THE HUMANE SOCIETY OF THE UNITED STATES

Government data confirm that wolves have a negligible effect on U.S. cattle & sheep industries

In the United States, data show that wolves (*Canis lupus*, *Canis lupus baileiy* and *Canis rufus*) kill few cattle and sheep. Livestock predation data collected by various governmental bodies differ significantly, however. The most recent data published by the U.S. Department of Agriculture-Animal and Plant Health Inspection Service (USDA)[1] indicate losses many times greater than those collected by states and the U.S. Fish and Wildlife Service (FWS). In the Northern Rocky Mountains, for instance, the USDA claims wolves killed 4,360 cattle in 2015, while the FWS verified only 161 such losses. The USDA's methodology involves collecting data from a few, mostly unverified sources, which the USDA then extrapolated statewide without calculating standard errors or using models to test relationships among various mortality factors.[2] This contravenes the scientific method and results in exaggerated livestock losses attributed to native carnivores and dogs. Unfortunately, this misinformation informs public policies that harm native carnivores, including helping to fuel countless legislative attacks on wolves, grizzly bears and the Endangered Species Act by Congress.

The Humane Society of the United States analyzed the USDA's embellished predation numbers. Their data show that farmers and ranchers lose nine times more cattle and sheep to health, weather, birthing and theft problems than to all predators combined. In the USDA reports, "predators" include mammalian carnivores (e.g., cougars, wolves and bears), avian carnivores (e.g., eagles and hawks) and domestic dogs. Domestic dogs, according to the USDA's data, kill 100 percent more cattle than wolves and 1,924 percent more sheep. According to the USDA, in the states where wolves live, they cause far fewer than one percent of unwanted cattle-calf (hereinafter "cattle") and sheep-lamb (hereinafter "sheep") losses by inventory.

We present our analysis of the USDA's data sets on cattle and sheep deaths in wolf-occupied states and wolves' effects on the national cattle and sheep industries. We compare the USDA's data to those of other governmental bodies that also collect this information, which corroborates our findings that while the USDA's predation figures are significantly exaggerated, they are nominal when compared to livestock mortalities from health, weather, theft and birthing problems (we refer to these livestock losses as "maladies"). We describe humane, efficacious and cost-effective non-lethal methods for cattle and sheep protection, and show that only a fraction of cattle and sheep growers in wolf-occupied states use non-lethal methods to protect their herds—even as numerous published scientific studies have found that non-lethal methods to protect non-native cattle and sheep from native carnivores are more efficacious and cost effective than the constant slaughter of wildlife that is ubiquitously employed—even on federally protected species.

I. Gray wolves' legal status under the Endangered Species Act varies across their range

Wolves in Minnesota are listed as "threatened." Wolves in Idaho, Montana, Wyoming, and the eastern portions of Washington and Oregon are not federally listed following a 2011 act of Congress directing the reissuance of a delisting rule previously overturned in federal court. Wolves across the rest of the lower-48 states remain protected as "endangered." Since 2007, FWS has made multiple unsuccessful attempts to delist wolves in the Western Great Lakes states, where wolves presently range in Minnesota, Wisconsin, and Michigan. Courts have consistently struck down these delisting efforts as inconsistent with the ESA, most recently in a 2017 opinion by the D.C. Circuit Court of Appeals in a case brought by HSUS. *Humane Society of the United States v. Zinke*, 865 F.3d 585 (D.C. Cir 2017).

Dated: Mar. 6, 2019

II. USDA data show most cattle and sheep die from health, weather and other maladies

USDA reports show that the primary causes of cattle and sheep losses in the U.S. come from health problems, weather, theft, and other maladies, but *not* from wild native carnivores, including wolves.[3] USDA data show that *nine times* more cattle and sheep died from maladies such as illness, birthing problems, weather, poisoning, and theft (3,990,035), than from all mammalian or avian predators together (474,965). Of the 119 million cattle and sheep inventoried in the U.S. in 2014 and 2015, fewer than one percent (0.4 percent) died from mammalian and avian predators combined. Figs. 1 and 3. Of the total unwanted cattle deaths in wolf states, between 86 percent and 98 percent came as a result of maladies. Fig. 5b.

A. Despite being inflated, USDA data show that few cattle die from wolves, other native carnivores or dogs

In 2015 the USDA inventoried 112.2 million cattle in the U.S.[4] Of that number, 4.5 million died from *all* unwanted causes. Most of those deaths, 3.6 million (3.2 percent of U.S. cattle inventory) stemmed from health-related maladies, weather, and theft. Mortalities from all predators amounted to 280,570 cattle deaths, representing a mere 0.3 percent of U.S. cattle inventory—with wolves taking 0.009 percent of the U.S. cattle inventory. Figs. 1 and 2.

Fig. 1. United States Cattle Inventory and Mortality by Cause

Data from USDA-APHIS (2017), Data Year 2015

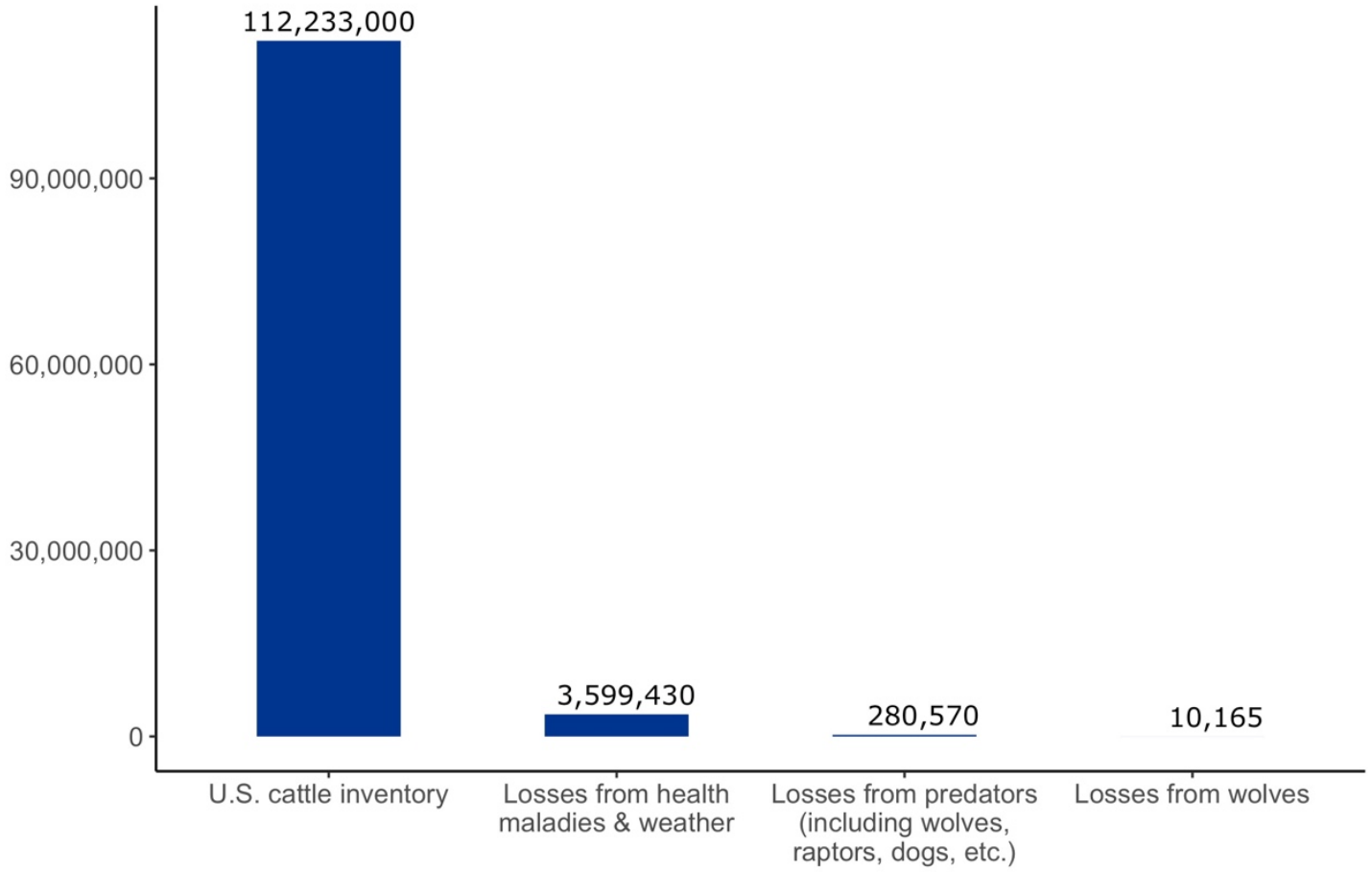
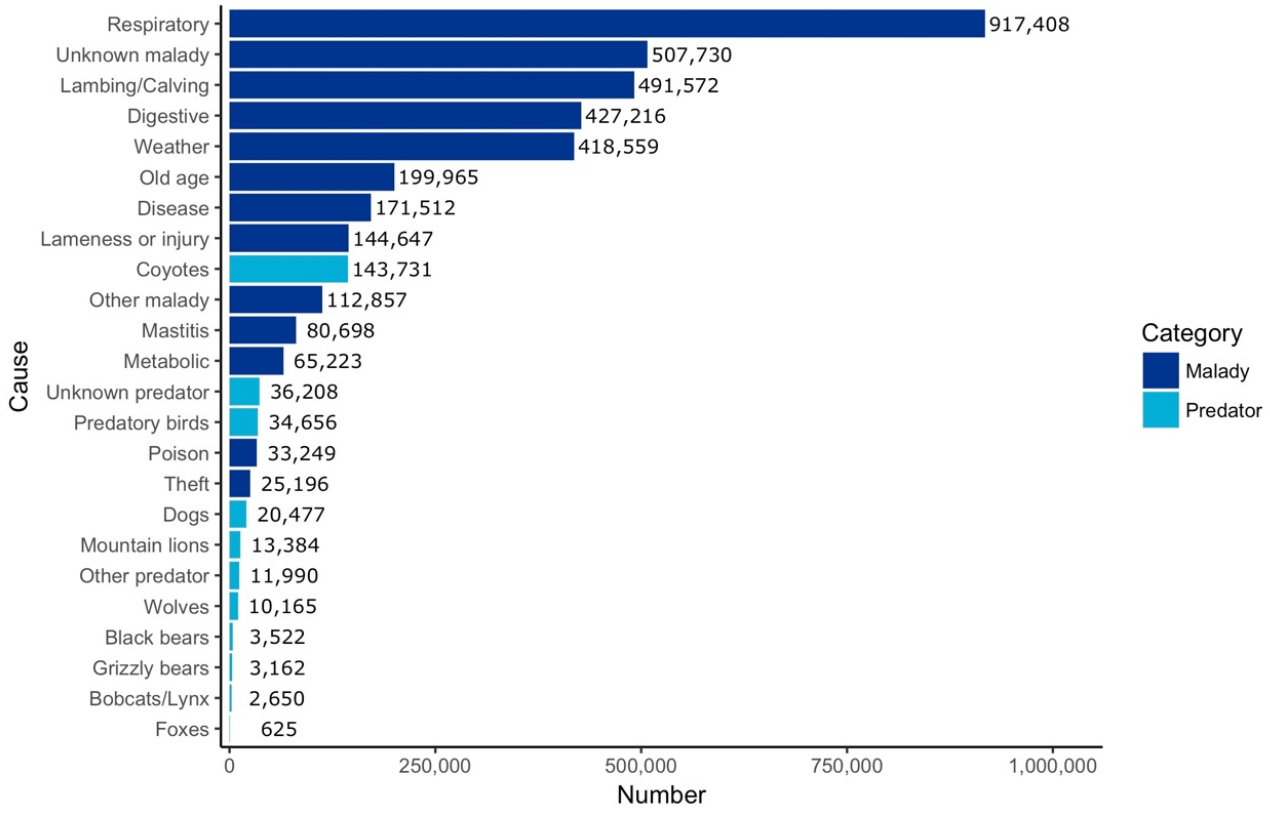


Fig. 2. United States Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015



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B. Despite being inflated, USDA data show that few sheep die from wolves, other native carnivores or dogs

In 2015, the U.S. sheep inventory amounted to 6.8 million individuals. Health, weather, poison, theft, and other maladies were responsible for the majority of ranchers and farmers' losses: 390,605 sheep deaths (5.7 percent of the U.S. sheep inventory). In comparison, mammalian carnivores, raptors and domestic dogs killed 194,395 sheep, or 2.9 percent of the U.S. sheep inventory, with wolves' contributions amounting to 0.01 percent of the U.S. sheep inventory.[5] Fig. 3 and 4. Predation of sheep is greater than of cattle, likely because sheep have smaller body size and lack predator-avoidance skills.[6] Despite this, the USDA's data show few sheep growers use non-lethal methods to protect their flocks (*see*: Figs. 29 and 30 below).

Fig. 3. United States Sheep Inventory and Mortality by Cause

Data from USDA-APHIS (2015), Data Year 2014

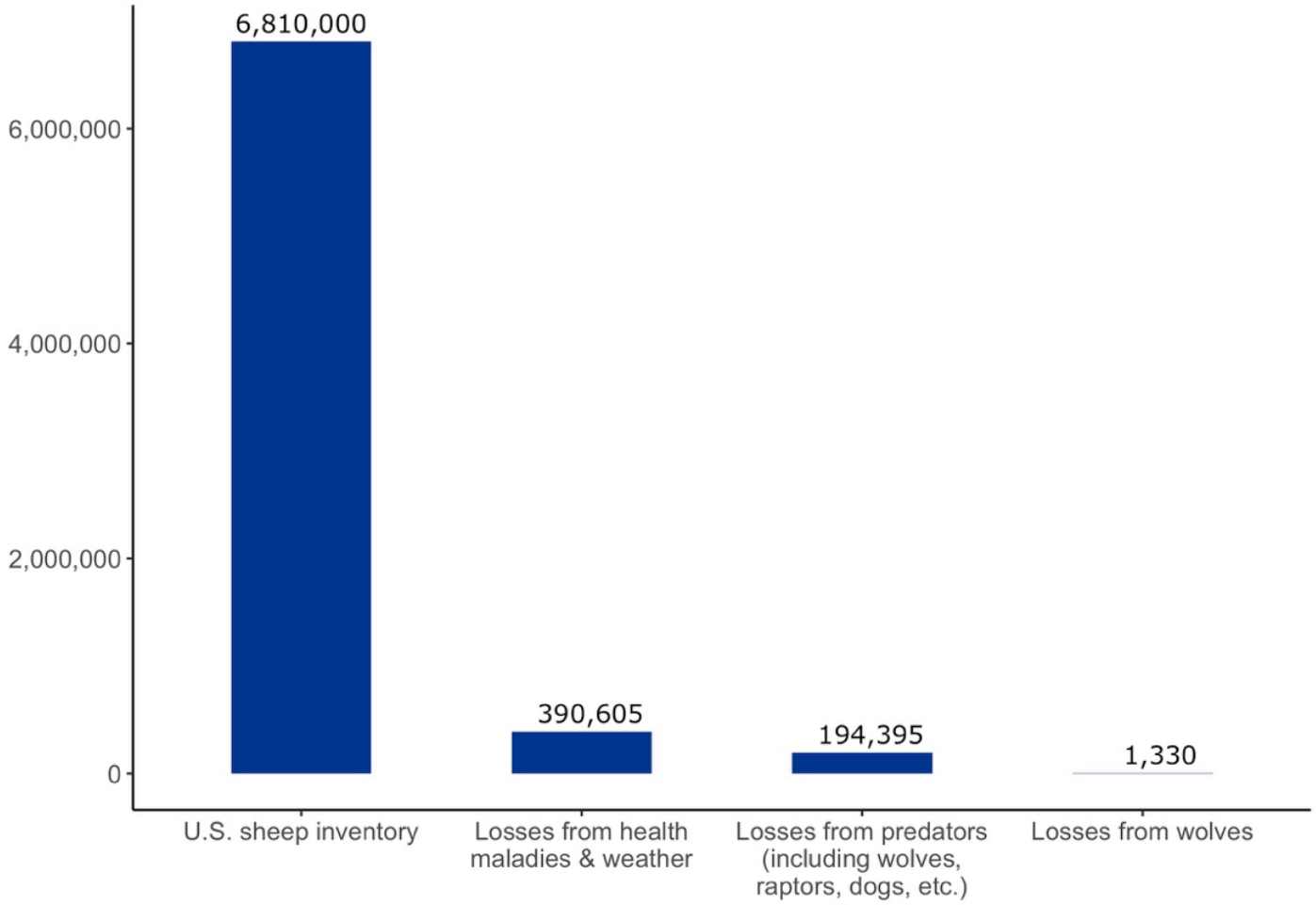
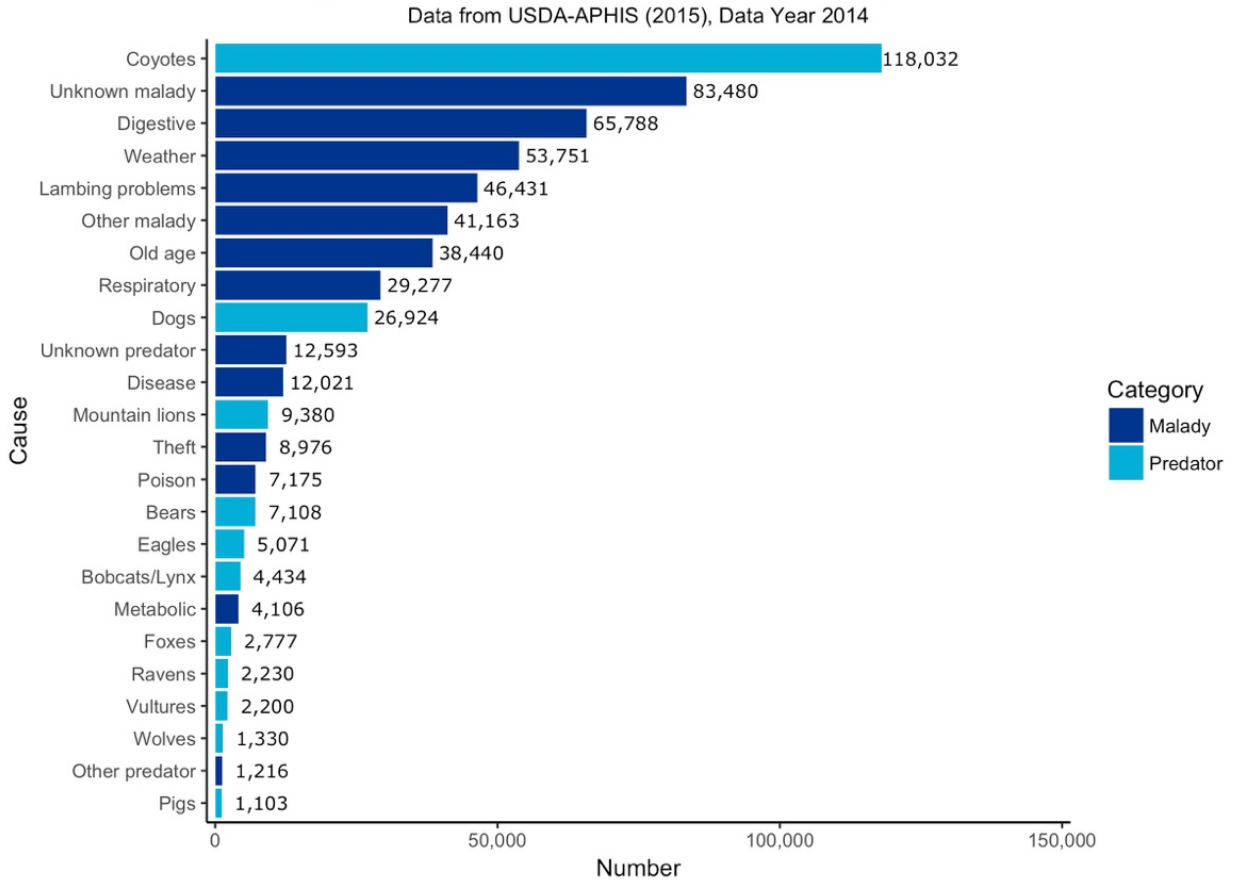


Fig. 4. United States Sheep Mortality by Rank



III. Even in wolf-occupied states, USDA's data show nominal losses of cattle and sheep to predators

- **Gray wolves (*Canis lupus*) in the Great Lakes States (Michigan, Minnesota and Wisconsin).** The USDA found that wolves killed 3,879 cattle (2015) and sheep (2014) from an inventory of 8.7 million cattle and sheep. In other words, wolves killed 0.04 percent of the cattle and sheep inventories in the Great Lakes states and were allegedly responsible for just 0.89 percent of unwanted losses. Figs. 1-12. Maladies accounted for more than 96 percent of unwanted losses. Fig. 5b. Data from these three states' wildlife departments, however, show far fewer losses by wolves than do the USDA's data. *See* section V.

- **Gray wolves (*Canis lupus*) in the Northern Rocky Mountains (Idaho, Montana, Oregon, Washington and Wyoming).** The USDA found that wolves killed 4,948 cattle (2015) and sheep (2014) from an inventory of 13.6 million. In other words, wolves killed 0.04 percent of the cattle and sheep inventories in the Northern Rocky Mountain states and were allegedly responsible for just 1.22 percent of unwanted losses. Figs. 1-6b and 13-22. Maladies accounted for more than 87 percent of unwanted losses. Fig. 5b. Data from the FWS show far fewer losses from wolves than do the USDA's data. *See* section VI.

- **Mexican gray wolves (*Canis lupus baileiy*) inhabit the Southwest desert (Arizona and New Mexico).** The USDA data show approximately 100 Mexican wolves allegedly killed 1,132 cattle (2015) and sheep (2014) out of an inventory of 3.1 million total animals, or 0.04 percent of the cattle and sheep inventory in Arizona and New Mexico. These figures show that wolves were allegedly responsible for just 0.83 percent of unwanted losses in Arizona and New Mexico. Figs. 1-6b and 23-26. Maladies accounted for more than 86 percent of unwanted losses. Fig. 5b. On the other hand, humans killed a record number of endangered Mexican wolves in 2018 in numbers far out of proportion to the alleged livestock losses.[7]

- **Red wolves (*Canis rufus*) of North Carolina** killed no cattle (2015) or sheep (2014). Figs. 5a – 6b.

Fig. 5a. U.S. Cattle Inventory Losses by Cause and by State (Unverified data, USDA-Animal and Plant Health Inspection Service, 2017 (Data year 2015))							
States	Cattle inventory	Cattle losses from maladies (illness, birthing problems, etc.)		Cattle losses from all predators		Cattle losses from wolves	
		Number	Percent of cattle inventory	Number	Percent of cattle inventory	Number	Percent of cattle inventory
Great Lakes wolf states							
MI	1,345,000	66,002	4.91%	1001	0.07%	350	0.03%
MN	2,710,000	125,020	4.61%	4903	0.18%	2,104	0.08%
WI	4,210,000	188,067	4.47%	4840	0.11%	1,386	0.03%
Northern Rocky Mountains wolf states							
ID	3,020,000	88,961	2.95%	3,953	0.13%	1,347	0.04%
MT	3,995,000	80,731	2.02%	7,269	0.18%	906	0.02%
OR	1,780,000	53,524	3.00%	7,528	0.42%	1,415	0.08%
WA	1,423,000	42,752	3.00%	1,280	0.09%	110	0.01%
WY	1,880,000	35,671	1.90%	3,401	0.18%	581	0.03%
Desert Southwest Mexican wolf states							
AZ	1,095,000	37,858	3.46%	4,122	0.38%	157	0.01%
NM	1,755,000	60,523	3.45%	9,508	0.54%	601	0.03%
Eastern Red wolf state							
NC	940,000	24,631	2.62%	2,369	0.25%	0	0.00%

Fig. 5b. U.S. Cattle Unwanted Losses by Cause and by State (Unverified data, USDA-Animal and Plant Health Inspection Service, 2017 (Data year 2015))							
States	Total unwanted cattle losses	Cattle losses from maladies (illness, birthing problems, etc.)		Cattle losses from all predators		Cattle losses from wolves	
		Number	Percent of total unwanted cattle losses	Number	Percent of total unwanted cattle losses	Number	Percent of total unwanted cattle losses
Great Lakes wolf states							
MI	67,003	66,002	98.51%	1001	1.49%	350	0.52%
MN	129,923	125,020	96.23%	4903	3.77%	2,104	1.62%
WI	192,907	188,067	97.49%	4840	2.51%	1,386	0.72%
Northern Rocky Mountains wolf states							
ID	92,914	88,961	95.75%	3,953	4.25%	1,347	1.45%
MT	88,000	80,729	91.74%	7,269	8.26%	906	1.03%
OR	61,052	53,524	87.67%	7,528	12.33%	1,415	2.32%
WA	44,032	42,752	97.09%	1,280	2.91%	110	0.25%
WY	39,072	35,671	91.30%	3,401	8.70%	581	1.49%
Desert Southwest Mexican wolf states							
AZ	41,980	37,858	90.18%	4,122	9.82%	157	0.37%
NM	70,031	60,523	86.42%	9,508	13.58%	601	0.86%
Eastern Red wolf state							
NC	27,000	24,631	91.23%	2,369	8.77%	0	0.00%

- The USDA failed to use *verified* cattle and sheep loss data—that is, they largely relied on growers to tell them how their domestic animals died without confirmation by USDA representatives. Therefore, some cattle or sheep losses here attributed to wolves, coyotes, and bears are likely either inflated or misidentified. For example, in its cattle loss report, the USDA reported that growers lost cattle to grizzly bears in six states where grizzly

bears are *absent* or never occurred historically. The USDA reported cattle losses to grizzly bears in Arkansas, Colorado, Georgia, Nevada, Oregon, and Wisconsin.[8] This indicates the extent to which the USDA's data are unverified and therefore, flawed—perhaps even inflated.

Fig. 6a.
U.S. Sheep Inventory Losses by Cause and by State
(Unverified data, USDA-Animal and Plant Health Inspection Service, 2017 (Data year 2015))

States	Sheep inventory	Sheep losses from maladies (illness, birthing problems, etc.)		Sheep losses from all predators		Sheep losses from wolves	
		Number	Percent of sheep inventory	Number	Percent of sheep inventory	Number	Percent of sheep inventory
Great Lakes wolf states							
MI	105,000	9,011	8.58%	906	0.86%	0	0.00%
MN	205,000	22,127	10.79%	1,827	0.89%	39	0.02%
WI	123,000	10,046	8.16%	890	0.72%	0	0.00%
Northern Rocky Mountains wolf states							
ID	342,000	11,437	3.34%	4,486	1.31%	277	0.08%
MT	361,000	18707	5.18%	10,171	2.27%	115	0.03%
OR	246,000	9,329	3.79%	5,594	2.50%	0	0.00%
WA	77,000	4,256	5.53%	647	0.84%	136	0.18%
WY	461,000	10,147	2.20%	8,862	1.92%	61	0.01%
Desert Southwest Mexican wolf states							
AZ	136,000	6,352	4.67%	5,611	4.13%	374	0.28%
NM	109,000	8,227	7.55%	4,664	4.28%	0	0.00%
Eastern Red wolf state							
NC	40,000	2,945	6.24%	1,182	2.96%	0	0.00%

PHOTO BY: JOS BAKKER

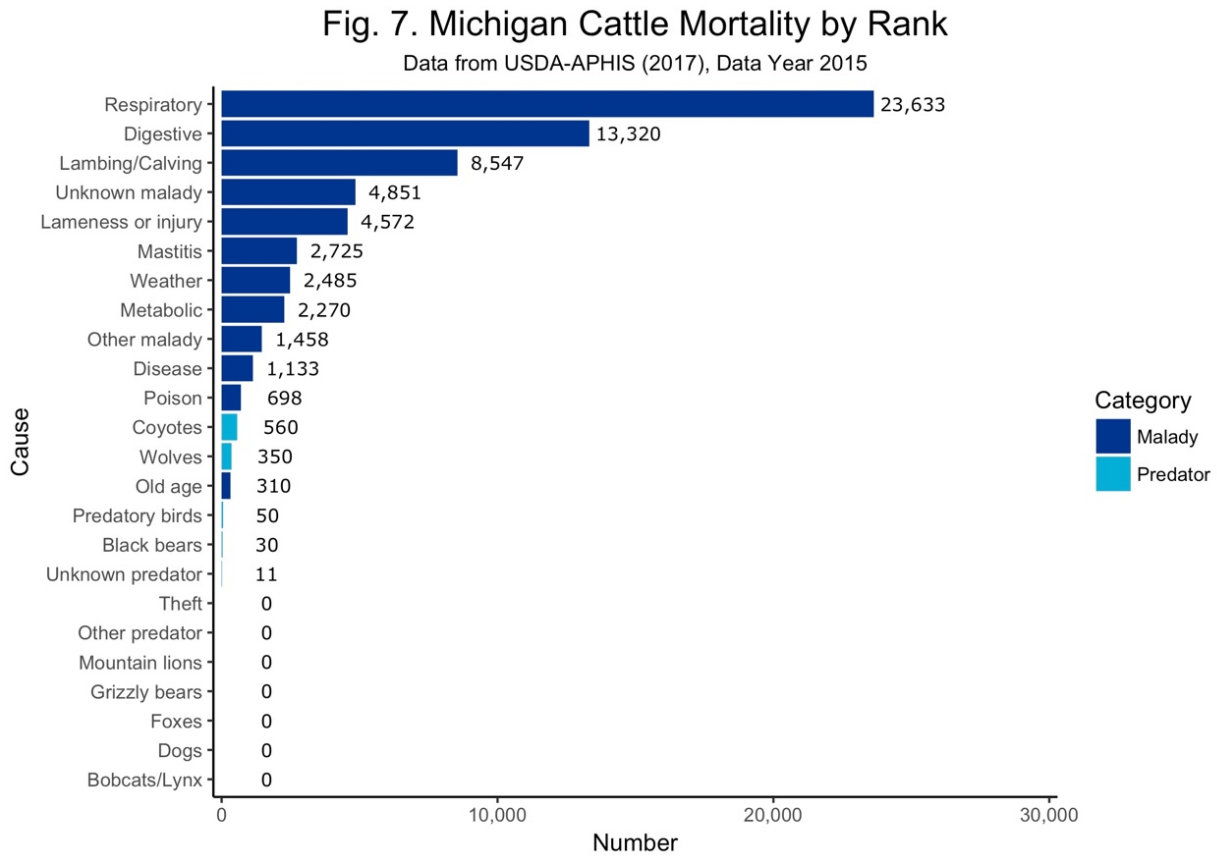
Fig. 6b. U.S. Sheep Unwanted Losses by Cause and by State (Unverified data, USDA-Animal and Plant Health Inspection Service, 2017 (Data year 2015))							
States	Total unwanted sheep losses	Sheep losses from maladies (illness, birthing problems, etc.)		Sheep losses from all predators		Sheep losses from wolves	
		Number	Percent of total unwanted sheep losses	Number	Percent of total unwanted Sheep losses	Number	Percent of total unwanted sheep losses
Great Lakes wolf states							
MI	9,917	9,011	90.86%	906	9.14%	0	0.00%
MN	23,954	22,127	92.37%	1,827	7.63%	39	0.16%
WI	10,936	10,046	91.86%	890	8.14%	0	0.00%
Northern Rocky Mountains wolf states							
ID	15,923	11,437	71.83%	4,486	28.17%	277	1.74%
MT	28,878	18,707	64.78%	10,171	35.22%	115	0.40%
OR	14,923	9,329	62.51%	5,594	37.49%	0	0.00%
WA	4,903	4,256	86.80%	647	13.20%	136	2.77%
WY	19,009	10,147	53.38%	8,862	46.62%	61	0.32%
Desert Southwest Mexican wolf states							
AZ	11,963	6,352	53.10%	5,611	46.90%	374	3.13%
NM	12,891	8,227	63.82%	4,664	36.18%	0	0.00%
Eastern Red wolf state							
NC	4,127	2,945	71.36%	1,182	28.64%	0	0.00%

IV. USDA *unverified* losses data for cattle and sheep losses, ranked

Based on data from other governmental agencies, the USDA exaggerates the cattle and sheep losses it attributes to native carnivores and dogs. Also, the USDA reports attribute wolf and grizzly bear deaths in states where neither species exists. Given that these data are exaggerated, there is value in showing the USDA's cattle and sheep loss numbers in rank order to demystify predator events on cattle and sheep. We show unwanted losses to cattle and sheep in each wolf-occupied state by region: Great Lakes, Northern Rocky Mountains and Desert Southwest. The data clearly show that health and weather problems are the biggest concerns livestock growers face.

ALAMY STOCK PHOTO

A. Great Lakes cattle and sheep losses by rank



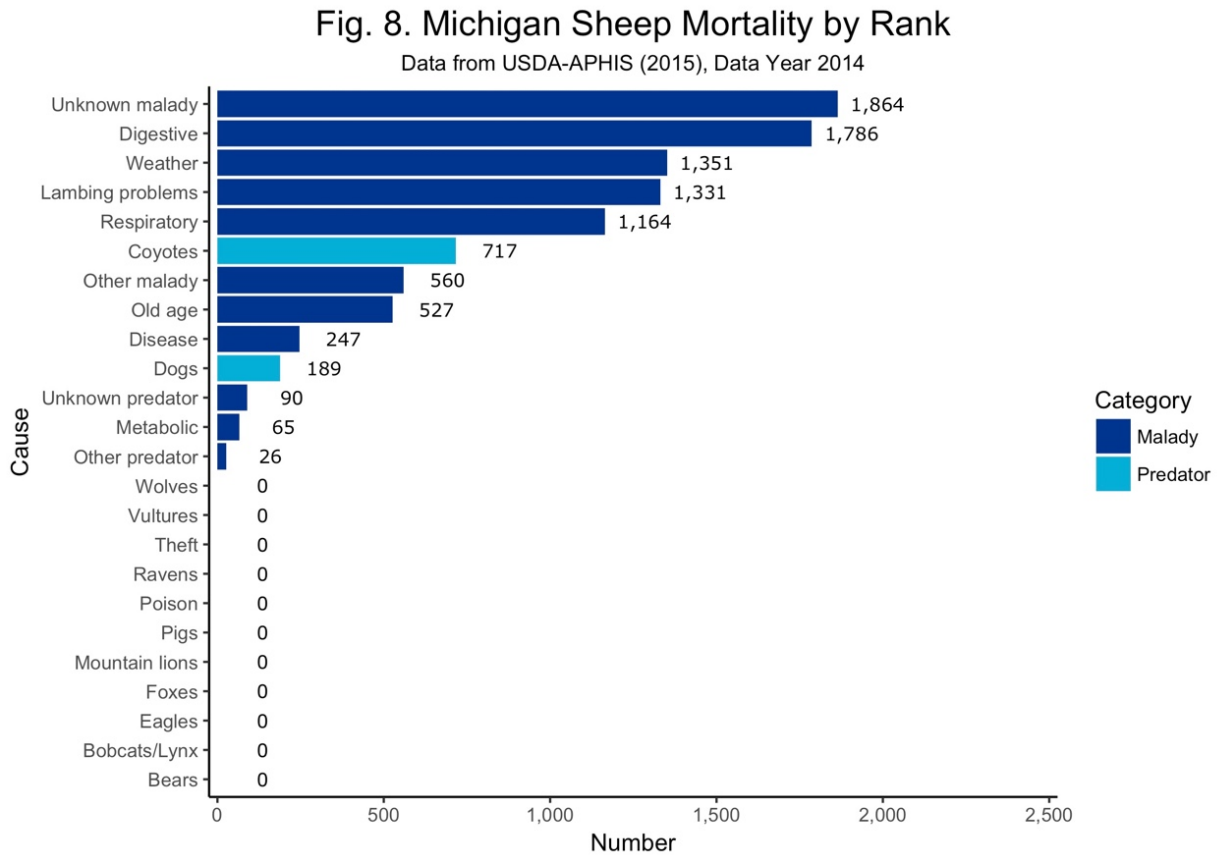


Fig. 9. Minnesota Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

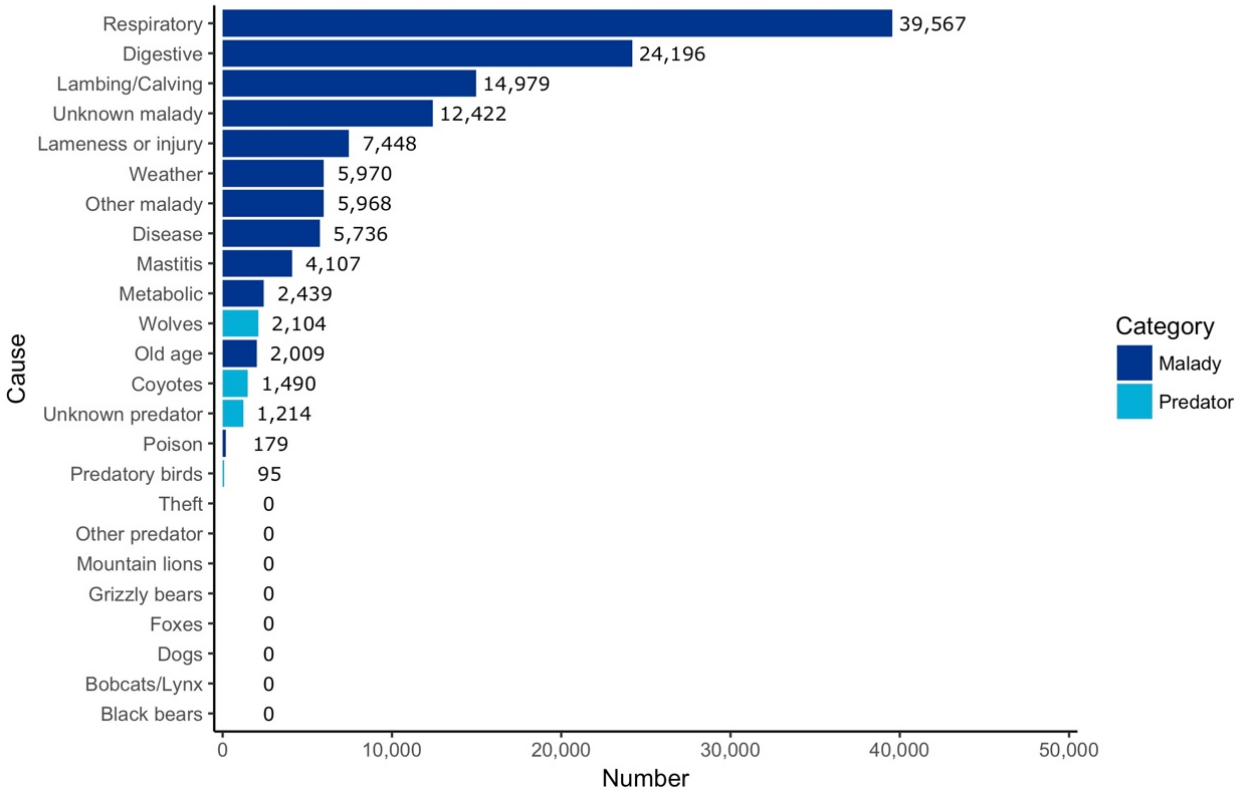


Fig. 10. Minnesota Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014

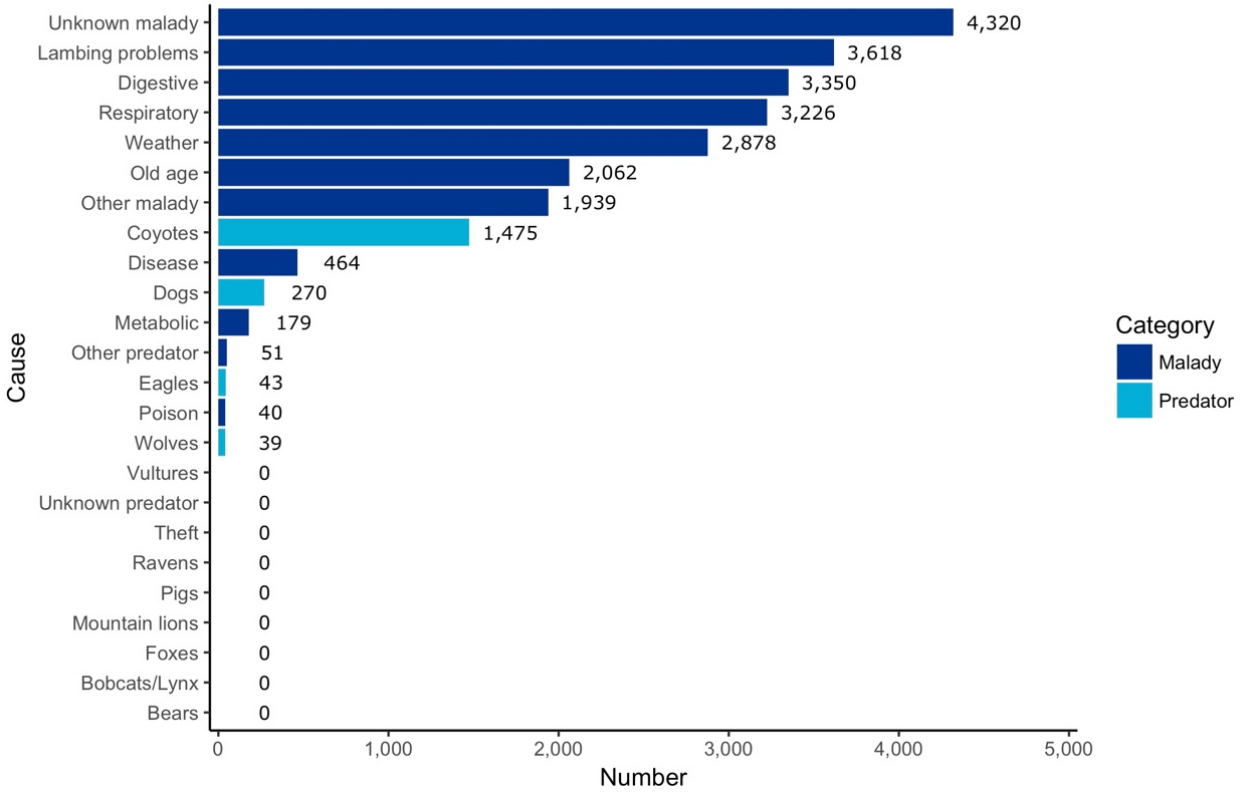


Fig. 11. Wisconsin Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

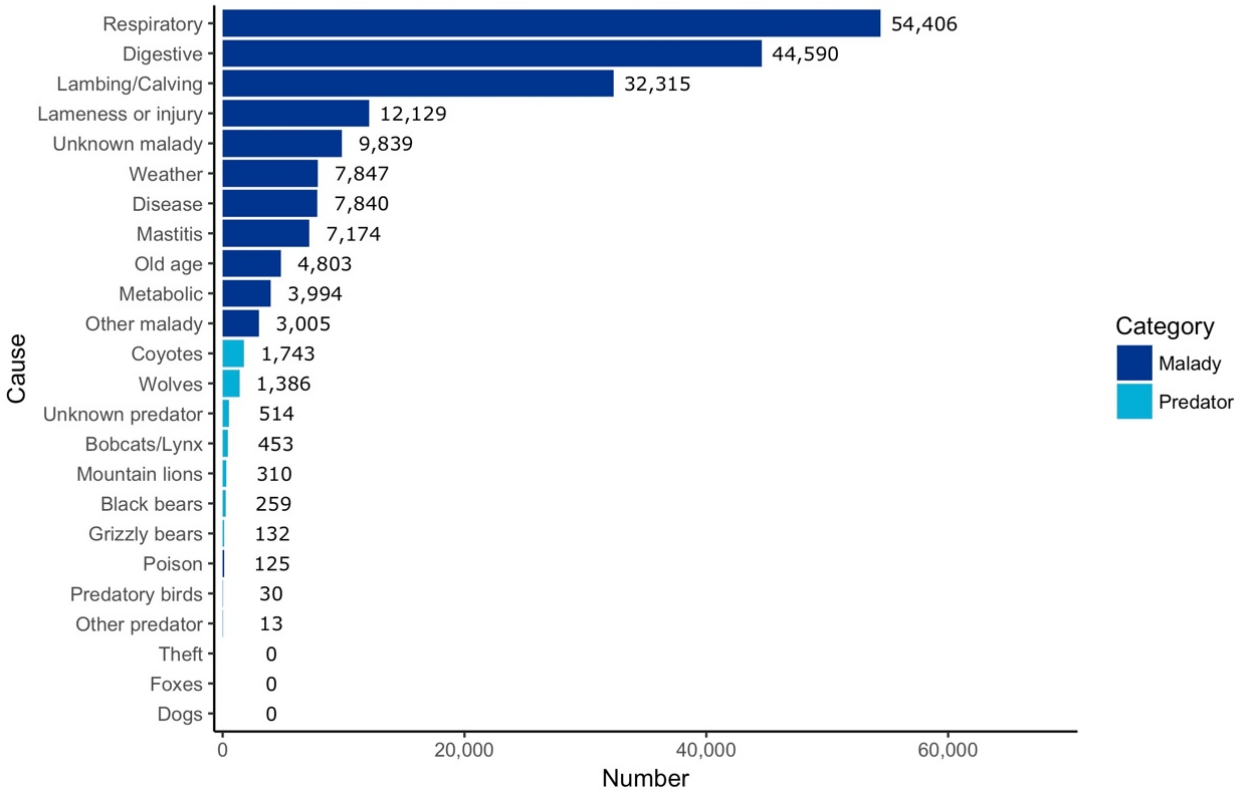
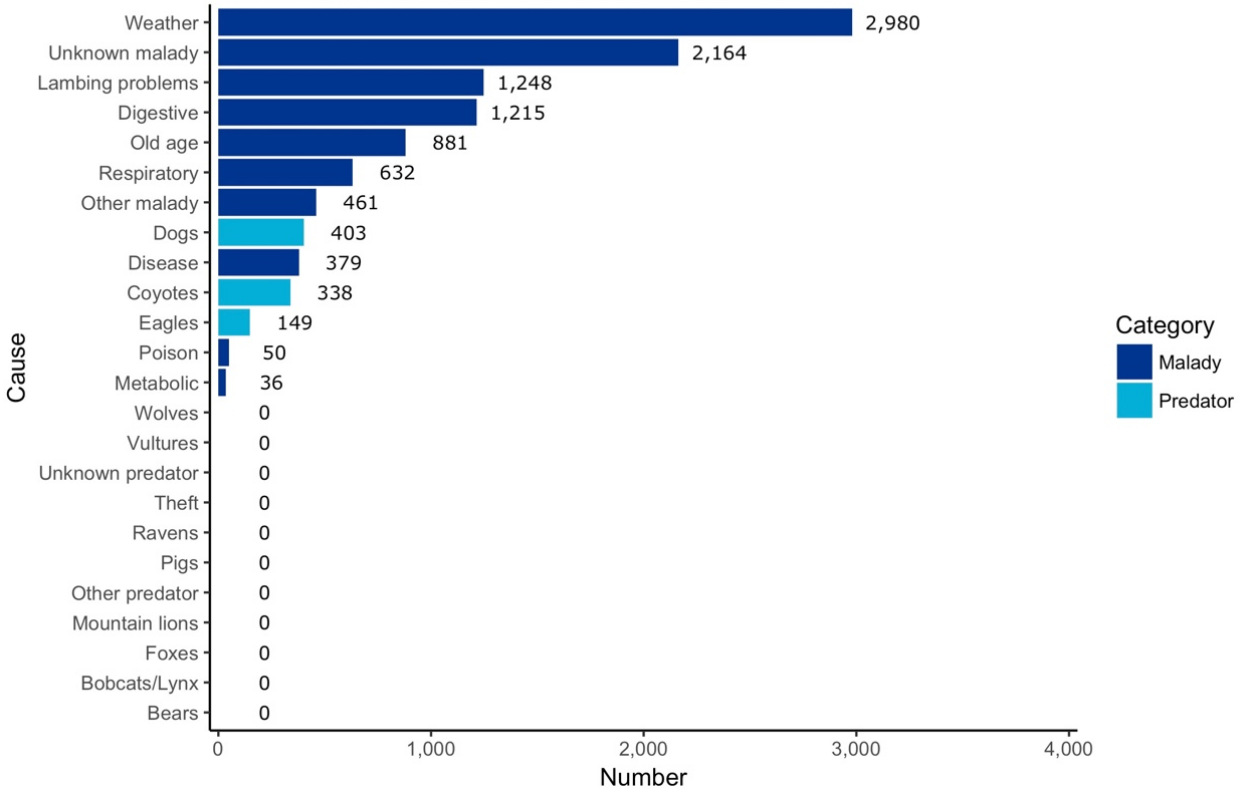


Fig. 12. Wisconsin Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014



B. Northern Rocky Mountains cattle and sheep losses by rank

Fig. 13. Idaho Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

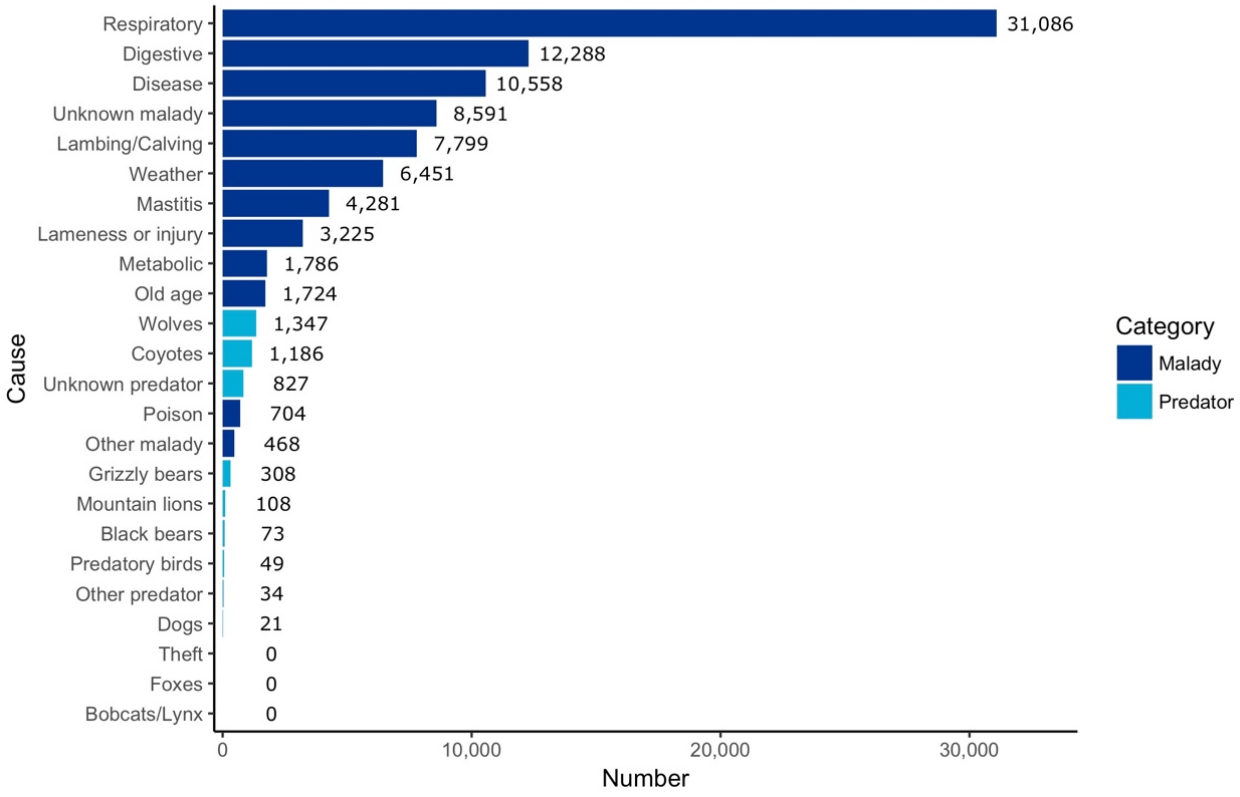


Fig. 14. Idaho Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014

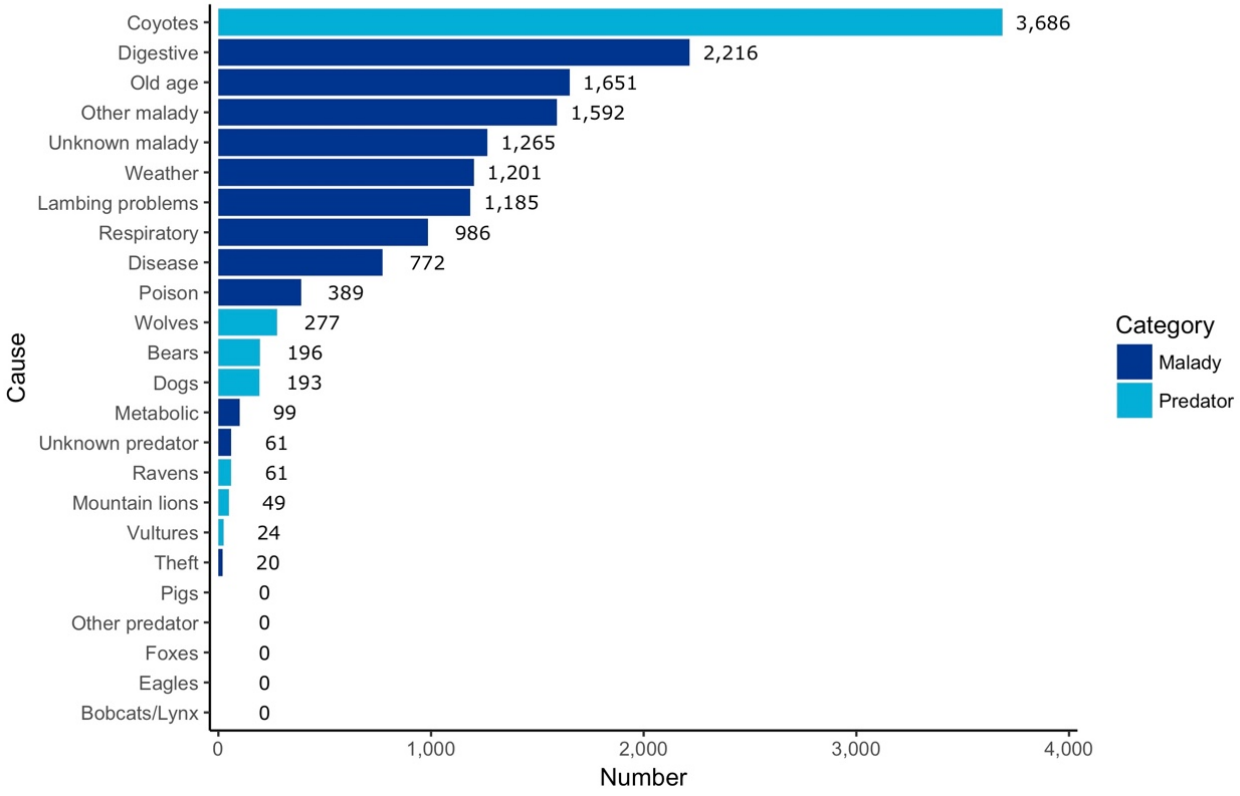


Fig. 15. Montana Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

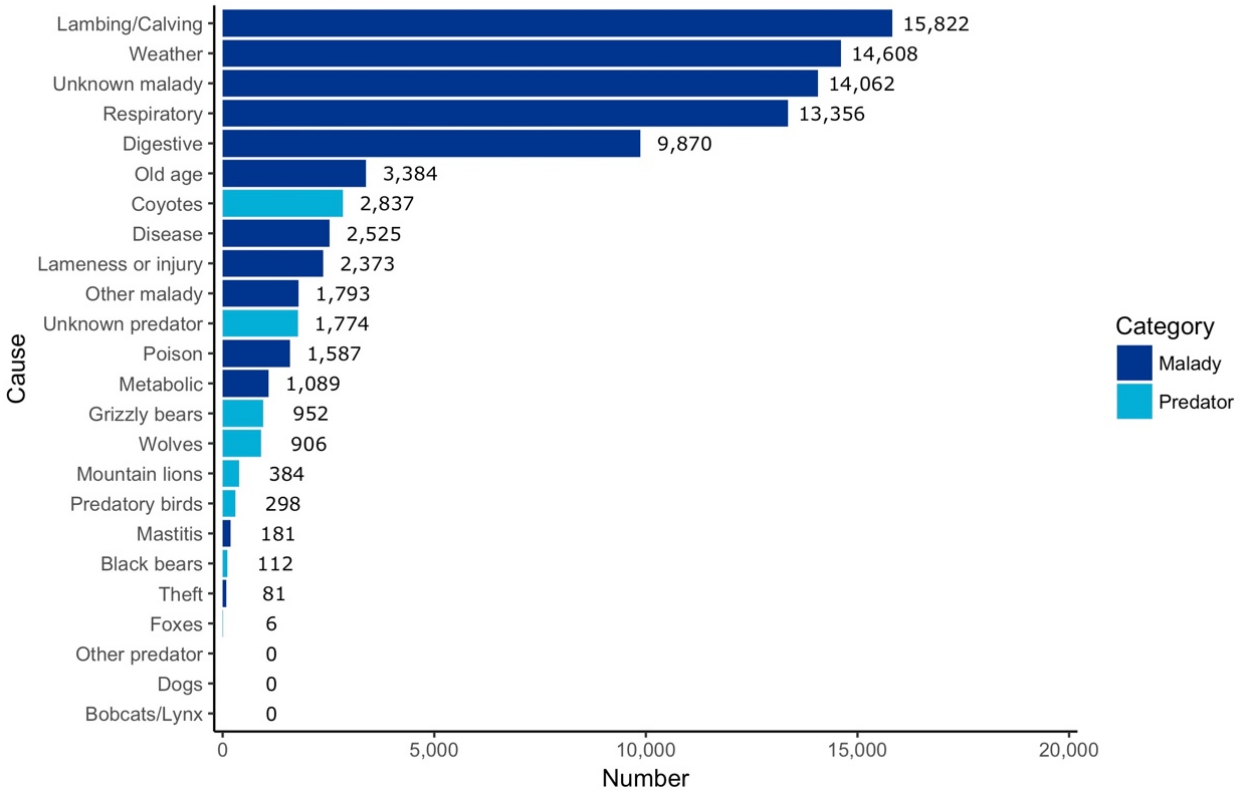


Fig. 16. Montana Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014

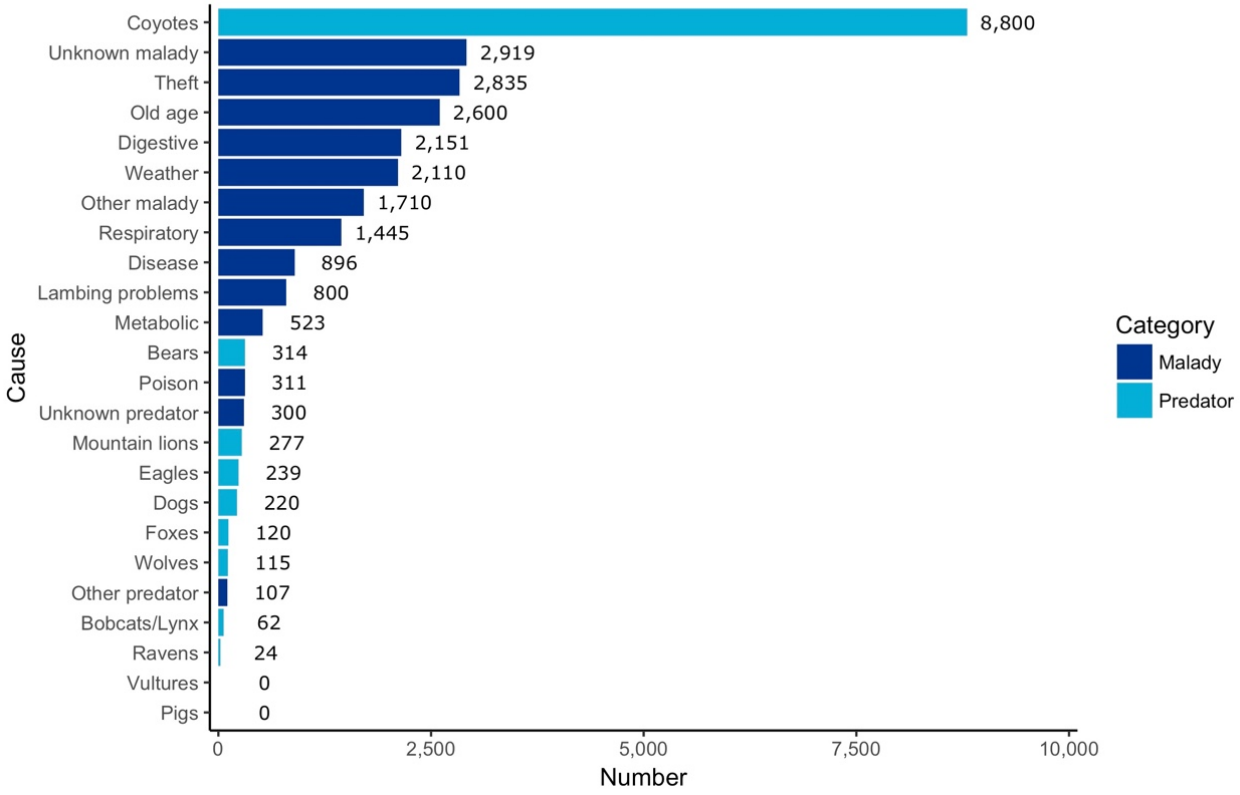


Fig. 17. Oregon Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

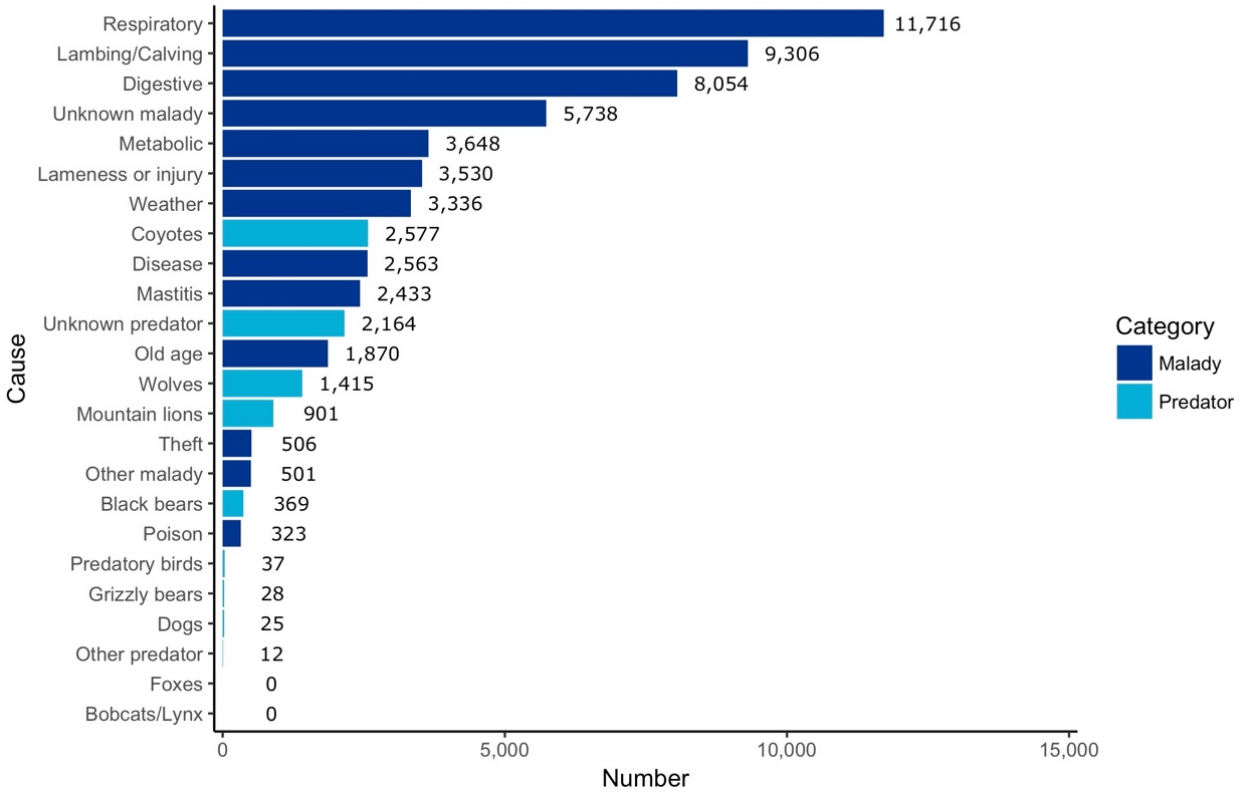


Fig. 18. Oregon Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014

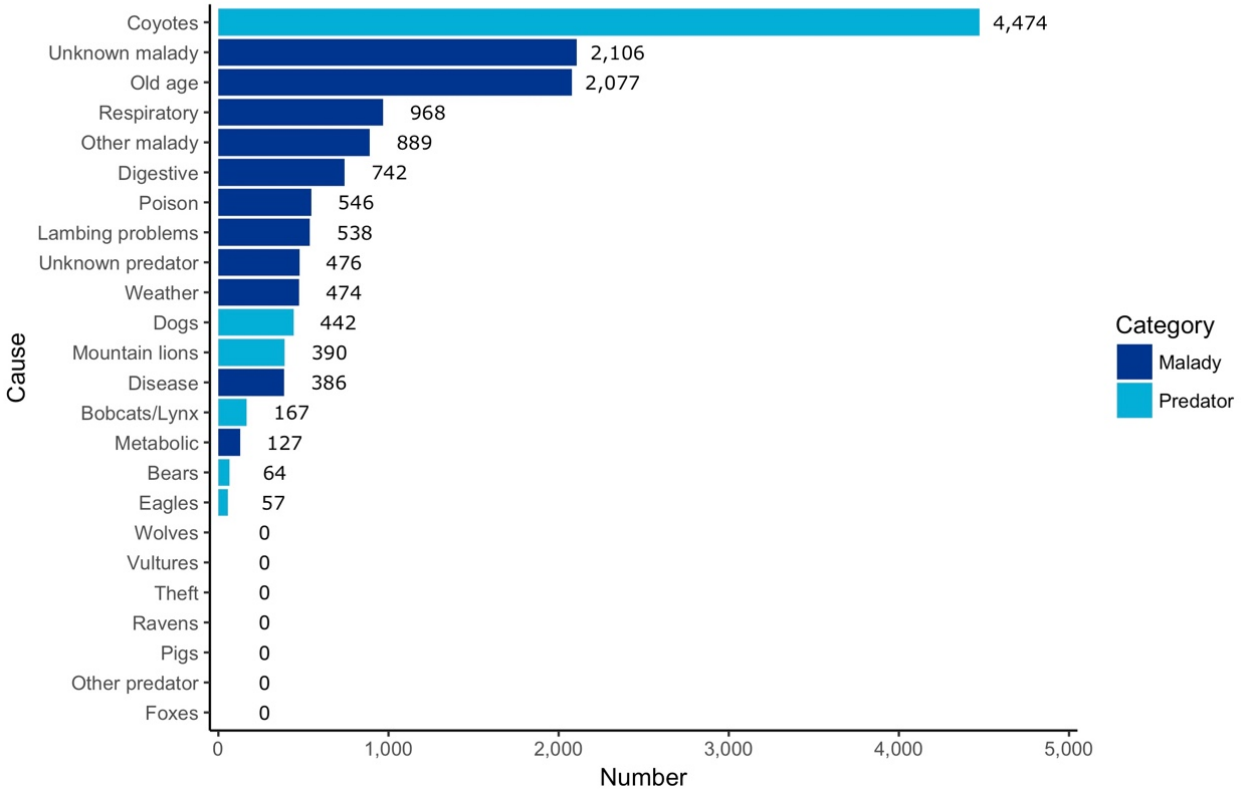


Fig. 19. Washington Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

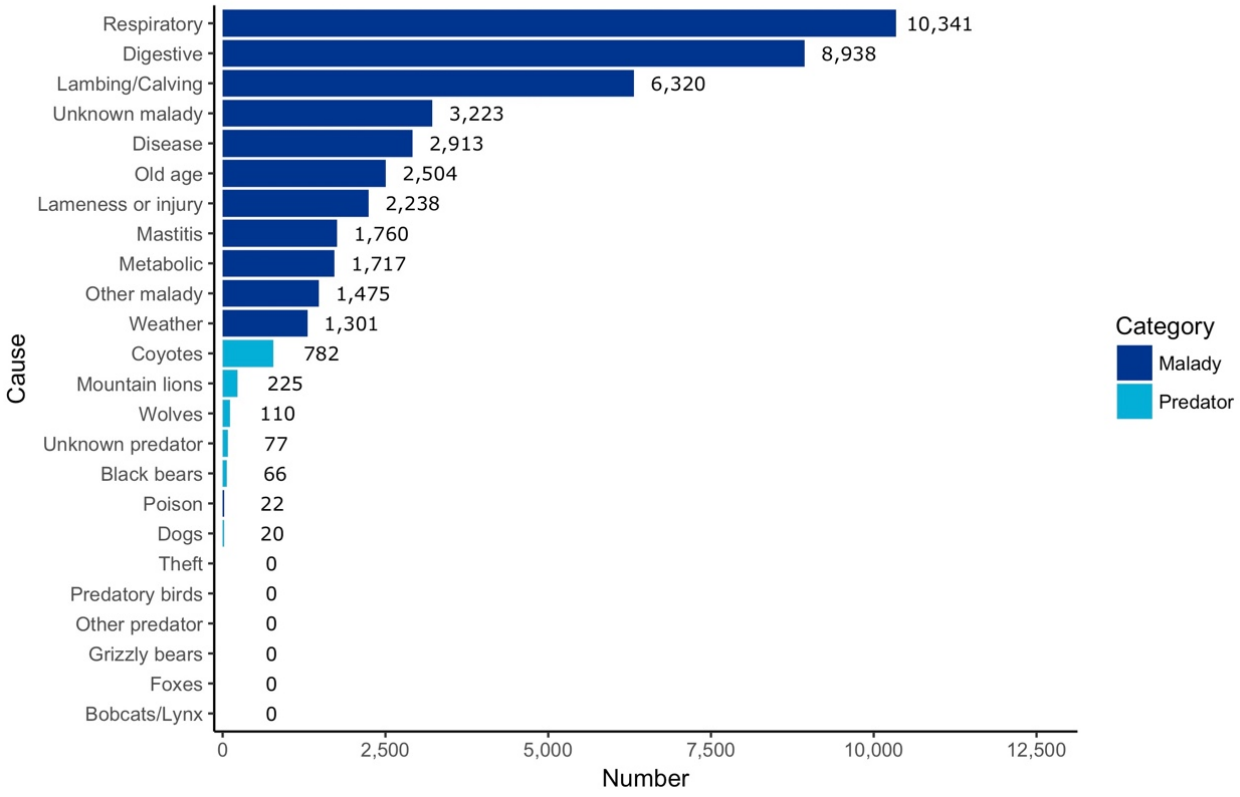


Fig. 20. Washington Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014

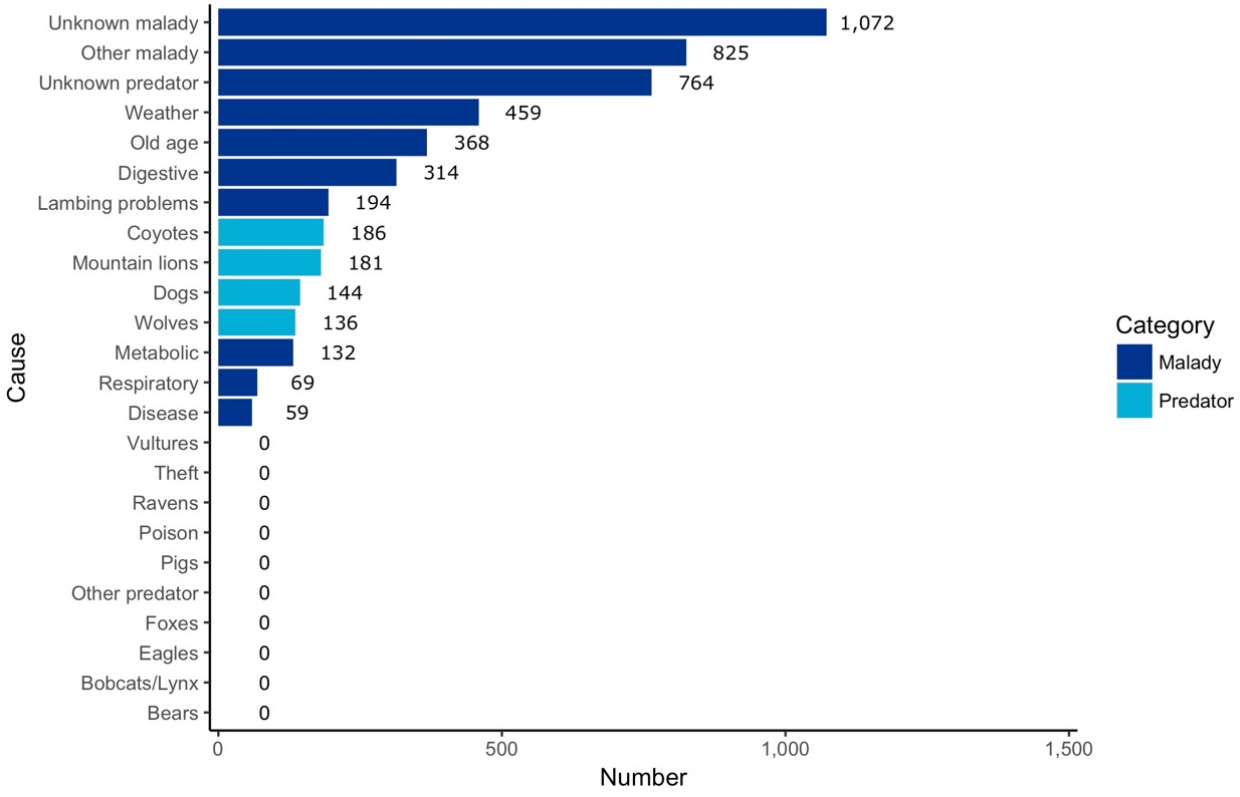


Fig. 21. Wyoming Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

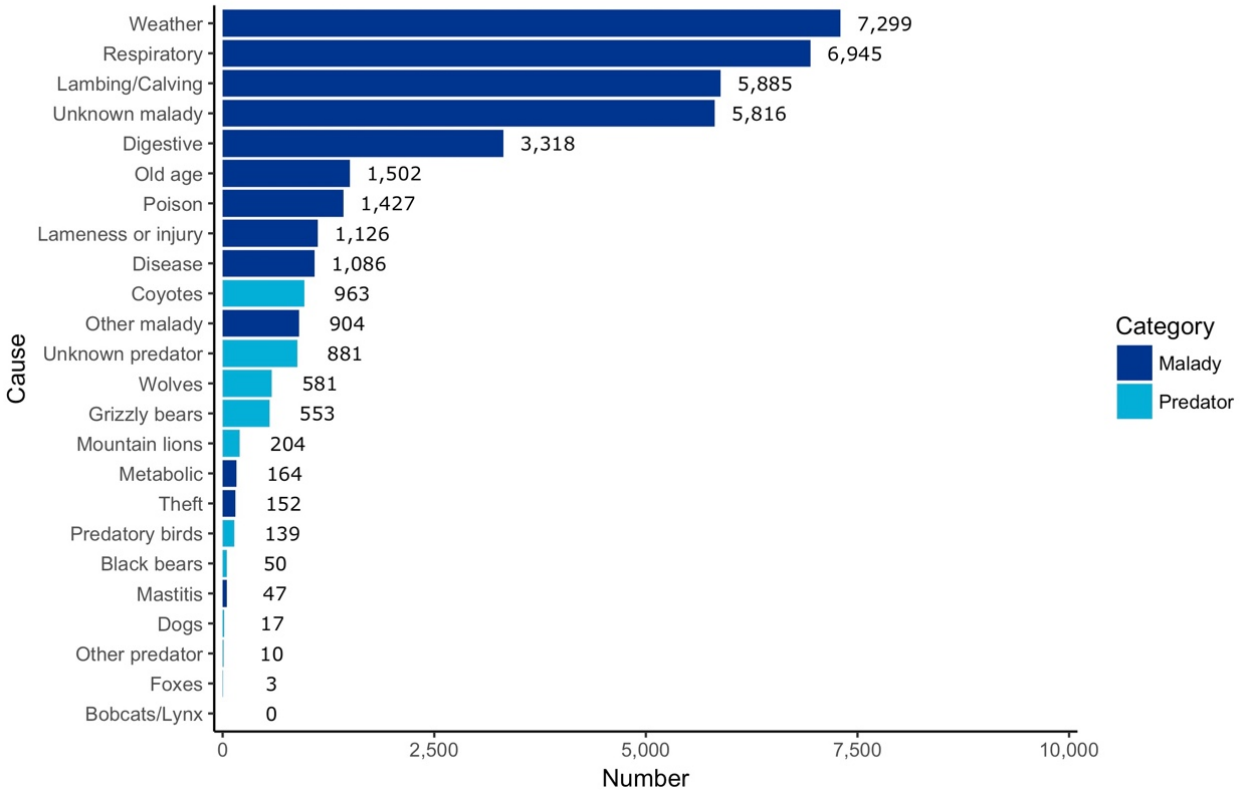
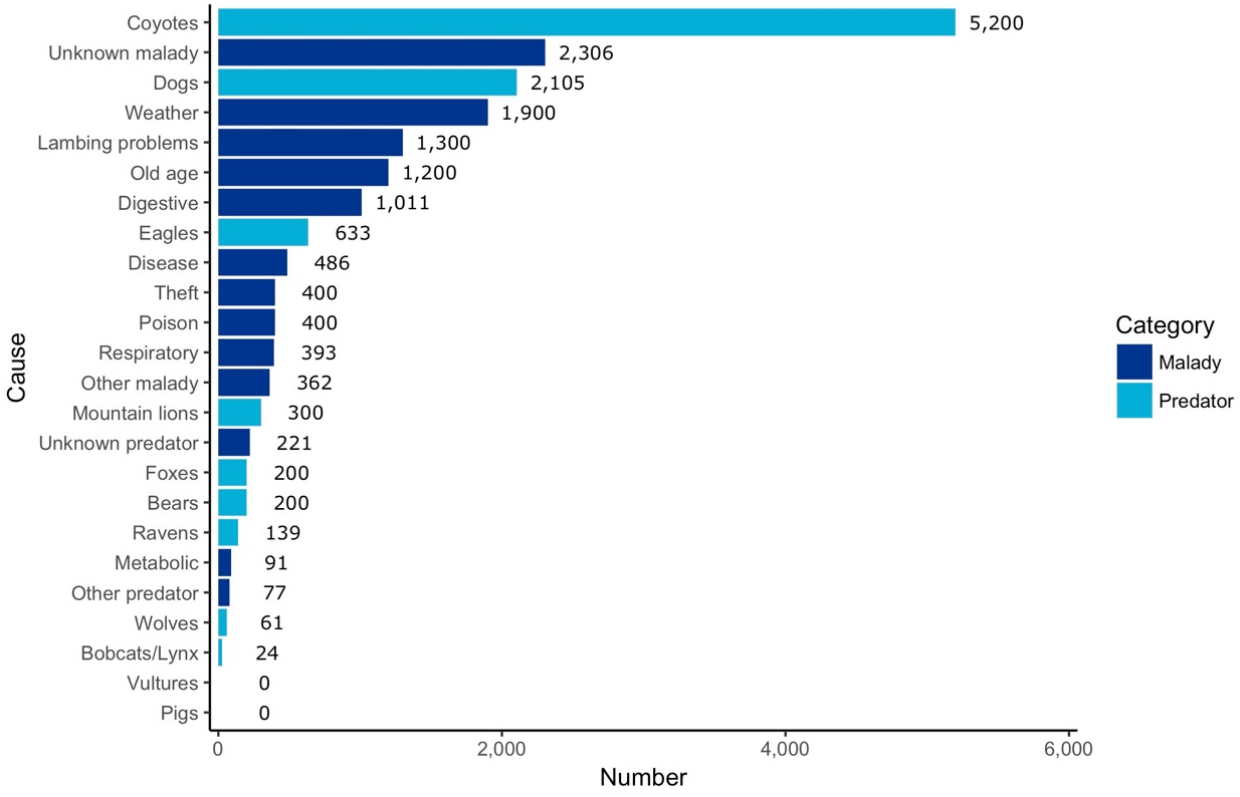


Fig. 22. Wyoming Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014



C. Desert Southwest losses to cattle and sheep by rank

Fig. 23. Arizona Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

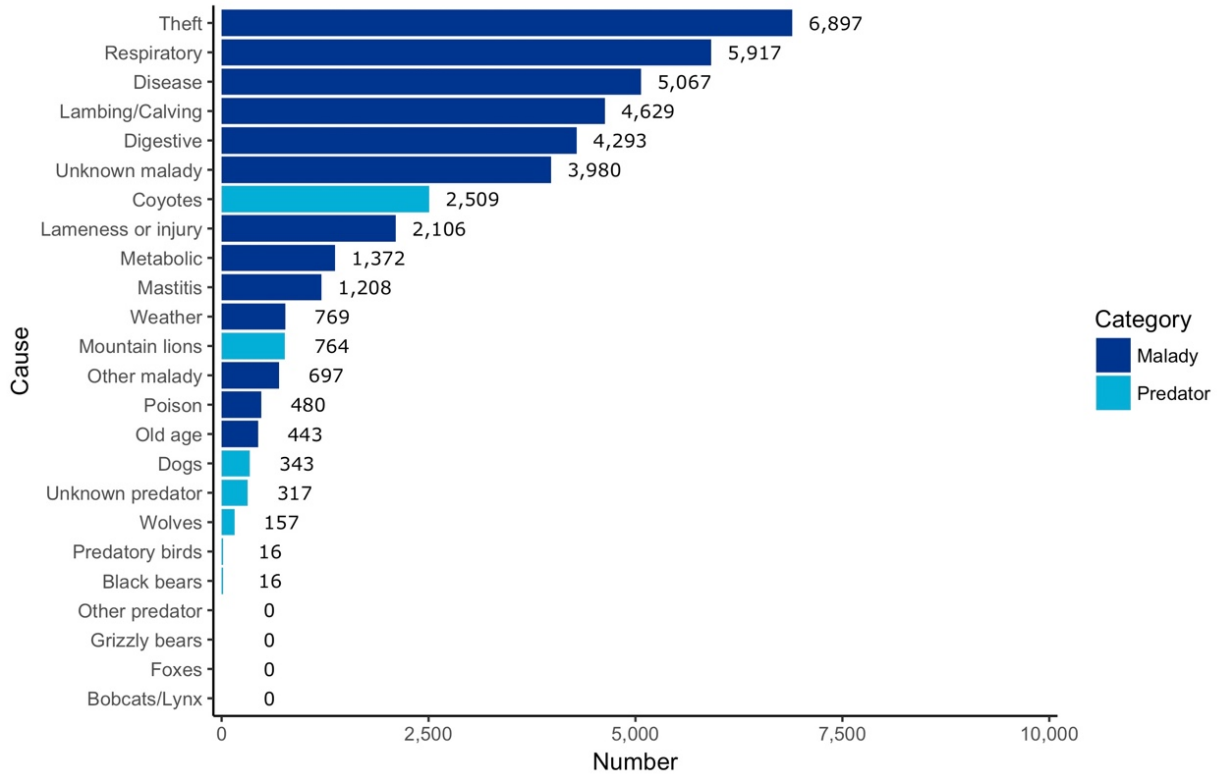


Fig. 24. Arizona Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014

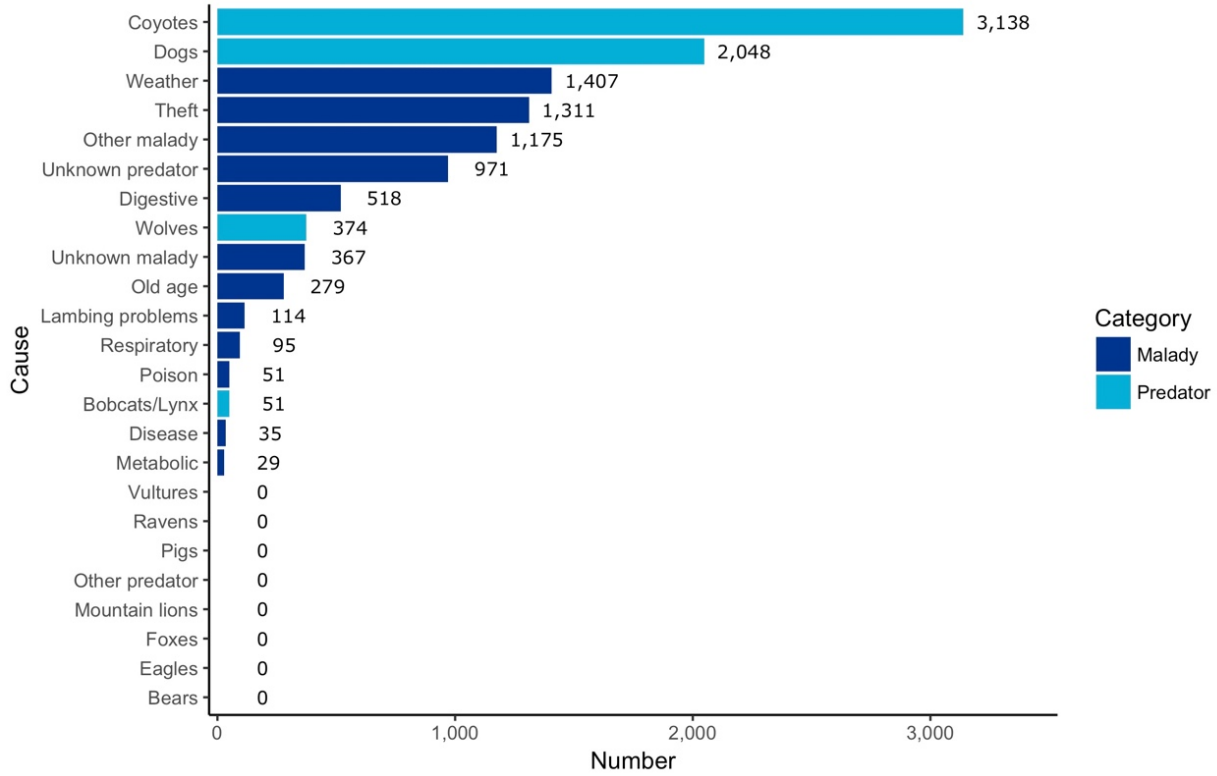


Fig. 25. New Mexico Cattle Mortality by Rank

Data from USDA-APHIS (2017), Data Year 2015

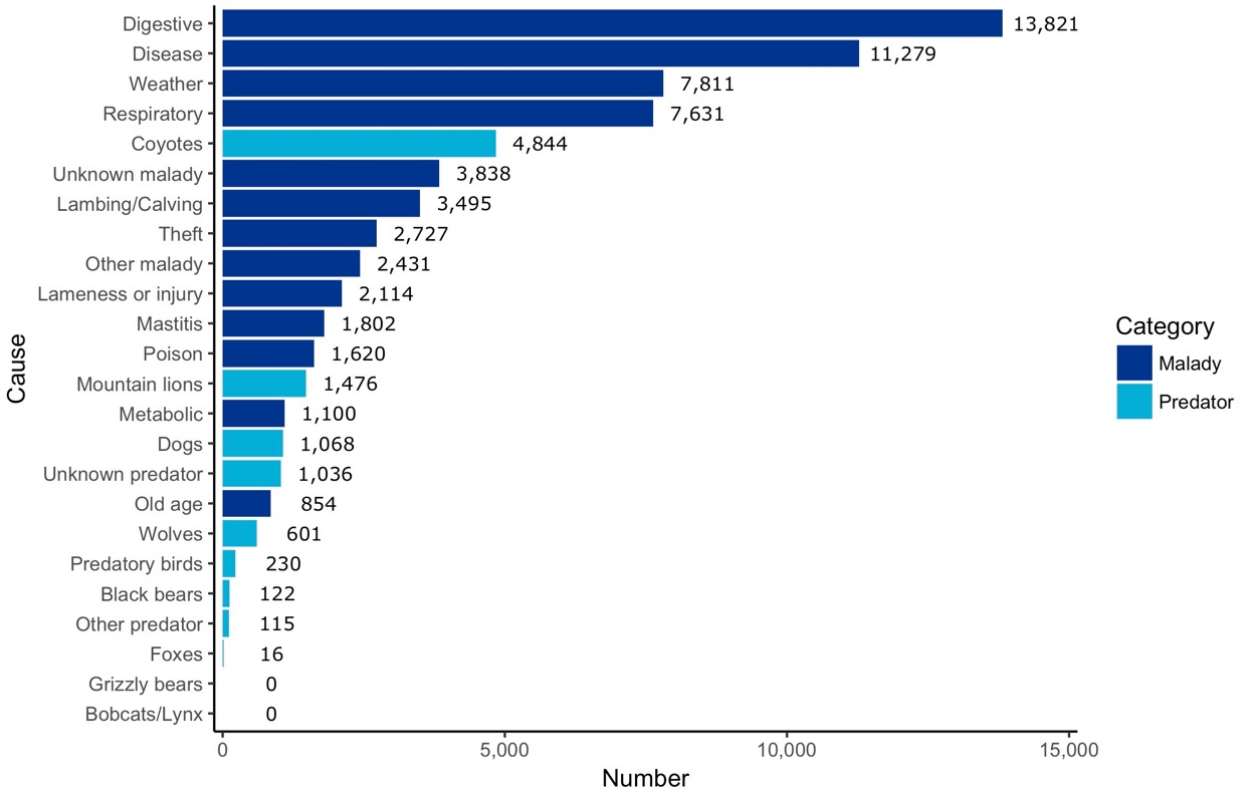
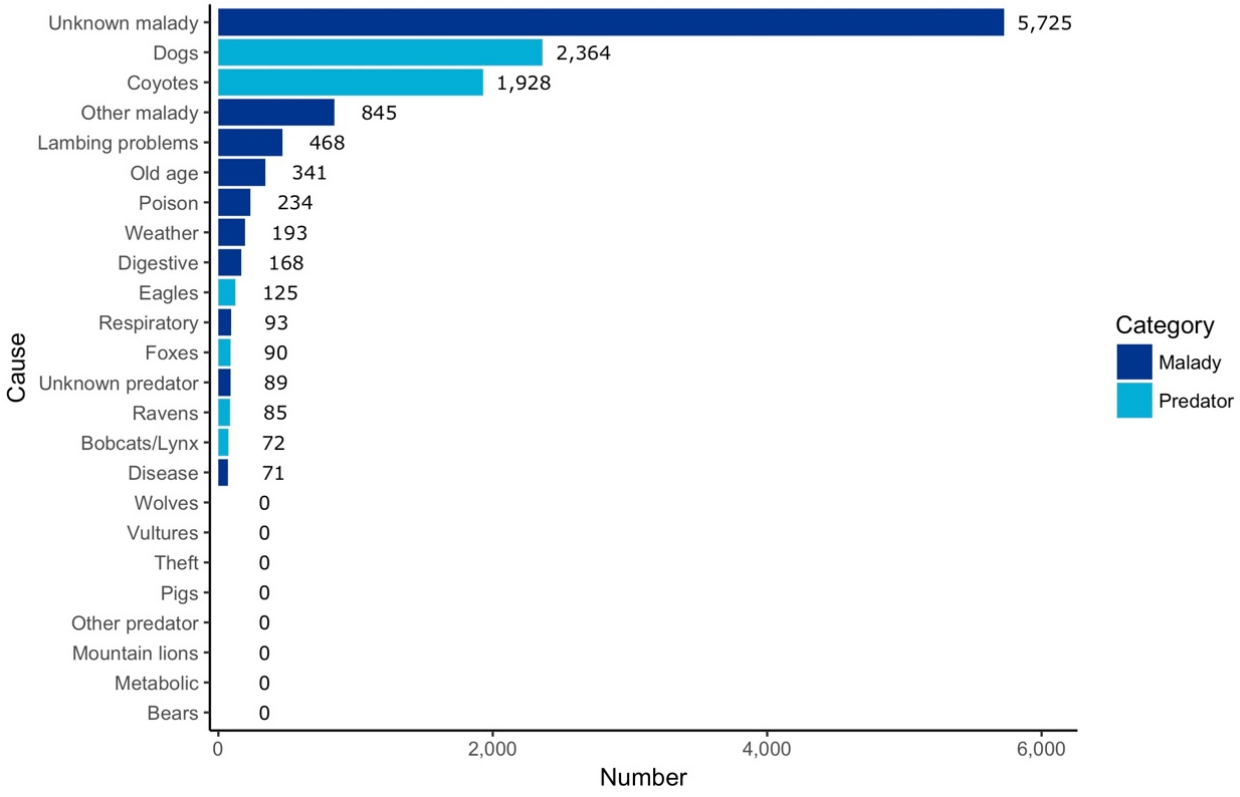


Fig. 26. New Mexico Sheep Mortality by Rank

Data from USDA-APHIS (2015), Data Year 2014



V. Great Lakes states' cattle data show that wolves have a minimal and decreasing effect on livestock

In the Great Lakes states, as the wolf population increases, livestock losses have declined. That is because under federal Endangered Species Act protections, wolves' social structures are maintained. That is, with the alpha pair (the parents) in place, other pack members are behaviorally sterile, leading to fewer breeders.[9] In stable (un-persecuted) packs, the pups and yearling animals are cared for by the entire pack and not fending for themselves.[10] When members of wolf packs are killed, however, packs disband and young wolves, who are less skilled hunters, are left to hunt for food on their own, increasing livestock losses.[11]

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Michigan: Michigan Department of Natural Resources (DNR) records for January to November 2018 show one livestock animal was confirmed as killed by wolves in the state's Upper Peninsula (U.P.), the region where almost all of the state's wolves live. This region has approximately 900 working farms, with about 50,000 head of cattle. Thus, wolf-caused livestock mortality in the U.P. only amounted to 0.002 percent of U.P. livestock inventory as of November, 2018.

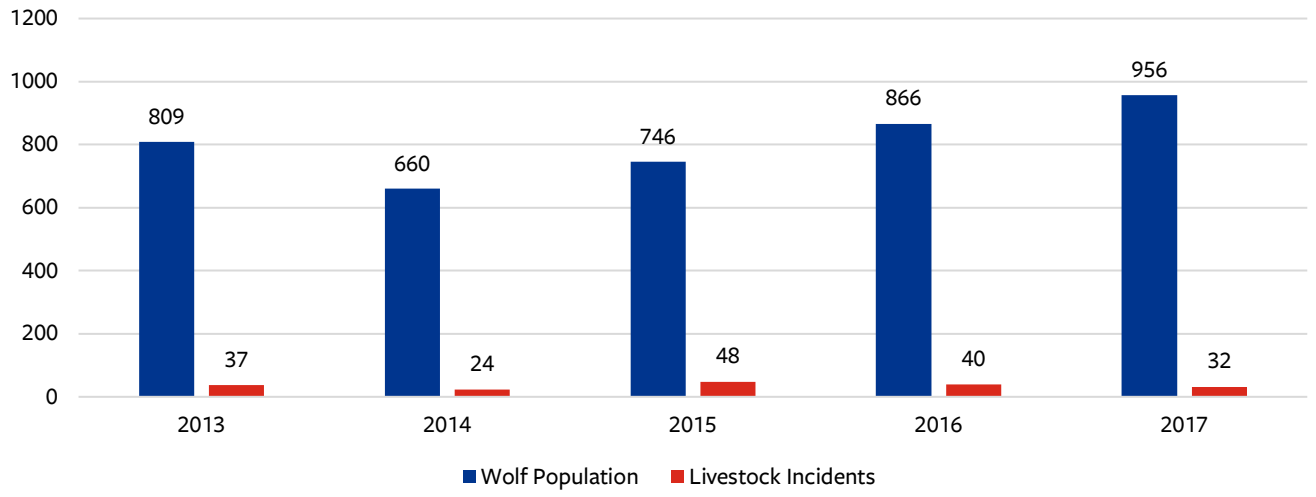
Minnesota: The Minnesota Department of Natural Resources does not publish statistics on its annual livestock losses to wolves, but in 2015, the same year that the USDA reported 2,104 cattle losses due to wolves in Minnesota, USDA-Wildlife Services received only 220 complaints of wolf conflicts with domestic animals, of which 115 were verified.[12] More recently, in October 2017, a USDA-Wildlife Services representative said that although the state's wolf population continues to recover, there has *not* been a concurrent increase in complaints about wolf attacks on livestock. He added that while Minnesota's 10-year average for wolf conflicts with livestock is about 175 complaints a year, those complaints numbered only 157 in 2016, and 2017 complaints were predicted to also be below average.[13] According to USDA-Wildlife Services data, losses were below average in 2017, with the agency verifying just 89 of the 152 complaints they received.[14] Despite such a low number of verified complaints, 190 wolves were killed by USDA-Wildlife Services personnel in Minnesota that same year.[15]

Wisconsin: Wisconsin has 24,300 dairy and beef cattle farms, with 1.5 million head of cattle.[16] Wolves exist throughout the state where cattle are raised. But Wisconsin Department of Natural Resources statistics show that even as the state's wolf population recovered from hunting, trapping, and hounding between 2012 and 2014, there was no rise in confirmed wolf attacks on livestock concurrent with that increase in wolf numbers, as illustrated in Fig. 27.

The FWS, in its 2014 Great Lakes wolves report, wrote:

> Actions to control wolf depredation of domestic animals occurred in Minnesota, Michigan and Wisconsin. In Michigan between the effective date of delisting, January 27, 2012, and June 30, 2013, 50 depredation incidents were recorded and 26 wolves were killed (Michigan DNR, *in litt.*). During the same time period in Wisconsin, 66 livestock and 10 non-livestock depredation incidents were recorded and in response, 84 wolves were killed – 64 of those were killed during the April 2012 to April 2013 timeframe, as reported above for Wisconsin (MacFarland and Wiedenhoeft 2013). During the 2013-2014 "April to April" reporting period, 66 wolves were killed in Wisconsin for depredation control (Wiedenhoeft et al. 2014). In Minnesota, verified complaints of wolf depredation dropped from 122 in 2012 to 70 in 2013 (Minnesota DNR, unpubl. data 2014). Numbers of wolves killed for depredation control also fell – from a record high number of 295 in 2012 to 127 in 2013.[17]

Fig. 27
Wisconsin DNR Data: Confirmed or suspected wolf attacks on livestock



These data show that the number of wolves killed nationwide are not proportional with the nominal losses of livestock caused by wolves. Livestock losses can be reduced through non-lethal controls, but only a fraction of livestock growers use them. Based on the USDA's data, only an average of 18 percent of cattle growers and 20 percent of sheep growers in wolf-occupied states use non-lethal methods to protect their animals. (*See* Section IX, Figs. 29 and 30.)

VI. FWS's *verified* wolf-livestock data from the Northern Rocky Mountain states show that USDA numbers are highly inflated

When governmental agencies *confirm* data on livestock losses, the results show many fewer livestock losses than the USDA's unverified claims. The verified livestock losses that the FWS provides for Northern Rocky Mountain states in 2015 are 27 times smaller for cattle than the USDA's numbers: 161 (FWS) vs 4,360 (USDA). Fig. 28. And the FWS's 2015 sheep losses are 2.7 times smaller: 218 (FWS) vs. 589 (USDA) sheep deaths attributed to wolves. Fig. 28. While mortalities of non-native cattle and sheep were nominal, the mortalities of Rocky Mountain wolves were spectacular. Total human-caused wolf mortalities for this region in 2015 were 694, with trophy hunters and predator control agents alone killing 91 percent (632) of them.[19] Washington state alone requires that ranchers use a variety of non-lethal measures such as the employ of range riders before they can be qualified to use lethal controls.

Fig. 28.
Confirmed cattle and sheep losses in the Northern Rocky Mountains (Verified data, FWS et al. (data year 2015))[18]

State	Cattle	Sheep
ID	35	125
MT	41	21
WY	75	62
OR	3	10
WA	7	0
Total	**161**	**218**

According to the FWS, in 2015, the total wolf mortality by state was 270 in Montana, 352 in Idaho, 62 in Wyoming, seven in Oregon, and seven in Washington. Only 16 of these mortalities were from natural (non-human) causes for all five states.[20]

VII. American values concerning predator control

Most Americans don't support killing wolves to protect livestock, according to a new national study.[21] And according to a 2017 public attitudes study, lethal predator controls such as shooting animals from aircraft (aerial gunning), neck snares, gassing of pups in dens, leg-hold traps and poisons are unpopular with the American public.[22] Predator control is only acceptable to the public if it removes the particular individuals who prey on livestock, damage crops or cause economic losses.[23] Unfortunately, predator control rarely works that way. Predator-control agents typically kill random animals instead of the individual animals responsible for livestock losses.

Another recent study indicates that when states or the federal government engage in lethal predator-control activities for the purpose of killing wolves to alleviate alleged or real livestock losses, then wolf-poaching activities increase.[24] This is because community members perceive that wolves have little value. Conversely, if no state-sponsored predator control is conducted, fewer people poach wolves, the opposite of what some surmise to be true.[25]

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VIII. Predator control of wolves likely exacerbates livestock conflicts

Wolf packs who are hunted experience high stress levels, studies show.[26] Stress increases wolves' reproductive hormones, but, depending on the level of persecution wolves face, they may not have the ability to overcome their losses even with increased breeding in the face of relentless human persecution.[27] When wolves experience social disruption, packs disband, and the elimination of the breeding pair can lead to the loss of pups and yearling wolves from starvation.[28] Killing wolves can lead to greater livestock losses than if packs are left intact.[29] Bryan et al. (2014) write: "{The] [h]unting [of wolves] can decrease pack size, which results in altered predation patterns, increased time spent defending kill sites from scavengers, and may lead to increased conflict with humans and livestock (Hayes et al. 2000; Wydeven et al. 2004; Zimmerman 2014)."[30] Killing wolves may shift livestock losses from cattle to sheep because of mesopredator release (coyotes).[31] While biologists have argued whether hunting wolves reduces livestock losses (see: e.g., Wielgus and Peebles (2014) Bradley et al. (2015)), subsequent studies found that killing wolves does not improve livestock safety. Wildlife biologists reviewed a 17-year data set that involved Michigan wolves and livestock losses. They discovered that the lethal removal of wolves for livestock protection reasons on one farm, increased future wolf predation on their neighbors' livestock.[32] Killing wolves on one farm increased future predation risks by nine and 14 percent per year at local scales.[33] Studies show, government and individuals' random killing of wolves (predator control) does little to protect livestock.[34] A Montana study also indicates that the trophy hunting of wolves does little-to-nothing to protect livestock.[35]

IX. Non-lethal methods to protect cattle and sheep are more cost-effective, less cruel and more efficacious

Not only is the public's view of predator control generally negative, but a bevy of studies also contradict the claimed efficacy of lethal predator control programs. Numerous wildlife biologists have declared these programs biologically and fiscally expensive.[36] That is, removing native carnivores through predator control harms wildlife and their ecosystems.[37] Predator control is also expensive to taxpayers—Wildlife Services receives tax money from municipalities, counties, states and federal appropriations.[38] New studies also show that non-lethal measures are the best means for protecting cattle, sheep and other domestic animals. Such methods include sanitary carcass removal, fladry and or turbo fladry, synchronizing birthing seasons with native ungulates, changing livestock types or breeds, spot lights, airhorns, guard animals, range riders, electric fencing and Foxlights™.[39]

In a seven-year study of open-range sheep in Idaho, in an area where a variety of non-lethal deterrents were used (including human herders or "range riders"), sheep losses were the lowest in the state. Whereas in the nearby study's control area where wolves were routinely killed, sheep losses were 3.5 times higher, demonstrating that non-lethal deterrents were far more effective than lethal ones, contrary to common misperceptions.[40] Despite the benefits of non-lethal methods, the USDA's data show that few farmers and ranchers use them to protect their herds. Only an average of 18 percent of cattle growers and about 20 percent of sheep growers in wolf-occupied states used all the non-lethal

methods available to them to protect their animals. Figs. 29 and 30. That is tragic, given the new science questioning lethal predator controls.

According to biologists, Treves et al. (2016), the published studies that laud the effectiveness of lethal predator control are concentrated in three or four journals, and the scientific methods involved in these studies was insufficient.[41] A subsequent study by Eklund et al. (2017) located 27,781 articles concerning predator control; of that number, only 562 met the authors' criteria for having some scientific merit.[42] And, of those 562 articles, only 21 used scientific methodologies the authors deemed excellent, a number so insufficient that it prevented authors from conducting a meta-analysis of the efficacy of predator control.[43]

Eklund et al. (2017) writes that although the loss of livestock to predators has occurred for thousands of years—likely since livestock were first domesticated—the scientific study of successful interventions is rare, and unfortunately our understanding of the efficacy of predator control is "based on narrative review" rather than sound science.[44] In fact, Treves et al. (2016) strongly suggest that all lethal predator controls should be suspended until "gold standard" reviews of the efficacy of some predator-control methods are completed.[45] Eklund et al. (2017) similarly concluded that the science of predator control is vacuous. In yet a third review article concerning predator control, Lennox et al. (2018), also recommend against the expensive, broadscale killing of native carnivores, and call upon us all to adapt to and coexist with carnivores because of their ecological benefits—even in urban areas.[46]

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Fig. 29 Percentage of Cattle Operators Using Non-Lethal Methods (USDA 2017, data year 2015)		
State	Percent of operations with any cattle deaths	Percent of operations that used some non-lethal method to protect cattle
AZ	13.8%	10.4%
ID	6.1%	10.1%
MI	2.5%	20.7%
MN	4.5%	12.6%
MT	10.6%	14.5%
NM	15.9%	34.4%
NC	5.7%	22.8%
OR	5.9%	23.4%
WA	2.9%	19.9%
WI	3.9%	11%
WY	10.30%	14%

Fig. 30 Percentage of sheep operators using non-lethal methods (USDA 2015, data year 2014)														
State	Guard Dogs	Llamas	Donkeys	Fences	Lamb shed	Herding	Night penning	Fright tactics	Remove carrion	Cull	Change bedding	Frequent checks	Altered breeding season	Other
AZ	71.9%	4.3%	0.0%	17.6%	27.4%	86.7%	72.2%	0.1%	10.6%	19.4%	22.1%	19.7%	7.6%	2.9%
ID	46.9%	11.3%	22.3%	52.3%	28.4%	4.1%	25.1%	1.4%	8.0%	23.4%	3.7%	19.1%	1.6%	0.9%
MI	38.4%	15.0%	5.1%	66.2%	46.2%	7.2%	34.0%	0.5%	16.9%	13.9%	29.4%	35.7%	7.6%	7.0%
MN	30.9%	7.0%	12.5%	63.4%	56.5%	4.8%	28.4%	3.2%	17.5%	21.9%	8.4%	12.7%	3.1%	2.1%
MT	38.9%	24.0%	9.3%	37.2%	49.0%	7.9%	48.0%	6.5%	24.5%	23.4%	12.2%	34.5%	0.6%	9.3%
NC	42.6%	9.0%	3.4%	33.6%	34.8%	5.1%	43.1%	3.9%	8.8%	22.8%	7.4%	9.0%	1.8%	6.8%
NM	28.9%	10.8%	22.5%	82.0%	41.7%	11.1%	20.7%	2.2%	30.3%	31.0%	29.8%	15.5%	3.0%	5.1%
OR	33.4%	14.2%	2.9%	55.2%	41.4%	10.2%	42.2%	6.0%	12.9%	19.5%	6.1%	14.2%	7.5%	4.7%
WA	41.2%	0.9%	22.3%	41.7%	23.5%	5.7%	21.1%	0.6%	3.3%	6.8%	0.8%	9.5%	0.0%	11.0%
WI	26.7%	16.2%	11.1%	57.4%	45.3%	5.9%	30.5%	0.6%	14.4%	17.7%	5.3%	8.6%	3.6%	3.5%
WY	42.9%	2.0%	20.1%	65.1%	26.5%	4.1%	19.7%	1.7%	6.2%	6.3%	6.6%	9.1%	1.7%	6.8%
Avg.	40.2%	10.4%	12.0%	52.0%	38.2%	13.9%	35.0%	2.4%	13.9%	18.7%	12.0%	17.1%	3.5%	5.5%

X. Conclusion

The Humane Society of the United States analyzed two data sets compiled by the USDA as part of its livestock reports. We make these data publicly decipherable, and, more importantly, unmask the fraction of losses that livestock operators experience from wolves, other native carnivores and domestic dogs. We found, using the USDA's data, that native carnivores and domestic dogs allegedly killed 0.4 percent of the 119 million cattle and sheep inventoried in the U.S. in 2014 and 2015. Furthermore, we found that other governmental data for the Great Lakes and Northern Rocky Mountain regions indicate that the USDA's attributions of cattle and sheep deaths by wolves and other carnivores are highly exaggerated because of the agency's suspect methodology.

As this report shows, farmers, ranchers and wildlife managers should most fear maladies—especially respiratory and birthing problems—that kill nine times more cattle and sheep than all predators (wild mammalian and avian carnivores and domestic dogs) combined. In the face of this evidence, the anxiety of some in society against native carnivores is misplaced. While wildlife managers and cattle and sheep ranchers are quick to kill wolves, coyotes, bears, cougars and bobcats allegedly for livestock protection reasons, the data show that few livestock growers use non-lethal measures to protect their herds from predation. In wolf-occupied states, according to the USDA's data, on average, less than 20 percent of cattle or sheep growers used some form of non-lethal method.

Wildlife biologists have found that predator-control programs to kill wolves and other native carnivores are unscientific, because most studies advocating predator control do not adhere to the scientific method, including the lack of study control areas for purposes of comparison. Three review articles, published in 2017 and 2018, reviewed the corpus of predator-control studies. All concluded that the use of non-lethal methods to protect livestock was more efficacious than killing native carnivores. While some in society complain about wolves and other carnivores, the reality is, we humans, are an unsustainable "super predator."[47] Because wolves live in a fraction of their historical range, it is time that we stop conducting lethal predator control and trophy hunting practices on wolves in the guise of livestock protection.

XI. Methodology

Methods:

All data wrangling and analyses were conducted in R v. 3.5.0 (R Core Team, 2018). We used the R package tabulizer (Leeper, 2018) to extract tables from the 2017 USDA report ″Death Loss in U.S. Cattle and Calves Due to Predator and Nonpredator Causes, 2015″ (1) and the 2015 USDA report ″Sheep and Lamb Predator and Nonpredator Death Loss in the United States, 2015″ (2). Once extracted, data were combined, summarized, and plotted using R packages dplyr (Wickham et al. 2018), tidyr (Wickham & Henry, 2018), ggplot2 (Wickham, 2016), and extrafont (Chang, 2014).

Data used from each report:

(1) From the 2017 USDA cattle report, we used data from the following tables: B.1. Number and percentage of cattle over 500 lbs. on Jan. 1, 2016, and calf crop (2015), by state, A.2.d. Number of cattle over 500 lbs. who died in 2015, by cause and by state, A.2.e. Number of calves who died in 2015, by cause and by State, A.2.h. Percentage of operations with any calf deaths due to nonpredator, predator and all causes, by state, A.2.j. Cattle death loss due to nonpredator, predator and all causes, as a percentage of inventory of cattle 500 lb. or more on Jan. 1, 2016, by state, A.2.k. Calf death loss due to nonpredator, predator and all causes, as a percentage of calf crop (2015), by state, C.1.g. Percentage of cattle deaths due to nonpredator causes, by cause and by state, C.2.f. Percentage of calf death loss due to nonpredator causes, by cause and by state, D.1.a. For all operations, number and percentage of cattle death loss due to predators, by predator, D.1.c. Percentage of cattle death loss due to predators, by state and by predator, D.2.d. Percentage of calf death loss due to predators, by state and by predator.

(2) From the 2015 sheep report, we used data from the following tables: B.1. Number of ewes, rams, market sheep and lamb crop, by state, A.2.a. Number of sheep and lambs that died, by State and by cause, A.2.d. Percentage of Jan. 1, 2015, adult-sheep inventory lost in 2014, as a percentage of adult-sheep inventory on January 1, 2015, by cause

and by state, B.8. Number of sheep and lambs who died due to enterotoxemia, internal parasites or other digestive problems in 2014, by state, B.9. Number of sheep and lambs who died due to respiratory problems, metabolic problems or other disease problems in 2014, by state, B.10. Number of sheep and lambs who died due to weather-related problems, starvation or lambing problems in 2014, by state, B.11. Number of sheep and lambs who died due to old age, being on back or poisoning in 2014, by state, B.12. Number of sheep and lambs who died due to theft, other nonpredator causes, were found dead or died from unknown nonpredator causes in 2014, by state, C.8. Number of sheep and lambs who died by bears, bobcats or lynx, coyotes or dogs, by state, C.9. Number of sheep and lambs who died by mountain lions (cougars/pumas), wolves or vultures, by state, C.10. Number of sheep and lambs who died by ravens, feral pigs, eagles, other known predator causes or other unknown predator causes, by state.

Endnotes

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[2] In their cattle report, the USDA explains its methodology as follows: "The numbers provided in this report are based on a sample of operations **and are thus estimates of the true numbers**. There is variability associated with each estimate, although the measures of variability (such as the standard error) are not always shown" (emphasis added). USDA-Animal and Plant Health Inspection Service, "Death Loss in U.S. Cattle and Calves Due to Predator and Nonpredator Causes, 2015," ii.
In their sheep report, the USDA explains its methodology here: "For 2015, death losses by cause were estimated to match NASS' total death losses published in "Sheep and Goats," released January 30, 2015. Estimates were generated with SUDAAN® software (Research Triangle Institute, version 11.0.1). Standard errors, where shown, account for the stratified study design....."The number of operations with sheep in 2014 (table A.2.a) was estimated using the number of operations in the sample, weighted by the expansion weight (the number of operations in the population that each sampled operation represents). Similarly, the total number of deaths are estimated by expanding the number of deaths in the sampled operations. For lamb losses, pre- and postdocking losses are captured separately for CO, MT, UT, and WY, while all other Western States count only postdocking losses. The lamb loss estimates in this report are estimated by expanding the postdocking losses for sampled operations in Western States and all losses for sampled operations in Eastern States." USDA-Animal and Plant Health Inspection Service, "Sheep and Lamb Predator and Non-Predator Death Loss in the United States."

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