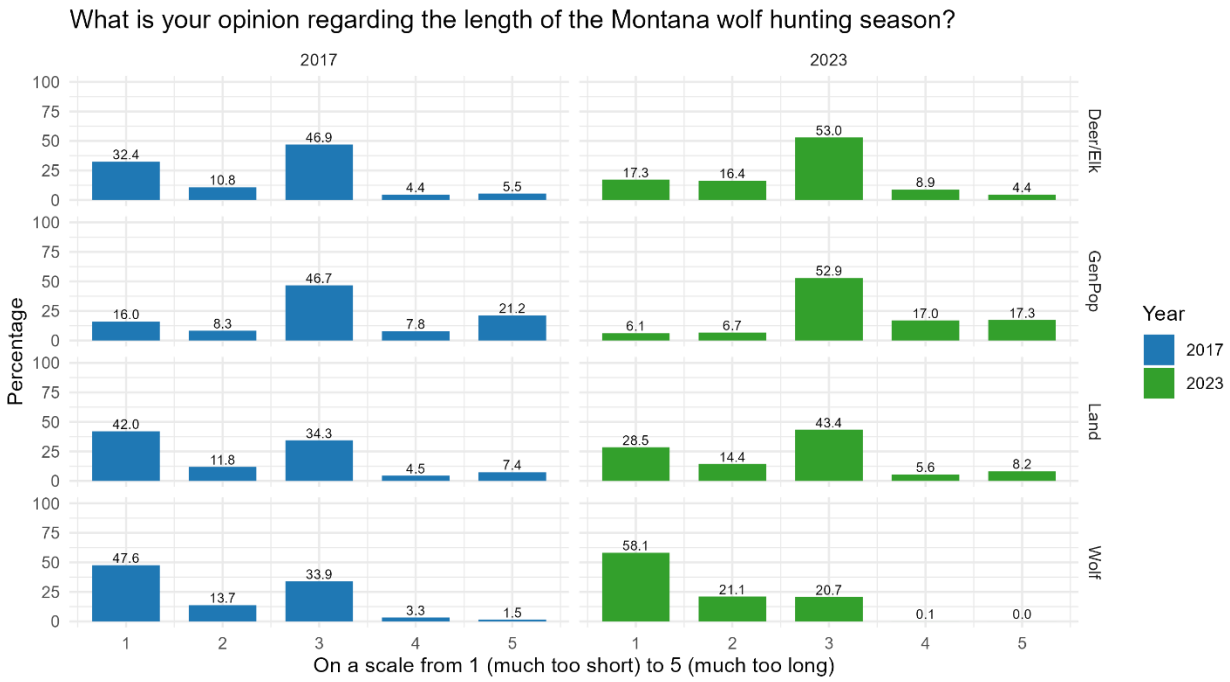

Figure 33 Wolf hunting season length frequencies

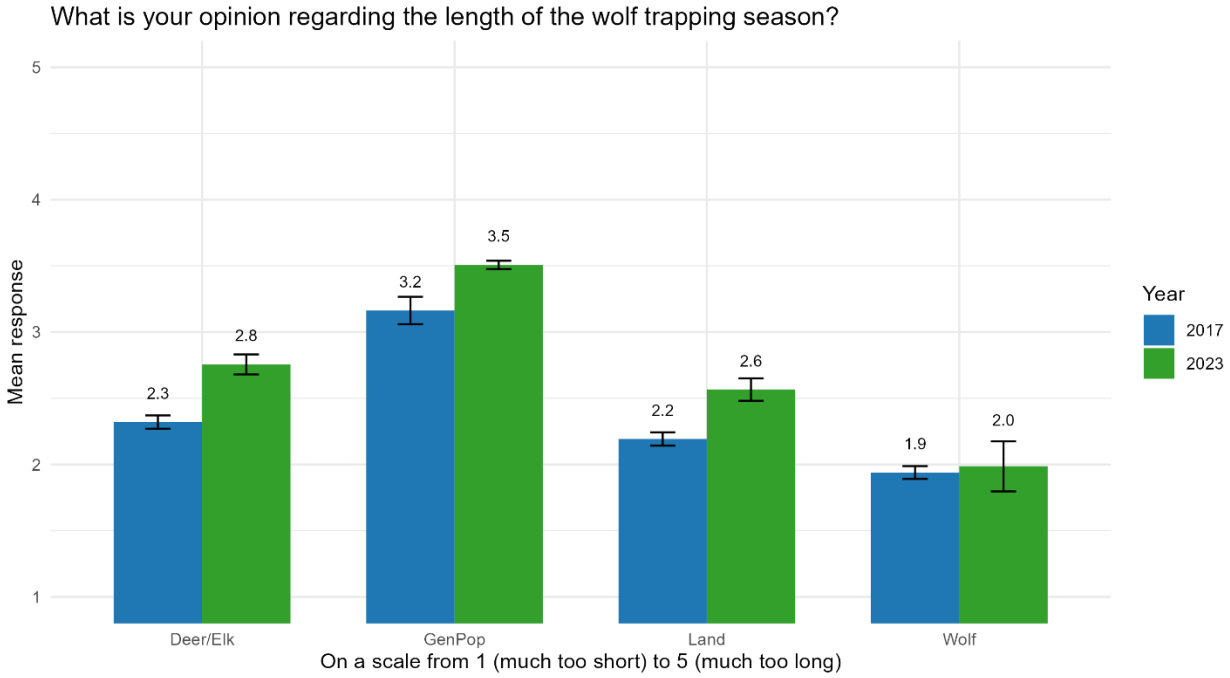

Figure 34 Wolf trapping season length means

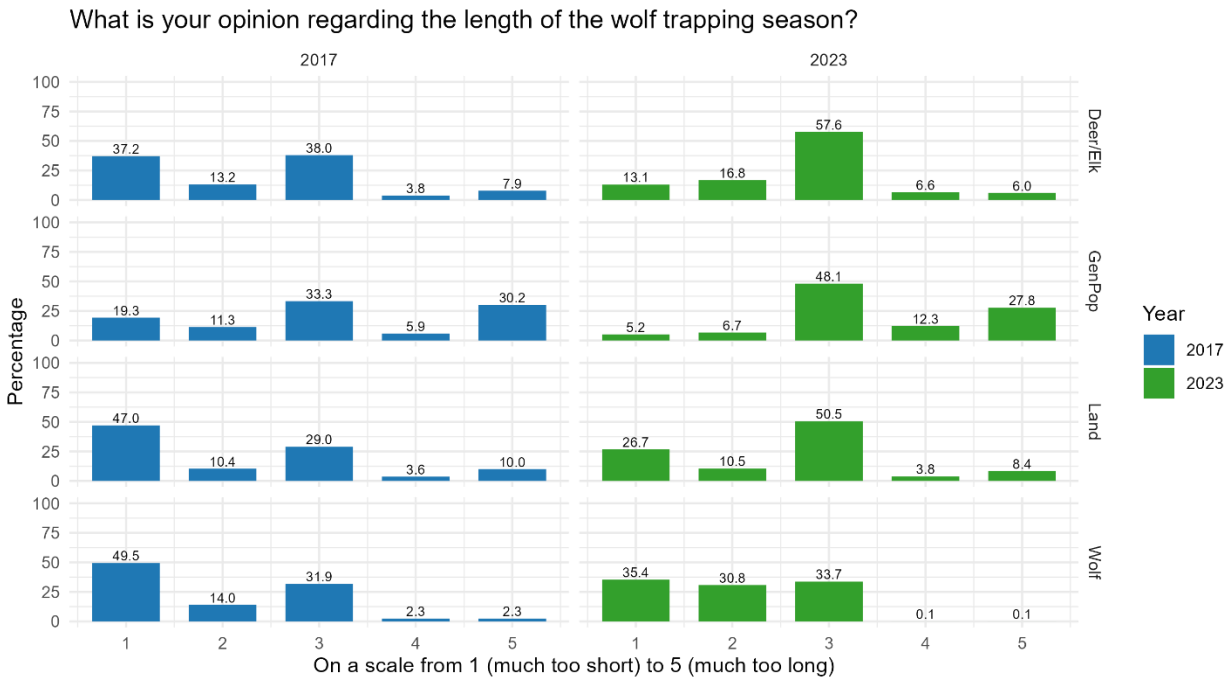

Figure 35 Wolf trapping season length frequencies

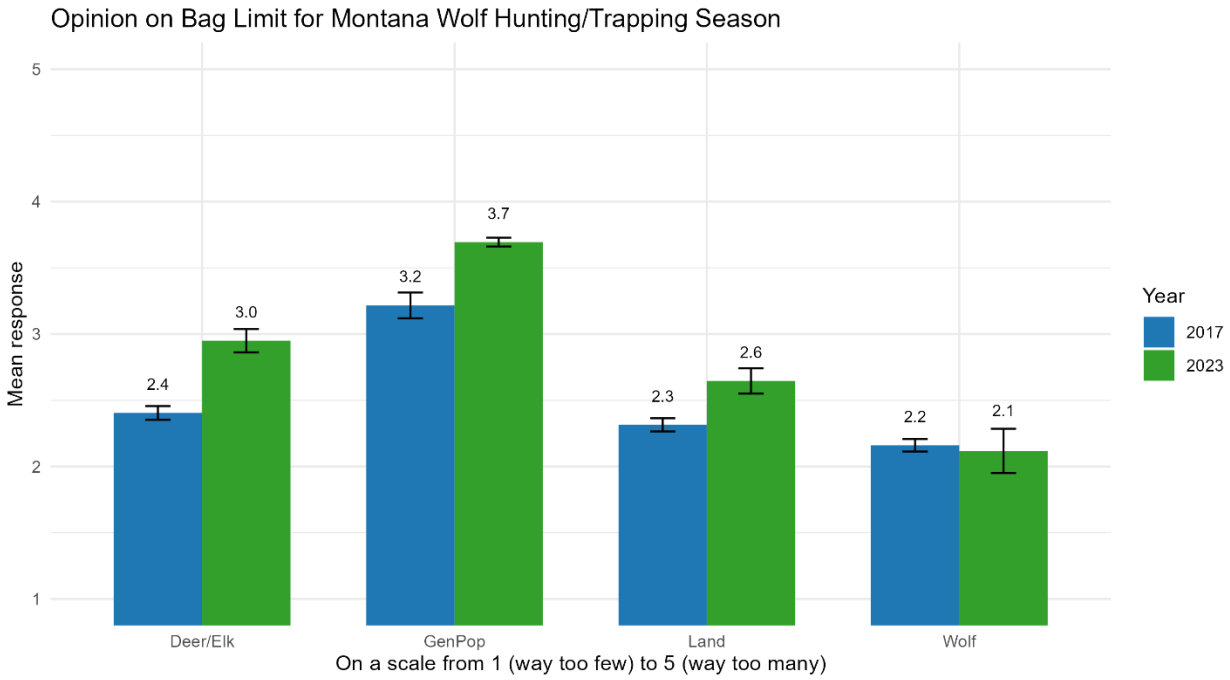

Figure 36 Wolf bag limit means

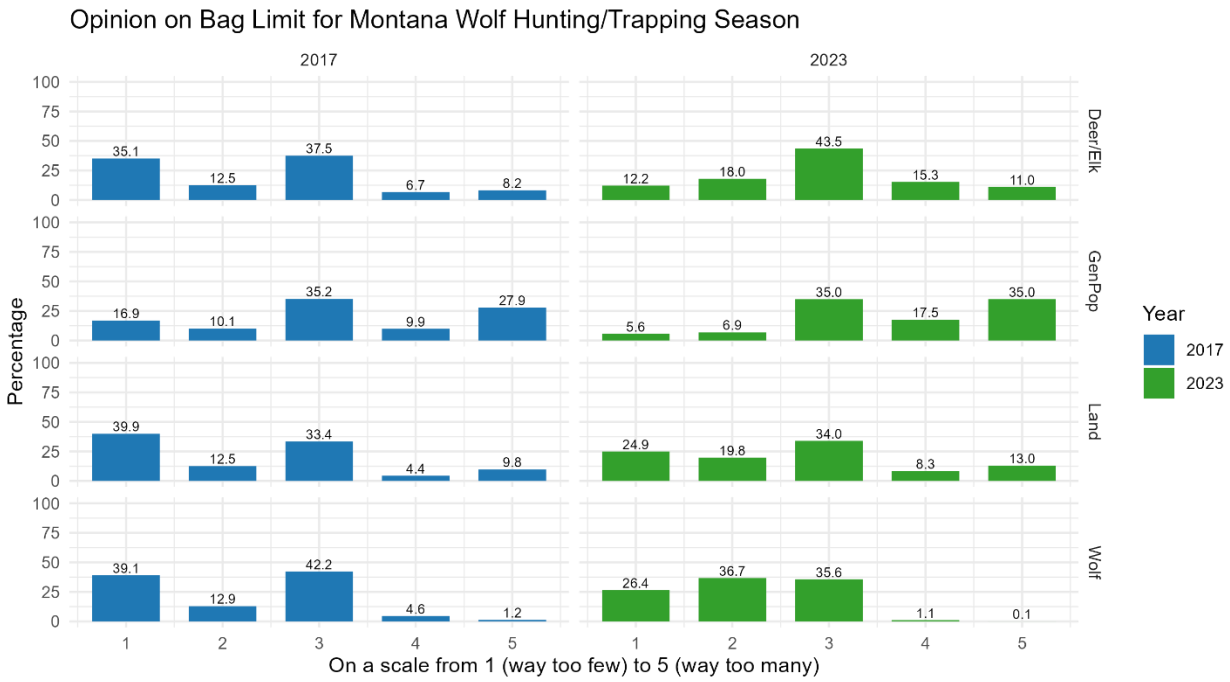

Figure 37 Wolf bag limit frequencies

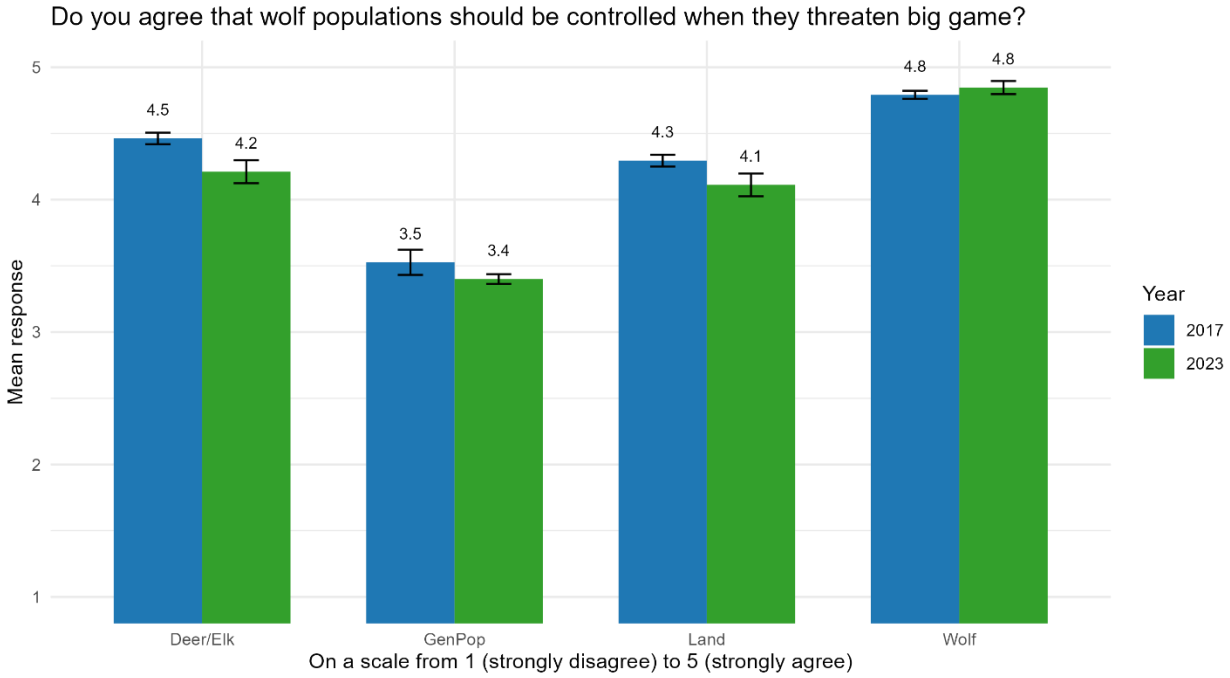

Figure 38 Control wolves if threaten big game means

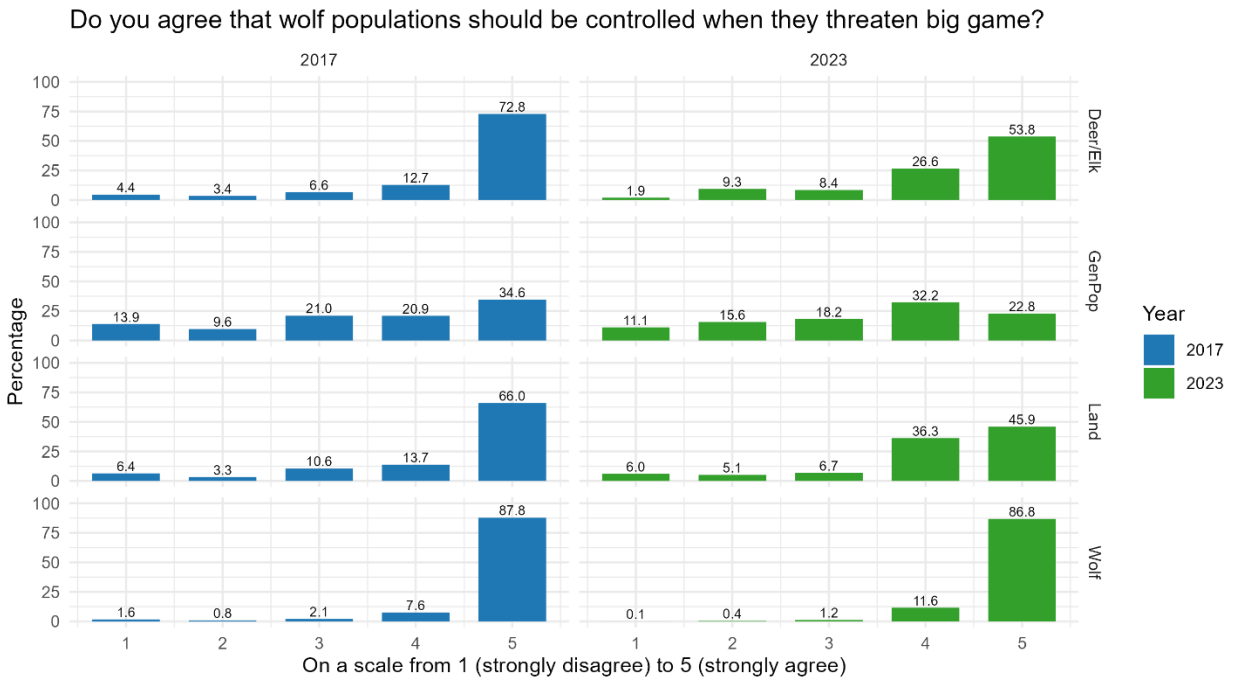

Figure 39 Control wolves if threaten big game frequencies

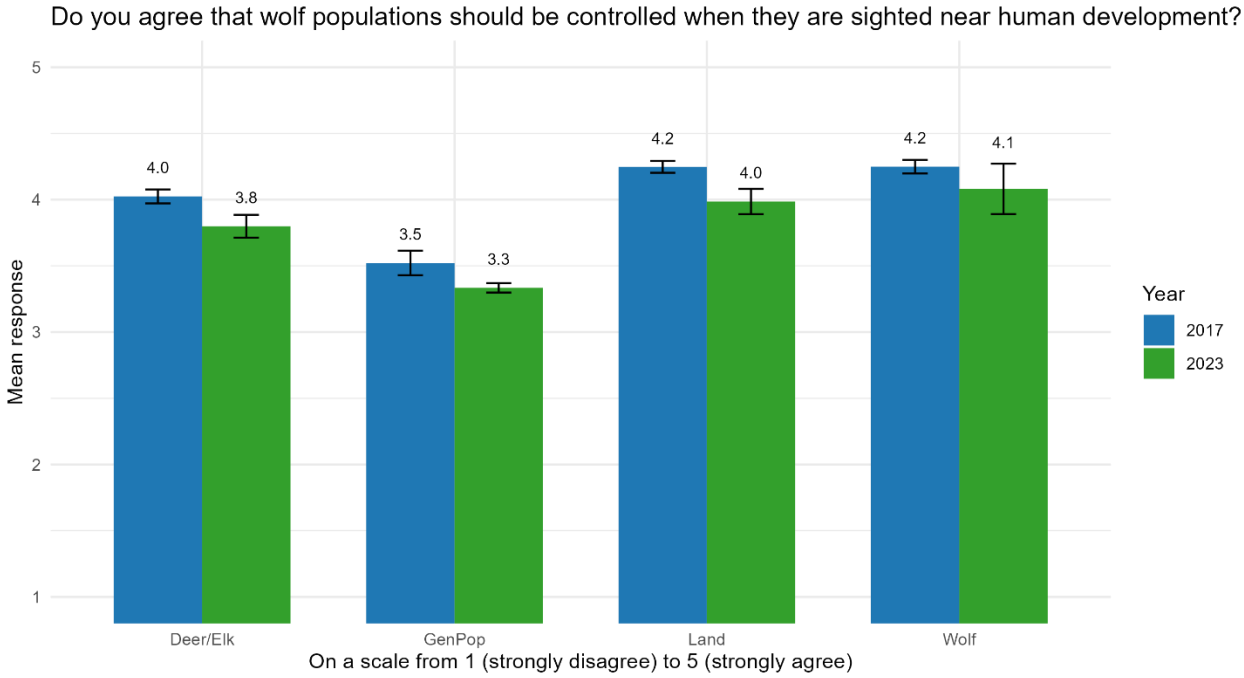

Figure 40 Control wolves if near human development means

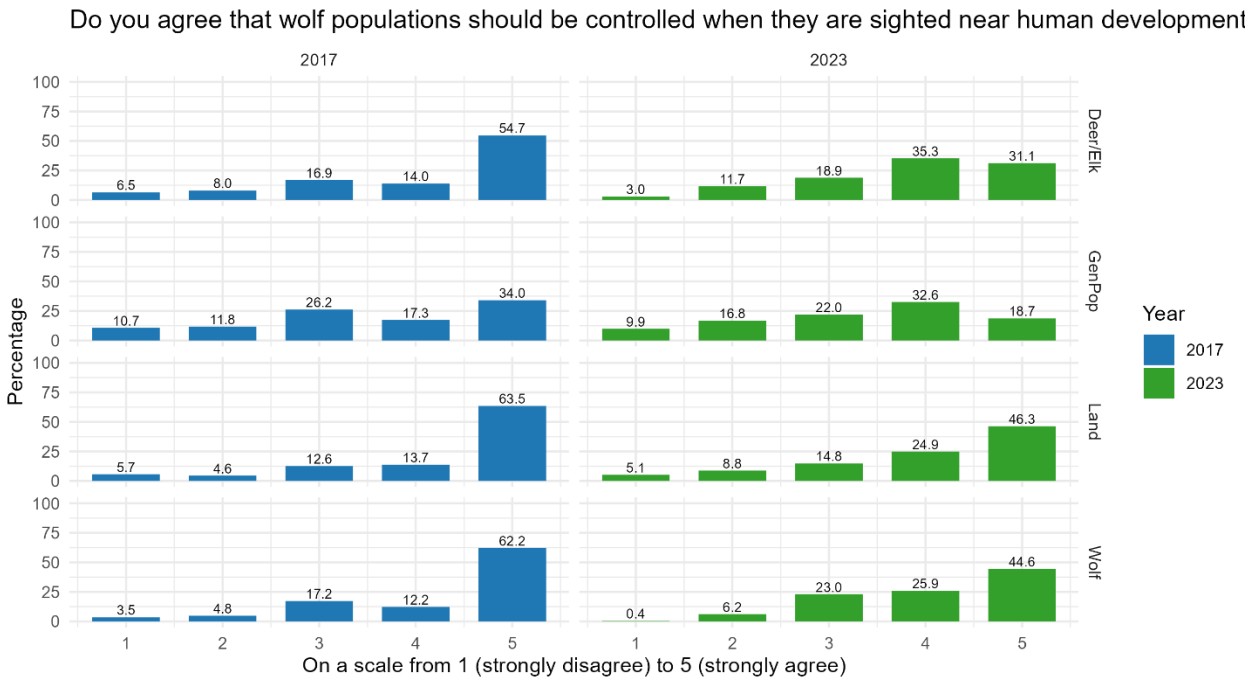

Figure 41 Control wolves if seen near human development frequencies

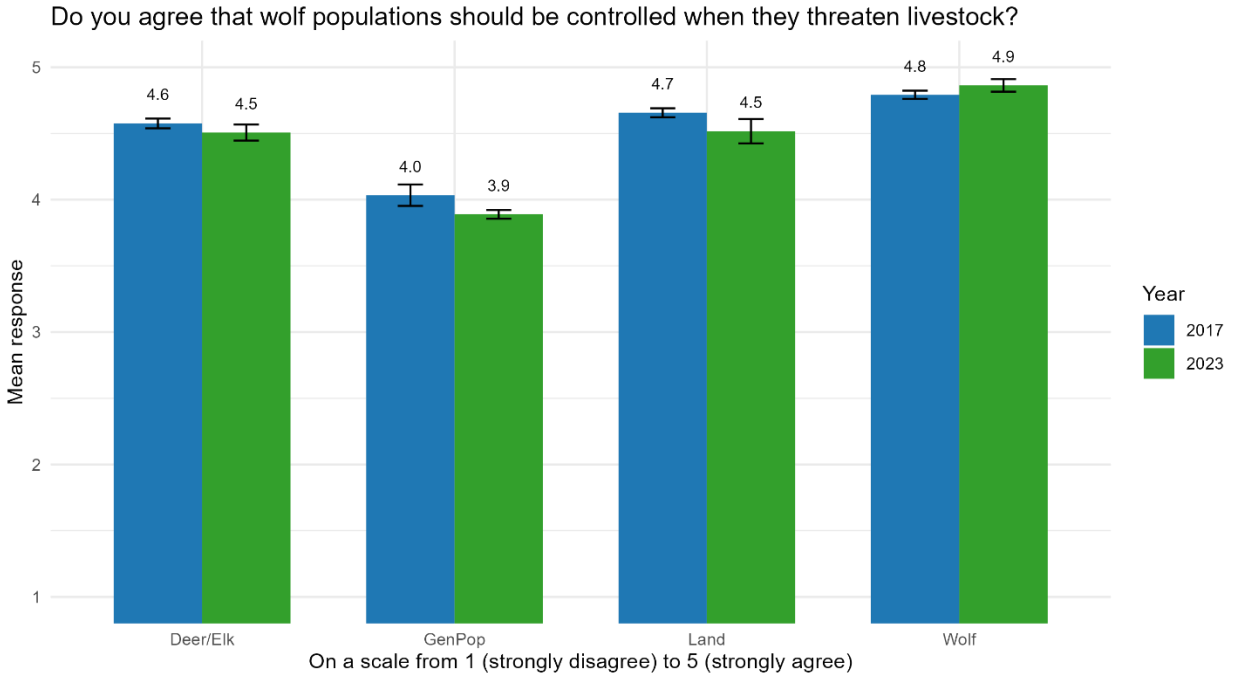

Figure 42 Control wolves if threaten livestock means

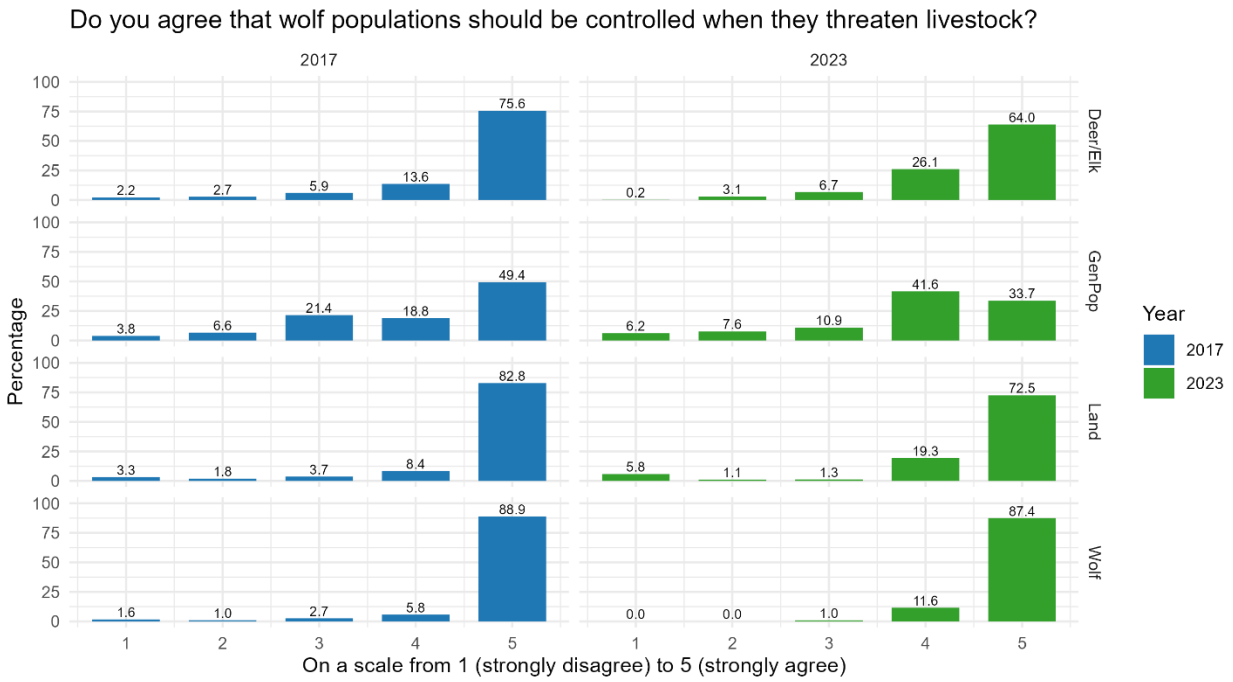

Figure 43 Control wolves if threaten livestock frequencies

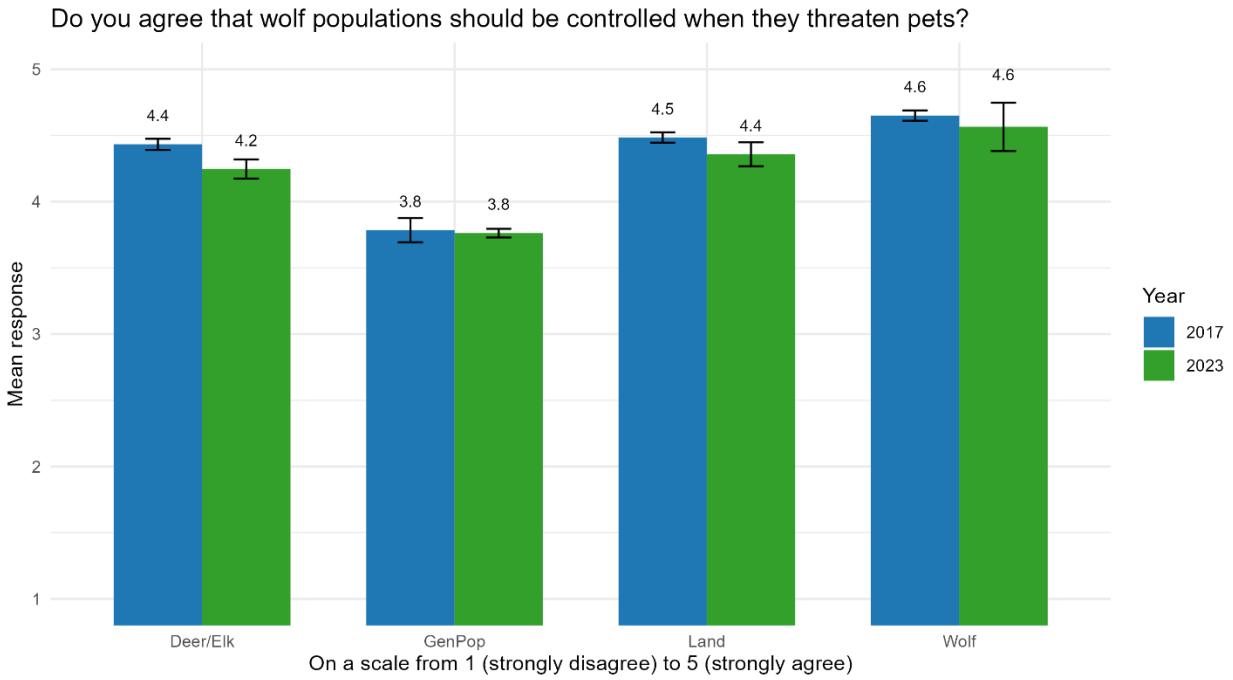

Figure 44 Control wolves if threaten pets means

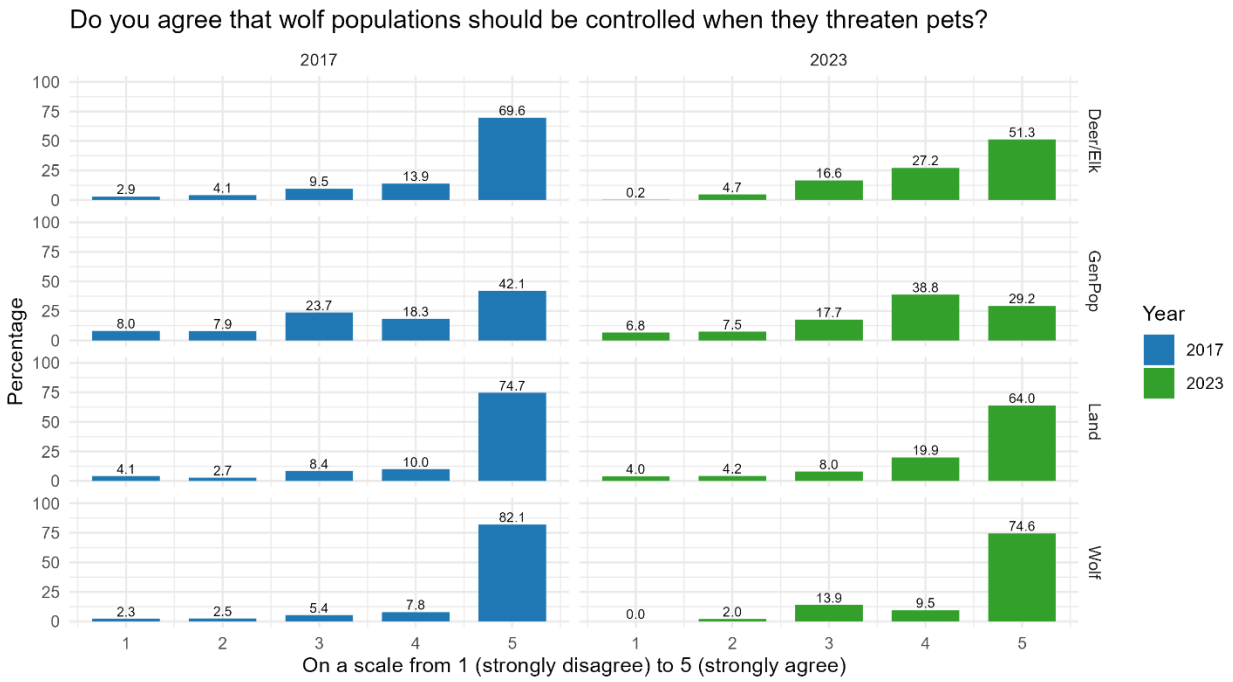

Figure 45 Control wolves if threaten pets frequencies

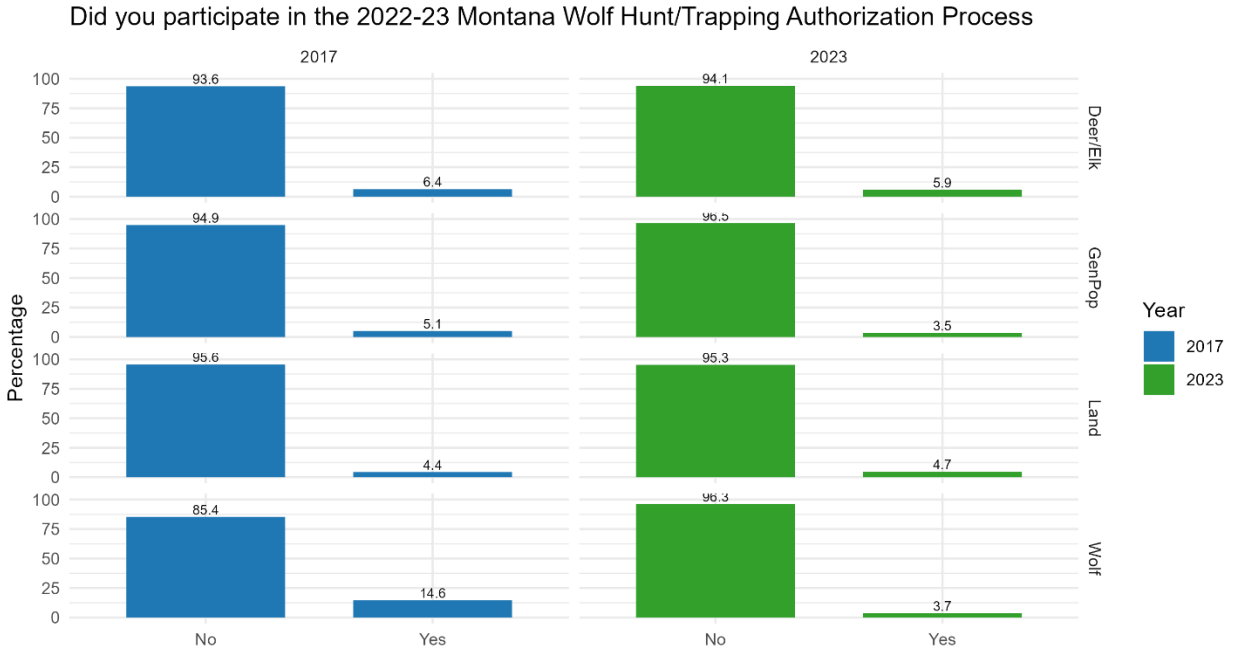

Figure 46 Participate in regulation process frequencies

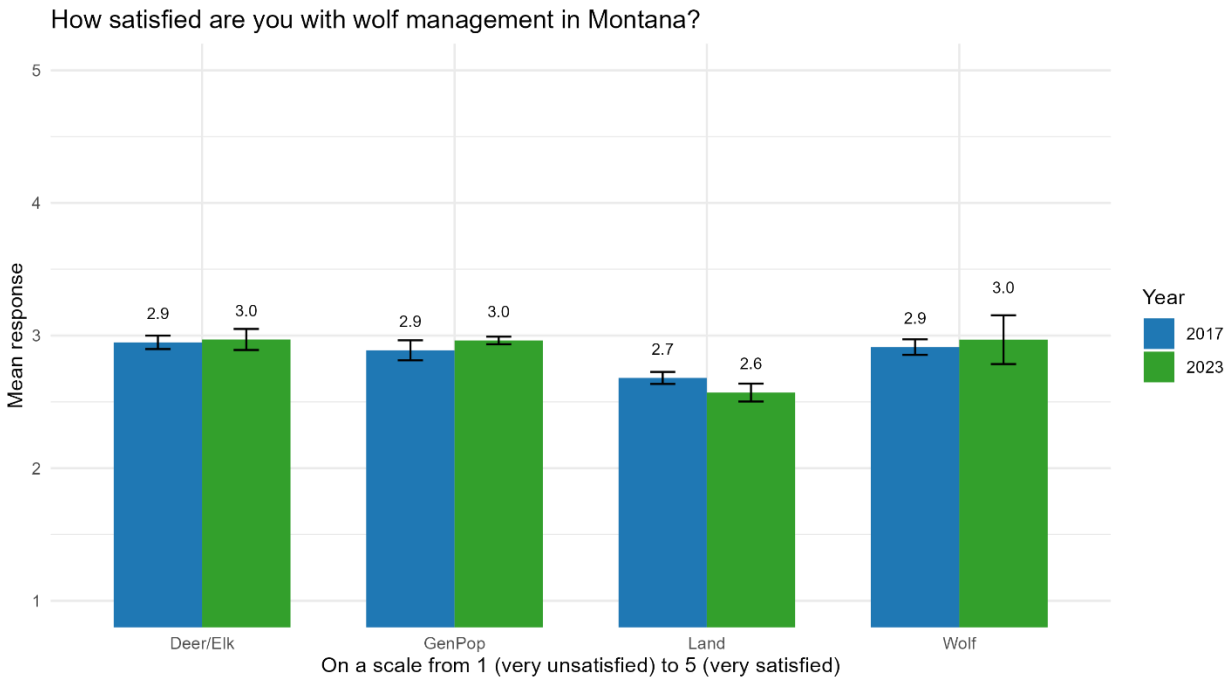

Figure 47 Satisfaction with wolf management means

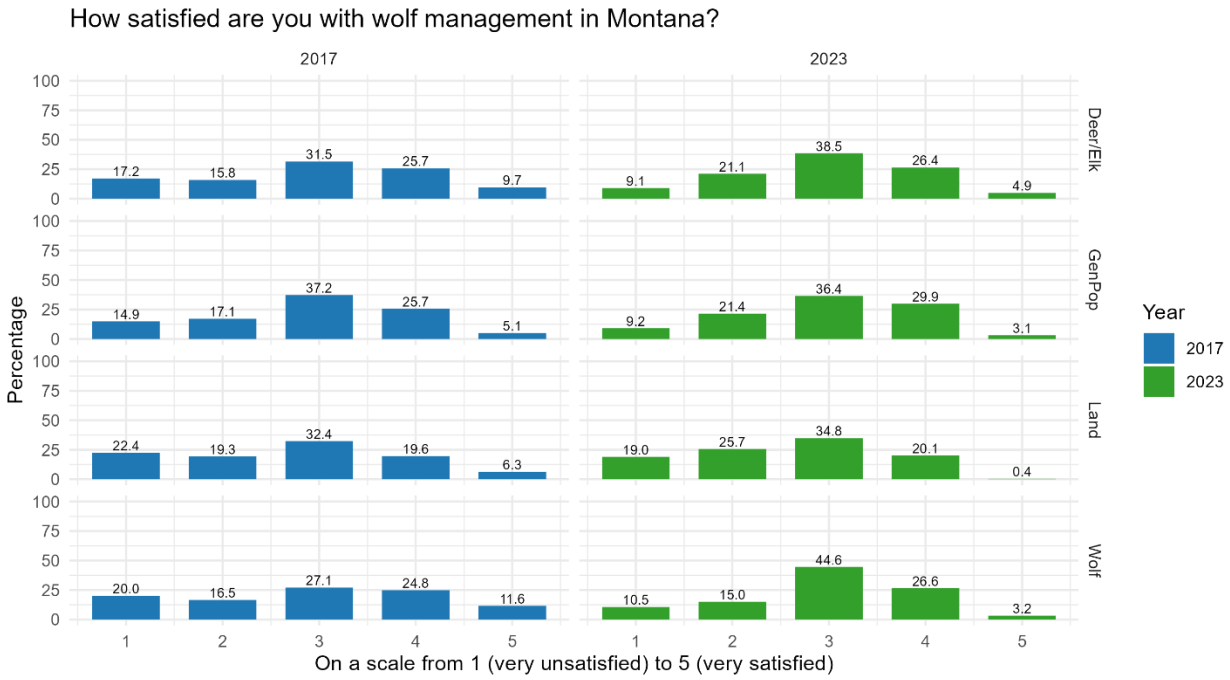

Figure 48 Satisfaction with wolf management frequencies

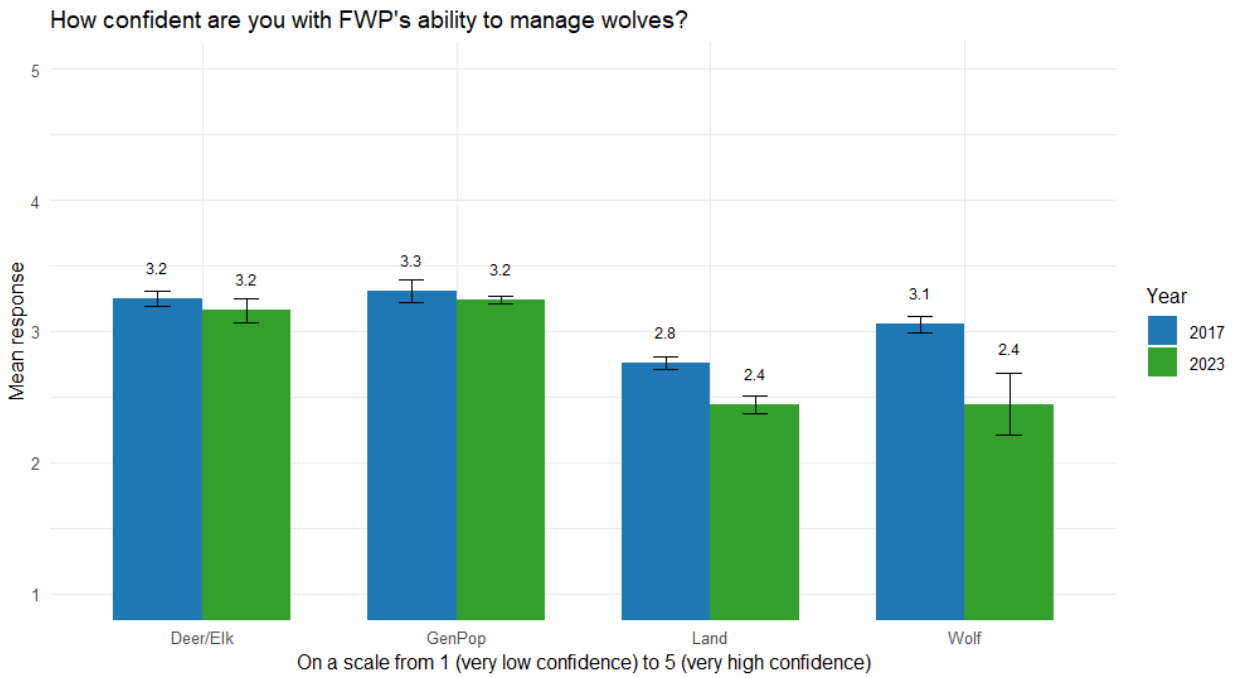

Figure 49 Confidence in FWP means

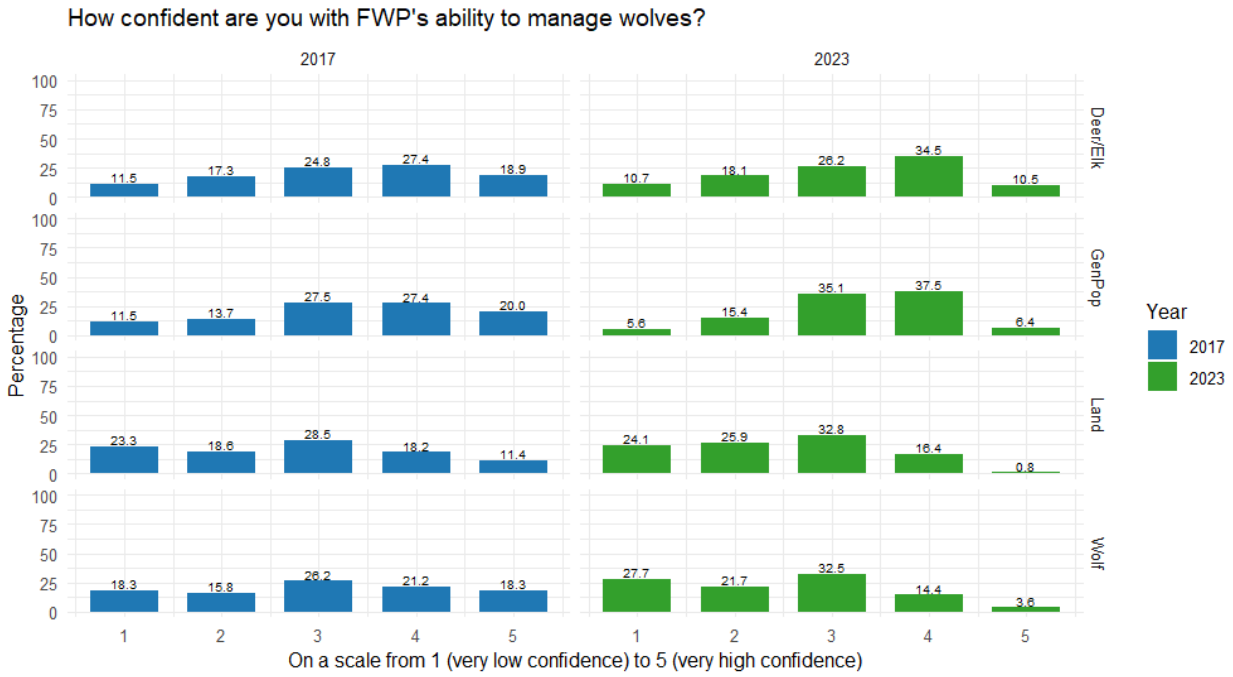

Figure 50 Confidence in FWP frequencies

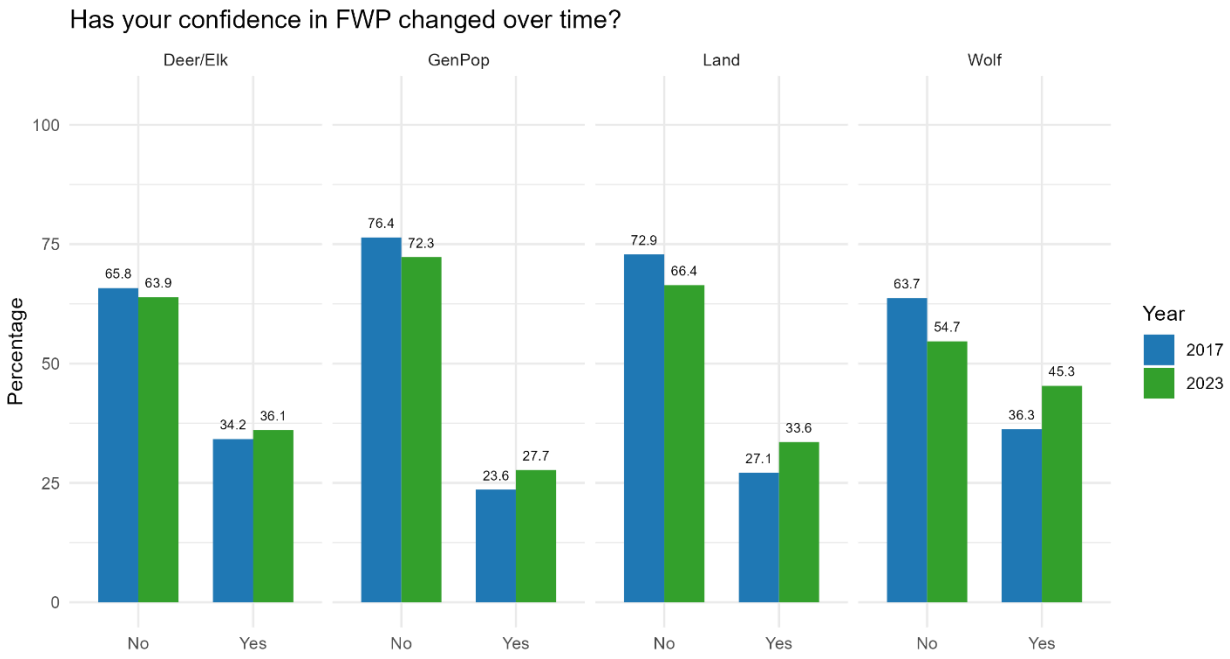

Figure 51 Self-reported change in confidence in FWP frequencies

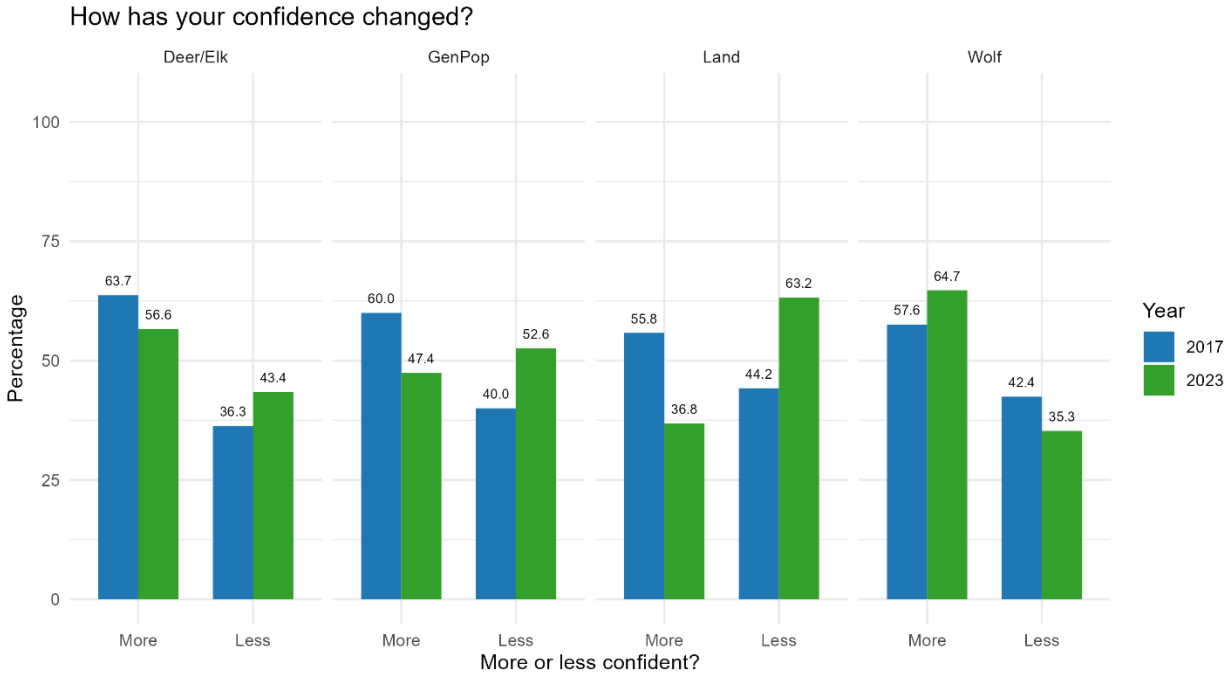

Figure 52 Self-reported change in confidence in FWP directionality frequencies

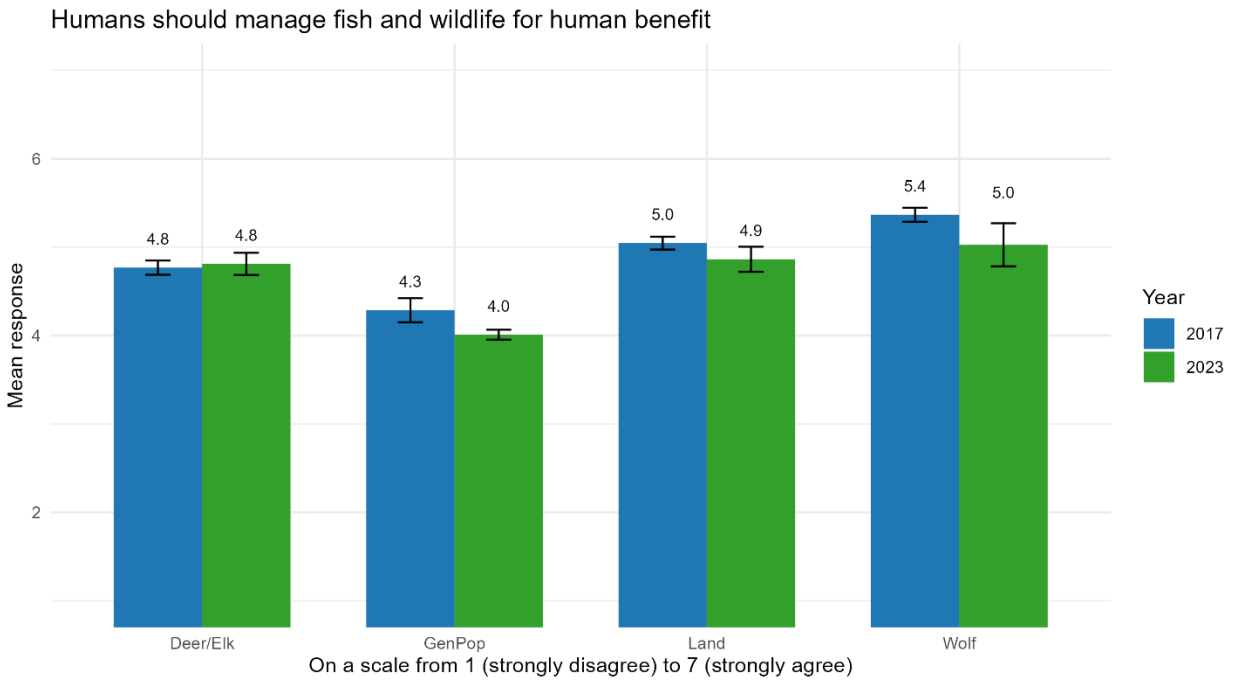

Figure 53 WVO human benefit means

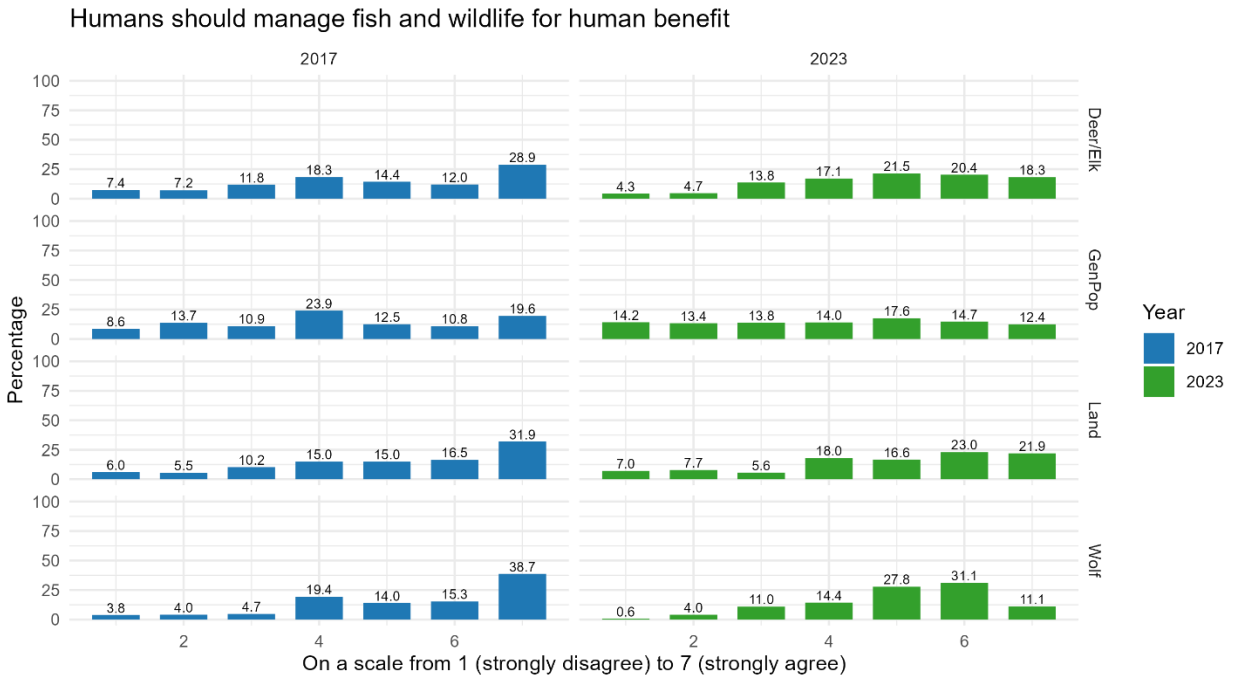

Figure 54 WVO human benefit frequencies

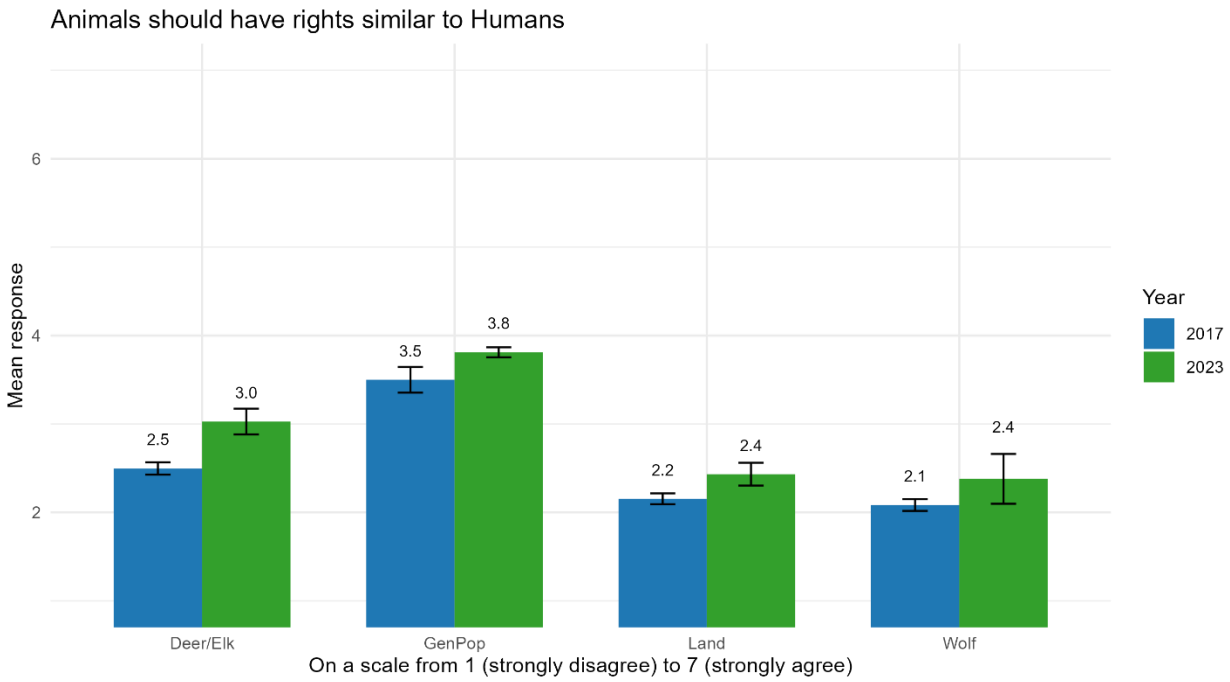

Figure 55 WVO rights similar means

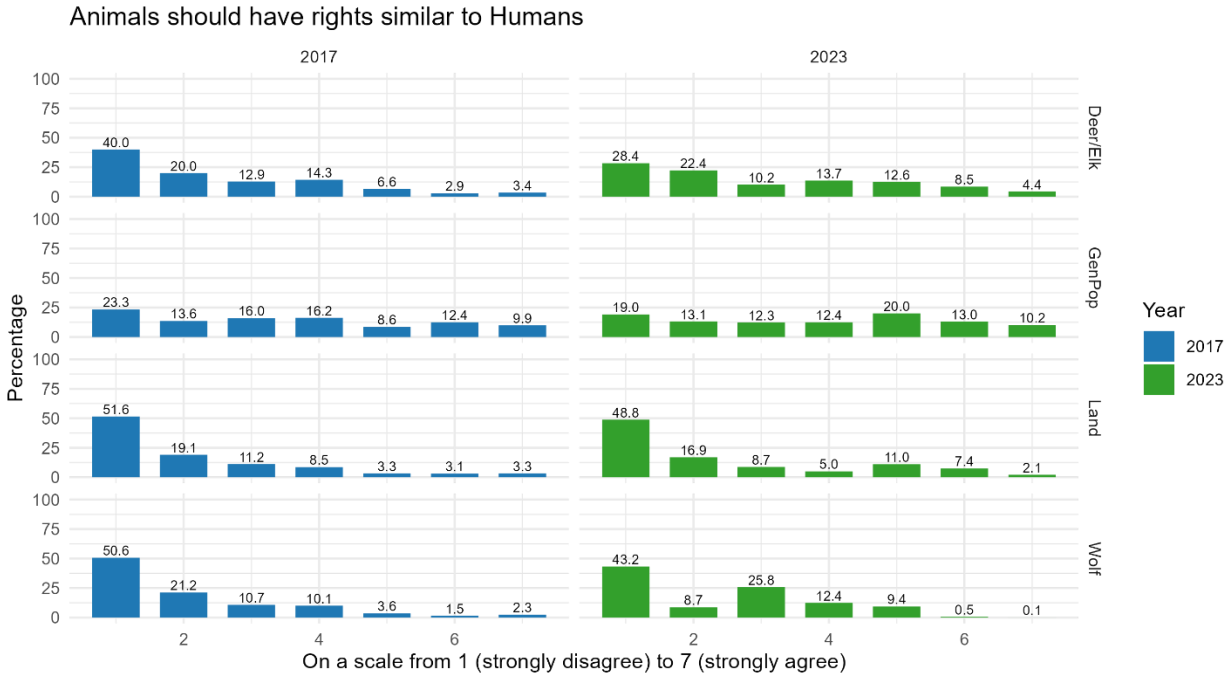

Figure 56 WVO rights similar frequencies

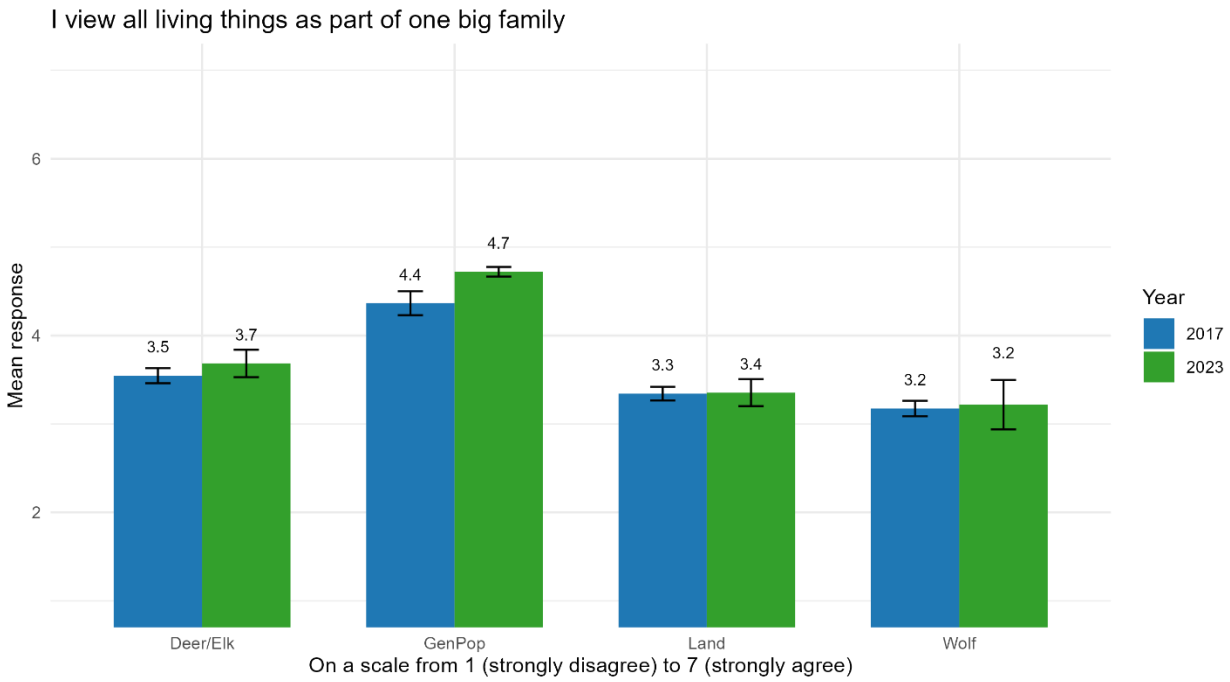

Figure 57 WVO family means

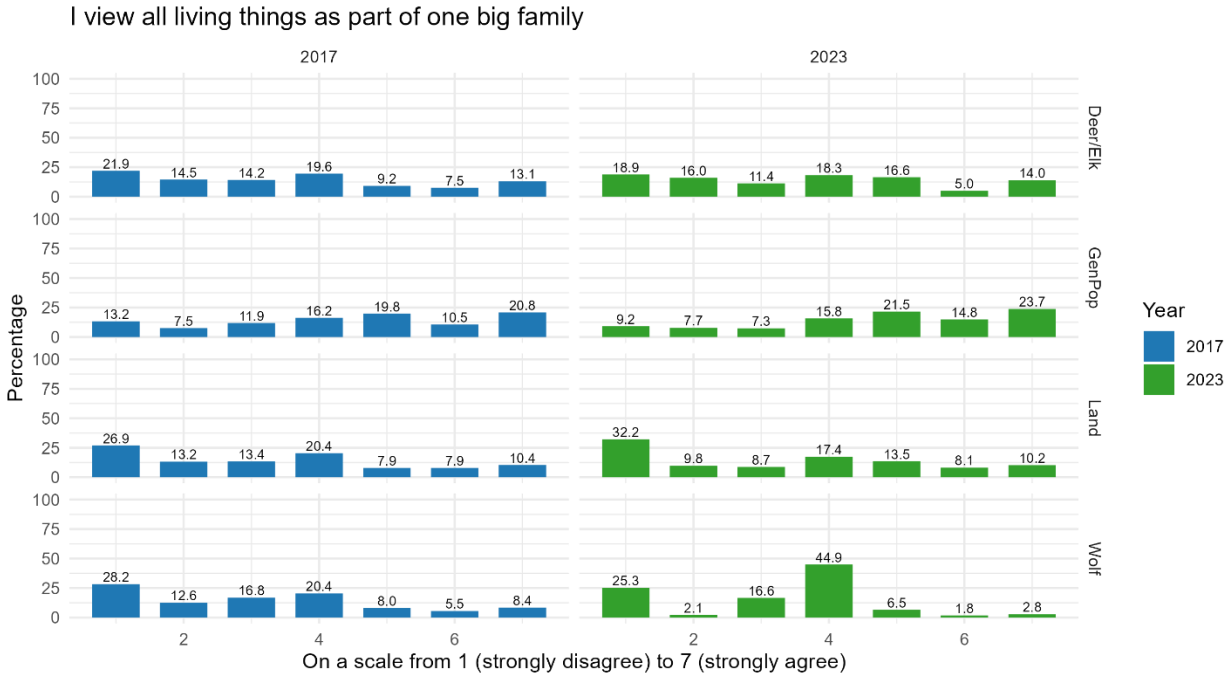

Figure 58 WVO family frequencies

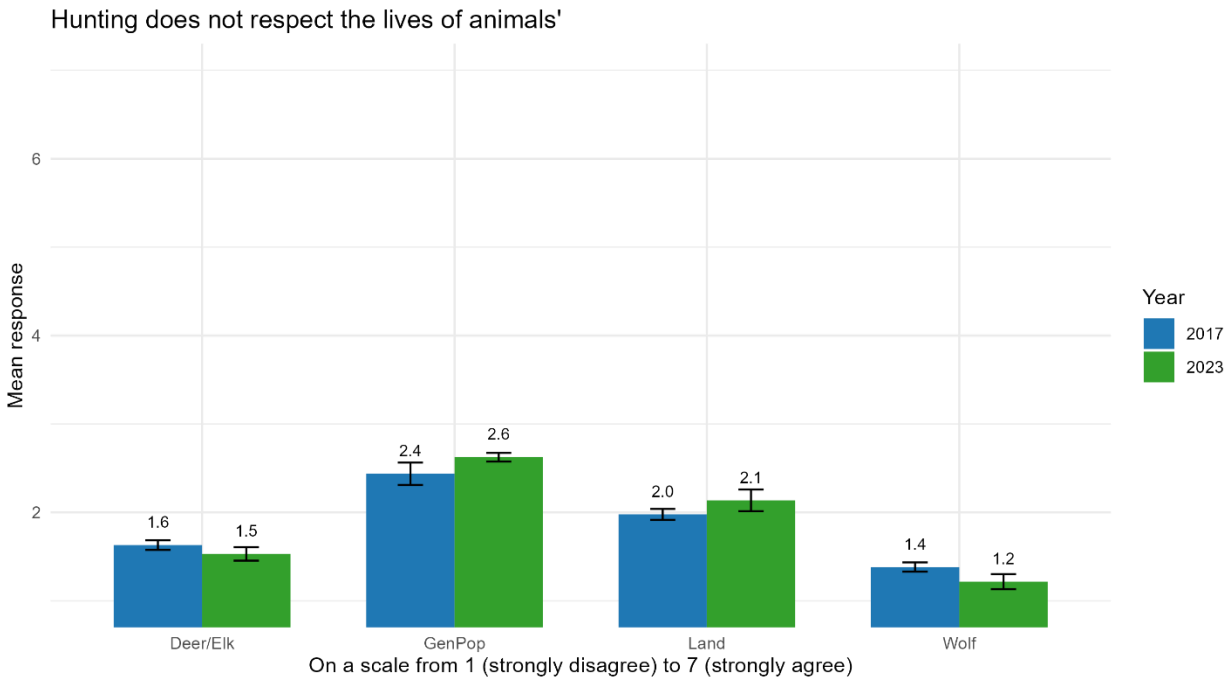

Figure 59 WVO hunting not respect means

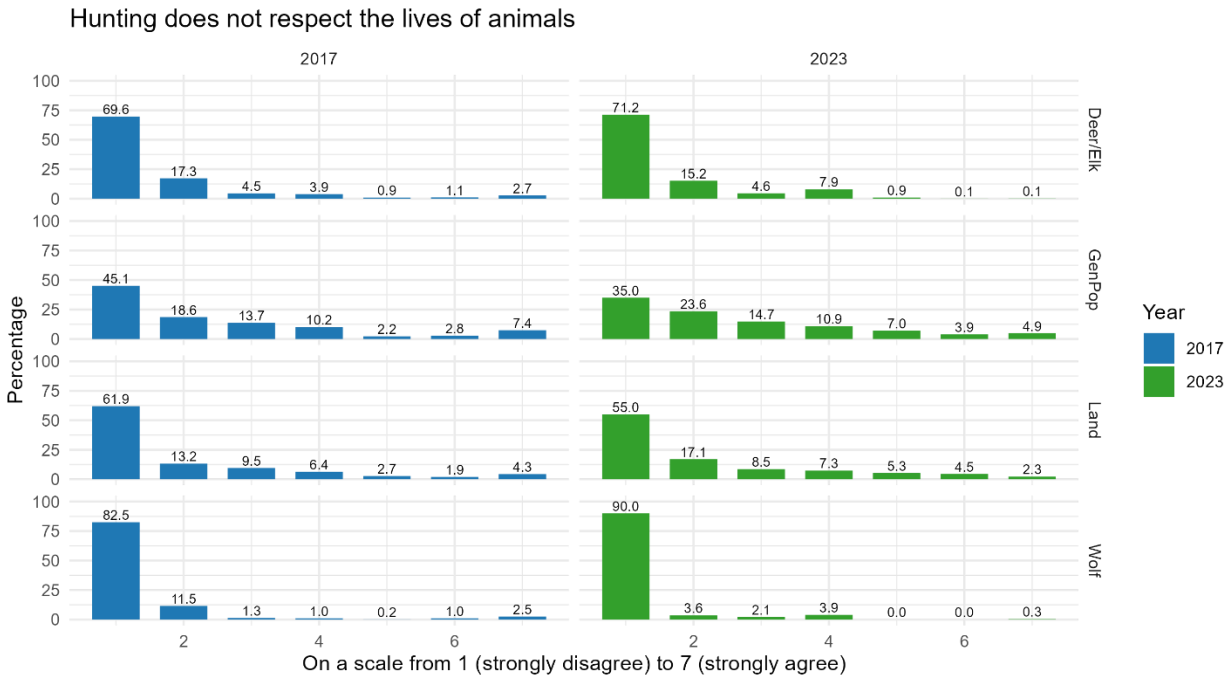

Figure 60 WVO hunting not respect frequencies

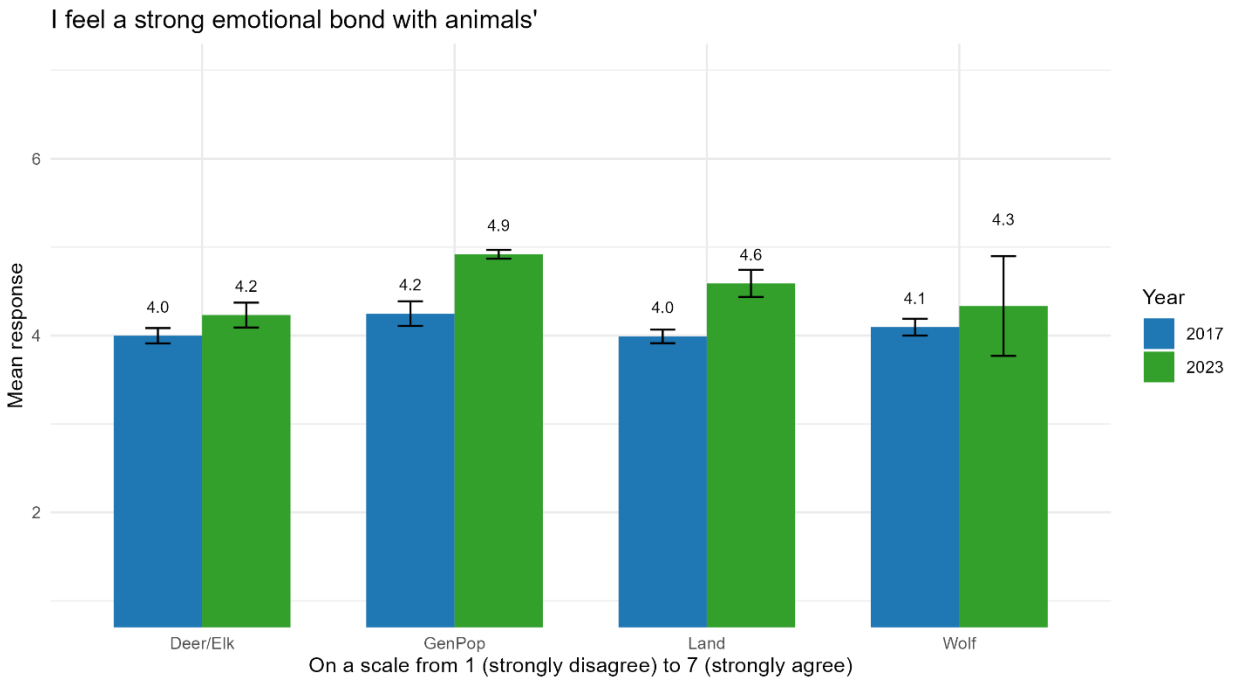

Figure 61 WVO emotional bond means

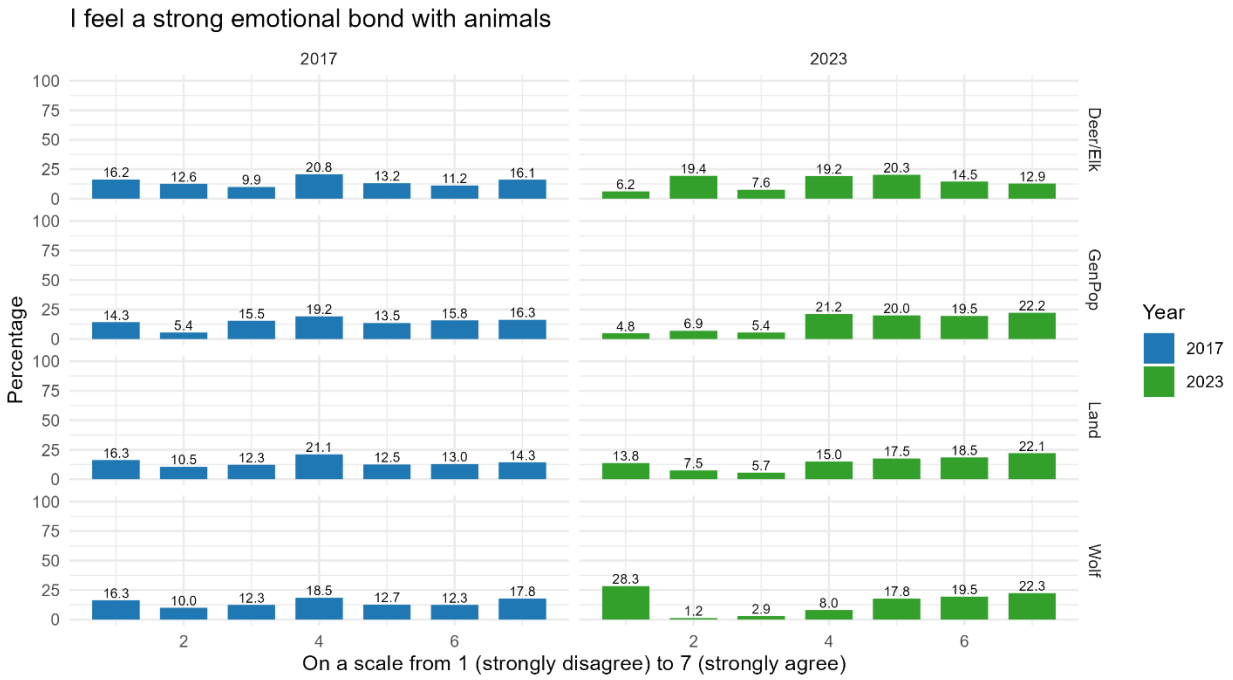

Figure 62 WVO emotional bond frequencies

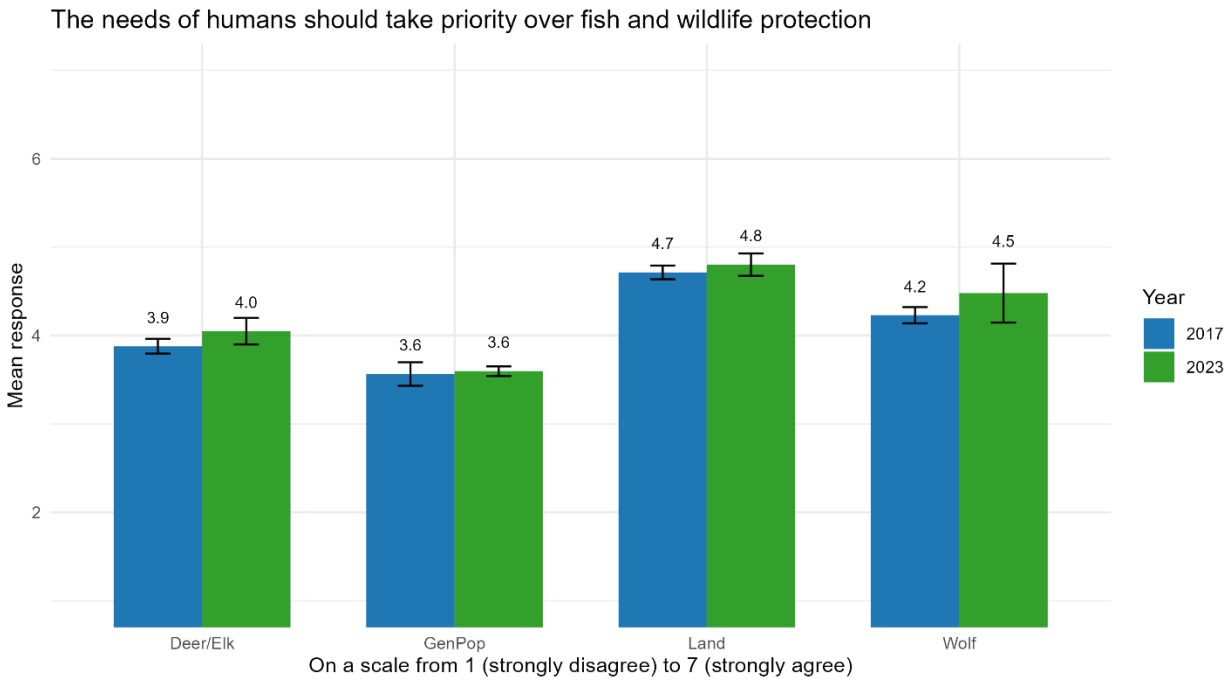

Figure 63 WVO human priority means

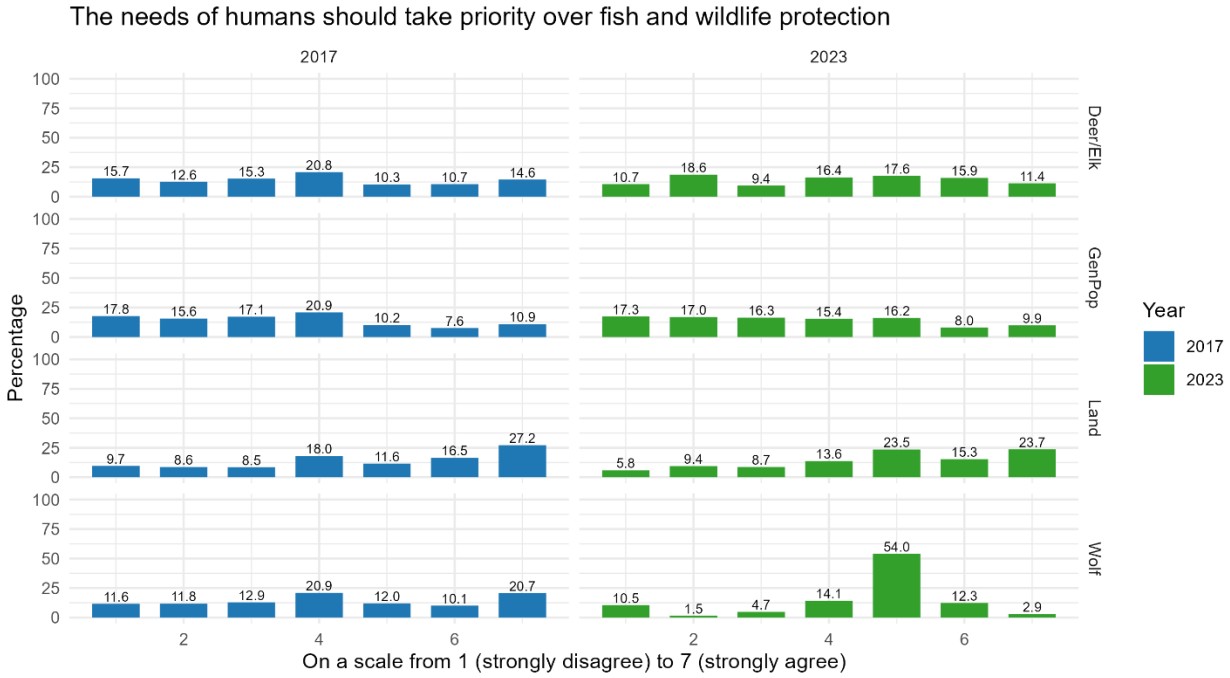

Figure 64 WVO human priority frequencies

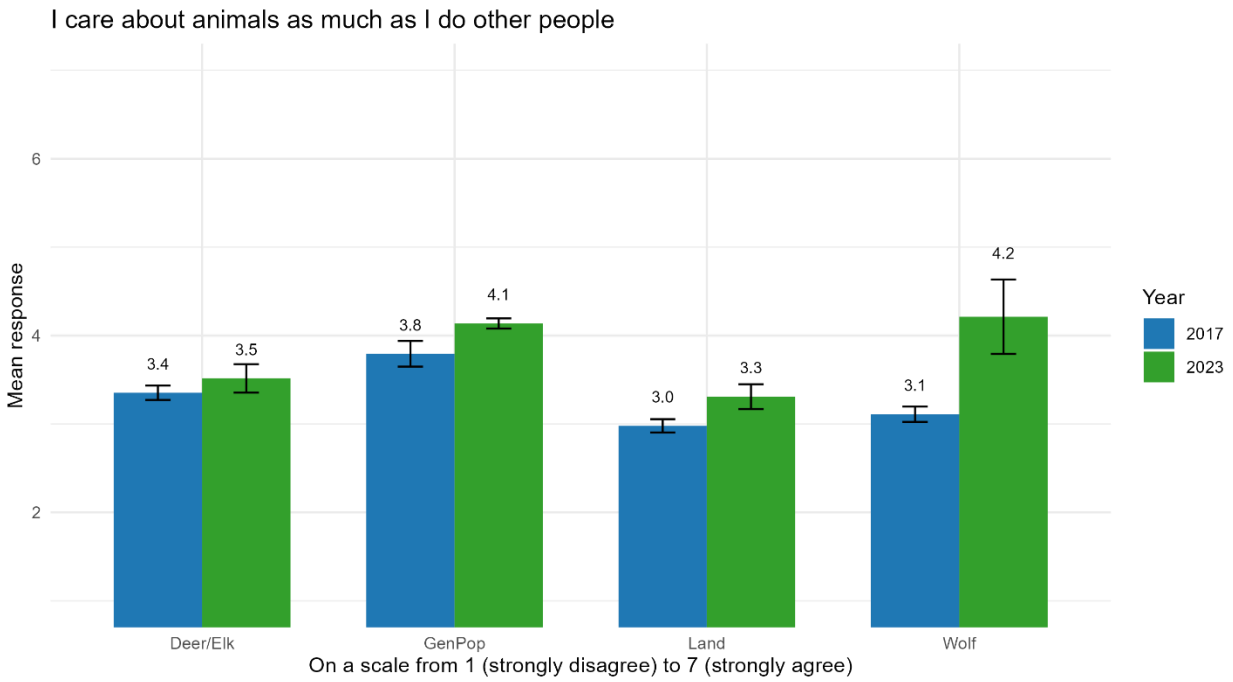

Figure 65 WVO equal care means

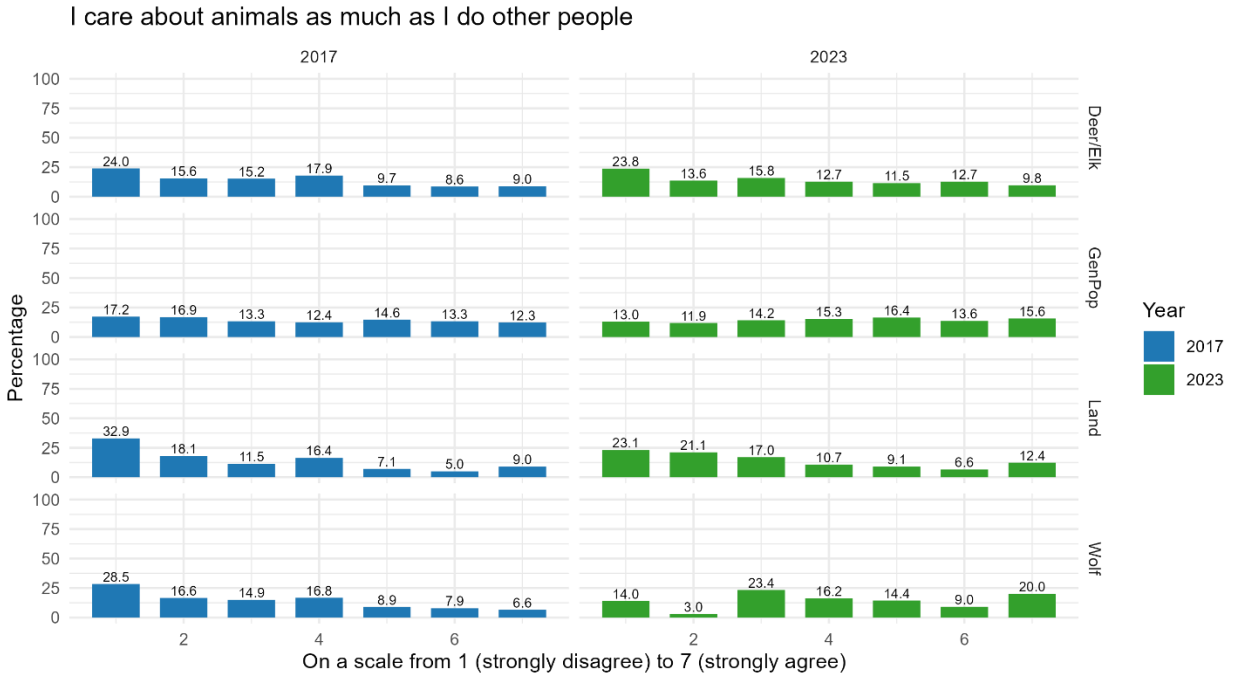

Figure 66 WVO equal care frequencies

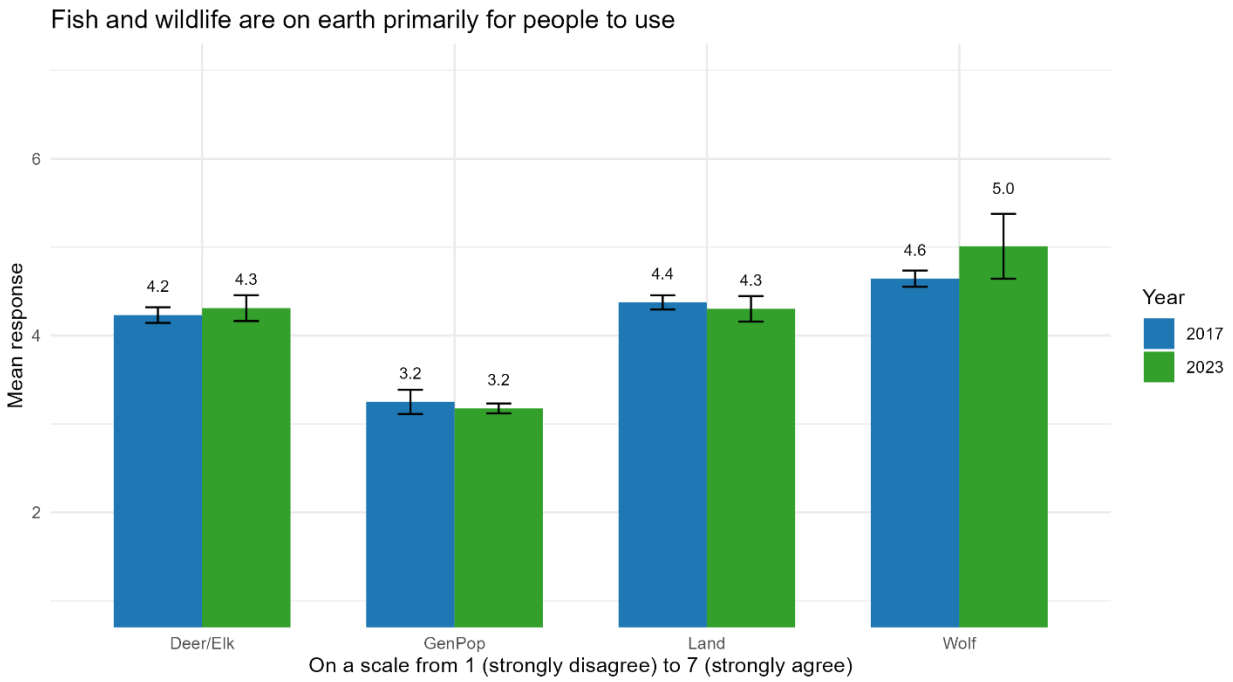

Figure 67 WVO people to use means

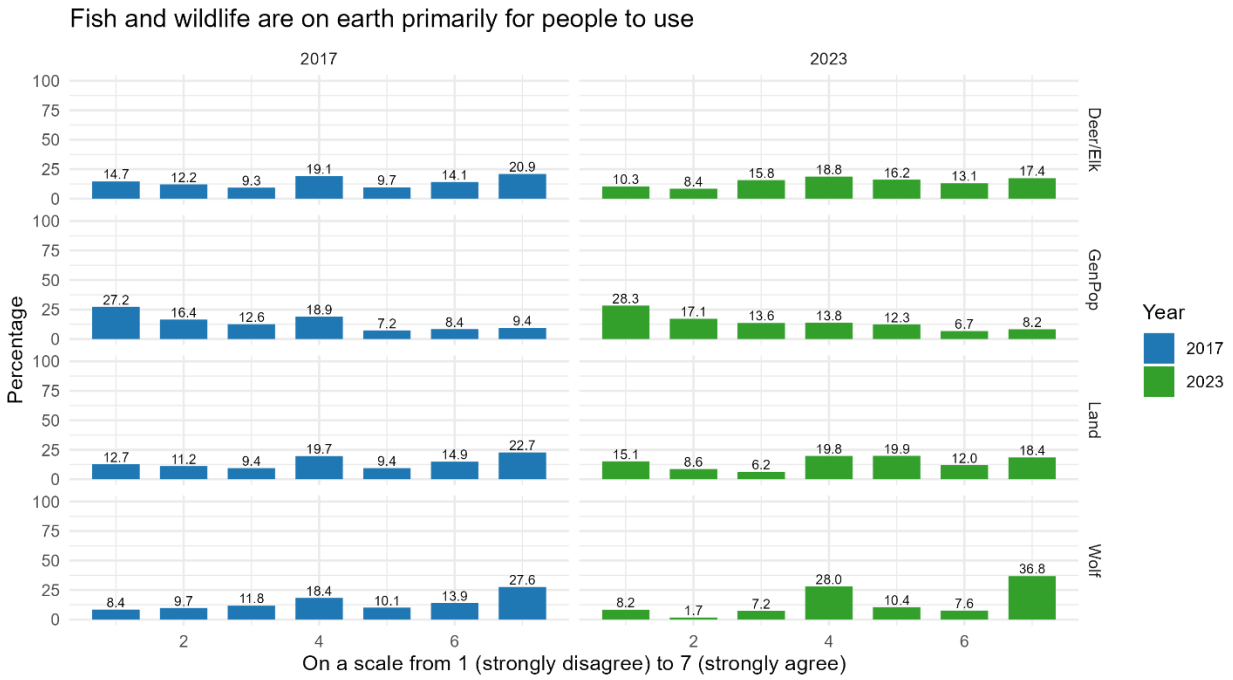

Figure 68 WVO people to use frequencies

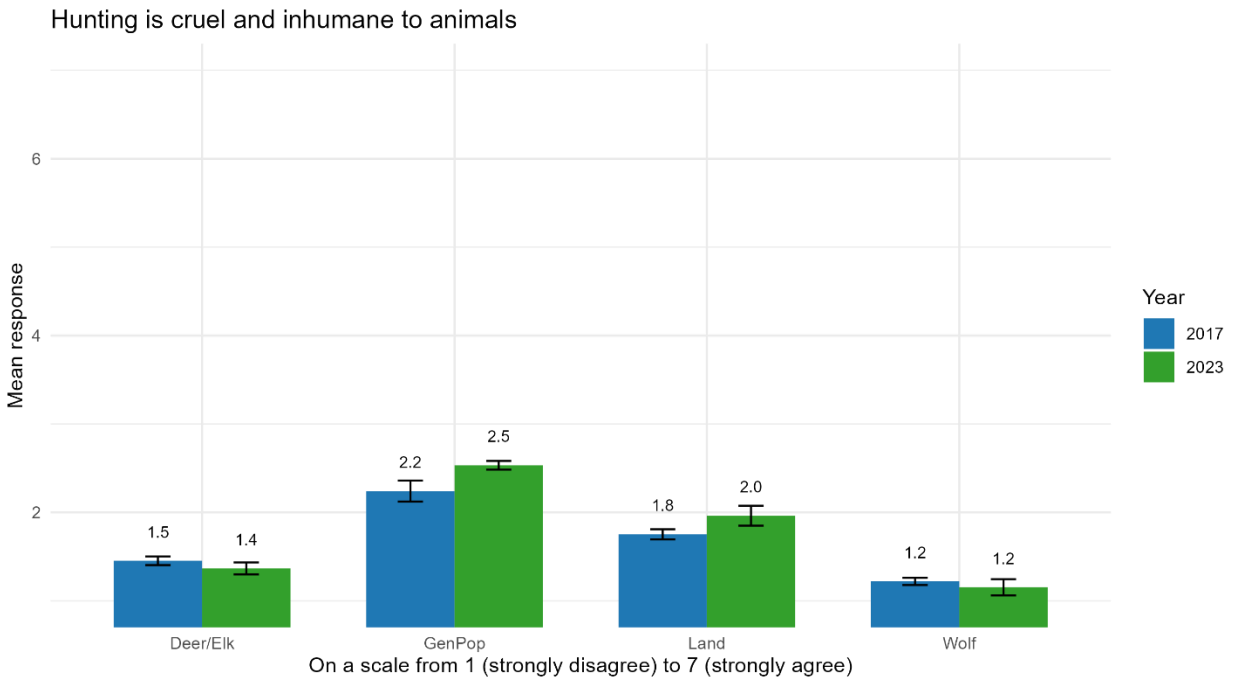

Figure 69 WVO hunting cruel means

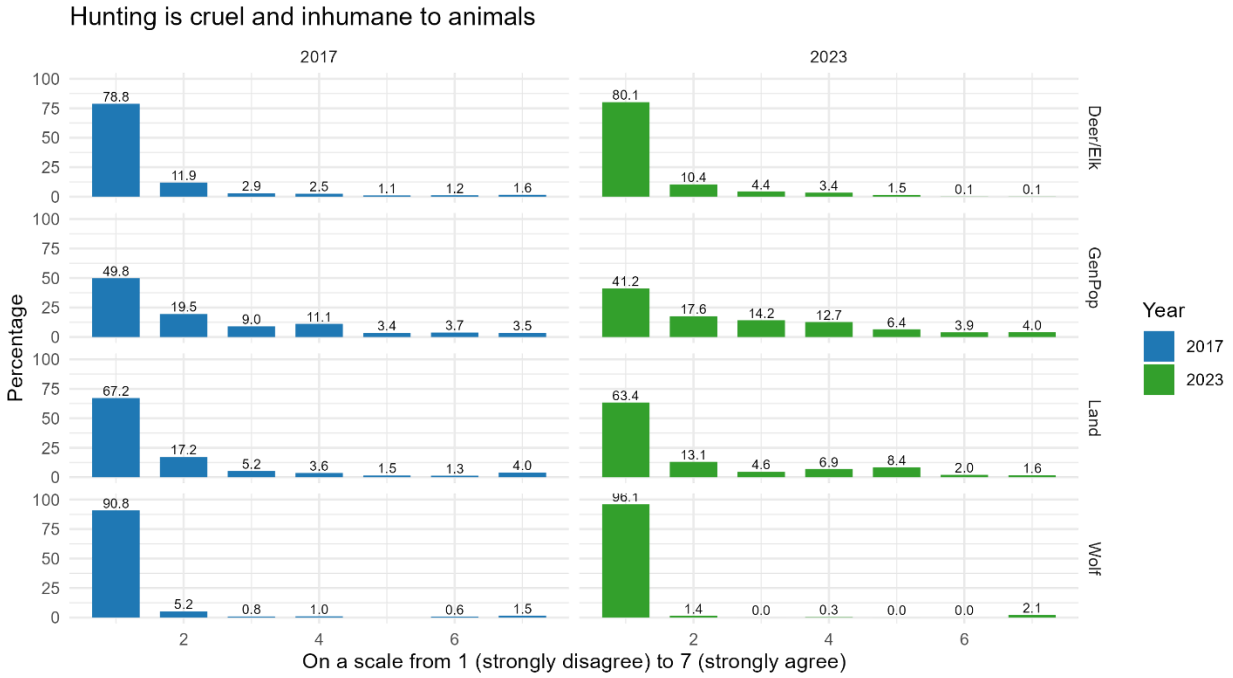

Figure 70 WVO hunting cruel frequencies

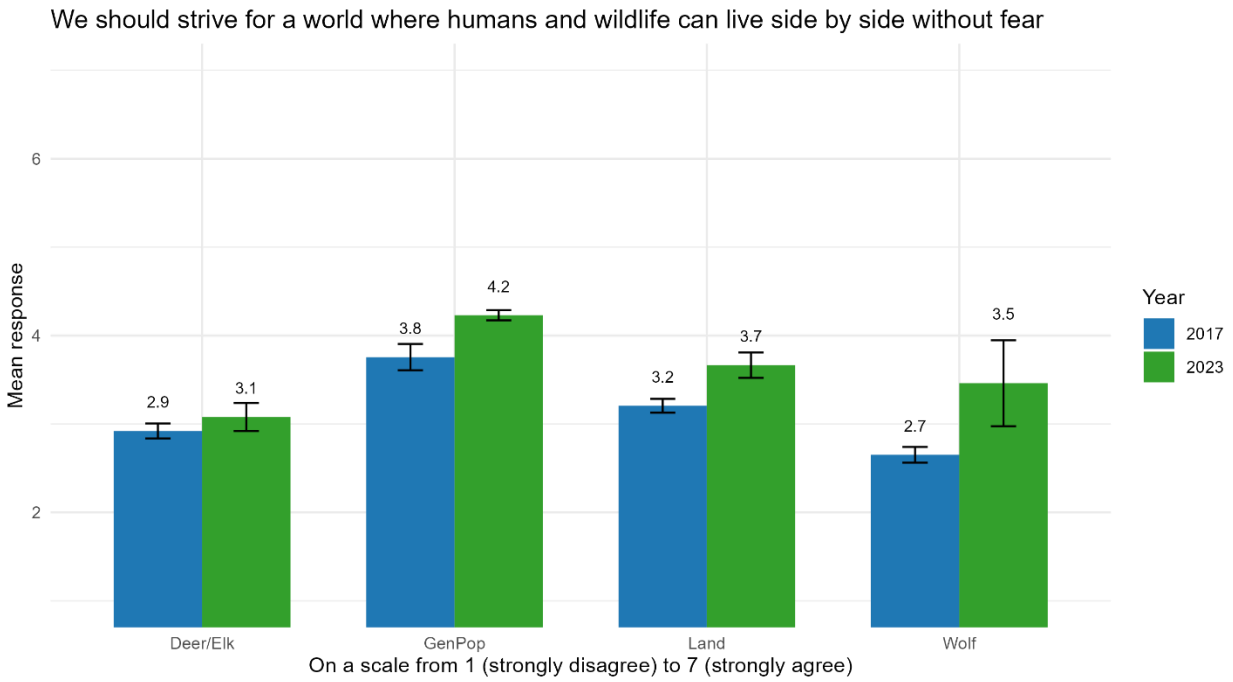

Figure 71 WVO without fear means

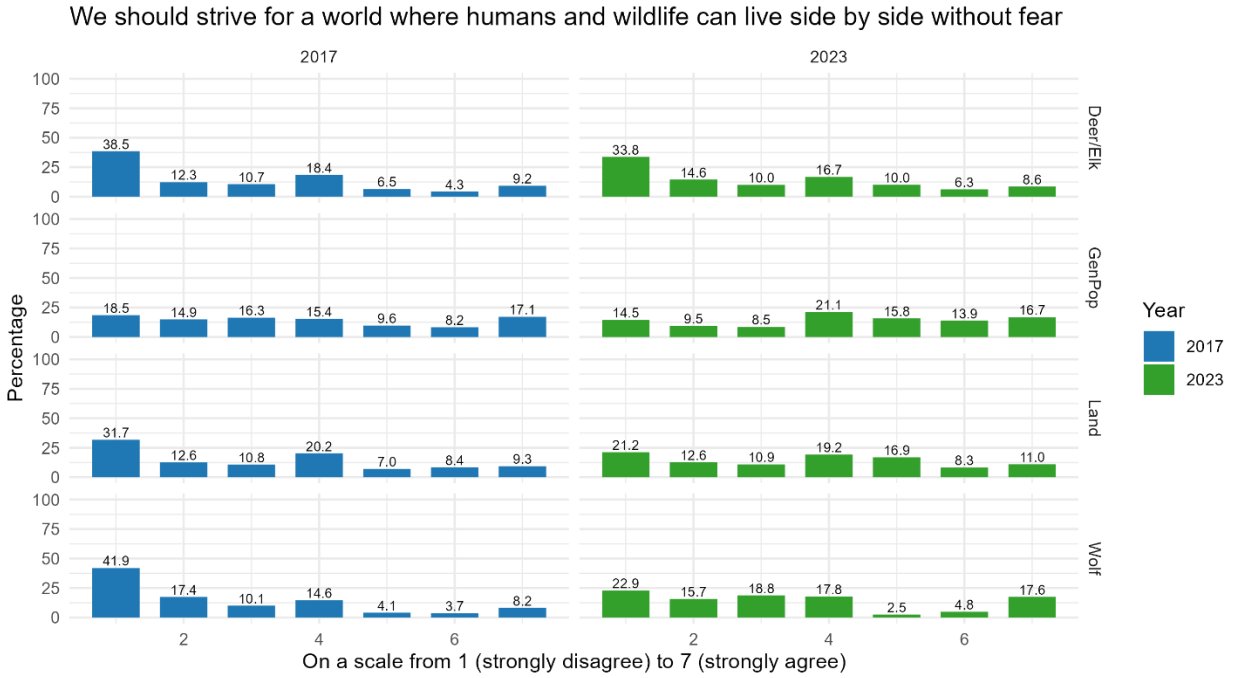

Figure 72 WVO without fear frequencies

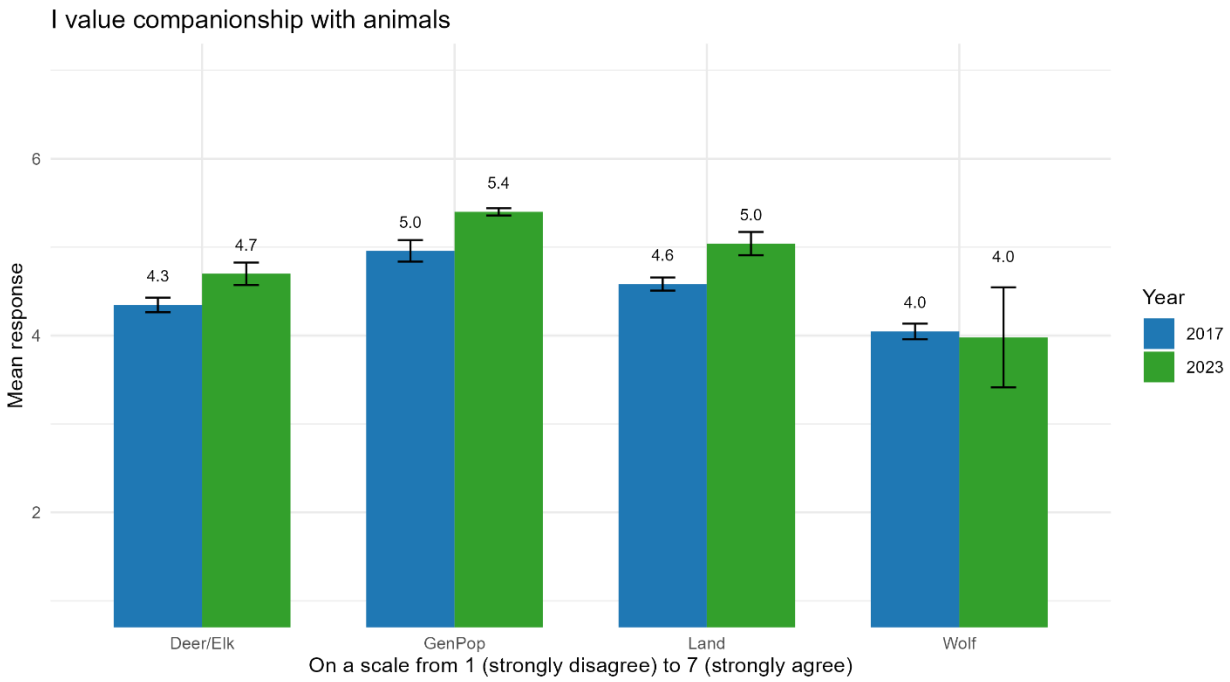

Figure 73 WVO companionship means

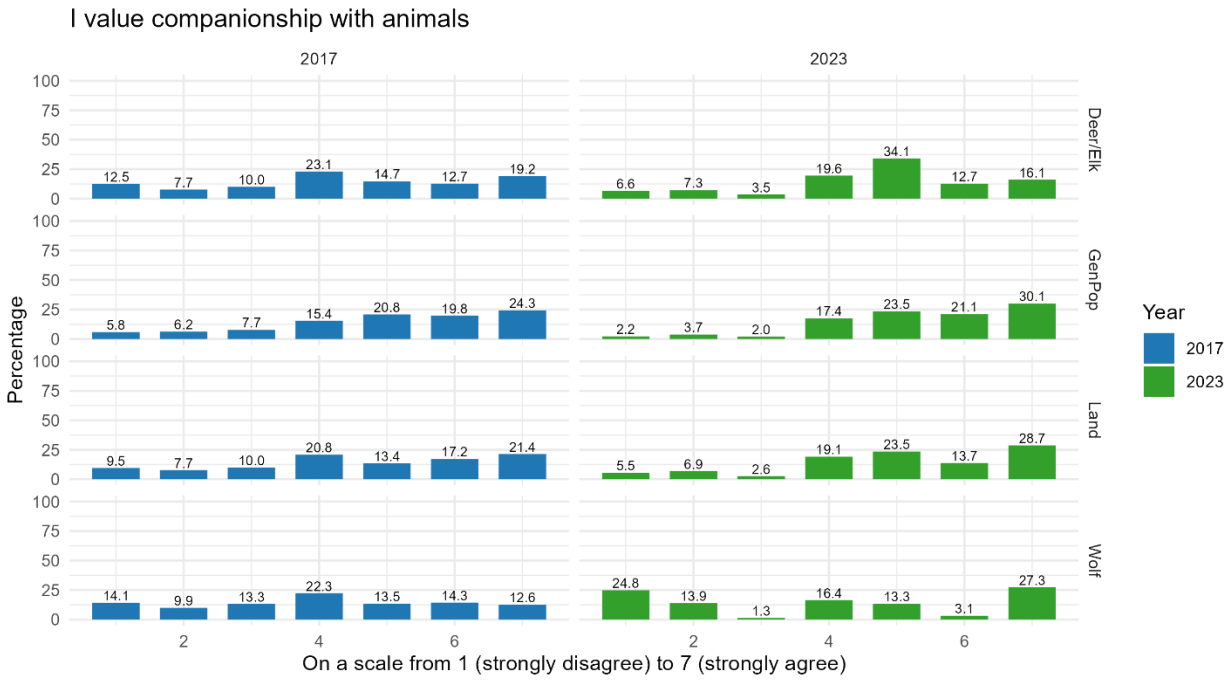

Figure 74 WVO companionship frequencies

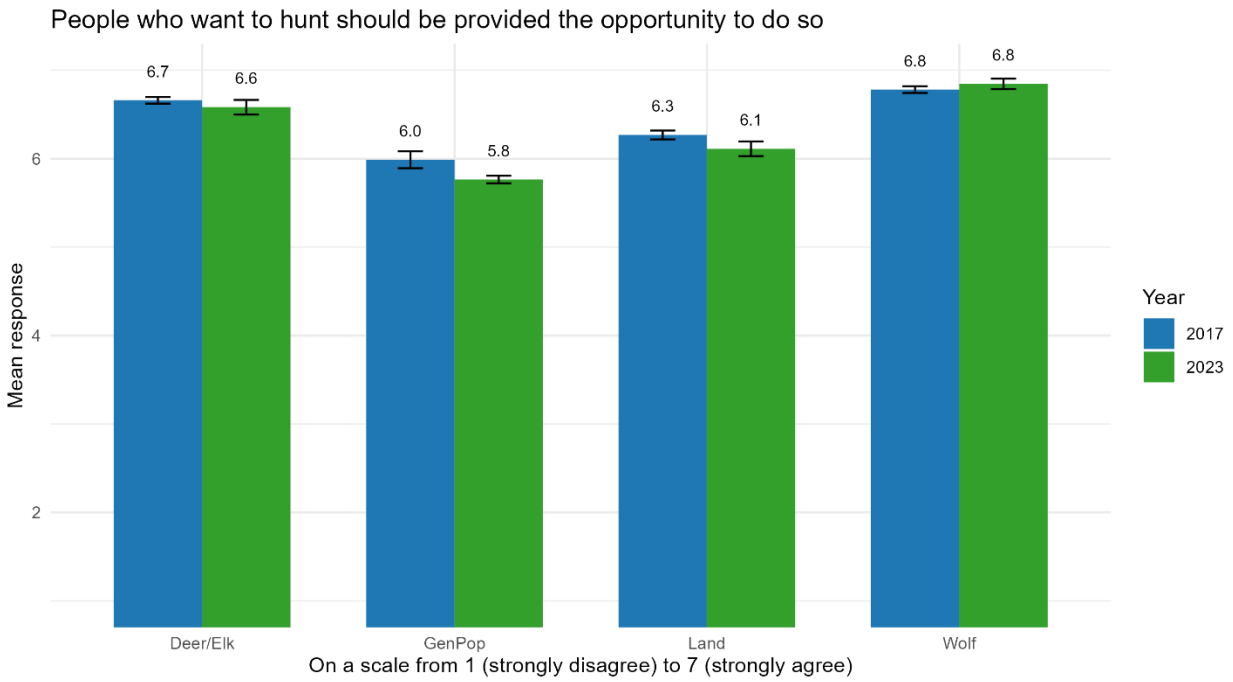

Figure 75 WVO hunt opportunity means

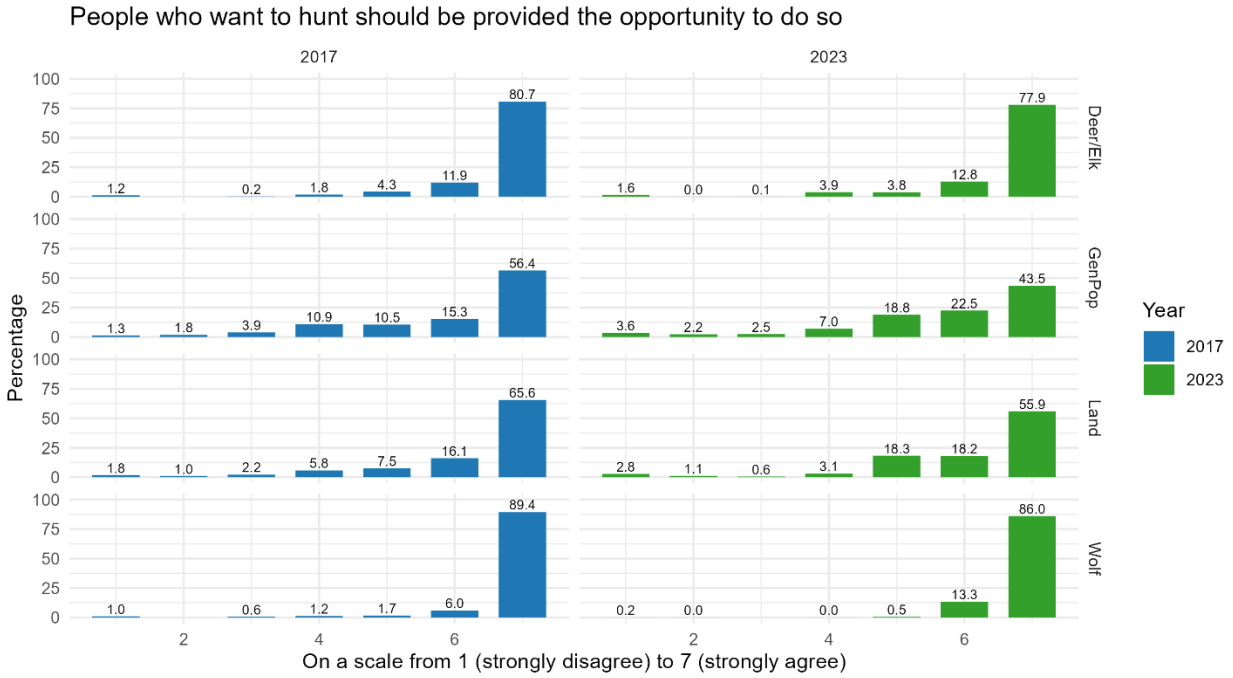

Figure 76 WVO hunt opportunity frequencies

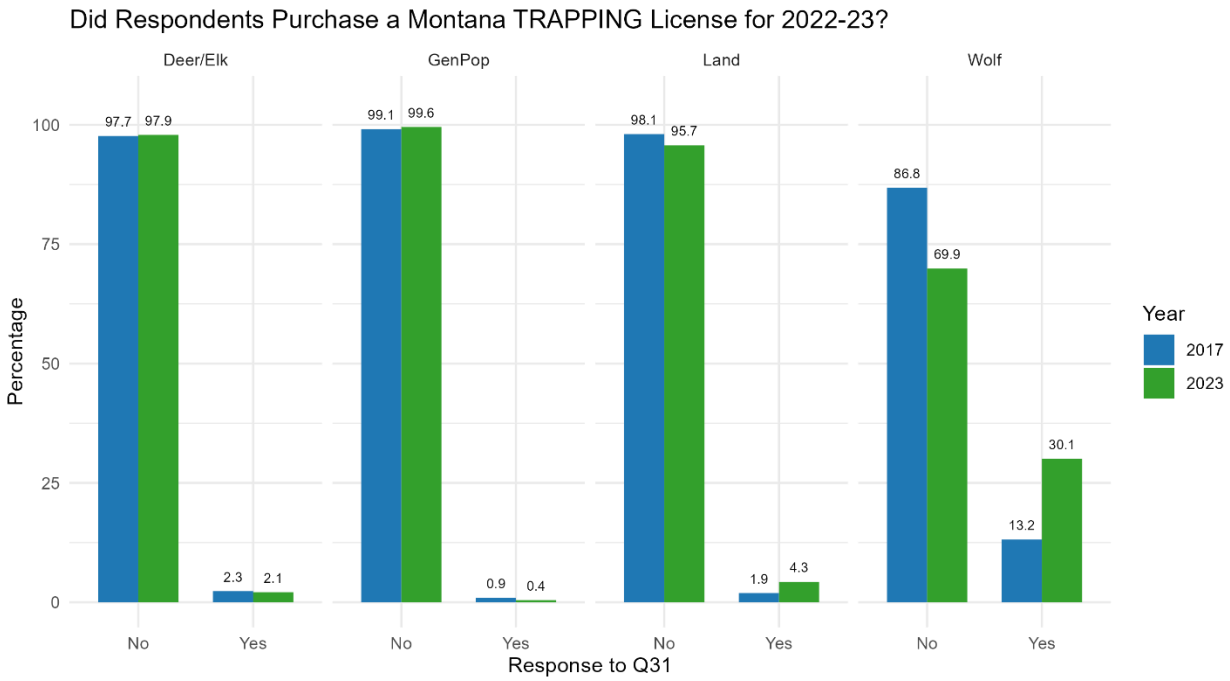

Figure 77 Purchase trapping license frequencies

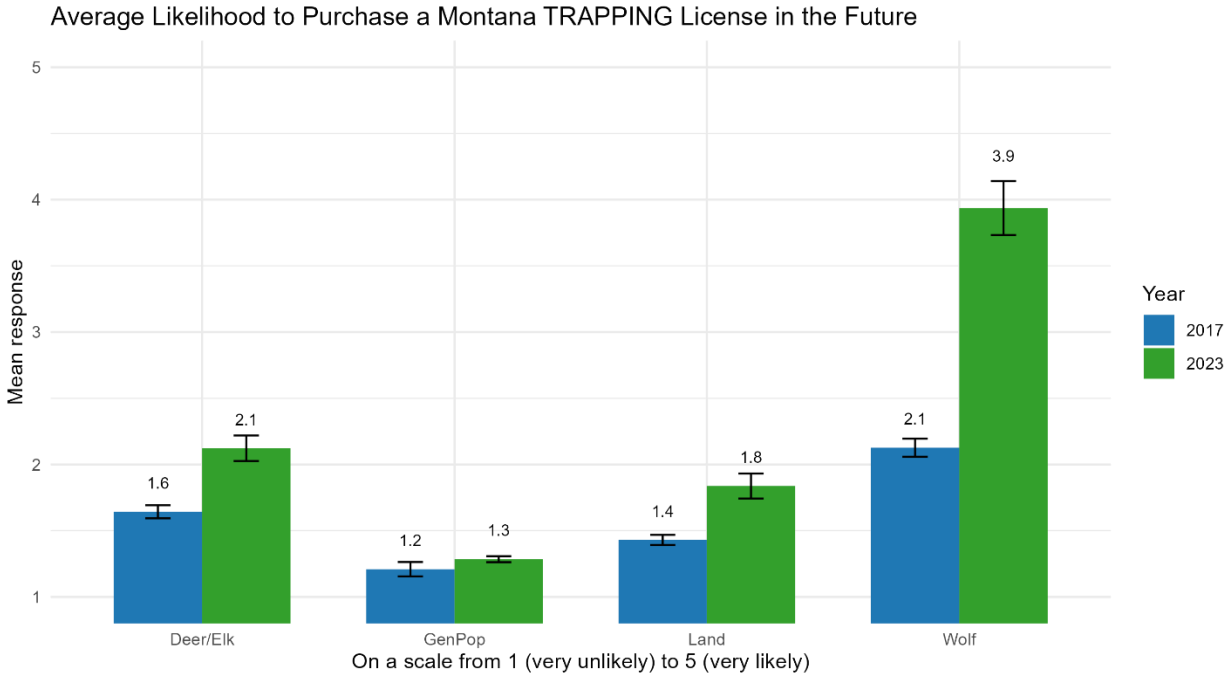

Figure 78 Likelihood to purchase trapping license means

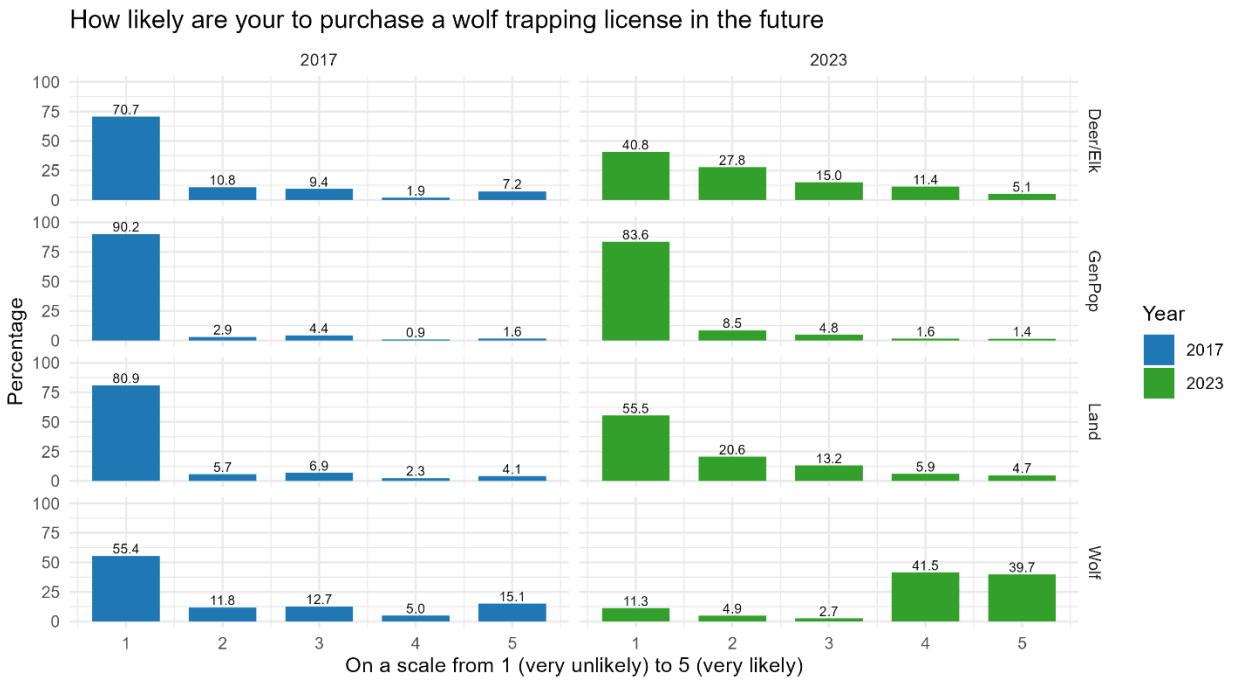

Figure 79 Likelihood to purchase trapping license frequencies

2023

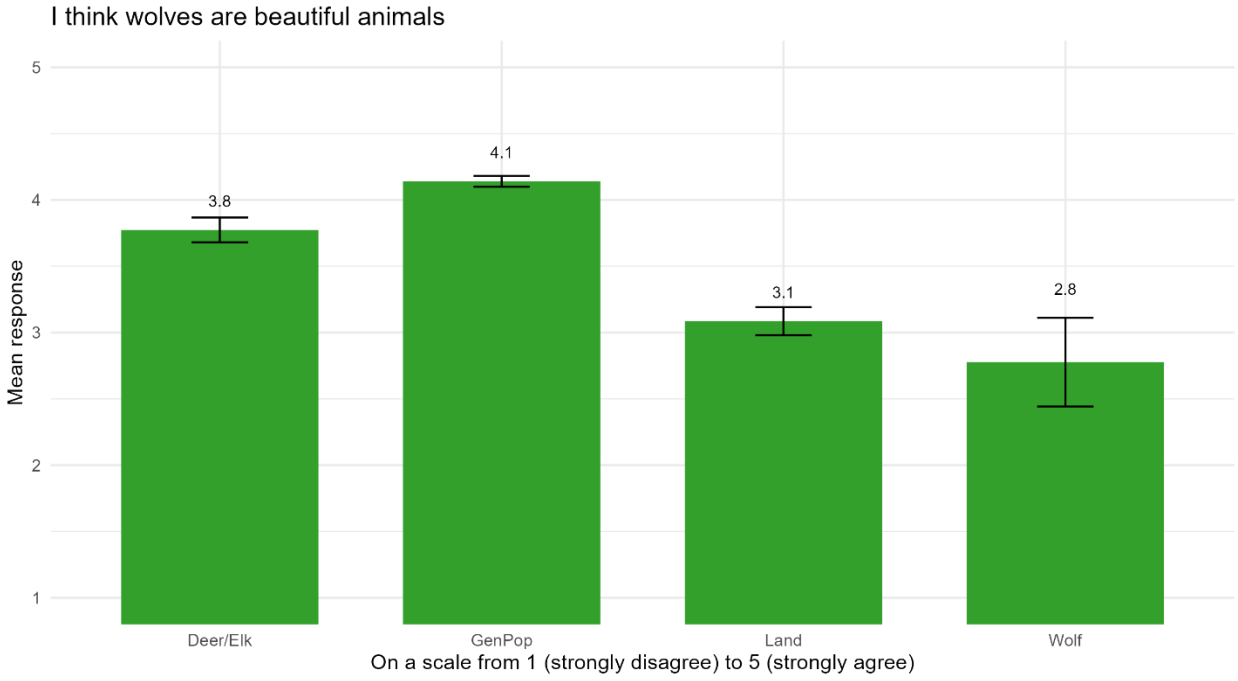

Figure 80 Wolves beautiful means

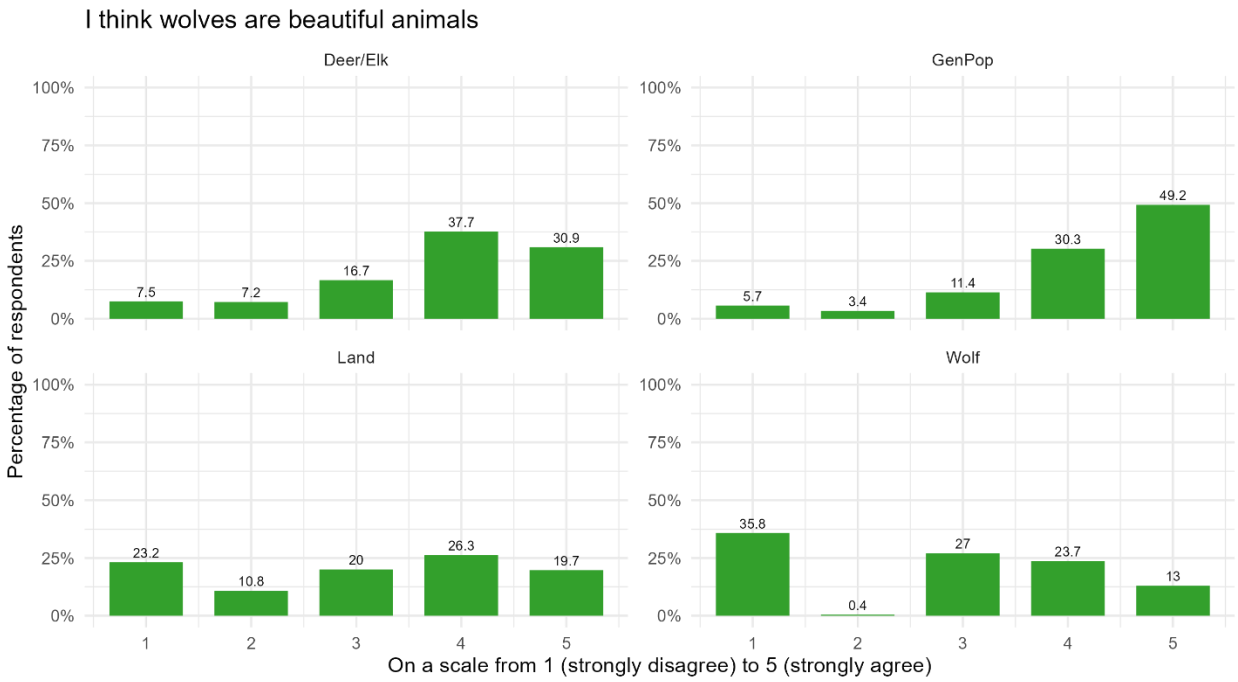

Figure 81 Wolves beautiful frequencies

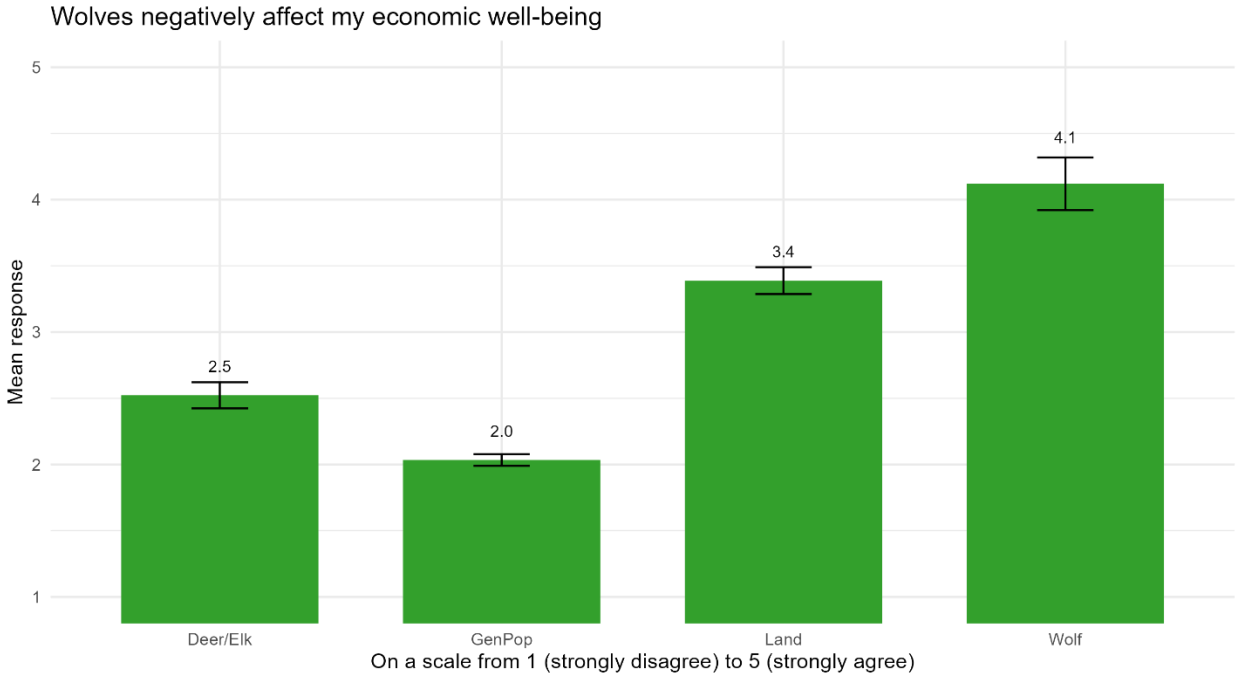

Figure 82 Wolves negative economic means

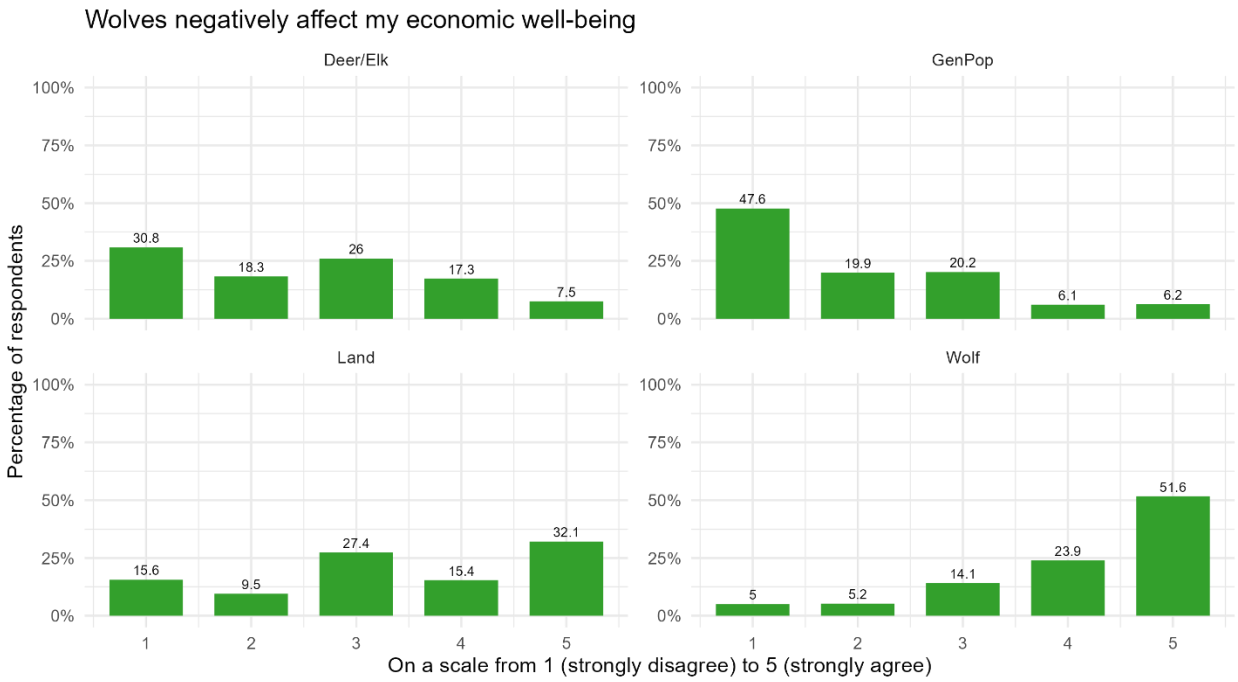

Figure 83 Wolves negative economic frequencies

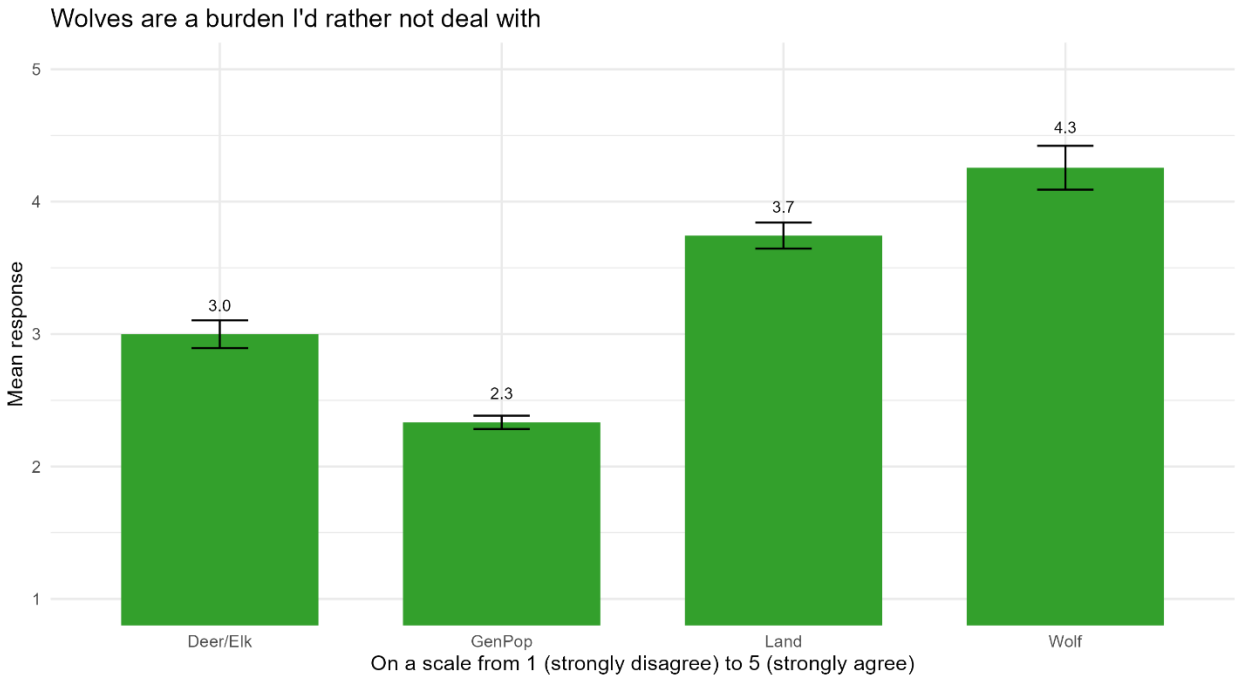

Figure 84 Wolves are burden means

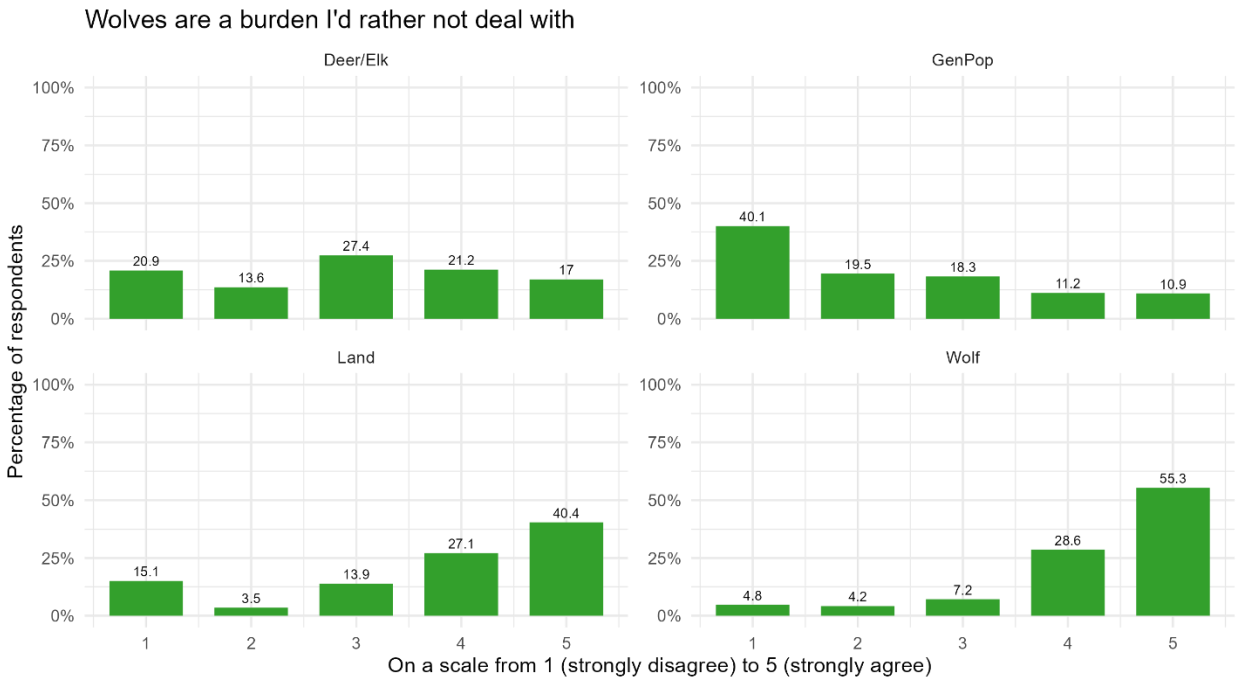

Figure 85 Wolves are burden frequencies

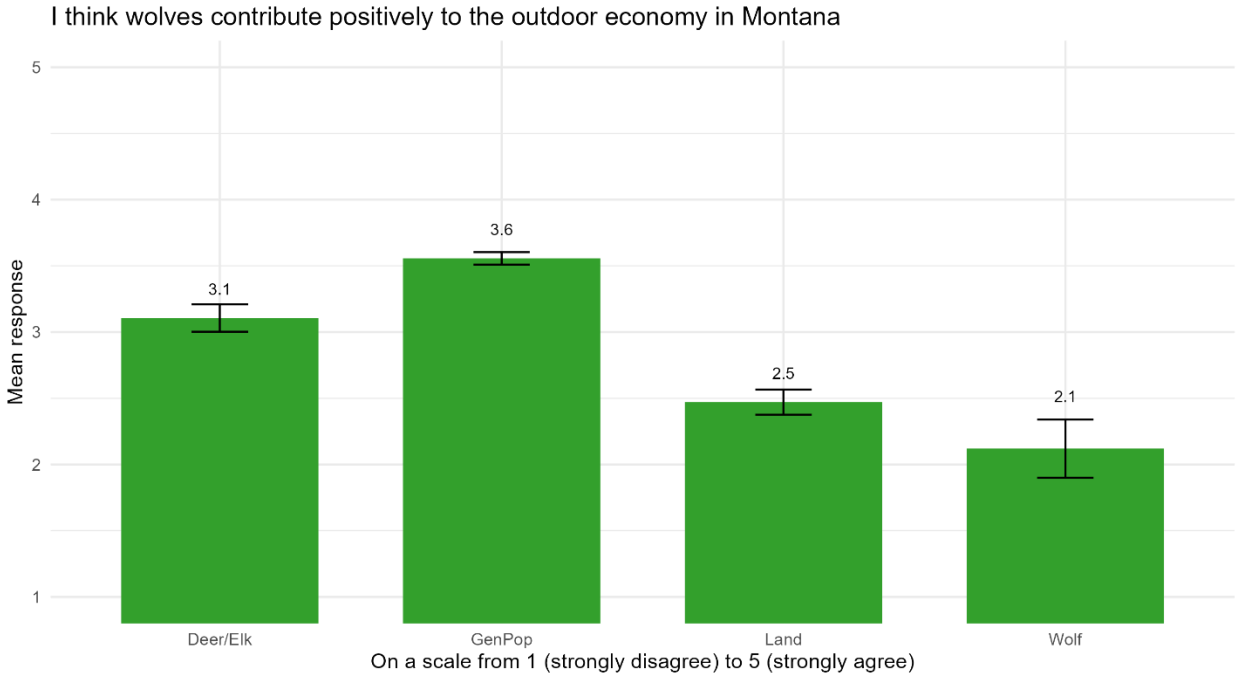

Figure 86 Wolves positive economic means

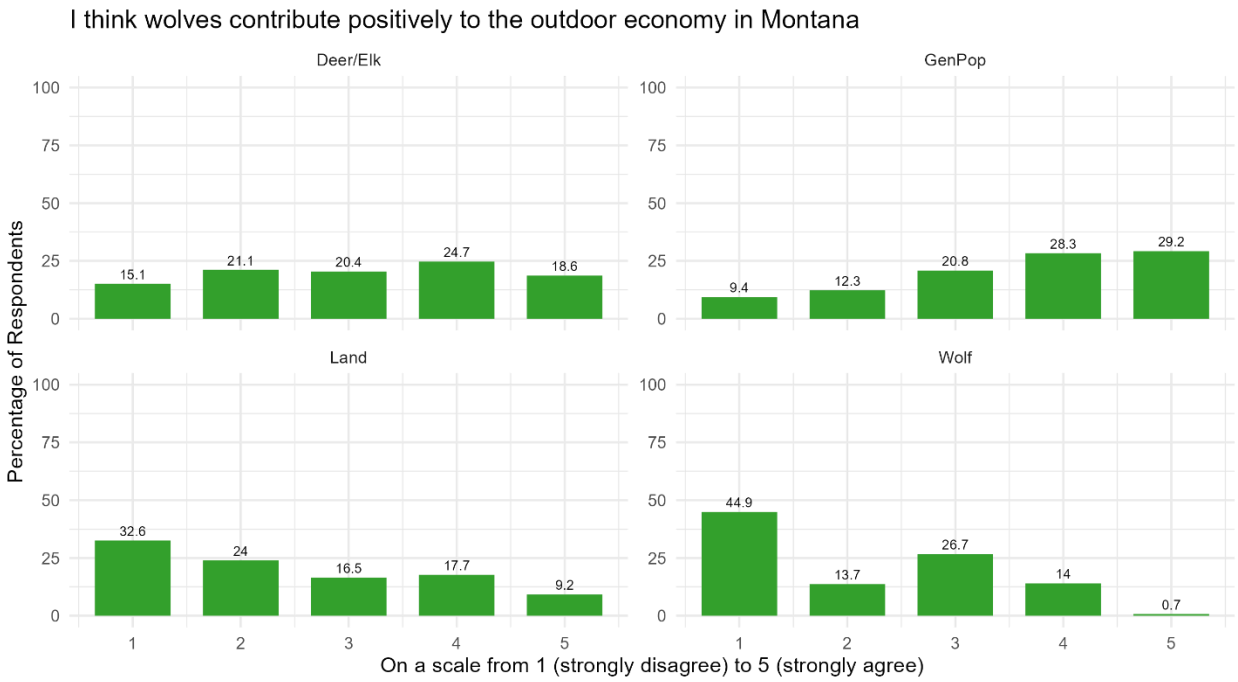

Figure 87 Wolves positive economic frequencies

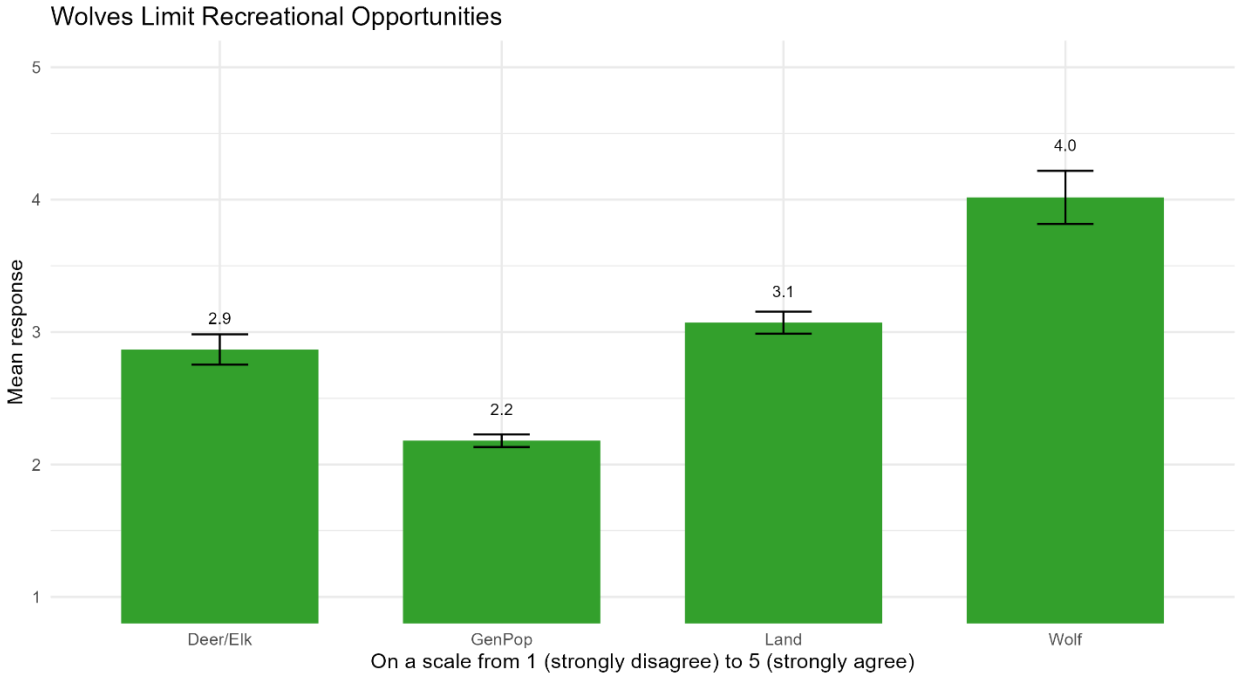

Figure 88 Wolves limit recreation means

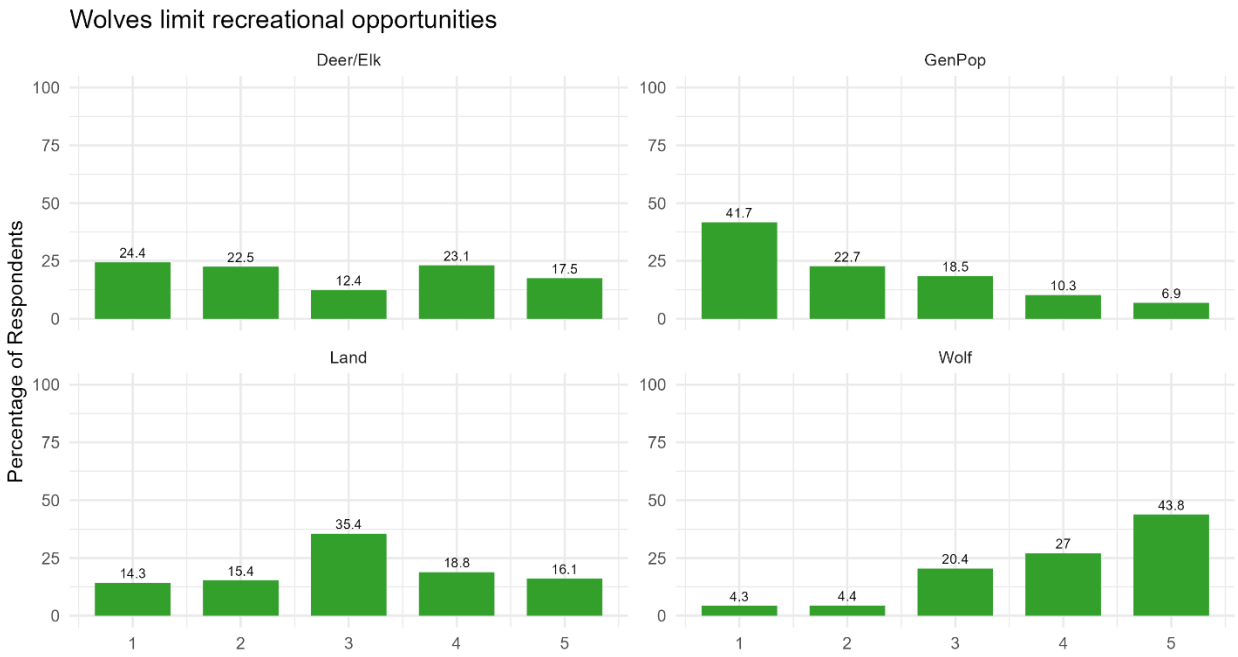

Figure 89 Wolves limit recreation frequencies

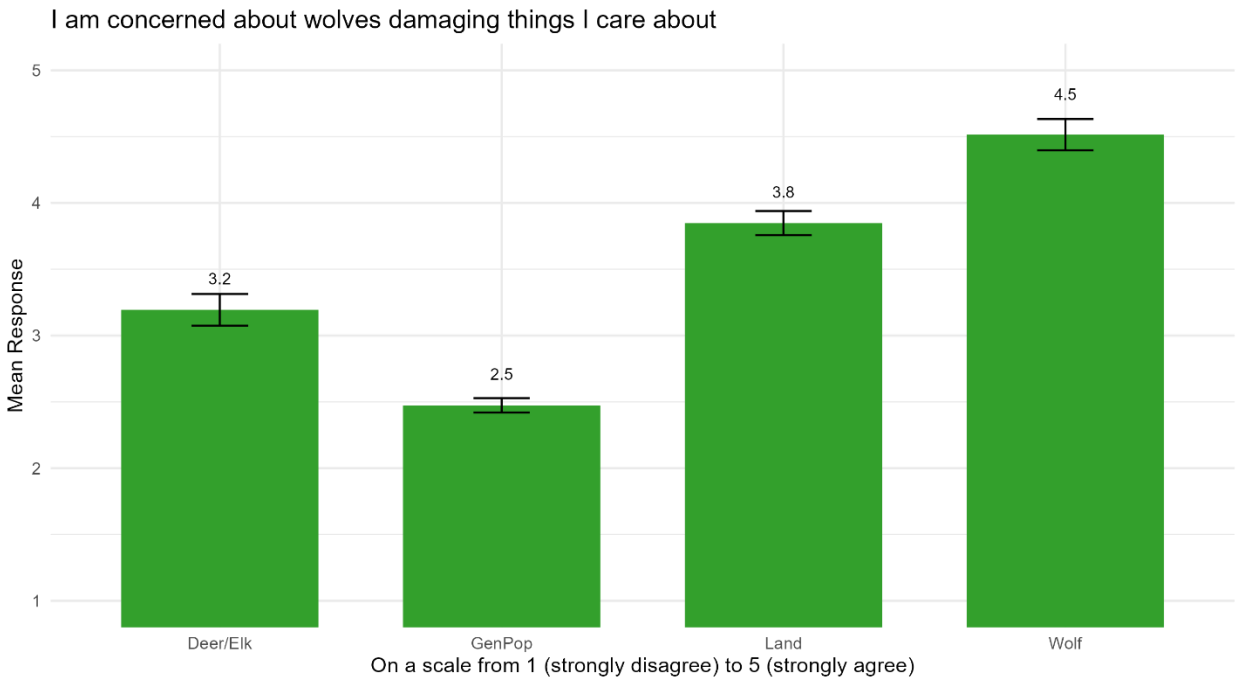

Figure 90 Concerned about wolf damage means

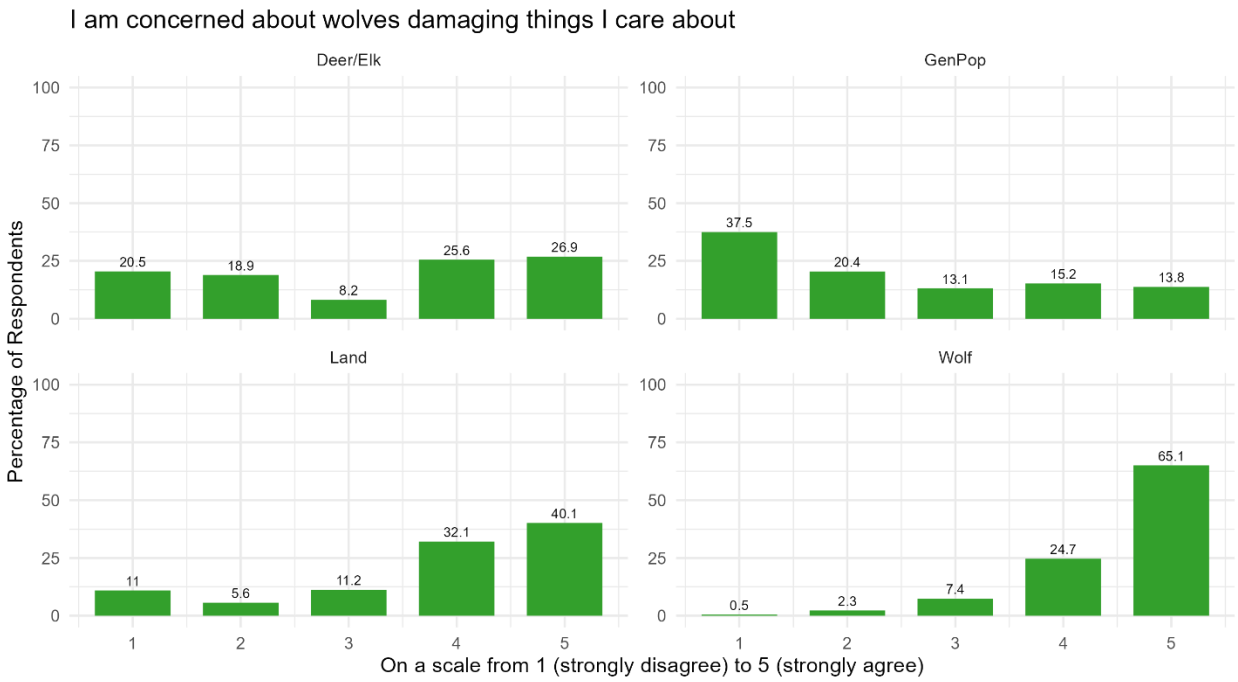

Figure 91 Concerned about wolf damage frequencies

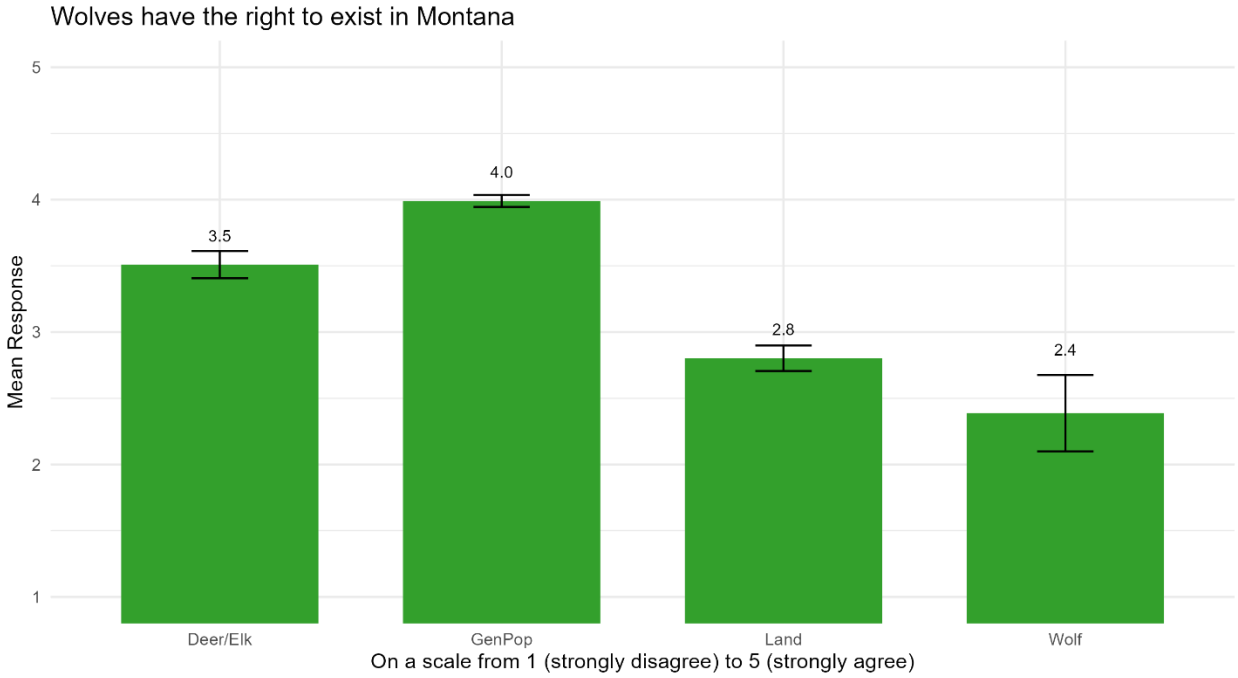

Figure 92 Wolves right to exist means

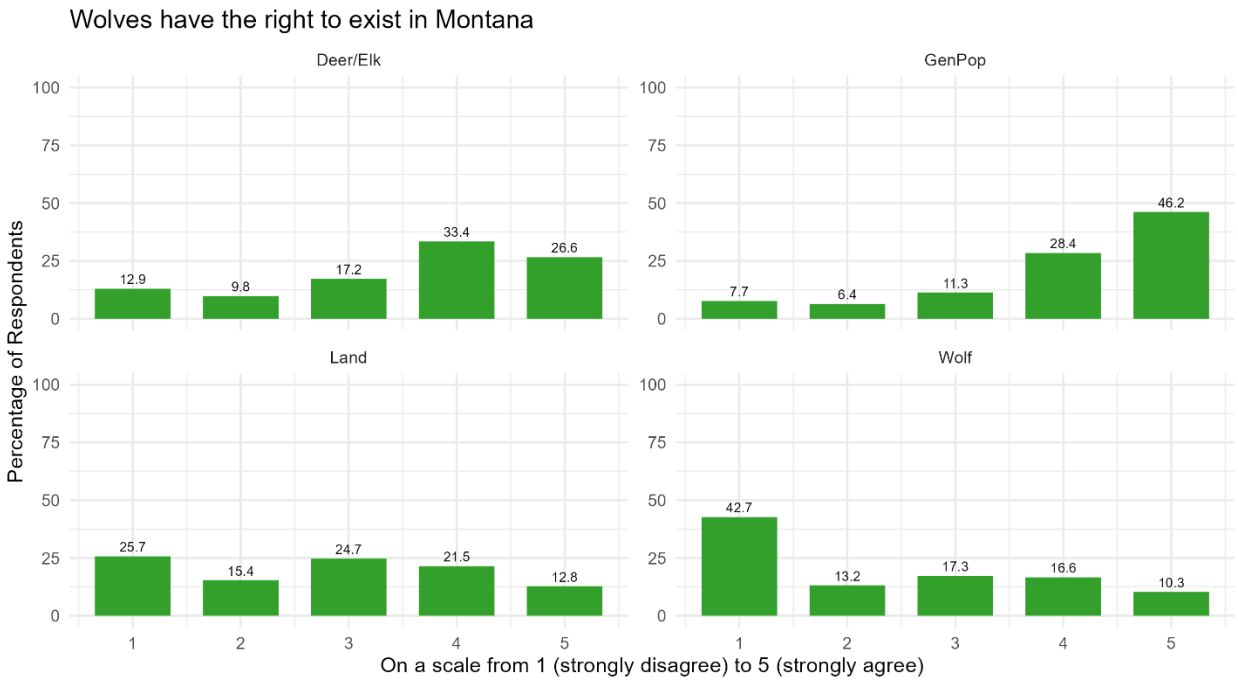

Figure 93 Wolves right to exist frequencies

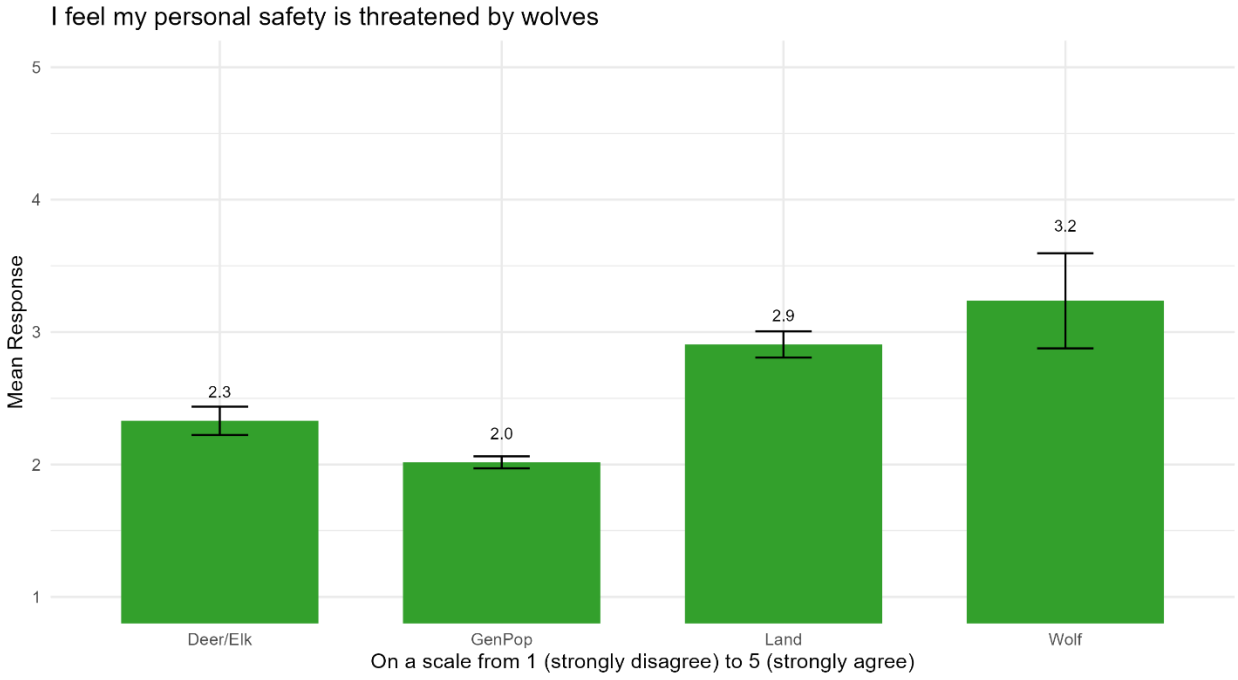

Figure 94 Wolves threaten safety means

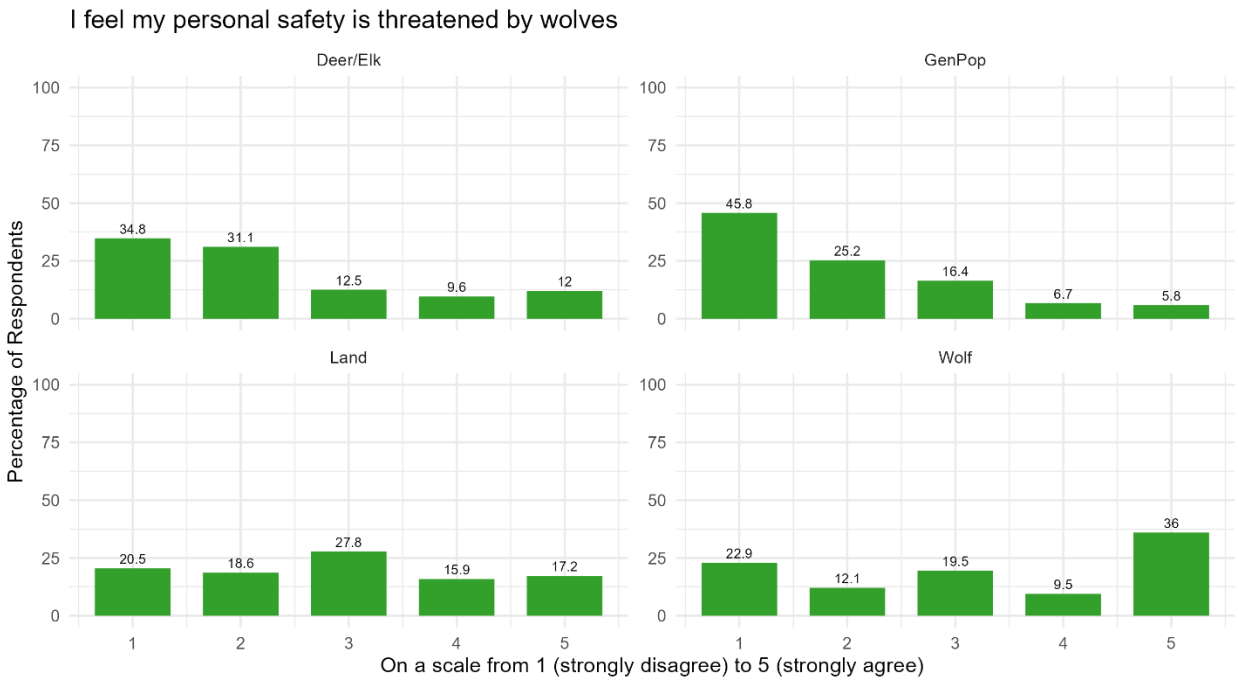

Figure 95 Wolves threaten safety frequencies

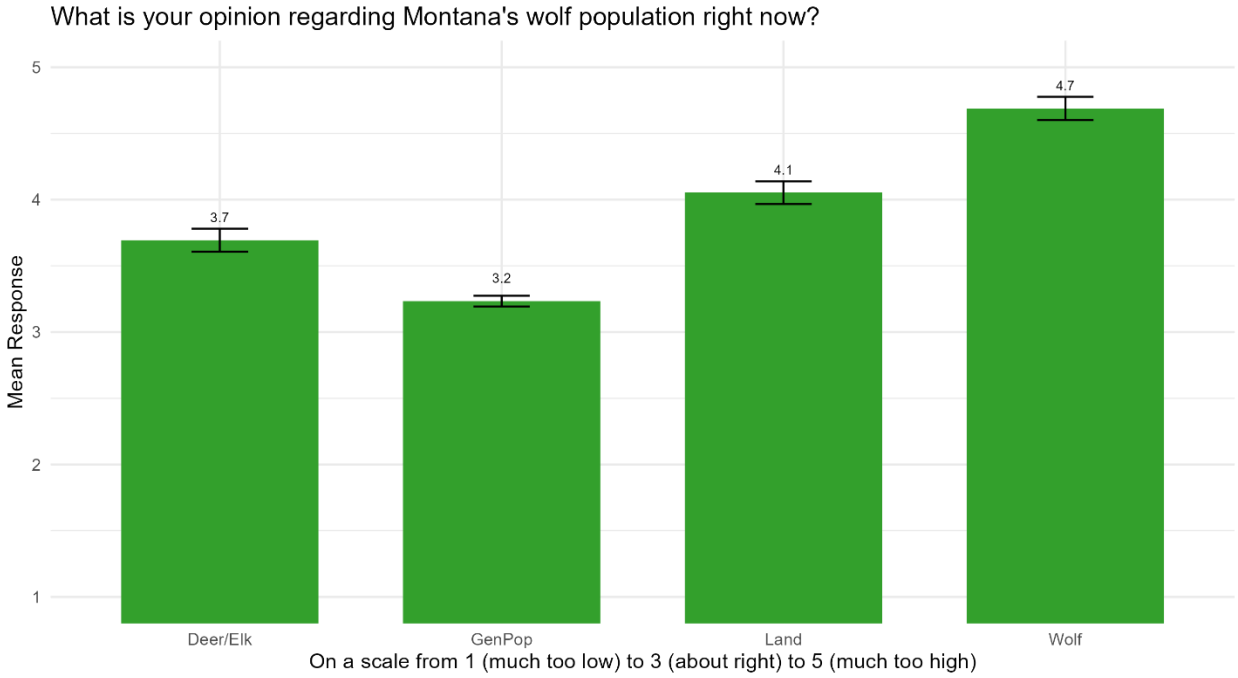

Figure 96 Wolf population too few/many means

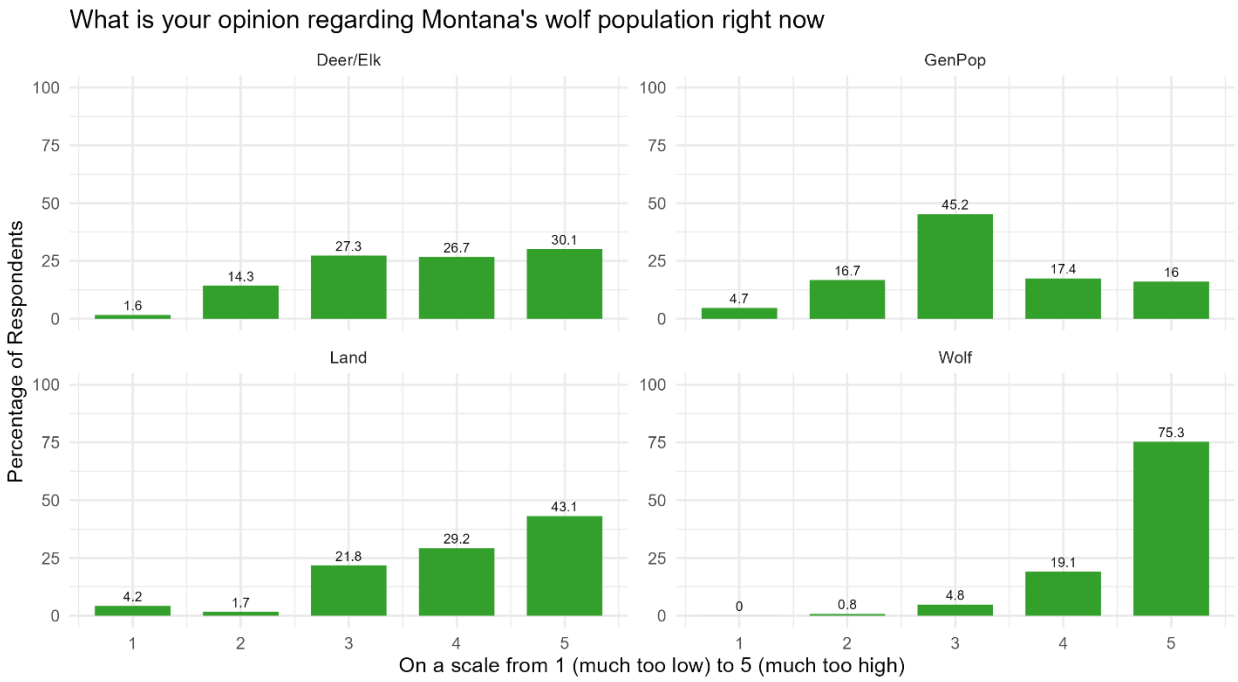

Figure 97 Wolf population too few/many frequencies

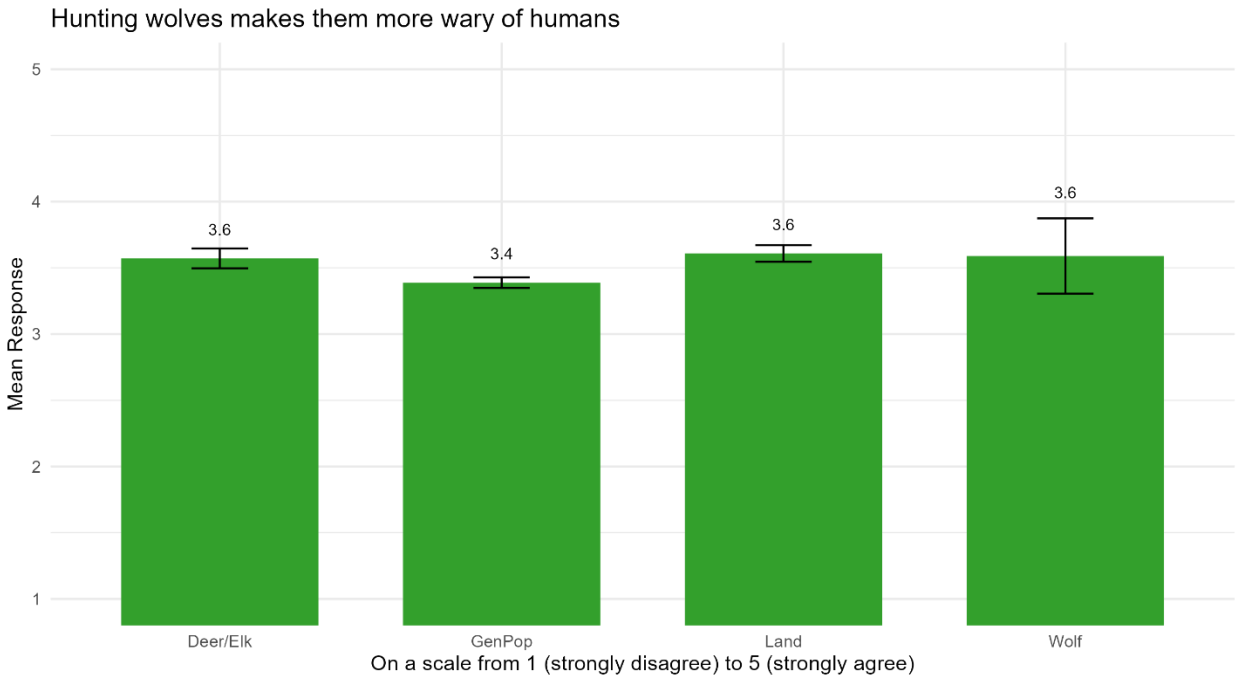

Figure 98 Hunting makes wolves wary means

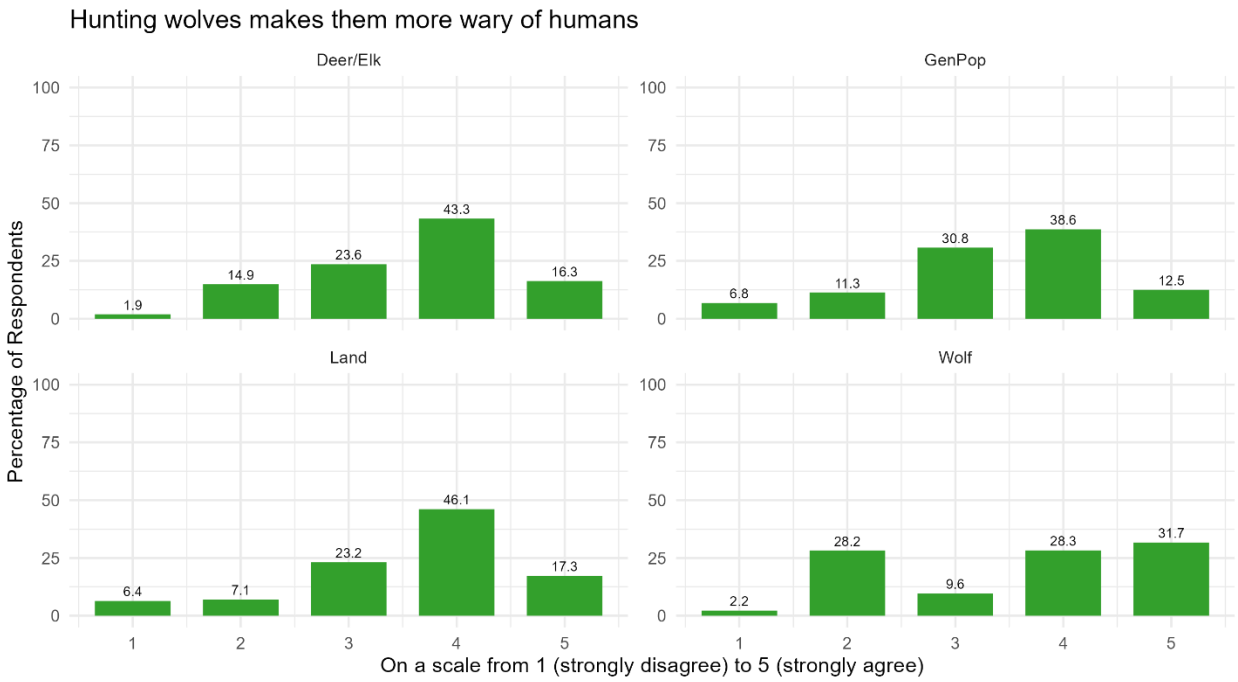

Figure 99 Hunting makes wolves wary frequencies

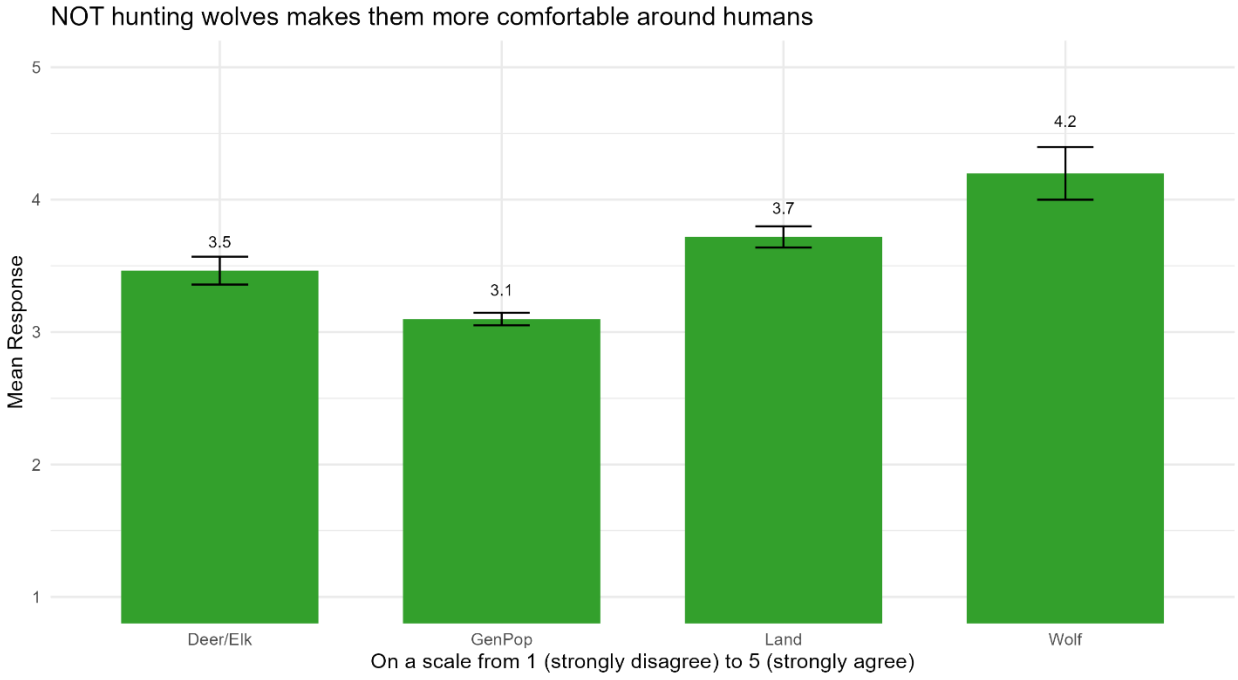

Figure 100 Not hunting makes wolves comfortable means

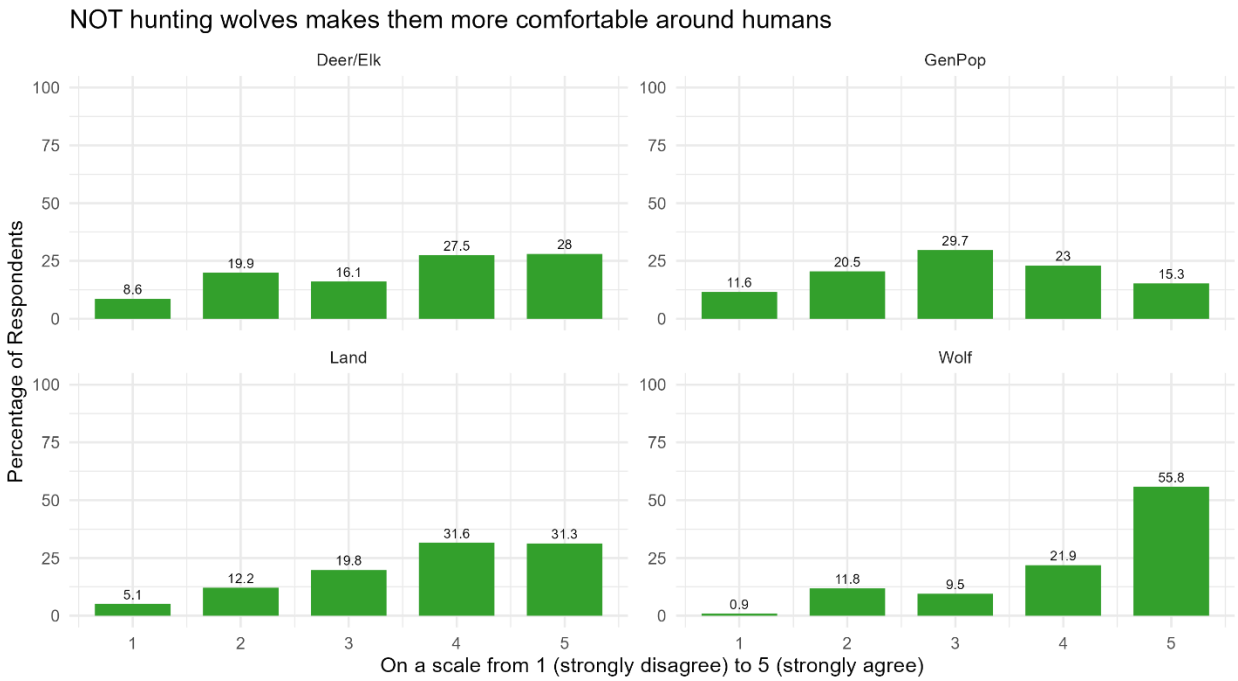

Figure 101 Not hunting makes wolves comfortable frequencies

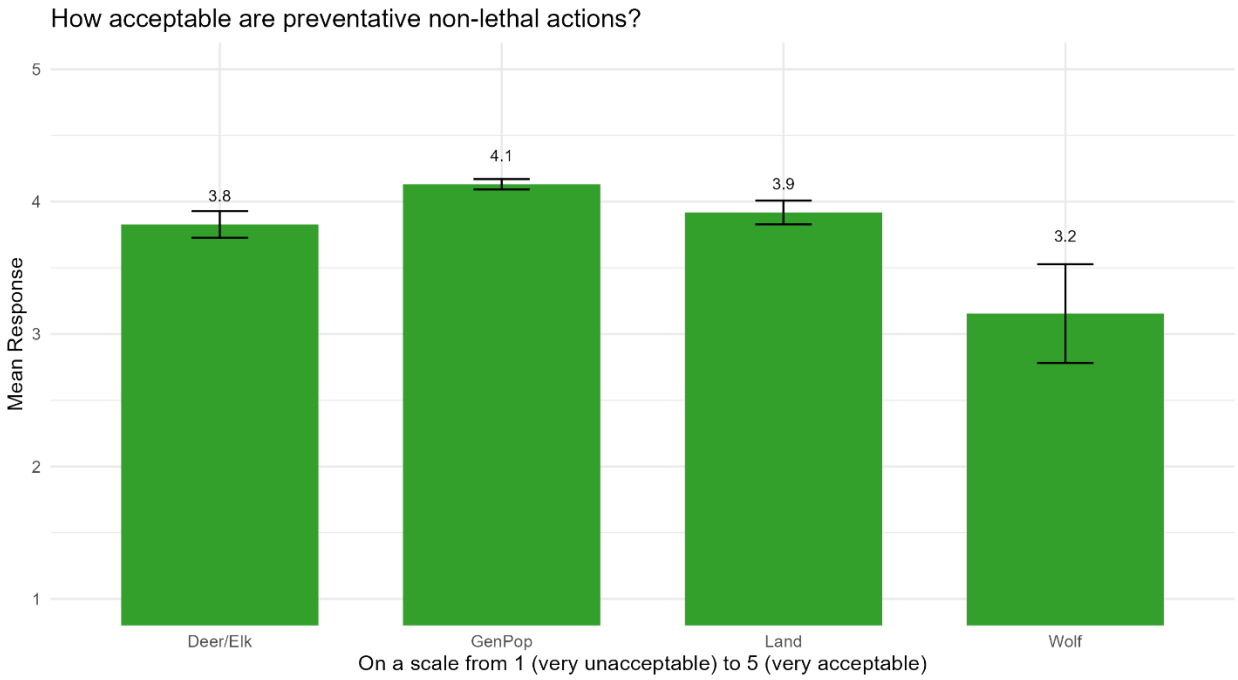

Figure 102 Acceptability of non-lethal preventative means

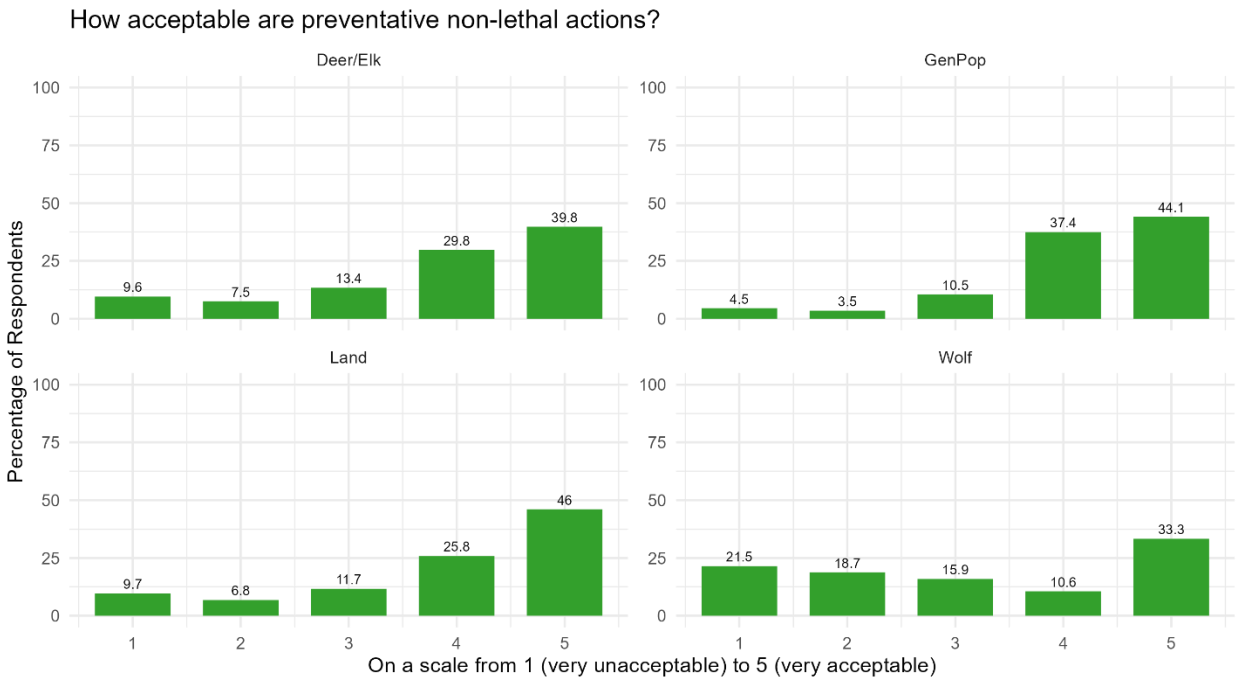

Figure 103 Acceptability of non-lethal preventative frequencies

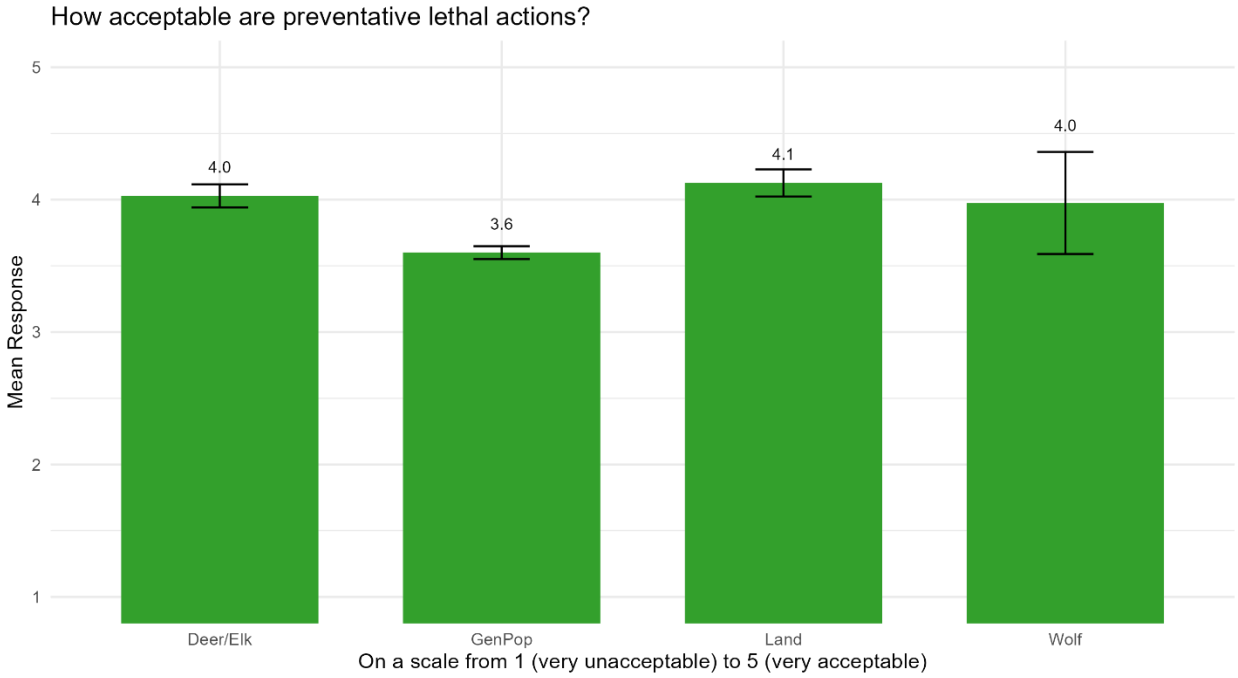

Figure 104 Acceptability of preventative lethal means

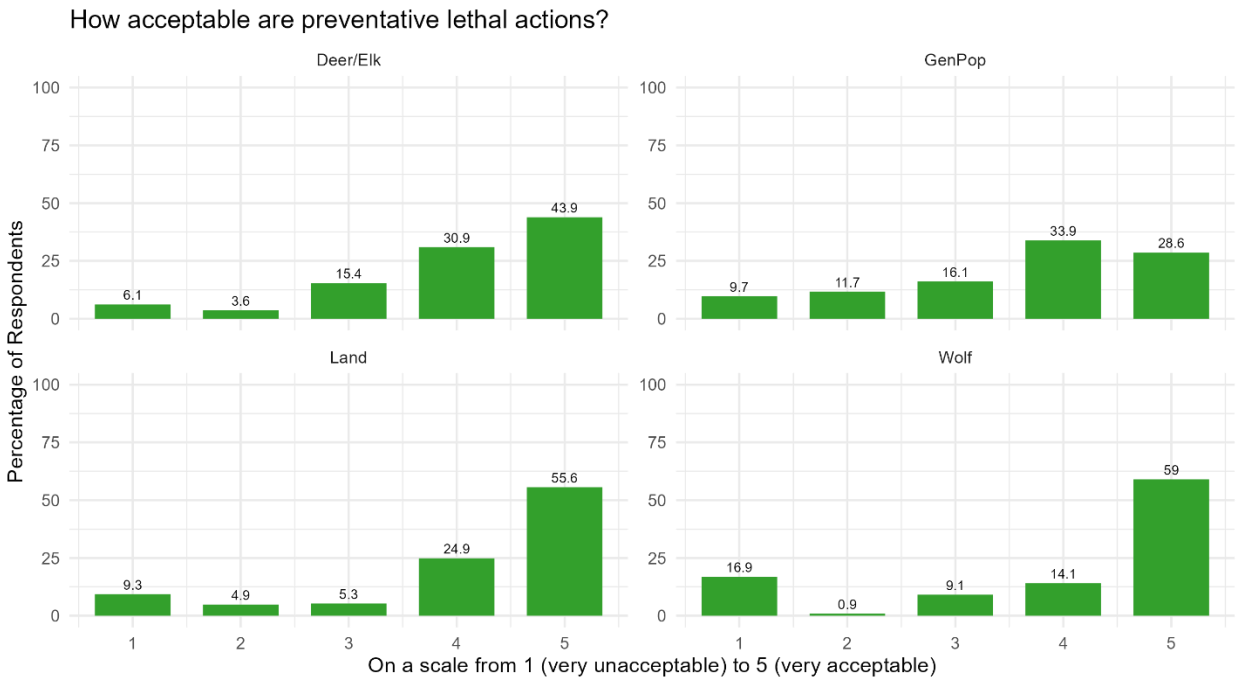

Figure 105 Acceptability of preventative lethal frequencies

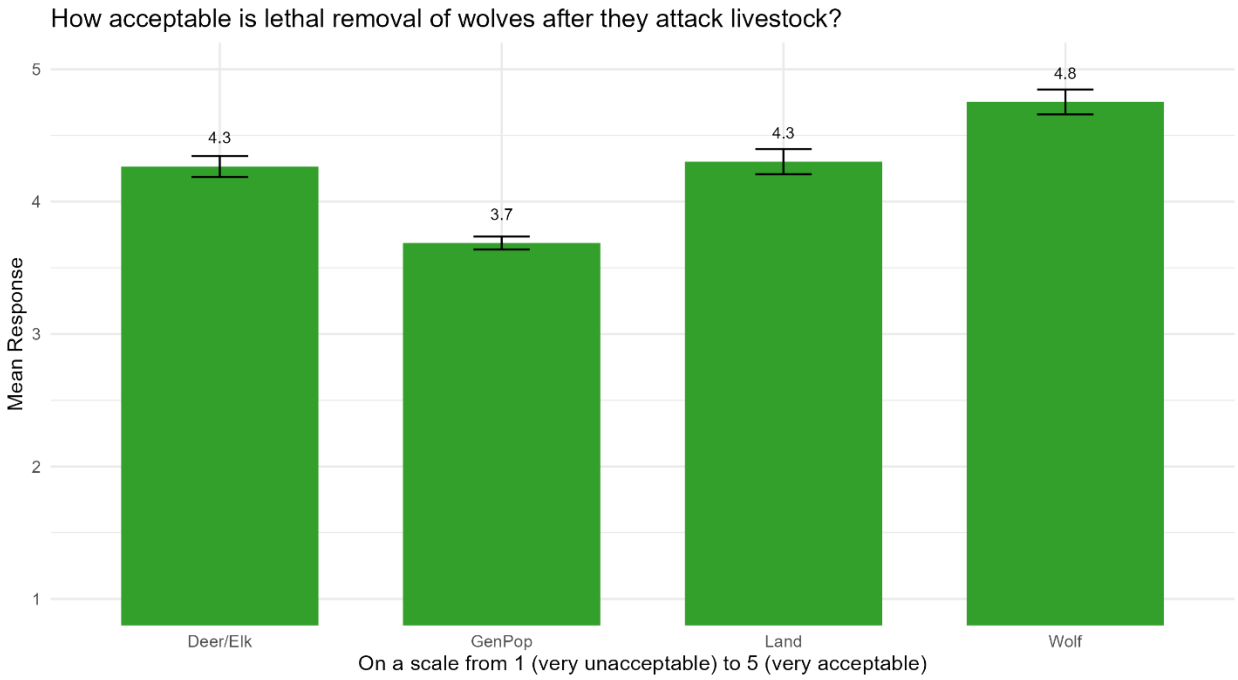

Figure 106 Acceptability of lethal after livestock attack means

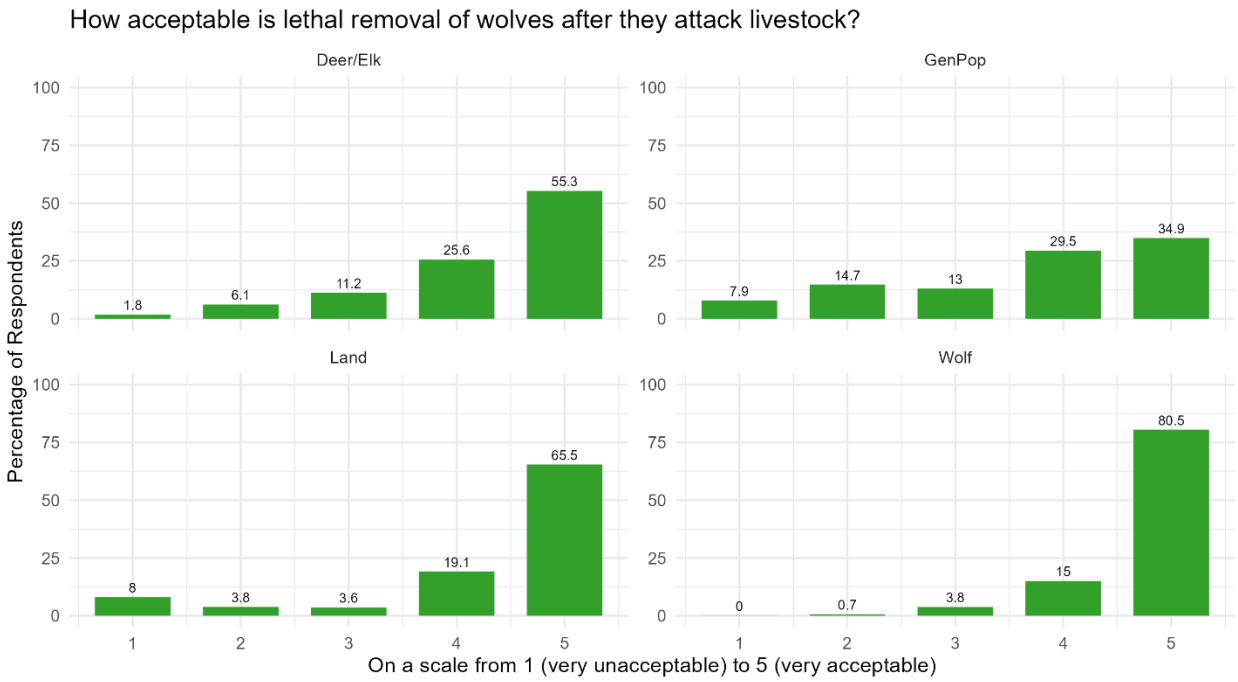

Figure 107 Acceptability of lethal after livestock attack frequencies

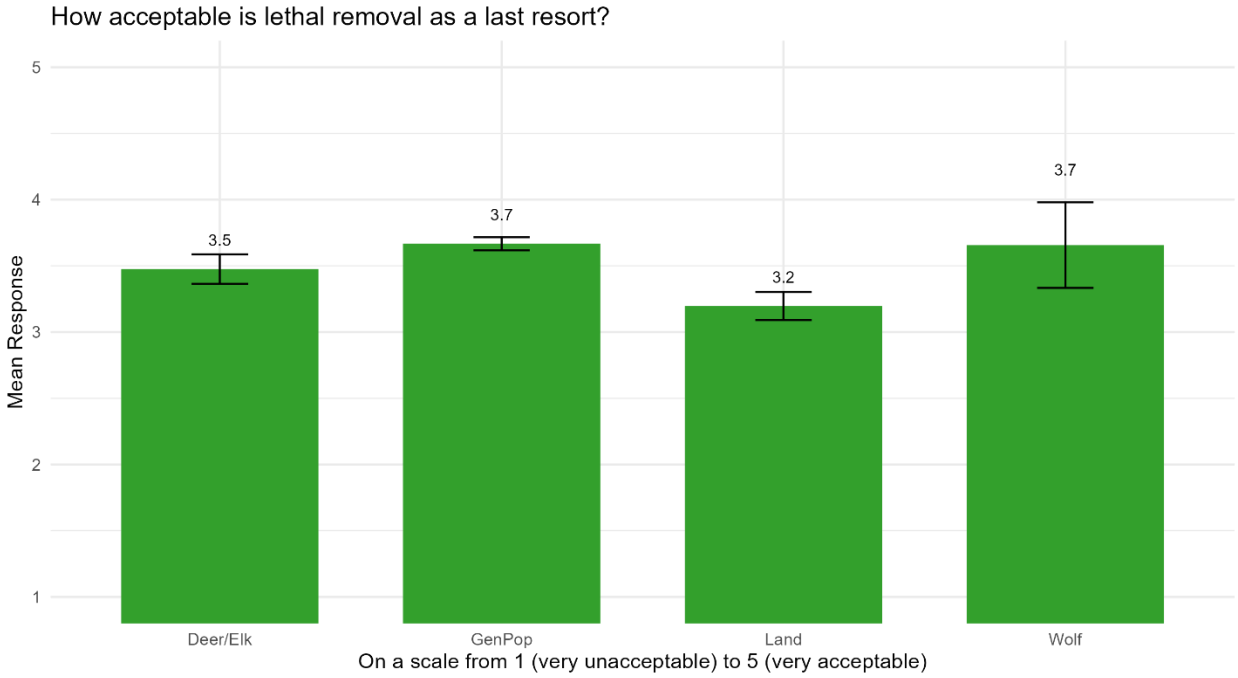

Figure 108 Acceptability of lethal as last resort means

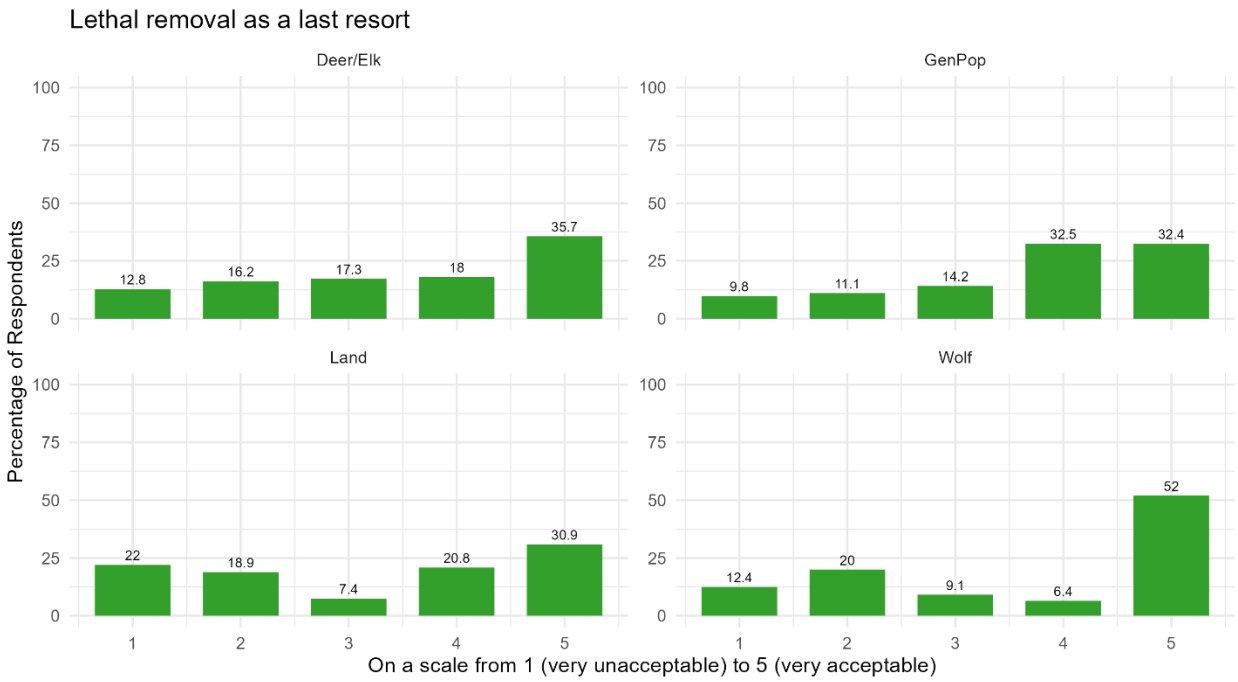

Figure 109 Acceptability of lethal as last resort frequencies

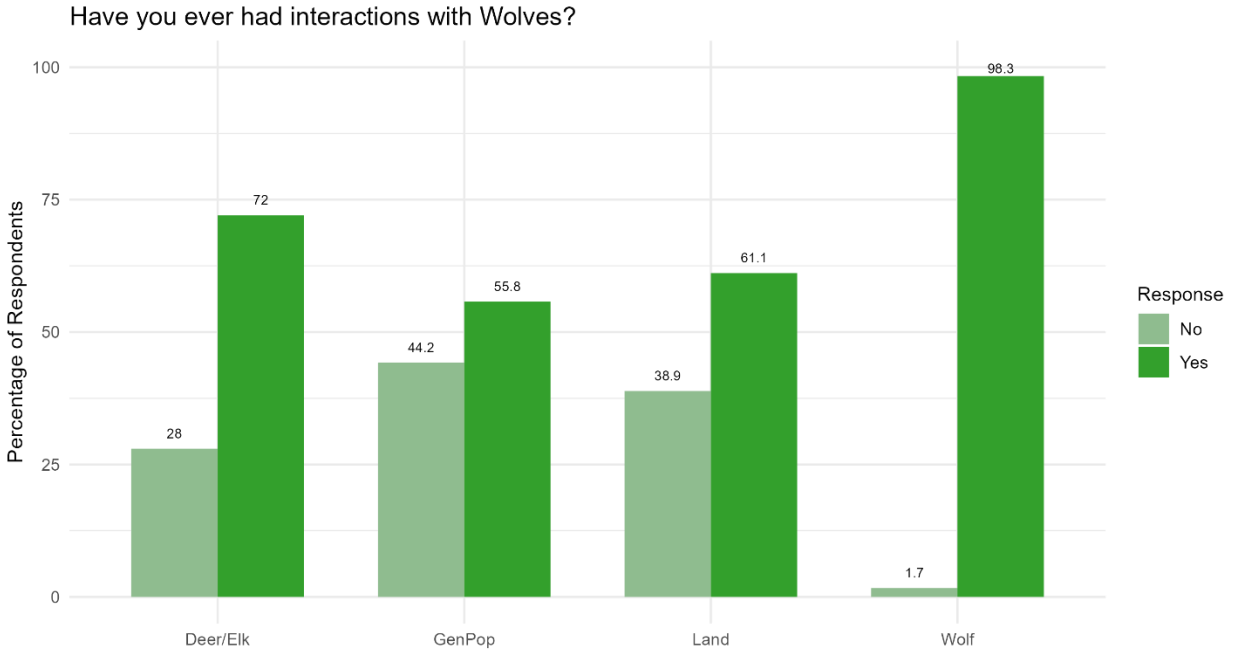

Figure 110 Interactions with wolves frequencies

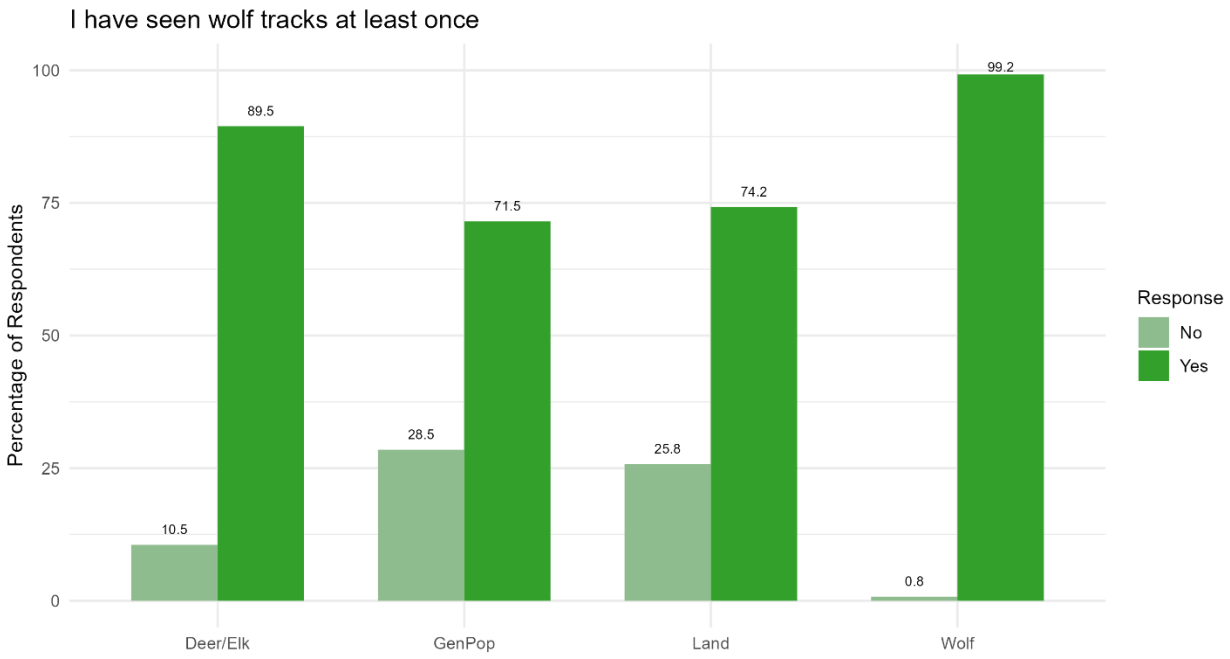

Figure 111 Seen wolf tracks frequencies

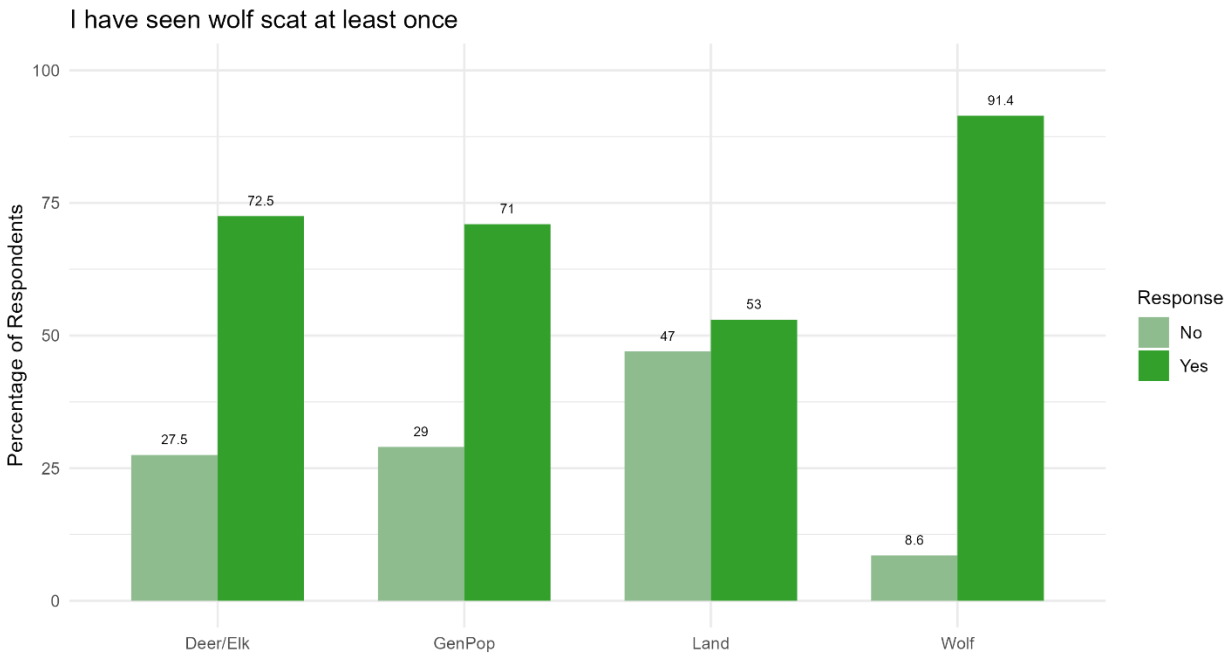

Figure 112 Seen wolf scat frequencies

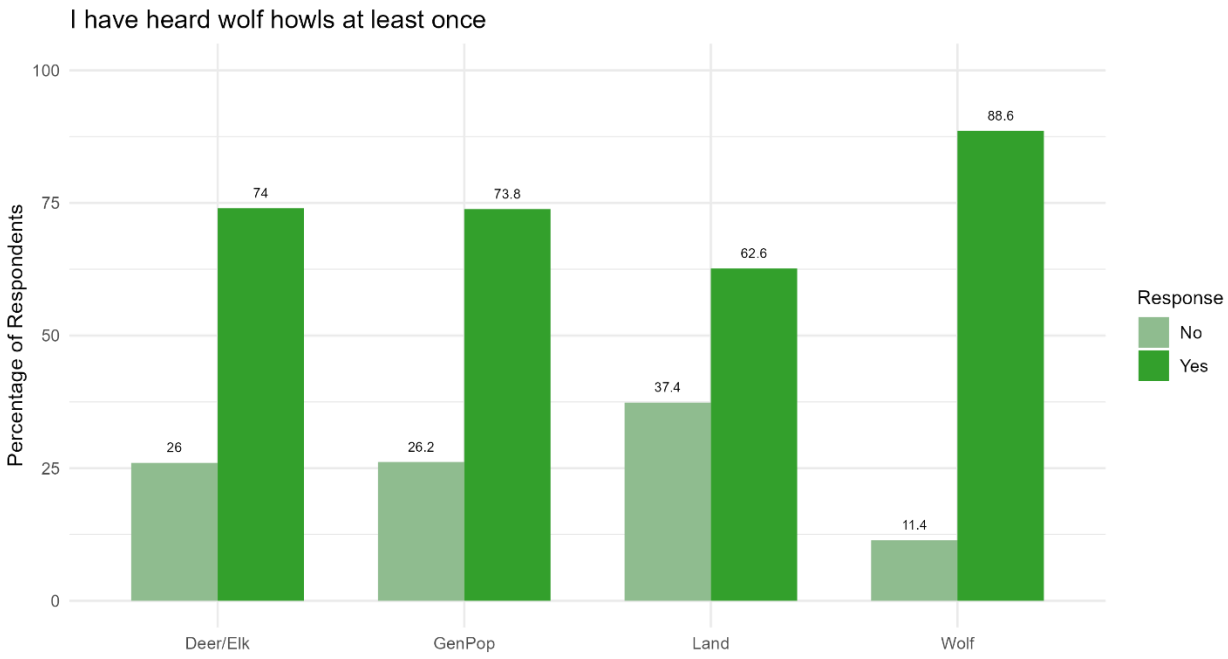

Figure 113 Heard wolves howl frequencies

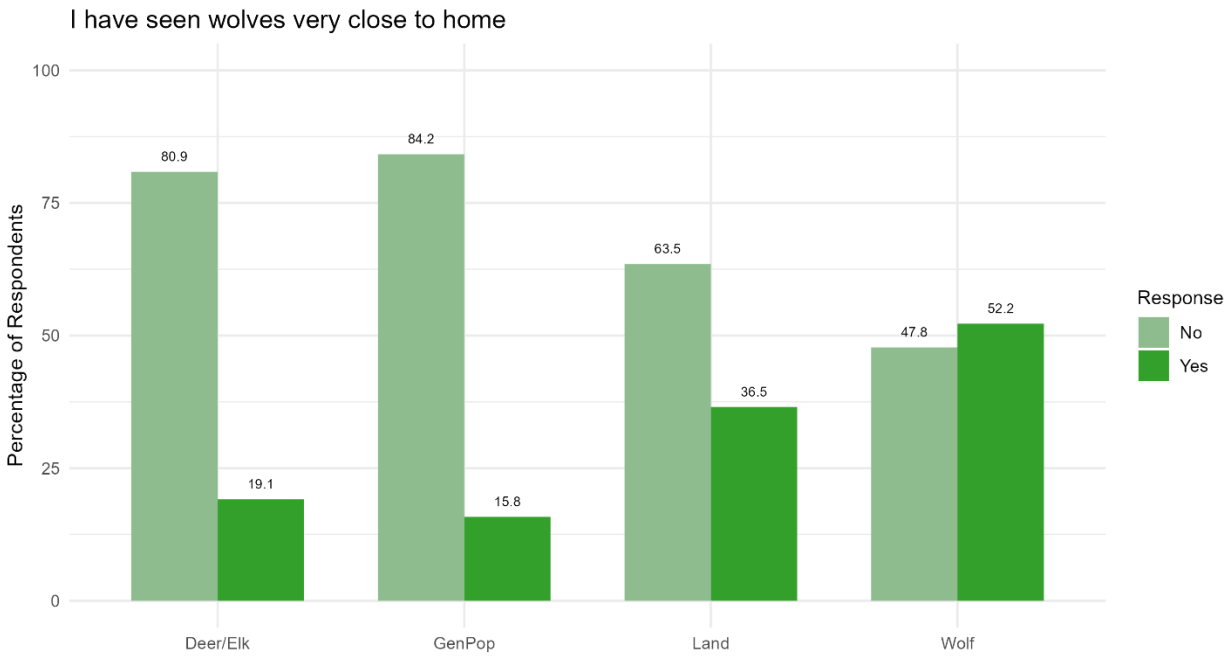

Figure 114 Seen wolves close to home frequencies

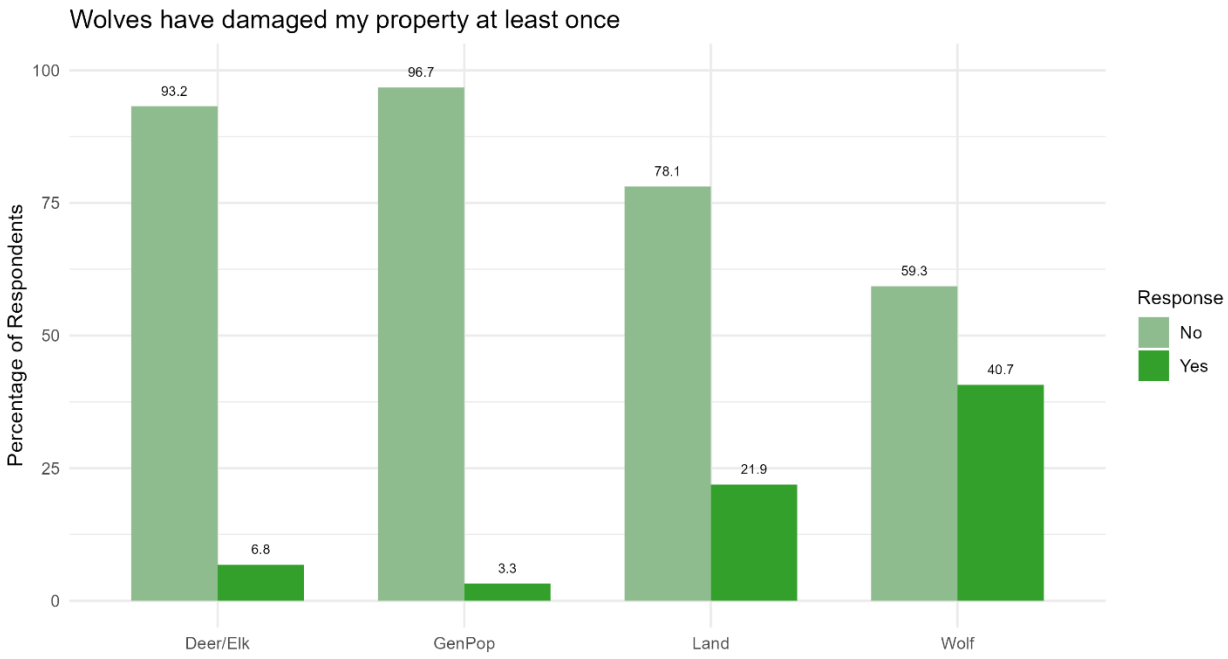

Figure 115 Wolves damaged property frequencies

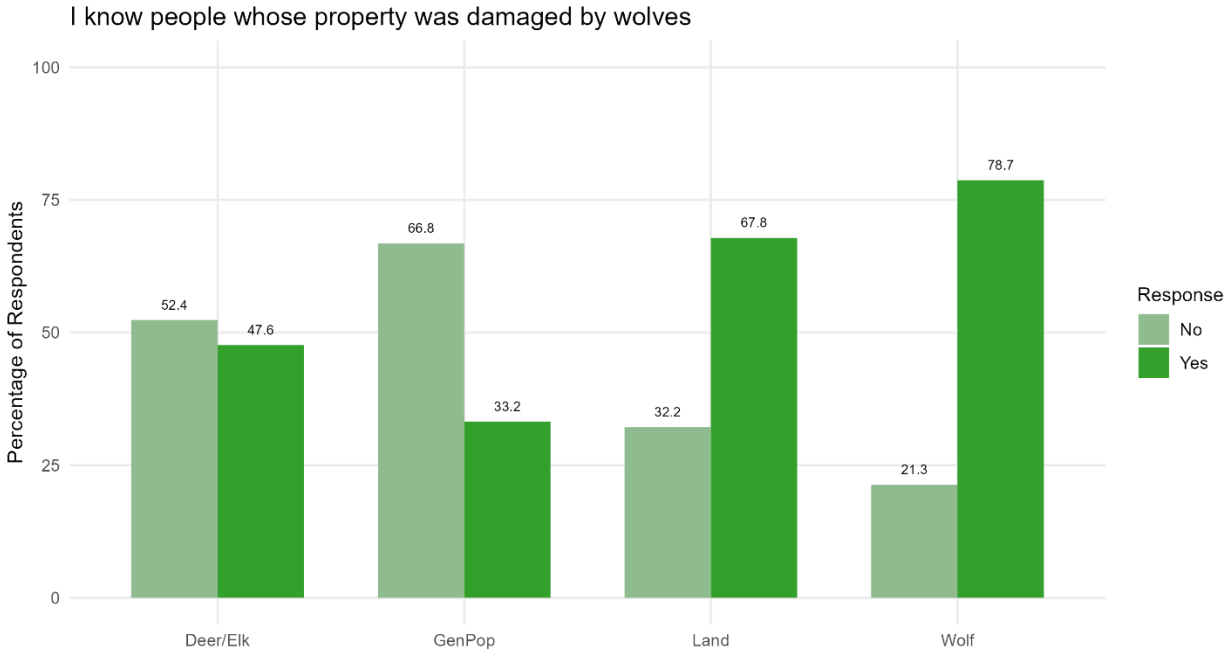

Figure 116 Vicarious property damage frequencies

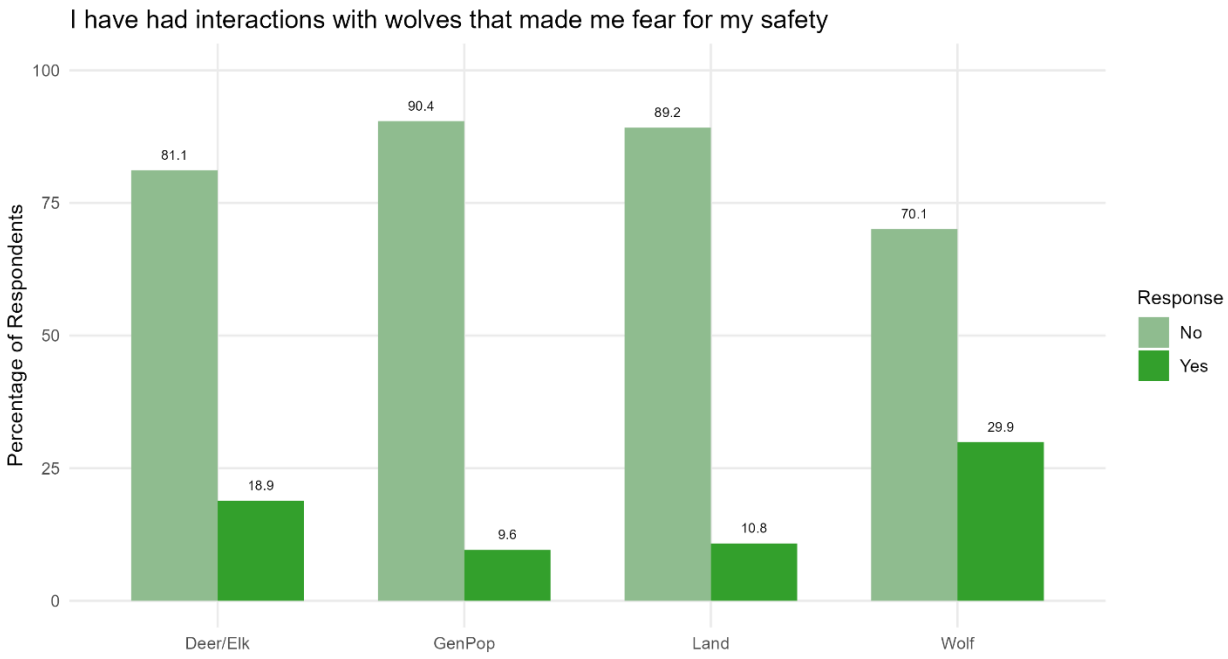

Figure 117 Fearful interaction frequencies

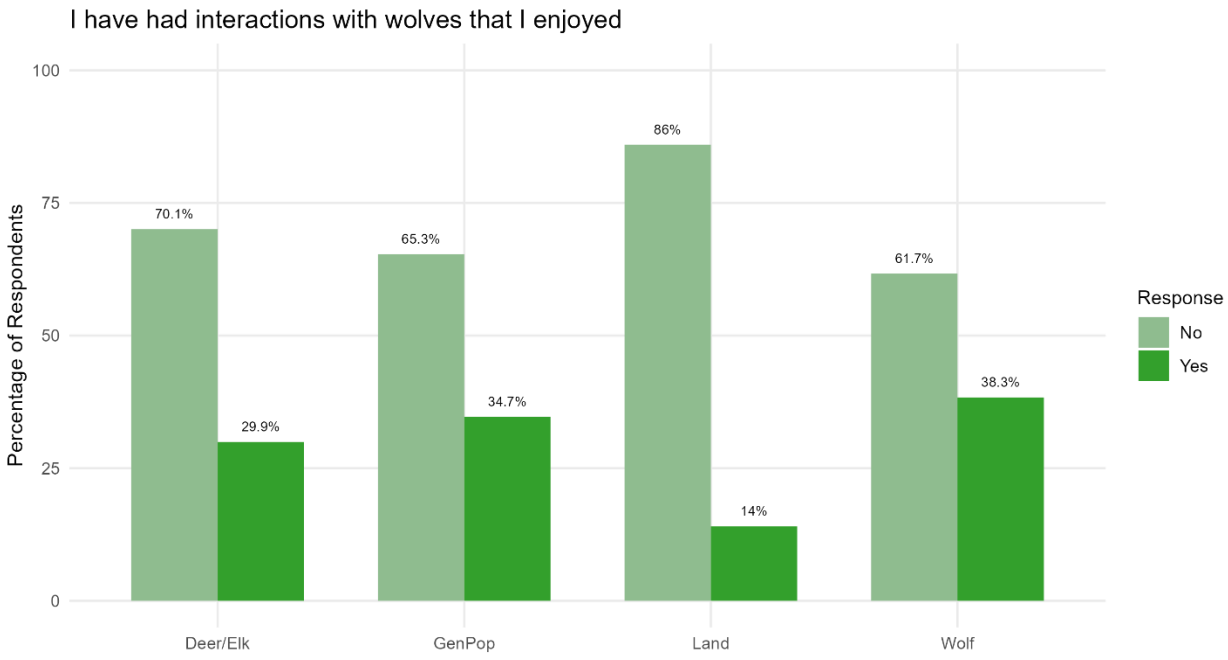

Figure 118 Enjoyed interactions frequencies

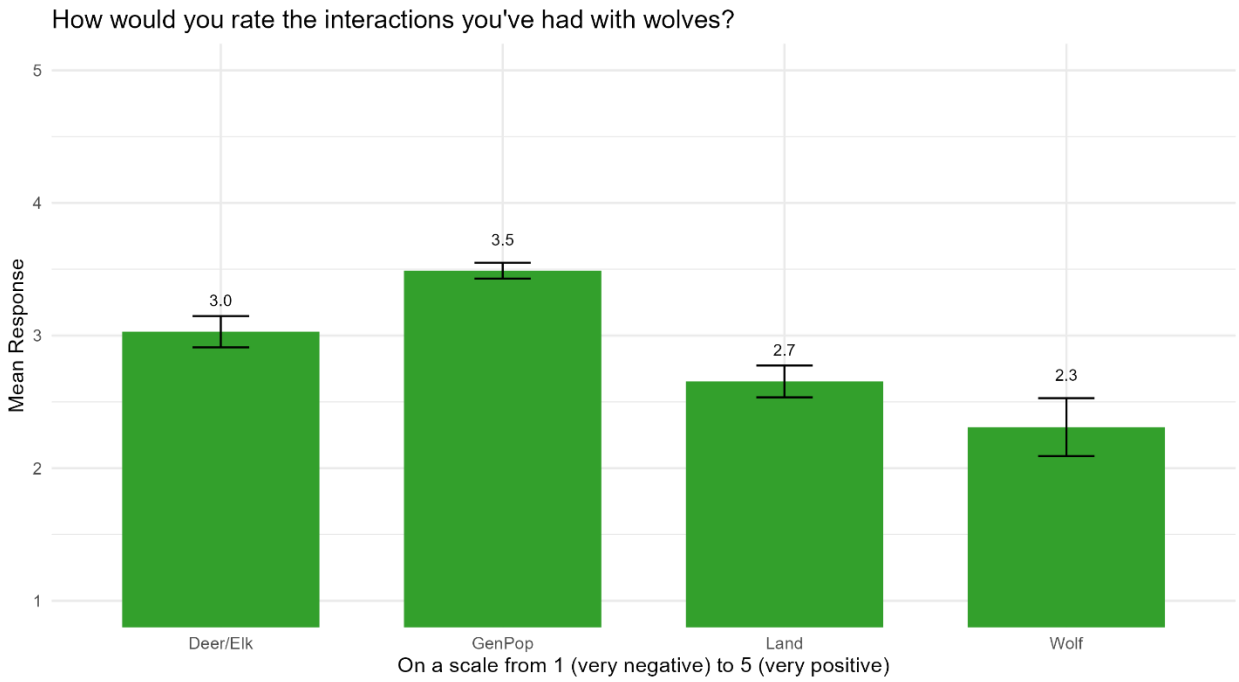

Figure 119 Interaction rating means

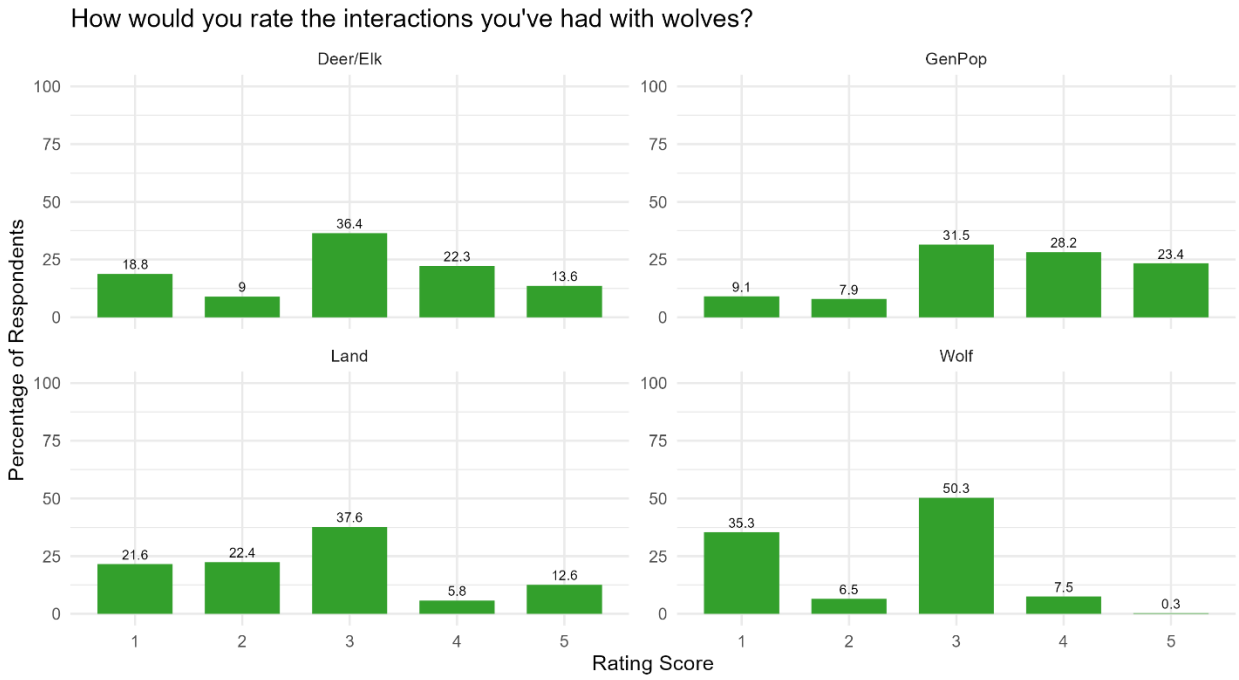

Figure 120 Interaction rating frequencies

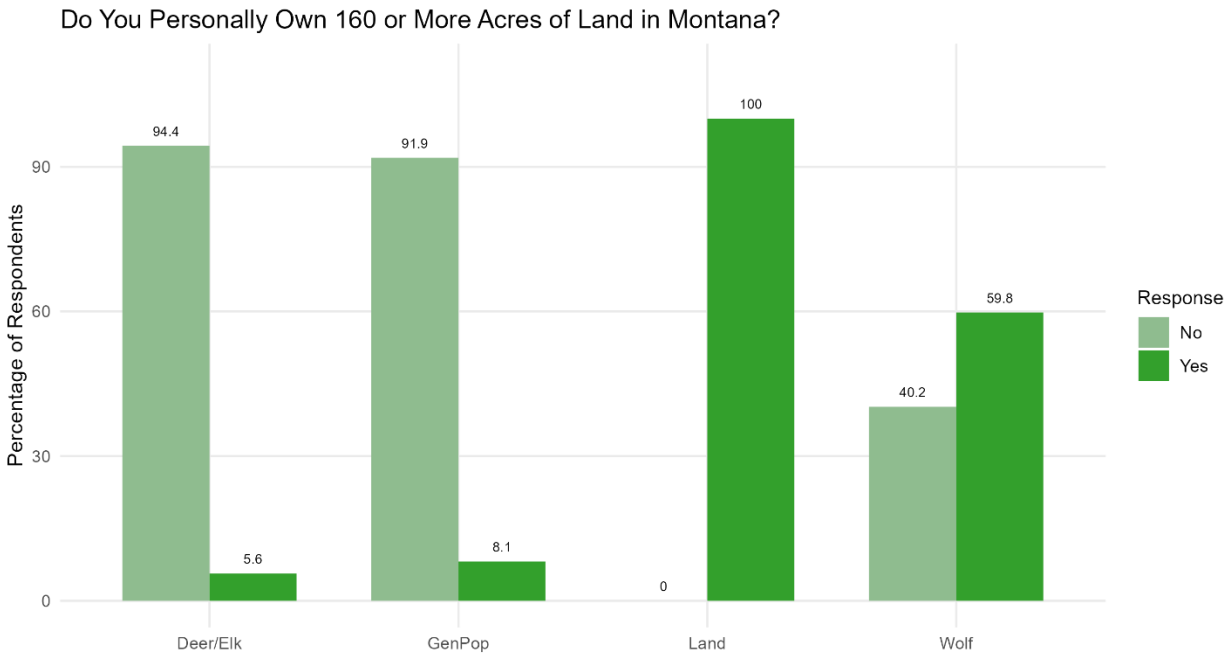

Figure 121 Self-report landownership frequencies

WILDLIFE VALUE ORIENTATIONS

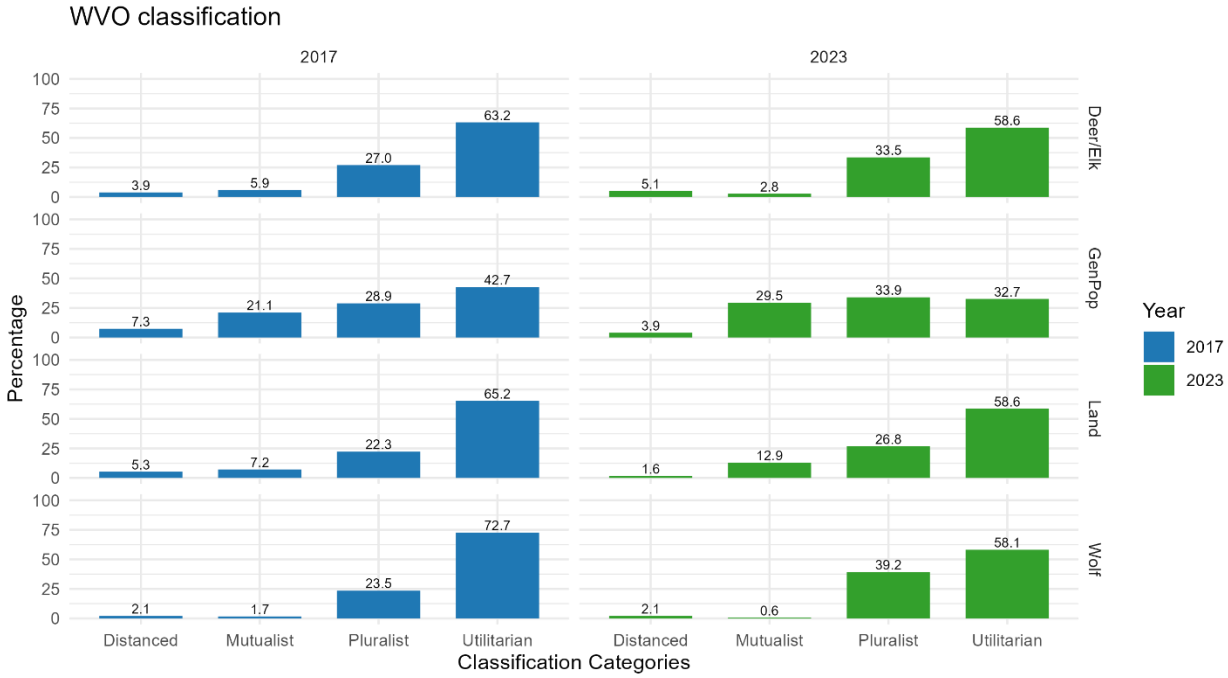

Figure 122 WVO classification frequencies

ATTITUDE-ACCEPTABILTIY TYPOLOGIES

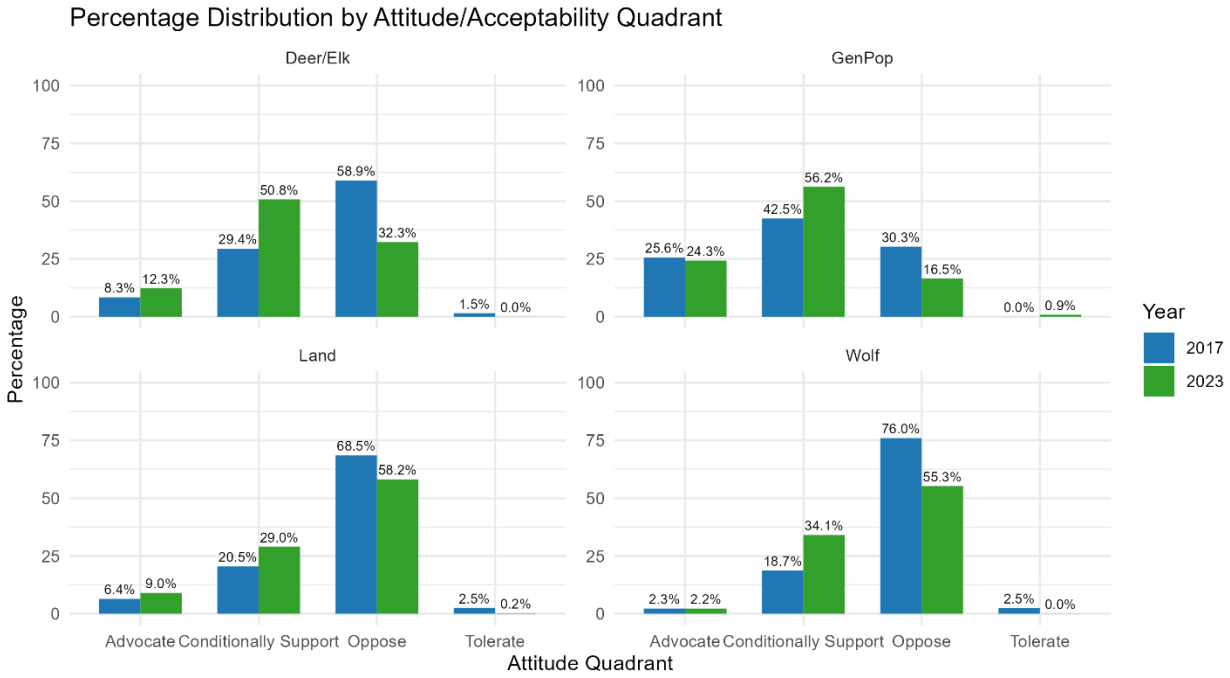

Figure 123 Attitude-Acceptability quadrant frequencies

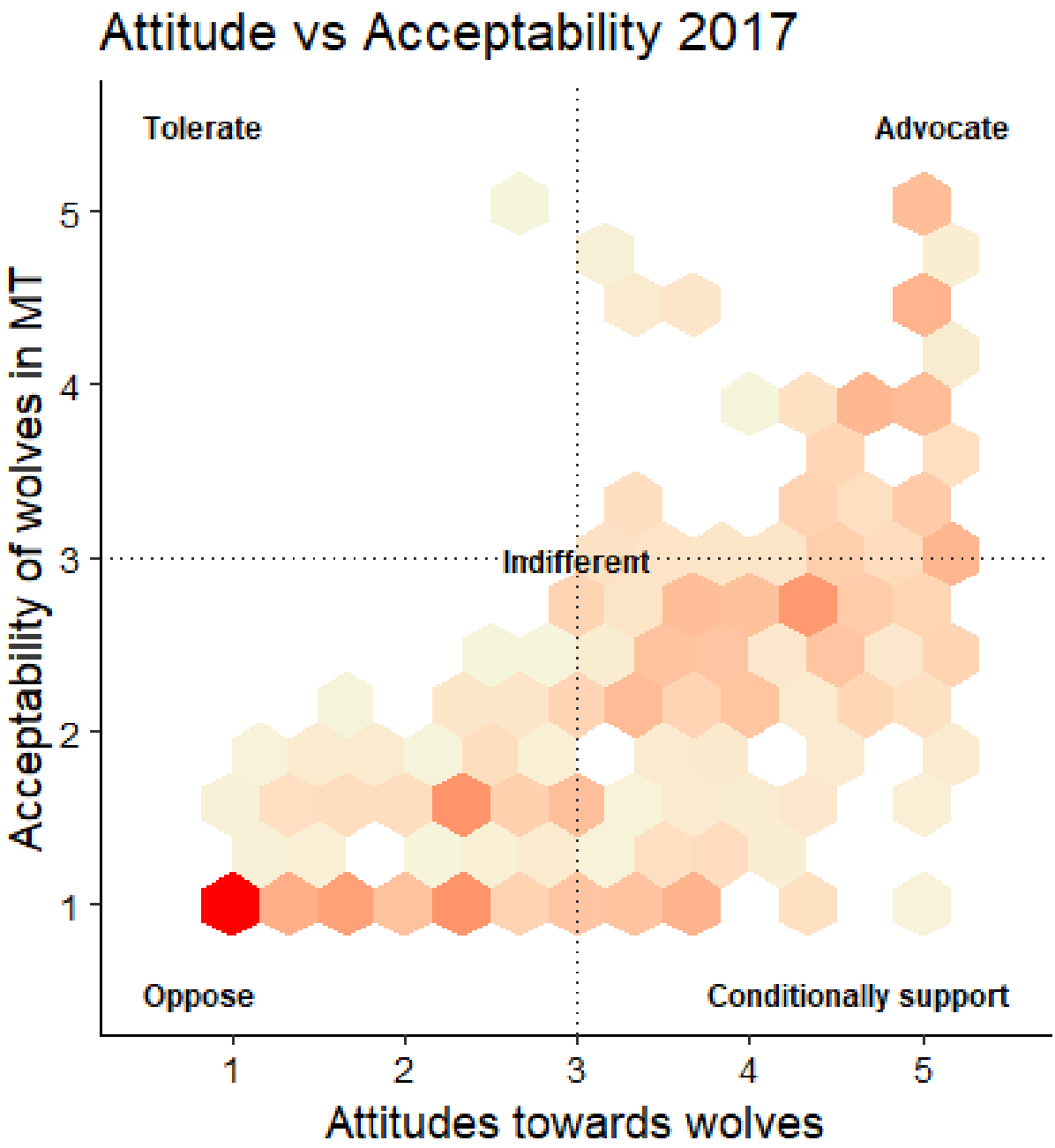

Figure 124 Attitude/Acceptability quadrant density map 2017

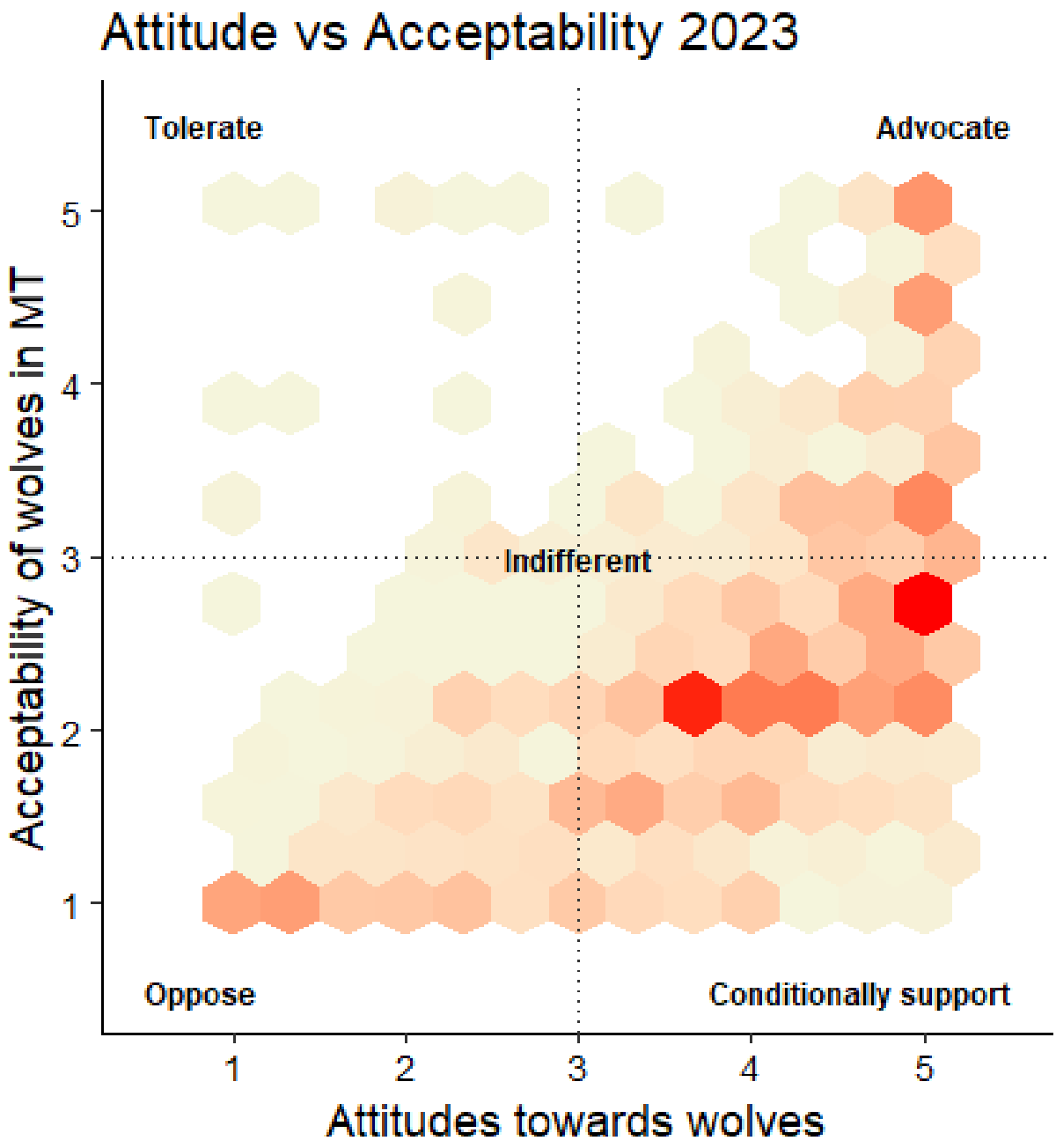

Figure 125 Attitude/Acceptability quadrant density map 2023