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National Animal Health Monitoring System

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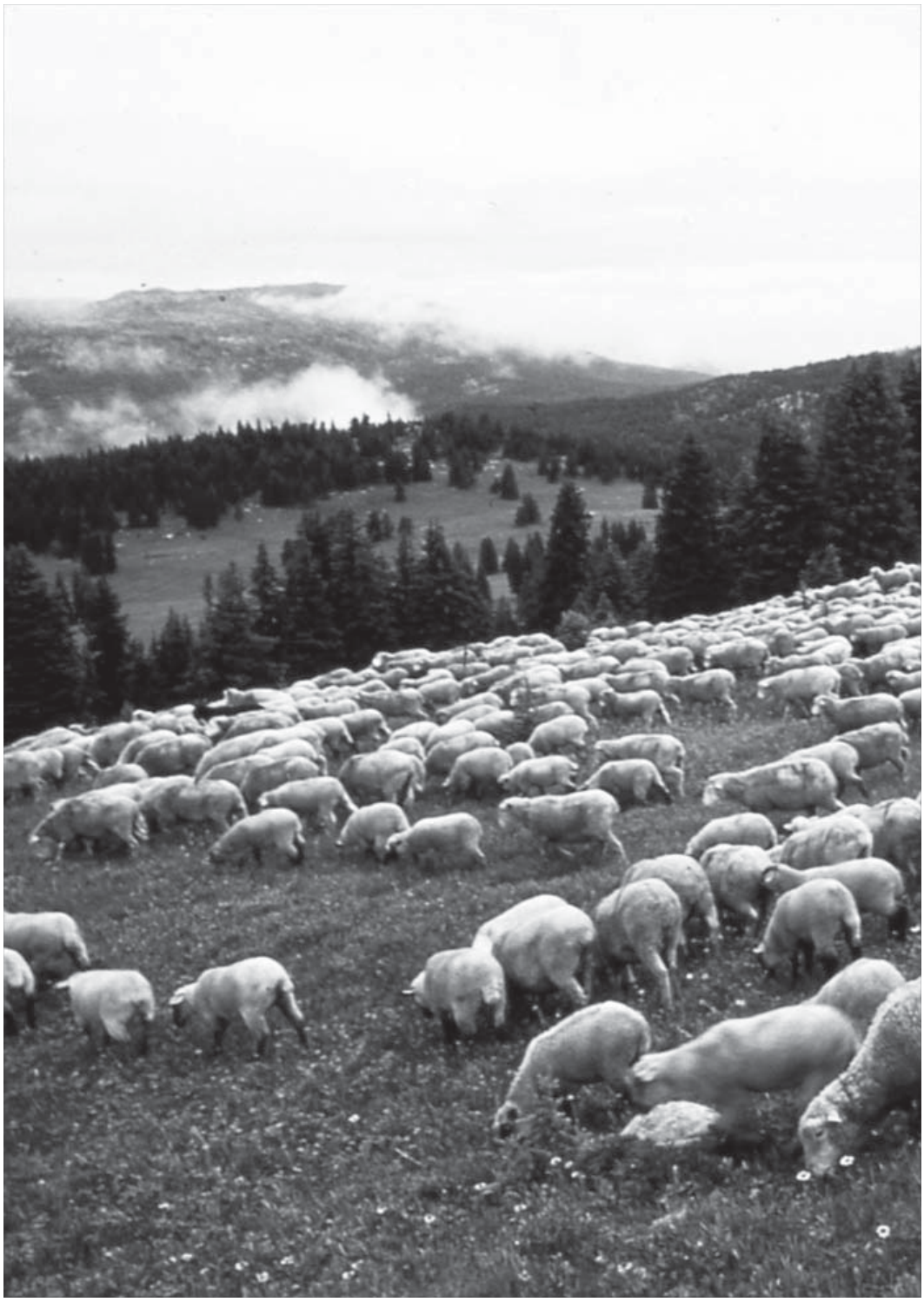
Sheep 2011

Part III: Health and Management Practices on U.S. Sheep Operations, 2011



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Items of Note

Flock additions

Producers sometimes inadvertently bring disease onto their operations by adding new animals to their flock. About one-third of U.S. sheep producers minimized their risk of acquiring new disease in their flock by not adding new animals, other than by natural birth. The longer an operation goes without adding animals, the higher the certainty that no asymptomatic, but infected, animals exist in the flock. Operations that did not add sheep during 2010 were considered “closed” flocks. On average, rams had not been added to closed flocks for 3.7 years, while ewes and lambs had not been added to closed flocks for 9.0 and 8.4 years, respectively.

Reproduction management

An accurate annual estimate of the actual lamb crop is an important measurement of flock productivity. Nearly all operations can provide their lambing rate, but it is not always clear how the rate is measured. For some operations in the largest lamb producing States (especially range flocks), the predocking period is an enigma. Therefore, their lambing rate is based on the number of lambs docked divided by the number of ewes bred. This method has its limitations. For these operations, the entire period from lambing to docking cannot be examined to determine whether the majority of lambs are lost to predators, a lack of colostrum, poor mothering, scours, pneumonia, or other causes. Losses are difficult to prevent if the cause of loss remains unknown.

Nearly half of all operations (47.3 percent) calculated the lambing rate by determining the number of lambs born divided by ewes bred. Over half of large operations (54.9 percent) determined lambing rate by estimating the number of lambs docked divided by the number of ewes bred. The producer-expected lambing percentage overall was 1.50. Small and medium operations had a higher expected lambing rate (1.53 and 1.47, respectively) than large operations (1.23).

Controlled internal drug release (CIDR) devices were approved for use in the United States in 2009. Overall, 6.7 percent of operations used CIDRs in 2010, and 95.6 percent of these operations would use them again. Three-fourths of operations that used CIDRs used them for out-of-season breeding.

Placentas can harbor infectious organisms and should be removed as soon after lambing as possible. Removing placentas is especially important on high-density operations in which ewes are clustered and exposure to placental organisms is high. In general, 67.9 percent of operations usually removed placentas from the lambing area. Composting and throwing out for carnivores were the two most common methods for disposing of placentas (30.8 and 28.0 percent of operations that removed placentas, respectively).

Diseases and control methods

Nearly all operations (92.0 percent) had an APHIS-assigned flock identification number.

Overall, producers on 84.8 percent of operations were either very or somewhat familiar with scrapie. Of these, about half (47.3 percent) implemented genetic selection for scrapie control, and of these almost all (98.8 percent) used replacement rams genetically less susceptible (RR alleles) to scrapie.

Toxoplasmosis and coxiellosis (Q fever) are common causes of abortion storms in sheep flocks, yet producers on 28.5 and 52.0 percent of operations had not heard of toxoplasmosis and Q fever, respectively.

Vaccines can reduce the prevalence or severity of disease and are an integral part of any flock management program. Overall, 81.6 percent of operations used vaccines in 2010. The highest percentage of operations vaccinated against enterotoxemia and tetanus (71.4 and 64.5 percent of operations, respectively). A higher percentage of herded/open range flocks vaccinated for sore mouth compared with other flock types. Because the sore mouth vaccine is comprised of live virus, vaccinating against sore mouth is only recommended when a flock is already infected with the virus. The highest percentage of operations that vaccinated for sore mouth (70.6 percent) used a commercially available sore mouth vaccine.

Antibiotic use

Record keeping is an essential part of responsible antibiotic use. Records should include the name of the antibiotic used, animals treated, date treated, and reason(s) for treatment. During 2010, 69.0 percent of operations administered oral, injectable, or topical antibiotics to lambs or ewes to treat any disease. Just over half of operations that administered antibiotics (51.0 percent) kept antibiotic-usage records. The most commonly treated illness on sheep operations was respiratory disease; for operations that gave any antibiotics, 67.7 percent treated sheep for this illness during 2010. The antibiotic class used most frequently to treat respiratory disease was penicillin (29.9 percent of operations), followed by tetracycline (19.2 percent) and florfenicol (13.6 percent).

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Acknowledgements

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All participants are to be commended, particularly the producers whose voluntary efforts made the Sheep 2011 study possible.

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Feedback
Feedback, comments, and suggestions regarding Sheep 2011 study reports are welcomed. You may submit feedback via online survey at: http://nahms.aphis.usda.gov (Click on “FEEDBACK on NAHMS reports.”)

Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the United States Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS). NAHMS is designed to help meet the Nation's animal-health information needs and has collected data on sheep health and management practices through two previous studies.

The NAHMS 1996 National Sheep Survey was developed through collaboration with the Research and Education Division of the American Sheep Industry Association (ASI) and focused on identifying health and productivity issues affecting America's sheep industry. Study results provided an overview of sheep health, productivity, and management on 5,174 U.S. sheep operations.

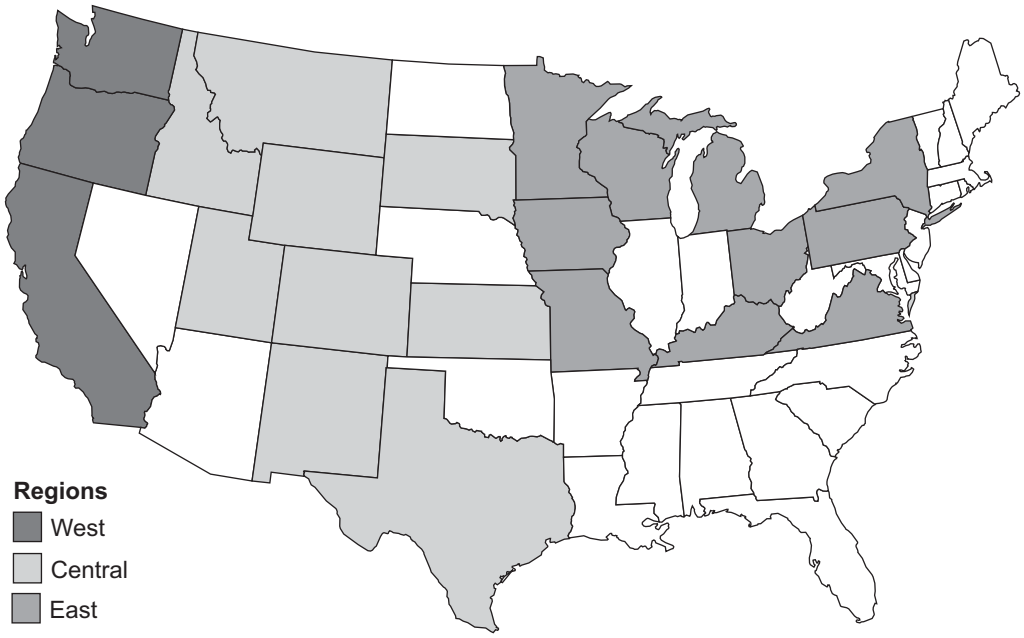
The NAHMS Sheep 2001 study was designed to provide both participants and the industry with information about the U.S. sheep flock on operations with one or more sheep. The USDA's National Agricultural Statistics Service (NASS) collaborated with APHIS' Veterinary Services (VS) to select a producer sample statistically designed to provide inferences to the Nation's sheep population in 22 participating States. These 22 States accounted for 87.4 percent of the U.S. sheep inventory on January 1, 2001, and 72.3 percent of U.S. sheep operations in 2000.

The NAHMS Sheep 2011 study was conducted in 22 of the Nation's major sheep-producing States (see map). The study provides participants, stakeholders, and the industry with valuable information representing 70.1 percent of U.S. farms with ewes and 85.5 percent of the U.S. ewe inventory (NASS 2007 Census of Agriculture).

"Part III: Health and Management Practices on U.S. Sheep Operations, 2011" is the third report containing national information from the NAHMS Sheep 2011 study. Data for this report were collected from 1,241 operations with 20 or more ewes. Representatives of these operations were personally interviewed by either Federal or State animal health officials from March 14 to June 30, 2011.

The methods used and number of respondents in the study can be found in section II and appendix I, respectively.

Sheep 2011 Participating States



Terms Used in This Report

Coxiellosis: A bacterial infection in sheep and other animals caused by *Coxiella burnetii.* Also known as Q fever in humans.

Ewe: A female sheep 1 year old or older.

Flock size: Flock sizes are based on the number of ewes for each operation on the NASS list sampling frame on January 1, 2011. Size breakouts are: small (20–99); medium (100–499); large (500 or more) [section II.B, p 144].

Flock type: The following flock types represent only flocks with 20 or more ewes. The majority of operations had more than one flock type.

- **Herded/open range:** Any unfenced acreage, even if it was a few acres surrounded by residential areas.
- **Fenced range:** Any fenced area not specifically cultivated to raise forage or browse.
- **Pasture:** Any fenced area specifically cultivated to raise forage or browse.
- **Dry lot/feedlot:** This study enrolled only operations with ewes. It does not include any typical sheep feedlot operations and is not meant to represent the sheep feedlot industry. Rather, the dry lot/feedlot category represents operations that fed ewes in dry lots or in "feedlot situations." In many ways, these operations managed, fed, and marketed their sheep and lambs similarly to the other flock types. Over two-thirds of these operations also kept their sheep on fenced range or pasture.

Lamb: Sheep less than 1 year old.

Operation average: A single value for each operation is summed over all operations reporting and divided by number of operations reporting.

Population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. For example, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (—). Column totals are shown as 100.0 to aid in interpretation. However, estimates may not sum to 100.0 due to rounding.

Regions:

West: California, Oregon, Washington
Central: Colorado, Idaho, Kansas, Montana, New Mexico, South Dakota, Texas, Utah, Wyoming
East: Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Virginia, Wisconsin

Sheep: Animal 1 year old and older.

Tail docking: The removal of lambs' tails, usually to prevent accumulation of manure around the hindquarters.

Section I: Population Estimates

Note: Column totals are shown as 100.0 to aid in interpretation. However, estimates may not sum to 100.0 due to rounding.

A. General Management

1. Ewe age

Just under one-fourth of ewes were between the ages of 1 and 2 years.

A.1.a. Percentage of ewes by age of ewes during 2010, and by flock size:

Percent Ewes

Flock Size (number of ewes)

Age (years)	**Small** (20–99) Pct.	Std. error	**Medium** (100–499) Pct.	Std. error	**Large** (500 or more) Pct.	Std. error	**All operations** Pct.	Std. error
1– <2	27.8	(1.1)	22.6	(0.9)	23.0	(1.5)	23.8	(0.9)
2 or more	72.2	(1.1)	77.4	(0.9)	77.0	(1.5)	76.2	(0.9)
Total	100.0		100.0		100.0		100.0	

A higher percentage of ewes on herded/open range operations (80.0 percent) were 2 years old or older compared with ewes on pasture operations (74.3 percent).

A.1.b. Percentage of ewes by age of ewes during 2010, and by primary flock type:

Percent Ewes

Primary Flock Type

Age (years)	**Herded/ open range** Pct.	Std. error	**Fenced range** Pct.	Std. error	**Pasture** Pct.	Std. error	**Dry lot/ feedlot** Pct.	Std. error
1– <2	20.0	(1.3)	24.9	(2.2)	25.7	(0.9)	24.6	(1.8)
2 or more	80.0	(1.3)	75.1	(2.2)	74.3	(0.9)	75.4	(1.8)
Total	100.0		100.0		100.0		100.0	

2. Flock additions

During 2010, 67.0 percent of operations added sheep or lambs in addition to those added naturally through births. Of these operations, the highest percentage (44.6 percent) added rams 1 year old or older. A lower percentage of small operations than large operations added new sheep of any kind (63.2 and 78.9 percent, respectively).

A.2.a. Percentage of operations that added sheep and lambs during 2010, by type of sheep added, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Sheep type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Ewes 1 year and older	25.4	(2.5)	29.3	(3.1)	27.9	(4.6)	26.5	(1.9)
Rams 1 year and older	38.3	(2.8)	56.1	(3.4)	70.3	(5.0)	44.6	(2.1)
Lambs less than 1 year old of either gender	29.2	(2.6)	28.9	(3.1)	31.7	(4.5)	29.3	(2.0)
Any	63.2	(2.8)	74.7	(2.7)	78.9	(4.9)	67.0	(2.1)

A.2.b. Percentage of operations that added sheep and lambs during 2010, by type of sheep added, and by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Sheep type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Ewes 1 year and older	28.1	(7.4)	30.6	(4.5)	23.2	(2.3)	39.8	(6.8)
Rams 1 year and older	66.5	(9.4)	46.8	(4.7)	42.8	(2.6)	43.9	(7.0)
Lambs less than 1 year old of either gender	16.3	(4.1)	26.7	(4.2)	29.3	(2.5)	36.4	(6.4)
Any	77.6	(9.1)	65.8	(4.6)	65.7	(2.6)	73.0	(6.6)

Rams were the most common additions to flocks in 2010 (21.9 percent of ram inventory were new additions). By comparison, 7.8 percent of ewes were new additions.

A.2.c. Percentage of sheep and lambs added during 2010, by type of sheep added and by flock size:

Percent Sheep and Lambs*

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Sheep type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Ewes 1 year and older	17.2	(11.4)	5.6	(0.9)	5.4	(1.1)	7.8	(2.3)
Rams 1 year and older	18.7	(2.4)	24.7	(2.5)	22.6	(2.7)	21.9	(1.5)
Lambs less than 1 year old of either gender	38.5	(34.1)	3.2	(0.9)	5.8	(1.5)	12.9	(8.3)

*Number of ewes, rams, or lambs added as a percentage of sheep inventory on January 1, 2011, including lambs born in 2010.

3. Operations with no flock additions in 2010

Producers sometimes inadvertently bring disease onto their operations through new animal additions to their flocks. A percentage of producers chose to minimize their risk of introducing new disease by not adding new animals to their flocks, other than by natural birth. The longer an operation goes without adding animals, the higher the certainty that no asymptomatic, but infected, animals exist in the flock. Operations that did not add any sheep during 2010 were considered “closed” flocks.

The average number of years since new animals were added to the flock varied by age and gender of sheep, but not across flock types. For example, on average, rams had not been added to closed operations for 3.7 years, while ewes and lambs had not been added to the closed operations for 9.0 and 8.4 years, respectively.

A.3.a. For operations that did not add any sheep during 2010, average number of years since last sheep addition, by type of sheep and by primary flock type:

Average Number of Years

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Sheep type	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
Ewes 1 year and older	7.2	(1.6)	10.1	(1.3)	9.2	(0.8)	5.9	(1.2)	9.0	(0.6)
Rams 1 year and older	2.5	(0.2)	3.2	(0.3)	4.1	(0.3)	2.8	(0.2)	3.7	(0.2)
Lambs less than 1 year old of either gender	7.5	(2.3)	9.0	(1.5)	9.1	(1.3)	5.0	(1.3)	8.4	(1.0)

Of the 73.5 percent of operations that did not add ewes during 2010, nearly one-third (31.5 percent) had not added ewes in 10 or more years. Of the 55.4 percent of operations that did not add rams during 2010, nearly half (44.5 percent) had added them in the previous 1 to 2 years. Of the 33.0 percent of operations that did not add any sheep during 2010 (table A.2.a), 41.4 percent had added sheep or lambs in the previous 1 to 2 years.

A.3.b. For operations that did not add any sheep during 2010, percentage of operations by number of years since the following sheep types were added:

Percent Operations

Number of years

	1–2		3–9		10 or more		All operations	
Sheep type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Ewes 1 year and older	23.5	(4.0)	45.1	(4.9)	31.5	(4.6)	73.5	(1.9)
Rams 1 year and older	44.5	(4.3)	51.3	(4.3)	4.2	(1.6)	55.4	(2.1)
Lambs less than 1 year old of either gender	29.4	(5.5)	47.5	(6.2)	23.1	(5.3)	70.7	(2.0)
Any	41.6	(2.5)	45.5	(2.5)	12.9	(1.6)	33.0	(2.1)

4. Contact with other animals

Direct contact with sheep from another operation (or their feed or manure), or sharing air space with another flock, such as through shared grazing land, at shows, and during breeding, pose risks for disease transmission.

During 2010, sheep on 50.2 percent of all operations had contact with other operations' sheep. Sheep on one-third of operations (33.7 percent) had contact with sheep from other operations while at shows, exhibitions, or through breeding prior to returning home.

A.4.a. Percentage of operations in which sheep had contact with sheep from another operation during 2010, by type of contact and by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Contact type	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
At shows, exhibitions, breeding, etc., then returned to operation	13.5	(4.5)	26.1	(4.2)	35.4	(2.6)	46.2	(7.0)	33.7	(2.1)
Grazed with sheep from another operation	24.2	(5.3)	11.5	(3.0)	8.4	(1.4)	11.5	(4.5)	9.9	(1.2)
Had fence-line contact with sheep from another operation	42.6	(8.4)	20.8	(3.4)	9.6	(1.5)	8.5	(3.7)	13.1	(1.3)
Had contact with sheep visiting from another operation	21.4	(7.2)	13.7	(2.9)	23.5	(2.3)	28.2	(6.2)	21.8	(1.8)
Other	1.6	(1.5)	2.5	(1.0)	2.4	(0.8)	2.8	(2.2)	2.4	(0.6)
Any	64.7	(8.9)	47.9	(4.7)	49.0	(2.7)	57.7	(6.8)	50.2	(2.2)

Just over one-third of operations whose sheep had opportunities for contact with sheep from other operations (34.6 percent) made efforts to decrease nose-to-nose contact with sheep from other operations.

A.4.b. For operations with sheep that had opportunities for contact with sheep from other operations, percentage of operations that made efforts to decrease nose-to-nose contact with sheep from other operations, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
20.7	(6.0)	30.2	(6.3)	36.3	(3.9)	36.8	(9.2)	34.6	(3.0)

Cats pose a risk of transmitting diseases (such as toxoplasmosis) to sheep by defecating in or around sheep areas or feed, and by giving birth. Nearly all operations had some type of cat present during 2010. The majority of operations had either outdoor domestic or indoor cats with outside access (79.2 percent) or feral or stray cats (74.5 percent).

A.4.c. Percentage of operations by type of cats present during 2010, and by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Cat type	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Outdoor domestic or indoor with outside access	36.7	(8.4)	75.4	(4.2)	83.7	(2.1)	72.8	(6.4)	79.2	(1.8)
Feral or stray	50.1	(8.2)	72.0	(4.3)	75.4	(2.4)	84.0	(5.1)	74.5	(1.9)
Wild or exotic (e.g., bobcats)	53.6	(8.5)	46.6	(4.5)	24.3	(2.2)	11.1	(4.7)	28.9	(1.8)
Any litters of kittens	21.4	(4.8)	39.7	(4.6)	49.2	(2.7)	52.1	(6.9)	46.4	(2.1)
Any cats	74.2	(9.8)	91.1	(3.1)	95.6	(1.3)	98.2	(1.2)	94.1	(1.1)

Only 4.4 percent of operations with domestic cats discarded the contents of cat litter boxes into the sheep-raising area.

A.4.d. Of operations with cats during 2010, percentage of operations that discarded the content of cat litter boxes into the sheep-raising area, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
0.0	(—)	5.7	(2.6)	4.7	(1.2)	0.5	(0.4)	4.4	(1.0)

5. Rodent control

Rodents contribute to the spread of disease and are attracted to stored livestock feed. Rodent fecal contamination of sheep feed can serve as a potential source of pathogens for sheep; therefore, rodent control is an important part of biosecurity on operations. The majority of operations (79.2 percent) had outdoor domestic cats or indoor domestic cats with outside access. It is assumed these cats provided some rodent control. Otherwise, a majority of operations (63.4 percent) used traps, bait, and/or poison as rodent control.

A.5. Percentage of operations by method used to control rats and mice during 2010, and by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Control method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Cats*	36.7	(8.4)	75.4	(4.2)	83.7	(2.1)	72.8	(6.4)	79.2	(1.8)
Dogs	50.4	(8.1)	24.9	(4.0)	25.9	(2.5)	29.4	(6.3)	27.1	(2.0)
Traps, bait, and/or poison	35.5	(6.4)	57.9	(4.6)	67.1	(2.6)	61.0	(6.7)	63.4	(2.1)
Professional exterminator	3.4	(1.5)	1.0	(0.7)	1.9	(0.7)	3.4	(2.7)	1.9	(0.5)
Other	0.0	(—)	1.4	(1.1)	3.3	(0.9)	0.8	(0.8)	2.5	(0.7)
Any of the above	85.3	(4.4)	92.2	(2.7)	97.3	(0.9)	90.0	(4.3)	95.1	(0.9)

*Outdoor domestic cats or indoor cats with outside access.

6. Visitors

Visitors—especially those who have contact with animals from other operations—can introduce disease agents via their boots, clothing, vehicles, or other equipment. As people travel more frequently throughout the world, the risk of inadvertent or intentional introduction of disease agents foreign to the United States increases.

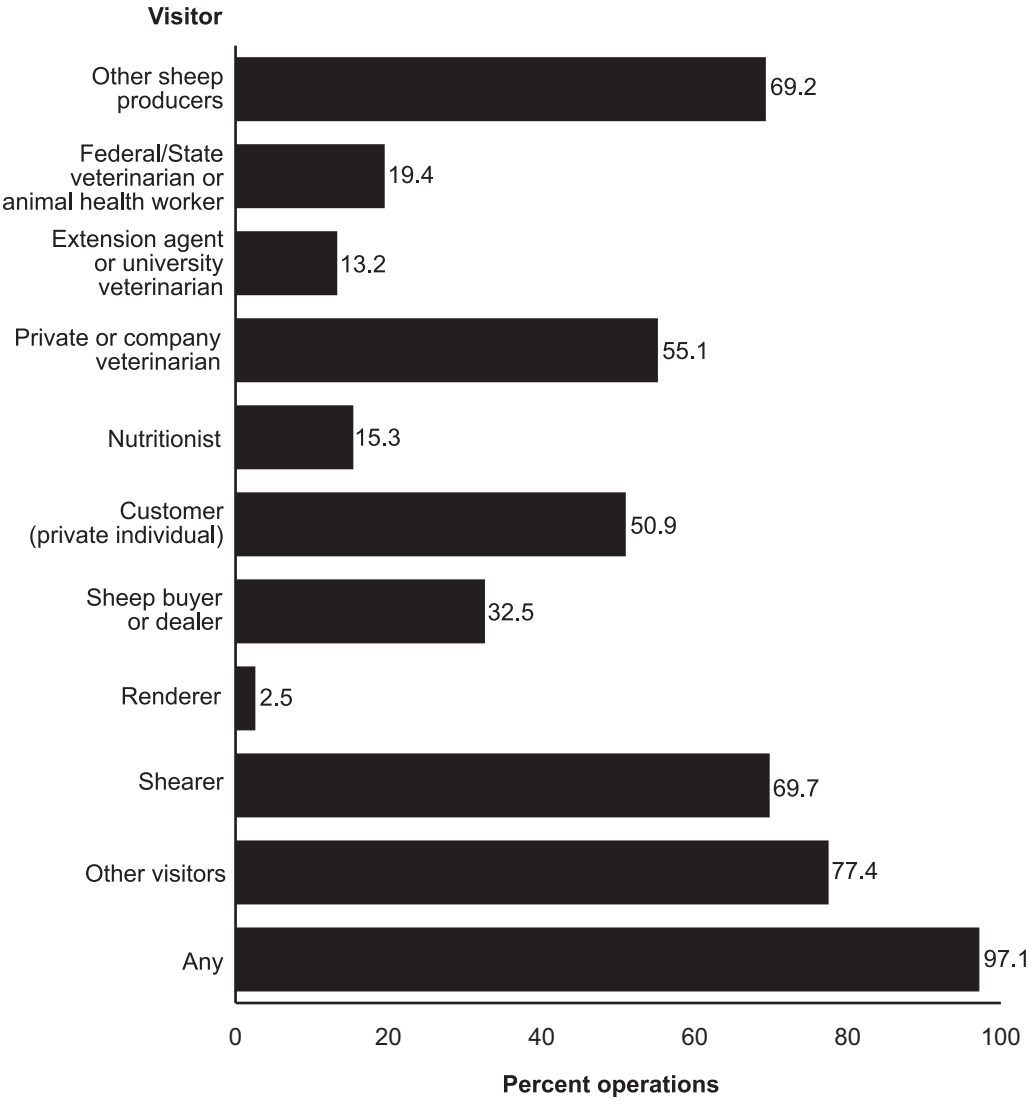
The majority of operations (97.1 percent), and all large operations, had some type of visitor to the operation during 2010.

A.6.a. Percentage of operations by type of visitor on the operation during 2010, and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Visitor type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Other sheep producers	69.0	(2.6)	67.2	(3.3)	80.6	(4.5)	69.2	(2.0)
Federal/State veterinarian or animal health worker	21.0	(2.3)	14.3	(2.2)	21.9	(4.0)	19.4	(1.7)
Extension agent or university veterinarian	10.0	(1.6)	18.8	(2.6)	27.7	(4.6)	13.2	(1.3)
Private or company veterinarian	54.0	(2.8)	54.9	(3.2)	68.8	(4.8)	55.1	(2.1)
Nutritionist	12.7	(1.9)	19.4	(2.5)	27.7	(4.5)	15.3	(1.5)
Customer (private individual) to purchase meat, wool, or other sheep products	52.3	(2.8)	47.9	(3.2)	47.2	(4.6)	50.9	(2.1)
Sheep buyer or dealer	31.0	(2.6)	32.3	(3.2)	51.0	(5.1)	32.5	(2.0)
Renderer	2.9	(0.9)	1.7	(0.8)	1.1	(0.7)	2.5	(0.7)
Shearer	64.5	(2.7)	78.9	(3.1)	92.3	(3.5)	69.7	(2.0)
Other visitors (neighbors, friends, school field trips, 4-H group, hunters, etc.)	79.0	(2.2)	71.2	(3.4)	84.2	(4.3)	77.4	(1.8)
Any	97.3	(0.8)	95.9	(2.0)	100.0	(0.0)	97.1	(0.8)

Percentage of operations by type of visitor on the operation during 2010



Of the 97.1 percent of operations that had visitors during 2010 (table A.6.a), 96.6 percent allowed the visitors access to sheep-raising areas. Other sheep producers were allowed to enter the sheep-raising areas on 84.2 percent of operations.

A.6.b. For operations that had visitors during 2010, percentage of operations that allowed the visitors access to sheep-raising areas, by type of visitor and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Visitor	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Other sheep producers	84.0	(2.5)	85.4	(3.0)	83.1	(5.3)	84.2	(1.9)
Federal/State veterinarian or animal health worker	78.8	(5.3)	80.1	(6.0)	74.5	(11.1)	78.7	(4.2)
Extension agent or university veterinarian	78.6	(7.4)	84.6	(6.6)	82.5	(9.8)	81.3	(4.6)
Private or company veterinarian	89.3	(2.7)	90.1	(2.6)	75.5	(6.7)	88.4	(2.0)
Nutritionist	56.6	(9.4)	54.6	(7.8)	65.5	(10.5)	57.2	(5.8)
Customer (private individual) to purchase meat, wool, or other sheep products	71.3	(3.7)	68.4	(4.8)	72.2	(6.2)	70.7	(2.9)
Sheep buyer or dealer	82.2	(4.1)	85.6	(3.7)	81.9	(4.3)	83.0	(2.9)
Renderer	36.9	(16.3)	41.7	(23.7)	46.9	(30.2)	38.1	(13.6)
Shearer	93.1	(1.8)	91.9	(2.0)	89.4	(2.4)	92.5	(1.3)
Other visitors (neighbors, friends, school field trips, 4-H group, hunters, etc.)	84.9	(2.3)	90.2	(2.0)	86.7	(3.3)	86.2	(1.7)
Any	96.4	(1.1)	97.2	(1.2)	97.1	(1.0)	96.6	(0.8)

Over one-fourth of operations in which visitors entered the sheep-raising area always had visitors park away from sheep areas.

A.6.c. For operations in which visitors entered the sheep-raising area during 2010, percentage of operations by biosecurity measure required for visitors and by frequency that biosecurity measures were performed before visitors entered:

	Percent Operations						
	Frequency						
	Always		Sometimes		Never		
Biosecurity measure	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Total
Change into clean clothes or coveralls	4.4	(0.9)	8.2	(1.2)	87.4	(1.5)	100.0
Use a footbath before entry	1.2	(0.4)	3.5	(0.8)	95.3	(0.9)	100.0
Change into clean boots or use shoe covers	5.9	(1.1)	14.3	(1.6)	79.8	(1.8)	100.0
Scrub footwear before or immediately after entry	2.2	(0.6)	8.9	(1.3)	88.9	(1.4)	100.0
Wash hands or use hand sanitizer before handling sheep	5.2	(1.0)	9.2	(1.2)	85.6	(1.5)	100.0
Park away from sheep area	28.3	(2.0)	12.0	(1.4)	59.7	(2.2)	100.0

A.6.d. For operations in which visitors entered the sheep-raising area during 2010, percentage of operations by biosecurity measure **always** or **sometimes** required before visitors were allowed to enter sheep-raising area, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Biosecurity measure	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Change into clean clothes or coveralls	13.8	(2.0)	10.4	(2.0)	7.6	(2.0)	12.6	(1.5)
Use a footbath before entry	4.3	(1.1)	6.5	(1.5)	2.9	(1.1)	4.7	(0.9)
Change into clean boots or use shoe covers	21.3	(2.4)	20.3	(2.2)	8.9	(2.6)	20.2	(1.8)
Scrub footwear before or immediately after entry	12.2	(1.9)	10.3	(2.2)	2.1	(0.9)	11.1	(1.4)
Wash hands or use hand sanitizer before handling sheep	15.3	(2.1)	13.4	(2.1)	7.9	(2.1)	14.4	(1.5)
Park away from sheep area	41.8	(2.9)	41.3	(3.4)	19.9	(3.3)	40.3	(2.2)

Photograph courtesy of Camilla Kristensen.

7. Housing

Nearly half of all operations (48.9 percent) had no housing structure for the majority of their ewes during summer 2010. During winter, only 26.5 percent of operations had no structure for the majority of their ewes; this percentage dropped to 13.6 percent during lambing.

A.7.a. Percentage of operations by type of housing structure used for the majority of ewes during 2010, and by season:

	Percent Operations					
	Season					
	Winter		Summer		Lambing	
Housing structure	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Four walls and roof with door closed most of the time	12.4	(1.4)	0.7	(0.3)	30.5	(1.9)
Four walls and roof with door open most of the time	33.4	(2.0)	22.5	(1.9)	34.6	(2.1)
Roof and three or fewer walls (e.g., loafing shed)	27.8	(1.9)	28.0	(2.0)	21.3	(1.7)
None	26.5	(1.7)	48.9	(2.1)	13.6	(1.4)
Total	100.0		100.0		100.0	

In winter 2010, a higher percentage of operations in the East region than in the West and Central regions housed the majority of their ewes in a structure with four walls and roof with a door either open or closed most of the time. In the West region, the highest percentage of operations provided a structure with roof and three or fewer walls for the majority of their ewes during winter. In summer, no structure was provided for the majority of ewes on 46.5 percent of operations in the West region, 60.1 percent in the Central region, and 41.8 percent in the East region.

A.7.b. Percentage of operations by housing structure used for the majority of ewes during winter and summer 2010, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Housing structure	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Winter						
Four walls and roof with door closed most of the time	1.8	(1.4)	6.2	(1.6)	20.2	(2.6)
Four walls and roof with door open most of the time	22.9	(4.6)	24.3	(2.7)	43.2	(3.2)
Roof and three or fewer walls (e.g., loafing shed)	48.4	(5.4)	30.4	(3.2)	19.2	(2.5)
None	26.9	(4.5)	39.1	(3.2)	17.4	(2.1)
Total	100.0		100.0		100.0	
Summer						
Four walls and roof with door closed most of the time	0.0	(—)	1.0	(0.8)	0.6	(0.4)
Four walls and roof with door open most of the time	14.9	(4.0)	11.0	(2.1)	33.0	(3.1)
Roof and three or fewer walls (e.g., loafing shed)	38.6	(5.3)	27.9	(3.3)	24.6	(2.7)
None	46.5	(5.3)	60.1	(3.3)	41.8	(3.1)
Total	100.0		100.0		100.0	

Over 40 percent of herded/open range operations provided no structure during lambing season, while over half of all other flock types provided a structure with four walls and roof.

A.7.c. Percentage of operations by housing structure used for the majority of ewes for **lambing** during 2010, and by primary flock type:

Percent Operations

Primary Flock Type

Housing structure	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Four walls and roof with door closed most of the time	7.8	(2.7)	24.3	(3.9)	31.0	(2.4)	49.1	(7.0)	30.5	(1.9)
Four walls and roof with door open most of the time	20.7	(6.7)	30.9	(4.2)	38.6	(2.7)	19.5	(5.1)	34.6	(2.1)
Roof and three or fewer walls (e.g., loafing shed)	31.3	(8.5)	24.7	(4.3)	19.1	(2.1)	26.2	(6.2)	21.3	(1.8)
None	40.1	(8.8)	20.1	(3.7)	11.3	(1.7)	5.3	(2.9)	13.6	(1.4)
Total	100.0		100.0		100.0		100.0		100.0	

Photograph courtesy of Camilla Kristensen.

8. Manure handling

The majority of operations (79.4 percent) disposed of manure by applying it to land owned or rented by the operation.

A.8.a. Percentage of operations by method used to dispose of manure, and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Method	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Applied to land either owned or rented by the operation	79.7	(2.2)	82.2	(2.9)	64.8	(5.0)	79.4	(1.7)
Sold or received other compensation	6.3	(1.4)	7.7	(2.0)	8.1	(2.2)	6.8	(1.1)
Gave away	35.8	(2.7)	25.6	(2.7)	26.3	(3.6)	32.8	(2.0)
Composted	41.4	(2.7)	43.2	(3.2)	26.3	(3.6)	40.9	(2.1)
Other	1.6	(0.7)	2.8	(1.2)	2.7	(1.3)	1.9	(0.6)

Nearly three-fourths of operations (73.6 percent) never used the same equipment to handle manure and feed. The percentage of operations by frequency that the same equipment was used to handle manure and feed did not vary substantially by flock size or flock type (data not shown).

A.8.b. Percentage of operations by frequency that the same equipment was used to handle manure and feed:

Percent Operations

Frequency						
Routinely		**Sometimes/rarely**		**Never**		
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Total**
11.1	(1.3)	15.4	(1.5)	73.6	(1.9)	100.0

For the 26.5 percent of operations that routinely or sometimes/rarely used the same equipment to handle manure and feed (table A.8.b), the majority of operations (70.8 percent) washed equipment used for both manure and feed with water and steam only.

A.8.c. For operations that **routinely** or **sometimes/rarely** used the same equipment to handle manure and feed**,** percentage of operations by equipment cleaning procedure used prior to handling feed:

Cleaning procedure	Percent operations	Std. error
Wash equipment with water or steam only	70.8	(3.5)
Chemically disinfect only	1.1	(0.8)
Wash equipment and chemically disinfect	2.0	(1.0)
Other	22.5	(3.3)
None	3.5	(1.2)
Total	100.0	

9. Official flock identification and ear tags

Participation in the Scrapie Eradication Program is mandatory and requires sheep and goat producers, dealers, markets, and slaughter plants to identify certain sheep and goats. Most sheep and goats must be officially identified prior to sale or transport from the place of birth. Records on tags or other official identification (ID), as well as records on sales and acquisitions, must be kept for 5 years.

Nearly all operations (92.0 percent) had a flock ID number assigned by the USDA's APHIS. A lower percentage of small operations (90.9 percent) had an officially assigned flock ID number than large operations (97.1 percent).

A.9.a. Percentage of operations that had an official flock ID number or used official scrapie program ear tags, by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
	Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Official flock ID	90.9	(1.7)	94.0	(1.8)	97.1	(1.2)	92.0	(1.3)
Scrapie program ear tag	87.9	(1.9)	89.0	(2.1)	94.0	(1.8)	88.6	(1.4)

A.9.b. Percentage of operations that had an official flock ID number or used official scrapie program ear tags, by region:

Percent Operations

Region

	West		**Central**		**East**	
	Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Official flock ID	88.1	(3.5)	90.9	(2.2)	94.2	(1.7)
Scrapie program ear tag	81.9	(4.0)	85.9	(2.5)	92.7	(1.9)

A lower percentage of herded/open range operations had an official flock ID or used scrapie program ear tags compared with fenced range, pasture, or dry lot/feedlot operations.

A.9.c. Percentage of operations that had an official flock ID number or used official scrapie program ear tags, by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Official flock ID	72.9	(10.1)	94.3	(2.2)	92.1	(1.6)	92.0	(4.6)
Scrapie program ear tag	56.8	(8.8)	92.6	(2.4)	88.8	(1.8)	89.9	(4.9)

For operations that used official scrapie program ear tags, 99.2 percent of operations had the operator or farm worker apply the tags. Only 2.0 percent of operations had tags applied at the market.

A.9.d. For operations that used official scrapie program ear tags, percentage of operations by the party responsible for applying tags, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Responsible party	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Operator or other farm worker	99.0	(0.7)	99.7	(0.3)	99.5	(0.5)	99.2	(0.5)
Veterinarian	0.8	(0.5)	0.0	(—)	0.0	(—)	0.5	(0.4)
Market	1.9	(0.9)	2.9	(1.8)	0.5	(0.5)	2.0	(0.8)

The only operations that used a veterinarian to apply official scrapie program ear tags were in the West region (3.5 percent of operations).

A.9.e. For operations that used official scrapie program ear tags, percentage of operations by party responsible for applying tags, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Responsible party	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Operator or other farm worker	98.1	(1.6)	98.7	(1.2)	99.9	(0.1)
Veterinarian	3.5	(2.4)	0.0	(—)	0.0	(—)
Market	0.2	(0.2)	3.0	(1.8)	1.9	(0.9)

The 3.5 percent of operations in the West region that had a veterinarian apply official scrapie program ear tags were pasture operations. None of the herded/open range or dry lot operations had the tags applied at the market.

A.9.f. For operations that used official scrapie program ear tags, percentage of operations by party responsible for applying tags, and by primary flock type:

	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Responsible party	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Operator or other farm worker	100.0	(0.0)	99.7	(0.3)	98.9	(0.7)	100.0	(0.0)
Veterinarian	0.0	(—)	0.0	(—)	0.8	(0.6)	0.0	(—)
Market	0.0	(—)	2.5	(1.9)	2.2	(0.9)	0.0	(—)

10. ID other than official scrapie program ear tags

Of the 11.4 percent of operations that did not use scrapie program ear tags (table A.9.a), 72.8 percent indicated that they only sold slaughter lambs and, therefore, were not required to apply the official ID. For the 6.0 percent of large operations that did not use the scrapie program ear tag (table A.9.a), 46.4 percent did not know they were required to officially identify sheep before leaving the operation. Only medium and small operations reported that they did not use scrapie ear tags because the operation did not move sheep off-farm. Nearly one-fourth of operations gave “other” as a reason for not using official ear tags. The majority of these operations reported that the tags fell out or the operator forgot to use them.

A.10.a. For operations that **did not** use scrapie program ear tags, percentage of operations by reason for not using the tags, and by flock size:

Percent Operations

Flock Size (number of ewes)

Reason	Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Only sell slaughter lambs so not required to apply official ID	76.4	(7.7)	63.8	(12.7)	53.6	(16.4)	72.8	(6.5)
Did not move sheep off farm so not required to apply official ID	68.5	(8.9)	47.0	(14.5)	0.0	(—)	62.5	(7.5)
Did not know operation was required to officially identify sheep before they left the operation	26.7	(8.5)	22.8	(10.3)	46.4	(16.4)	26.6	(6.9)
Used another type of official ID instead of official ear tags	7.3	(4.8)	6.4	(6.0)	9.5	(7.5)	7.2	(3.9)
Other	21.2	(8.5)	27.2	(13.0)	0.0	(—)	21.6	(7.0)

Just over half of all operations that did not use the scrapie program ear tags (53.5 percent) were aware that the tags are available and free.

A.10.b. For operations that **did not** use scrapie program ear tags, percentage of operations that were aware of the availability of the free scrapie ear tags, by flock size:

Percent Operations

Flock Size (number of ewes)

Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
50.4	(9.1)	63.9	(11.7)	68.8	(13.6)	53.5	(7.5)

B. Reproduction Management

An accurate, annual estimate of the lamb crop is an important measurement of flock productivity. Nearly all operations can provide their lambing rate, but it is not always clear how the rate is measured. For some operations in the largest lamb-producing States, the predocking period is an enigma. Therefore, their lambing rate is based on the number of lambs tails docked divided by the number of ewes bred in a given year. This method of determining the lambing ratio is not as efficient as maintaining individual-ewe lambing records, partly because it cannot be determined whether the majority of lamb losses were due to predators, no colostrum, poor mothering, scours, pneumonia, or other causes. These losses are difficult to prevent if the cause of loss is unknown.

1. Calculation of lambing rate

The highest percentage of operations (47.3 percent) calculated lambing rates using the number of lambs born divided by ewes bred in a given year. The second most common method used (29.6 percent of operations) was to use the number of lambs weaned divided by ewes bred. Over half of large operations (54.9 percent) calculated lambing rates using the number of lambs docked divided by ewes bred, while a similar percentage of small operations used lambs born divided by ewes bred.

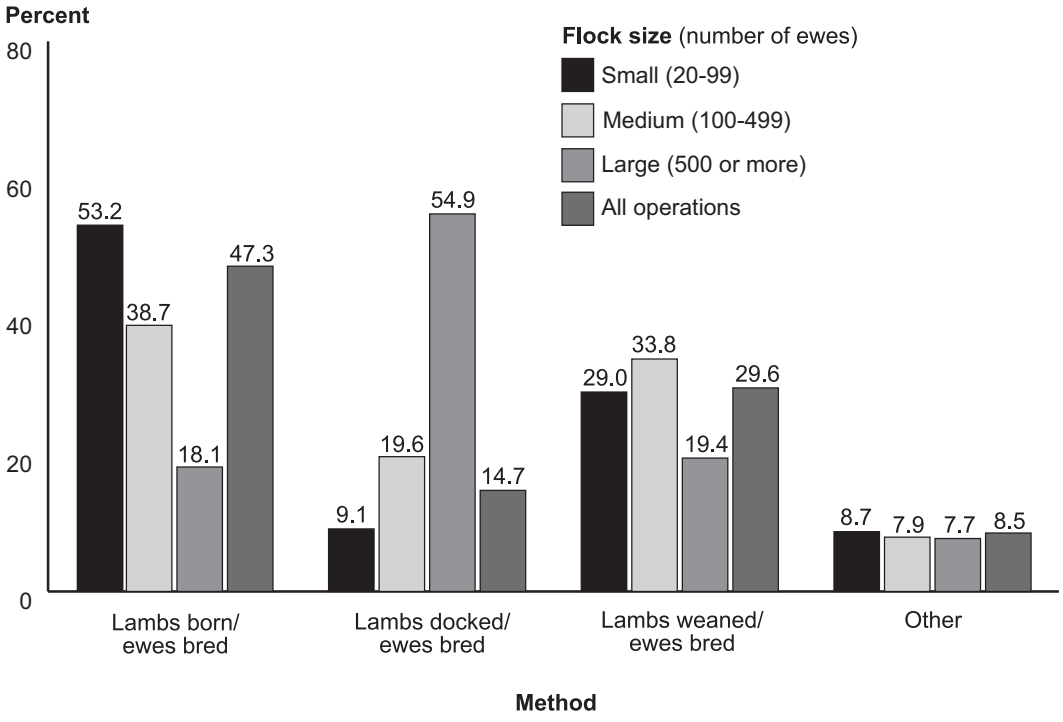
B.1.a. Percentage of operations by method of calculating lambing rate, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Method	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Lambs born/ ewes bred	53.2	(3.0)	38.7	(3.3)	18.1	(3.2)	47.3	(2.2)
Lambs docked/ ewes bred	9.1	(1.7)	19.6	(2.8)	54.9	(4.9)	14.7	(1.4)
Lambs weaned/ ewes bred	29.0	(2.8)	33.8	(3.4)	19.4	(4.0)	29.6	(2.1)
Other	8.7	(1.7)	7.9	(1.6)	7.7	(2.1)	8.5	(1.2)
Total	100.0		100.0		100.0		100.0	

Percentage of operations by method of calculating lambing rate, and by flock size



Lambing-rate calculations in the Central region were split fairly evenly across methods, while just over half the operations in the West and East regions calculated lambing rates by dividing lambs born by ewes bred (52.8 and 54.5 percent of operations, respectively).

B.1.b. Percentage of operations by method of calculating lambing rate, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Lambs born/ewes bred	52.8	(5.6)	33.3	(3.2)	54.5	(3.3)
Lambs docked/ewes bred	18.8	(4.1)	25.7	(2.7)	6.2	(1.7)
Lambs weaned/ewes bred	21.2	(4.7)	33.3	(3.5)	29.9	(3.1)
Other	7.3	(2.8)	7.7	(1.5)	9.4	(2.1)
Total	100.0		100.0		100.0	

As expected, a higher percentage of herded/open range operations calculated lambing rates by dividing lambs docked by ewes bred compared with other flock types.

B.1.c. Percentage of operations by method of calculating lambing rate, and by primary flock type:

	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Lambs born/ewes bred	15.6	(6.0)	34.0	(4.5)	52.2	(2.8)	50.4	(7.3)
Lambs docked/ewes bred	57.0	(6.6)	27.5	(3.9)	10.1	(1.6)	7.5	(3.6)
Lambs weaned/ewes bred	21.1	(4.9)	33.6	(4.7)	28.3	(2.5)	33.4	(7.2)
Other	6.2	(3.0)	4.8	(1.9)	9.4	(1.6)	8.6	(3.6)
Total	100.0		100.0		100.0		100.0	

2. Normal or average lambing rate

More than half of small operations calculated lambing rate by using lambs born/ewes bred (table B.1.a), while a similar percentage of large operations calculated this rate as lambs docked/ewes bred. The average expected lambing rate for operations that calculated lambing rate by lambs born/ewes bred was 1.60, while operations that calculated lambing rate by lambs docked/ewes bred expected a rate of 1.34. It is essential to understand how a lambing rate was calculated when interpreting this measure of productivity.

B.2.a. Average expected lambing rate, by method of calculating lambing rate and by flock size:

	Average Lambing Rate							
	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Method	**Avg.**	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**
Lambs born/ ewes bred	1.61	(0.02)	1.60	(0.04)	1.52	(0.06)	1.60	(0.02)
Lambs docked/ ewes bred	1.41	(0.06)	1.38	(0.05)	1.14	(0.05)	1.34	(0.04)
Lambs weaned/ ewes bred	1.42	(0.04)	1.36	(0.04)	1.22	(0.08)	1.40	(0.03)
Other	1.59	(0.04)	1.54	(0.05)	1.28	(0.04)	1.56	(0.04)
Average expected lambing rate	1.53	(0.02)	1.47	(0.02)	1.23	(0.04)	1.50	(0.02)

The overall expected average lambing rate in the Central region was lower than in the East region (1.38 and 1.59, respectively), especially when comparing the lambs weaned to ewes bred ratio (1.27 and 1.49, respectively).

B.2.b. Average expected lambing rate, by method of calculating lambing rate and by region:

	Average Lambing Rate					
	Region					
	West		Central		East	
Method	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
Lambs born/ewes bred	1.55	(0.05)	1.52	(0.05)	1.66	(0.02)
Lambs docked/ewes bred	1.36	(0.08)	1.28	(0.04)	1.48	(0.07)
Lambs weaned/ewes bred	1.37	(1.1)	1.27	(0.04)	1.49	(0.03)
Other	1.47	(0.07)	1.53	(0.06)	1.60	(0.05)
Average expected lambing rate	1.47	(0.04)	1.38	(0.03)	1.59	(0.02)

Overall pasture and dry lot operations expected a higher lambing rate than herded/open range or fenced range operations. When calculated by the number of lambs weaned to ewes bred, the lambing rate for herded/open range and fenced range operations was lower than the rate for pasture operations (1.20, 1.23, and 1.46, respectively). When calculated using number of lambs born, there was no difference.

B.2.c. Average expected lambing rate, by method of calculating lambing rate and by primary flock type:

Average Lambing Rate

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Method	**Avg.**	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**
Lambs born/ ewes bred	1.51	(0.09)	1.54	(0.06)	1.61	(0.02)	1.63	(0.05)
Lambs docked/ ewes bred	1.31	(0.03)	1.20	(0.06)	1.45	(0.05)	1.42	(0.09)
Lambs weaned/ ewes bred	1.20	(0.06)	1.23	(0.05)	1.46	(0.03)	1.40	(1.0)
Other	1.26	(0.04)	1.40	(0.06)	1.59	(0.04)	1.50	(0.03)
Average expected lambing rate	1.32	(0.03)	1.33	(0.04)	1.55	(0.02)	1.52	(0.05)

3. Lambing season

When the questionnaire for this report was administered, 51.2 percent of operations had not yet finished lambing. Data for these operations represent the previous year's lambing season (spring/summer/fall 2010, or winter/spring 2011).

B.3. Percentage of operations by season of last completed lambing season, and by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Season	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Spring 2010	38.3	(5.3)	41.1	(3.2)	39.3	(3.1)	39.7	(2.1)
Summer 2010	11.7	(3.5)	5.0	(1.3)	1.7	(0.6)	4.5	(0.8)
Fall 2010	11.9	(3.2)	6.9	(2.0)	5.5	(1.3)	7.0	(1.1)
Winter 2010–11	36.2	(5.3)	28.8	(3.2)	36.2	(3.1)	33.6	(2.1)
Spring 2011	1.9	(1.0)	18.3	(2.9)	17.5	(2.6)	15.2	(1.6)
Total	100.0		100.0		100.0		100.0	

4. Breeding management for the last completed lambing season

All operations bred at least some of their own ewes, while just 6.1 percent of operations added ewes already bred.

B.4.a. Percentage of operations by breeding locale and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Locale	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Bred on this operation	100.0	(0.0)	100.0	(0.0)	100.0	(0.0)	100.0	(0.0)
Added to this operation already bred	6.0	(1.3)	7.3	(1.9)	3.2	(1.2)	6.1	(1.0)

Overall, 99.2 percent of ewes bred in the last completed lambing season were bred on the operation, and 0.8 percent were added to the operation already bred.

B.4.b. Percentage of ewes by breeding locale and by flock size:

Percent Ewes*

Flock Size (number of ewes)

Locale	**Small** (20–99) Pct.	Std. error	**Medium** (100–499) Pct.	Std. error	**Large** (500 or more) Pct.	Std. error	**All operations** Pct.	Std. error
Bred by this operation	98.6	(0.5)	98.6	(0.6)	99.8	(0.1)	99.2	(0.2)
Added to this operation already bred	1.4	(0.5)	1.4	(0.6)	0.2	(0.1)	0.8	(0.2)
Total	100.0		100.0		100.0		100.0	

*As a percentage of total bred ewes in last completed lambing season.

Photograph courtesy of American Sheep Industry Association.

Overall, 86.9 percent of operations had first-lambing ewes in 2010.

B.4.c. Percentage of operations that had first-lambing ewes, by flock size:

Percent Operations

Flock Size							
Small (20-99)		**Medium** (100 - 499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
86.6	(2.0)	87.9	(2.4)	85.1	(4.8)	86.9	(1.5)

Newly added bred ewes and first-lambing ewes can be potential sources of infection for the rest of the flock. Overall, 17.5 percent of operations that added bred ewes also separated these ewes from the flock until after they had lambed. Additionally, 20.2 percent of operations separated first-lambing ewes from the rest of the flock until after they had lambed.

B.4.d. For operations that added bred ewes or that had any first-lambing ewes, percentage of operations that separated the ewes from the flock until after they had lambed:

	Percent operations	**Std. error**
Ewes already bred when added	17.5	(6.4)
First-lambing ewes	20.2	(1.8)

Overall, 93.0 percent of bred ewes lambed with full-term births. Of these, 17.8 percent were first-lambing ewes.

B.4.e. Percentage of all bred ewes that lambed with full-term births, and percentage of these ewes that were first-lambing ewes, by flock size:

Percent Ewes

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
	Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
All bred ewes that lambed	92.9	(0.7)	93.2	(0.7)	92.9	(0.7)	93.0	(0.4)
First-lambing ewes	19.2	(0.9)	16.5	(0.9)	17.9	(1.2)	17.8	(0.7)

5. Lambing outcome

Note: Tables in this section apply to the last completed lambing season.

Overall, 96.4 percent of lambs were born alive. This percentage was similar across flock types.

B.5.a. Percentage of lambs born alive, by primary flock type:

Percent Lambs*

Primary Flock Type

Herded/ open range		**Fenced range**		**Pasture**		**Dry lot/ feedlot**		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
97.5	(0.3)	97.0	(0.3)	95.8	(0.2)	95.0	(0.5)	96.4	(0.1)

*Number of lambs born alive as a percentage of all lambs born.

B.5.b. Percentage of operations that docked lambs, by flock size:

Percent Operations							
Flock Size (number of ewes)							
Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
86.1	(2.0)	87.2	(2.8)	95.5	(3.3)	86.9	(1.6)

B.5.c. Percentage of operations that docked lambs, by primary flock type:

Percent Operations							
Primary Flock Type							
Herded/ open range		**Fenced range**		**Pasture**		**Dry lot/feedlot**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
86.4	(8.4)	86.4	(3.8)	88.0	(1.9)	79.3	(6.4)

When using the number of all lambs born, the lambing rate was higher for small and medium operations (1.51 and 1.45, respectively) than it was for large operations (1.28). The lamb weaning rate was highest for small operations (1.33) and lowest for large operations (1.06). The calculated lambing rate for all operations, using number of lambs born, was 1.38, and 1.16 for lambs weaned and 1.10 for lambs docked. The average number of lambs docked per ewe bred was limited to operations that used docking to measure lambing rates, with the assumption that these operations would likely dock all lambs.

B.5.d. Average number of lambs born, weaned, and docked per ewe bred for the last completed lambing season, by flock size:

	Average Lambing Rate							
	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
	No.	**Std. error**	**No.**	**Std. error**	**No.**	**Std. error**	**No.**	**Std. error**
Born	1.51	(0.0)	1.45	(0.0)	1.28	(0.0)	1.38	(0.0)
Weaned	1.33	(0.0)	1.23	(0.0)	1.06	(0.0)	1.16	(0.0)
Docked*	1.30	(0.1)	1.21	(0.1)	1.06	(0.0)	1.10	(0.0)

*For operations that use docking to measure lambing rate.

Lambing and weaning ratios were higher in pasture and dry lot/feedlot flocks than in herded open/range and fenced range flocks.

B.5.e. Average number of lambs born, weaned, and docked per ewe bred, by primary flock type:

	Average Lambing Rate							
	Primary Flock Type							
	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
	No.	Std. error	No.	Std. error	No.	Std. error	No.	Std. error
Born	1.29	(0.0)	1.29	(0.0)	1.48	(0.0)	1.47	(0.0)
Weaned	1.08	(0.0)	1.06	(0.0)	1.28	(0.0)	1.27	(0.0)
Docked*	1.12	(0.1)	1.02	(0.1)	1.24	(0.1)	1.1	(0.1)

*For operations that use docking to measure lambing rate.

Of the lambs born alive, 89.3 percent were weaned and 87.0 percent were docked. Hair sheep are normally not docked, and some wool sheep producers choose not to dock lambs tails. Some operations that dock only dock certain sheep, such as females or replacement ewe lambs.

B.5.f. Percentage of lambs born alive that were weaned and percentage that were docked, by flock size:

	Percent Lambs							
	Flock Size (number of ewes)							
	Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Weaned	92.2	(0.7)	89.2	(1.0)	87.8	(1.4)	89.3	(0.7)
Docked	79.0	(2.5)	83.8	(2.2)	93.5	(0.9)	87.0	(1.0)

A lower percentage of lambs in pasture flocks were docked (83.4 percent) compared with lambs in herded/open range flocks (92.6 percent).

B.5.g. Percentage of lambs born alive that were weaned and percentage that were docked, by primary flock type:

Percent Lambs

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Weaned	87.7	(1.7)	88.8	(1.9)	90.2	(0.8)	89.6	(1.5)
Docked	92.6	(1.5)	90.0	(1.9)	83.4	(1.8)	79.1	(5.4)

6. Low lambing rate

Note: Tables in this section apply to the last completed lambing season.

Roughly one-third of operations had a lower-than-expected lambing rate for the most recently completed lamb crop.

B.6.a. Percentage of operations that had a lower-than-expected lambing rate for the most recently completed lamb crop, by flock size:

Percent Operations

Flock Size (number of ewes)

Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
35.8	(2.8)	32.2	(3.3)	48.9	(5.1)	35.7	(2.1)

The percentage of operations with a lower-than-expected lambing rate in their most recently completed lamb crop did not vary by season of the last completed lambing season.

B.6.b. Percentage of operations that had a lower-than-expected lambing rate for the most recently completed lamb crop, by season:

Percent Operations

Lambing Season

Fall		Winter		Spring		Summer		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
36.1	(7.7)	29.8	(3.6)	39.4	(2.9)	34.7	(8.5)	35.7	(2.1)

A higher percentage of operations in the East region (41.2 percent) had a lower-than-expected lambing rate for the most recently completed lamb crop compared with operations in the West region (25.1 percent).

B.6.c. Percentage of operations that had a lower-than-expected lambing rate for the most recently completed lamb crop, by region:

Percent Operations

Region

West		Central		East	
Percent	Std. error	Percent	Std. error	Percent	Std. error
25.1	(4.7)	33.0	(3.2)	41.2	(3.3)

Of operations with a lower-than-expected lambing rate, nearly one-third (32.2 percent) indicated that reduced twinning/triplets was the primary cause of the lower rate. Reduced twinning/triplets was a primary reason for lower rates in all flock types, with the exception of herded/open range operations. The highest percentage of herded/open range operations reported lamb deaths as the primary reason of the lower rate. A number of operations cited “other” as the cause of a lower-than-expected lambing rate. The primary reasons they listed were: multiple causes, yearling ewes, or weather (heat/drought). There were no measurable differences by flock size or by region (data not shown).

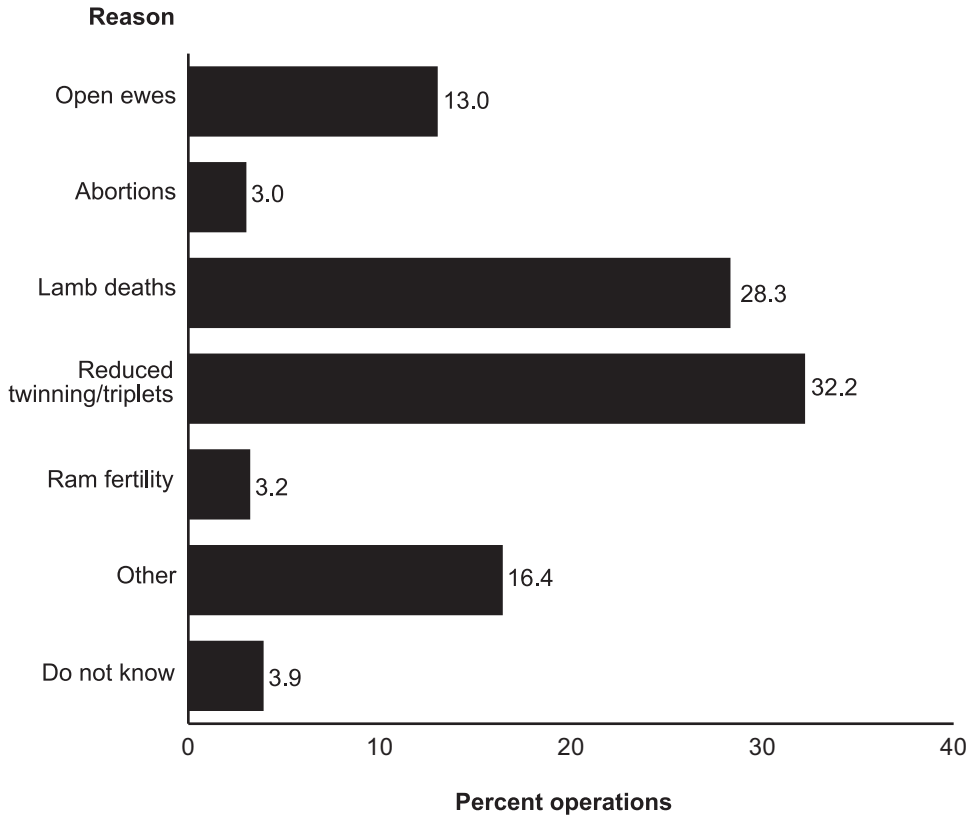
B.6.d. For operations with a lower-than-expected lambing rate, percentage of operations by primary cause of lower rate, and by flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Cause	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Open ewes (bred but did not take)	24.7	(13.0)	13.2	(5.9)	12.1	(2.9)	14.9	(9.2)	13.0	(2.5)
Abortions	5.8	(4.1)	0.6	(0.6)	3.7	(2.0)	3.1	(3.0)	3.0	(1.4)
Lamb deaths (including stillborns)	44.0	(13.5)	32.6	(7.4)	27.4	(4.2)	14.7	(9.5)	28.3	(3.4)
Reduced twinning/triplets	3.1	(1.8)	29.5	(6.7)	33.9	(4.4)	39.5	(14.7)	32.2	(3.5)
Ram fertility	0.0	(—)	2.6	(2.6)	3.6	(1.7)	3.3	(3.2)	3.2	(1.2)
Other	7.5	(5.0)	16.1	(5.3)	17.0	(3.3)	19.5	(12.0)	16.4	(2.6)
Do not know	14.9	(13.1)	5.4	(4.5)	2.4	(1.5)	4.9	(4.7)	3.9	(1.6)
Total	100.0		100.0		100.0		100.0		100.0	

For operations with a lower-than-usual lambing rate, percentage of operations by primary cause of lower rate



Overall, 17.1 percent of operations did not know the cause of lamb deaths in the last completed lamb crop. Compared with other flock sizes, a higher percentage of large operations indicated predators were the primary cause of lamb deaths. A higher percentage of small operations (20.7 percent) did not know the primary cause of lamb deaths compared with medium or large operations (9.7 and 5.2 percent, respectively). For operations in which disease was the primary cause of death, pneumonia or parasites were the leading causes. “Other” causes of death were primarily starvation or multiple reasons.

B.6.e. Percentage of operations by primary cause of lamb deaths, and by flock size:

	Percent Operations							
	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Cause	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Predators	6.7	(1.4)	19.4	(3.0)	42.8	(5.1)	12.0	(1.3)
Weather (temperature, lightning, flood, etc.)	21.5	(2.4)	21.8	(3.0)	28.4	(3.5)	22.0	(1.8)
Disease	13.9	(1.9)	22.1	(2.5)	9.6	(2.4)	15.6	(1.4)
Other	28.9	(2.6)	25.1	(2.9)	14.1	(3.0)	27.1	(1.9)
Do not know	20.7	(2.4)	9.7	(1.8)	5.2	(3.2)	17.1	(1.7)
No lamb deaths	8.3	(1.6)	1.9	(0.8)	0.0	(0.0)	6.2	(1.1)
Total	100.0		100.0		100.0		100.0	

A lower percentage of herded/open range operations than pasture operations (6.1 and 16.1 percent, respectively) indicated disease was the primary cause of lamb deaths in the last completed lamb crop. Just over 40 percent of operations listed “other” as the primary cause of death, which primarily included starvation or multiple reasons.

B.6.f. Percentage of operations by primary cause of lamb deaths, and by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Primary cause	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Predators	22.7	(5.0)	19.3	(3.4)	10.4	(1.6)	3.4	(2.7)
Weather (temperature, lightning, flood, etc.)	38.6	(8.4)	28.8	(4.3)	19.7	(2.2)	17.4	(5.2)
Disease	6.1	(3.6)	17.5	(3.5)	16.1	(1.8)	12.9	(4.4)
Other	24.3	(9.1)	13.1	(3.1)	29.2	(2.5)	41.1	(6.8)
Do not know	8.3	(6.3)	16.7	(3.7)	17.9	(2.2)	16.3	(5.3)
No lamb deaths	0.0	(—)	4.6	(2.1)	6.8	(1.5)	8.9	(5.0)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations that lambed in spring (15.7 percent) reported predators as the primary cause of lamb death compared with operations that lambed in winter (6.4 percent).

B.6.g. Percentage of operations by primary cause of lamb deaths, and by lambing season:

	Percent Operations							
	Lambing Season							
	Fall		Winter		Spring		Summer	
Primary cause	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Predators	10.8	(3.9)	6.4	(1.8)	15.7	(2.0)	14.7	(5.3)
Weather (temperature, lightning, flood, etc.)	12.0	(4.6)	27.5	(3.5)	20.1	(2.4)	23.6	(7.1)
Disease	15.9	(5.6)	11.8	(2.2)	17.1	(2.0)	16.6	(7.5)
Other reasons	28.3	(7.3)	30.2	(3.5)	24.8	(2.6)	25.0	(8.3)
Do not know	22.2	(7.7)	17.6	(3.2)	16.6	(2.3)	15.2	(7.0)
No lamb deaths	10.7	(5.0)	6.6	(2.2)	5.7	(1.5)	5.0	(4.8)
Total	100.0		100.0		100.0		100.0	

7. Lamb supplements

Note: Tables in this section apply to the last completed lamb crop.

Feeding lambs high-quality colostrum following birth helps ensure the transfer of antibodies needed to protect lambs against disease. Usually lambs receive adequate colostrum from their mothers. Sometimes it is necessary to supplement newborns using other colostrum sources. Over half of all operations (54.5 percent) gave lambs colostrum from a source other than the lambs' mothers.

B.7.a. Percentage of operations that gave lambs colostrum from a source other than the lambs' mothers during 2010, by flock size:

Percent Operations

Flock Size (number of ewes)

Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
50.9	(2.8)	64.3	(3.5)	55.2	(5.2)	54.5	(2.2)

A higher percentage of fenced range and pasture operations (54.6 and 56.0 percent, respectively) gave lambs colostrum following birth from a source other than their mothers compared with herded/open range operations (28.0 percent). There were no substantial differences by region (data not shown).

B.7.b. Percentage of operations that gave lambs colostrum from a source other than the lambs' mothers during 2010, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/feedlot	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
28.0	(6.1)	54.6	(4.7)	56.0	(2.7)	54.2	(7.1)

The majority of operations that gave lambs colostrum from a source other than the lambs' mothers (73.2 percent) used sheep colostrum from ewes on their own operation. The second most commonly used source of colostrum was dried sheep colostrum, used by about one-third of operations (32.2 percent). A higher percentage of operations that gave cow colostrum used colostrum from a herd that was not tested for Johne's disease or had an unknown Johne's-disease status, compared with operations that used colostrum from a herd that was tested for Johne's disease (17.6 and 3.2 percent of operations, respectively).

B.7.c. For operations that gave lambs colostrum from a source other than the lambs' mothers during 2010, percentage of operations by source of colostrum:

Source	Percent operations	Std. error
Sheep colostrum from own operation	73.2	(2.4)
Liquid sheep colostrum from outside source	3.2	(1.0)
Dried colostrum	32.2	(2.6)
Any cow colostrum	20.8	(2.2)
Cow colostrum from a herd tested for Johne's disease	3.2	(1.0)
Cow colostrum from a herd not tested for Johne's disease or did not know if tested	17.6	(2.0)
Goat colostrum	8.6	(1.6)
Other	4.9	(1.2)

When colostrum was fed, it was given within 2 hours following birth by 56.2 percent of operations. A higher percentage of small operations (63.4 percent) gave colostrum within 2 hours following birth compared with medium or large operations (43.5 and 42.6 percent, respectively). Less than 5 percent of operations gave colostrum 9 or more hours following birth. There was no variation across flock types in time of first colostrum feeding (data not shown).

B.7.d. For operations that gave lambs colostrum from a source other than the lambs' mothers during 2010, percentage of operations by average number of hours following birth that lambs were typically given/fed their first colostrum, and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Time until first feeding (hr)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Less than 2	63.4	(3.8)	43.5	(3.8)	42.6	(6.6)	56.2	(2.7)
2 to <5	27.2	(3.5)	42.3	(3.9)	35.0	(5.7)	32.2	(2.6)
5 to 9	6.2	(1.9)	8.2	(1.9)	17.1	(4.3)	7.5	(1.4)
9 or more	3.2	(1.3)	6.0	(1.7)	5.3	(2.6)	4.2	(1.0)

A variety of liquid diets are commonly fed to lambs unable to obtain the necessary nutrition from their mothers. Properly pasteurizing and handling milk reduces pathogen loads without affecting milk quality. Nearly three-fourths of all operations supplemented lambs with milk or milk replacer.

B.7.e. Percentage of operations that supplemented lambs with milk or milk replacer, by flock size:

Percent Operations

Flock Size (number of ewes)								
Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
73.4	(2.6)	83.4	(3.1)	70.3	(5.3)	73.2	(2.0)

A lower percentage of operations in the Central region (65.5 percent) supplemented lambs with milk or milk replacer compared with operations in the East region (80.1 percent). There was no difference by flock type (data not shown).

B.7.f. Percentage of operations that supplemented lambs with milk or milk replacer, by region:

Percent Operations

Region					
West		**Central**		**East**	
Percent	**Std. error**	**Percent**	**Std. error**	**Percent**	**Std. error**
68.7	(5.1)	65.5	(3.4)	80.1	(2.6)

Nearly all operations that supplemented lambs (94.6 percent) used dried milk or milk replacer. A higher percentage of large operations than small operations used sheep milk from their own operation to supplement lambs (44.3 and 26.3 percent, respectively).

B.7.g. For operations that supplemented lambs with milk or milk replacer, percentage of operations by source of supplemental milk or milk replacer, and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Source	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Sheep milk from own operation	26.3	(2.9)	28.5	(3.6)	44.3	(5.3)	27.9	(2.2)
Liquid sheep milk from outside source	0.0	(0.0)	0.7	(0.5)	0.0	(0.0)	0.2	(0.1)
Dried milk or milk replacer	93.6	(1.7)	97.2	(1.0)	95.5	(1.7)	94.6	(1.2)
Cow milk (cows tested for Johne's disease)	2.4	(1.2)	1.8	(0.8)	0.7	(0.6)	2.2	(0.9)
Cow milk (cows not tested for Johne's disease or did not know if tested)	6.2	(1.6)	7.0	(1.7)	13.9	(3.2)	6.9	(1.2)
Goat milk	10.0	(1.9)	7.7	(2.3)	14.3	(3.2)	9.7	(1.5)
Other	0.8	(0.5)	0.7	(0.5)	0.7	(0.6)	0.7	(0.4)

A higher percentage of operations in the East region (3.8 percent) than in the West or Central region (0.3 and 0.2 percent, respectively) used cow milk from cows tested for Johne's disease.

B.7.h. For operations that supplemented lambs with milk or milk replacer, percentage of operations by source of supplemental milk or milk replacer, and by region:

Percent Operations

	Region					
	West		Central		East	
Source	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep milk from own operation	38.0	(6.2)	26.2	(3.3)	26.1	(3.2)
Liquid sheep milk from outside source	0.7	(0.7)	0.0	(0.0)	0.1	(0.1)
Dried milk or milk replacer	94.8	(3.0)	96.0	(1.2)	93.7	(2.0)
Cow milk (cows tested for Johne's disease)	0.3	(0.2)	0.2	(0.2)	3.8	(1.5)
Cow milk (cows not tested for Johne's disease or did not know if tested)	6.1	(3.2)	6.9	(1.7)	7.1	(1.8)
Goat milk	15.8	(5.0)	11.6	(2.2)	6.9	(1.9)
Other	2.8	(2.2)	0.6	(0.6)	0.2	(0.2)

Feeding pasteurized milk or milk replacer reduces the possibility of disease transmission. Nonpasteurized milk can contain a variety of pathogens, including those that cause mastitis (e.g., *Staphylococcus* and *Streptococcus* species), diarrhea (e.g., *Escherichia coli, Salmonella* species), respiratory disease (e.g., *Pasteurella*, *Mycoplasma* species), abscesses (*Corynebacterium pseudotuberculosis*), and a variety of systemic diseases (e.g., listeriosis, caprine arthritis-encephalitis, Johne's disease, brucellosis).

Pasteurization is especially important if the supplemented milk is pooled from a number of ewes or acquired from another flock, which can increase the odds of exposing lambs to disease. Scrapie may also be transmitted to sheep or goats through milk from infected sheep or goats. Pasteurization is unlikely to eliminate scrapie infectivity from milk. As a result, milk or colostrum should not be sourced from other sheep or goat herds of unknown scrapie status. Nearly all operations that supplemented lambs with fresh milk (96.7 percent) did not pasteurize the milk.

B.7.i. For operations that supplemented lambs with fresh milk, percentage of operations by whether supplemented milk was pasteurized:

Pasteurized	Percent operations	Std. error
Yes	2.5	(1.5)
No	96.7	(1.7)
Don't know	0.8	(0.8)

8. Ewe synchronization

Controlled internal drug release (CIDR) devices contain progesterone intended to prevent ewes from returning to estrus and ovulating. Once these devices are removed, the ewe will ovulate within a few days. CIDRs were approved for use in the United States in 2009. A very low percentage of all operations (6.7 percent) used CIDRs in 2010. An especially low percentage of large operations (1.5 percent) used CIDRs.

B.8.a. Percentage of operations that used a CIDR progesterone insert as a breeding tool in 2010, by flock size:

Percent Operations							
Flock Size (number of ewes)							
Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
6.7	(1.4)	8.2	(2.0)	1.5	(0.7)	6.7	(1.1)

While 6.7 percent of all operations used CIDRs in 2010, this percentage mainly reflects fenced range, pasture, and dry lot/feedlot operations; less than 1 percent of herded/open range operations used CIDRs in 2010.

B.8.b. Percentage of operations that used a CIDR progesterone insert as a breeding tool in 2010, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/feedlot	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
0.7	(0.6)	5.9	(2.3)	6.8	(1.4)	9.1	(4.1)

Three-fourths of the operations that used CIDRs used them for out-of-season breeding. “Other” reasons for using CIDRs included preparing lambs for show.

B.8.c. For operations that used a CIDR progesterone insert as a breeding tool in 2010, percentage of operations by reason for use:

Reason	Percent operations	Std. error
For out-of-season breeding	75.7	(7.9)
To synchronize estrus in season	49.2	(8.8)
With a gonadotropin (GnRH)	52.1	(8.8)
Other	7.5	(5.1)

Nearly all operations that used a CIDR insert (95.6 percent) indicated they would use it again.

B.8.d. For operations that used a CIDR progesterone insert as a breeding tool in 2010, percentage of operations that would use the insert again:

Use CIDR again?	Percent operations	Std. error
Yes	95.6	(3.7)
No	0.0	(—)
Don’t know	4.4	(3.7)
Total	100.0	

C. Lambing Management

1. Manure and waste bedding management during lambing

Cleaning the lambing area is crucial in preventing disease transmission from ewes to lambs and from ewes to ewes. Periparturient ewes, which may be immunosuppressed, and newborn lambs, with immature immune systems, are especially susceptible to infectious diseases. At the same time, the tissue and fluid left by infected ewes after giving birth often shed harmful organisms into the environment. Organisms that pose such risks include prions (cause of scrapie), *Mycobacterium avium* subspecies paratuberculosis (cause of Johne's disease), *Coxiella burnetii* (cause of Q fever), *Toxoplasma gondii*, and various *Salmonella* species, to name a few.

Just over one-fourth of operations (25.7 percent) cleaned manure and waste bedding from the lambing area either between each lambing (10.9 percent of operations) or between two or more lambings (14.8 percent). The remainder of operations either cleaned the lambing area at the end of lambing (48.8 percent) or never cleaned the lambing area (25.4 percent). A lower percentage of large operations (2.9 percent) than small operations (13.1 percent) cleaned the lambing area between each ewe lambing.

C.1.a. Percentage of operations by frequency that manure and waste bedding were cleaned from the lambing area during lambing season, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Cleaning frequency	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Between each lambing	13.1	(1.8)	6.7	(2.0)	2.9	(1.2)	10.9	(1.3)
Between two or more lambings	14.5	(1.9)	15.6	(2.4)	16.2	(3.2)	14.8	(1.5)
At the end of lambing season	48.9	(2.7)	50.7	(3.3)	40.7	(4.1)	48.8	(2.1)
Not cleaned	23.5	(2.4)	27.0	(3.3)	40.3	(4.9)	25.4	(1.9)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations in the West region (18.0 percent) cleaned between each lambing compared with operations in the East region (6.4 percent).

C.1.b. Percentage of operations by frequency that manure and waste were bedding were cleaned from the lambing area during lambing season, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Cleaning frequency	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Between each lambing	18.0	(4.3)	13.9	(2.5)	6.4	(1.5)
Between two or more lambings	14.0	(3.8)	15.3	(2.2)	14.8	(2.2)
At the end of lambing season	27.8	(4.7)	43.1	(3.2)	59.9	(3.1)
Not cleaned	40.2	(5.3)	27.6	(3.2)	18.8	(2.6)
Total	100.0		100.0		100.0	

Jugs are small individual pens used to house the ewe-lamb pair shortly after lambing. These pens allow the ewe and lamb to bond before being put in with the rest of the flock and also provide a means for ensuring that the lamb is nursing properly. Over three-fourths of operations (79.8 percent) used jugs. This management practice varied little by size of operation (data not shown) or by region.

C.1.c. Percentage of operations that used jugs, by region:

Percent Operations							
Region							
West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
84.0	(3.9)	74.5	(3.2)	82.1	(2.6)	79.8	(1.8)

For operations that used jugs, 39.2 percent cleaned them between each ewe lambing. There was little variation in the cleaning frequency of jugs by flock size (data not shown), but there were some substantial differences by region. For example, a higher percentage of operations in the West region (63.5 percent) cleaned the jugs between each ewe lambing compared with operations in the East region (22.7 percent).

C.1.d. For operations that used jugs, percentage of operations by frequency that manure and waste bedding were cleaned from jugs, and by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Cleaning frequency	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Between each ewe	63.5	(5.8)	51.7	(3.3)	22.7	(3.1)	39.2	(2.2)
Between two or more ewes	18.9	(4.6)	22.5	(2.6)	27.0	(3.3)	24.1	(2.0)
At the end of lambing season	9.6	(3.7)	21.1	(2.7)	45.8	(3.6)	31.5	(2.2)
Not cleaned	8.0	(3.4)	4.7	(1.6)	4.6	(1.4)	5.2	(1.1)
Total	100.0		100.0		100.0		100.0	

2. Placenta removal and disposal

Placentas can harbor infectious organisms and should be removed from the lambing area as soon after lambing as possible. Removing placentas is especially important on high-density operations in which ewes are clustered, making exposure to harmful organisms in placentas more likely.

In general, 67.9 percent of operations usually removed placentas from the lambing area. A total of 75.3 percent of small operations removed placentas from the lambing area compared with 52.9 percent of medium operations and 43.7 percent of large operations.

C.2.a. Percentage of operations that usually removed placentas from the lambing area, by flock size:

Percent Operations

Flock Size (number of ewes)

Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
75.3	(2.5)	52.9	(3.4)	43.7	(4.9)	67.9	(2.0)

A higher percentage of pasture operations (71.0 percent) removed placentas compared with herded/open range operations (42.2 percent). Lambs on herded/open range operations are often born on the open range.

C.2.b. Percentage of operations that usually removed placentas from the lambing area, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		**Fenced range**		**Pasture**		**Dry lot/feedlot**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
42.2	(8.3)	62.6	(4.6)	71.0	(2.4)	68.1	(6.5)

Typically, operations that removed placentas removed them within 6 hours of birth. A low percentage of operations (4.8 percent) removed the placentas more than 12 hours following birth.

C.2.c. For operations that usually removed placentas from the lambing area, percentage of operations by average length of time that placentas were left on the ground before removal, and by primary flock type:

Percent Operations

	Primary Flock Type									
	Herded/ open range		**Fenced range**		**Pasture**		**Dry lot/ feedlot**		**All operations**	
Time left on ground (hr)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Less than 6	77.2	(7.1)	64.2	(5.9)	78.0	(2.7)	85.6	(6.3)	76.0	(2.4)
6–12	14.7	(5.4)	24.3	(5.4)	18.6	(2.6)	14.0	(6.3)	19.2	(2.2)
More than 12	8.1	(4.6)	11.6	(4.0)	3.4	(1.3)	0.4	(0.3)	4.8	(1.2)
Total	100.0		100.0		100.0		100.0		100.0	

Composting and throwing out for carnivores were the two most common methods used to dispose of placentas (30.8 and 28.0 percent of operations, respectively). Over half of herded/open range operations (51.4 percent) threw out placentas for carnivores; only 15.7 percent of dry lots left placentas for carnivores. It is not clear that leaving placentas for carnivores constitutes purposeful removal. The majority of operations that reported "other" as a method of removing placentas tossed the placentas in the manure pile or spread the placentas with manure. This method does not truly represent removal, since infectious organisms are still spread in the environment and might be consumed by dogs or other carnivores.

C.2.d. For operations that usually removed placentas from the lambing area, percentage of operations by usual method of placenta disposal, and by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Method	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Burn/incinerate	3.7	(2.3)	10.2	(3.4)	8.5	(1.8)	14.6	(6.4)	9.3	(1.5)
Bury	1.7	(1.4)	4.1	(2.0)	8.3	(1.7)	2.8	(2.7)	6.9	(1.3)
Render	0.0	(—)	0.0	(—)	0.1	(0.1)	0.0	(—)	0.1	(0.1)
Landfill/dump	15.4	(5.7)	14.2	(4.2)	15.7	(2.4)	28.0	(7.8)	16.5	(2.0)
Compost	20.9	(6.9)	28.0	(5.1)	31.9	(3.1)	31.0	(7.8)	30.8	(2.5)
Throw out for carnivores	51.4	(10.8)	36.3	(5.6)	26.6	(2.9)	15.7	(5.9)	28.0	(2.4)
Other	6.9	(3.6)	7.3	(2.9)	8.9	(1.9)	8.0	(4.8)	8.5	(1.5)
Total	100.0		100.0		100.0		100.0		100.0	

3. Abortion

Overall, 86.8 percent of operations had first-lambing ewes in 2010.

C.3.a. Percentage of operations that had first-lambing ewes, by flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
90.9	(6.6)	87.7	(3.3)	86.7	(1.9)	83.7	(5.2)	86.8	(1.5)

For operations with first-lambing ewes, 60.4 percent had first lambing ewes that aborted, while 43.8 percent of all operations had abortions from bred ewes of all age groups. Over three-fourths of herded/open range operations (80.5 percent) had any ewes abort in 2010, while just 42.6 percent of pasture operations had any ewes abort during the same period.

C.3.b. Percentage of operations with one or more ewes that aborted during 2010, by primary flock type:

Percent Operations[1]

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Ewe type	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
First-lambing[2]	71.2	(10.2)	45.2	(7.3)	64.7	(4.1)	46.0	(11.2)	60.4	(3.3)
Any	80.5	(10.2)	45.5	(5.5)	42.6	(3.0)	32.9	(7.6)	43.8	(2.4)

[1]Only operations in which the last completed lambing season was in 2010.
[2]For operations with first lambing ewes.

Overall, 1.7 percent of bred ewes aborted during 2010.

C.3.c. Percentage of bred ewes that aborted, by primary flock type:

Percent Ewes

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
1.9	(0.2)	1.2	(0.2)	1.7	(0.1)	1.6	(0.4)	1.7	(0.1)

First-lambing ewes accounted for just 17.8 percent of bred ewes with full-term births (table B.4.e) but 36.7 percent of ewes that aborted.

C.3.d. For operations that had ewes abort, percentage of all ewes that aborted during 2010 that were first-lambing ewes, by primary flock type:

Percent Ewes

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
33.9	(4.8)	40.7	(5.8)	38.3	(3.4)	20.5	(5.8)	36.7	(2.5)

Most operations (83.5 percent) managed aborting ewes in some way. Over three-fourths of operations with ewes that aborted in 2010 (79.6 percent) removed placentas or fetuses as soon as possible after the abortion. A higher percentage of pasture and dry lot/feedlot operations (82.3 and 94 percent, respectively) removed placentas or fetuses compared with herded/open range operations (42.5 percent). Nearly one-third of operations (32.6 percent) separated aborting ewes from the rest of the flock.

C.3.e. For operations with ewes that aborted during 2010, percentage of operations by protocol used for aborting ewes, and by primary flock type:

Percent Operations

	Primary Flock Type									
	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Protocol	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Remove placentas or fetuses as soon as possible	42.5	(8.7)	76.1	(6.3)	82.3	(3.1)	94.0	(4.2)	79.6	(2.5)
Clean the area by removing bedding and/or dirt	27.2	(8.9)	36.5	(6.8)	27.2	(3.6)	41.0	(10.3)	30.3	(2.9)
Disinfect the area	9.0	(3.6)	15.8	(5.6)	8.3	(2.3)	8.4	(4.0)	9.6	(1.9)
Physically separate ewes that aborted from other ewes	25.8	(6.1)	36.7	(6.7)	28.4	(3.6)	59.1	(10.3)	32.6	(2.9)
Any of the above	56.1	(9.7)	80.7	(6.1)	85.5	(2.9)	94.0	(4.2)	83.5	(2.4)

Almost half of operations that separated ewes that had aborted from the rest of the flock (45.1 percent) kept the ewes out of the flock for the rest of the lambing season.

C.3.f. For operations that physically separated ewes that aborted from the rest of the flock, percentage of operations by number of days aborting ewes remained separated, and by primary flock type:

Number of days	Percent operations	Std. error
1–7 days	19.6	(4.0)
8–30 days	12.4	(3.2)
More than 30 days	7.0	(2.9)
Not returned to flock for rest of lambing season	45.1	(5.4)
Never returned to flock	16.0	(3.7)
Total	100.0	

Over one-fourth of operations (26.2 percent) indicated that the cause of abortion during 2010 was due to one of the causes in the following table. Chlamydiosis was one of the most commonly reported causes of abortion (9.0 percent of operations); only 37.3 percent of these operations had the chlamydiosis diagnosis confirmed by a veterinarian or laboratory. A veterinarian or laboratory confirmed the cause of less than half the abortions attributed to the listed organisms, even though most infectious causes of abortion cannot be accurately diagnosed without laboratory evaluation. The majority of "other" reported causes of abortion was trauma, usually by predators, but also because of shearing stress.

C.3.g. For operations with ewes that aborted during 2010, percentage of operations by cause of abortions, and percentage of these operations in which the diagnosis was made by a veterinarian or laboratory:

	Percent Operations			
	Abortions in 2010		Cause diagnosed by veterinarian or laboratory	
Cause	Percent	Std. error	Percent	Std. error
Campylobacteriosis (vibrio abortion)	6.6	(1.3)	22.6	(6.7)
Chlamydiosis (enzootic abortion)	9.0	(1.6)	37.3	(8.9)
Toxoplasmosis	3.4	(1.1)	6.9	(6.5)
Q fever	0.1	(0.1)	0.0	(—)
Salmonellosis	0.1	(0.1)	0.0	(—)
Listeriosis	0.7	(0.3)	0.0	(—)
Cache Valley virus	1.1	(0.5)	43.0	(21.6)
Other	10.3	(1.8)	3.5	(3.3)
Any cause above	26.2	(2.6)	21.6	(4.4)
Unknown	73.8	(2.6)	NA	
Total	100.0			

Having a dedicated lambing area separate from the sick ewe area reduces the risk of disease transmission. Less than one-fifth of operations (19.3 percent) kept sick ewes in the lambing area during the lambing season, while 30.6 percent kept sick ewes in the lambing area at times other than the lambing season. There was no measurable variation by flock type or size.

C.3.h. Percentage of operations that used the lambing area for sick ewes during lambing and/or at other times during 2010, by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot		All operations	
Used . . .	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
During lambing	32.6	(9.0)	22.4	(3.9)	17.4	(1.9)	21.3	(5.4)	19.3	(1.6)
At other times of the year	38.1	(9.3)	30.3	(4.4)	29.6	(2.5)	34.3	(6.4)	30.6	(2.0)

4. Tail docking

Tail docking keeps fecal matter from accumulating on the tail and hindquarters. Fecal matter accumulation attracts flies, can lead to wool maggots, and potentially reduces pelt value. Tail docking is also required for shows, although the required tail length can vary by show. Some sheep breeds (e.g., hair sheep, fat-tailed sheep, rat-tailed sheep) do not require tail docking. Just over one-tenth of operations did not dock lamb tails. Over half the operations docked lambs' tails at the caudal fold. The caudal fold consists of two flaps of skin under—and attached to each side of—the tail. These flaps meet in a "V" at the end of the caudal fold.

C.4.a. Percentage of operations that docked the tails of lambs born during 2010, by location of docking for the majority of lambs' tails and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Location	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Between the body and the caudal fold	26.6	(2.5)	14.3	(2.5)	7.5	(2.0)	22.4	(1.9)
At the "V" of the caudal fold	52.1	(2.8)	59.0	(3.4)	58.8	(5.2)	54.2	(2.1)
Distal to the caudal fold	9.0	(1.6)	14.3	(2.0)	29.0	(5.0)	11.5	(1.3)
No tail docking performed	12.3	(1.9)	12.5	(2.8)	4.7	(3.1)	11.9	(1.5)
Total	100.0		100.0		100.0		100.0	

The percentage of operations that docked tails distal to the caudal fold ranged from 3.5 percent of operations in the West region to 13.8 percent of operations in the East region.

C.4.b. Percentage of operations that docked the tails of lambs born during 2010, by location of docking for the majority of lambs' tails and by region:

	Percent Operations					
	Region					
	West		Central		East	
Location	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Between the body and the caudal fold	27.8	(5.0)	22.5	(2.9)	20.5	(2.7)
At the "V" of the caudal fold	58.3	(5.4)	54.5	(3.3)	52.6	(3.2)
Distal to the caudal fold	3.5	(1.1)	12.2	(2.0)	13.8	(2.1)
No tail docking performed	10.4	(3.4)	10.8	(2.6)	13.1	(2.1)
Total	100.0		100.0		100.0	

All herded/open range flocks docked the tails of their lambs, and over half docked at the caudal fold, while nearly one-fourth docked distal to the caudal fold.

C.4.c. Percentage of operations that docked the tails of lambs born during 2010, by location of docking for the majority of lambs' tails and by primary flock type:

	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Location	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Between the body and the caudal fold	20.6	(8.3)	21.3	(4.1)	20.7	(2.3)	36.5	(6.9)
At the "V" of the caudal fold	54.9	(8.8)	52.5	(4.7)	56.9	(2.7)	38.8	(6.6)
Distal to the caudal fold	24.4	(6.8)	12.8	(2.9)	10.3	(1.5)	12.3	(3.7)
No tail docking performed	0.0	(0.0)	13.3	(3.7)	12.1	(1.8)	12.4	(5.2)
Total	100.0		100.0		100.0		100.0	

D. Disease Control and Illness

1. Health management

Sick and injured sheep should be separated from the rest of the flock to reduce disease transmission, facilitate treatment, and allow injured sheep to heal. A similar percentage of operations removed sick sheep and injured sheep from the rest of the flock (65.0 and 64.5 percent, respectively). There was no variation in this practice by flock size, region, or primary flock type.

D.1.a. For operations that had sick or injured sheep, percentage of operations that separated sick sheep and percentage that separated injured sheep from the rest of the flock during 2010, by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
	Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Sick sheep	69.1	(3.0)	58.5	(3.7)	54.3	(5.3)	65.0	(2.2)
Injured sheep	68.6	(3.2)	55.9	(3.8)	63.4	(5.4)	64.5	(2.4)

For the 65.0 percent of operations that isolated sick sheep, 60.4 percent put them in a pen specifically for sick animals, although the sick pen was in the same housing area used for healthy sheep. “Other” places sick sheep were penned included the lambing pen or jug.

D.1.b. For operations that isolated sick sheep during 2010, percentage of operations by usual isolation area used for sick sheep, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Isolation area	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
In pen specifically for sick animals but located in the same housing as other sheep	65.0	(3.8)	52.5	(4.3)	41.7	(6.1)	60.4	(2.9)
In a separate, covered structure	26.2	(3.6)	33.6	(4.2)	29.8	(6.8)	28.4	(2.7)
In a separate, fenced area outside	21.8	(3.4)	27.0	(3.8)	46.1	(6.2)	24.8	(2.5)
Other	3.9	(1.7)	6.4	(2.4)	5.0	(2.0)	4.6	(1.3)

For the 65.0 percent of operations that isolated sick sheep during 2010, a higher percentage in the East region (69.5 percent) kept sick sheep in a pen specifically for sick animals compared with operations in the West or Central regions (47.7 and 51.5 percent, respectively). A higher percentage of operations in the West region kept sick sheep in a separate covered structure (45.2 percent) or separate fenced outside area (41.6 percent) compared with operations in the East region (21.3 and 16.0 percent, respectively).

D.1.c. For operations that isolated sick sheep during 2010, percentage of operations by usual isolation area used for sick sheep, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Isolation area	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
In pen specifically for sick animals but located in the same housing as other sheep	47.7	(7.2)	51.5	(5.1)	69.5	(3.8)
In a separate, covered structure	45.2	(7.3)	31.4	(5.0)	21.3	(3.3)
In a separate, fenced area outside	41.6	(7.3)	31.4	(4.5)	16.0	(3.2)
Other	5.7	(3.1)	7.6	(3.4)	2.8	(1.3)

For the 65.0 percent of operations that isolated sick sheep during 2010, a higher percentage of herded/open range operations (63.6 percent) kept sick sheep in a separate fenced outside area compared with pasture and dry lot operations (21.1 and 4.7 percent, respectively).

D.1.d. For operations that isolated sick sheep during 2010, percentage of operations by usual isolation area used for sick sheep, and by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Isolation area	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
In pen specifically for sick animals but located in the same housing as other sheep	34.8	(12.5)	53.7	(6.6)	62.3	(3.5)	67.9	(11.5)
In a separate, covered structure	32.1	(12.5)	32.4	(6.5)	27.7	(3.3)	25.4	(9.5)
In a separate, fenced area outside	63.6	(12.2)	37.6	(6.3)	21.1	(3.0)	4.7	(3.4)
Other	5.2	(3.4)	6.7	(3.6)	2.9	(1.0)	19.2	(12.4)

For the 65.0 percent of operations that isolated sick sheep during 2010, 35.1 percent cleaned the area after each sick animal left. Another one-third (32.5 percent) cleaned this area seasonally. The majority of large operations either cleaned the area seasonally (29.9 percent) or had no set time period to clean the pen (37.1 percent).

D.1.e. For operations that isolated sick sheep during 2010, percentage of operations by frequency that isolation area was cleaned, and by flock size:

Percent Operations

Flock Size (number of ewes)

Cleaning frequency	Small (20–99) Pct.	Small (20–99) Std. error	Medium (100–499) Pct.	Medium (100–499) Std. error	Large (500 or more) Pct.	Large (500 or more) Std. error	All operations Pct.	All operations Std. error
After each sick animal left	39.1	(3.9)	29.0	(3.9)	16.5	(4.2)	35.1	(2.9)
Weekly	6.3	(2.1)	4.2	(1.6)	8.1	(2.7)	5.9	(1.5)
Monthly	5.1	(1.7)	1.9	(0.9)	8.4	(3.6)	4.5	(1.2)
Seasonally	32.4	(3.8)	33.2	(4.0)	29.9	(6.1)	32.5	(2.8)
No set time period to clear out the pen	17.1	(2.9)	31.7	(4.2)	37.1	(6.5)	22.0	(2.3)
Total	100.0		100.0		100.0		100.0	

For the 65.0 percent of operations that isolated sick sheep during 2010, a higher percentage of operations in the West region (59.1 percent) cleaned the isolation area after each sick animal compared with operations in the East region (26.7 percent).

D.1.f. For operations that isolated sick sheep during 2010, percentage of operations by frequency that isolation area was cleaned, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Cleaning frequency	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
After each sick animal left	59.1	(6.9)	35.8	(4.9)	26.7	(3.9)
Weekly	3.3	(2.7)	6.3	(2.3)	6.5	(2.4)
Monthly	0.0	(0.0)	6.6	(2.5)	4.8	(1.8)
Seasonally	11.4	(4.4)	30.1	(4.4)	41.0	(4.4)
No set time period to clear out the pen	26.2	(5.9)	21.2	(3.9)	21.1	(3.3)
Total	100.0		100.0		100.0	

Pregnant ewes that demonstrate weight loss despite a normal appetite and do not respond to treatment are showing signs consistent with scrapie and Johne's disease and may present a risk for disease transmission to the rest of the flock, especially at lambing. Just over one-tenth of operations (11.1 percent) would cull these animals prior to lambing, while 78.9 percent would allow them to lamb and then re-evaluate or cull at that time. A higher percentage of large operations than small operations would keep the ewe regardless of the signs (23.3 and 8.4 percent, respectively).

D.1.g. Percentage of operations by the health management practice that best describes what would most likely be done if a pregnant ewe demonstrated weight loss despite a normal appetite and did not respond to treatment, and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Ewe management practice	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Cull before lambing	10.5	(1.7)	13.4	(2.4)	8.7	(2.2)	11.1	(1.3)
Allow to lamb, then re-evaluate or cull	81.1	(2.3)	75.3	(3.1)	68.0	(5.3)	78.9	(1.8)
Keep regardless of the above signs	8.4	(1.6)	11.3	(2.3)	23.3	(5.2)	10.0	(1.5)
Total	100.0		100.0		100.0		100.0	

A number of infectious diseases can cause ewes to lose weight despite a normal appetite and treatment. Since at least one of these—Johne's disease—can infect lambs in utero, it is recommended these ewes be culled before lambing. If not infected in utero, the lambs will likely then become infected through the dam's milk or by ingesting feces from the infected dam. A higher percentage of herded/open range operations than fenced range operations would, after lambing, re-evaluate or cull ewes that demonstrated weight loss despite a normal appetite.

D.1.h. Percentage of operations by the health management practice that best describes what would most likely be done if a pregnant ewe demonstrated weight loss despite a normal appetite and did not respond to treatment, and by primary flock type:

Percent Operations

	Primary Flock Type							
	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Ewe management practice	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Cull before lambing	3.9	(1.6)	11.6	(3.1)	11.2	(1.7)	12.7	(4.6)
Allow to lamb and then re-evaluate or cull	88.9	(3.1)	70.9	(4.3)	80.4	(2.2)	80.4	(5.4)
Keep regardless of the above signs	7.3	(2.6)	17.5	(3.6)	8.4	(1.5)	6.9	(3.2)
Total	100.0		100.0		100.0		100.0	

2. Johne's disease

Johne's disease is caused by the bacteria *Mycobacterium avium* subspecies *paratuberculosis*. All ruminant species are susceptible to Johne's disease, which is considered a common infection of cattle, sheep, goats, deer, and bison. There are several strains of this organism. While there are strains that primarily infect cattle and strains that primarily infect sheep, some cross infections do occur. Therefore, infected cattle can pose a risk to sheep. The majority of animals are infected in the first several months of life by ingesting bacteria shed in the feces of infected animals. While usually infected when young, most sheep do not show clinical signs of Johne's disease until they are 2 to 6 years old. In sheep, the most common sign is losing weight despite a normal appetite. Over half of operations (55.9 percent) had either never heard of Johne's disease or had heard the name only.

D.2.a. Percentage of operations by level of familiarity with Johne's disease, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Level of familiarity	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Very familiar	14.5	(2.1)	12.7	(1.9)	6.5	(1.9)	13.6	(1.5)
Somewhat familiar	29.2	(2.5)	33.5	(3.0)	31.9	(4.9)	30.5	(1.9)
Heard of name only	27.1	(2.5)	32.0	(3.2)	32.7	(4.6)	28.6	(1.9)
Never heard of	29.2	(2.6)	21.8	(2.6)	28.9	(5.1)	27.3	(1.9)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations in the East region (19.9 percent) were very familiar with Johne's disease compared with operations in the Central region (6.4 percent).

D.2.b. Percentage of operations by familiarity with Johne's disease, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Level of familiarity	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Very familiar	9.8	(3.3)	6.4	(1.5)	19.9	(2.6)
Somewhat familiar	29.7	(4.8)	20.5	(2.4)	37.7	(3.0)
Heard of name only	32.3	(5.0)	33.7	(3.0)	23.9	(2.9)
Never heard of	28.2	(4.9)	39.4	(3.2)	18.6	(2.7)
Total	100.0		100.0		100.0	

For operations very or somewhat familiar with Johne's disease, 8.8 percent had a flock health management program specifically to control the disease. There was no variation by flock size.

D.2.c. For operations **very familiar** or **somewhat familiar** with Johne's disease, percentage of operations that had a flock health management program specifically to control or prevent Johne's disease, by flock size:

Percent Operations							
Flock Size (number of ewes)							
Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
9.3	(2.4)	7.7	(2.2)	8.6	(3.7)	8.8	(1.8)

3. Scrapie

Scrapie is a fatal, degenerative disease affecting the central nervous system of sheep and goats. Infected flocks with a high percentage of susceptible animals can experience significant production losses. In these flocks, the number of infected animals increases over a period of several years, and the age at onset of clinical signs decreases, making these flocks economically unviable. Animals sold from infected flocks can spread scrapie to other flocks. The presence of scrapie in the United States also prevents the export of breeding stock, semen, and embryos to many other countries. Scrapie is part of an eradication program in the United States. For more information, visit www.eradicatescrapie.org.

Overall, 84.8 percent of operations were either very or somewhat familiar with scrapie. There was no substantial variation by flock type (data not shown).

D.3.a. Percentage of operations by level of familiarity with scrapie, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Level of familiarity	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Very familiar	43.1	(2.8)	40.1	(3.0)	31.6	(4.5)	41.6	(2.1)
Somewhat familiar	42.0	(2.8)	42.9	(3.2)	58.6	(5.1)	43.2	(2.1)
Heard of name only	12.7	(1.9)	15.9	(2.8)	9.3	(3.4)	13.3	(1.5)
Never heard of	2.3	(0.9)	1.2	(0.9)	0.5	(0.4)	1.9	(0.7)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations in the Central region had heard of scrapie by name only or had never heard of scrapie compared with operations in the West and East regions.

D.3.b. Percentage of operations by familiarity with scrapie and by region:

	Percent Operations					
	Region					
	West		Central		East	
Level of familiarity	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Very familiar	51.0	(5.4)	36.9	(3.2)	41.8	(3.1)
Somewhat familiar	43.9	(5.3)	36.7	(3.1)	47.5	(3.2)
Heard of name only	4.5	(2.1)	21.1	(3.0)	10.7	(2.1)
Never heard of	0.6	(0.4)	5.3	(1.8)	0.0	(—)
Total	100.0		100.0		100.0	

Nearly half of operations very or somewhat familiar with scrapie (47.3 percent) implemented genetic selection to control scrapie in their flock. There was no substantial variation by size or by region.

D.3.c. For operations **very familiar** or **somewhat familiar** with scrapie, percentage of operations that implemented genetic selection to control scrapie in their flock, by flock size:

Percent Operations							
Flock Size (number of ewes)							
Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
48.3	(3.1)	47.6	(3.3)	35.7	(4.2)	47.3	(2.3)

For the 47.3 percent of operations that implemented genetic selection, 98.8 percent used replacement rams genetically resistant to scrapie (RR alleles). A lower percentage of large operations (22.7 percent) selected genetically less susceptible ewes compared with small operations (53.2 percent). The majority of "other" methods for genetic selection were to keep a closed flock. There was no variation by region (data not shown).

D.3.d. For operations that genetically selected for scrapie control and were **very familiar** or **somewhat familiar** with scrapie, percentage of operations by genetic selection practices currently being used for scrapie control, and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Selection practice	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Use genetically less susceptible replacement rams (i.e., RR alleles)	98.5	(1.0)	99.5	(0.5)	100.0	(—)	98.8	(0.7)
Select genetically less susceptible ewes (i.e., QR or RR alleles)	53.2	(4.5)	40.7	(4.9)	22.7	(5.5)	48.6	(3.4)
Cull genetically more susceptible ewes (i.e., QQ alleles)	32.1	(4.2)	18.4	(4.2)	11.4	(4.0)	27.8	(3.1)
Other	1.7	(1.2)	4.6	(2.2)	0.0	(—)	2.3	(1.0)

4. Ovine progressive pneumonia

Ovine Progressive Pneumonia (OPP) is a slowly progressive viral disease of adult sheep caused by an ovine lentivirus. Most sheep do not show clinical signs of OPP, but the sheep that do typically do not display signs until 2 years of age or older because of the virus's long incubation period. Often, the first sign noticed is a general loss of body condition referred to as "thin ewe syndrome." Weight loss occurs despite the affected sheep having normal appetites. Another common sign of OPP is increased breathing effort at rest; animals tire easily and may be seen trailing the flock. These sheep are often called "lungers." Secondary bacterial infection is very common and results in additional signs such as fever, cough, lethargy, and nasal discharge. OPP infection also can cause "hard bag," an enlarged, firm udder with reduced or no milk flow. Infection with OPP virus also may cause other problems such as meningitis and encephalitis. Clinical signs include an unsteady gait, twitching, or stumbling, which can progress to hind limbs or total paralysis. Arthritis may accompany OPP infection. Pain and swelling of the joints and a shortened gait are common.

Once infected, animals remain infected for life, though many will never show clinical signs of disease. Flocks infected with OPP can have lowered production efficiency because of early culling, decreased milk production, and lower weaning weights.

Just over half of all operations (53.5 percent) were very or somewhat familiar with ovine progressive pneumonia (OPP).

D.4.a. Percentage of operations by familiarity with OPP and by region:

Percent Operations

Region

	West		Central		East		All operations	
Level of familiarity	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Very familiar	15.0	(3.9)	14.9	(2.1)	15.9	(2.2)	15.4	(1.5)
Somewhat familiar	39.7	(5.4)	35.3	(3.2)	39.6	(3.1)	38.1	(2.1)
Heard of name only	23.8	(4.7)	20.2	(2.6)	19.5	(2.6)	20.4	(1.8)
Never heard of	21.5	(4.5)	29.6	(3.3)	25.0	(2.8)	26.0	(1.9)
Total	100.0		100.0		100.0		100.0	

Of operations very or somewhat familiar with OPP, 16.2 percent had a flock health management program specifically to control or prevent OPP.

D.4.b. For operations **very** or **somewhat familiar** with OPP, percentage of operations that had a flock health management program specifically to control or prevent OPP, by region:

Percent Operations

Region

West		Central		East		All operations	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
24.5	(6.5)	16.2	(2.9)	13.4	(2.7)	16.2	(2.0)

Over half of operations that had a flock health management program for OPP removed all seropositive sheep and lambs from the flock (52.6 percent) or kept the flock isolated from infected sheep or goats (55.8 percent).

D.4.c. For operations that had a flock health management program for OPP, percentage of operations by method used to control or prevent OPP:

Method	Percent operations	Std. error
Remove all seropositive sheep and lambs from flock (sold and/or isolated in separate facilities)	52.6	(6.8)
Keep flock isolated from infected sheep or goats	55.8	(6.7)
Add only seronegative sheep to flock	42.3	(8.3)
Add only sheep from OPP-seronegative flocks	42.7	(8.2)
Test goats (if present) for caprine arthritis encephalitis	21.9	(9.7)
Other method	25.9	(5.6)

Nearly three-fourths of operations (72.7 percent) did not know their current OPP status. The lowest percentage of operations known to be currently infected with OPP was in the West region (0.7 percent).

D.4.d. Percentage of operations by current OPP status of flock, and by region:

	Percent Operations							
	Region							
	West		Central		East		All operations	
Flock status	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Currently infected with OPP	0.7	(0.4)	7.8	(1.8)	5.4	(1.6)	5.4	(1.0)
Previously infected with OPP but now negative	3.7	(2.6)	4.4	(1.8)	2.3	(1.1)	3.3	(0.9)
Never infected with OPP	25.6	(6.6)	9.4	(2.7)	22.4	(3.8)	18.7	(2.4)
Do not know current OPP status	70.1	(6.8)	78.4	(3.5)	69.9	(4.0)	72.7	(2.6)
Total	100.0		100.0		100.0		100.0	

5. Toxoplasmosis and coxiellosis

Toxoplasmosis and coxiellosis (Q fever) can cause abortion storms, yet 28.5 percent of sheep producers had not heard of toxoplasmosis, and 52.0 percent had not heard of Q fever.

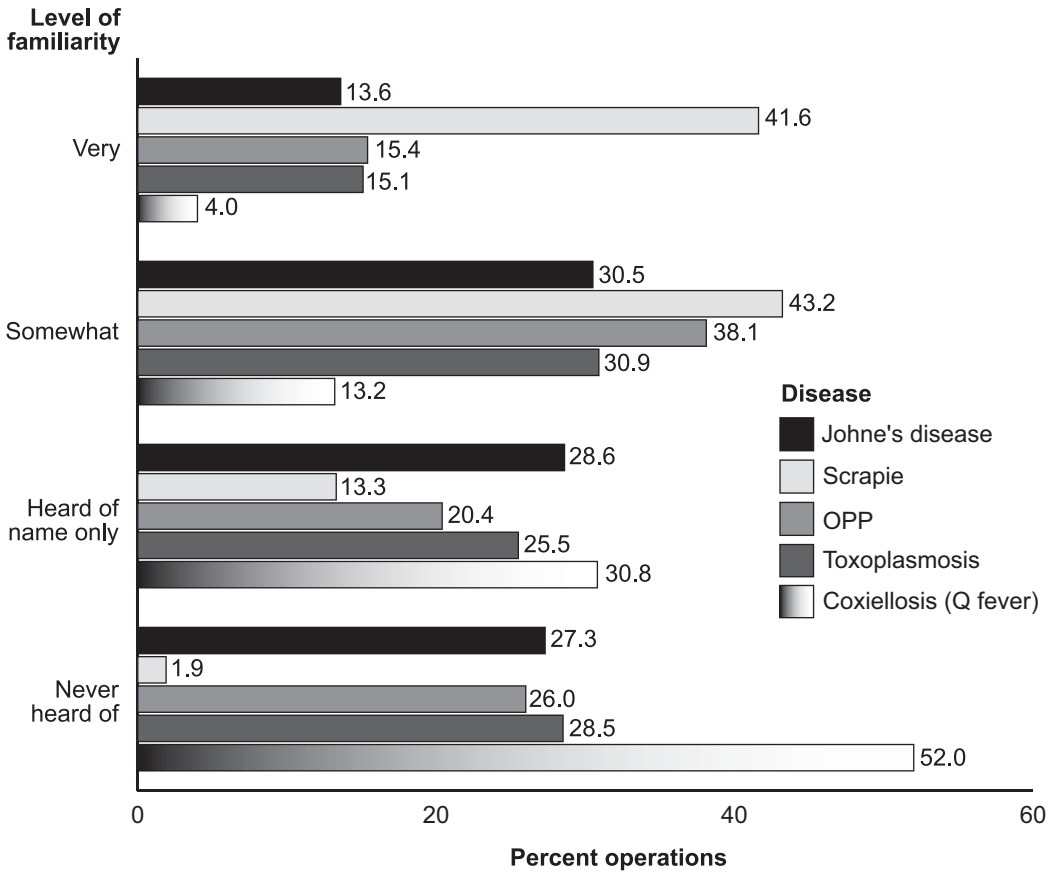
D.5. Percentage of operations by level of familiarity with toxoplasmosis and Q fever:

Percent Operations

Level of Familiarity

	Very		Somewhat		Heard of name only		Never heard of		
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Total
Toxoplasmosis	15.1	(1.6)	30.9	(1.9)	25.5	(1.9)	28.5	(2.0)	100.0
Q fever	4.0	(0.9)	13.2	(1.4)	30.8	(2.0)	52.0	(2.2)	100.0

Percentage of operations by level of familiarity with the following diseases



6. Diseases present in the last 3 years

The four most commonly seen diseases in the previous 3 years were sore mouth (43.7 percent of operations), footrot (37.3 percent), enterotoxemia/overeating disease (35.0 percent), and coccidiosis (34.0 percent). Scrapie was suspected on only 1.7 percent of participating operations during the previous 3 years. Of this 1.7 percent, 70.4 percent indicated that scrapie diagnosis was made by a veterinarian or laboratory. Some of these operations may have reported that scrapie had been suspected on their operation because their sheep were exposed to scrapie-positive or high-risk animals; however, their sheep may not have been infected.

D.6. Percentage of operations by disease present in the last 3 years, and percentage of these operations in which disease was diagnosed by a veterinarian or laboratory:

Disease	Percent operations with disease	Std. error	Percent in which disease diagnosed by veterinarian or laboratory	Std. error
Johne's (paratuberculosis)	2.5	(0.6)	40.8	(12.7)
Scrapie	1.7	(0.6)	70.4	(19.6)
Ovine progressive pneumonia (OPP)	8.2	(0.9)	24.6	(4.6)
Footrot	37.3	(2.1)	8.4	(1.9)
Caseous lymphadenitis (lumpy jaw)	24.5	(1.9)	24.1	(3.8)
Enterotoxemia/ overeating disease (*Clostridium perfringens* type C&D) (not grain overload)	35.0	(1.9)	19.7	(2.7)
Other clostridial diseases (e.g., blackleg, malignant edema, braxy, tetanus, botulism, big head)	10.4	(1.2)	17.7	(4.2)
Coccidiosis	34.0	(2.0)	37.0	(3.5)
Sore mouth (contagious ecthyma, orf)	43.7	(2.1)	12.2	(2.1)
Ring worm or club lamb fungus	8.9	(1.3)	18.8	(6.5)
Bluetongue	3.6	(0.7)	19.6	(9.5)

7. Vaccination practices

Because they can reduce the prevalence or severity of disease, vaccines are an integral part of any flock management program. Whether an operation should use particular vaccines, however, depends on whether the flock is open or closed, the geographic region of the country, diet, soil type, age of the sheep, and previous disease problems. Overall, 81.6 percent of operations vaccinated their sheep or lambs in 2010. There was no substantial variation by size, region, or flock type (data not shown).

D.7.a. Percentage of operations that vaccinated any sheep or lambs during 2010, by flock size:

Percent Operations

Flock Size (number of ewes)

Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
80.3	(2.4)	83.1	(2.9)	89.5	(3.5)	81.6	(1.8)

D.7.b. Percentage of operations that vaccinated any sheep or lambs during 2010, by region:

Percent Operations

Region

West		**Central**		**East**	
Percent	**Std. error**	**Percent**	**Std. error**	**Percent**	**Std. error**
87.6	(3.6)	76.9	(3.2)	82.7	(2.6)

The two vaccines used by the highest percentage of operations were enterotoxemia (71.4 percent) and tetanus (64.5 percent). The Footvax® vaccine was used to control footrot but was discontinued for sale in the United Stated in 2011. Since then, there have been efforts by the U.S. sheep industry to have the vaccine approved for limited sale and distribution.

D.7.c. For operations with the specified sheep type, percentage of operations by type of vaccine given and by type of sheep vaccinated during 2010:

Percent Operations

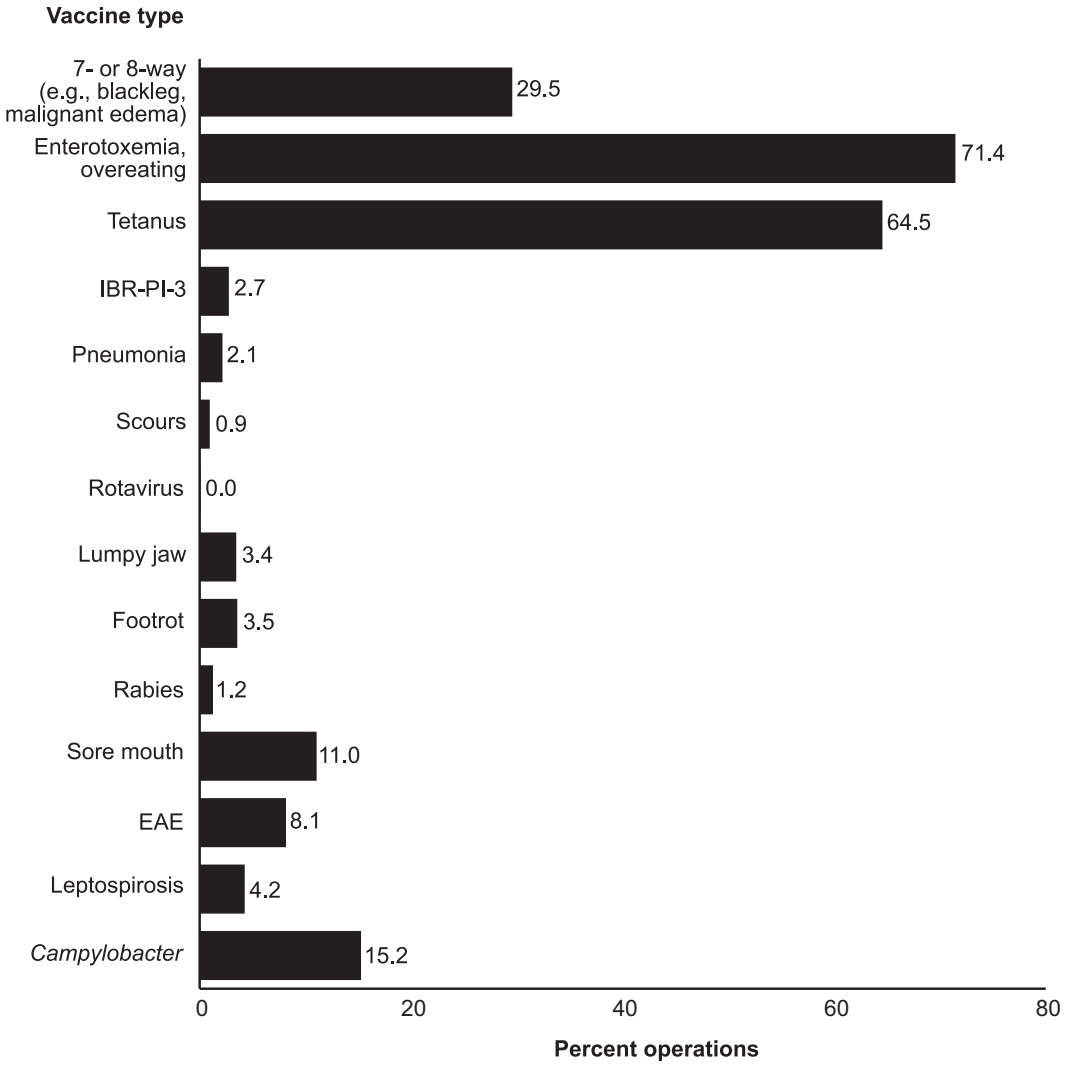
	Sheep Type											
	Nursing lambs		**Weaned feeder** (market) **lambs**		**Weaned replace-ment lambs**		**Ewes**		**Rams**		**Any**	
Vaccine type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Clostridial												
7- or 8-way (e.g., blackleg, malignant edema)	19.2	(1.7)	12.7	(1.5)	15.3	(1.5)	20.5	(1.7)	14.8	(1.5)	29.5	(1.9)
C. perfringens C and D (enterotoxemia, overeating)	60.5	(2.1)	39.8	(2.2)	37.9	(2.1)	38.8	(2.1)	28.8	(1.9)	71.4	(2.0)
C. tetani (tetanus)	55.0	(2.1)	32.9	(2.1)	33.0	(2.1)	34.0	(2.0)	25.3	(1.9)	64.5	(2.1)
Respiratory												
IBR-PI-3	1.9	(0.5)	0.6	(0.3)	0.6	(0.3)	0.0	(—)	NA		2.7	(0.6)
Pneumonia (*Pasteurella/ Mannheimia*)	0.8	(0.3)	0.6	(0.3)	0.8	(0.3)	1.5	(0.5)	0.5	(0.2)	2.1	(0.5)
Digestive												
Scours (*E. coli*)	0.3	(0.2)	0.8	(0.4)	0.3	(0.2)	0.3	(0.2)	NA		0.9	(0.4)
Rotavirus	NA		NA		0.0	(0.0)	0.0	(0.0)	NA		0.0	(0.0)

D.7.c. (cont'd.) For operations with the specified sheep type, percentage of operations by type of vaccine given and by type of sheep vaccinated during 2010:

Percent Operations

	Sheep Type											
	Nursing lambs		**Weaned feeder** (market) **lambs**		**Weaned replace-ment lambs**		**Ewes**		**Rams**		**Any**	
	Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Reproductive												
Ram epididymitis bacterin (*Brucella*)	NA		NA		NA		NA		0.0	(0.0)	NA	
EAE (*Chlamydiophila abortus*)	NA		NA		5.7	(1.0)	7.6	(1.1)	NA		8.1	(1.1)
Leptospirosis	NA		NA		2.9	(0.7)	4.1	(0.9)	NA		4.2	(0.9)
Campylobacter fetus/jejuni (vibrio)	NA		NA		10.7	(1.2)	14.6	(1.4)	NA		15.2	(1.4)
Other												
Lumpy jaw (caseous lymphadenitis)	1.5	(0.6)	0.8	(0.4)	2.0	(0.6)	2.4	(0.7)	2.5	(0.7)	3.4	(0.8)
Footrot	0.3	(0.2)	0.1	(0.1)	1.1	(0.4)	3.4	(0.8)	2.0	(0.6)	3.5	(0.8)
Rabies	0.0	(—)	0.1	(0.1)	0.6	(0.3)	1.1	(0.5)	1.1	(0.5)	1.2	(0.5)
Sore mouth (contagious ecthyma)	8.1	(1.0)	2.7	(0.7)	4.3	(0.9)	1.5	(0.6)	0.9	(0.4)	11.0	(1.2)

For operations with any nursing lambs, weaned feeder (market) lambs, weaned replacement lambs, ewes, or rams, percentage of operations by type of vaccine given



Of the 15.2 percent of operations that vaccinated for *Campylobacter fetus/jejuni* (vibrio) (table D.7.c), most used the Colorado Serum Company vaccine.

D.7.d. For operations that vaccinated for *Campylobacter fetus/jejuni* (vibrio) in weaned replacement lambs and ewes, percentage of operations by vaccine type used:

	Percent Operations			
	Weaned replacement lambs		Ewes	
Vaccine type	**Percent**	**Std. error**	**Percent**	**Std. error**
Colorado Serum Co.	61.0	(5.9)	61.6	(5.0)
Hygienia Biological Labs	24.8	(5.6)	19.4	(4.3)
Both	0.7	(0.7)	0.0	(—)
Don’t know	13.6	(3.6)	19.0	(3.9)

Because the sore mouth vaccine is comprised of live virus, vaccinating against sore mouth is only recommended when a flock is already infected with the virus. Vaccinating a flock can introduce the infection to a flock not already infected.

Of the 11.0 percent of operations that vaccinated any sheep for sore mouth, 70.6 percent used a commercially available vaccine and 5.9 percent used an autogenous vaccine from a veterinarian. While 11.1 percent of operations in the Central region used an autogenous sore mouth vaccine, none of the operations in the West and East regions did. In the East region, 21.6 percent of operations did not know which sore mouth vaccine was used.

D.7.e. Percentage of operations that vaccinated any sheep* for sore mouth during 2010, and for those operations, percentage of operations by type of vaccine most recently used, and by region:

Percent Operations

	Region							
	West		Central		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Vaccinated any sheep for sore mouth	21.2	(4.3)	16.7	(2.0)	3.5	(1.4)	11.0	(1.2)
Vaccine								
Colorado Serum Company	88.6	(7.6)	57.6	(6.6)	78.4	(18.2)	70.6	(5.4)
Autogenous vaccine from veterinarian	0.0	(—)	11.1	(4.7)	0.0	(—)	5.9	(2.6)
Other	10.4	(7.5)	24.3	(6.2)	0.0	(—)	16.0	(4.2)
Do not know	1.0	(0.9)	7.0	(3.2)	21.6	(18.2)	7.5	(3.7)
Total	100.0		100.0		100.0		100.0	

*Nursing lambs, weaned feeder (market) lambs, weaned replacement lambs, ewes, or rams.

When the sore mouth vaccine was given, the owner/operator gave the vaccine on 86.2 percent of operations. Gloves help to protect hands from accidental exposure to live virus and were worn more frequently when the owner/operator gave the vaccine (45.4 percent of operations) than when a farm worker gave the vaccine (13.1 percent).

D.7.f. For operations that vaccinated any sheep* for sore mouth during 2010, percentage of operations by who administered the vaccine, and percentage of these operations by whether gloves were worn while vaccinating:

	Percent Operations			
	Gave vaccine		Gloves worn	
Person administering vaccine	**Percent**	**Std. error**	**Percent**	**Std. error**
Veterinarian	0.0	(—)	NA	
Farm worker(s)	29.0	(5.6)	13.1	(3.5)
Owner/operator	86.2	(4.4)	45.4	(6.2)

*Nursing lambs, weaned feeder (market) lambs, weaned replacement lambs, ewes, or rams.

As mentioned previously, the Footvax vaccine was not available for sale in the United States at the time of this study. If it had been, 26.2 percent of operations indicated they would have used it. This percentage did not vary substantially by flock size, region, or primary flock type (data not shown).

D.7.g. Percentage of operations that would use Footvax vaccine if it were available, by flock size:

Percent Operations							
Flock Size (number of ewes)							
Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
24.3	(2.7)	30.9	(3.1)	27.2	(3.7)	26.2	(2.0)

8. Market lamb injections

Note: In this section, “weaned market lambs” refers to lambs intended for market and weaned while still on the operation. It does not include lambs that were weaned at the time of transport.

The majority of operations (79.3 percent) had weaned lambs intended for market during 2010.

D.8.a. Percentage of operations with weaned lambs intended for market during 2010, by flock size:

Percent Operations

Flock Size (number of ewes)

Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
78.8	(2.2)	84.1	(2.3)	65.3	(4.9)	79.3	(1.7)

A higher percentage of operations in the East region (89.3 percent) had weaned lambs intended for market during 2010 compared with the operations in the Central region (65.7 percent).

D.8.b. Percentage of operations with weaned lambs intended for market during 2010, by region:

Percent Operations

Region

West		**Central**		**East**	
Percent	**Std. error**	**Percent**	**Std. error**	**Percent**	**Std. error**
77.9	(4.2)	65.7	(3.2)	89.3	(2.0)

A lower percentage of herded/open range operations (51.9 percent) had weaned market lambs compared with pasture operations (85.1 percent). This result is likely because many herded/open range operations wean their market lambs as they leave the operation and these lambs are not included in this section.

D.8.c. Percentage of operations with weaned lambs intended for market during 2010, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/feedlot	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
51.9	(8.8)	64.9	(4.6)	85.1	(1.9)	80.3	(5.9)

Injections are administered to market lambs for a variety of reasons, including vaccination, antibiotic treatment for disease, and manipulation of the reproductive cycle. Although injection-site lesions are not a food safety issue, scar tissue at the injection site can affect meat quality. Therefore, it is generally recommended that all injections be given in the neck. Over one-third of operations with weaned lambs (37.9 percent) gave no injections to their weaned market lambs, while nearly half (48.7 percent) gave one to two injections to each of their market lambs. There was no substantial difference by flock size.

D.8.d. For operations with weaned market lambs, percentage of operations by number of injections of any kind given to weaned market lambs during 2010, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Number of injections	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
0	37.3	(3.2)	38.2	(3.8)	44.7	(6.9)	37.9	(2.4)
1–2	47.2	(3.2)	53.9	(3.8)	41.9	(6.7)	48.7	(2.4)
3–4	14.3	(2.3)	6.8	(1.5)	9.0	(2.9)	12.1	(1.7)
5 or more	1.3	(0.7)	1.1	(0.6)	4.4	(2.1)	1.4	(0.5)
Total	100.0		100.0		100.0		100.0	

No operations in the East region gave five or more injections of any kind to their weaned market lambs, but 3.8 percent of operations in the West region and 2.8 percent in the Central region did.

D.8.e. For operations with weaned market lambs, percentage of operations by number of injections of any kind given to weaned market lambs during 2010, and by region:

	Percent Operations					
	Region					
	West		Central		East	
Number of injections	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
0	38.6	(6.0)	42.7	(4.0)	35.3	(3.4)
1–2	39.7	(5.9)	46.9	(3.9)	52.1	(3.5)
3–4	17.8	(4.9)	7.6	(1.9)	12.6	(2.4)
5 or more	3.8	(2.1)	2.8	(1.5)	0.0	(—)
Total	100.0		100.0		100.0	

A higher percentage of herded/open range operations (70.2 percent) gave no injections to their weaned market lambs compared with fenced range (39.6 percent), pasture (37.1 percent), and dry lot/feedlot (35.5 percent) operations. A low percentage of herded/open range (3.9 percent), fenced range (3.4 percent), and pasture (1.0 percent) operations gave five or more injections to their weaned market lambs.

D.8.f. For operations with weaned market lambs, percentage of operations by number of injections of any kind given to weaned market lambs during 2010, and by primary flock type:

	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Number of injections	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
0	70.2	(8.8)	39.6	(5.7)	37.1	(2.9)	35.5	(7.8)
1–2	25.9	(8.0)	50.3	(5.9)	49.0	(3.0)	48.5	(7.8)
3–4	0.0	(—)	6.8	(2.7)	12.9	(2.1)	16.0	(5.9)
5 or more	3.9	(3.6)	3.4	(2.4)	1.0	(0.5)	0.0	(—)
Total	100.0		100.0		100.0		100.0	

Nearly all injections given to weaned market lambs were administered by farm personnel. There was very little difference across flock sizes, regions, or flock types in the percentage of operations by person administering injections (data not shown).

D.8.g. For operations that gave injections of any kind to weaned market lambs during 2010, operation average percentage of all injections administered, by person administering injections and by flock size:

Operation Average Percent Injections

Flock Size (number of ewes)

Person administering injection	Small (20–99) Avg.	Small (20–99) Std. error	Medium (100–499) Avg.	Medium (100–499) Std. error	Large (500 or more) Avg.	Large (500 or more) Std. error	All operations Avg.	All operations Std. error
Farm personnel	99.6	(0.4)	96.4	(1.3)	100.0	(0.0)	98.8	(0.4)
Veterinarian	0.1	(0.1)	2.4	(1.0)	0.0	(—)	0.7	(0.3)
Other	0.4	(0.4)	1.2	(0.8)	0.0	(—)	0.6	(0.3)
Total	100.0		100.0		100.0		100.0	

Approximately three-fourths of injections given to weaned market lambs (76.7 percent) were given subcutaneously (SQ). Virtually no injections were given intravenously (IV). There were no substantial differences in injection route by region or flock type (data not shown).

D.8.h. For operations that gave injections of any kind to weaned market lambs during 2010, operation average percentage of all injections given, by injection route and by flock size:

Operation Average Percent Injections

Flock Size (number of ewes)

Injection route	Small (20–99) Avg.	Small (20–99) Std. error	Medium (100–499) Avg.	Medium (100–499) Std. error	Large (500 or more) Avg.	Large (500 or more) Std. error	All operations Avg.	All operations Std. error
Intramuscular (IM)	17.7	(3.8)	16.7	(4.0)	30.7	(15.0)	23.3	(7.3)
Subcutaneous (SQ)	82.3	(3.8)	83.3	(4.0)	69.3	(15.0)	76.7	(7.3)
Intravenous (IV)	0.0	(—)	0.0	(0.0)	0.0	(—)	0.0	(0.0)
Total	100.0		100.0		100.0		100.0	

Of the 23.3 percent of operations that gave intramuscular (IM) injections (table D.8.h), over half (58.1 percent) gave IM injections in the neck, while 38.6 percent gave IM injections in the leg. Nearly all large operations (95.8 percent) gave IM injections in the neck compared with only 49.3 percent of small operations. Only 4.2 percent of large operations gave IM injections in the leg compared with 47.7 percent of small operations.

D.8.i. For operations that gave IM injections of any kind to weaned market lambs during 2010, percentage of operations by primary location of injection and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
IM injection location	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Neck	49.3	(8.3)	69.4	(10.0)	95.8	(3.8)	58.1	(6.4)
Loin	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)
Leg	47.7	(8.4)	26.3	(9.8)	4.2	(3.8)	38.6	(6.4)
Other location	3.1	(3.0)	4.3	(3.1)	0.0	(—)	3.3	(2.1)
Total	100.0		100.0		100.0		100.0	

E. Antibiotics

1. Antibiotic use

Overall, 69.0 percent of operations administered oral, injectable, or topical antibiotics to lambs or ewes to treat any disease during 2010; 59.0 percent of operations gave antibiotics to ewes, and 15.7 percent gave antibiotics to weaned market lambs.

E.1.a. For operations with the specified sheep type, percentage of operations that administered antibiotics* to treat any disease during 2010, by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Sheep type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Nursing lambs	40.9	(2.7)	48.1	(3.0)	48.8	(4.6)	43.1	(2.1)
Weaned replacement lambs	17.8	(2.2)	21.1	(2.5)	20.5	(4.2)	18.8	(1.7)
Weaned market lambs	13.4	(1.9)	21.6	(2.4)	18.3	(3.1)	15.7	(1.4)
Ewes	56.4	(2.8)	64.7	(3.4)	65.4	(5.1)	59.0	(2.1)
Any	67.2	(2.7)	73.5	(3.2)	70.5	(5.2)	69.0	(2.1)

*Oral, injectable, or topical.

Weaned market lambs were administered oral, injectable, or topical antibiotics by 9.5 percent of operations in the Central region and by 19.6 percent of operations in the West region.

E.1.b. For operations with the specified sheep type, percentage of operations that administered antibiotics* to treat any disease during 2010 by region:

Percent Operations

Region

	West		Central		East	
Sheep type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Nursing lambs	44.4	(5.4)	38.6	(2.8)	45.9	(3.2)
Weaned replacement lambs	24.2	(4.7)	15.7	(2.4)	19.2	(2.5)
Weaned market lambs	19.6	(4.5)	9.5	(1.7)	18.8	(2.2)
Ewes	66.5	(5.2)	50.3	(3.2)	62.6	(3.2)
Any	73.6	(4.9)	62.1	(3.3)	72.2	(3.0)

*Oral, injectable, or topical.

A lower percentage of herded/open range and fenced range operations (5.8 and 5.7 percent, respectively) administered oral, injectable, or topical antibiotics to market lambs to treat disease compared with pasture operations (18.4 percent).

E.1.c. For operations with the specified sheep type, percentage of operations that administered antibiotics* to treat any disease during 2010 by primary flock type:

Percent Operations

Primary Flock Type

	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
Sheep type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Nursing lambs	34.9	(6.3)	33.5	(4.1)	47.2	(2.6)	36.7	(6.4)
Weaned replacement lambs	9.7	(3.1)	14.3	(3.3)	19.7	(2.1)	22.1	(5.6)
Weaned market lambs	5.8	(2.3)	5.7	(1.9)	18.4	(1.9)	22.0	(5.5)
Ewes	53.3	(8.5)	49.7	(4.6)	63.4	(2.7)	49.4	(6.9)
Any	53.3	(8.5)	58.1	(4.7)	73.8	(2.5)	63.7	(7.0)

*Oral, injectable, or topical.

2. Antibiotic treatment records

An essential part of responsible antibiotic use is record keeping. At a minimum, these records should note the antibiotic name, animals treated, date treated, and reason for treatment. Just over half of all operations that administered antibiotics (51.0 percent) kept any records of antibiotic use. Overall, the highest percentage of operations that administered antibiotics (45.8 percent) kept records on the identity of animals treated. Knowing what animals were treated helps ensure an adequate withdrawal time before an animal is sent to slaughter, or before its milk is used for human consumption. A higher percentage of small operations kept records for name of product, identity of animals treated, and reason for treatment compared with large operations. There were no substantial differences in record-keeping practices by region (data not shown).

E.2.a. For operations that administered antibiotics* to lambs or ewes during 2010, percentage of operations by type of antibiotic treatment records kept, and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Record type	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Product expiration date	17.1	(2.6)	15.0	(2.8)	16.7	(3.3)	16.5	(1.9)
Name of product	38.1	(3.2)	34.5	(3.4)	23.2	(3.9)	36.2	(2.4)
Identity of animals treated	49.3	(3.3)	41.1	(3.5)	27.9	(4.2)	45.8	(2.4)
Reason for treatment	41.0	(3.3)	32.2	(3.4)	18.2	(3.6)	37.3	(2.4)
Any record	53.5	(3.2)	47.4	(3.6)	38.3	(4.4)	51.0	(2.4)

*Oral, injectable, or topical.

Herded/open range operations accounted for the lowest percentage of operations that kept antibiotic-use records of any kind (27.6 percent).

E.2.b. For operations that administered antibiotics* to lambs or ewes during 2010, percentage of operations by type of antibiotic treatment records kept and by primary flock type:

Percent Operations

Primary Flock Type

Record type	Herded/ open range		Fenced range		Pasture		Dry lot/ feedlot	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Product expiration date	13.1	(4.4)	15.3	(4.3)	16.4	(2.3)	22.7	(7.6)
Name of product	18.0	(4.8)	29.9	(5.2)	36.7	(2.9)	47.3	(8.1)
Identity of animals treated	21.1	(5.5)	43.3	(5.7)	45.1	(3.0)	61.1	(7.6)
Reason for treatment	9.8	(4.0)	34.3	(5.6)	37.3	(2.9)	48.4	(8.0)
Any record	27.6	(5.8)	51.2	(5.7)	49.8	(3.0)	63.6	(7.4)

*Oral, injectable, or topical.

3. Antibiotics given[1]

For the 69.0 percent of operations that gave any antibiotics (table E.1.a), respiratory disease was the most common illness treated with antibiotics (67.7 percent of operations). The antibiotic class used most frequently to treat respiratory disease was penicillin, followed by tetracycline, and phenicol (29.9, 19.2, and 13.6 percent of operations that gave any antibiotics, respectively).

Mastitis, lameness, and diarrhea/scours or other digestive disorder were the next most frequently treated diseases or disorders (44.2, 35.8, and 30.4 percent of operations that gave any antibiotics, respectively). The antibiotic used most frequently to treat mastitis was penicillin (26.1 percent of operations) while the most frequently used antibiotic to treat for lameness was tetracycline (22.2 percent). Aminoglycosides were used more frequently than any other antibiotic to treat diarrhea/scours or other digestive disorder (12.6 percent).

Few drugs are approved for use in sheep, thus many of the drugs listed below are being used under the Animal Medicinal Drug Use Clarification Act (AMDUCA), which requires a valid veterinary-client-patient relationship; such use is considered to be extra-label. While currently allowed under AMDUCA, aminoglycoside use is generally discouraged due to its prolonged persistence in tissues.

[1]See appendix III for antibiotic classes and active ingredients.

E.3. For operations that gave any antibiotics* (excluding preventive treatments) to individual lambs or ewes during 2010, percentage of operations by antibiotic given and by disease or disorder treated:

	Percent Operations									
	Disease or Disorder									
	Respiratory		Diarrhea/ scours or other digestive		Pinkeye		Navel infection		Lameness/ footrot	
Antibiotic class	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Aminoglycoside	0.1	(0.1)	12.6	(1.7)	0.4	(0.2)	0.1	(0.1)	0.2	(0.2)
Penicillin	29.9	(2.4)	4.0	(0.9)	1.6	(0.6)	7.6	(1.2)	8.1	(1.4)
Cephalosporin	4.4	(1.0)	1.1	(0.5)	0.2	(0.2)	0.9	(0.4)	1.1	(0.6)
Phenicol (i.e., florfenicol)	13.6	(1.8)	1.1	(0.5)	0.0	(—)	0.4	(0.3)	3.8	(1.2)
Lincosamide	0.3	(0.3)	0.0	(—)	0.0	(—)	0.1	(0.1)	0.0	(0.0)
Macrolide	4.5	(1.0)	0.0	(—)	0.0	(—)	0.1	(0.1)	0.5	(0.4)
Sulfonamide	1.0	(0.5)	7.9	(1.4)	0.0	(0.0)	0.0	(—)	0.0	(0.0)
Tetracycline	19.2	(1.8)	5.7	(1.0)	7.2	(1.3)	2.0	(0.5)	22.2	(2.0)
Other	3.4	(1.0)	1.4	(0.6)	3.8	(1.0)	0.5	(0.4)	0.7	(0.5)
Any	67.7	(2.5)	30.4	(2.3)	13.2	(1.8)	11.8	(1.4)	35.8	(2.5)

*Oral, injectable, or topical.

E.3. (con't.) For operations that gave any antibiotics* (excluding preventive treatments) to individual lambs or ewes during 2010, percentage of operations by antibiotic given and by disease or disorder treated:

	Percent Operations							
	Disease or Disorder							
	Reproductive		Mastitis		Abortion		Other	
Antibiotic	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Aminoglycoside	0.1	(0.1)	0.4	(0.3)	0.0	(—)	0.0	(—)
Penicillin	13.2	(1.7)	26.1	(2.2)	4.1	(1.0)	8.2	(1.5)
Cephalosporin	0.7	(0.4)	3.3	(0.8)	0.1	(0.1)	0.4	(0.2)
Phenicol (i.e., florfenicol)	0.8	(0.5)	2.4	(0.8)	0.4	(0.3)	1.5	(0.6)
Lincosamide	0.0	(—)	0.6	(0.3)	0.1	(0.1)	0.0	(—)
Macrolide	0.1	(0.1)	1.6	(0.6)	0.0	(—)	0.3	(0.3)
Sulfonamide	0.6	(0.2)	0.3	(0.1)	0.1	(0.1)	0.0	(—)
Tetracycline	3.7	(0.8)	9.1	(1.4)	3.9	(0.8)	4.3	(1.1)
Other	0.4	(0.4)	0.6	(0.6)	0.0	(—)	0.3	(0.3)
Any	19.7	(1.9)	44.2	(2.5)	8.7	(1.3)	14.2	(1.8)

*Oral, injectable, or topical.

4. Treatment of nursing lambs

One-third of operations with nursing lambs (33.8 percent) treated them for respiratory disease. About half that many (18.6 percent) treated nursing lambs for diarrhea/scours or other digestive problem. The use of antibiotics to treat navel infections increased as flock size increased.

E.4.a. For operations with nursing lambs, percentage of operations that gave nursing lambs any antibiotics* to treat the following diseases disorders, by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Disease/disorder	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Respiratory	31.0	(2.6)	37.8	(3.0)	40.6	(4.4)	33.8	(2.0)
Diarrhea/scours or other digestive problem	17.1	(2.0)	21.6	(2.4)	23.8	(3.5)	18.6	(1.5)
Pinkeye	2.3	(0.8)	3.2	(1.0)	5.3	(1.8)	2.7	(0.6)
Navel infection	4.5	(1.2)	15.3	(2.0)	19.0	(3.3)	8.1	(1.0)
Other	3.9	(1.0)	2.9	(0.9)	2.4	(1.1)	3.5	(0.7)
Any	40.9	(2.7)	48.1	(3.0)	48.8	(4.6)	43.1	(2.1)

*Oral, injectable, or topical.

Of the 43.1 percent of operations that treated nursing lambs with antibiotics during 2010 (table E.1.a), 43.6 percent treated for respiratory disease using penicillin. Penicillin was also used most commonly to treat navel infection in nursing lambs (64.9 percent of operations). Aminoglycosides were used by 43.9 percent of operations to treat diarrhea/ scours or other digestive problem, while tetracycline was used most commonly to treat pinkeye (43.5 percent of operations). The majority of "other" antibiotics used to treat pinkeye were a tetracycline/peptide class compound.

E.4.b. For operations that treated nursing lambs with antibiotics* during 2010, percentage of operations by antibiotic given, and by disease or disorder treated:

Percent Operations

Disease or Disorder

	Respiratory		Diarrhea/ scours or other digestive		Pinkeye		Navel infection		Other	
Antibiotic	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Aminoglycoside	0.0	(—)	43.9	(4.7)	9.3	(5.6)	0.7	(0.7)	0.0	(—)
Penicillin	43.6	(3.5)	11.1	(2.9)	12.6	(5.8)	64.9	(5.9)	59.1	(10.2)
Cephalosporin	5.5	(1.4)	2.9	(1.5)	0.0	(—)	8.0	(3.4)	0.0	(—)
Phenicol (i.e., florfenicol)	19.7	(2.9)	3.7	(1.8)	0.0	(—)	3.1	(2.7)	11.2	(6.9)
Lincosamide	0.0	(—)	0.0	(—)	0.0	(—)	1.2	(1.1)	0.0	(—)
Macrolide	4.7	(1.6)	0.0	(—)	0.0	(—)	0.9	(0.8)	6.6	(6.3)
Sulfonamide	1.5	(0.9)	19.7	(4.0)	1.1	(1.0)	0.0	(—)	0.0	(—)
Tetracycline	20.3	(2.5)	15.3	(2.9)	43.5	(11.8)	16.9	(4.1)	16.7	(6.2)
Other	4.7	(1.7)	3.3	(1.6)	33.5	(10.5)	4.2	(3.1)	6.4	(4.7)

*Oral, injectable, or topical.

Not all sick animals on operations that used antibiotics were treated. For example, on the 43.1 percent of operations that treated nursing lambs with antibiotics (table E.1.a), 2.8 percent of nursing lambs had respiratory disease; of these lambs, 93.9 percent were treated. Therefore, 2.6 percent of nursing lambs on operations that used oral, injectable, or topical antibiotics were treated for respiratory disease. While 3.5 percent of nursing lambs on operations that used oral, injectable, or topical antibiotics had diarrhea/scours or other digestive problems, just 82.2 percent of those lambs were treated. Therefore, 2.9 percent of all nursing lambs on operations that used oral, injectable, or topical antibiotics were treated for diarrhea/scours or other digestive problem.

E.4.c. For operations that treated nursing lambs with antibiotics[1] during 2010, percentage of nursing lambs affected by disease, and percentage of affected lambs treated, by disease/disorder treated:

	Percent Nursing Lambs[2]			
Disease/disorder	Affected	Std. error	Of those affected, percent treated	Std. error
Respiratory	2.8	(0.3)	93.9	(2.1)
Diarrhea/scours or other digestive problem	3.5	(0.6)	82.2	(10.0)
Pinkeye	0.2	(0.1)	97.0	(2.2)
Navel infection	0.4	(0.1)	95.8	(1.6)
Other	0.7	(0.5)	98.7	(1.3)

[1] Oral, injectable, or topical.
[2] As a percentage of lambs born in 2011.

5. Treatment of weaned replacement lambs

Overall, 12.0 percent of operations with weaned replacement lambs treated them for respiratory disease. A lower percentage of operations treated weaned replacement lambs for diarrhea/scours or other digestive problem (5.1 percent), lameness (3.8 percent), or pinkeye (1.8 percent). There was no variation by flock size or region (data not shown).

E.5.a. For operations with weaned replacement lambs, percentage of operations that gave weaned replacement lambs any antibiotics* to treat the following diseases or disorders, by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Disease/disorder	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Respiratory	10.8	(1.8)	14.7	(2.0)	14.9	(4.0)	12.0	(1.4)
Diarrhea/scours or other digestive problem	5.4	(1.3)	4.4	(1.6)	5.1	(3.3)	5.1	(1.0)
Pinkeye	1.7	(0.7)	1.2	(0.6)	4.8	(3.2)	1.8	(0.5)
Lameness	3.3	(1.0)	4.8	(1.2)	4.9	(1.9)	3.8	(0.7)
Other	2.4	(0.9)	0.3	(0.3)	0.6	(0.5)	1.8	(0.6)
Any	17.8	(2.2)	21.1	(2.5)	20.5	(4.2)	18.8	(1.7)

*Oral, injectable, or topical antibiotics.

Of the 18.8 percent of operations that gave antibiotics to weaned replacement lambs (table E.1.a), 29.8 percent treated weaned replacement lambs with phenicol for respiratory disease. Tetracycline was used to treat a broad spectrum of diseases. The majority of "other" antibiotics used to treat pinkeye were a tetracycline/peptide class compound.

E.5.b. For operations that treated weaned replacement lambs with antibiotics* during 2010, percentage of operations by antibiotic given, and by disease or disorder treated:

Percent Operations

Disease or Disorder

	Respiratory		Diarrhea/ scours or other digestive		Pinkeye		Lameness/ footrot		Other	
Antibiotic	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Aminoglycoside	0.0	(—)	27.0	(9.9)	0.0	(—)	1.6	(1.5)	0.0	(—)
Penicillin	24.1	(5.4)	12.3	(6.6)	5.4	(3.7)	19.7	(8.5)	50.2	(18.2)
Cephalosporin	7.1	(2.8)	5.4	(5.2)	0.0	(—)	6.6	(6.2)	5.5	(5.4)
Phenicol (i.e., florfenicol)	29.8	(5.4)	7.1	(5.3)	0.0	(—)	4.0	(3.8)	23.6	(13.6)
Lincosamide	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)
Macrolide	9.3	(4.1)	0.0	(—)	0.0	(—)	6.7	(6.3)	0.0	(—)
Sulfonamide	0.3	(0.2)	36.8	(10.1)	0.0	(—)	0.0	(—)	0.0	(—)
Tetracycline	24.2	(4.9)	11.3	(5.9)	29.6	(14.8)	54.8	(10.0)	20.7	(13.6)
Other	5.2	(2.4)	0.0	(—)	65.0	(15.7)	6.6	(6.2)	0.0	(—)

*Oral, injectable, or topical antibiotics.

Not all of the operations that used antibiotics treated all sick weaned replacement lambs. For example, on the 18.8 percent of operations that administered antibiotics to weaned replacement lambs (table E1.a), 1.2 percent of lambs had respiratory disease and, of these lambs, 93.5 percent were treated with antibiotics. Therefore, 1.1 percent of all weaned replacement lambs on these operations were treated for respiratory disease during 2010.

E.5.c. For operations that treated weaned replacement lambs with antibiotics[1] during 2010, percentage of weaned replacement lambs affected by disease, and percentage of affected lambs treated, by disease/disorder treated:

	Percent Weaned Replacement Lambs[2]			
Disease/disorder	Affected	Std. error	Of those affected, percent treated	Std. error
Respiratory	1.2	(0.2)	93.5	(3.4)
Diarrhea/scours or other digestive problem	0.6	(0.2)	90.7	(5.9)
Pinkeye	0.3	(0.1)	98.8	(1.2)
Lameness	1.1	(0.5)	98.8	(1.0)
Other	0.2	(0.1)	97.8	(2.2)

[1] Oral, injectable, or topical.
[2] As a percentage of lambs born in 2010.

6. Treatment of weaned market lambs

Overall, 11.2 percent of operations with weaned market lambs treated the lambs for respiratory disease. In comparison, a lower percentage of these operations treated weaned market lambs for diarrhea/scours or other digestive problem (5.1 percent), lameness (3.8 percent), or pinkeye (1.1 percent).

E.6.a. For operations with weaned market lambs, percentage of operations that gave weaned market lambs any antibiotics* to treat the following diseases or disorders, by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Disease/disorder	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Respiratory	9.2	(1.6)	15.6	(2.0)	16.4	(3.0)	11.2	(1.2)
Diarrhea/scours or other digestive problem	5.7	(1.3)	4.1	(1.2)	2.6	(1.1)	5.1	(1.0)
Pinkeye	0.9	(0.5)	1.6	(1.2)	2.4	(1.1)	1.1	(0.5)
Lameness/footrot	2.9	(0.9)	6.4	(1.4)	3.9	(1.6)	3.8	(0.7)
Other	0.8	(0.4)	0.9	(0.5)	1.1	(0.6)	0.9	(0.3)
Any	13.4	(1.9)	21.6	(2.4)	18.3	(3.1)	15.7	(1.4)

*Oral, injectable, or topical.

Of the 15.7 percent of operations that treated weaned market lambs with antibiotics (table E.1.a), most used tetracycline to treat pinkeye and lameness (62.2 and 59.3 percent of operations, respectively). The treatment for respiratory disease varied, with 31.4 percent of operations using florphenicol, 25.8 percent of operations using tetracycline, and 22.8 percent of operations using penicillin. The treatment for diarrhea/ scours or other digestive problem was even more split, with sulfonamide, aminoglycoside, tetracycline, cephalosporin, and penicillin all used to some extent. The majority of "other" antibiotics used to treat pinkeye were a tetracycline/peptide class compound.

E.6.b. For operations that treated weaned market lambs with antibiotics* during 2010, percentage of operations by antibiotic given, and by disease or disorder treated:

Percent Operations

Disease or Disorder

	Respiratory		Diarrhea/ scours or other digestive		Pinkeye		Lameness/ footrot		Other	
Antibiotic	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Aminoglycoside	0.0	(—)	20.1	(8.6)	0.0	(—)	0.0	(—)	0.0	(—)
Penicillin	22.8	(4.8)	12.1	(6.5)	7.5	(5.6)	17.6	(7.6)	18.3	(12.5)
Cephalosporin	9.4	(3.6)	13.3	(7.3)	0.0	(—)	11.9	(7.5)	11.5	(10.8)
Phenicol (i.e., florfenicol)	31.4	(5.5)	1.7	(1.0)	0.0	(—)	3.5	(2.2)	22.7	(14.4)
Lincosamide	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)
Macrolide	6.8	(2.9)	0.0	(—)	0.0	(—)	0.9	(0.8)	0.0	(—)
Sulfonamide	0.3	(0.3)	27.9	(8.6)	0.0	(—)	0.8	(0.7)	0.0	(—)
Tetracycline	25.8	(4.6)	18.9	(7.9)	62.2	(23.8)	59.3	(9.5)	47.4	(19.9)
Other	3.5	(2.2)	9.0	(5.6)	30.3	(23.9)	6.0	(5.6)	0.0	(—)

*Oral, injectable, or topical antibiotics.

Not all operations that used antibiotics treated all sick animals. For example, on the 15.7 percent of operations that administered antibiotics to weaned market lambs (table E.1.a), 11.0 percent of weaned market lambs were lame or had footrot, and 81.4 percent of affected lambs were treated. Therefore, 8.9 percent of all weaned market lambs on these operations were treated for lameness or footrot.

E.6.c. For operations that treated weaned market lambs with antibiotics[1] during 2010, percentage of lambs affected by the following diseases:

	Percent Weaned Market Lambs[2]			
Disease/disorder	Affected	Std. error	Of those affected, percent treated	Std. error
Respiratory	6.0	(1.3)	92.5	(3.4)
Diarrhea/scours or other digestive problem	5.3	(2.1)	78.8	(8.7)
Pinkeye	1.1	(0.7)	83.6	(13.3)
Lameness/footrot	11.0	(3.5)	81.4	(7.5)
Other	0.7	(0.3)	74.5	(14.9)

[1] Oral, injectable, or topical.
[2] As a percentage of weaned market lambs on January 1, 2011.

7. Treatment of ewes

About one-fourth of all operations treated ewes for respiratory disease and lameness (24.6 and 24.4 percent, respectively). There were no substantial differences by region (data not shown).

E.7.a. For operations with ewes, percentage of operations that gave ewes any antibiotics* to treat the following diseases or disorders, by flock size:

	Percent Operations							
	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Disease/disorder	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Respiratory	23.2	(2.3)	25.0	(2.5)	39.0	(4.3)	24.6	(1.7)
Diarrhea/scours or other digestive problem	4.0	(1.0)	1.8	(0.8)	3.4	(1.3)	3.4	(0.8)
Pinkeye	6.6	(1.4)	6.5	(1.9)	8.3	(2.1)	6.6	(1.1)
Lameness/footrot	21.5	(2.3)	31.2	(2.8)	29.6	(3.7)	24.4	(1.8)
Reproductive	11.0	(1.7)	14.6	(2.0)	23.0	(3.4)	12.6	(1.3)
Mastitis	27.3	(2.4)	37.2	(3.2)	41.3	(4.8)	30.6	(1.9)
Abortion	4.6	(1.1)	7.8	(1.5)	13.6	(3.0)	5.9	(0.9)
Other	6.4	(1.4)	4.1	(1.1)	5.5	(2.0)	5.8	(1.0)
Any	56.4	(2.8)	64.7	(3.4)	65.4	(5.1)	59.0	(2.1)

*Oral, injectable, or topical.

On the 59.0 percent of operations that treated ewes with antibiotics (table E.1.a), tetracycline was the most commonly used antibiotic to treat pinkeye and lameness (60.5 and 61.5 percent of operations, respectively). Just over two-thirds of operations (67.1 percent) that treated ewes with antibiotics used penicillin to treat for reproductive disease. Sulfonamide was rarely used for any condition other than diarrhea/scours or other digestive disorder. The majority of "other" antibiotics used to treat pinkeye were a tetracycline/peptide class compound.

E.7.b. For operations that treated ewes with antibiotics* during 2010, percentage of operations by antibiotic given, and by disease or disorder treated:

	Percent Operations							
	Disease or Disorder							
	Respiratory		Diarrhea/ scours or other digestive		Pinkeye		Lameness/ footrot	
Antibiotic	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Aminoglycoside	0.2	(0.2)	11.8	(7.7)	0.0	(—)	0.6	(0.4)
Penicillin	38.8	(4.0)	19.9	(9.5)	10.1	(5.7)	21.4	(3.5)
Cephalosporin	5.0	(2.1)	3.6	(3.4)	0.4	(0.3)	2.0	(1.3)
Phenicol (i.e., florfenicol)	14.6	(2.9)	3.6	(3.5)	0.0	(—)	11.0	(3.1)
Lincosamide	0.8	(0.8)	0.0	(—)	0.0	(—)	0.1	(0.1)
Macrolide	3.5	(1.2)	0.0	(—)	0.0	(—)	1.3	(1.0)
Sulfonamide	0.5	(0.4)	41.6	(12.4)	0.5	(0.4)	0.0	(—)
Tetracycline	33.2	(3.6)	19.6	(9.2)	60.5	(8.8)	61.5	(4.2)
Other	3.2	(1.2)	0.0	(—)	28.5	(7.8)	2.0	(1.3)

*Oral, injectable, or topical.

E.7.b. (cont'd.) For operations that treated ewes with antibiotics* during 2010, percentage of operations by antibiotic given, and by disease or disorder treated:

	Percent Operations							
	Disease or Disorder							
	Reproductive		Mastitis		Abortion		Other	
Antibiotic	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Aminoglycoside	0.5	(0.5)	0.9	(0.7)	0.0	(—)	0.0	(—)
Penicillin	67.1	(4.9)	59.0	(3.6)	47.1	(7.8)	55.4	(9.1)
Cephalosporin	3.8	(2.0)	7.4	(1.9)	1.2	(1.2)	3.0	(2.1)
Phenicol (i.e., florfenicol)	3.9	(2.4)	5.4	(1.7)	4.5	(3.8)	8.1	(5.4)
Lincosamide	0.0	(—)	1.2	(0.7)	1.2	(1.2)	0.0	(—)
Macrolide	0.7	(0.7)	3.5	(1.4)	0.0	(—)	0.0	(—)
Sulfonamide	3.0	(1.2)	0.6	(0.3)	1.4	(1.3)	0.0	(—)
Tetracycline	18.8	(3.8)	20.6	(3.1)	44.5	(7.6)	33.5	(8.7)
Other	2.2	(1.9)	1.4	(1.3)	0.0	(—)	0.0	(—)

*Oral, injectable, or topical.

Not all operations that used antibiotics treated all sick animals. For example, on the 59.0 percent of operations that administered antibiotics to ewes (table E.1.a), 1.5 percent of ewes had respiratory disease and, of these ewes, 96.0 percent were treated with antibiotics. Therefore, 1.4 percent of ewes on operations that used oral, injectable, or topical antibiotics during 2010 were treated for respiratory disease.

E.7.c. For operations that treated ewes with antibiotics[1] during 2010, percentage of ewes affected by disease, and percentage of affected ewes treated, by disease/disorder treated:

	Percent Ewes[2]			
Disease/disorder	Affected	Std. error	Of those affected, percent treated	Std. error
Respiratory	1.5	(0.2)	96.0	(1.7)
Diarrhea/scours or other digestive	0.4	(0.1)	74.6	(13.8)
Pinkeye	0.6	(0.2)	95.6	(2.3)
Lameness/footrot	3.9	(0.5)	89.7	(3.4)
Reproductive	0.7	(0.1)	96.6	(1.4)
Mastitis	1.4	(0.1)	89.0	(2.7)
Abortion	0.7	(0.2)	74.6	(8.4)
Other	0.3	(0.1)	94.7	(2.4)

[1]Oral, injectable, or topical.
[2]As a percentage of ewe inventory on January 1, 2011.

8. Coccidiostats and growth promotants

Subclinical coccidiosis in lambs is often responsible for significant reduction in weight gain. Therefore, coccidiostats are generally considered cost effective. Overall, 39.8 percent of operations used a coccidiostat in feed or water. The most commonly used coccidiostat used was ionophores in feed (21.9 percent of operations). A higher percentage of small and medium operations (21.8 and 25.5 percent, respectively) used ionophores in feed during 2011 compared with large operations (8.1 percent).

E.8.a. Percentage of operations that used coccidiostats in feed or water during 2010, by coccidiostat used and by flock size:

	Percent Operations							
	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Coccidiostat	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Feed								
Ionophores	21.8	(2.4)	25.5	(2.6)	8.1	(3.4)	21.9	(1.8)
Sulfa drugs	1.4	(0.7)	1.3	(0.7)	1.1	(1.0)	1.4	(0.5)
Decoquinate	14.8	(2.0)	16.7	(2.1)	14.2	(2.7)	15.2	(1.5)
Amprolium	2.7	(1.0)	1.9	(0.7)	1.2	(0.8)	2.4	(0.7)
Other	0.3	(0.3)	0.0	(—)	0.0	(—)	0.2	(0.2)
Water								
Sulfa drugs	6.9	(1.4)	3.9	(1.0)	2.7	(1.2)	5.9	(1.0)
Decoquinate	0.3	(0.2)	1.1	(0.9)	1.5	(1.0)	0.6	(0.3)
Amprolium	11.3	(1.8)	11.5	(2.0)	7.5	(2.4)	11.1	(1.4)
Other	0.0	(—)	0.3	(0.3)	0.0	(—)	0.1	(0.1)
Any coccidiostat in feed or water	40.0	(2.7)	41.9	(2.9)	29.1	(4.4)	39.8	(2.0)

A higher percentage of operations in the East region (55.5 percent) used coccidiostats in feed or water compared with operations in the West or Central regions (30.9 and 21.6 percent, respectively). A higher percentage of operations in the East region used ionophores or decoquinate in feed (31.8 and 21.0 percent, respectively) compared with operations in the West region (14.7 and 9.4 percent, respectively) or the Central region (11.4 and 10.0 percent, respectively). Very few operations in the Central and East regions (0.6 and 0.7 percent, respectively) used decoquinate in water, and virtually no operations in the West region did.

E.8.b. Percentage of operations that used coccidiostats in feed or water during 2010, by coccidiostat used and by region:

	Percent Operations					
	Region					
	West		Central		East	
Coccidiostat	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Feed						
Ionophores	14.7	(3.9)	11.4	(1.8)	31.8	(3.1)
Sulfa drugs	0.4	(0.4)	0.7	(0.4)	2.1	(1.1)
Decoquinate	9.4	(3.3)	10.0	(1.7)	21.0	(2.5)
Amprolium	0.6	(0.4)	1.2	(0.5)	3.9	(1.3)
Other	0.0	(0.0)	0.5	(0.5)	0.0	(0.0)
Water						
Sulfa drugs	5.2	(2.5)	1.4	(0.6)	9.4	(1.9)
Decoquinate	0.0	(0.0)	0.6	(0.4)	0.7	(0.5)
Amprolium	8.3	(3.0)	5.0	(1.1)	16.4	(2.4)
Other	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)
Any coccidiostat in feed or water	30.9	(5.1)	21.6	(2.3)	55.5	(3.1)

Overall, 20.8 percent of operations used any growth promotant in feed or water. A total of 12.5 percent of operations used aureomycin premix or soluble powder in feed as a growth promotant, and 4.8 percent used tetracycline. Only 1.1 percent of operations used tetracycline in water.

E.8.c. Percentage of operations that used a growth promotant in feed or water during 2010, by growth promotant used and by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Growth promotant	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Feed								
Aureomycin premix or soluble powder	12.2	(1.8)	12.3	(2.0)	15.9	(3.2)	12.5	(1.4)
Tetracycline	4.3	(1.0)	5.2	(1.3)	9.3	(2.4)	4.8	(0.8)
Neomycin sulfate	0.3	(0.3)	0.4	(0.4)	0.0	(—)	0.3	(0.2)
Other antibiotics	0.0	(—)	0.4	(0.4)	0.0	(—)	0.1	(0.1)
Ionophores	10.3	(1.8)	16.5	(2.1)	5.0	(1.8)	11.5	(1.3)
Water								
Aureomycin premix or soluble powder	0.0	(—)	0.4	(0.4)	1.4	(0.9)	0.2	(0.1)
Tetracycline	1.2	(0.7)	0.7	(0.5)	2.0	(1.1)	1.1	(0.5)
Neomycin sulfate	0.0	(—)	0.2	(0.2)	0.0	(—)	0.0	(0.0)
Other antibiotics	0.3	(0.3)	0.4	(0.4)	0.0	(—)	0.3	(0.3)
Any growth promotant in feed or water	19.4	(2.2)	24.1	(2.4)	23.4	(3.6)	20.8	(1.7)

A higher percentage of operations in the East and Central regions (26.5 and 18.5 percent, respectively) gave any growth promotants in feed or water compared with operations in the West region (8.3 percent). Very few operations in the East region used either neomycin sulfate (0.7 percent) or other antibiotics (0.2 percent) in feed, while no operations in the West or Central regions used either in feed.

E.8.d. Percentage of operations that used a growth promotant in feed or water during 2010, by growth promotant used and by region:

	Percent Operations					
	Region					
	West		Central		East	
Growth promotant	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Feed						
Aureomycin premix or soluble powder	4.9	(2.3)	8.7	(1.5)	17.6	(2.4)
Tetracycline	1.9	(1.5)	6.1	(1.2)	4.8	(1.3)
Neomycin sulfate	0.0	(—)	0.0	(—)	0.7	(0.5)
Other antibiotics	0.0	(—)	0.0	(—)	0.2	(0.2)
Ionophores	3.9	(1.8)	7.6	(1.6)	16.7	(2.4)
Water						
Aureomycin premix or soluble powder	0.0	(—)	0.2	(0.2)	0.2	(0.2)
Tetracycline	1.0	(0.6)	1.2	(1.1)	1.1	(0.6)
Neomycin sulfate	0.0	(—)	0.1	(0.1)	0.0	(—)
Other antibiotics	0.0	(—)	0.0	(—)	0.7	(0.5)
Any growth promotant in feed or water	8.3	(2.7)	18.5	(2.3)	26.5	(2.8)

F. Parasites and Deworming

In sheep, internal parasites commonly live in the abomasum and the small and large intestines, where they damage the mucosa and, depending on the worm species, feed on blood, leading to reduced weight gain, weight loss, and death. Parasites are a major limiting factor to sheep production on pastures located in moist and warm climates. Sheep raised on herded/open range, or even fenced range in dry climates, will not normally develop a heavy parasite burden. In more intensive grazing systems, controlling gastrointestinal parasites is critical; however, controlling parasites is becoming more difficult as resistance to dewormers becomes more frequent.

Fecal egg counts are commonly used to diagnose parasite species and quantify the amount of gastrointestinal parasites present in the flock. Egg counts can also be used to determine which sheep always have high egg counts and, therefore, should probably be culled. Fecal egg counts are also valuable in determining whether anthelminthic resistance is present in the flock. The presence of worms does not necessarily indicate that deworming is required. Sheep should be dewormed strategically, based on a number of indicators including timing (prelambing), clinical signs, and pasture movement. Deworming should never be used alone as a control strategy. More information on when to deworm sheep can be found at: www.acsrpc.org.

1. Fecal testing

A higher percentage of operations in the East region (19.8 percent) performed fecal testing for intestinal parasites compared with operations in the Central region (9.9 percent).

F.1.a. Percentage of operations that performed fecal testing for intestinal parasites during 2010, by region:

Percent Operations

Region

West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
17.3	(4.0)	9.9	(1.8)	19.8	(2.5)	16.0	(1.5)

Very few herded/open range operations (4.4 percent) performed fecal testing for intestinal parasites during 2010 compared with fenced range (14.8 percent) or pasture (18.0 percent) operations.

F.1.b. Percentage of operations that performed fecal testing for intestinal parasites during 2010, by primary flock type:

Percent Operations							
Primary Flock Type							
Herded/ open range		Fenced range		Pasture		Dry lot/feedlot	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
4.4	(1.9)	14.8	(3.0)	18.0	(2.0)	7.9	(3.5)

2. Deworming

The majority of operations never used dewormers in sheep feed for stomach or intestinal worms during 2010. There were no substantial differences by region, flock size, or flock type (data not shown).

F.2.a. Percentage of operations by frequency dewormers were used in sheep feed for stomach or intestinal worms (not including coccidia) during 2010, and by region:

	Percent Operations							
	Region							
	West		Central		East		All operations	
Frequency	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Always	7.9	(3.1)	3.9	(1.5)	3.4	(1.2)	4.3	(0.9)
Sometimes	4.9	(2.0)	5.6	(1.7)	10.9	(1.9)	8.1	(1.2)
Never	87.2	(3.6)	90.5	(2.2)	85.8	(2.2)	87.6	(1.4)
Total	100.0		100.0		100.0		100.0	

The majority of operations (89.2 percent) used an oral (not in feed) or injectable dewormer in 2010. A lower percentage of operations in the Central region (78.4 percent) used oral or injectable dewormers compared with operations in the West or East regions (90.8 and 96.2 percent, respectively).

F.2.b. Percentage of operations that used a dewormer given orally (not in feed) or by injection during 2010, by region:

Percent Operations

Region

West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
90.8	(3.0)	78.4	(2.7)	96.2	(1.3)	89.2	(1.3)

The percentage of operations that used oral or injectable dewormers during 2010 ranged from 49.0 percent of herded/open range operations to 93.3 percent of pasture operations.

F.2.c. Percentage of operations that used a dewormer given orally (not in feed) or by injection during 2010, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/feedlot	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
49.0	(8.6)	84.5	(3.2)	93.3	(1.4)	86.2	(4.9)

Ewes and lambs were dewormed as a general preventive measure by the highest percentage of operations (87.3 and 78.8 percent, respectively).

F.2.d. For operations that used a dewormer given orally (not in feed) or by injection in ewes and lambs during 2010, percentage of operations by reason for administering dewormer:

	Percent Operations			
	Dewormer Used in . . .			
	Ewes		Lambs	
Reason	Percent	Std. error	Percent	Std. error
General preventive measure	87.3	(1.6)	78.8	(2.0)
Because worms were seen	21.3	(2.0)	23.9	(2.1)
Fecal test results indicated a need	11.0	(1.3)	11.5	(1.5)
Because sheep or lambs were thin or doing poorly	48.0	(2.3)	44.0	(2.4)
Bottlejaw, scours, and other clinical signs	38.9	(2.2)	33.6	(2.3)
Other	2.0	(0.6)	2.2	(0.7)

The FAMACHA© card originated in South Africa and has been validated by the Southern Consortium for Small Ruminant Parasite Control as a very effective method for controlling the intestinal parasite *Haemonchus contortus*, or barber's pole worm, so named because of its blood-filled intestines spiraling around its white egg-filled uterus. Barber's pole worms are arguably one of the most economically important parasites for sheep and goat producers. They live in the animal's intestines and feed on blood from the host, sometimes causing anemia, bottle jaw (swelling under the jaw), or death. Barber's pole worms can also damage the nutrition-absorbing cells of the intestines, causing weight loss, poor growth, and reduced milk production.

Young lambs are most sensitive to *Haemonchus,* while older lambs and sheep usually acquire some immunity to the parasite. Not all lambs or sheep become clinically ill with severe anemia. Animals with minimal or no anemia do not need to be treated for worms. In fact, treating all sheep for worms can contribute to the development of resistance to dewormers. Dewormer resistance is a serious concern for the sheep and other animal industries. The FAMACHA card allows producers to identify which sheep need to be treated for barber's pole worms and which do not. The card provides a chart with examples of inner eyelid color and allows a producer to compare sheep eyelid color with the chart to determine whether anemia exists and, therefore, which animals need to be

treated for worms. However, it is important to note that anemia can be caused by many things other than the barber's pole worm. Therefore, if deworming does not improve the animal's condition, then some other illness might be present. Sheep that always need to be treated may need to be evaluated for culling, and good record keeping will help identify these animals.

Just over one-tenth of operations (11.3 percent) used the FAMACHA card/eye color anemia score for sheep or lambs.

F.2.e. Percentage of operations that used the FAMACHA card/eye color (anemia) score for sheep or lambs, by flock size:

Percent Operations

Flock Size (number of ewes)

Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
11.1	(1.8)	12.6	(2.1)	8.5	(3.5)	11.3	(1.4)

A higher percentage of pasture operations (14.4 percent) used the FAMACHA card compared with fenced range (5.3 percent) or herded/open range (0.0 percent) operations.

F.2.f. Percentage of operations that used the FAMACHA card/eye color (anemia) score for sheep or lambs, by primary flock type:

Percent Operations

Primary Flock Type

Herded/ open range		Fenced range		Pasture		Dry lot/feedlot	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
0.0	(—)	5.3	(2.3)	14.4	(1.9)	7.4	(3.6)

A higher percentage of operations in the East region (17.5 percent) used the FAMACHA card than operations in the Central region (3.2 percent).

F.2.g. Percentage of operations that used the FAMACHA card/eye color (anemia) score for sheep or lambs, by region:

Percent Operations					
Region					
West		Central		East	
Percent	Std. error	Percent	Std. error	Percent	Std. error
9.6	(3.3)	3.2	(1.1)	17.5	(2.4)

Of the 11.3 percent of operations that used the FAMACHA card system in 2010 (table F.2.e), 81.9 percent used it to selectively deworm sheep or lambs. The majority of "other" reasons for using the FAMACHA card was as a learning tool.

F.2.h. For operations that used the FAMACHA card/eye color (anemia) score for sheep or lambs, percentage of operations by reason for using the FAMACHA card:

Reason	Percent operations	Std. error
Identify or cull worm-susceptible sheep or lambs	60.6	(6.4)
Selectively deworm sheep or lambs (e.g., only sheep or lambs with certain scores were dewormed)	81.9	(5.1)
Other	10.5	(3.8)

A higher percentage of operations dewormed ewes more than once a year than dewormed the other sheep types. The frequency of deworming preweaned and weaned lambs may reflect operation deworming schedule and not apply to individual animals (e.g., cannot deworm a preweaned lamb less than once per year because of short duration for this life stage).

F.2.i. Percentage of operations by frequency of deworming sheep using conventional or natural/alternative dewormers during 2010, and by sheep type:

Percent Operations

	Frequency								
	Never		Less than once a year		Once a year		More than once a year		
Sheep type	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Total
Preweaned lambs	58.8	(2.1)	4.7	(1.0)	20.4	(1.8)	16.0	(1.6)	100.0
Weaned replacement lambs	18.3	(1.6)	2.9	(0.7)	28.0	(1.9)	50.6	(2.2)	100.0
Weaned market lambs	35.9	(2.1)	3.8	(0.8)	26.9	(2.0)	33.3	(2.1)	100.0
Ewes	8.6	(1.0)	4.2	(0.9)	22.9	(1.7)	64.2	(2.0)	100.0

A higher percentage of operations in the Central region (18.0 percent) never dewormed their sheep compared with operations in the West or East regions (6.6 and 1.7 percent, respectively).

F.2.j. Percentage of operations that **never** used conventional or natural/alternative dewormers on any sheep or lambs during 2010, by region:

Percent Operations

Region							
West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
6.6	(2.5)	18.0	(2.4)	1.7	(0.7)	8.1	(1.0)

The dewormers used by the highest percentage of operations were from the classes benzimidazole (69.1 percent of operations) and avermectin (69.0 percent). A higher percentage of operations in the West region used an avermectin product compared with operations in the Central or East regions. A higher percentage of operations in the East region used a moxidectin product compared with operations in the Central and West regions.

F.2.k. For operations that used conventional or natural/alternative dewormers during 2010, percentage of operations by type of natural or chemical dewormers used, and by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Dewormer	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
High tannin concentrate plants (e.g., lespedeza)	0.2	(0.2)	0.4	(0.3)	0.9	(0.5)	0.6	(0.3)
Natural or alternative dewormers (e.g., diatomaceous earth, botanicals, herbs, cayenne pepper, copper oxide wire particles)	3.1	(2.2)	8.3	(2.5)	5.9	(1.6)	6.2	(1.2)
Avermectin (e.g., Dectomax®, Ivomec®)	87.3	(3.7)	66.2	(3.5)	64.6	(3.2)	69.0	(2.1)
Moxidectin (e.g., Cydectin®/Quest®)	18.2	(4.4)	24.1	(3.3)	42.5	(3.1)	32.9	(2.1)
Benzimidazole (e.g., Valbazen®)	65.6	(5.4)	59.7	(3.7)	75.6	(2.9)	69.1	(2.1)
Morantel (e.g., Rumatel®) or Pyrantel (e.g., Strongid®)	1.5	(1.5)	0.3	(0.3)	2.3	(1.1)	1.6	(0.6)
Levamisole (e.g., Prohibit®)	25.1	(4.9)	12.4	(2.5)	23.3	(2.6)	20.3	(1.8)
Other	1.5	(1.5)	0.0	(—)	1.0	(0.7)	0.8	(0.4)

3. Dewormer efficacy and information sources

The most commonly used method to prolong or improve the efficacy of dewormers was to rotate dewormer type. The majority of operations (70.4 percent) rotated dewormer types during 2010. About one-fourth of operations (26.9 percent) chose to deworm more often, while 33.0 percent dewormed less often/strategically as a means to prolong or improve the efficacy of the dewormers. There were no substantial differences by region, flock size, or flock type (data not shown).

F.3.a. For operations that used conventional or natural/alternative dewormers in sheep during 2010, percentage of operations by method used to prolong or improve the efficacy of the dewormers used, and by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Technique	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Rotate dewormer type	66.9	(5.3)	66.4	(3.5)	73.8	(3.0)	70.4	(2.1)
Monitor effectiveness by fecal testing	11.9	(3.6)	7.1	(1.6)	11.8	(2.0)	10.4	(1.3)
Deworm more often	22.5	(4.6)	22.0	(3.2)	31.2	(3.1)	26.9	(2.1)
Deworm less often/ strategically	34.1	(5.4)	22.9	(3.3)	38.5	(3.2)	33.0	(2.2)
Other	7.2	(3.0)	3.6	(1.4)	8.1	(1.7)	6.6	(1.1)

The appearance of the sheep was the primary method used by the majority of operations (67.2 percent) to determine whether or not a dewormer was working.

F.3.b. For operations that used conventional or natural/alternative dewormers on sheep during 2010, percentage of operations by **primary method** used to determine whether or not the dewormer program was working, and by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Primary method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Achieve expected performance	6.1	(2.7)	13.2	(2.3)	14.2	(2.3)	12.6	(1.5)
Appearance of sheep	67.0	(5.3)	72.2	(3.2)	64.4	(3.1)	67.2	(2.1)
Fecal consistency (no diarrhea)	10.6	(3.5)	6.6	(2.1)	4.2	(1.3)	6.0	(1.1)
Improved eye score	0.4	(0.4)	1.5	(0.7)	6.5	(1.5)	4.0	(0.8)
Laboratory testing	3.2	(2.1)	2.4	(0.9)	3.8	(1.2)	3.3	(0.8)
Other	12.6	(3.5)	4.1	(1.1)	7.0	(1.6)	7.0	(1.1)
Total	100.0		100.0		100.0		100.0	

For the 91.9 percent of operations that used either conventional or natural/alternative dewormers (table F.2.j), the primary information sources regarding deworming were veterinarian (69.1 percent of operations) and other sheep producers (66.8 percent).

F.3.c. For operations that used conventional or natural/alternative dewormers on sheep during 2010, percentage of operations that ranked the following sources of deworming information as **somewhat** or **very important**, by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Information source	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Veterinarian	61.9	(5.4)	69.1	(3.7)	71.4	(3.0)	69.1	(2.1)
Other sheep producers	64.0	(5.4)	62.4	(3.7)	70.3	(3.1)	66.8	(2.2)
Sales representative	14.3	(3.7)	18.5	(2.5)	20.9	(2.6)	19.0	(1.7)
Extension/ university personnel	34.0	(5.2)	39.5	(3.5)	48.3	(3.2)	43.2	(2.2)
Magazines/ journals/club or 4-H publications (articles and/ or ads)	47.4	(5.5)	51.4	(3.7)	63.1	(3.2)	56.9	(2.2)
Internet	38.0	(5.5)	32.8	(3.5)	44.7	(3.3)	40.0	(2.3)
Other	5.1	(2.5)	8.6	(2.4)	5.6	(1.5)	6.4	(1.2)

There was no difference between flock sizes in whether a veterinarian was involved in the diagnosis of parasite infections. Overall, 33.7 percent of operations involved a veterinarian in the diagnosis of parasite infections.

F.3.d. Percentage of operations by level of veterinarian's involvement regarding diagnosis of parasite infections, and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Level of involvement	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Very involved	11.2	(1.8)	12.6	(1.9)	14.1	(3.0)	11.7	(1.4)
Somewhat involved	21.6	(2.3)	21.5	(2.8)	28.7	(4.9)	22.0	(1.8)
Not involved	67.3	(2.7)	66.0	(3.1)	57.2	(5.1)	66.4	(2.0)
Total	100.0		100.0		100.0		100.0	

While 69.1 percent of producers thought the veterinarian was an important source of deworming information (table F.3.c), just 44.7 percent indicated veterinarians were very or somewhat involved with decisions about treatments. Regardless of size, over half of operations that treated their sheep with a dewormer (55.3 percent) did not include a veterinarian in the decision about parasite treatments. There were no substantial differences by region (data not shown).

F.3.e. Percentage of operations by level of veterinarian's involvement regarding decisions about parasite treatments (dewormer), and by flock size:

Percent Operations

Flock Size (number of ewes)

	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Level of involvement	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Very involved	15.4	(2.1)	16.0	(2.2)	20.9	(4.7)	15.8	(1.6)
Somewhat involved	29.2	(2.7)	28.4	(3.4)	26.4	(4.7)	28.9	(2.1)
Not involved	55.4	(3.0)	55.6	(3.5)	52.7	(5.7)	55.3	(2.3)
Total	100.0		100.0		100.0		100.0	

Overall, just 8.7 percent of operations used a fecal egg count reduction test to determine whether resistance to dewormers was occurring on their operations.

F.3.f. For operations that dewormed, percentage of operations by fecal test used to determine resistance to dewormers during 2010:

Fecal test	Percent operations	Std. error
Fecal egg count reduction (worm egg count both before and after deworming)	8.7	(1.2)
DrenchRite (assay for resistance to dewormers)	0.6	(0.4)
Other	0.2	(0.2)

4. Fly, ked, and tick control

External parasites (ectoparasites) can be a cause of economic loss on U.S. sheep operations and are often controlled through the use of insecticides. These parasites include a number of fly species, some of which can deposit eggs in wounds or larvae in nasal passages. Fly larvae feed on tissue until the next stage in their life cycle and cause extensive tissue damage. Ectoparasites also include keds, blood-sucking flies commonly referred to as sheep ticks. Ked bites cause irritation, wool loss due to rubbing or biting, and reduced weight gain due to discomfort. The bites may cause hard nodules on the skin, which reduce the value of pelts. True ticks are not host specific, are widely distributed throughout the United States and, while generally not a serious concern for sheep, may be responsible for disease transmission. It is likely at least some producers answered questions regarding tick control as if the control was for keds.

Nearly one-third of operations (30.7 percent) used control methods for flies and/or keds during 2010, and 19.3 percent used control methods for ticks. Over half of large operations (59.2 percent) used a control method for flies and/or keds compared with just one-fourth of small operations (25.4 percent). A higher percentage of large operations used pour-on products for flies, keds, and ticks compared with small and medium operations.

F.4.a. Percentage of operations that used the following control methods for flies and/or keds, and ticks during 2010, by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		**Medium** (100–499)		**Large** (500 or more)		**All operations**	
Control method	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Flies and/or keds								
Pour-on product	14.5	(1.8)	27.4	(2.8)	42.1	(4.7)	19.4	(1.5)
Topical spray	14.5	(2.0)	14.6	(2.6)	21.6	(4.2)	15.0	(1.6)
Dip	0.7	(0.5)	0.1	(0.1)	0.0	(—)	0.6	(0.4)
Any	25.4	(2.4)	38.4	(3.3)	59.2	(5.3)	30.7	(1.9)
Ticks								
Pour-on product	10.6	(1.6)	18.4	(2.1)	38.2	(4.6)	14.2	(1.3)
Topical spray	4.6	(1.2)	5.5	(1.6)	16.7	(3.9)	5.5	(0.9)
Dip	0.4	(0.4)	1.4	(1.3)	0.0	(—)	0.6	(0.4)
Any	14.5	(1.9)	24.3	(2.8)	53.6	(5.2)	19.3	(1.5)

Pour-on products were used by a higher percentage of operations in the Central region to control flies and/or keds and ticks compared with operations in the East region.

F.4.b. Percentage of operations that used the following control methods for flies and/or keds, and ticks during 2010, by region:

	Percent Operations					
	Region					
	West		Central		East	
Control method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Flies and/or keds						
Pour-on product	19.3	(4.2)	29.5	(2.8)	12.3	(1.8)
Topical spray	18.9	(4.2)	14.0	(2.3)	14.3	(2.3)
Dip	1.6	(1.5)	0.9	(0.8)	0.0	(—)
Any	35.1	(5.1)	39.5	(3.1)	23.0	(2.6)
Ticks						
Pour-on product	15.7	(3.9)	23.5	(2.4)	7.2	(1.4)
Topical spray	6.7	(2.4)	8.2	(1.8)	3.4	(1.2)
Dip	0.0	(—)	0.9	(0.8)	0.6	(0.6)
Any	21.7	(4.3)	31.1	(2.8)	10.2	(1.8)

G. Pasture Management, Water Sources, and Feeding Practices

Alternating sheep grazing with either another domestic species or crop or hay production can reduce parasite loads on pastures.

1. Pasture management

The majority of operations (85.5 percent) alternated pasture methods or commingled sheep with other species during 2010. A higher percentage of operations in the Central region (36.8 percent) commingled cattle or horses with ewe/lamb pairs compared with operations in the East region (23.4 percent).

G.1.a. Percentage of operations that grazed sheep on pasture during 2010, by pasturing method and by region:

	Percent Operations							
	Region							
	West		Central		East		All operations	
Pasturing method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Alternated grazing sheep and other domestic species, such as cattle or horses	26.7	(4.6)	33.6	(3.1)	25.2	(2.8)	28.4	(1.9)
Commingled cattle or horses with ewe/lamb pairs	23.1	(4.5)	36.8	(3.2)	23.4	(2.5)	28.0	(1.8)
Alternated grazing sheep and crop or hay production	36.4	(4.8)	45.7	(3.3)	44.6	(3.2)	43.6	(2.1)
Any of the above	88.7	(3.6)	82.1	(2.7)	86.7	(2.2)	85.5	(1.6)

G.1.b. Percentage of operations that used pasture rotation during 2010, by region:

Percent Operations							
Region							
West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
75.1	(4.6)	61.9	(3.2)	73.5	(2.9)	69.8	(2.0)

Over half of operations that used pasture rotation (55.2 percent) rested pastures for 22 to 63 days between grazing sheep. A higher percentage of operations in the Central region than in the other regions allowed pastures to rest for more than 9 weeks between grazing sheep.

G.1.c. For operations that used pasture rotation, percentage of operations by number of days pasture was allowed to rest between grazing sheep, and by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Number of days	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
1–21	34.5	(5.8)	18.0	(3.1)	44.9	(3.8)	34.8	(2.5)
22–63	58.6	(6.0)	57.3	(4.2)	52.8	(3.8)	55.2	(2.6)
64 or more	7.0	(2.6)	24.8	(3.7)	2.3	(1.1)	10.0	(1.4)
Total	100.0		100.0		100.0		100.0	

Just over half of all operations (51.4 percent) placed harvested or commercial feed directly on the ground for sheep to eat, ranging from 46.1 percent of small operations to 75.5 percent of large operations.

G.1.d. Percentage of operations that placed harvested or commercial feed directly on the ground for sheep to eat during 2010, by flock size:

Percent Operations

	Flock Size (number of ewes)							
	Small (20–99)		Medium (100–499)		Large (500 or more)		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
46.1	(2.8)	60.2	(3.5)	75.5	(4.9)	51.4	(2.2)

A higher percentage of operations in the Central region (65.4 percent) placed harvested or commercial feed directly on the ground for sheep to eat compared with operations in the West or East regions.

G.1.e. Percentage of operations that placed harvested or commercial feed directly on the ground for sheep to eat during 2010, by region:

Percent Operations					
Region					
West		Central		East	
Percent	Std. error	Percent	Std. error	Percent	Std. error
45.5	(5.4)	65.4	(3.1)	43.5	(3.3)

Photograph courtesy of American Sheep Industry Association.

2. Water sources

Approximately three-fourths of operations provided sheep access to a bucket, trough, or waterer in which the rim was less than 2 feet off the ground (higher likelihood of fecal contamination), regardless of season (winter or summer) or region. A higher percentage of operations in the West region had a stream (or other running water) during winter compared with operations in the other regions.

G.2.a. Percentage of operations in which the flock typically had access to the following water sources during winter and summer, by region:

	Percent Operations							
	Region							
	West		Central		East		All operations	
Water source	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Winter								
Pond/lake/reservoir (or other standing water)	33.6	(5.0)	28.3	(3.3)	16.7	(2.4)	23.4	(1.8)
Stream (or other running water)	47.9	(5.4)	22.3	(2.8)	26.6	(2.8)	28.7	(1.9)
Bucket, trough, or waterer in which rim was less than 2 ft off the ground	79.1	(4.4)	76.4	(2.9)	74.8	(2.7)	76.1	(1.8)
Bucket, trough, or waterer in which rim was 2 ft or more off the ground	39.3	(5.3)	36.3	(3.2)	38.7	(3.1)	38.0	(2.1)
Other	0.7	(0.6)	7.9	(1.6)	2.8	(0.9)	4.2	(0.7)
Summer								
Pond/lake/reservoir (or other standing water)	30.4	(4.6)	46.2	(3.3)	35.2	(3.0)	38.1	(2.0)
Stream (or other running water)	42.5	(5.2)	43.9	(3.2)	38.1	(3.1)	40.8	(2.1)
Bucket, trough, or waterer in which rim was less than 2 ft off the ground	77.6	(4.6)	68.0	(3.1)	74.2	(2.8)	72.6	(1.9)
Bucket, trough, or waterer in which rim was 2 ft or more off the ground	33.7	(5.1)	32.5	(3.2)	37.4	(3.1)	35.1	(2.1)
Other	0.7	(0.6)	2.2	(1.3)	0.7	(0.5)	1.2	(0.5)

The primary source of water for operations during winter and summer was a bucket, trough, or waterer in which the rim was less than 2 feet off the ground. The next most common water source in winter and summer was a bucket, trough, or waterer in which the rim was 2 feet or more off the ground.

G.2.b. Percentage of operations by **primary** water source during winter and summer, by region:

Percent Operations

	Region							
	West		Central		East		All operations	
Primary water source	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Winter								
Pond/lake/reservoir (or other standing water)	3.6	(1.6)	4.8	(1.8)	1.7	(0.8)	3.1	(0.8)
Stream (or other running water)	15.2	(3.8)	7.9	(1.7)	7.3	(1.7)	8.8	(1.2)
Bucket, trough, or waterer in which rim was less than 2 ft off the ground	52.6	(5.4)	53.9	(3.4)	58.2	(3.1)	55.8	(2.1)
Bucket, trough, or waterer in which rim was 2 ft or more off the ground	19.0	(4.3)	20.5	(2.8)	25.3	(2.7)	22.6	(1.8)
Other water source	2.0	(1.5)	6.6	(1.1)	2.8	(1.0)	4.0	(0.7)
Multiple water sources used equally	7.7	(2.6)	6.3	(1.6)	4.8	(1.4)	5.8	(1.0)
Total	100.0		100.0		100.0		100.0	
Summer								
Pond/lake/reservoir (or other standing water)	3.0	(1.6)	16.1	(2.5)	5.9	(1.4)	8.9	(1.1)
Stream (or other running water)	14.3	(3.8)	18.0	(2.0)	10.8	(2.0)	13.9	(1.4)
Bucket, trough, or waterer in which rim was less than 2 ft off the ground	55.2	(5.4)	40.0	(3.3)	52.3	(3.1)	48.5	(2.1)
Bucket, trough, or waterer in which rim was 2 ft or more off the ground	19.1	(4.3)	16.9	(2.7)	21.2	(2.6)	19.4	(1.7)
Other water source	2.0	(1.5)	2.2	(0.8)	0.7	(0.6)	1.4	(0.5)
Multiple water sources used equally	6.5	(2.3)	7.0	(1.6)	9.1	(1.8)	7.9	(1.1)
Total	100.0		100.0		100.0		100.0	

3. Feeding practices

On just under two-thirds of operations (61.9 percent), weaned lambs less than 12 months of age shared common feed or water sources with adult sheep.

G.3.a. Percentage of operations in which weaned lambs less than 12 months of age generally shared common feed or water sources with adult sheep, by region:

Percent Operations

Region							
West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
66.7	(5.2)	68.7	(3.0)	55.6	(3.1)	61.9	(2.0)

G.3.b. Percentage of operations in which weaned lambs less than 12 months of age generally shared common feed or water sources with adult sheep, by region:

Percent Operations

Region							
West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
23.7	(4.7)	24.4	(2.7)	28.3	(2.9)	26.2	(1.9)

Placing thin ewes with younger sheep can expose the younger sheep to chronic diseases such as Johne's disease. Approximately one-fourth of operations (26.2 percent) placed young sheep with thin ewes to encourage or increase the ewes' feed intake.

G.3.c. Percentage of operations that ever placed thin ewes with younger sheep to encourage or to increase the ewes' feed intake, by region:

Percent Operations

Region							
West		Central		East		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
23.7	(4.7)	24.4	(2.7)	28.4	(2.9)	26.2	(1.9)

Section II: Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and contacting industry members about their informational needs and priorities during a needs assessment phase. The needs assessment for the NAHMS Sheep 2011 study collected information from U.S. sheep producers and other sheep specialists about what they perceived to be the most important sheep health and productivity issues. A driving force of the needs assessment was the desire of NAHMS to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, Federal and State governments, and industry organizations. Information was collected through a needs assessment questionnaire, and top issues were prioritized by teleconferences with representatives of the sheep industry, along with extension agents and other university affiliates.

The needs assessment for Sheep 2011 was conducted from December 2009 through February 2010. A total of 275 stakeholders completed the needs assessment questionnaire. In addition, a focus group of producers, researchers, extension veterinarians, and clinicians helped develop the study objectives. Of these, 37 percent were meat producers, 14 percent wool producers, 0.8 percent milk producers, 8.0 percent 4-H or club lamb participants, 1.9 percent veterinarians, 21.8 percent Federal or State governments, 5.3 percent university or extension agents, 0.8 percent allied industry, and 10.3 percent classified themselves as “other,” which included mostly producers of meat and wool, hair sheep, or seed stock. The number of sheep raised by producers was between 1 and 5,000. Of the respondents, 49.2 percent were from the Eastern time zone, 34.9 percent from the Central time zone, 7.0 percent from the Mountain time zone, and 8.9 percent from the Pacific time zone.

Ewe health/management was the most important management issue, with 40 percent of respondents ranking health/management as either their first, second, or third most important issue. For producers who indicated ewe health as a priority, their specific areas of interest included: mastitis, Q fever, ovine progressive pneumonia, Johne’s disease, abortion prevention, parasites, nutrition, and proactive information for ewe health.

Internal parasites were the most important disease issue for survey respondents. Overall, 65.7 percent of respondents ranked internal parasites as one of their top three disease issues. This top ranking held true for producer respondents and veterinary and university extension agents. The next most important disease issues were scrapie (22.0 percent of respondents), abortions (19.8 percent), and lameness (19.8 percent).

Federal and State veterinarians made up nearly 22 percent of respondents. The following describes their responses to the survey: The top three management issues were: identification (15.9 percent), infectious disease (15.2 percent), and disease prevalence (13.4 percent). The top three disease-specific issues were: scrapie (18.1 percent), internal parasites (13.6 percent), and Johne’s disease (10.6 percent).

Once the most important issues were identified, the study objectives were created by prioritizing the needs during discussions with producers, veterinarians, university extension agents, and government personnel.

Objectives for NAHMS Sheep 2011 study were:

- Describe trends in sheep health and management practices from 1996 to 2011.
- Describe management and biosecurity practices used to control common infectious diseases, including scrapie, ovine progressive pneumonia, Johne's disease, and caseous lymphadenitis.
- Estimate the prevalence of gastrointestinal parasites and anthelmintic resistance.
- Estimate the prevalence of *Mycoplasma ovipneumonie* in domestic sheep flocks. Relate presence of the organism in blood and nasal secretions to clinical signs and demographic and management factors.
- Facilitate the collection of information and samples regarding causes of abortion storms in sheep.
- Determine producer awareness of the zoonotic potential of contagious ecthyma (sore mouth) and the management practices used to prevent transmission of the disease.
- Provide sera to include in the serological bank for future research.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done from January through April 2010, using the National Agricultural Statistics Service (NASS) 2007 Census of Agriculture and the January 29, 2010, "Sheep and Goat Report." A goal for NAHMS national studies is to include States that account for at least 70 percent of animals and producer populations in the United States. The 22 States recommended for inclusion in the study were California, Colorado, Iowa, Idaho, Kentucky, Kansas, Michigan, Minnesota, Missouri, Montana, New Mexico, New York, Ohio, Oregon, Pennsylvania, South Dakota, Texas, Utah, Virginia, Washington, Wisconsin, and Wyoming. These States, according to the 2007 Census of Agriculture, represented 85.5 percent of the U.S. ewe inventory and 70.1 percent of farms with ewes. In addition, the States included 84.6 percent of the January 1, 2010, ewe inventory (NASS annual ewe inventory, 2010).

A memo identifying these 22 States was provided in July 2010 to the USDA–APHIS–VS–CEAH Director and, in turn, the VS regional directors. Each regional director sought input from the respective States about being included or excluded from the study. The 22 States were included in the study.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size stratum was the number of sheep and lambs for each operation on the list sampling frame at the time of sample selection. These procedures were used to select the sample for the NASS January 2010 Sheep survey. Sampling efficiencies were gained by drawing a subsample of respondents to this survey. This procedure eliminated a large number of out-of-business and zero-inventory reports. The sample was selected from those producers who reported one or more ewes on hand January 1, 2010. The sample of sheep producers was selected in each State. Among producers reporting fewer than 20 ewes, 1,381 operations were selected for Phase Ia. For operations reporting 20 or more ewes, a total of 3,539 operations were selected for contact during Phase Ib. Therefore a total of 4,920 operations were selected for the study.

Operations with 20 or more ewes that participated in Phase I were invited to participate in data collection for Phase II. A total of 1,240 operations agreed via written consent to be contacted by veterinary medical officers as part of Phase II in the study.

3. Population inferences

a. Phases Ia and Ib: general sheep management questionnaire

Inferences cover the population of sheep producers with at least 1 ewe on hand January 1, 2010, in the 22 participating States. As of December 31, 2007 (2007 Census of Agriculture), these States accounted for 85.5 percent of all ewes in the United States (3,005,813 head out of 3,516,409) and 70.1 percent of farms with ewes (47,855 out of 68,222). In addition, these States accounted for 84.6 percent of the January 1, 2010, ewe inventory in the United States or 2,824,000 head out of 3,340,000 head. (See appendix II for respective data on individual States.) All respondent data were statistically weighted to reflect the population from which they were selected. The inverse of the probability of selection by strata for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group from the NASS survey as well as adjusted for subsampling and again for nonresponse to this study. These adjustments and weighting allow for inferences back to the original population from which the sample was selected.

b. Phase II: VS visit

Inferences cover the population of sheep producers with 20 or more ewes in the 22 participating States. For operations eligible for Phase II data collection (those with 20 or more ewes that completed the general sheep management questionnaire) weights were adjusted to account for operations that did not want to continue to Phase II. The 22-State

target population of operations with 20 or more ewes was estimated to represent 74.5 percent of all sheep operations with 20 or more ewes in the 22 States on January 1, 2011 (see appendix II).

C. Data Collection

1. Data collectors and data collection period

a. Phases Ia and 1b: general sheep management questionnaire

All data were collected from January 1 to February 11, 2011. Producers with fewer than 20 ewes were contacted via telephone interviewers who administered the questionnaire, which averaged approximately 30 minutes. NASS enumerators administered the general sheep management questionnaire to producers with 20 or more ewes via an in-person interview, which took approximately 1 hour.

b. Phase II: VS visit

Data were collected from producers by Federal or State veterinary medical officers (VMOs) or animal health technicians (AHTs) from March 14 to June 30, 2011. The interview took approximately 1.5 hours.

D. Data Analysis

1. Phase I: Validation—general sheep management questionnaire

Telephone interviews were conducted via computer-assisted telephone interview software at each individual State NASS office and edited. For the in-person administered questionnaire, initial data entry and validation for the general sheep management questionnaire were also performed in the individual NASS State offices. Data were entered into a SAS data set and edited. Individual State data files were then combined and sent to NAHMS national staff, which performed additional data validation on the entire data set.

2. Phase II: Validation—VS visit questionnaires

After completing the VS visit questionnaires, data collectors sent them to their respective State NAHMS coordinators who reviewed the questionnaire responses for accuracy. Data entry and validation were completed by CEAH staff using SAS.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term “response rate” was used as a catchall parameter, but there are many ways to define and calculate response rates. Therefore, the following table presents an evaluation based on a number of response measurement parameters, which are defined with an “x” in categories that contribute to the measurement.

1. Phase Ia: general sheep management questionnaire—fewer than 20 ewes

A total of 1,381 operations were selected for the survey. Of these operations, 64.2 percent completed the questionnaire.

			Measurement parameter		
Response category	**Number operations**	**Percent operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Refused GSM questionnaire/inaccessible	298	21.6	x[4]		
Ineligible (no sheep or lambs on Jan. 1, 2011)	196	14.2	x	x	
Complete	887	64.2	x	x	x
Total	1,381	100.0		887	887
Percent of total operations				64.2	64.2
Percent of total operations weighted[3]				60.6	60.6

[1]Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Weighted response—the rate was calculated using the initial selection weights.
[4]The number of operations that refused verses those that were not contacted was not tracked.

2. Phase Ib: general sheep management questionnaire—20 or more ewes

A total of 3,539 operations were selected for the questionnaire. Of these operations, 3,191 (90.2 percent) were contacted. There were 2,661 operations that provided usable inventory information (75.2 percent of the total selected and 83.4 percent of those contacted). In addition, there were 2,369 operations (66.9 percent) that provided "complete" information for the questionnaire.

			Measurement parameter		
Response category	**Number operations**	**Percent operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Zero sheep on January 1, 2011	211	5.9	x	x	
Out of business	81	2.3	x	x	
Refused GSMQ questionnaire	530	15.0	x		
Complete VMO consent signed	1,241	35.1	x	x	x
Complete VMO consent refused	1,025	29.0	x	x	x
Complete, ineligible for VMO	103	2.9	x	x	x
Out of scope	17	0.5			
Office hold (NASS elected not to contact)	69	1.9			
Inaccessible	262	7.4			
Total	3,539	100.0	3,191	2,661	2,369
Percent of total operations			90.2	75.2	66.9
Percent of total operations weighted[3]			90.9	77.9	68.5

[1]Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Weighted response—the rate was calculated using the initial selection weights.

3. Phase II: VS initial visit questionnaire

There were 1,241 operations that consented during Phase I to be contacted by a veterinary medical officer (VMO) for Phase II. Of these 1,241, 761 (61.3 percent) agreed to continue in Phase II of the study and completed the VMO initial visit questionnaire; 330 (26.6 percent) refused to participate. Approximately 11.0 percent of the 1,291 operations were not contacted, and 1.0 percent were ineligible because they had fewer than 20 sheep at the time they were contacted by the VMO during Phase II of the study.

			Measurement parameter		
Response category	Number operations	Percent operations	Contacts	Usable[1]	Complete[2]
Survey complete	761	61.3	x	x	x
Survey refused	330	26.6	x		
Not contacted	137	11.0			
Ineligible[3]	13	1.0	x	x	
Total	1,241	100			
Percent of total operations			89.0	62.4	61.4
Percent of total operations weighted[4]			88.1	59.6	58.4

[1]Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no ewes at time of interview, which occurred from March 14 to June 30, 2011.
[4]Weighted response—the rate was calculated using the initial selection weights.

Appendix I: Sample Profile

A. Responding Operations

1. Number of responding operations, by herd size

	Phase Ia: general sheep management questionnaire—fewer than 20 ewes	Phase Ib: general sheep management questionnaire—20 or more ewes	Phase II: VS initial visit questionnaire
Herds (number of ewes)	**Number of responding operations**		
Fewer than 20	887		
20 to 99		1,049	343
100 to 499		859	287
500 or more		461	131
Total	887	2,369	761

2. Number of responding operations, by region

	Phase Ia: general sheep management questionnaire—fewer than 20 ewes	Phase Ib: general sheep management questionnaire—20 or more ewes	Phase II: VS initial visit questionnaire
Region	**Number of responding operations**		
West	175	325	116
Central	348	1,208	349
East	364	836	296
Total	887	2,369	761

Appendix II: U.S. Ewes Population and Farms

A. Number of Ewes–State, Region, and United States

Region	State	Number of Ewes			Number of Farms		
		Ewes on farms with 1 or more head	Ewes on farms with 20 or more head	Pct. of total	Farms with 1 or more head	Farms with 20 or more head	Pct. of total
West	CA	286,544	269,021	93.9	3,413	946	27.7
	OR	119,356	104,842	87.8	2,802	804	28.7
	WA	35,138	(D)		1,977	367	18.6
	Total	441,038	(D)		8,192	2,117	25.8
Central	CO	200,269	194,698	97.2	1,265	493	39.0
	ID	161,935	(D)		1,047	367	35.1
	KS	52,614	48,143	91.5	1,011	450	44.5
	MT	184,087	(D)		1,375	859	62.5
	NM	87,131	78,150	89.7	2,152	756	35.1
	SD	210,005	(D)		1,580	1,231	77.9
	TX	580,861	550,346	94.7	6,814	2,694	39.5
	UT	210,388	203,621	96.8	1,430	514	35.9
	WY	258,096	255,618	99.0	817	495	60.6
	Total	1,945,386	(D)		17,491	7,859	44.9
East	IA	128,518	113,364	88.2	3,168	1,606	50.7
	KY	22,225	15,880	71.5	1,171	309	26.4
	MI	48,398	38,932	80.4	1,969	582	29.6
	MN	85,049	75,343	88.6	2,225	1,038	46.7
	MO	51,328	41,933	81.7	1,911	718	37.6
	NY	42,321	35,260	83.3	1,523	497	32.6
	OH	74,331	59,700	80.3	2,929	1,103	37.7
	PA	62,828	46,728	74.4	3,067	837	27.3
	VA	48,219	38,991	80.9	1,796	691	38.5
	WI	56,172	44,057	78.4	2,413	780	32.3
	Total	619,389	510,188	82.4	22,172	8,161	36.8
Total (22 States)		3,005,813	(D)		47,855	18,137	37.9
Percent of U.S.		85.5			70.1	74.5	
Total U.S. (50 States)		3,516,409	3,193,721	90.8	68,222	24,346	35.7

Source: NASS 2007 Census of Agriculture.

B. Ewes, Flock Size Distribution–State, Region, and United States

		Flock Size							
		1–19		20–99		100–499		500 or more	
Region	State	Farms	Head	Farms	Head	Farms	Head	Farms	Head
West	CA	2,467	17,523	737	28,185	129	24,906	80	215,930
	OR	1,998	14,514	633	24,712	133	27,549	38	52,581
	WA	1,610	(D)	347	(D)	15	(D)	5	(D)
	Total	6,075	(D)	1,717	(D)	277	(D)	123	(D)
Central	CO	772	5,571	347	14,083	88	18,594	58	162,021
	ID	680	5,029	276	10,663	50	9,498	41	136,745
	KS	561	4,471	353	14,825	76	(D)	21	(D)
	MT	516	(D)	486	(D)	277	59,288	96	(D)
	NM	1,396	8,981	674	23,660	52	(D)	30	(D)
	SD	349	(D)	724	(D)	410	81,396	97	(D)
	TX	4,120	30,515	1,762	73,910	666	13,7602	266	338,834
	UT	916	6,767	344	14,137	85	15,843	85	173,641
	WY	322	2,478	298	13,032	96	21,418	101	221,168
	Total	9,632	(D)	5,264	(D)	1,800	368,680	795	1,284,513
East	IA	1,562	15,154	1,357	55,777	236	40,053	13	17,534
	KY	862	6,345	277	9,786	30	(D)	2	(D)
	MI	1,387	9,466	504	20,852	71	12,595	7	5,485
	MN	1,187	9,706	848	33,723	177	32,280	13	9,340
	MO	1,193	9,395	626	23,980	87	14,503	5	3,450
	NY	1,026	7,061	418	16,213	74	15,064	5	3,983
	OH	1,826	14,631	995	38,956	103	17,205	5	3,539
	PA	2,230	16,100	740	28,103	90	13,962	7	4,663
	VA	1,105	9,228	607	23,140	82	(D)	2	(D)
	WI	1,633	12,115	682	26,719	97	(D)	1	(D)
	Total	14,011	109,201	7,054	277,249	1,047	(D)	60	(D)
Total (22 States)		29,718	(D)	14,035	(D)	3,124	604,820	978	1,613,763
Percent of U.S.		67.7		71.7		83.2	84.7	95.0	94.2
Total U.S. (50 States)		43,876	322,688	19,563	767,044	3,753	714,448	1,030	1,712,229

Source: NASS 2007 Census of Agriculture.

C. U.S. Sheep and Lamb Population, January 1, 2011, Inventory

Region	State	Ewes (x1,000 head)	Rams (x1,000 head)	Replacement lambs (x1,000 head)	Total breeding sheep and lambs (x1,000 head)	All sheep and lambs (x1,000 head)
West	CA	283	12	45	340	610
	OR	118	7	23	148	215
	WA	36	3	7	46	56
	Total	437	22	75	534	881
Central	CO	142	5	28	175	370
	ID	153	6	26	185	235
	KS	33	2	8	43	70
	MT	170	7	38	215	230
	NM	77	5	15	97	110
	SD	176	7	32	215	275
	TX	525	40	125	690	880
	UT	211	9	35	255	280
	WY	220	8	47	275	365
	Total	1,707	89	354	2,150	2,815
East	IA	106	5	19	130	200
	KY	22	1.5	4.5	28	34
	MI	44	3	11	58	74
	MN	77	4	14	95	130
	MO	57	3	13	73	81
	NY	43	3	10	56	70
	OH	81	6	16	103	129
	PA	62	6	16	84	98
	VA	55	3	9	67	90
	WI	59	3	14	76	90
	Total	606	37.5	126.5	770	996
Total (22 States)		2,750	148.5	555.5	3,454	4,692
Percent of U.S.		84.5	78.2	82.9	83.9	84.8
Total U.S. (50 States)		3,255	190	670	4,115	5,530

Source: NASS “Sheep and Goats report,” January 28, 2011.

D. Breeding Sheep: Survey Percent by Size Group, United States, 2008–09

	1–99 head		200–499 head		500–4,999 head		5,000+ head	
	2008	2009	2008	2009	2008	2009	2008	2009
Operations	92.5	93.7	6.2	5.2	1.2	1.0	0.1	0.1
Inventory	32.6	36.2	22.7	20.8	30.2	31.3	14.5	11.7

Source: NASS Farms, Land in Farms, and Livestock Operations, 2009 Summary, February 2010.

Appendix III: Antibiotic Classes and Active Ingredients*

Antibiotic class	Active ingredient
Aminoglycoside	Gentamicin
	Gentamicin sulfate
	Neomycin sulfate
	Neomycin
Penicillin	Penicillin
	Ampicillin trihydrate
	Penicillin G benthazine and Pen G Procaine
	Penicillin G benzathine
	Peniciilin G procaine
	Penicillin-dihydrostreptomycin
Cephalosporin	Ceftiofur sodium
	Ceftiofur crystalline
	Ceftiofur hydrochloride
	Cephapirin benzathine/cephapirin sodium
Phenicol	Florfenicol
Lincosamide	Pirlimycin hydrochloride
Macrolide	Tulathromycin
	Tilmicosin phosphate
Sulfonamide	Trimethorim sulfadiazine
	Sulfachlorpyridazine
	Sulfamethazine
	Trimethoprim sulfadiazine
Tetracycline	Oxytetracycline
	Oxytetracycline hydrochloride

*Not a complete list of available antibiotics in each class.

Appendix IV: Study Objectives and Related Outputs

To develop the objectives for the NAHMS Sheep 2011 study, a needs assessment was conducted from December 2009 through February 2010 to determine the current issues facing the U.S. sheep industry. A total of 278 stakeholders completed the needs assessment questionnaire. In addition, an advisory group of producers, researchers, extension veterinarians, and clinicians helped develop the study objectives.

Objectives for NAHMS Sheep 2011 study

1. Describe trends in sheep health and management practices from 1996 to 2011.

- Part I: Reference of Sheep Management Practices in the United States, 2011, May 2012
- Part II: Reference of Sheep Marketing and Biosecurity Practices in the United States, 2011, December 2012
- Part III: Health and Management on U.S. Sheep Operations, 2011, Summer 2013
- Part IV: Trends in the U.S. Sheep Industry, 1996–2011, expected Fall 2013
- Vaccination Practices on U.S. Sheep Operations, 2011, info sheet, expected spring 2013
- Sheep and Lamb Losses on U.S. Sheep Operations, 2011, info sheet, expected spring 2013
- Lambing Management on U.S. Sheep Operations, 2011, info sheet, expected spring 2013

2. Describe management and biosecurity practices used to control common infectious diseases, including scrapie, ovine progressive pneumonia, Johne's disease, and caseous lymphadenitis.

- Biosecurity Practices on U.S. Sheep Operations, 2011, info sheet, expected summer 2013
- Parasite Control on U.S. Sheep Operations, 2011, info sheet, expected summer 2013
- Producer Disease Awareness, 2011, info sheet, expected summer 2013
- Antimicrobial Drug Use on U.S. Sheep Operations, 2011, info sheet, expected summer 2013

3. Estimate the prevalence of gastrointestinal parasites and anthelmintic resistance.

- Gastrointestinal Parasites and Anthelmintic Resistance, 2011, info sheet, expected fall 2013

4. Estimate the prevalence of *Mycoplasma ovipneumonia* in domestic sheep flocks. Relate presence of the organism in blood and nasal secretions to clinical signs and demographic and management factors.

- *Mycoplasma ovipneumonia* in Domestic Sheep Flocks, 2011, info sheet, expected fall 2013

5. Facilitate the collection of information and samples regarding causes of abortion storms in sheep.

- Toxoplasmosis in Lambs in U.S. Sheep Flocks, 2011, info sheet, expected fall 2013
- Q Fever in Sheep in the United States, 2011, info sheet, expected fall 2013
- *Campylobacter* on U.S. Sheep Operations, 2011, info sheet, expected summer 2013
- *Salmonella* on U.S. Sheep Operations, 2011, info sheet, June 2013

6. Determine producer awareness of the zoonotic potential of contagious ecthyma (sore mouth) and the management practices used to prevent transmission of the disease.

- Sore Mouth on U.S. Sheep Operations, 2011, info sheet, expected fall 2013

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