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Sheep 2011

Part IV: Changes in Health and Production Practices in the U.S. Sheep Industry, 1996–2011



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Items of Note

Breed

Hair sheep accounted for the greatest change in the type of sheep breeds on U.S. sheep operations. For example, in 1996 only 1.0 percent of U.S. sheep operations owned hair sheep, compared with 4.6 percent in 2001 and 21.7 percent 2011 (p 24). Hair sheep breeds are known for parasite resistance and heat tolerance, and a rise in ownership of these breeds in hot, parasite-prone regions of the country would be expected. However, the percentage of operations with hair sheep has increased in all regions of the country (section II, table A.1.c). Hair sheep also represented a higher percentage of the U.S. sheep and lamb inventory in 2011 (11.0 percent) than in 2001 and 1996 (1.2, and 0.4 percent, respectively).

Primary use

Ownership of sheep primarily for meat production increased from 60.7 percent of operations in 2001 to 81.6 percent in 2011, while the percentage of operations in which the primary use of sheep was wool production or showing remained steady (p 29).

Producer experience

A higher percentage of sheep producers had been in business for 21 years or longer in 2011 than in 2001 (59.5 and 39.4 percent, respectively) [p 31].

Animal identification

Flock and individual-animal identification (ID) are important parts of industry efforts to control disease in sheep. In 2011, 81.5 percent of operations used at least one flock ID method compared with just 27.4 percent in 2001 (p 42). In November 2001, after the Sheep 2001 study, new ID requirements were implemented that required ID for sheep that changed ownership and/or entered interstate commerce. These new requirements led to a substantial increase in flock ID.

A higher percentage of culled ewes had flock ID when they left the operation in 2011 than in 2001. The difference is especially true for ewes culled from farm or pasture flocks. For example, in 2001 just 34.2 percent of cull ewes had flock ID when they left the operation compared with 81.6 percent of cull ewes in 2011 (p 82).

Ewe breeding

Breeding ewes out of season was more common in 2011 than in 2001 (24.5 and 12.1 percent of breeding operations, respectively) [p 52]. Newly approved drugs are rare in the sheep industry, but in fall 2009 the Food and Drug Administration approved the use of a progesterone controlled internal drug release (CIDR) used to induce estrus in ewes

during seasonal anestrus. Twice the percentage of operations in 2011 used hormone treatments compared with operations in 2001.

The percentage of operations that rated the ability of ewes to breed out of season as very or somewhat important more than tripled from 2001 to 2011 (10.3 and 33.6 percent, respectively) [p 57].

Consistent with previous data showing increases in out-of-season breeding, the use of estrus-inducing hormones, and the popularity of ewes that breed out of season, a higher percentage of operations in 2011 than in 2001 had lambs born in June through December (p 60).

Lamb management

Consistent with the increased percentage of hair sheep—whose tails are typically not docked—a lower percentage of operations docked lambs' tails in 2011 than in 2001 (p 64).

Lambs were weaned at a younger average age in 2011 than in 2001 (15.6 and 17.5 weeks, respectively) [p 72].

Cull rams and ewes

Operations cull animals for many reasons, including disease, to reduce flock size, improve genetics for desirable phenotypic traits, or to economize during episodes of high feed costs. Operations attempting to enlarge their flocks are less likely to cull animals for any of these reasons. A lower percentage of rams and ewes were culled in 2011 than in 2001. Nearly one-fourth of rams (23.8 percent) were culled and sold in 2001 compared with 16.2 percent in 2011. Approximately one-fifth of ewes (18.3 percent) were culled and sold in 2001 compared with 14.0 percent 2011 (p 79). The average age of culled ewes was slightly higher in 2011 than in 2001 (6.3 and 5.9 years, respectively).

Carcass disposal methods

The decision about which methods to use to dispose of carcasses depends on local, county, and State laws; a producer's skill/knowledge of disposal methods (e.g., incineration and composting); method costs; and equipment availability (e.g., for burying, rendering, and incinerating). The cost of different carcass disposal methods also influences a producer's decision on what methods to use. Composting accounted for the biggest change in carcass disposal methods from 2001 to 2011: 6.9 percent of operations composted carcasses in 2001 compared with 26.5 percent in 2011 (p 86).

Biosecurity

Overall, a higher percentage of operations in 2011 than in 2001 conducted health management practices on new additions (p 96). Specifically, in 2011 nearly twice the percentage of operations vaccinated new additions prior to arrival at the operation compared with operations in 2001 (70.1 and 35.6 percent, respectively). Similarly, more than twice the percentage of operations in 2011 conducted external parasite treatments on new additions prior to arrival compared with operations in 2001 (29.5 vs. 13.6 percent, respectively). In general, a higher percentage of operations in 2011 than in 2001 conducted health management activities after the arrival of new additions.

Approximately twice the percentage of operations consulted a veterinarian for disease diagnosis, disease prevention, and lambing problems in 2011 than in 2001 (p 101).

Cleaning the lambing area is crucial in preventing disease transmission from ewes to lambs and from ewes to ewes. A higher percentage of operations in 2011 than in 2001 did not clean lambing areas (25.4 and 7.6 percent, respectively). Conversely, a lower percentage of operations in 2011 usually removed placentas from the lambing area compared with operations in 2001 (p 105).

For operations in 2011 that had some pregnant ewes abort due to suspected infectious causes, 21.6 percent had the cause of abortions diagnosed by a laboratory or veterinarian compared with 51.3 percent of operations in 2001 (p 109). This trend of fewer suspected cases being diagnosed by a veterinarian or laboratory was also true for several other infectious causes of disease (p 109).

A higher percentage of producers were familiar with diseases such as Johne's disease, scrapie, OPP, toxoplasmosis, and Q fever in 2011 than in 2001 (p 112–119).

Shearing

Changes in the sheep industry in the last several decades include a reduction in wool marketing entities and related infrastructure, resulting in difficult marketing schemes with fewer domestic wool buyers, increased distances to markets, and fewer selling systems. In addition, low wool prices and difficulties in finding shearers have sometimes made producing wool a liability. As a result, more producers are raising hair sheep, which do not need to be sheared. In 2011, 80.2 percent of operations had sheared sheep and lambs in the previous year compared with 90.4 percent of operations in 2001 (p 129).

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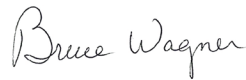
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All participants are to be commended, particularly the producers whose voluntary efforts made the Sheep 2011 study possible.

A handwritten signature in cursive script that reads "Bruce Wagner".

Bruce A. Wagner
Director
National Animal Health Monitoring System

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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 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).

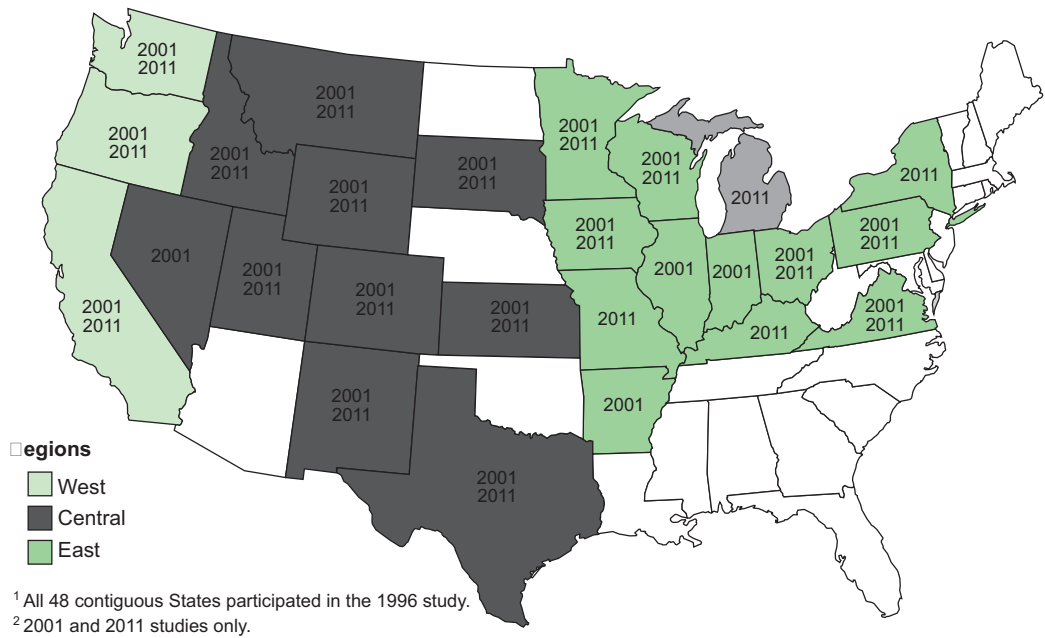
This report, "Part IV: Changes in Health and Production Practices in the U.S. Sheep Industry, 1996–2011" is the fourth report from the Sheep 2011 study and focuses primarily on changes in health and management practices on U.S. sheep operations over time, specifically comparing results from each of the three NAHMS national sheep studies. Interpreting changes in estimates among the three studies, however, is sometimes problematic. For example, comparing results from Sheep 1996 with results from Sheep 2001 and Sheep 2011 is difficult due to structure and coverage of the 1996 study. Thus, results from the 1996 study are only included in a few tables, and these results should be interpreted with caution. In addition, the difference between the 2001 and 2011 studies in how "feedlot/dry lot" operations were defined resulted in the removal of this classification from almost all comparison tables in this report.

In general, major influences behind differences in estimates may be due, in part, to differences in the composition of the target population. These differences are documented in each summary table to aid in interpretation. Differences also may occur in the factors being measured, e.g., changes in question wording, random variation,

and true secular time trends in the sheep industry. These differences have also been documented to aid in interpretation.

Reports and information sheets from all three NAHMS national sheep studies are available at www.aphis.usda.gov/nahms

Participating States¹ by study year and by region²



The methods used and number of respondents in each study can be found in appendices II and III of this report, respectively.

**Terms Used in
This Report**

Being on back: Sheep that have rolled onto their backs (often referred to as “cast” sheep), sometimes due to heavy infestation by keds. Keds may cause excessive itching and ewes roll onto their backs to relieve the itch. Heavily pregnant ewes are most susceptible, but other sheep types may also be vulnerable, including those with full fleeces, stocky builds, or those that have rolled over into a soft spot of ground.

Biosecurity: Management practices used to prevent the spread of disease between groups of animals on an operation and reduce the likelihood of disease entering an operation.

Coccidiostat: A drug that controls coccidia, the cause of coccidiosis.

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

Disease: Any morbid condition that impairs the full productive potential of an animal.

Ewe: A female sheep 1 year of age or older.

Primary flock type: The following flock types represent only flocks with 20 or more ewes. Although the majority of operations had more than one flock type, all had a primary flock type:

Herded/open range—any unfenced acreage, even if a only a few acres surrounded by residential areas.

Fenced range—any fenced area not specifically cultivated to raise forage or browse.

Farm/pasture—any fenced area specifically cultivated to raise forage or browse.

Flushing: Temporary but purposeful elevation in nutritional status around breeding time. Ewes are fed extra energy rations prior to the breeding season to improve ovulations, conception, and embryo implantation rate, ultimately increasing the lamb crop ratio.

Lamb: Sheep less than 1 year old.

Lambing jug: Small, individual pen used to house ewe-lamb pairs shortly after lambing. Pen allows the ewe and lamb to bond and also provides a means for ensuring that the lamb is nursing properly.

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

Operation size:

Sheep 2001 (number of ewes):

- Very small: fewer than 25
- Small: 25 to 99
- Medium: 100 to 999
- Large: 1,000 or more

Sheep 2011 (number of ewes):

- Very small: fewer than 20
- Small: 20 to 99
- Medium: 100 to 499
- Large: 500 or more

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. 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). Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (—).

Regions in 2001 and 2011 studies:

West: California, Oregon, Washington

Central: Arkansas, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, South Dakota, Texas, Utah, Wyoming

East: Illinois, Indiana, 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 of sheep.

Section I: Historic Changes in the U.S. Sheep Industry (1996, 2001, and 2011)

A. General Trends

The USDA's National Agriculture Statistics Service (NASS) conducts the census of agriculture every 5 years. The census is a complete count of U.S. farms, ranches, and the people who manage them. Since 1974, a farm (operation) has been defined as a place from which \$1,000 or more of agricultural products are produced and sold during the year—or normally would have been sold during the census year. The following table provides census numbers since 1890 on sheep inventory, number of sheep operations, and average number of ewes on hand.

1. Sheep and lamb inventory

New sheep operations are continually entering the market. As is the case with other livestock commodities, newer operations tend to be relatively small. In 2007, the average number of ewes per farm was 51.5 compared with the 1978 average of 94.9. The trend of fewer ewes per operation is also reflected in the following table's column "all sheep and lambs average flock size." This column, however, also shows that average flock size peaked in 1974 at 141.6 sheep per operation, decreasing to 70.0 sheep per operation by 2007. Total sheep inventories peaked in 1930 at 56,975,000 sheep and have steadily decreased since.

Although sheep inventory declined from 2002 to 2007, the number of sheep operations increased by nearly 10,000 during the same period. This finding follows the decline in the number of sheep operations from 1982 to 2002, which could indicate an influx of new, smaller operations to the sheep sector.

A.1.a. Changes in U.S. sheep and lamb January 1 inventory, by census year:

Census year	All sheep and lambs inventory (1,000 head)	All sheep and lamb operations	All sheep and lambs average flock/herd size	Ewes 1 year+ inventory (1,000 head)	Ewes 1 year+ farms	Ewes 1 year+ average number per operation
1890	35,935			NA	NA	
1900	61,504	763,543	80.6	NA	NA	
1910	52,448	610,894	85.9	NA	NA	
1920	35,034	538,593	65.0	NA	NA	
1930	56,975	583,578	97.6	NA	NA	
1940	40,129	584,935	68.6	NA	NA	
1945	41,224	456,986	90.2	NA	NA	
1950	31,406	320,351	98.0	NA	NA	
1954	31,619	361,001	87.6	NA	NA	
1959	33,945	341,952	99.3	NA	NA	
1964	25,471	234,789	108.5	NA	NA	
1969	21,611	170,888	126.5	NA	NA	
1974	15,380	108,646	141.6	NA	NA	
1978	12,243	90,437	135.4	7,808	82,287	94.9
1982	12,438	101,582	122.4	7,666	90,500	84.7
1987	11,059	92,489	119.6	6,882	83,552	82.4
1992	10,770	80,839	133.2	6,401	70,730	90.5
1997	8,083	77,112	104.8	4,579	65,505	69.9
2002	6,342	73,814	85.9	3,632	66,789	54.4
2007	5,819	83,134	70.0	3,516	68,222	51.5

Source: National Agricultural Statistics Service.

NASS publishes information on sheep operations in January of each year. The following tables include selected data from NASS surveys that generally correspond to the range of years from 2001 to 2011 and illustrate the changes in the total U.S. inventory of breeding sheep, sheep and lambs, and ewes. The “percent of previous year” column reflects annual changes in ewe inventory, while the “percent of 2001” shows trends from 2001 to 2011.

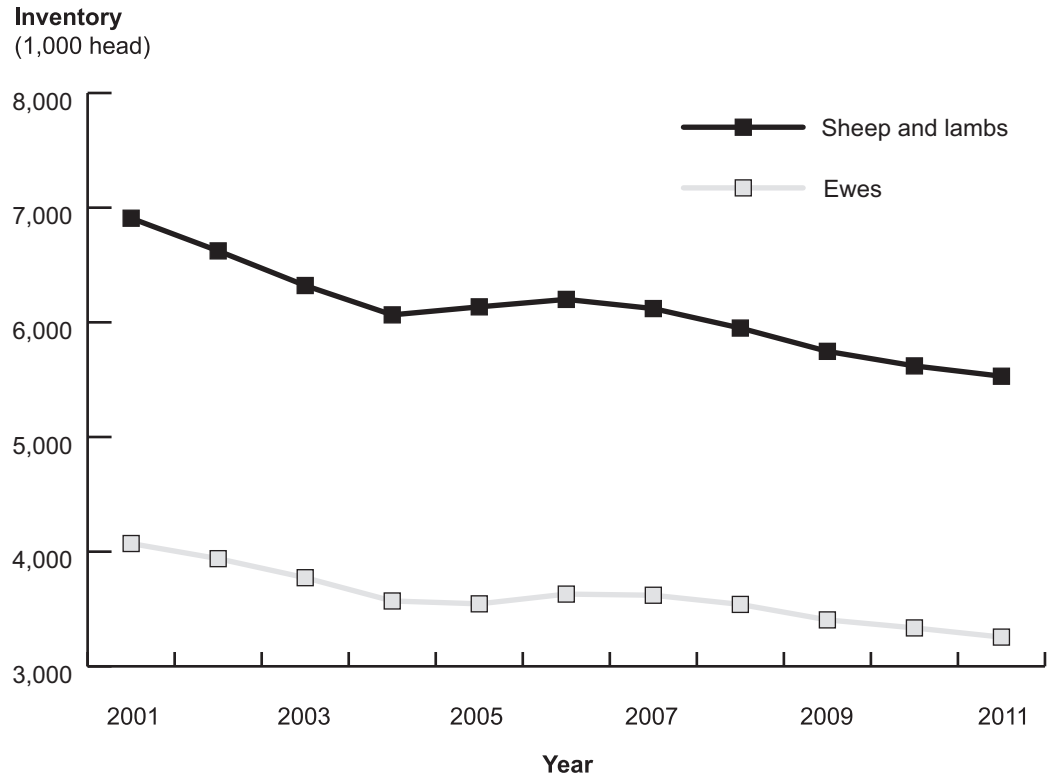
With the exception of 2005 and 2006, sheep and lamb inventories declined steadily from 2001 to 2011. The increases in inventory in 2005 and 2006 were likely due to the USDA’s Farm Service Agency’s Ewe Lamb Replacement and Retention Program implemented in late 2004; this program provided direct payments to help sheep and lamb producers replace and retain their ewe lamb breeding stock.

A.1.b. Changes in U.S. ewe January 1 inventory, 2001–11:

Year	Sheep and lambs inventory (1,000 head)	Breeding sheep inventory (1,000 head)	Ewe inventory (1,000 head)	Pct. of previous year ewe inventory	Pct. of 2001 ewe inventory
2001	6,908	4,952	4,071	96.7	100.0
2002	6,623	4,871	3,939	96.8	96.8
2003	6,321	4,670	3,773	95.8	92.7
2004	6,065	4,464	3,570	94.6	87.7
2005	6,135	4,520	3,545	99.3	87.1
2006	6,200	4,616	3,630	102.4	89.2
2007	6,120	4,553	3,620	99.7	88.9
2008	5,950	4,432	3,540	97.8	87.0
2009	5,747	4,247	3,405	96.2	83.6
2010	5,620	4,185	3,335	97.9	81.9
2011	5,480	4,080	3,225	96.7	79.2

Source: National Agricultural Statistics Service.

Changes in U.S. ewe January 1 inventory, 2001–11



Source: National Agricultural Statistics Service.

Replacement ewe lambs replace ewes that die or are culled. Replacement lambs are most often generated within the flock and should represent the best of the flock's genetics. The average age of cull ewes was 6.3 years (NAHMS Sheep 2011, Part I). Assuming lambs are bred at about 1 year of age, replacement lambs should represent approximately 19 percent of ewe inventory in order to keep the flock of breeding ewes approximately the same size. Replacement lambs represented 16.7 percent of ewe breeding lambs in 2001. This percentage increased each year until 2005, then decreased slightly each year until increasing again in 2010 and 2011.

A.1.c. Percentage changes in U.S. ewe replacement lambs, January 1 inventory, 2001–11:

Year	Ewe replacement inventory (1,000 head)	Percent of previous year	Percent of 2001	Percent of ewes 1 year or older
2001	679	93.7	100.0	16.7
2002	732	107.8	107.8	18.6
2003	703	96.0	103.5	18.6
2004	705	100.2	103.8	19.7
2005	783	111.1	115.3	22.1
2006	786	100.4	115.8	21.7
2007	735	93.4	108.2	20.3
2008	697	94.8	102.7	19.7
2009	647	92.8	95.2	19.0
2010	655	101.3	96.5	19.6
2011	665	101.5	98.9	20.6

Source: National Agricultural Statistics Service.

In 2011, there was a slightly higher percentage of breeding sheep in the 1 to 99 flock size and a slightly lower percentage of breeding sheep in the other flock sizes compared with 2003.

A.1.d. Percentage of U.S. breeding sheep inventory by flock size, 2001–11:

Year	Flock size (number of breeding sheep)				Total
	1–99	100–499	500–4,999	5,000 or more	
2001	NA	NA	NA	NA	NA
2002	NA	NA	NA	NA	NA
2003	31.7	22.0	33.0	13.3	100.0
2004	30.3	22.0	33.5	14.2	100.0
2005	30.3	22.0	33.5	14.2	100.0
2006	28.7	24.0	33.8	13.5	100.0
2007	32.9	21.4	31.9	13.8	100.0
2008	32.6	22.7	30.2	14.5	100.0
2009	36.2	20.8	31.3	11.7	100.0
2010	35.8	20.1	30.6	13.5	100.0
2011	35.9	21.1	31.1	11.9	100.0

Source: National Agricultural Statistics Service.

2. Number and size of operations with breeding sheep

The number of operations with breeding sheep grew from 68,600 in 2001 to 83,130 in 2007, and then stabilized at 80,000 in 2011.

A.2.a. Changes in the number of operations with breeding sheep, 2001–11:

Year	Number of operations	Pct. of previous year	Pct. of 2001
2001	68,600	99.1	100.0
2002	68,150	99.3	99.3
2003	67,720	99.4	98.7
2004	67,630	99.9	98.6
2005	68,460	101.2	99.8
2006	69,180	101.1	100.8
2007	83,130	120.2	121.2
2008	82,500	99.2	120.3
2009	82,000	99.4	119.5
2010	81,000	98.8	118.1
2011	80,000	98.8	116.6

Source: National Agricultural Statistics Service.

The percentage of operations with breeding sheep in the 100 to 499 and 500 to 4,999 flock sizes declined slightly from 2003 to 2011.

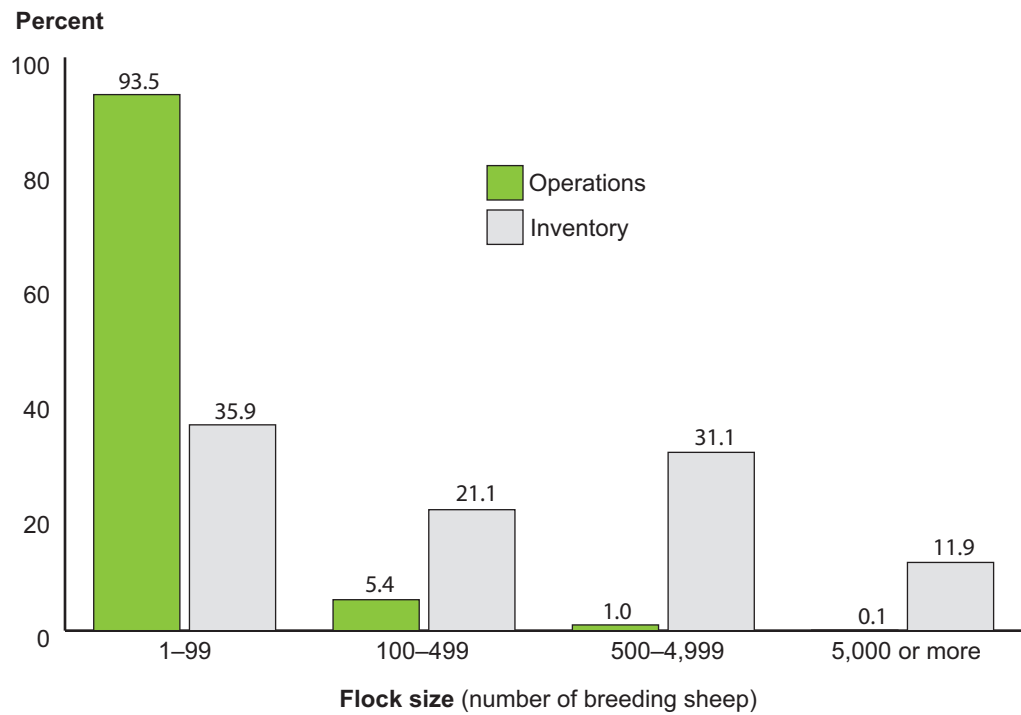
A.2.b. Percentage of operations with breeding sheep, by flock size, 2001–2011:

Year	Flock size (number of breeding sheep)				Total
	1–99	100–499	500–4,999	5,000 or more	
2001	NA	NA	NA	NA	NA
2002	NA	NA	NA	NA	NA
2003	92.2	6.3	1.4	0.1	100.0
2004	92.0	6.5	1.4	0.1	100.0
2005	92.0	6.5	1.4	0.1	100.0
2006	90.8	7.6	1.5	0.1	100.0
2007	92.5	6.1	1.3	0.1	100.0
2008	92.5	6.2	1.2	0.1	100.0
2009	93.7	5.2	1.0	0.1	100.0
2010	93.8	5.1	1.0	0.1	100.0
2011	93.5	5.4	1.0	0.1	100.0

Source: National Agricultural Statistics Service.



Photograph courtesy of Judy Rodriguez.

Percentage of operations with breeding sheep and percentage of breeding sheep inventory in Sheep 2011, by herd size

3. Lamb crop

Lamb inventory gradually declined from 4.5 million head in 2001 to 3.5 million in 2011.

A.3. Changes in U.S. lamb crop, 2001–11:

Year	Inventory (1,000 head)	Percent of previous year	Lambs per 100 ewes on January 1
2001	4,520	97.3	111
2002	4,355	96.4	111
2003	4,035	92.7	107
2004	4,040	100.1	113
2005	4,015	99.4	113
2006	3,950	98.4	109
2007	3,895	98.6	108
2008	3,710	95.3	105
2009	3,690	99.5	108
2010	3,570	96.7	107
2011	3,510	98.3	109

Source: National Agricultural Statistics Service "Sheep and Goats" reports.

4. Wool production

The value of wool production increased substantially from 2001 to 2011, while wool production fell by nearly 13,000 lb during the same period.

A.4. Changes in sheep shorn, weight per fleece, and wool production, 2001–11:

Year	Sheep shorn (1,000 head)	Pounds per fleece	Production (1,000 lb)	Value of wool production (\$1,000)	Pct. of 2001 value of wool production
2001	5,596	7.5	42,156	14,841	100.0
2002	5,462	7.5	41,078	21,689	146.1
2003	5,077	7.5	38,197	28,129	189.5
2004	5,066	7.4	37,581	29,954	201.8
2005	5,061	7.3	37,182	26,249	176.9
2006	4,847	7.4	35,899	24,300	163.7
2007	4,657	7.5	34,723	30,242	203.8
2008	4,434	7.4	32,963	30,486	205.4
2009	4,195	7.4	30,860	24,337	164.0
2010	4,180	7.3	30,370	35,018	236.0
2011	4,030	7.3	29,290	48,925	329.6

Source: National Agricultural Statistics Service "Sheep and Goats" reports.

5. Sheep and lamb slaughter

While the number of sheep slaughtered under Federal inspection declined from 2001 to 2011, the number of sheep slaughtered under “other” inspection rose slightly. Slaughter of mature sheep, lambs, and yearlings equals federally inspected slaughter. Federally inspected slaughter plus “other” equals commercial slaughter. From 2001 to 2011, farm slaughter increased by 35.0 percent.

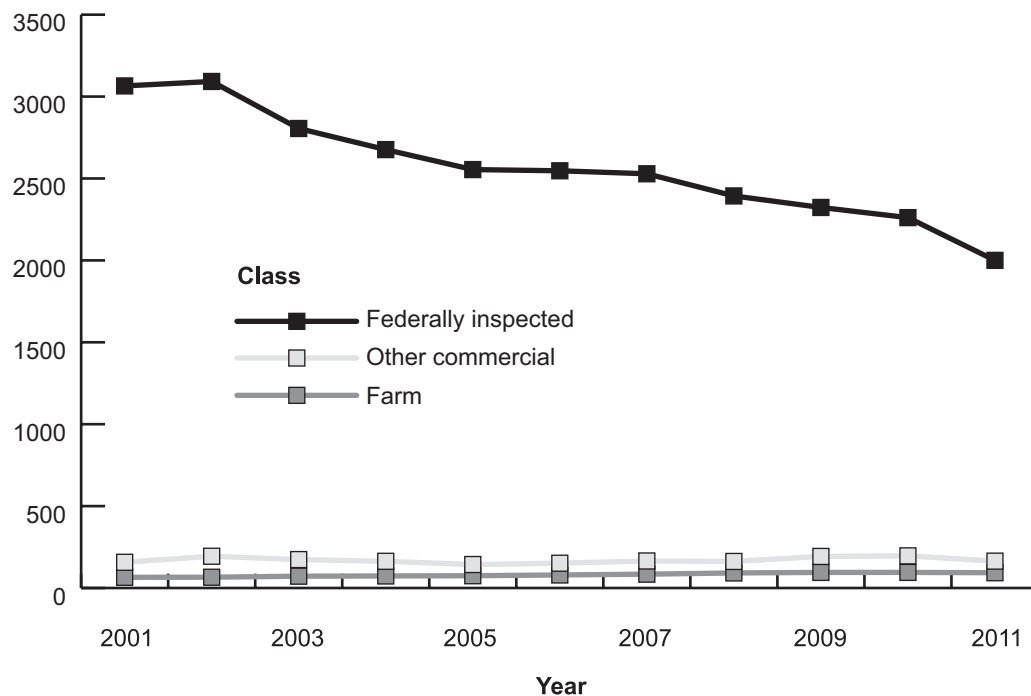
A.5.a. Changes in sheep slaughter by class, 2001–11:

Year	Mature sheep (1,000 head)	Lambs and yearlings (1,000 head)	Federally inspected (1,000 head)	Other (1,000 head)	Commercial (1,000 head)	Farm (1,000 head)
2001	143.7	2,921.3	3,065.0	157.2	3,222.1	65.4
2002	148.0	2,944.3	3,092.3	194.0	3,286.3	65.9
2003	143.2	2,662.0	2,805.2	173.6	2,978.8	72.2
2004	147.3	2,529.0	2,676.3	163.1	2,839.3	73.5
2005	129.3	2,425.1	2,554.4	143.4	2,697.8	74.9
2006	118.1	2,429.0	2,547.0	151.4	2,698.5	79.7
2007	115.6	2,413.1	2,528.7	165.1	2,693.8	84.5
2008	122.3	2,271.1	2,393.5	162.1	2,555.5	91.9
2009	157.7	2,165.3	2,323.1	192.8	2,515.9	95.2
2010	156.4	2,103.7	2,261.1	196.4	2,457.5	95.3
2011	140.7	1,859.5	2,000.2	164.1	2,164.3	93.2

Source: National Agricultural Statistics Service “Livestock Slaughter” reports.

Changes in sheep slaughter, 2001–11

Number slaughtered
(1,000 head)



Source: National Agricultural Statistics Service "Livestock Slaughter" reports.

The average total commercial slaughter weights started high in 2001 (140 lb), declined somewhat, then rose again in 2011 (138 lb).

A.5.b. Sheep and lamb slaughter weights by class, 2001–11:

Year	Federally inspected (lb)	Other (lb)	Commercial production (lb)
2001	142	106	140
2002	135	100	133
2003	136	105	134
2004	138	111	136
2005	140	107	138
2006	138	105	137
2007	138	104	136
2008	138	103	136
2009	139	97	136
2010	137	98	134
2011	141	99	138

Source: National Agricultural Statistics Service "Livestock Slaughter" reports.

6. Value of production

Lamb prices have increased since 2007 and in 2011 reached historic highs. These prices helped return the value of sheep and lamb production in 2010 to levels not seen since 2005, despite generally low inventories.

A.6. Recent changes in value of sheep and lamb production (excludes value of wool), 2001–11:

Year	Production (\$1,000)	Pct. of 2001
2001	303,186	100.0
2002	313,946	103.5
2003	389,201	128.4
2004	412,691	136.1
2005	451,467	148.9
2006	367,799	121.3
2007	362,941	119.7
2008	351,287	115.9
2009	365,030	120.4
2010	442,899	146.1
2011	NA ¹	

¹Value not reported by NASS for 2011.

Source: National Agricultural Statistics Service "Meat Animals PDI" reports.

B. Sheep Inventory by State

In 2001, California, Colorado, Montana, South Dakota, Texas, and Wyoming accounted for 53.3 percent of the total U.S. sheep and lamb inventory. In 2011, these same States accounted for 49.4 percent of the total sheep and lamb inventory. During those same years, States with lower inventories, such as Arizona, Missouri, Virginia, and Wisconsin, increased their sheep and lamb inventories by 11 to 47 percent of 2001 levels. Some of the biggest sheep producing States, however, decreased their inventories during the same period.

B. Changes in total sheep and lamb inventory, and number of ewes 1 year and older, January 1:

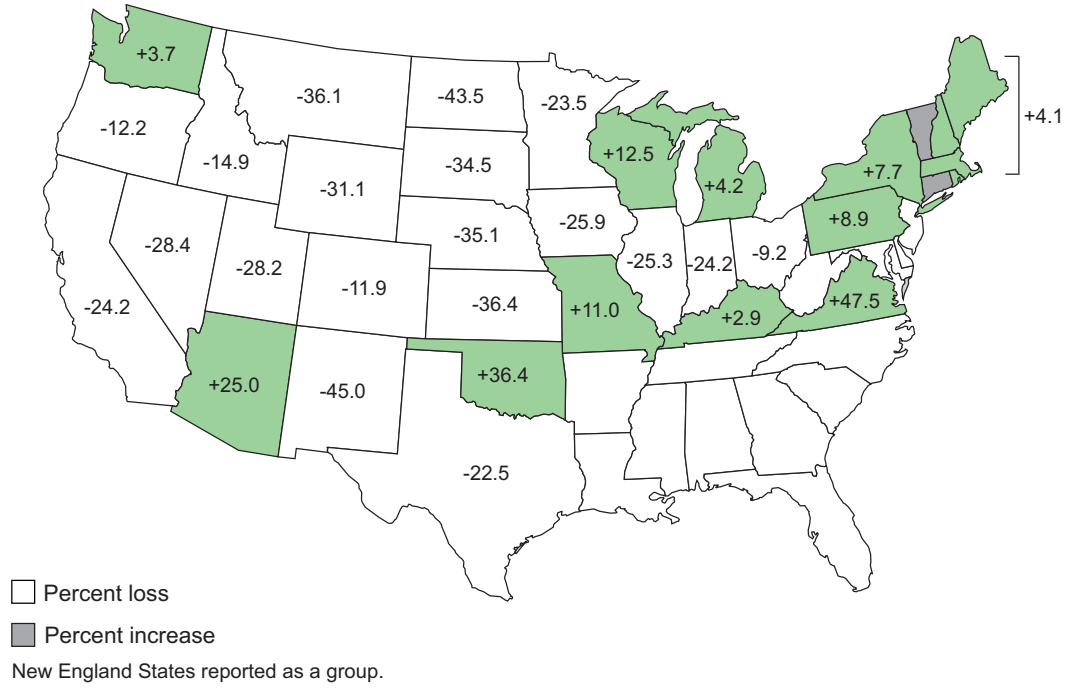
State	2001		2011		Pct. of 2001	
	Total sheep and lambs (1,000 head)	Ewes 1+ (1,000 head)	Total sheep and lambs (1,000 head)	Ewes 1+ (1,000 head)	Total sheep and lambs (1,000 head)	Ewes 1+ (1,000 head)
Arizona	120	53	150	75	125.0	141.5
California	805	310	600	273	75.8	91.3
Colorado	420	165	370	142	88.1	86.1
Idaho	275	195	235	151	85.5	78.5
Illinois	75	48	56	36	74.7	75.0
Indiana	66	45	50	34	75.8	75.6
Iowa	270	144	200	104	74.1	73.6
Kansas	110	58	70	33	63.6	56.9
Kentucky	—	—	34	22	—	—
Michigan	71	40	74	44	104.2	110.0
Minnesota	170	90	130	77	76.5	85.6
Missouri	73	47	81	57	111.0	121.3
Montana	360	265	230	170	63.9	64.2
Nebraska	114	77	74	46	64.9	59.7
Nevada	95	68	68	46	71.6	67.6
New Mexico	200	130	110	75	55.0	59.2
New York	65	41	70	43	107.7	104.9

B. (cont'd.) Changes in total sheep and lamb inventory, and number of ewes 1 year and older, January 1:

State	2001		2011		Pct. of 2001	
	Total sheep and lambs (1,000 head)	Ewes 1+ (1,000 head)	Total sheep and lambs (1,000 head)	Ewes 1+ (1,000 head)	Total sheep and lambs (1,000 head)	Ewes 1+ (1,000 head)
North Carolina	—	—	27	16	—	—
North Dakota	138	89	78	50	56.5	56.2
Ohio	142	86	129	81	90.8	94.2
Oklahoma	55	33	75	45	136.4	136.4
Oregon	245	120	215	118	87.8	98.3
Pennsylvania	90	64	98	62	108.9	96.9
South Dakota	420	265	265	173	65.5	66.4
Tennessee	—	—	35	22	—	—
Texas	1,150	710	850	515	76.5	73.9
Utah	390	300	280	210	71.8	70.3
Virginia	61	37	90	55	147.5	148.6
Washington	54	35	56	36	103.7	102.9
West Virginia	35	24	34	24	97.1	100.0
Wisconsin	80	53	90	59	112.5	111.3
Wyoming	530	340	365	220	68.9	64.7
New England	49	32	51	32	104.1	94.1
Other States	180	107	140	79	77.8	73.8
United States	6,908	4,071	5,480	3,225	80.1	80.0

Source: National Agricultural Statistics Service "Sheep and Goats" reports.

Changes in total sheep and lamb inventory, 2001–11



Section II: Population Estimates (1996, 2001, 2011)

Note: This report compares results from the Sheep 1996 and Sheep 2001 studies with those from the Sheep 2011 study. In some cases, questions were asked about practices or occurrences during the calendar year preceding the study (i.e., 1995 for Sheep 1996, 2000 for Sheep 2001, and 2010 for Sheep 2011), while other questions were asked about usual or ongoing practices or occurrences without a specific time frame (i.e., what the producer typically does).

A. Changes in Inventory

1. Breed categories

In 2011, the highest percentage of operations (48.6 percent) owned black-faced sheep, but black-faced sheep and lambs owned represented just 14.0 percent of the January 1 sheep and lamb inventory (table A.1.c). In the Sheep 2011 study, the crossbred category used in 1996 and 2001 was changed to mottle-, brockle-, or speckle-faced crossbred. This change might explain the substantial decline in the percentage of operations that reported they owned sheep in this category. The change was made to more clearly identify ownership of sheep breeds that have historically been at a higher risk for scrapie compared with white-faced breeds. It is possible that in 1996 and 2001 operations included white-faced crossbreds in the crossbred category, even though the majority of these should have been included in the fine- or medium-wool white-faced categories. It is also likely that black-faced crossbreds were included in the crossbred category in 1996 and 2001.

The greatest change in 2011 compared with 1996 and 2001 was the increase in the percentage of operations that owned hair sheep, which increased from 1.0 percent of operations in 1996 to 21.7 percent 2011.

A.1.a. Percentage of operations by breed category of sheep and lambs, and by study:

Breed category	Percent Operations					
	Sheep 1996		Sheep 2001		Sheep 2011 ¹	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Black faced, wool	32.3	(1.1)	38.8	(1.6)	48.6	(1.1)
White faced, fine wool	13.0	(0.7)	17.2	(1.1)	26.2	(0.9)
White faced, medium wool	20.6	(0.9)	23.3	(1.3)	32.7	(1.1)
Long wool	NA		3.8	(0.6)	4.6	(0.5)
Mottle-, brockle-, or speckle-faced crossbred	23.8 ²	(1.0)	48.2 ²	(1.6)	13.7	(0.8)
Colored wool	2.4	(0.3)	8.3	(0.9)	5.2	(0.5)
Hair sheep	1.0	(0.3)	4.6	(0.8)	21.7	(1.0)
Milk sheep	0.0	(0.0)	0.1	(0.1)	0.9	(0.2)
Other	6.9 ³	(0.6)	7.4	(0.9)	6.7	(0.6)
Unknown	NA		0.2 ⁴	(0.1)	0.9	(0.2)

An operation may have multiple breeds of sheep.

Question variations:

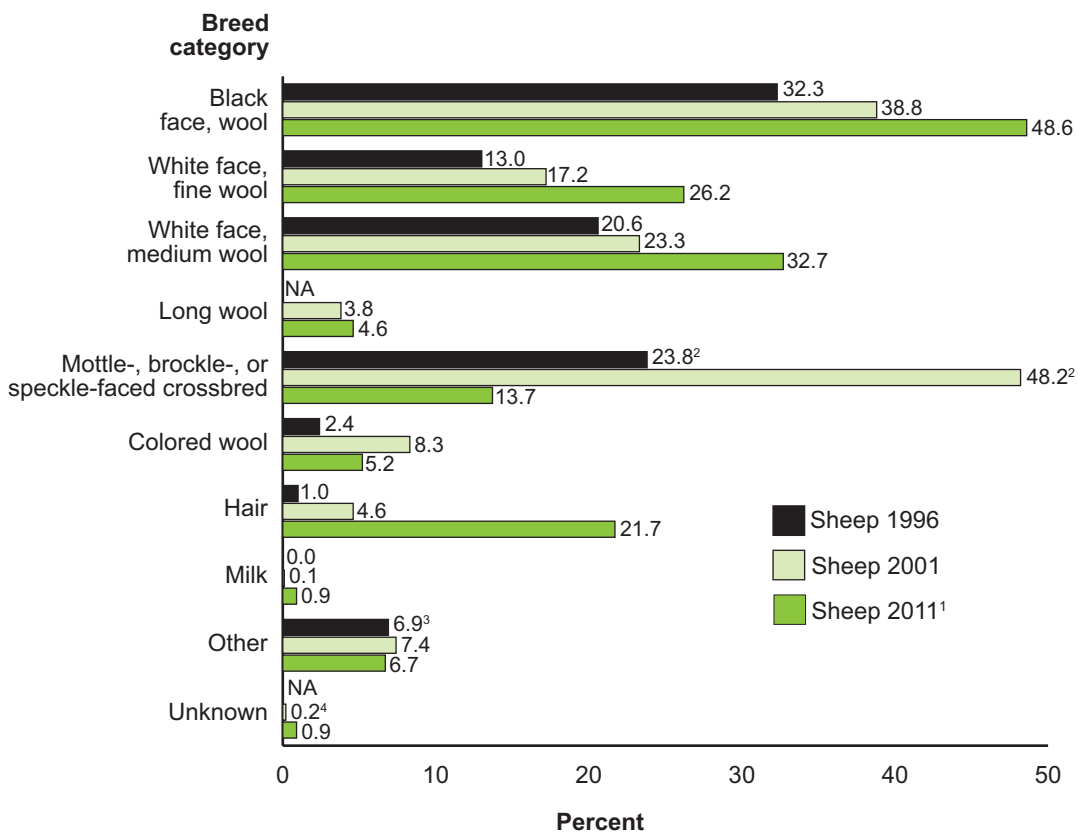
¹In 2011 only operations with ewes on January 1 were included.

²Category was "Crossbred" in 1996 and 2001.

³Category was "Multiple" in 1996.

⁴Unknown—feedlot operations only.

Percentage of operations by breed category of sheep and lambs, and by study



An operation may have had multiple breeds of sheep.

Question variation:

¹In 2011, only operations with ewes on January 1 were included.

²Category was "Crossbred" in 1996 and 2001.

³Category was "Multiple" in 1996.

⁴Unknown—feedlot operations only.

A substantial downward trend across all regions in the percentage of operations that owned mottle-, brockle-, or speckle-faced crossbreds occurred from 2001 to 2011. Conversely, there was a substantial upward trend across regions in the percentage of operations that owned hair sheep. From 2001 to 2011, the percentage of operations in the East region that owned black-faced wool breeds, white-faced medium wool breeds, and long-wool breeds increased.

A.1.b. Percentage of operations by breed category of sheep and lambs, and by region:

	Percent Operations											
	Region											
	West				Central				East			
	Sheep 2001		Sheep 2011 ¹		Sheep 2001		Sheep 2011 ¹		Sheep 2001		Sheep 2011 ¹	
Breed categories	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Black-faced, wool	47.6	(4.5)	49.5	(2.5)	37.8	(2.6)	38.9	(1.5)	35.8	(2.2)	46.9	(1.5)
White-faced, fine wool	11.6	(2.5)	12.1	(1.6)	28.4	(2.1)	35.0	(1.5)	11.2	(1.5)	13.9	(1.1)
White-faced, medium wool	23.6	(3.7)	23.5	(2.1)	22.4	(2.0)	19.8	(1.1)	23.7	(1.9)	34.3	(1.5)
Long wool	5.6	(1.7)	10.8	(1.6)	2.6	(0.8)	1.7	(0.4)	3.8	(0.9)	7.9	(0.9)
Mottle-, brockle-, or speckle-faced crossbred ²	56.4	(4.5)	12.5	(1.6)	36.9	(2.4)	7.7	(0.7)	53.1	(2.3)	12.4	(0.9)
Colored wool	9.1	(2.5)	9.0	(1.5)	6.1	(1.3)	4.1	(0.6)	9.6	(1.4)	9.2	(1.0)
Hair	3.8	(1.2)	20.4	(2.0)	5.2	(1.8)	27.1	(1.5)	4.4	(1.0)	18.1	(1.2)
Milk	0.1	(0.1)	0.7	(0.4)	0.0	(0.0)	0.6	(0.3)	0.2	(0.1)	0.9	(0.3)
Other	6.1	(2.1)	6.2	(1.2)	5.4	(1.3)	5.5	(0.9)	9.4	(1.4)	8.4	(0.9)
Unknown ³	0.6	(0.5)	1.6	(0.7)	0.3	(0.1)	1.0	(0.4)	0.0	(0.0)	1.3	(0.4)

An operation may have multiple breeds of sheep.

Question variations:

¹In 2011 only operations with ewes on January 1 were included.

²Category was "crossbred" in 2001.

³Unknown—feedlot operations only in 2001.

In 2011, the white-faced, fine- wool sheep breeds represented the single highest percentage of sheep and lamb inventory (43.5 percent of the January 1 sheep and lamb inventory). This percentage remained relatively unchanged from 1996 to 2011. Hair sheep represented largest increase in the percentage of sheep and lamb inventory by breed category. There was a slight uptick in the percentage of hair sheep from 1996 to 2001, but a 900-percent increase from 2001 to 2011. The percentage decrease of operations with mottle-, brockle-, or speckle-faced crossbreds was likely due to a change in the definition of this category.

A.1.c. Percentage of January 1 sheep and lamb inventory, by breed category:

Breed categories	Percent Sheep and Lambs					
	Sheep 1996		Sheep 2001		Sheep 2011 ¹	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Black-faced, wool	10.2	(0.7)	8.9	(0.6)	14.0	(0.7)
White-faced, fine wool	41.8	(2.4)	34.3	(1.3)	43.5	(1.5)
White-faced, medium wool	26.0	(2.4)	17.9	(0.9)	18.3	(0.9)
Long wool	NA		0.7	(0.1)	1.0	(0.1)
Mottle-, brockle-, or speckle-faced crossbred ²	15.6	(2.4)	29.4	(1.5)	5.4	(0.5)
Colored wool	0.6	(0.1)	1.2	(0.3)	0.8	(0.1)
Hair	0.4	(0.1)	1.2	(0.2)	11.0	(0.7)
Milk	0.0	(0.0)	0.1	(0.0)	0.7	(0.4)
Other ³	5.4	(0.7)	3.4	(0.9)	4.8	(0.7)
Unknown ⁴	NA		2.9	(0.6)	0.5	(0.2)
Total	100.0		100.0		100.0	

Question variations:

¹In 2011 only operations with ewes on January 1 were included.

²Category was "crossbred" in 1996 and 2001.

³Category was "multiple" in 1996.

⁴Unknown—feedlot operations only.

In the West region, inventories of black-faced wool breeds increased from 10.0 percent of sheep and lambs in 2001 to 24.2 percent in 2011. Inventories of white-faced, medium wool breeds declined in the Central region and increased in the East region from 2001 to 2011. Hair sheep inventories increased in all regions.

A.1.d. Percentage of January 1 sheep and lamb inventory by breed category and by region:

Breed categories	Percent Sheep and Lambs											
	Region											
	West				Central				East			
	Sheep 2001		Sheep 2011 ¹		Sheep 2001		Sheep 2011 ¹		Sheep 2001		Sheep 2011 ¹	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Black faced, wool	10.0	(1.3)	24.2	(2.8)	5.9	(0.8)	7.3	(0.5)	18.2	(1.5)	26.1	(1.2)
White faced, fine wool	25.9	(4.2)	33.3	(3.3)	45.0	(1.6)	57.8	(1.9)	5.7	(0.8)	8.5	(0.8)
White faced, medium wool	10.7	(2.5)	13.8	(2.0)	20.9	(1.2)	15.1	(1.2)	15.0	(1.3)	28.7	(1.5)
Long wool	1.7	(0.6)	3.1	(0.5)	0.3	(0.1)	0.2	(0.1)	1.1	(0.3)	2.0	(0.3)
Mottle-, brockle-, or speckle-faced crossbred ²	42.6	(5.0)	9.4	(1.6)	20.9	(1.6)	2.0	(0.4)	45.3	(2.8)	10.4	(1.3)
Colored wool	1.7	(1.0)	1.0	(0.2)	1.0	(0.3)	0.6	(0.2)	1.8	(0.4)	2.5	(0.4)
Hair	1.4	(0.5)	7.2	(1.1)	0.8	(0.2)	12.5	(1.0)	2.1	(0.5)	13.7	(1.1)
Milk	0.0	(0.0)	2.1	(1.9)	0.0	(0.0)	0.1	(0.0)	0.4	(0.2)	1.0	(0.3)
Other	2.8	(0.9)	5.7	(1.7)	1.5	(0.3)	4.0	(0.9)	10.2	(4.6)	6.1	(0.8)
Unknown ³	3.0	(1.5)	0.1	(0.0)	3.6	(0.9)	0.4	(0.2)	0.1	(0.1)	1.2	(0.5)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Question variations:

¹In 2011 only operations with ewes on January 1 were included.

²Category was "crossbred" in 2001.

³Unknown—feedlot operations only in 2001.

2. Primary use

Primary uses of sheep and lambs include meat, wool, show, competition, 4-H or club lambs, seed or breeding stock, milk, and other uses. In 2001, 60.7 percent of operations raised some sheep and lambs primarily for meat compared with 81.6 percent of operations in 2011. The percentage of operations that raised some sheep and lambs primarily for seed or breeding stock decreased from 35.6 percent in 2001 to 26.5 percent in 2011.

A.2.a. Percentage of operations by primary use of lambs and sheep, and by study:

Primary use*	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Meat	60.7	(1.7)	81.6	(1.0)
Wool	13.3	(1.1)	15.8	(0.8)
Showing, competition, 4-H, or club	15.0	(1.2)	12.6	(0.8)
Seed or breeding stock	35.6	(1.6)	26.5	(1.1)
Milk	0.3	(0.1)	0.5	(0.1)
Other	10.9	(1.2)	3.3	(0.5)

*An operation may have had sheep and lambs for different purposes. Therefore, one operation may have had sheep of more than one primary-use category.

Meat was the primary use of the majority of all sheep and lambs in 2001 and 2011 (64.8 and 70.4 percent of inventory, respectively). Seed or breeding stock accounted for 20.4 percent of inventory in 2001 but only 11.5 of inventory in 2011.

A.2.b. Percentage of January 1 sheep inventory by primary use of lambs and sheep, and by study:

Primary use	Percent Inventory (January 1)			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Meat	64.8	(1.0)	70.4	(1.3)
Wool	10.3	(0.6)	14.7	(1.2)
Showing, competition, 4-H, or club	2.8	(0.2)	2.3	(0.2)
Seed or breeding stock	20.4	(0.8)	11.5	(0.8)
Milk	0.1	(0.1)	0.3	(0.1)
Other	1.6	(0.2)	0.8	(0.2)
Total	100.0		100.0	



Photograph courtesy of American Sheep Institute.

B. Flock Management

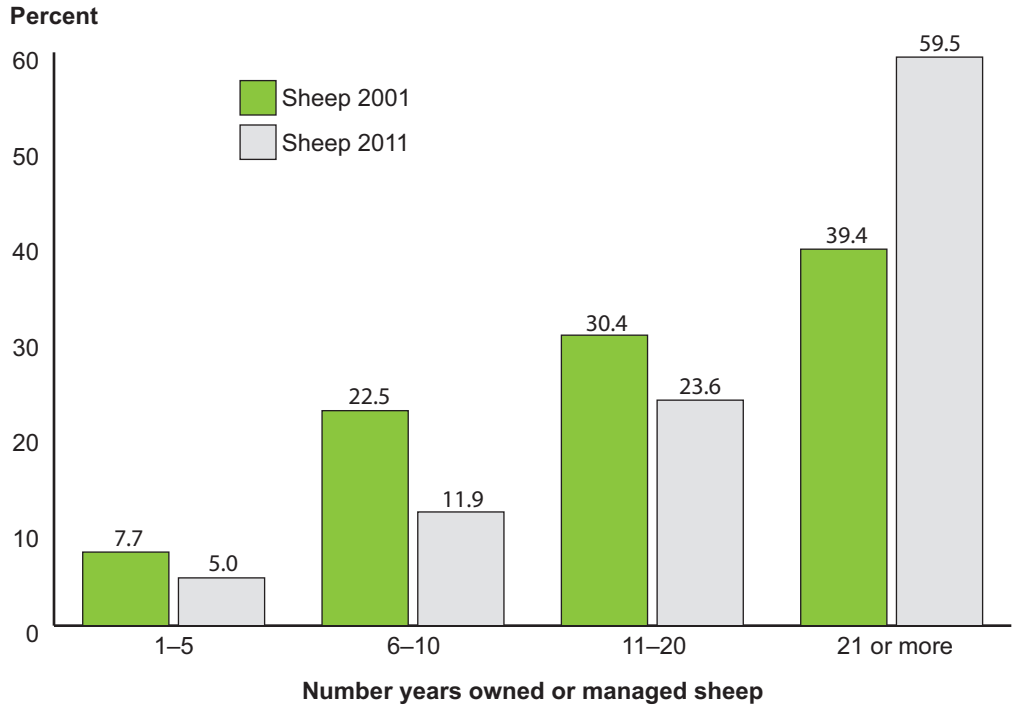
1. Operator experience

Operations in which the primary producer had been in the sheep business for 21 years or more made up a higher percentage of operations in 2011 (59.5 percent) than in 2001 (39.4 percent), suggesting a decline in the number of new producers or a decline in the number of new producers that stayed in business.

B.1.a. Percentage of operations by number of years the primary operator had owned or managed any sheep, and by study:

Number years	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
1–5	7.7	(0.9)	5.0	(0.5)
6–10	22.5	(1.5)	11.9	(0.8)
11–20	30.4	(1.5)	23.6	(1.0)
21–59	31.8	(1.5)	54.4	(1.2)
60 or more	7.6	(0.7)	5.1	(0.5)
Total	100.0		100.0	

Percentage of operations by number of years the primary operator had owned or managed any sheep, and by study



In 2001, the primary operator on 69.5 percent of herded/open range operations and 55.8 percent of fenced range operations had been in business 21 or more years. In 2011, producers on more than half of operations across flock types had been in business 21 to 59 years.

B.1.b. Percentage of operations by number of years the primary operator had owned or managed any sheep, and by primary flock type:

Number years	Percent Operations					
	Primary Flock Type					
	Herded/ open range		Fenced range		Farm/pasture	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001						
1–5	5.8	(3.7)	5.5	(1.9)	8.0	(1.0)
6–10	3.8	(0.9)	17.7	(3.8)	23.4	(1.7)
11–20	20.9	(4.0)	21.0	(2.7)	32.1	(1.7)
21–59	51.0	(7.7)	41.3	(3.8)	30.1	(1.6)
60 or more	18.5	(3.7)	14.5	(1.8)	6.4	(0.8)
Total	100.0		100.0		100.0	
Sheep 2011						
1–5	3.6	(1.7)	5.3	(1.1)	4.7	(0.7)
6–10	4.1	(1.1)	10.4	(1.5)	12.5	(1.0)
11–20	16.6	(3.5)	22.7	(2.0)	24.2	(1.4)
21–59	59.3	(5.2)	55.2	(2.3)	54.6	(1.5)
60 or more	16.3	(4.6)	6.5	(1.0)	3.9	(0.6)
Total	100.0		100.0		100.0	

2. Inventory expectations in 5 years

A lower percentage of producers in 2011 (6.4 percent) expected to leave the sheep industry in the next 5 years compared with producers in 2001 (15.6 percent) and 1996 (11.8 percent). In 2011, 82.9 percent of producers expected to have the same number or more sheep in 5 years, compared with 73.6 percent of producers in 2001 and 78.7 percent in 1996.

In Sheep 1996, 11.8 percent of producers did not expect to have sheep in 5 years, which was a slightly lower percentage than actually went out of business; according to the NASS, there were 79,900 U.S. sheep operations in 1995 and only 66,100 in 2000, a 17.3 percent decrease.

B.2.a. Percentage of operations by sheep inventory expected in 5 years, as compared with the January 1 inventory in 1996, 2001, and 2011:

Number sheep next 5 years	Percent Operations					
	Study					
	Sheep 1996		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
None	11.8	(0.8)	15.6	(1.3)	6.4	(0.6)
Fewer	9.5	(0.7)	10.8	(1.0)	10.6	(0.7)
About the same	43.7	(1.2)	48.5	(1.7)	59.0	(1.2)
More	35.0	(1.1)	25.1	(1.4)	23.9	(1.0)
Total	100.0		100.0		100.0	

In 2001, producers on about half the operations that did not expect to have sheep in 5 years (55.3 percent) reported that the main reason was a personal/family situation (e.g., retirement, lack of successor, etc.). The majority of producers in the “Other” category cited a combination of the reasons below as to why they did not expect to have sheep in 5 years. In 2011, producers on 79.3 percent of operations that did not expect to have sheep in 5 years cited personal/family situation as the reason.

B.2.b. For operations that did not expect to have sheep in in the next 5 years, percentage of operations by main reason for not having sheep, and by study:

Reason	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Personal/family situation	55.3	(4.7)	79.3	(3.9)
Price of wool	8.8	(2.9)	2.2	(1.7)
Price of lambs	7.3	(2.1)	2.8	(1.8)
Predator loss	2.6	(0.6)	4.7	(1.9)
Labor shortage	2.5	(1.3)	2.7	(1.4)
Government regulations	0.8	(0.5)	0.6	(0.4)
Sheep disease	0.2	(0.1)	0.2	(0.2)
Loss of wool incentive	2.8	(1.6)	NA	
Other	19.7	(4.0)	7.5	(2.6)
Total	100.0		100.0	

3. Sources of information on sheep health

In 2001 and 2011, the top three sources of sheep health information rated by producers as very important were veterinarians, other sheep producers, and shearers. The percentage of operations in which producers considered the Internet a very important source of information tripled from 2001 to 2011 (7.3 and 25.8 percent, respectively).

B.3.a. Percentage of operations that rated the following sources of sheep health information as **very important**, by study:

Health information source	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Sheep Industry Development (SID) Sheep Production Handbook	10.5	(1.0)	19.1	(0.9)
Industry meetings	10.2	(1.0)	11.7	(0.7)
Internet	7.3	(0.9)	25.8	(1.0)
Magazines/newsletters	22.7	(1.3)	26.3	(0.9)
University/extension	22.0	(1.3)	27.6	(1.0)
Veterinarians*	39.1	(1.6)	40.4	(1.1)
Feed or drug salespeople	9.2	(0.9)	13.4	(0.8)
Shearers	29.3	(1.5)	31.7	(1.0)
Other sheep producers	30.7	(1.5)	38.3	(1.1)

*2001 question variation: veterinarians, private practitioners, or consultants.

From 2001 to 2011, herded/open range operations accounted for the biggest increase in the percentage of operations in which producers rated the Internet as an important source of sheep health information. A higher percentage of producers on herded/open range operations valued feed or drug salespeople as important sources of information in 2011 than producers on the other flock types.

B.3.b. Percentage of operations that rated the following sources of sheep health information as **very important**, by study and by primary flock type:

Health information source	Percent Operations					
	Primary Flock Type					
	Herded/ open range		Fenced range		Farm/ pasture	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001						
Sheep Industry Development (SID) Sheep Production Handbook	8.6	(2.4)	9.7	(2.6)	10.7	(1.1)
Industry meetings	17.8	(3.5)	15.0	(3.2)	9.4	(1.0)
Internet	3.0	(0.7)	5.7	(2.1)	7.5	(1.0)
Magazines/newsletters	22.1	(3.9)	32.1	(3.6)	21.2	(1.3)
University/extension	29.0	(4.9)	28.6	(3.7)	21.0	(1.4)
Veterinarians*	45.3	(7.4)	34.5	(3.5)	39.6	(1.8)
Feed or drug salespeople	9.6	(1.7)	10.7	(1.6)	8.9	(1.0)
Shearer	30.1	(5.4)	28.3	(3.4)	29.6	(1.7)
Other sheep producers	40.0	(6.6)	30.7	(3.3)	30.7	(1.7)
Sheep 2011						
Sheep Industry Development (SID) Sheep Production Handbook	16.1	(4.3)	16.8	(1.7)	19.1	(1.3)
Industry meetings	22.6	(3.5)	11.2	(1.2)	13.0	(1.1)
Internet	18.0	(4.1)	17.2	(1.7)	26.8	(1.4)
Magazines/newsletters	26.1	(4.5)	26.4	(1.9)	30.3	(1.4)
University/extension	27.6	(4.3)	26.7	(2.0)	29.1	(1.4)
Veterinarians*	45.0	(5.2)	34.5	(2.1)	39.2	(1.5)
Feed or drug salespeople	24.8	(5.3)	12.0	(1.4)	10.8	(1.0)
Shearer	47.8	(5.3)	31.0	(1.9)	28.9	(1.4)
Other sheep producers	42.7	(5.0)	41.4	(2.2)	38.8	(1.5)

*2001 question variation: veterinarians, private practitioners, or consultants.

4. Production records

Record-keeping systems are commonly used to track productivity, reproduction, and the health of ewes. In 2011, 30.8 percent of operations (25.7 plus 5.1 percent) used computerized record keeping for some or all of their production records. In 2001, only 10.2 percent of operations used computerized records, and just two of three operations (67.9 percent) used either computerized or handwritten/typed records. In 2011, only 13.3 percent of operations kept no production records compared with 32.1 percent of operations in 2001.

B.4. Percentage of operations by type of production records kept, and by study:

Record type	Percent Operations					
	Sheep 1996		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Computerized	10.8	(0.7)	10.2	(0.9)	5.1	(0.5)
Handwritten/ typed/manual	77.1	(1.1)	64.8	(1.6)	55.9	(1.2)
Either	NA		67.9	(1.6)	86.7	(0.9)
Both	NA		NA		25.7	(1.0)
None	19.5	(1.0)	32.1	(1.6)	13.3	(0.9)
Other (1996)	1.7	(0.3)	NA		NA	

5. Primary flock type

During the 1996, 2001, and 2011 studies, producers were asked how they primarily managed their sheep: herded/open range, fenced range, farm/pasture, dry lot/intensive confinement, or other. All three studies reported that the majority of operations managed at least some of their sheep on farm/pasture. Although only 14.1 percent of all operations were primarily fenced/open range operations, 56.0 percent of all sheep and lambs were on these type of operations in 2001, which is indicative of the large size of these operations compared with farm/pasture operations; farm/pasture operations accounted for 85.1 percent of all operations but only 31.5 percent of all sheep and lambs.

The percentage of operations that primarily managed the sheep in a feedlot/dry lot increased from 0.8 percent in 2001 to 7.3 percent in 2011, likely because in the Sheep 2001 study questionnaire the feedlot category was restricted to only operations that managed their sheep in intensive confinement where the primary purpose was to finish sheep on a high-energy diet for slaughter. In 2011, any operation that kept its sheep in a dry lot (for any reason) was allowed to designate its primary operation type as a feedlot/dry lot, which might partially explain the lower percentage of operations that managed their sheep primarily as a farm/pasture operation in 2011 compared with 2001. In 2011, twice the percentage of operations managed their flock as fenced range or herded/open range compared with 2001; however, the percentage of ewes on fenced range operations remained constant.

B.5.a. Percentage of operations by **primary** type of flock management used, and by study:

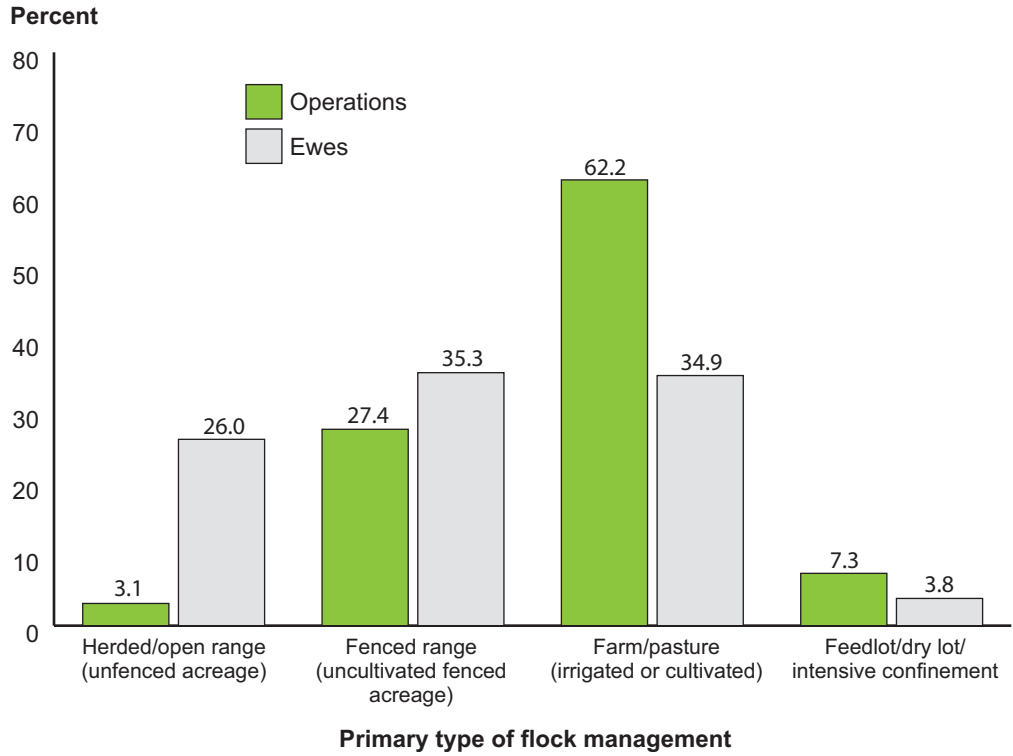
Primary type of flock management	Percent Operations					
	Sheep 1996		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Herded/open range (unfenced acreage)	1.0	(0.1)	1.3	(0.2)	3.1	(0.3)
Fenced range (uncultivated fenced acreage)	10.0	(0.6)	12.8	(0.9)	27.4	(1.0)
Farm/pasture (irrigated or cultivated)	84.9	(0.8)	85.1	(1.0)	62.2	(1.0)
Feedlot/dry lot/intensive confinement	2.3	(0.3)	0.8	(0.2)	7.3	(0.6)
Other/multiple (1996)	1.8	(0.3)	NA		NA	
Total	100.0		100.0		100.0	

A slightly higher percentage of ewes were managed on herded/open range operations in 2011 than in 2001. While the percentage of operations that managed sheep on fenced range nearly tripled from 1996 to 2011 (table B.5.a), the percentage of sheep on fenced range operations remained about the same, suggesting a decrease in the average size of fenced operations.

B.5.b. Percentage of ewes by **primary** type of flock management used, and by study:

Primary type of flock management	Percent Ewes					
	Sheep 1996		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Herded/open range (unfenced acreage)	18.9	(2.4)	18.7	(1.1)	26.0	(1.5)
Fenced range (uncultivated fenced acreage)	37.3	(2.3)	37.3	(1.2)	35.3	(1.2)
Farm/pasture (irrigated or cultivated)	34.6	(1.6)	31.5	(0.8)	34.9	(1.1)
Feedlot/dry lot/intensive confinement	6.4	(2.5)	12.5	(1.5)	3.8	(0.4)
Other/multiple (1996)	2.8	(0.5)	NA		NA	
Total	100.0		100.0		100.0	

Percentage of operations and percentage of ewes by primary type of flock management used in 2011



6. Animal identification

Note: Excludes operations in Sheep 2001 that identified themselves as primarily dry lot or feedlot operations.

Flock and individual-animal ID are important parts of industry efforts to control disease. Data collected during the Sheep 2001 study represented sheep ID practices used before new ID requirements were implemented in November 2001 for sheep that changed ownership and/or entered interstate commerce. In 2001, the highest percentage of operations (14.2 percent) used ear tags to identify animals. Overall, 27.4 percent of operations used some form of flock ID in 2001 compared with 81.5 percent of operations in 2011. This substantial increase in flock ID is testament to the scrapie eradication efforts made by the sheep industry, producers, and State and Federal agencies.

B.6.a. Percentage of operations by flock ID methods used and by study:

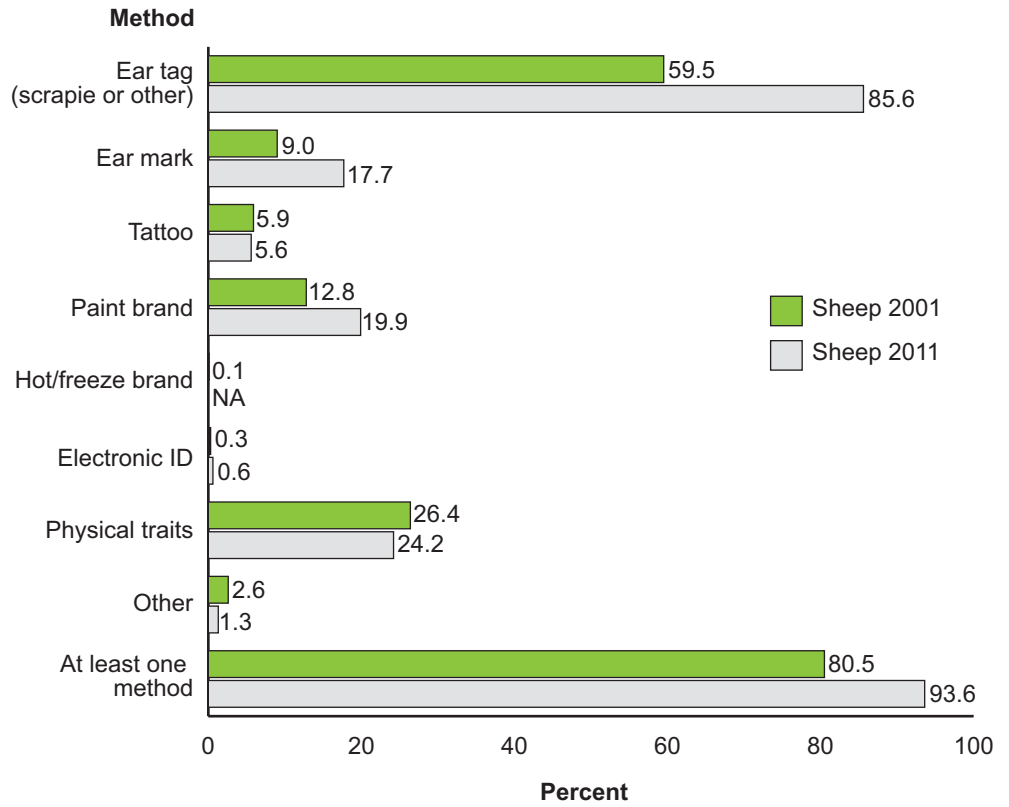
Flock ID method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Ear tag (scrapie or other)	14.2	(1.1)	77.6	(1.0)
Ear mark	4.9	(0.4)	11.3	(0.6)
Tattoo	2.0	(0.4)	1.4	(0.3)
Paint brand	5.9	(0.4)	10.7	(0.6)
Hot/freeze brand	0.2	(0.0)	NA	
Electronic chip	0.1	(0.0)	NA	
Physical trait	6.9	(1.0)	NA	
Other	1.2	(0.7)	0.4	(0.1)
At least one method	27.4	(1.4)	81.5	(1.0)

In 2001, 80.5 percent of operations used at least one method of individual-animal ID; 59.5 percent of these operations used ear tags. By 2011, the use of individual-animal ID increased to 93.6 percent of operations, 85.6 percent of which used ear tags.

B.6.b. Percentage of operations by individual-animal ID method(s) used and by study:

Individual-animal ID method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Ear tag (scrapie or other)	59.5	(1.7)	85.6	(0.9)
Ear mark	9.0	(0.7)	17.7	(0.8)
Tattoo	5.9	(0.7)	5.6	(0.6)
Paint brand	12.8	(0.9)	19.9	(0.9)
Hot/freeze brand	0.1	(0.0)	NA	
Electronic ID	0.3	(0.1)	0.6	(0.2)
Physical traits	26.4	(1.6)	24.2	(1.1)
Other	2.6	(0.6)	1.3	(0.3)
At least one individual- animal ID method used	80.5	(1.4)	93.6	(0.6)

Percentage of operations by individual-animal ID method(s) used, and by study



The percentage of operations that used ear tags as a means of individual-animal ID increased from 2001 to 2011 for all primary flock types.

B.6.c. Percentage of operations by individual-animal ID method(s) used and by primary flock type:

Individual-animal ID method	Percent Operations					
	Primary Flock Type					
	Herded/ open range		Fenced range		Farm/ pasture	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001						
Ear tag (scrapie or other)	36.3	(6.2)	43.5	(3.6)	62.3	(1.9)
Ear mark	29.2	(4.8)	19.4	(2.1)	7.1	(0.8)
Tattoo	4.4	(2.1)	5.4	(1.4)	6.0	(0.8)
Paint brand	32.4	(5.2)	14.9	(1.5)	12.2	(1.0)
Hot/freeze brand	1.1	(0.4)	0.6	(0.1)	0.1	(0.0)
Electronic ID	1.9	(1.1)	0.1	(0.1)	0.3	(0.1)
Physical traits	8.2	(2.8)	10.1	(2.6)	29.2	(1.8)
Other	13.9	(11.2)	1.2	(0.4)	2.7	(0.7)
At least one method	73.2	(6.0)	62.7	(4.1)	83.3	(1.4)
Sheep 2011*						
Ear tag (scrapie or other)	63.8	(5.5)	75.9	(2.0)	79.2	(1.3)
Ear mark	47.7	(5.2)	26.3	(1.8)	12.7	(0.9)
Tattoo	2.7	(1.7)	4.9	(1.0)	6.2	(0.7)
Paint brand	50.3	(5.2)	17.3	(1.5)	19.5	(1.1)
Hot/freeze brand	NA		NA		NA	
Electronic ID	0.3	(0.2)	0.8	(0.4)	0.5	(0.2)
Physical traits	21.9	(4.9)	18.9	(1.8)	26.6	(1.4)
Other	1.4	(0.6)	1.2	(0.4)	1.4	(0.4)
At least one method	91.7	(3.5)	92.3	(1.3)	94.3	(0.8)

*Operations with 20 or more ewes.

7. Rodent control

Rodents contribute to the spread of disease and are attracted to stored livestock feed. Sheep feed contaminated with rodent fecal matter can be a potential source of pathogens; therefore, rodent control is an important part of any operation's biosecurity efforts. Rodent control was consistently applied by a variety of methods in both studies.

B.7. Percentage of operations by control method(s) used to control rats and mice, and by study:

Control method	Percent Operations			
	Sheep 2001		Sheep 2011 ¹	
	Percent	Std. error	Percent	Std. error
Cats	82.1	(1.8)	79.2	(1.8)
Dogs	28.9	(2.2)	27.1	(2.0)
Traps ²	19.2	(1.9)	63.4	(2.1)
Bait and/or poison	56.6	(2.4)		
Professional exterminator	0.9	(0.3)	1.9	(0.5)
Other	2.3	(0.6)	2.5	(0.7)
Any method	96.5	(0.7)	95.1	(0.9)

¹Operations with 20 or more ewes.

²In 2001, "traps" was a separate category from bait and/or poison.

8. Housing

There was little change in the housing structure used for ewes from 2001 to 2011. The percentage of operations that used a fully enclosed structure in winter increased from 6.2 percent in 2001 to 12.4 percent in 2011.

B.8.a. Percentage of operations by housing structure used for the majority of ewes, and by season and study:

Housing structure	Percent Operations			
	Sheep 2001		Sheep 2011 ²	
	Percent	Std. error	Percent	Std. error
Winter				
Structure with four walls and roof with door closed most of the time (fully enclosed ¹)	6.2	(1.3)	12.4	(1.4)
Structure with four walls and roof with door open most of the time (enclosed structure ¹)	39.8	(2.4)	33.4	(2.0)
Structure with roof and three or fewer walls (e.g., loafing shed, open structure ¹)	30.8	(2.4)	27.8	(1.9)
No structure	23.2	(1.6)	26.5	(1.7)
Total	100.0		100.0	
Summer				
Structure with four walls and roof with door closed most of the time (fully enclosed ¹)	0.5	(0.3)	0.7	(0.3)
Structure with four walls and roof with door open most of the time (enclosed structure ¹)	17.5	(1.9)	22.5	(1.9)
Structure with roof and three or fewer walls (e.g., loafing shed, open structure ¹)	27.7	(2.3)	28.0	(2.0)
No structure	54.3	(2.4)	48.9	(2.1)
Total	100.0		100.0	

¹Categories as they were described for the 2011 study.

²Operations with 20 or more ewes.

B.8.b. Percentage of operations by housing structure typically used for the majority of the flock for lambing, and by study:

Housing structure	Percent Operations			
	Sheep 2001 ¹		Sheep 2011 ²	
	Percent	Std. error	Percent	Std. error
Structure with four walls and roof with door closed most of the time (fully enclosed ³)	23.6	(2.0)	30.5	(1.9)
Structure with four walls and roof with door open most of the time (enclosed structure ³)	39.9	(2.3)	34.6	(2.1)
Structure with roof and three or fewer walls (e.g., loafing shed, open structure ³)	24.0	(2.2)	21.3	(1.7)
No structure	12.5	(1.2)	13.6	(1.4)
Total	100.0		100.0	

¹Data for 2001 are for first (or only) lambing season.

²Operations with 20 or more ewes only.

³Categories as they were described for the 2001 study.



Photograph courtesy of Camilla Kristensen.

C. Breeding Management

1. Breeding practices

In 2001 and 2011, nearly all operations bred 1 or more ewes (94.8 and 98.4 percent, respectively).

C.1.a. Percentage of operations that bred any ewes, by study:

Percent Operations			
Sheep 2001		Sheep 2011	
Percent	Std. error	Percent	Std. error
94.8	(0.9)	98.4	(0.3)

The reproductive performance of a sheep flock can be improved by intensive management practices such as flushing ewes, crutching, providing a teaser ram, using a breeding mark, ultrasound, conducting breeding soundness exams, udder palpation, embryo transfer, and estrous synchronization. Flushing is used to provide ewes with extra nutrition prior to, and sometimes during, the breeding season. Flushing increases the number of ovulations, resulting in a higher proportion of twins and triplets.

A breeding-soundness examination should be conducted before each breeding season to assess buck fertility. A breeding-soundness exam should include a physical examination for general health, but examination of the reproductive organs (scrotal palpation/evaluation and semen evaluation) is the basis for this exam.

In 2001, 67.7 percent of operations used at least one reproductive management practice listed in table C.1.b; in 2011 that percentage increased to 99.6. Flushing was used most commonly among operations as a reproductive management practice in 1996, 2001, and 2011 (54.7, 46.3, and 52.8 percent of operations, respectively).

The percentage of operations that used artificial insemination remained at less than 2 percent across studies. The use of udder palpation/bagging of ewes and breeding soundness exams of rams decreased from 1996 to 2001 and increased from 2001 to 2011.

C.1.b. For operations that bred any ewes during the previous year, percentage of operations by reproductive practice and by study:

Reproductive practice	Percent Operations					
	Sheep 1996		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Flushing (ewes fed extra energy ration prior to breeding season)	54.7	(1.2)	46.3	(1.6)	52.8	(1.2)
Crutching (prelambing shearing)	NA		NA		22.9	(1.0)
Teaser ram	7.7	(0.5)	4.5	(0.6)	9.7	(0.7)
Breeding mark	NA		18.4	(1.2)	21.1	(1.0)
Ultrasound (pregnancy diagnosis, fetal counting)	6.0	(0.4)	4.6	(0.7)	7.1	(0.6)
Breeding soundness exam (rams)	20.5	(0.9)	14.7	(1.1)	23.4	(1.0)
Udder palpation or bagging	NA		25.9	(1.4)	38.3	(1.1)
Embryo transfer	0.2	(0.1)	0.1	(0.1)	1.5	(0.3)
Artificial insemination	1.2	(0.2)	1.3	(0.4)	1.4	(0.3)
Estrus synchronization	3.3	(0.3)	NA		6.6	(0.6)
Accelerated lambing (1996)	7.9	(0.5)	NA		NA	
Other	NA		7.7	(1.0)	NA	
Any	NA		67.7	(1.7)	99.6	(0.2)

2. Breeding seasons

Although the percentage of operations with one defined breeding season remained about the same from 2001 to 2011, a lower percentage of operations in 2011 (10.0 percent) had no defined breeding season compared with operations in 2001 (18.6 percent).

C.2.a. For operations that bred any ewes during the previous year, percentage of operations by number of breeding seasons and by study:

Breeding seasons	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
One defined breeding season per year	74.2	(1.5)	75.5	(1.1)
Two or more defined breeding seasons per year ¹	7.2	(0.7)	11.9	(0.8)
Three defined breeding seasons per 2 years ²	NA		2.5	(0.4)
No defined breeding season	18.6	(1.4)	10.0	(0.8)

¹In 2011, this category included only operations with two breeding seasons per year.

²This category was not an option in 2001.

Out-of-season breeding (February to July) can be advantageous because of better forage and weather conditions, decreased parasites, and improved markets for spring lambs. Success often depends on using one or more of the reproductive management practices listed in table C.2.c.

The percentage of operations that bred ewes out of season decreased from 21.8 percent in 1996 to 12.1 percent in 2001 and increased to 24.5 percent in 2011. There were no regional differences in the percentage of operations that bred ewes out of season (data not shown). For the 2001 and 2011 studies, out-of-season breeding was defined as occurring during February through July. For the 1996 study, no definition was provided for out-of-season breeding. Therefore, some producers in 1996 may have reported breeding ewes bred out of season, even though they bred ewes from August to January.

C.2.b. For operations that bred any ewes during the previous year, percentage of operations that bred ewes out of season (February to July):

Percent Operations					
Sheep 1996		Sheep 2001		Sheep 2011	
Percent	Std. error	Percent	Std. error	Percent	Std. error
21.8	(0.9)	12.1	(1.1)	24.5	(1.1)



Photograph courtesy of Camilla Kristensen.

The two methods reported most commonly for out-of-season breeding in 2001 and 2011 were placing rams with ewes (86.7 and 85.5 percent of operations, respectively) and selecting sheep with a genetic predisposition to breed out of season (31.4 and 33.8 percent, respectively). Putting a teaser (sterile) ram with anestrus ewes that have been kept from a ram for at least 30 days produces the “ram effect,” which can induce estrus in ewes outside the normal breeding season. Genetically selecting rams and ewes for the ability to breed out of season also plays an important role. Many operations that reported using an “other” method for breeding out of season did not use any method and indicated that out-of-season breeding was accidental. Regulating light as a means of breeding ewes out of season was rarely used in either study. At the same time, twice the percentage of operations that used hormone treatments in 2001 did so in 2011. This increase is likely due to the November 2009 FDA approval of a progesterone controlled internal drug release (CIDR), which induces estrus in ewes during seasonal anestrus.

C.2.c. For operations that bred any ewes out of season during the previous year, percentage of operations by method used for out-of-season breeding (February to July):

Method	Percent Operations			
	Sheep 2001*		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Genetic selection for ability to breed out of season	31.4	(4.1)	33.8	(2.3)
Placing ram with ewes	86.7	(3.5)	85.5	(1.8)
Regulating light	2.0	(1.1)	0.7	(0.4)
Hormone treatments (CIDRs, hormone protocols, etc.)*	6.0	(1.9)	11.6	(1.6)
Other hormone treatment*	NA		0.0	(0.0)
Other	8.0	(3.1)	5.5	(1.1)

*In 2001 there was only one option for all hormone treatments.

3. Ewe breeding

Overall, 92.4 and 97.4 percent of operations that bred ewes in 2001 and 2011, respectively, used natural breeding methods by utilizing rams present on the operation. Just over 1 percent used artificial insemination. Of operations that used artificial insemination, the majority used frozen semen and semen collected from rams belonging to a different operation. While artificial insemination permits the breeding of more ewes with genetically superior rams, it can also be a more expensive method, which may explain why it was not used widely in 2001 or 2011. The percentage of operations that bred ewes naturally using another operation's ram decreased by half from 2001 to 2011.

C.3.a. Percentage of operations by method used to breed (service) ewes, and by study:

Servicing method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Artificial insemination	1.3	(0.4)	1.4	(0.3)
Natural, by this operation's rams	92.4	(1.1)	97.4	(0.4)
Natural, by another operation's rams	9.6	(1.1)	4.7	(0.5)

The percentage of ewes serviced by artificial insemination was similar in 2001 and 2011.

C.3.b. Percentage of ewes by method used to breed (service) ewes, and by study:

Servicing method	Percent Ewes			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Artificial insemination (AI)	0.2	0.0	0.2	(0.0)
Natural, by this operation's rams	97.3	0.3	97.7	(0.4)
Natural, by another operation's rams	2.5	0.3	2.2	(0.4)
Total	100.0		100.0	

There were no substantial differences in semen type or source of semen used in 2001 and 2011.

C.3.c. For operations that artificially inseminated ewes in the previous year, percentage of operations by type or source of semen used, and by study:

Semen type or source	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Fresh	32.1	(15.4)	28.6	(9.8)
Frozen	99.0	(0.6)	79.3	(9.1)
This operation	47.2	(15.4)	34.8	(10.3)
Other operation	82.5	(8.0)	81.5	(8.1)

C.3.d. For operations that bred any ewes in the previous year, percentage of operations that used any rams for natural breeding and percentage of ewes bred naturally, by study:

Study	Percent operations	Std. error	Percent ewes	Std. error
Sheep 2001	92.4	(1.1)	97.3	(0.3)
Sheep 2011	99.8	(0.1)	99.9	(0.4)

4. Ram and ewe lamb selection

Since rams account for half of a flock's genetics, ram selection is an important part of flock health and productivity. The National Sheep Improvement Program (NSIP) offers a genetic evaluation system for U.S. sheep flocks. Historically, NSIP has provided expected progeny differences to help producers determine the genetic merit of an animal for a particular trait, such as number of lambs born, wool characteristics, milking traits, etc. NSIP generates estimated breeding values using breed-specific genetic parameters. These values allow for genetic evaluations for carcass traits and parasite resistance across breeds, as well as other evaluations not previously available.

When selecting a ram for natural breeding in 2011, 77.4 percent of operations indicated that visual appearance was a very important characteristic compared with 71.5 percent in 2001. Genetic resistance to scrapie and to intestinal parasites were very important for 39.3 and 30.2 percent of operations, respectively, in 2011; these data were not available in 2001. Soundness of a ram's flock of origin was important to a higher percentage of operations in 2011 than in 2001 (60.3 and 52.7 percent, respectively).

C.4.a. For operations that used rams for natural breeding during the previous year, percentage of operations by ram lamb characteristics that were **very important** when selecting rams:

Ram lamb characteristic	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Visual appearance	71.5	(1.6)	77.4	(1.1)
Scrotal circumference, semen quality	34.1	(1.5)	35.3	(1.2)
Wool quality	20.6	(1.3)	21.0	(0.9)
Meat production	61.4	(1.7)	69.8	(1.2)
Ram's average daily gain as a lamb	34.5	(1.6)	28.4	(1.1)
Pedigree	31.4	(1.5)	33.1	(1.2)
Breeding history	34.7	(1.6)	31.3	(1.2)
NSIP records	3.5	(0.5)	5.7	(0.5)
Genetic resistance to scrapie	NA		39.3	(1.2)
Genetic resistance to intestinal parasites	NA		30.2	(1.1)
Genetic resistance to other diseases	28.6	(1.5)	7.7	(0.7)
Soundness of ram's flock of origin	52.7	(1.7)	60.3	(1.2)
Nonram-related reasons (cost, proximity, availability)	25.8	(1.5)	27.5	(1.1)
Other ram characteristics	20.5	(1.3)	NA	

In 2011, a higher percentage of operations acquired ewes based on their genetic resistance to scrapie (41.9 percent) than acquired rams for the same reason (39.3 percent), even though using ram genetics is more efficient.

C.4.b. For operations that acquired replacement ewe lambs during the previous year, percentage of operations that rated the following ewe-lamb selection characteristics as very important:

Ewe-lamb characteristic	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Visual appearance/ conformation	74.0	(1.8)	79.7	(2.5)
Wool quality	NA		20.5	(2.3)
Meat production	NA		69.8	(2.8)
Ability to breed out of season	10.3	(1.1)	14.2	(2.3)
National Sheep Improvement Program records	3.5	(0.6)	5.6	(1.5)
Ability to have multiple lambs ¹	49.9	(1.9)	47.0	(3.2)
Health status of flock origin	62.6	(1.9)	61.8	(3.1)
Early sexual maturity	28.8	(1.6)	22.6	(2.7)
Pedigree	31.3	(1.8)	36.1	(3.0)
Average daily gain	34.9	(1.9)	26.6	(2.8)
Genetic resistance to scrapie (RR)	NA		48.3	(3.2)
Genetic resistance to intestinal parasites	NA		33.8	(3.1)
Other genetic resistance to disease ²	40.0	(1.9)	7.3	(1.7)
Non ewe-related reasons (cost, availability, etc.)	21.5	(1.6)	22.8	(2.7)

¹Multiple births in 2001.

²"Genetic resistance to disease" in 2001.

The majority of replacement ewe lambs and replacement ram lambs were born and raised on the operation in in 2001 and 2011.

C.4.c. For operations that had replacement ewe or ram lambs during the previous year, percentage of replacement ewe and ram lambs, by source and by study:

Percent Replacement Lambs								
Source of replacement lambs	Sheep 2001				Sheep 2011			
	Pct. ewes	Std. error	Pct. rams	Std. error	Pct. ewes	Std. error	Pct. rams	Std. error
Born and raised on this operation	83.8	(1.4)	73.2	(2.5)	82.7	(1.5)	81.0	(2.6)
Acquired elsewhere	16.2	(1.4)	26.8	(2.5)	17.3	(1.5)	19.0	(2.6)
Total	100.0		100.0		100.0		100.0	

Overall, in 2011 a lower percentage of operations (3.8 percent) acquired bred and pregnant ewes with the intention of lambing them compared with operations in 2001 (7.3 percent). This finding was more apparent in the West region (1.7 and 5.1 percent, respectively) and Central region (2.3 and 7.0 percent, respectively).

C.4.d. Percentage of operations that acquired bred and pregnant ewes with the intention of lambing them in 2001 and for the last breeding season in 2011, by region:

Percent Operations								
Study	Region							
	West		Central		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001 ¹	5.1	(1.7)	7.0	(1.0)	8.3	(1.2)	7.3	(0.8)
Sheep 2011 ²	1.7	(0.8)	2.3	(0.4)	5.9	(0.9)	3.8	(0.5)

¹Purchased bred ewes.

²Purchased pregnant ewes for the most recent lamb crop.

5. Outcome of ewes expected to lamb

In 2001, just 9.9 percent of bred ewes had multiple births compared with 47.8 percent of bred ewes in 2011.

C.5. Of ewes expected to lamb during the most recent lamb crop, average percentage of ewes by breeding outcome:

	Percent Ewes			
	Sheep 2001*		Sheep 2011*	
	Percent	Std. error	Percent	Std. error
Single live births	79.9	(0.4)	45.3	(0.6)
Multiple births	9.9	(0.4)	47.8	(0.6)
Only dead births	1.5	(0.1)	1.5	(0.1)
Aborted	0.9	(0.0)	0.9	(0.1)
Died prior to lambing	1.6	(0.0)	1.0	(0.1)
Removed from operation prior to lambing	0.9	(0.1)	0.4	(0.1)
Never became pregnant	5.3	(0.2)	3.0	(0.2)
Total	100.0		100.0	

*The 2001 study questionnaire asked about all ewes exposed.

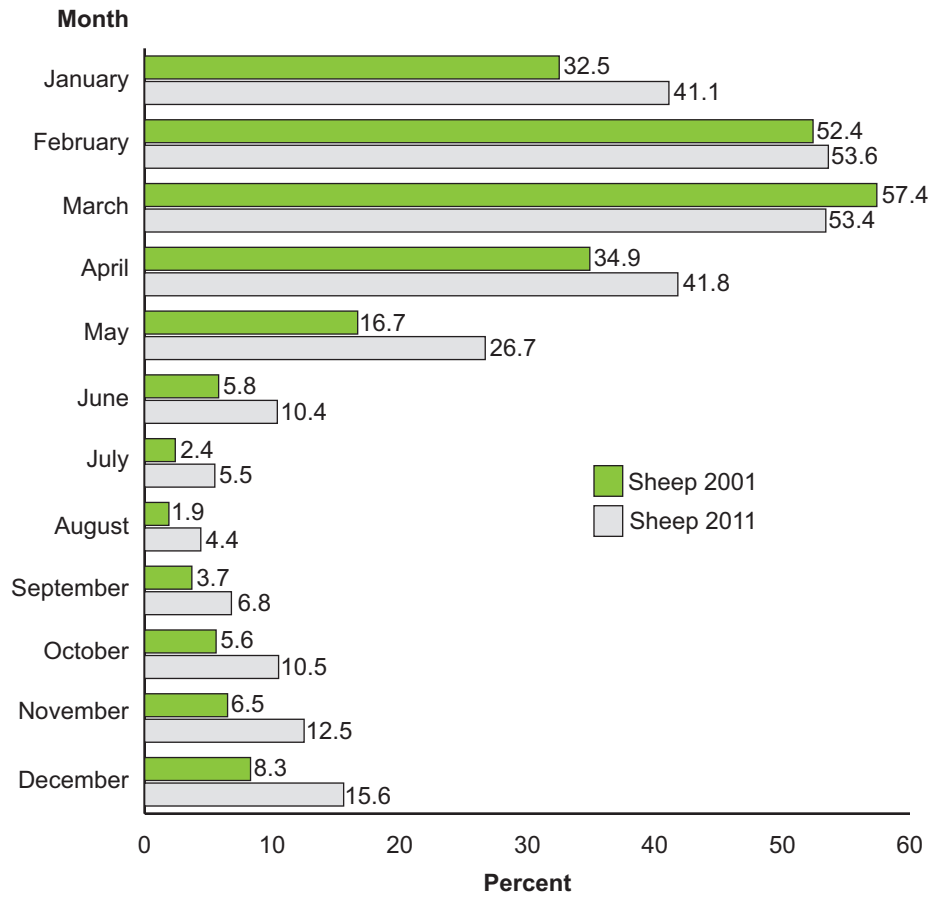
D. Reproductive Outcomes**1. Lambs born**

In 2001, over half of all operations (52.4 percent) had one or more lambs born in February; the same was true for March (57.4 percent). Also, 77.2 percent of lambs born were born in February, March, April, and May (table D.1.b). About twice the percentage of operations in 2011 had lambs born in June through December compared with operations in 2001. This finding is consistent with other data collected regarding selection of ewes for breeding out of season, breeding ewes out of season, and use of hormones to breed out of season.

D.1.a. Percentage of operations with one or more lambs born in each of the following months, by study:

Month	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
January	32.5	(1.5)	41.1	(1.2)
February	52.4	(1.7)	53.6	(1.2)
March	57.4	(1.7)	53.4	(1.3)
April	34.9	(1.5)	41.8	(1.2)
May	16.7	(1.1)	26.7	(1.1)
June	5.8	(0.7)	10.4	(0.7)
July	2.4	(0.5)	5.5	(0.6)
August	1.9	(0.4)	4.4	(0.6)
September	3.7	(0.5)	6.8	(0.7)
October	5.6	(0.7)	10.5	(0.8)
November	6.5	(0.7)	12.5	(0.8)
December	8.3	(0.9)	15.6	(0.9)

Percentage of operations with one or more lambs born in each of the following months, by study



While a higher percentage of operations in 2011 than in 2001 had lambs born out of season (end of June to December) [table D.1.a], the percentage of lambs born out of season was not substantially different from 2001 to 2011. This finding suggests that small operations bred out of season or bred only a few of their ewes out of season. Only 8.7 and 10.1 percent of all lambs were born from October through December in 2001 and 2011, respectively.

D.1.b. Percentage of lambs born alive or dead during the previous year, by month and by study:

Percent Lambs Born				
Month	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
January	10.5	(0.4)	11.7	(0.6)
February	20.1	(0.6)	17.4	(0.6)
March	22.8	(0.6)	17.5	(0.7)
April	19.6	(0.6)	19.8	(0.9)
May	14.7	(0.5)	18.9	(1.4)
June	2.7	(0.2)	3.0	(0.4)
July	0.2	(0.0)	0.5	(0.1)
August	0.1	(0.0)	0.3	(0.1)
September	0.6	(0.1)	0.9	(0.1)
October	2.7	(0.3)	3.1	(0.3)
November	3.1	(0.3)	3.4	(0.3)
December	2.9	(0.2)	3.6	(0.3)
Total	100.0		100.0	

There was no difference in the percentage of lambs born alive from 2001 to 2011.

D.1.c. Percentage of lambs born alive, by primary flock type:

Percent Lambs Born Alive								
Primary Flock Type								
Study	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	96.6	(0.3)	95.9	(0.4)	95.1	(0.2)	95.7	(0.2)
Sheep 2011	96.4	(0.5)	96.7	(0.1)	95.5	(0.2)	96.1	(0.1)

D.1.d. Operation average number of lambs born per ewe exposed, by primary flock type and by study:

Operation Average Lambing Rate								
Primary Flock Type								
Study	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
Sheep 2001	1.31	(0.0)	1.25	(0.0)	1.55	(0.0)	1.38	(0.0)
Sheep 2011*	1.29	(0.0)	1.29	(0.0)	1.48	(0.0)	1.38	(0.0)

*20 or more ewes.

Tail-docking keeps fecal matter from accumulating on the tail and hindquarters of sheep. 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, and rat-tailed sheep) do not require tail docking.

A lower percentage of lambs born alive were docked in 2011 than in 2001 (81.5 and 91.7 percent, respectively). This difference was noted for all flock types. The percentage of operations that docked tails also declined from 86.1 percent of operations in 2001 to 78.6 percent in 2011. This decline occurred mostly in farm/pasture flocks.

D.1.e. Percentage of operations that docked lambs' tails and percentage of lambs born alive that were docked, by primary flock type and by study:

Percent								
Primary Flock Type								
Study	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Percent operations								
Sheep 2001	90.1	(6.2)	76.7	(4.7)	87.4	(1.3)	86.1	(1.3)
Sheep 2011	82.1	(5.3)	75.4	(2.2)	80.0	(1.3)	78.6	(1.1)
Percent lambs								
Sheep 2001	94.7	(0.7)	91.1	(0.8)	90.8	(0.7)	91.7	(0.4)
Sheep 2011	89.4	(1.2)	82.2	(1.6)	79.1	(1.3)	81.5	(0.8)

The caudal fold is the flap of skin located under and attached to each side of the tail. The two sides meet in a “V” at the end of the fold. From 2001 to 2011, The percentage of operations that docked lambs’ tails longer than the caudal fold (distal) decreased.

D.1.f. For operations that docked lambs’ tails, percentage of operations by location of docking for the majority of lambs’ tails, and by study:

Location	Percent Operations			
	Sheep 2001		Sheep 2011*	
	Percent	Std. error	Percent	Std. error
Shorter than the caudal fold	19.9	(2.1)	25.4	(2.0)
At the “V” of the caudal fold	57.8	(2.4)	61.5	(2.2)
Distal to the caudal fold	22.4	(2.0)	13.1	(1.4)
Total	100.0		100.0	

*20 or more ewes.

2. Lambing locations

Increased monitoring afforded by more confined lambing areas may influence the average number of live lambs born to exposed ewes, since administering assistance to ewes and lambs is more easily achieved when the animals are confined. There are, however, a number of other factors in addition to lambing observation that also influence the average number of live lambs born per ewe exposed.

In 2001 and 2011, about half the operations (50.3 and 48.4 percent, respectively) had lambs born in a barn or shed. A lower percentage of operations in 2011 than in 2001 (24.0 and 30.8 percent, respectively) had lambs born in individual lambing pens. As a general practice, many operations allowed ewes to lamb in a group setting, such as in a large pen or shed, but moved ewe lamb pairs to individual jugs after lambing. Conversely, a higher percentage of operations in 2011 lambed on the open range (5.9 percent) and in dry lots (6.0 percent) compared with 2001 (2.8 and 3.8 percent, respectively).

D.2.a. For operations with lambs born during the previous year, percentage of operations by lambing locations used for at least one lamb, and by study:

Lambing location	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Individual lambing pen	30.8	(1.5)	24.0	(1.0)
Barn or shed (covered, but without individual pens)	50.3	(1.7)	48.4	(1.2)
Special lambing pasture that allows increased observation and/or shelter	12.6	(1.0)	16.6	(0.9)
Other fenced pasture	16.5	(1.3)	27.8	(1.1)
Open range	2.8	(0.3)	5.9	(0.5)
Dry lot (pen which does not allow grazing)	3.8	(0.5)	6.0	(0.5)
Other	1.2	(0.5)	0.5	(0.2)

In 2001, almost half the lambs born (48.4 percent) were born in individual lambing pens, barns, or sheds. A slightly lower percentage of lambs were born in these facilities in 2011 (42.9 percent).

D.2.b. For operations with lambs born during the previous year, percentage of lambs born, by lambing location and by study:

Lambing location	Percent Lambs			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Individual lambing pen	19.8	(0.8)	16.7	(1.2)
Barn or shed (covered, but without individual pens)	28.6	(0.8)	26.2	(1.1)
Special lambing pasture that allows increased observation and/or shelter	14.4	(0.8)	11.7	(0.8)
Other fenced pasture	15.7	(0.8)	21.8	(1.1)
Open range	16.4	(0.9)	18.1	(1.6)
Dry lot (pen which does not allow grazing)	4.7	(0.6)	5.2	(0.5)
Other	0.4	(0.1)	0.2	(0.1)
Total	100.0		100.0	

3. Lamb feeding supplements

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, however, it is necessary to supplement newborns using other colostrum sources. The percentage of operations that supplemented lambs with colostrum from a source other than the lambs' mothers decreased from 63.6 percent of operations in 2001 to 54.5 percent in 2011.

D.3.a. Percentage of operations that supplemented lambs during the last completed lamb crop, by supplement source and by study:

Supplement source	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Provided lambs with colostrum from a source other than its mother	63.6	(2.3)	54.5	(2.2)
Milk or milk replacer	57.5	(2.4)	73.2	(2.0)

A higher percentage of operations gave lambs dried sheep colostrum in 2011 than in 2001. The percentages of other colostrum sources did not change substantially during the same period. A similar percentage of operations in both studies provided milk or milk replacer from the listed sources.

D.3.b. For operations that supplemented lambs with colostrum or supplemental milk or milk replacer in the last completed lamb crop, percentage of operations by source of colostrum and supplemental milk or milk replacer, and by study:

Source	Percent Operations			
	Sheep 2001		Sheep 2011 ¹	
	Percent	Std. error	Percent	Std. error
Colostrum				
Sheep colostrum from own operation	73.0	(2.8)	73.2	(2.4)
Liquid sheep colostrum from outside source	2.8	(1.0)	3.2	(1.0)
Dried sheep colostrum	8.2	(1.4)	32.2	(2.6)
Cow colostrum from a herd tested for Johne's disease	2.8	(0.9)	3.2	(1.0)
Cow colostrum from a herd not tested for Johne's disease	25.5	(2.7)	17.6	(2.0)
Goat colostrum	16.1	(2.3)	8.6	(1.6)
Other ²	5.9	(1.9)	4.9	(1.2)
Milk or milk replacer				
Sheep milk from own operation	33.9	(2.9)	27.9	(2.2)
Sheep milk from an outside source	0.2	(0.1)	0.2	(0.1)
Dried milk or milk replacer	90.8	(1.8)	94.6	(1.2)
Fresh cow milk (cow(s) tested for Johne's) ³	1.3	(0.7)	2.2	(0.9)
Fresh cow milk (cow(s) not tested for Johne's disease) ⁴	7.8	(1.5)	6.9	(1.2)
Goat milk	13.2	(2.1)	9.7	(1.5)
Other	4.0	(1.7)	0.7	(0.4)

¹20 or more ewes.

²In the Sheep 2001 questionnaire, an additional category—Synthetic—was an option (24.1 percent; SE=2.7). This option was not included in the Sheep 2011 questionnaire.

³In the Sheep 2001 questionnaire, this category was "cow from herd tested for Johne's disease."

⁴In the Sheep 2011 questionnaire, this category was "cow from herd with unknown Johne's disease status."

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* and *Salmonella* species), respiratory disease (e.g., *Pasteurella* and *Mycoplasma* species), abscesses (*Corynebacterium pseudotuberculosis*), and a variety of systemic disease (e.g., listeriosis, caprine arthritis encephalitis, Johne’s disease, and brucellosis).

Pasteurization is especially important if supplemented milk is pooled from a number of ewes or acquired from another flock, both of which can increase the risk of exposing lambs to disease. Scrapie may also be transmitted to sheep or goats through colostrum and milk from infected sheep or goats. Pasteurization is unlikely to eliminate scrapie infectivity from colostrum or milk. As a result, colostrum or milk should not be sourced from other sheep or goat herds of unknown scrapie status. Nearly all operations that supplemented lambs with fresh milk in 2001 and 2011 did not pasteurize the milk.

D.3.c. For operations that supplemented lambs with fresh milk, percentage of operations that used pasteurized milk:

Percent Operations			
Sheep 2001		Sheep 2011	
Percent	Std. error	Percent	Std. error
3.5	(1.2)	2.5	(1.5)

4. Castration management

In 2001 and 2011, ram lambs were castrated on about three-fourths of all operations (77.4 and 75.1percent, respectively).

D.4.a. For operations with ram lambs born alive during the previous year, percentage of operations that castrated ram lambs, by primary flock type and by study:

Percent Operations								
Primary Flock Type								
Study	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	88.7	(5.8)	77.4	(4.0)	77.3	(1.7)	77.4	(1.5)
Sheep 2011	86.3	(4.8)	73.0	(2.2)	75.7	(1.4)	75.1	(1.1)

In 2001 and 2011, ram lambs were castrated at just over 3 weeks of age.

D.4.b. For operations with castrated ram lambs during the previous year, operation average age (in days) that rams were castrated, by study:

Operation Average Age (days)			
Sheep 2001		Sheep 2011	
Average	Std. error	Average	Std. error
22.3	(1.1)	24.7	(0.8)

D.4.c. For operations with castrated ram lambs during the previous year, percentage of operations that castrated ram lambs, by age of rams at castration and by study:

Age at castration (days)	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
1–7	34.6	(1.7)	38.3	(1.3)
8–21	31.8	(1.8)	24.8	(1.2)
22 or more	33.6	(1.7)	36.9	(1.2)
Total	100.0		100.0	

5. Age and weight of weaned lambs

The average age of lambs at weaning was lower in 2011 than in 2001 (15.6 weeks and 17.5 weeks, respectively). As expected, lamb weaning weights were also lower in 2011 than in 2001 (66.7 and 78.9 lb, respectively).

D.5. For lambs weaned in the previous year, average age and weight of lambs at weaning, by study and by primary flock type:

Study	Average Primary Flock Type							
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
Average age (weeks)								
Sheep 2001	21.8	(0.3)	19.4	(0.2)	13.7	(0.2)	17.5	(0.1)
Sheep 2011	20.4	(0.2)	17.6	(0.1)	14.8	(0.0)	15.6	(0.0)
Average weight (lb)								
Sheep 2001	95.2	(0.7)	75.4	(0.8)	64.0	(0.5)	78.9	(0.4)
Sheep 2011	89.0	(3.3)	70.7	(1.0)	64.0	(0.7)	66.7	(0.5)

E. Marketing Practices

This section presents information on sheep that were removed from the operation alive and marketed through various channels. It does not include sheep that were slaughtered for home consumption or were otherwise dead when removed, nor does it capture sheep that were sold and slaughtered on the operation by the buyer or the producer.

Marketing animals at an auction or sale barn requires little effort in finding a buyer. Direct sales to consumers, however, can be more profitable since there may be no transportation costs and no middleman or sales commission. Almost all operations marketed some sheep or lambs in 2011.

1. Operations that sold or moved lambs

E.1.a. Percentage of operations that sold, moved, or permanently removed any sheep or lambs, by sheep type and by study:

Sheep type	Percent Operations			
	Study			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Lambs	84.5	(1.4)	82.4	(0.9)
Cull sheep	47.4	(1.6)	48.2	(0.9)
Any sheep	51.9	(1.7)	55.1	(1.0)
Any sheep or lambs	86.0	(1.4)	98.0	(0.5)

In 2011, a higher percentage of all operations (20.1 percent) moved or sold lambs directly to a separate feedlot compared with operations in 2001 (9.5 percent). This trend was also evident in fenced range and farm/pasture operations.

E.1.b. For operations that sold, moved, or permanently removed lambs during the previous year, percentage of operations that moved lambs directly to a feedlot separate from the operation, by study and by primary flock type:

Study	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	42.1	(7.0)	13.6	(1.7)	8.4	(0.9)	9.5	(0.8)
Sheep 2011	51.2	(5.1)	22.3	(1.8)	17.9	(1.2)	20.1	(0.9)

A higher percentage of operations that sold lambs directly to a separate feedlot in 2011 retained no ownership of the lambs compared with operations in 2001.

E.1.c. For operations that sold, moved, or permanently removed lambs directly to a separate feedlot during the previous year, percentage of operations by ownership of the majority of lambs sold or moved, and by primary flock type:

Lamb ownership	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001								
Retain complete ownership	12.9	(2.6)	22.6	(7.0)	13.1	(3.4)	15.1	(2.9)
Retain partial ownership	3.1	(1.2)	4.0	(1.5)	6.2	(3.6)	5.6	(2.7)
Retain no ownership	84.0	(3.1)	73.4	(6.8)	80.7	(4.6)	79.3	(3.7)
Total	100.0		100.0		100.0		100.0	
Sheep 2011								
Retain complete ownership	9.4	(3.3)	4.0	(0.8)	4.7	(0.7)	5.0	(0.5)
Retain partial ownership	4.1	(3.1)	0.6	(0.4)	0.0	(0.0)	0.4	(0.2)
Retain no ownership	86.5	(4.3)	95.4	(0.9)	95.3	(0.7)	94.6	(0.5)
Total	100.0		100.0		100.0		100.0	

In 2001 and 2011, relatively few lambs were sold in the first quarter (January through March). This finding is consistent with seasonal breeding patterns and lambing dates in the United States. Weaned lambs sold from July through December in 2011 were more evenly distributed across quarters compared with weaned lambs sold during the same period in 2001.

E.1.d. Of weaned lambs sold, moved, or permanently removed during the previous year (including lambs weaned at the time of removal), percentage of lambs sold, by quarter and by study:

Percent Lambs Sold				
Quarter	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
January–March	4.4	(0.3)	5.8	(0.4)
April–June	21.5	(0.9)	21.7	(0.9)
July–September	43.3	(1.1)	38.4	(1.3)
October–December	30.8	(1.0)	34.1	(1.4)
Total	100.0		100.0	

Weaned lambs sold were slightly younger and lighter in 2011 than in 2001.

E.1.e. Of weaned lambs sold, moved, or permanently removed during the previous year (including lambs weaned at the time of removal), operation average age and weight of lambs when sold, by study:

Operation Average				
	Sheep 2001		Sheep 2011	
	Average	Std. error	Average	Std. error
Age (weeks)	23.2	(0.2)	22.0	(0.2)
Weight (pounds)	96.8	(0.6)	92.3	(0.7)

2. Type of marketing

Over half the operations in 2001 and 2011 (56.8 and 52.5 percent, respectively) marketed lambs directly to an auction market/sale barn. In both studies, roughly one-fourth of lambs were marketed at the auction market/sale barn (table E.2.b). More marketing channel options were offered in the 2011 study questionnaire than in the 2001 study questionnaire, which may have influenced producer responses. In 2011, only 10.7 percent of operations marketed lambs directly to another operation, while 8.9 percent of operations removed lambs for personal use or because of euthanasia. About half the operations in 2011 (50.1 percent) marketed adult sheep directly to another operation. This marketing channel was not accounted for in Sheep 2001. In the 2001 study, operations likely reported this marketing channel as sales at the auction market/sale barn or in the “Other” category. In 2001, 68.1 percent of operations marketed adult sheep at the auction market/sale barn, while in 2011 just 22.8 percent of operations marketed adult sheep in this channel.

E.2.a. For operations that sold, moved, or permanently removed lambs and sheep, percentage of operations by marketing channel used and by study:

Marketing channel	Percent Operations							
	Lambs				Sheep			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	
Slaughter	15.1	(1.2)	19.0	(0.9)	12.8	(1.4)	4.5	(1.0)
Feedlot	5.5	(0.7)	5.6	(0.5)	1.4	(0.4)	0.7	(0.4)
Backgrounder	1.4	(0.3)	2.2	(0.3)	0.6	(0.1)	0.4	(0.3)
Consumer or ethnic market	13.9	(1.3)	17.2	(0.9)	4.7	(1.0)	6.7	(1.3)
Another operation	NA		10.7	(0.8)	NA		50.1	(2.4)
Auction market/sale barn	56.8	(1.7)	52.5	(1.1)	68.1	(1.9)	22.8	(1.9)
Buyer/dealer	18.0	(1.3)	16.8	(0.9)	13.5	(1.2)	12.9	(1.6)
Personal use/euthanized	NA		8.9	(0.7)	NA		3.4	(0.9)
Other	13.4	(1.2)	7.5	(0.6)	8.4	(1.2)	3.8	(0.9)

E.2.b. For operations that sold, moved, or permanently removed lambs and sheep, percentage of lambs and sheep by marketing channel used and by study:

Marketing channel	Percent Lambs and Sheep							
	Lambs				Sheep			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Slaughter	22.0	(1.5)	25.5	(1.8)	12.2	(1.7)	2.6	(0.7)
Feedlot	16.7	(0.9)	15.1	(1.4)	1.8	(0.7)	0.1	(0.1)
Backgrounder	3.4	(0.4)	3.9	(0.6)	0.8	(0.2)	0.1	(0.1)
Consumer or ethnic market	3.5	(0.5)	3.9	(0.3)	1.6	(0.3)	4.7	(2.8)
Another operation	NA		3.4	(0.3)	NA		52.5	(5.3)
Auction market/sale barn	28.5	(0.9)	26.5	(1.2)	45.0	(1.9)	27.2	(4.0)
Buyer/dealer	22.0	(1.0)	17.7	(1.1)	31.0	(1.9)	10.2	(1.7)
Personal use/euthanized	NA		0.4	(0.1)	NA		0.5	(0.2)
Other	3.9	(0.5)	3.5	(0.6)	7.6	(1.3)	2.1	(0.6)
Total	100.0		100.0		100.0		100.0	

3. Cull rams and ewes

Operations cull animals because of disease, to reduce operation size, remove undesirable genetic or phenotypic traits, and to economize during episodes of high feed costs. Operations attempting to enlarge their flocks are less likely to cull animals for any of these reasons.

A lower percentage of rams and ewes were culled in 2011 than in 2001. Nearly one-fourth of rams (23.8 percent) were culled and sold in 2001, while 16.2 percent of rams were culled in 2011. Approximately one-fifth of ewes (18.3 percent) were culled and sold in 2001 compared with 14.0 percent of ewes in 2011.

E.3.a. Percentage of sheep culled, by gender and by study:

Gender	Percent Sheep*			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Rams	23.8	(1.0)	16.2	(0.8)
Ewes	18.3	(0.5)	14.0	(1.4)

*As a percentage of the January 1 inventory.

In 2001, the highest percentages of culled rams and ewes were sold in July through September, while in 2011 the percentages of culled rams and ewes sold were more evenly split between July through September and October through December. The lowest percentages of culled rams and ewes were sold January through March in 2001 and 2011.

E.3.b. Of sheep culled during the previous year, percentage of cull rams and percentage of ewes, by quarter sheep were sold or removed, and by study:

Percent Cull Rams and Ewes								
Quarter	Rams				Ewes			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
January–March	9.1	(0.9)	13.2	(1.5)	8.1	(0.6)	9.5	(1.3)
April–June	24.3	(1.7)	23.1	(1.8)	25.9	(1.2)	28.5	(1.2)
July–September	36.6	(2.1)	29.7	(2.2)	38.3	(1.6)	30.2	(1.5)
October–December	30.0	(1.9)	34.0	(2.6)	27.7	(1.3)	31.8	(1.4)
Total	100.0		100.0		100.0		100.0	

In 2001, 18.0 percent of ewes culled were culled due to economic issues compared with just 1.7 percent of ewes in 2011. A slightly higher percentage of ewes were culled due to old age in 2011 than in 2001 (55.6 and 47.9 percent, respectively). Otherwise, there were few differences in reasons for culling in 2001 and 2011.

E.3.c. Of rams and ewes culled during the previous year, percentage of cull rams and percentage of ewes, by primary reason for culling and by study:

Primary reason for culling	Percent Cull Rams and Ewes							
	Sheep 2001				Sheep 2011			
	Rams		Ewes		Rams		Ewes	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Old age	47.7	(2.1)	47.9	(1.8)	49.3	(2.5)	55.6	(1.4)
Teeth problems	0.8	(0.3)	5.3	(0.5)	3.0	(0.9)	7.6	(1.3)
Poor mothering			3.3	(0.3)			4.7	(0.3)
Hard-bag syndrome			5.3	(0.3)			7.1	(0.8)
Mastitis			3.3	(0.2)			6.7	(0.5)
Failure to lamb (open or aborted)			5.5	(0.4)			7.7	(0.5)
Single-lamb births			0.6	(0.1)			1.1	(0.2)
Ram breeding soundness	13.8	(1.4)			17.0	(2.3)		
Other reproductive problems	3.6	(1.1)	1.2	(0.4)	3.1	(1.4)	0.9	(0.3)
Chronic weight loss/thin ewe			1.9	(0.2)	1.2	(0.3)	2.1	(0.6)
Other illness	1.0	(0.3)	0.6	(0.1)	1.9	(0.6)	1.2	(0.4)
Economic issues (e.g., drought, flock reduction, market conditions)	13.1	(2.0)	18.0	(2.1)	10.2	(2.2)	1.7	(0.4)
Other	20.0	(1.8)	7.1	(1.1)	14.3	(1.7)	3.7	(0.6)
Total	100.0		100.0		100.0		100.0	

The average age of culled ewes was slightly higher in 2011 than in 2001 across operation sizes.

E.3.d. Average age of sheep, by gender, study, and size of operation:

Average Age (years)								
Size of Operation*								
	Very small		Small		Large		All operations	
Gender	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
Sheep 2001								
Rams	4.4	(0.4)	4.1	(0.3)	4.8	(0.1)	4.9	(0.1)
Ewes	5.1	(0.3)	5.9	(0.1)	5.9	(0.1)	6.2	(0.1)
Sheep 2011								
Rams	NA		4.6	(0.2)	5.2	(0.1)	5.5	(0.1)
Ewes	NA		6.2	(0.1)	6.3	(0.1)	6.8	(0.2)

*See “Terms Used in This Report” for operation size breakouts.

Compared with 2001, a higher percentage of all operations in 2011— especially farm/pasture flocks—culled ewes that had flock ID when they left the operation.

E.3.e. For operations that culled at least one ewe during the previous year, percentage of operations in which any ewes had flock ID when they left the operation, by study and by primary flock type:

Percent Operations								
Primary Flock Type								
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
Study	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	67.2	(3.5)	65.4	(3.4)	34.2	(2.3)	54.9	(2.0)
Sheep 2011	79.9	(5.4)	76.4	(2.5)	81.6	(1.5)	80.9	(1.2)

F. Lamb and Sheep Deaths and Losses

1. Lamb and sheep losses

The percentage of operations that lost either lambs or sheep to predators declined slightly from 2001 to 2011, while nonpredator losses remained constant.

F.1.a. Percentage of operations that lost sheep during the previous year, by sheep type, cause of loss, and study:

Sheep type	Percent Operations											
	Cause of Loss											
	Predator				Nonpredator				Any			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011		Sheep 2001	Sheep 2011		
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error		
Lambs	32.7	(2.0)	23.6	(0.8)	56.4	(1.7)	53.2	(1.0)	63.9	(1.7)	65.1	(1.0)
Sheep	18.3	(1.5)	13.2	(0.6)	50.0	(1.7)	47.2	(1.0)	54.4	(1.7)	53.8	(1.0)

In 2011, operations lost a slightly higher percentage of lambs born alive compared with operations in 2001 (11.4 and 10.0 percent, respectively). There was no difference in the percentage of sheep lost to all causes from 2001 to 2011.

F.1.b. Percentage of lambs and sheep lost to all causes during the previous year, by study:

Sheep type	Percent Lambs and Sheep			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Lambs ¹	10.0	(0.3)	11.4	(0.3)
Sheep ²	5.0	(0.1)	4.8	(0.2)

¹Percentage of lambs born alive.

²Percentage of January 1 sheep inventory.

Lamb losses increased slightly in the Central region from 2001 to 2011.

F.1.c. Percentage of lambs and sheep lost to all causes during the previous year, by region:

Percent Lambs and Sheep												
Region												
West												
Central												
East												
Sheep type	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Lambs ¹	8.4	(0.5)	8.7	(0.6)	11.3	(0.3)	13.1	(0.5)	8.3	(4.3)	8.7	(0.4)
Sheep ²	4.9	(0.1)	4.9	(0.3)	4.8	(0.1)	4.8	(0.2)	5.3	(0.3)	4.8	(0.2)

¹Percentage of lambs born alive.

²Percentage of January 1 sheep inventory.

Herded/open range operations lost a higher percentage of lambs in 2011 than in 2001.

F.1.d. Percentage of lambs and sheep lost to all causes during the previous year, by primary flock type:

Percent Lambs and Sheep												
Primary Flock Type												
Herded/open range												
Fenced range												
Farm/pasture												
Sheep type	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Lambs ¹	10.9	(0.2)	13.9	(0.6)	11.3	(0.5)	11.9	(0.5)	8.9	(0.5)	9.3	(0.5)
Sheep ²	4.5	(0.1)	5.0	(0.3)	4.7	(0.1)	4.0	(0.2)	5.6	(0.2)	5.5	(0.3)

¹Percentage of lambs born alive.

²Percentage of January 1 sheep inventory.

Old age was responsible for a higher percentage of sheep loss in 2011 than in 2001. In addition, a higher percentage of lamb death loss was attributed to weather-related causes in 2011 than in 2001 (28.1 and 11.2 percent, respectively). Identifying specific digestive problems via the questionnaire, such as internal parasites and enterotoxemia, might have resulted in a higher percentage of loss being attributed to those issues in 2011.

F.1.e. For operations that lost lambs and sheep to nonpredator causes during the previous year, percentage of lambs and percentage of sheep by cause of loss and by study:

Nonpredator cause	Percent Lambs and Sheep							
	Lambs				Sheep			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Digestive problems*	9.9	(0.6)			6.7	(0.6)		
Internal parasites			7.5	(0.7)			10.0	(1.0)
Enterotoxemia (overeating)			6.4	(0.7)			2.1	(0.3)
Other digestive problems			6.4	(0.5)			4.2	(0.5)
Respiratory problems	11.7	(0.7)	12.1	(0.7)	7.0	(0.8)	6.1	(0.5)
Metabolic problems	1.0	(0.1)	1.2	(0.2)	3.7	(0.4)	1.2	(0.4)
Other disease problems	2.0	(0.3)	2.1	(0.3)	3.0	(0.2)	6.7	(0.9)
Weather-related causes	11.2	(0.5)	28.1	(1.4)	5.0	(0.5)	8.8	(1.2)
Lambing problems			12.1	(0.8)	12.3	(0.5)	13.8	(0.9)
Old age					15.4	(0.8)	21.5	(1.1)
Being on back	0.1	(0.0)	0.2	(0.0)	2.7	(0.2)	2.9	(0.2)
Poison	1.0	(0.1)	2.1	(0.3)	4.9	(0.5)	3.1	(0.4)
Theft	0.7	(0.1)	1.2	(0.4)	1.8	(0.4)	1.6	(0.5)
Other known nonpredator causes	7.3	(0.5)	6.2	(0.5)	4.3	(0.5)	4.3	(0.6)
Unknown nonpredator causes	11.0	(0.6)	14.4	(1.3)	9.7	(0.5)	13.7	(2.1)
Total	100.0		100.0		100.0		100.0	

*Digestive problems were not differentiated in Sheep 2001 but were differentiated in 2011.

2. Carcass disposal methods

The decision about which methods to use to dispose of carcasses depends on local, county, and State laws; a producer's skill/knowledge of disposal methods (e.g., incineration and composting); method costs; and equipment availability (e.g., for burying, rendering, and incinerating).

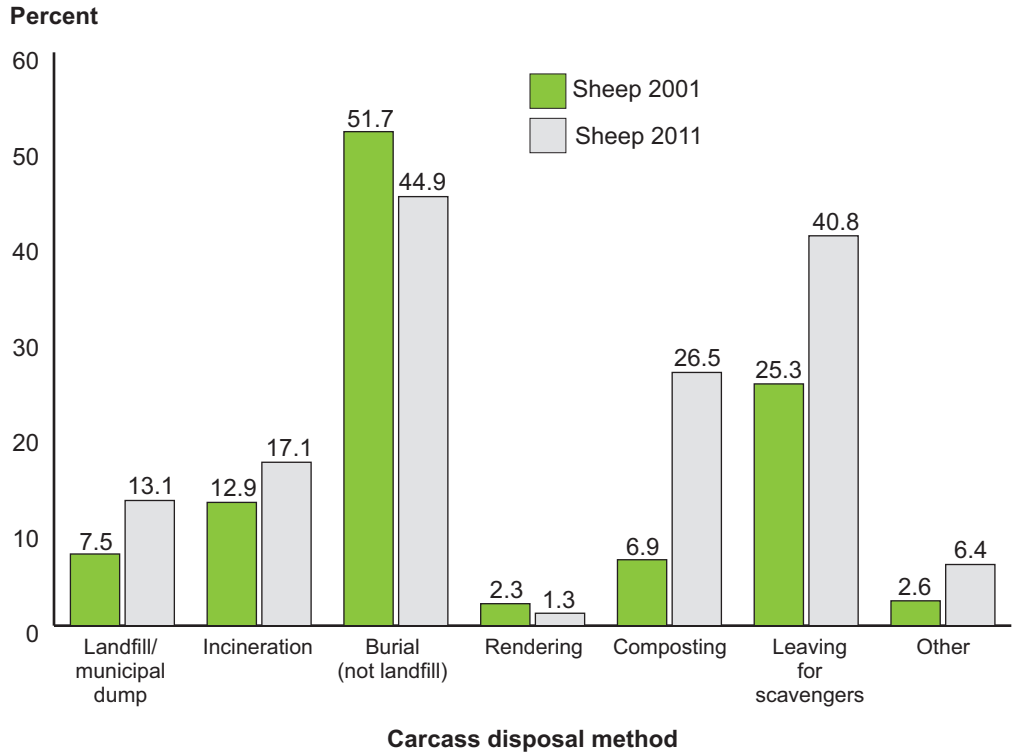
Rendering sheep carcasses is allowed only in a few locations, which is reflected by the very low percentage of operations that rendered their carcasses.

The biggest change in carcass-disposal methods from 2001 to 2011 was in composting: 26.5 percent of operations composted carcasses in 2011 compared with just 6.9 percent in 2001. A higher percentage of operations in 2011 than in 2001 left carcasses for scavengers, incinerated carcasses, or used put carcasses in a landfill.

F.2.a. For operations that had any lamb and/or sheep deaths in the previous year, percentage of operations by carcass disposal method and by study:

Carcass disposal method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Landfill/municipal dump	7.5	(1.0)	13.1	(0.9)
Incineration	12.9	(1.0)	17.1	(1.1)
Burial (not landfill)	51.7	(1.7)	44.9	(1.3)
Rendering	2.3	(0.6)	1.3	(0.3)
Composting	6.9	(0.8)	26.5	(1.2)
Leaving for scavengers	25.3	(1.4)	40.8	(1.3)
Other	2.6	(0.6)	6.4	(0.7)

For operations that had any lamb and/or sheep deaths during the previous year, percentage of operations by carcass disposal method used and by study



Photograph courtesy of Camilla Kristensen.

Overall, the percentage of operations that composted carcasses increased from 2001 to 2011. The largest increase occurred in the West region, where 10 times the percentage of operations composted carcasses in 2011 compared with operations in 2001 (20.5 and 2.0 percent, respectively). Composting also increased in the East region from 9.6 percent of operations in 2001 to 45.6 percent in 2011. The largest increase in carcass disposal by incineration occurred in the West region, where 5.8 percent of operations incinerated carcasses in 2001 compared 13.7 percent in 2011.

F.2.b. For operations that had any lamb and/or sheep deaths during the previous year, percentage of operations by carcass disposal method, study, and region:

Carcass disposal method	Percent Operations											
	Sheep 2001						Sheep 2011					
	West		Central		East		West		Central		East	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Landfill/ municipal dump	10.8	(3.3)	12.1	(1.7)	2.6	(0.8)	19.7	(3.2)	16.7	(1.4)	7.1	(1.2)
Incineration	5.8	(1.7)	10.8	(1.4)	17.2	(1.7)	13.7	(2.8)	13.1	(1.4)	22.0	(1.8)
Burial (not landfill)	52.2	(5.0)	32.5	(2.5)	66.1	(2.3)	48.2	(3.8)	39.6	(1.9)	48.5	(2.1)
Rendering	6.9	(2.7)	1.5	(0.7)	1.0	(0.5)	1.8	(0.9)	0.5	(0.2)	1.9	(0.6)
Composting	2.0	(0.8)	5.9	(1.3)	9.6	(1.3)	20.5	(3.2)	7.4	(1.0)	45.6	(2.1)
Leaving for scavengers	27.4	(4.3)	44.7	(2.5)	9.8	(1.4)	48.3	(3.8)	57.2	(1.8)	20.7	(1.8)
Other	5.8	(2.4)	1.2	(0.2)	2.4	(0.9)	7.2	(2.2)	8.2	(1.2)	4.4	(1.0)

Nearly half of lamb and sheep carcasses were left for scavengers in 2001 and 2011. A lower percentage of carcasses were buried in 2011 than in 2001, and nearly three times the percentage of carcasses were composted in 2011 than in 2001 (14.1 and 5.0 percent, respectively).

F.2.c. For lambs and sheep that died during the previous year, percentage of dead lambs and sheep by carcass disposal method and by study:

Carcass disposal method	Percent Dead Lambs and Sheep			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Landfill/ municipal dump	6.9	(0.7)	4.4	(0.4)
Incineration	7.5	(0.6)	7.7	(0.9)
Burial (not landfill)	27.1	(1.0)	21.8	(1.1)
Rendering	4.2	(1.2)	0.6	(0.2)
Composting	5.0	(0.5)	14.1	(1.0)
Leaving for scavengers	47.4	(1.3)	48.5	(1.6)
Other	1.9	(0.4)	3.1	(0.4)
Total	100.0		100.0	

The percentage of carcasses buried in the West and East regions was higher in 2001 than in 2011 (42.5 and 25.4 percent, respectively).

F.2.d. For lambs and sheep that died during the previous year, percentage of dead lambs and sheep, by carcass disposal method, region, and study:

Percent Dead Lambs and Sheep												
Carcass disposal method	Sheep 2001						Sheep 2011					
	West		Central		East		West		Central		East	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Landfill/ municipal dump	7.8	(2.0)	7.9	(0.9)	1.9	(0.5)	9.2	(1.9)	4.1	(0.4)	3.0	(0.7)
Incineration	8.2	(2.3)	4.7	(0.6)	18.2	(1.7)	7.5	(2.1)	6.6	(1.2)	10.8	(1.3)
Burial (not landfill)	42.5	(3.8)	17.7	(1.0)	53.0	(2.6)	25.4	(2.6)	19.8	(1.5)	25.9	(2.0)
Rendering	1.9	(0.8)	5.5	(1.7)	0.9	(0.5)	2.4	(1.2)	0.1	(0.0)	0.9	(0.3)
Composting	4.0	(1.1)	3.3	(0.6)	12.9	(1.4)	17.5	(3.4)	4.2	(0.6)	42.0	(2.6)
Leaving for scavengers	30.4	(2.8)	59.5	(1.6)	12.2	(2.9)	33.5	(3.1)	62.3	(1.9)	14.8	(2.3)
Other	5.2	(2.1)	1.4	(0.3)	1.5	(0.5)	4.5	(1.3)	2.9	(0.5)	2.6	(0.7)

G. Lambs and Sheep on Feed

1. Lambs and sheep on a high-energy diet

The percentage of all operations that fed lambs or sheep a high-energy diet to finish them for slaughter increased from 2001 to 2011. In 2001 and 2011, farm/pasture operations accounted for the highest percentage of operations that fed lambs or sheep a high-energy diet to finish them for slaughter. The biggest change between the two studies was in fenced-range operations, where over twice the percentage of operations fed a high-energy diet to lambs in 2011 compared with 2001. The majority of animals that were fed a high-energy diet in 2011 were lambs (27.3 percent of lambs weaned in 2010). Similar data were not collected in Sheep 2001.

G.1. Percentage of operations that fed a high-energy diet to lambs or sheep during the previous year to finish them for slaughter, by study and by primary flock type:

Study	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	7.0	(2.1)	7.6	(1.4)	28.6	(1.5)	26.2	(1.3)
Sheep 2011*	8.1	(1.5)	20.3	(1.7)	35.0	(1.4)	31.4	(1.0)

*For operations with 20 or more ewes.

2. Weight of market lambs

A higher percentage of operations in 2011 than in 2001 placed on feed lambs that weighed more than 105 lb. In both studies, the majority of operations that fed a high-energy diet placed lambs weighing less than 65 lb. In addition, in 2011 the single highest percentage of lambs were placed on feed when weighing less than 65 lb. In 2001, lambs tended to be heavier when placed on feed.

G.2. For market lambs fed a high-energy diet during the previous year, percentage of operations and percentage of lambs by weight of lambs when placed on feed and by study:

	Percent							
	Operations				Lambs			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
Weight (lb)	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Less than 65	65.0	(2.8)	58.3	(2.1)	20.0	(2.1)	43.7	(3.6)
65–84	28.9	(2.6)	25.9	(1.9)	30.5	(2.9)	21.1	(2.4)
85–105	10.7	(1.7)	16.5	(1.5)	37.1	(3.2)	17.2	(4.8)
More than 105	6.6	(1.5)	20.9	(1.7)	12.4	(2.6)	18.0	(2.3)
Total					100.0		100.0	

H. Biosecurity Practices

1. Flock additions

H.1.a. Percentage of operations that added sheep or lambs during the previous year:

Percent Operations			
Sheep 2001		Sheep 2011	
Percent	Std. error	Percent	Std. error
33.2	(1.5)	28.6	(0.9)

Keeping a closed flock is one of the best ways to maintain healthy animals, as introducing new sheep to a flock poses one of the greatest threats to biosecurity. In a closed flock, replacement females are selected from within the flock, and genetic improvements are made through artificial insemination.

Each age group introduced to the flock poses its own biosecurity risks. Bred ewes can harbor reproductive pathogens that are detectable only when ewes abort or lamb. Replacement lambs can introduce new strains of respiratory and enteric pathogens to other lambs.

For operations that added sheep, similar percentages of operations in 2001 and 2011 added ewes and rams of all sheep types. In both studies, these operations also added roughly the same percentages of ewes and rams of all sheep types.

H.1.b. For operations that added any sheep or lambs during the previous year, percentage of operations and percentage of lambs or sheep, by type of sheep added and by study:

Sheep type	Percent							
	Operations				Lambs or Sheep			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Replacement ewe lambs less than 1 year old	34.4	(2.6)	26.8	(1.8)	14.4	(2.1)	19.6	(3.0)
Replacement ewes 1 year or older	28.4	(2.3)	30.3	(1.8)	27.8	(2.9)	24.0	(2.9)
Replacement ram lambs less than 1 year old	35.1	(2.4)	36.8	(1.9)	2.1	(0.3)	1.9	(0.3)
Replacement rams 1 year and older	38.2	(2.5)	42.5	(1.9)	2.4	(0.3)	2.4	(0.3)
All other sheep and lambs	11.4	(2.0)	7.1	(1.0)	53.3	(4.7)	52.0	(5.2)
Total					100.0		100.0	

Many outwardly healthy animals carry infectious organisms that can affect flock productivity. For this reason, quarantining new additions is always recommended. Quarantining animals provides an opportunity to detect diseases in the new additions without risking disease introduction and transmission to the rest of the flock. For the purpose of this report, quarantine is defined as the physical separation of an animal or group of animals from other sheep on the operation.

General recommendations for the minimum length of quarantine vary from 14 to 28 days. Quarantining should provide sufficient time for the incubation and detection of infectious diseases. Diseases for which quarantining is most effective have incubation periods shorter than the quarantine period; thus, animals will show signs of infection prior to being introduced to the flock. Quarantining is not effective for diseases with long incubation periods or for diseases in which animals can be silent carriers. Diseases for which quarantining is not effective include Johne's disease, scrapie, and sore mouth. For these diseases, it is especially important to purchase new additions from disease-free, closed flocks that have not introduced new animals for a number of years.

Quarantine areas should be separate from other housing and far enough away from resident sheep to prevent airborne disease transmission. Quarantined animals should have no physical contact with other animals; therefore, producers should ensure that quarantined animals do not share fence lines, waterers, or feeders, all of which allow disease transmission.

A higher percentage of operations that added sheep in 2011 (47.9 percent) quarantined new additions compared with operations in 2001 (33.9 percent).

H.1.c. For operations that added any sheep or lambs during the previous year, percentage of operations that quarantined any sheep or lambs after arrival and percentage of sheep or lambs quarantined after arrival, by sheep type and by study:

Sheep type	Percent							
	Operations				Sheep or Lambs			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Replacement ewe lambs less than 1 year old	29.7	(4.2)	47.8	(3.9)	29.0	(6.0)	21.5	(4.7)
Replacement ewes 1 year or older	30.4	(4.2)	43.4	(3.6)	15.2	(2.1)	24.0	(3.5)
Replacement ram lambs less than 1 year old	41.4	(4.0)	51.8	(3.2)	39.8	(4.3)	36.8	(5.0)
Replacement rams 1 year and older	27.7	(3.4)	44.2	(3.0)	27.6	(2.4)	30.1	(2.9)
All other sheep and lambs	16.3	(7.1)	43.5	(7.1)	12.1	(3.3)	35.0	(8.4)
Any sheep or lambs	33.9	(2.4)	47.9	(2.0)	16.4	(2.4)	29.5	(4.6)

Overall, the percentage of operations that used health management practices for new additions to prevent disease increased from 2001 to 2011. Specifically, nearly twice the percentage of operations in 2011 vaccinated new additions before they arrived compared with operations in 2001 (70.1 and 35.6 percent, respectively). In addition, more than twice the percentage of operations in 2011 conducted external parasite treatments on new animals before they arrived compared with operations in 2001.

H.1.d. For operations that added lambs or sheep during the previous year, percentage of operations that performed the following health management practices on all or some of the new arrivals before or after their arrival, by study:

Health management practice	Percent Operations							
	Sheep 2001				Sheep 2011			
	Prior to arriving at operation		After arrival at operation		Prior to arriving at operation		After arrival at operation	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Any vaccinations	35.6	(2.5)	37.9	(2.5)	70.1	(2.1)	43.5	(2.0)
Shearing	32.2	(2.5)	29.1	(2.4)	44.0	(2.1)	33.0	(1.9)
Foot trim	21.4	(2.1)	31.7	(2.5)	37.7	(2.2)	36.6	(2.0)
Medicated footbath	6.1	(1.4)	12.0	(1.9)	10.5	(1.5)	15.3	(1.5)
Deworm	33.1	(2.5)	57.5	(2.6)	64.2	(2.2)	67.9	(1.9)
External parasite treatment	13.6	(1.8)	21.7	(2.0)	29.5	(2.2)	25.2	(1.7)
OPP testing	6.0	(1.2)	0.5	(0.1)	7.6	(1.3)	2.1	(0.6)
Johne's testing	3.3	(0.9)	0.2	(0.1)	8.4	(1.4)	1.6	(0.5)
Scrapie susceptibility testing	NA		NA		42.1	(2.3)	10.1	(1.3)
Other	3.8	(0.9)	3.3	(0.7)	5.2	(1.1)	2.3	(0.6)

2. Contact with other sheep

Disease transmission can occur when sheep from one operation have contact with sheep from another operation (or their feed or manure). Sharing air space from another flock through shared grazing land, at shows, or during breeding also presents risks for transmitting disease. The percentages of operations by types of contact the operations' sheep had with sheep from another operation showed little change from 2001 to 2011.

H.2.a. Percentage of operations in which sheep had contact with sheep from another operation, by type of contact and by study:

Contact type	Percent Operations			
	Sheep 2001*		Sheep 2011	
	Percent	Std. error	Percent	Std. error
At shows, exhibitions, breeding, etc., then returned to operation	32.4	(2.3)	33.7	(2.1)
Grazed with sheep from another operation	6.0	(1.1)	9.9	(1.2)
Had fence-line contact with sheep from another operation	11.2	(1.1)	13.1	(1.3)
Had contact with sheep visiting from another operation	19.4	(1.8)	21.8	(1.8)
Other	8.3	(1.3)	2.4	(0.6)
Any contact	50.6	(2.4)	50.2	(2.2)

*In 2001, an additional category—temporarily brought rams onto operation for breeding purposes—was also included.

A similar percentage of operations in 2001 and 2011 made an effort to decrease nose-to-nose contact between their sheep and sheep from other operations (28.7 and 34.6 percent, respectively).

H.2.b. For operations on which sheep had opportunities for contact with sheep from other operations, percentage of operations that made efforts to decrease nose-to-nose contact with their sheep and sheep from other operations, by study and by primary flock type:

Percent Operations								
Primary Flock Type								
Study	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	20.4	(4.4)	19.6	(4.1)	30.8	(3.6)	28.7	(3.0)
Sheep 2011	20.7	(6.0)	30.2	(6.3)	36.3	(3.9)	34.6	(3.0)

Cats pose a risk of transmitting diseases (such as toxoplasmosis) to sheep by defecating in or around sheep feed areas and by giving birth in sheep-raising areas. Nearly all operations in 2001 and 2011 had some type of cat present (96.5 and 94.1 percent, respectively).

Nearly all operations in 2001 and 2011 had some type of rodent control (96.5 and 94.1 percent, respectively) [table B.7]. For both studies, cats were the predominant method of rat and mouse control. Similar percentages of operations in 2001 and 2011 used each of the control methods in the table below.

H.2.c. Percentage of operations in which outdoor cats, including domestic, stray, or wild (e.g., bobcats), were present on the operation, by study and by primary flock type:

Percent Operations								
Primary Flock Type								
Study	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	92.2	(1.8)	96.9	(2.2)	96.4	(1.0)	96.5	(0.9)
Sheep 2011	74.2	(9.8)	91.1	(3.1)	95.6	(1.3)	94.1	(1.1)

The percentage of operations in which llamas or alpacas had access to sheep or lamb areas increased from 9.8 percent in 2001 to 19.4 percent in 2011. Conversely, the percentage of operations with cats that had access to sheep or lamb areas decreased from 78.2 percent in 2001 to 70.4 percent in 2011.

H.2.d. Percentage of operations by type of animals that had access to sheep or lamb areas (i.e., grazing areas, sheds, holding pens, food, or water) during the previous year, and by study:

Animal	Percent Operations			
	Sheep 2001		Sheep 2011*	
	Percent	Std. error	Percent	Std. error
Goats (domestic or wild)	21.3	(1.3)	24.5	(1.0)
Cattle	42.7	(1.6)	48.3	(1.2)
Horses, donkeys	38.1	(1.6)	39.1	(1.1)
Llamas, alpacas	9.8	(0.9)	19.4	(0.9)
Pigs (domestic and feral)	6.6	(0.8)	8.4	(0.7)
Poultry (chickens, turkeys, etc.)	25.1	(1.5)	28.4	(1.1)
Dogs	77.4	(1.4)	76.6	(1.0)
Cats	78.2	(1.4)	70.4	(1.1)

*In 2011 the question asked about animals having open access to sheep-raising areas.

3. Professional consultants

A higher percentage of operations in 2011 than in 2001 were visited by Federal/State veterinarians, extension agents, or nutritionists.

H.3.a. Percentage of operations by type of professional consultant that visited for any sheep-related reason during the previous year, and by study:

Professional consultant	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Private veterinarian	NA		28.2	(1.0)
Federal/State veterinarian	2.9	(0.5)	5.6	(0.5)
Extension agent	3.7	(0.5)	5.6	(0.5)
Nutritionist	2.1	(0.3)	5.2	(0.5)

While just 28.2 percent of operations were visited by a private veterinarian in 2011 (table H.3.a), 51.8 percent of operations had consulted with a private veterinarian during the previous year. This percentage is higher than the percentage of operations that consulted with a private veterinarian in 2001 (46.1 percent). From 2001 to 2011, there were substantial increases in the percentage of operations that consulted with a veterinarian for disease diagnosis, disease prevention, and lambing problems.

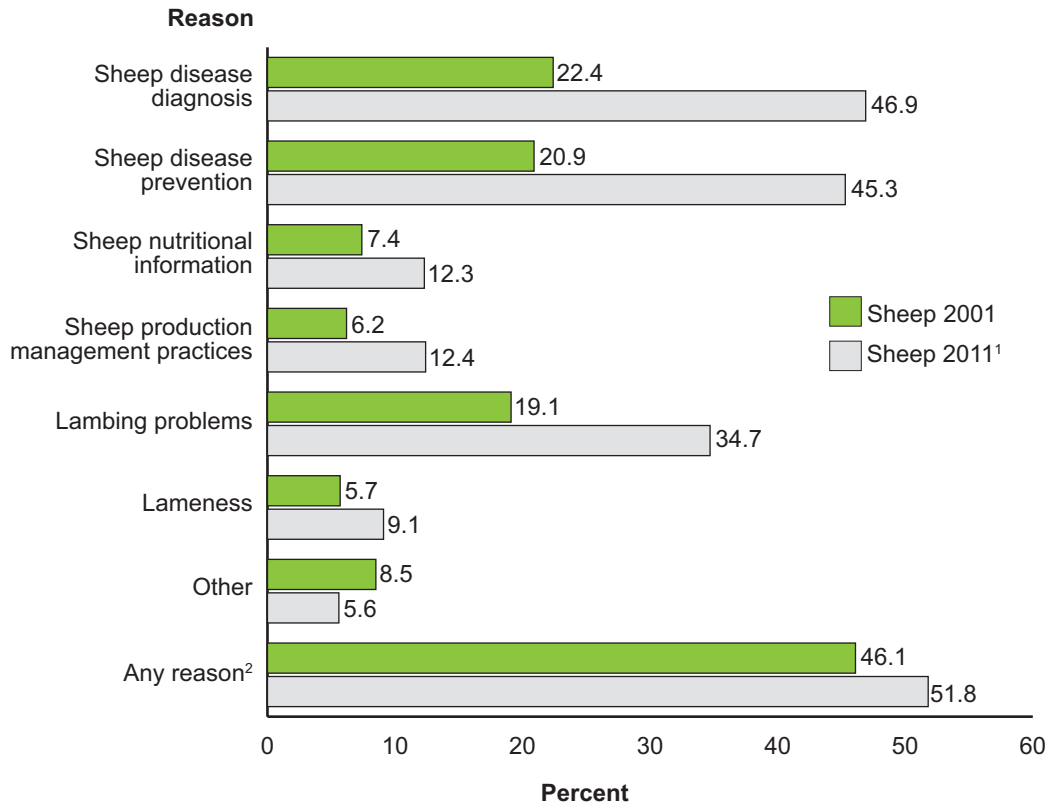
H.3.b. Percentage of operations that consulted a private veterinarian during the previous year, by reason and by study:

Reason	Percent Operations			
	Sheep 2001		Sheep 2011 ¹	
	Percent	Std. error	Percent	Std. error
Sheep disease diagnosis	22.4	(1.3)	46.9	(1.6)
Sheep disease prevention	20.9	(1.2)	45.3	(1.6)
Sheep nutritional information	7.4	(0.7)	12.3	(1.0)
Sheep production management practices	6.2	(0.6)	12.4	(1.0)
Lambing problems	19.1	(1.2)	34.7	(1.5)
Lameness	5.7	(0.7)	9.1	(0.9)
Other	8.5	(0.9)	5.6	(0.8)
Any reason ²	46.1	(1.6)	51.8	(1.2)

¹In 2011, additional reasons listed and not included here were "interstate health certificate," "breeding soundness exam," and "pregnancy check."

²Includes all reasons listed as options in 2011.

Percentage of operations that had consulted a private veterinarian during the previous year, by reason and by study



¹In 2011, additional reasons listed and not included here were “interstate health certificate,” “breeding soundness exam,” and “pregnancy check.”
²Includes all reasons listed as options in 2011.

4. Manure management

A higher percentage of operations in 2011 than in 2001 gave away or composted manure.

H.4. Percentage of operations by methods used to dispose of manure:

Method	Percent Operations			
	Sheep 2001*		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Applied to land either owned or rented by the operation	78.2	(2.0)	79.4	(1.7)
Sold or received other compensation	3.0	(0.6)	6.8	(1.1)
Gave away	17.7	(1.8)	32.8	(2.0)
Composted	29.0	(2.2)	40.9	(2.1)

*In 2001, there was an additional category not included here::applied to land **not** owned, rented, or leased by operation.

I. Reproduction Management

1. Manure and waste-bedding management during lambing

Cleaning the lambing area is crucial for preventing disease transmission between ewes and from ewes to lambs. Periparturient ewes, which may be immunosuppressed, and newborn lambs, which have immature immune systems, are especially susceptible to infectious disease. Also, tissue and fluid left by infected ewes after they have given birth often shed pathogenic 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 just a few.

A higher percentage of operations in 2011 did not clean lambing areas compared with operations in 2001 (25.4 and 7.6 percent, respectively).

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

Cleaning frequency	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Between each ewe	24.8	(2.4)	10.9	(1.3)
Between two or more ewes	16.2	(1.8)	14.8	(1.5)
At end of lambing season	51.4	(2.6)	48.8	(2.1)
Not cleaned	7.6	(1.3)	25.4	(1.9)
Total	100.0		100.0	

I.1.b. Percentage of operations by frequency that the operation cleaned manure and waste bedding from jugs for ewe-lamb pairs during lambing season, and by study:

Percent Operations				
Cleaning frequency	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Between each ewe	38.4	(2.7)	39.2	(2.2)
Between two or more ewes	18.4	(1.9)	24.1	(2.0)
At end of lambing season	39.5	(2.7)	31.5	(2.2)
Not cleaned	3.7	(1.1)	5.2	(1.1)
Total	100.0		100.0	

2. Placenta removal

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.

I.2.a. Percentage of operations that usually removed placentas from the lambing area, by study and by primary flock type:

Percent Operations								
Study	Primary Flock Type							
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	49.3	(5.4)	55.5	(5.1)	81.0	(2.0)	75.2	(1.9)
Sheep 2011	42.2	(8.3)	62.6	(4.6)	71.0	(2.4)	67.9	(2.0)

I.2.b. For operations that usually removed placentas from the lambing area, percentage of operations by average length of time placentas were left on the ground before removal, and by study:

Time left on ground (hr)	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Less than 6	68.4	(2.7)	76.0	(2.4)
6–12	23.7	(2.5)	19.2	(2.2)
More than 12	7.9	(1.6)	4.8	(1.2)
Total	100.0		100.0	

For operations that removed placentas, the most common methods of removal for both studies were composting, throwing out for carnivores, and putting in the landfill/dump. A higher percentage of operations in 2011 than in 2001 (28.0 and 15.4 percent, respectively) removed placentas from the lambing area by throwing them out for carnivores .

I.2.c. For operations that usually removed placentas from the lambing area, percentage of operations by usual method of placenta disposal and by study:

Method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Burn/incinerate	12.7	(1.8)	9.3	(1.5)
Bury	11.2	(1.5)	6.9	(1.3)
Render	0.3	(0.3)	0.1	(0.1)
Landfill/dump	17.9	(2.4)	16.5	(2.0)
Compost	29.4	(2.7)	30.8	(2.5)
Throw out for carnivores	15.4	(2.1)	28.0	(2.4)
Other	13.1	(2.0)	8.5	(1.5)

3. Abortion and sick ewe management

There was no difference from 2001 to 2011 in either the percentage of operations that had ewes abort or in the percentage of bred ewes that aborted.

I.3.a. Percentage of operations with one or more ewes that aborted, by study and by primary flock type:

Percent Operations								
Primary Flock Type								
Study	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	61.9	(6.3)	41.1	(5.2)	52.4	(2.8)	50.6	(2.4)
Sheep 2011	80.5	(10.2)	45.5	(5.5)	42.6	(3.0)	43.8	(2.4)

I.3.b. Percentage of ewes that aborted, by study:

Percent Operations			
Sheep 1996		Sheep 2011	
Percent	Std. error	Percent	Std. error
1.8	(0.1)	1.7	(0.1)

In 2011, a lower percentage of operations with ewes that aborted removed placentas or fetuses as soon as possible and disinfected the area compared with operations in 2001.

I.3.c. For operations with ewes that aborted, percentage of operations by practice used for aborting ewes and by study:

Practice	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Remove placentas or fetuses as soon as possible	88.8	(1.7)	79.6	(2.5)
Clean the area by removing bedding and/or dirt	41.2	(3.2)	30.3	(2.9)
Disinfect the area	20.8	(2.9)	9.6	(1.9)
Physically separate ewes that aborted from other ewes	44.1	(3.1)	32.6	(2.9)

The percentage of abortions suspected to be caused by *Campylobacter* did not change from 2001 to 2011; however, the percentage of those suspected cases diagnosed by a veterinarian or a laboratory decreased from 53.7 percent in 2001 to 22.6 percent in 2011. For all listed pathogens, the percentage of suspected causes diagnosed by a veterinarian or a laboratory decreased from 2001 to 2011.

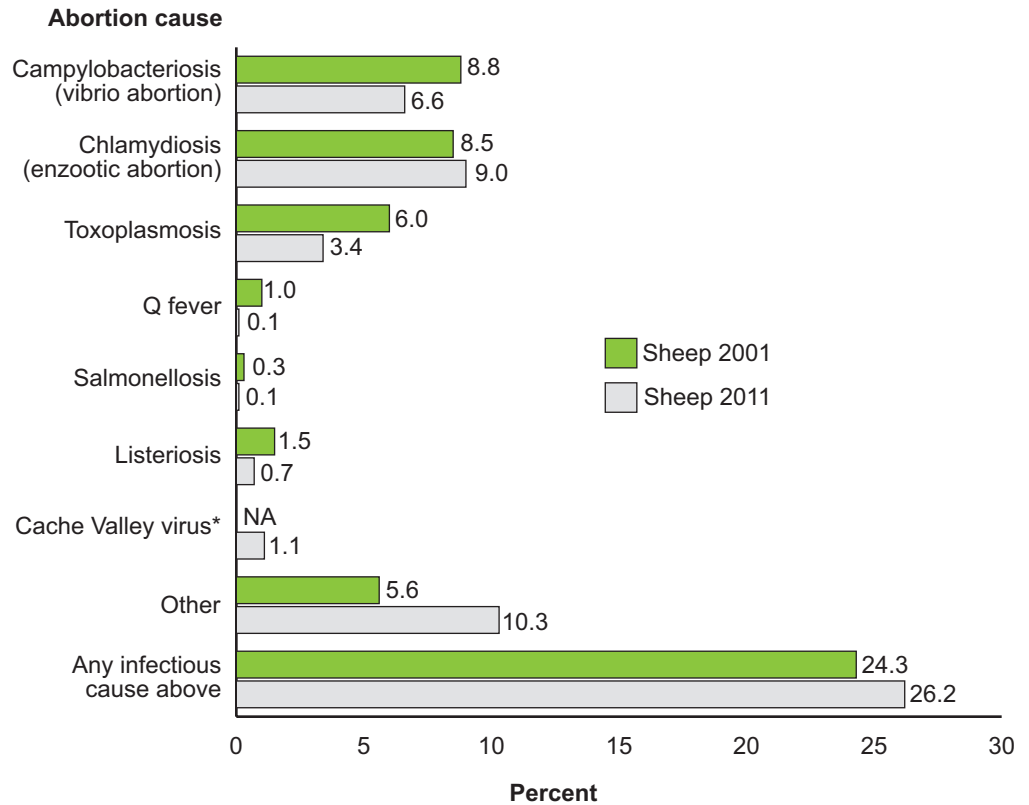
I.3.d. For operations that had ewes that aborted during the previous year, percentage of operations by suspected cause of abortions, percentage of operations in which the diagnosis was made by either a veterinarian or laboratory, and by study:

Abortion cause	Percent Operations							
	Suspected				Suspected cases diagnosed by a veterinarian or laboratory			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Campylobacteriosis (vibrio abortion)	8.8	(1.6)	6.6	(1.3)	53.7	(9.7)	22.6	(6.7)
Chlamydiosis (enzootic abortion)	8.5	(1.8)	9.0	(1.6)	43.6	(11.0)	37.3	(8.9)
Toxoplasmosis	6.0	(1.9)	3.4	(1.1)	26.2	(10.0)	6.9	(6.5)
Q fever	1.0	(0.8)	0.1	(0.1)	²		²	
Salmonellosis	0.3	(0.1)	0.1	(0.1)	²		²	
Listeriosis	1.5	(1.0)	0.7	(0.3)	²		²	
Cache Valley virus ¹	NA		1.1	(0.5)	NA		²	
Other	5.6	(2.1)	10.3	(1.8)	73.3	(14.3)	3.5	(3.3)
Any infectious cause above	24.3	(3.0)	26.2	(2.6)	51.3	(7.4)	21.6	(4.4)

¹Not a choice in the Sheep 2001 questionnaire.

²Too few observations to report.

For operations that had ewes that aborted during the previous year, percentage of operations by suspected cause of abortions and by study



*Not a choice in the Sheep 2001 questionnaire.

Having a dedicated lambing area separate from the sick-ewe area reduces the risk of disease transmission. There was no substantial change in the percentage of operations that used the lambing area for sick ewes from 2001 to 2011.

I.3.e. Percentage of operations that used the lambing area for sick ewes, by time period and by study:

Time period	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
During lambing	23.0	(2.1)	19.3	(1.6)
At other times of the year	32.2	(2.3)	30.6	(2.0)

4. Feeding practices

I.4.a. Percentage of operations in which weaned lambs less than 12 months old generally shared common feed or water sources with adult sheep:

	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
	61.5	(2.4)	61.9	(2.0)

Placing thin ewes with younger sheep can expose the younger sheep to chronic diseases such as Johne's disease. A similar percentage of operations in both studies placed ewes with younger sheep to encourage or increase the ewes' feed intake.

I.4.b. Percentage of operations that ever placed thin ewes with younger sheep to encourage or to increase the ewes' feed intake:

	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
	28.0	(2.2)	26.2	(1.9)

J. Disease Control, Illness, and Death

1. 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, including those that primarily infect cattle and those that primarily infect sheep, although some cross-infections do occur. Infected cattle, therefore, can pose a risk to sheep and vice versa. Most 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.

J.1. Percentage of operations by level of familiarity with Johne's disease and by study:

Level of familiarity	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Very familiar	6.5	(1.1)	13.6	(1.5)
Somewhat familiar	25.3	(2.2)	30.5	(1.9)
Heard of name only	38.0	(2.3)	28.6	(1.9)
Never heard of	30.2	(2.2)	27.3	(1.9)
Total	100.0		100.0	

2. Weight loss despite normal appetite

A number of infectious diseases can cause ewes to lose weight, despite a normal appetite and treatment. Johne's is one such disease, and since it can infect lambs in utero it is recommended that ewes with Johne's be culled before lambing. If not infected in utero, lambs born to ewes infected with Johne's will likely become infected through the dam's milk or by accidentally ingesting infected feces. There was no substantial change from 2001 to 2011 in health management practices used for pregnant ewes that demonstrated weight loss, despite a normal appetite and treatment.

J.2. Percentage of operations by the health management practice that best describes what would most likely be done if a pregnant ewe demonstrated weight loss but had a normal appetite and did not respond to treatment:

Health management practice	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Cull her before lambing	12.3	(1.3)	11.1	(1.3)
Allow her to lamb and then re-evaluate or cull her	79.3	(1.8)	78.9	(1.8)
Keep her regardless of the above signs	8.4	(1.4)	10.0	(1.5)
Total	100.0		100.0	

3. Scrapie

Scrapie is a fatal degenerative disease that affects 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.

The impacts of the scrapie eradication program can be seen in the following tables. From 2001 to 2011, the percentage of operations that were very familiar with scrapie increased, while the percentage of operations that had heard of the name only or had never heard of scrapie decreased.

J.3.a. Percentage of operations by level of familiarity with scrapie:

Level of familiarity	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Very familiar	19.5	(1.9)	41.6	(2.1)
Somewhat familiar	44.6	(2.4)	43.2	(2.1)
Heard of name only	28.5	(2.2)	13.3	(1.5)
Never heard of	7.4	(1.2)	1.9	(0.7)
Total	100.0		100.0	

The percentage of operations that used genetic selection to control scrapie in their flocks quadrupled from 2001 to 2011. This increase is likely due to increased knowledge about scrapie and the benefits of genetic selection as well as greater testing availability.

J.3.b. Percentage of operations that used genetic selection to control scrapie in their flocks:

Percent Operations			
Sheep 2001		Sheep 2011	
Percent	Std. error	Percent	Std. error
10.8	(1.5)	47.3	(2.3)

A higher percentage of operations in 2011 than in 2001 culled genetically more susceptible ewes or used genetically less susceptible replacement rams. An RR ram has a high genetic resistance to scrapie, and all his offspring will be resistant or less susceptible to scrapie.

J.3.c. For operations that genetically selected for scrapie control, percentage of operations by genetic selection practice used:

Selection practice	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Use genetically less susceptible replacement rams (i.e., RR alleles)	84.4	(5.1)	98.8	(0.7)
Selecting genetically less susceptible ewes (i.e., QR or RR alleles)	31.1	(6.0)	48.6	(3.4)
Culling genetically more susceptible ewes (i.e., QQ alleles)	17.0	(4.2)	27.8	(3.1)
Selected less susceptible breeds	22.6	(5.3)	NA	
Other*	9.2	(5.0)	2.3	(1.0)



Photograph courtesy of American Sheep Industry.

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 show clinical signs until 2 years of age or older because of the virus's long incubation period. Often, the first sign noticed is general loss of body condition referred to as "thin ewe syndrome." Weight loss occurs despite the affected sheep having a normal appetite. Increased breathing at rest is another common sign of OPP. Often called "lungers," these sheep tire easily and may be seen trailing the flock. Bacterial infections secondary to OPP are very common and result in additional signs such as a 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 can also cause other problems such as meningitis and encephalitis. Clinical signs include an unsteady gait, twitching, or stumbling, which can progress to hind limb or total paralysis. Arthritis may accompany OPP infection as well. Pain and swelling of the joints and a shortened gait are common. In addition, flocks infected with OPP can have lowered production efficiency because of early culling, decreased milk production, and lower weaning weights.

The percentage of operations that were somewhat familiar with OPP increased from 2001 to 2011, and the percentage of operations that had heard of the name only decreased during the same period.

J.4.a. Percentage of operations by familiarity with OPP and by study:

Level of familiarity	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Very familiar	10.9	(1.4)	15.4	(1.5)
Somewhat familiar	28.4	(2.1)	38.1	(2.1)
Heard of name only	29.2	(2.3)	20.4	(1.8)
Never heard of	31.5	(2.2)	26.0	(1.9)
Total	100.0		100.0	

There was no difference from 2001 to 2011 in the percentage of operations that had a flock health management program designed specifically to control or prevent OPP.

J.4.b. For operations that were very familiar, somewhat familiar, or had heard of OPP, percentage of operations that had a flock-health management program designed specifically to control or prevent OPP, by study:

Study	Percent operations	Std. error
Sheep 2001	16.7	(2.3)
Sheep 2011	16.2	(2.0)

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

Method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Removed all seropositive sheep and lambs from flock (sold and/or isolated in separate facilities)	36.4	(6.7)	52.6	(6.8)
Kept flock isolated from infected sheep or goats	62.8	(6.0)	55.8	(6.7)
Added only seronegative sheep to flock	36.3	(6.8)	42.3	(8.3)
Added only sheep from OPP-seronegative flocks*	NA		42.7	(8.2)
Tested goats (if present) for caprine arthritis encephalitis (CAE)	4.9	(3.0)	21.9	(9.7)
Other method	41.9	(6.2)	25.9	(5.6)

*Category not included in the Sheep 2001 questionnaire.

The percentage of operations infected with OPP increased from 2001 to 2011. However, the percentage of operations that did not know the current OPP status of their flock decreased from 2001 to 2011.

J.4.d. Percentage of operations by current OPP status of flock and by study:

Flock status	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Currently infected with OPP	1.2	(0.3)	5.4	(1.0)
Previously infected with OPP but now negative	1.6	(0.6)	3.3	(0.9)
Never infected with OPP	10.9	(1.8)	18.7	(2.4)
Do not know current OPP status	86.3	(1.9)	72.7	(2.6)
Total	100.0		100.0	

5. Toxoplasmosis and Q fever

A higher percentage of operations were very or somewhat familiar with toxoplasmosis and Q fever in 2011 than in 2001.

J.5. Percentage of operations by level of familiarity with toxoplasmosis and Q fever, and by study:

Level of familiarity	Percent Operations							
	Disease							
	Toxoplasmosis				Q fever			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	
Very familiar	9.7	(1.4)	15.1	(1.6)	2.6	(0.7)	4.0	(0.9)
Somewhat familiar	25.4	(2.2)	30.9	(1.9)	6.0	(1.2)	13.2	(1.4)
Heard of name only	22.6	(2.1)	25.5	(1.9)	15.0	(1.7)	30.8	(2.0)
Never heard of	42.3	(2.3)	28.5	(2.0)	76.4	(2.1)	52.0	(2.2)
Total	100.0		100.0		100.0		100.0	

6. Diseases present in the last 3 years

The percentage of suspected scrapie cases did not change from 1996 to 2011. However, the percentage of those suspected cases that were diagnosed by a veterinarian or laboratory more than doubled during the same time period, which might reflect increased scrapie eradication efforts. For all other diseases listed, the percentage of suspect cases diagnosed by a veterinarian or laboratory either remained the same or declined.

J.6. Percentage of operations in which the following diseases were suspected during the last 3 years, and percentage of operations in which the following diseases were diagnosed by a veterinarian or lab, by study:

Disease	Percent Operations									
	Suspected					Suspected cases diagnosed by a veterinarian or laboratory				
	Sheep 1996 ¹		Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	
Johne's (paratuberculosis)	0.8	(0.1)	1.6	(0.5)	2.5	(0.6)	33.3	(14.9)	40.8	(12.7)
Scrapie	1.2	(0.2)	1.2	(0.4)	1.7	(0.6)	26.7	(12.0)	70.4	(19.6)
Ovine progressive pneumonia (OPP)	5.1	(0.4)	7.1	(1.2)	8.2	(0.9)	21.7	(7.9)	24.6	(4.6)
Footrot	28.1	(1.0)	34.9	(2.2)	37.3	(2.1)	15.2	(2.8)	8.4	(1.9)
Caseous lymphadenitis (lumpy jaw)	13.8	(0.7)	20.4	(1.9)	24.5	(1.9)	24.9	(5.2)	24.1	(3.8)
Enterotoxemia/overeating disease (clostridium C&D) (not grain overload) ²	NA		38.8	(2.3)	35.0	(1.9)	30.9	(3.4)	19.7	(2.7)
Other clostridial diseases (e.g., blackleg, malignant edema, braxy, tetanus, botulism, big head)	9.8	(0.6)	11.9	(1.4)	10.4	(1.2)	17.3	(3.5)	17.7	(4.2)
Coccidiosis	18.2	(0.8)	30.4	(2.3)	34.0	(2.0)	50.0	(4.7)	37.0	(3.5)
Sore mouth (contagious ecthyma, orf)	20.6	(0.8)	40.0	(2.3)	43.7	(2.1)	17.9	(2.8)	12.2	(2.1)
Ring worm or club lamb fungus ²	NA		7.3	(1.2)	8.9	(1.3)	22.5	(6.0)	18.8	(6.5)
Bluetongue	2.6	(0.3)	4.2	(1.0)	3.6	(0.7)	37.2	(12.3)	19.6	(9.5)

¹The Sheep 1996 study asked about disease presence in the previous 5 years.

²These categories were not specifically identified in the Sheep 1996 study.

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, sheep diet, soil type, age of the sheep, and previous disease problems. The percentage of operations that vaccinated nursing lambs for sore mouth decreased from 2001 to 2011; there were no substantial differences from 2001 to 2011 in the percentages of operations that vaccinated nursing lambs for the other listed diseases.

J.7.a. Percentage of operations that vaccinated nursing lambs, weaned feeder lambs, and/or breeding rams against the following diseases, by vaccine type and by study:

Vaccine type	Percent Operations											
	Animal Type											
	Nursing lambs				Weaned feeder (market) lambs				Breeding rams			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011		Sheep 2001	Sheep 2011		
	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)	15.3	(1.5)	19.2	(1.7)	9.6	(1.3)	12.7	(1.5)	16.8	(1.8)	14.8	(1.5)
Enterotoxemia, overeating	66.9	(2.3)	60.5	(2.1)	44.8	(2.6)	39.8	(2.2)	36.0	(2.4)	28.8	(1.9)
Tetanus	55.1	(2.4)	55.0	(2.1)	28.9	(2.5)	32.9	(2.1)	30.7	(2.4)	25.3	(1.9)
Respiratory												
Pneumonia (<i>Pasteurella/Mannheimia</i>)	1.8	(0.6)	0.8	(0.3)			0.6	(0.3)	1.4	(0.6)	0.5	(0.2)
Digestive												
Scours (<i>E. coli</i>)	2.9	(0.9)	0.3	(0.2)	1.1	(0.4)	0.8	(0.4)	1.4	(0.7)		
Reproductive												
Ram epididymitis bacterin (<i>Brucella</i>)									1.0	(0.5)	0.0	(0.0)
Other												
Footrot	2.3	(0.7)	0.3	(0.2)	0.8	(0.3)	0.1	(0.1)	5.7	(1.0)	2.0	(0.6)
Lumpy jaw (caseous lymphadenitis)	1.2	(0.5)	1.5	(0.6)			0.8	(0.4)	2.4	(0.7)	2.5	(0.7)
Rabies	0.1	(0.1)	0.0	(—)			0.1	(0.1)	0.1	(0.1)	1.1	(0.5)
Sore mouth (contagious ecthyma)	14.0	(1.4)	8.1	(1.0)	4.9	(1.0)	2.7	(0.7)	4.2	(0.9)	0.9	(0.4)

The percentage of operations that vaccinated any sheep for enterotoxemia increased from 1996 to 2011, while the percentage of operations by vaccination practices for the other listed diseases remained about the same.

J.7.b. Percentage of operations that vaccinated ewes, weaned replacement lambs, replacement or breeding ewes, and/or any sheep against the following diseases during the previous year, by vaccine type and by study:

Vaccine type	Percent Operations									
	Animal Type									
	Ewes		Replacement or breeding ewes		Sheep		Any sheep		Sheep	
	Sheep 2011	Std. error	Sheep 2001	Std. error	1996	Std. error	2001	Std. error	2011	Std. error
	Pct.		Pct.	Pct.		Pct.		Pct.		
Clostridial										
7- or 8-way (e.g., blackleg, malignant edema)	20.5	(1.7)	20.9	(1.8)	25.2	(1.0)	25.0	(1.9)	29.5	(1.9)
Enterotoxemia, overeating	38.8	(2.1)	48.4	(2.4)	58.7	(1.2)	76.7	(2.0)	71.4	(2.0)
Tetanus	34.0	(2.0)	37.5	(2.4)	56.7	(1.1)	62.8	(2.2)	64.5	(2.1)
Respiratory										
Pneumonia (<i>Pasteurella/Mannheimia</i>)	1.5	(0.5)	1.7	(0.6)			2.3	(0.6)	2.1	(0.5)
Digestive										
Scours (<i>E. coli</i>)	0.3	(0.2)	2.1	(0.6)	8.8	(0.7)	4.1	(0.9)	0.9	(0.4)
Other										
Footrot	3.4	(0.8)	7.1	(1.2)	17.0	(0.8)	7.8	(1.2)	3.5	(0.8)
Lumpy jaw (caseous lymphadenitis)	2.4	(0.7)	3.1	(0.9)	2.5	(0.3)	3.2	(1.0)	3.4	(0.8)
Rabies	1.1	(0.5)	0.1	(0.1)			0.2	(0.1)	1.2	(0.5)
Sore mouth (contagious ecthyma)	1.5	(0.6)	5.1	(0.8)	14.8	(0.8)	15.0	(1.4)	11.0	(1.2)
EAE (<i>Chlamydia abortus</i>)	7.6	(1.1)	7.6	(1.4)	6.7	(0.5)	7.7	(1.4)	8.1	(1.1)
Leptospirosis	4.1	(0.9)	7.7	(1.4)			7.9	(1.4)		
<i>Campylobacter fetus/jejuni</i> (vibrio)	14.6	(1.4)	15.5	(1.7)	12.3	(0.7)	15.6	(1.7)	15.2	(1.4)

K. Parasites and Dewormers

1. External parasites

External parasites live on or within the skin of their hosts, are usually more problematic in the winter due to closer living conditions, and may cause financial loss and animal welfare concerns. External parasites on sheep include ticks, keds, fly larvae, and mites. Topical treatments are usually more effective and easier to apply on shorn animals and often include the use of pesticides or anthelmintics.

There was no difference from 2001 to 2011 in the percentage of operations that treated sheep for external parasites.

K.1. Percentage of operations that treated any sheep for external parasites (keds, ticks, lice, etc.) during the previous year, by study and by primary flock type:

Study	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	77.6	(6.2)	37.8	(3.3)	36.5	(1.7)	37.4	(1.5)
Sheep 2011	69.0	(5.5)	38.3	(2.1)	40.9	(1.5)	40.7	(1.1)

2. Internal parasites

A similar percentage of operations performed fecal testing for intestinal parasites in 2001 and 2011.

K.2. Percentage of operations that performed fecal testing for intestinal parasites during the previous year, by study and by region:

Study	Percent Operations							
	Region							
	West		Central		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	12.1	(2.8)	15.8	(2.7)	17.4	(2.8)	16.1	(1.8)
Sheep 2011	17.3	(4.0)	9.9	(1.8)	19.8	(2.5)	16.0	(1.5)

3. Dewormers

There was no difference in the percentage of operations by frequency dewormers were used in sheep feed from 2001 to 2011. Low-level continuous feeding of dewormers encourages the development of resistant parasites. A small percentage of operations always used dewormers in sheep feed.

K.3.a. Percentage of operations by frequency dewormers were used in sheep feed for stomach or intestinal worms (not including coccidia) during the previous year, and by study:

Frequency	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Always	3.9	(1.0)	4.3	(0.9)
Sometimes	7.9	(1.5)	8.1	(1.2)
Never	88.2	(1.7)	87.6	(1.4)
Total	100.0		100.0	

In 2001 and 2011, a lower percentage of operations in the Central region used a dewormer either orally (not in feed) or by injection compared with operations in the other regions. Overall, from 2001 to 2011 a similar percentage of operations used a dewormer that was not in feed.

K.3.b. Percentage of operations that used a dewormer given orally (not in feed) or by injection during the previous year, by study and by region:

Study	Percent Operations							
	Region							
	West		Central		East		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	94.1	(3.2)	86.4	(2.5)	94.8	(1.8)	91.5	(1.4)
Sheep 2011	90.8	(3.0)	78.4	(2.7)	96.2	(1.3)	89.2	(1.3)

The percentage of operations that used a dewormer in ewes and lambs because the animals were thin or doing poorly increased from 2001 to 2011.

K.3.c. Percentage of operations that used a dewormer given either orally (not in feed) or by injection to ewes and lambs during the previous year, by reason for administering dewormer and by study:

Percent Operations								
Dewormer Used in . . .								
Reason	Ewes				Lambs			
	Sheep 2001		Sheep 2011		Sheep 2001		Sheep 2011	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
General preventive measure	96.8	(0.5)	87.3	(1.6)	84.6	(1.7)	78.8	(2.0)
Because worms were seen	16.9	(1.7)	21.3	(2.0)	19.3	(2.0)	23.9	(2.1)
Fecal test results indicated a need	10.3	(1.5)	11.0	(1.3)	10.5	(1.6)	11.5	(1.5)
Because sheep or lambs were thin or doing poorly	31.8	(2.3)	48.0	(2.3)	27.8	(2.1)	44.0	(2.4)
Bottlejaw, scours, and other clinical signs*			38.9	(2.2)			33.6	(2.3)
Other	3.4	(0.8)	2.0	(0.6)	3.4	(0.8)	2.2	(0.7)

*Not an option on the Sheep 2001 questionnaire.

The percentage of operations that used moxidectin products increased from 2.5 percent in 2001 to 32.9 percent in 2011.

K.3.d. For operations that used dewormers, percentage of operations by type of dewormers used and by study:

Dewormer	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Ivomec®-ivermectin or Dectomax® (doramectin)	70.8	(2.2)	69.0	(2.1)
Cydectin®/Quest® (moxidectin)	2.5	(0.9)	32.9	(2.1)
Valbazen® (albendazole), Synanthic® (oxfendazole), or Benzimidazole	61.5	(2.5)	69.1	(2.1)
Rumatel® (morantel) or Strongid® (pyrantel)	0.5	(0.4)	1.6	(0.6)
Levasole®/Tramisol® (levamisole)	30.8	(2.2)	20.3	(1.8)

L. Shearing Practices

Changes in the sheep industry in the late 1900s included reduced wool marketing entities and related infrastructure, which resulted in difficult marketing schemes with fewer domestic wool buyers, distance-to-market challenges, and fewer selling systems. A worldwide shortage of shearers magnified problems for sheep producers and limited their ability to increase sheep numbers. A combination of low wool prices and the difficulty of finding shearers have sometimes made producing wool a liability. Possibly in response to this situation, producers have focused on raising hair sheep (table A.1.a), which do not need to be sheared.

1. Shearing management

The wool issues discussed above are reflected in the lower percentage of operations that sheared sheep and lambs in 2011 than in 2001 (80.2 and 90.4 percent of operations, respectively).

L.1.a. Percentage of operations that sheared sheep and lambs during the previous year, by study and by primary flock type:

Study	Percent Operations							
	Primary Flock Type							
	Herded/ open range		Fenced range		Farm/ pasture		All operations	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Sheep 2001	93.4	(5.5)	85.4	(3.9)	91.2	(1.2)	90.4	(1.1)
Sheep 2011	89.8	(4.4)	73.8	(2.1)	82.0	(1.2)	80.2	(0.9)

While a lower percentage of operations in 2011 used a hired individual to shear sheep compared with operations in 2001 (50.9 and 65.3 percent, respectively), hiring individual shearers is still the most common method for shearing sheep. A higher percentage of operations in 2011 used contracted shearing crews to shear sheep compared with operations in 2001.

L.1.b. For operations that sheared sheep or lambs during the previous year, percentage of operations by type of shearer and by study:

Shearer	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Employees (including owner)	21.2	(1.4)	26.2	(1.2)
Contracted shearing crew	15.1	(0.9)	29.2	(1.0)
Hired individual	65.3	(1.6)	50.9	(1.3)
Other	3.2	(0.7)	1.7	(0.4)

Disinfecting shears between individual sheep can reduce the likelihood of transmitting disease from one sheep to another. One disease in particular (caseous lymphadenitis) is likely to be transmitted from sheep to sheep when skin is broken or cut by contaminated shearing equipment. Shears should always be disinfected between flocks and, ideally, should be disinfected between each individual sheep sheared. From 2001 to 2011, no change occurred in the percentage of operations that disinfected shears between individual sheep.

L.1.c. For operations that sheared sheep or lambs during the previous year, percentage of operations by frequency shears were disinfected between individual sheep, and by study:

Frequency	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Always	5.2	(0.8)	8.4	(0.8)
Sometimes	11.5	(1.1)	15.3	(1.0)
Never	59.7	(1.7)	54.0	(1.3)
Don't Know	23.6	(1.5)	22.2	(1.1)
Total	100.0		100.0	

Shearing sheep in order from the youngest to the oldest is one method of reducing the risk of transmitting disease between sheep. There was no difference in shearing order from 2001 to 2011.

L.1.d. For operations that sheared sheep or lambs during the previous year, percentage of operations by shearing practice and by study:

Shearing practice	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
From youngest to oldest	2.3	(1.4)	3.8	(0.5)
From oldest to youngest	4.1	(0.9)	4.5	(0.5)
In no particular order	93.1	(1.6)	91.6	(0.7)
Based on time on feed	0.5	(0.7)	NA	
Total	100.0		100.0	

2. Wool management and marketing

Wool is easily stored, so some operations bag and store their wool until market conditions improve. Some operations—especially smaller ones—have developed niche markets and sell their wool to hand spinners and weavers.

The percentage of operations that stored wool in bags increased from 38.4 percent of operations in 2001 to 48.8 percent in 2011. Nearly three times the percentage of operations had their wool analyzed by a laboratory in 2011 than in 2001 (11.3 and 3.8 percent, respectively). A lower percentage of operations gave wool away in 2011 than in 2001.

L.2.a. For operations that sheared lambs or sheep during the previous year, percentage of operations by wool management method used and by study:

Wool management method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Analyzed by a laboratory	3.8	(0.4)	11.3	(0.6)
Sold on a clean basis	10.8	(1.0)	14.6	(0.8)
Sold on a greasy basis	44.2	(1.6)	61.5	(1.3)
Given away	19.9	(1.5)	14.4	(1.0)
Spun (on this operation or elsewhere)	7.9	(1.0)	9.0	(0.8)
Used for animal bedding	2.3	(0.5)	3.3	(0.5)
Used for mulch	3.8	(0.7)	5.8	(0.6)
Used for insulation	1.1	(0.4)	3.2	(0.5)
Stored in bags	38.4	(1.6)	48.8	(1.3)
Thrown away	21.6	(1.5)	18.9	(1.0)
Other	4.4	(0.7)	3.3	(0.5)

The primary methods for marketing wool were similar in 2001 and 2011.

L.2.b. For operations that sold any wool during the previous year, percentage of operations by primary method used to market wool and by study:

Primary wool marketing method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Cooperative pools	28.3	(1.9)	33.8	(1.4)
Direct sales	43.6	(2.1)	40.0	(1.4)
Warehouses	21.1	(1.6)	22.7	(1.1)
Other	7.0	(1.2)	3.5	(0.6)

M. Pasture Management, Water Sources, and Feeding Practices

1. Grazing

The Bureau of Land Management and the U.S. Forest Service manage grazing on public lands with the objective of maximizing public land health and productivity. Public land grazing permits and leases are given to livestock owners for a fee once they meet certain requirements. A higher percentage of operations in 2011 grazed sheep on public land and on crop residue compared with operations in 2001.

M.1. Percentage of operations by type of land used for grazing and by study:

Land type	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Public land	2.0	(0.2)	3.9	(0.3)
Grazing association land	0.4	(0.1)	0.8	(0.1)
Leased, private land	32.0	(1.5)	26.3	(1.0)
Harvested fields for grazing/ crop residue or byproducts	8.1	(0.7)	21.1	(0.9)

2. Pasture management

The percentage of operations that alternated sheep grazing and crop or hay production increased from 2001 to 2011; other methods of pasturing did not change.

M.2.a. Percentage of operations that grazed sheep on pasture, by pasturing method used during the previous year, and by study:

Pasturing method	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Alternated grazing sheep and other domestic species, such as cattle or horses	28.0	(2.1)	28.4	(1.9)
Commingled cattle or horses with ewe/lamb pairs	28.6	(2.1)	28.0	(1.8)
Alternated grazing sheep and crop or hay production	31.7	(2.1)	43.6	(2.1)

M.2.b. Percentage of operations that used pasture rotation during the previous year, by study:

Percent Operations			
Sheep 2001		Sheep 2011	
Percent	Std. error	Percent	Std. error
67.8	(2.4)	69.8	(2.0)

M.2.c. For operations that used pasture rotation, percentage of operations by length of time (in days) pasture was allowed to rest between sheep grazing, and by study:

Percent Operations				
Days pasture rested	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
0–21	31.4	(2.7)	34.8	(2.5)
22–63	53.6	(2.9)	55.2	(2.6)
64 or more	15.0	(1.8)	10.0	(1.4)

M.2.d. Percentage of operations that placed harvested or commercial feed directly on the ground for sheep to eat during the previous year:

Percent Operations			
Sheep 2001		Sheep 2011	
Percent	Std. error	Percent	Std. error
55.5	(2.4)	51.4	(2.2)

3. Water sources

The percentage of operations that used a bucket with a rim less than 2 feet off the ground to water their sheep decreased from 2001 to 2011, but the use of a bucket with a rim 2 feet or more off the ground increased during the same period in winter and summer.

M.3.a. Percentage of operations in which the flock typically had access to the following water sources during winter and summer, by study:

Water source	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Winter				
Pond/lake/reservoir (or other standing water)	17.5	(1.5)	23.4	(1.8)
Stream (or other running water)	26.9	(2.0)	28.7	(1.9)
Bucket, trough, or waterer where rim was less than 2 ft off the ground	86.5	(1.4)	76.1	(1.8)
Bucket, trough, or waterer where rim was 2 ft or more off the ground	18.6	(1.8)	38.0	(2.1)
Other	6.2	(0.9)	4.2	(0.7)
Summer				
Pond/lake/reservoir (or other standing water)	33.6	(2.2)	38.1	(2.0)
Stream (or other running water)	41.5	(2.3)	40.8	(2.1)
Bucket, trough, or waterer where rim was less than 2 ft off the ground	80.1	(1.7)	72.6	(1.9)
Bucket, trough, or waterer where rim was 2 ft or more off the ground	17.5	(1.8)	35.1	(2.1)
Other	5.1	(1.1)	1.2	(0.5)

The percentage of operations in which the primary water source for sheep was a bucket with a rim less than 2 feet off the ground decreased from 2001 to 2011, but the percentage of operations in which the primary water source was a bucket with a rim 2 feet or more off the ground increased during the same period in winter and summer.

M.3.b. Percentage of operations by **primary** water source during winter and summer:

Primary water source	Percent Operations			
	Sheep 2001		Sheep 2011	
	Percent	Std. error	Percent	Std. error
Winter				
Pond/lake/reservoir (or other standing water)	3.9	(0.8)	3.1	(0.8)
Stream (or other running water)	8.5	(1.1)	8.8	(1.2)
Bucket, trough, or waterer where rim was less than 2 ft off the ground	70.2	(2.0)	55.8	(2.1)
Bucket, trough, or waterer where rim was 2 ft or more off the ground	10.3	(1.3)	22.6	(1.8)
Multiple water sources used equally	3.6	(0.7)	5.8	(1.0)
Other	3.5	(0.7)	4.0	(0.7)
Total	100.0		100.0	
Summer				
Pond/lake/reservoir (or other standing water)	10.2	(1.2)	8.9	(1.1)
Stream (or other running water)	17.5	(1.7)	13.9	(1.4)
Bucket, trough, or waterer where rim was less than 2 ft off the ground	56.1	(2.3)	48.5	(2.1)
Bucket, trough, or waterer where rim was 2 ft or more off the ground	7.6	(1.2)	19.4	(1.7)
Multiple water sources used equally	7.2	(1.3)	7.9	(1.1)
Other	1.4	(0.6)	1.4	(0.5)
Total	100.0		100.0	

Appendix I: Breed Categories

Breed categories	Breed examples
Black-faced wool breeds	Suffolk, Hampshire, Oxford, Clun Forest, Scottish Blackfaced, Shropshire
White-faced fine wool	American Cormo, Booroola Merino, Debouillet, Rambouillet, Delaine Merino,
White-faced medium wool	Cheviot, Columbia, Corriedale, Finnsheep, Montadale, North Country Cheviot, Panama, Southdown, Targhee
Long wool	Border Leicester, Coopworth, Cotswold, Lincoln, Romney, Wensleydale
Colored wool	Black Welsh Mountain, California Red, Icelandic, Jacob, Navajo-Churro, Shetland
Hair	Barbados Blackbelly, Dorper, Katahdin, St. Croix,
Milk	East Friesian, Rideau Arcott, Lacaune

Appendix II: Sample Profile

A. Responding Operations— Sheep 1996

1. Number of responding operations by region:

Region	Number operations
East North Central	844
East South Central	139
Mountain	862
Northeast	510
Southeast	328
West Coast	597
West North Central	1,440
West South Central	454
Total	5,174

2. Number of responding operations by number of ewes present on January 1, 1996:

Number ewes	Number Operations							
	West Coast	Mountain	West North Central	West South Central	East North Central	East South Central	North-east	South-east
0	120	139	335	111	176	26	99	66
1–49	241	244	512	77	440	75	302	159
50–99	84	92	271	51	145	18	58	69
100–499	99	193	269	94	77	19	46	30
500 or more	47	191	38	119	5	0	4	1
Total	597	862	1,440	454	844	139	510	328

Regions:

West Coast: California, Oregon, Washington

Mountain: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming

West North Central: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota

West South Central: Oklahoma, Texas

East North Central: Illinois, Indiana, Michigan, Ohio, Wisconsin

East South Central: Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Tennessee

Northeast: Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont

Southeast: Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia

3. Number of responding operations by total sheep inventory present on January 1, 1996:

Number Operations								
Region								
Number sheep	West Coast	Mountain	West North Central	West South Central	East North Central	East South Central	North-east	South-east
Fewer than 50	337	340	725	173	545	88	369	199
50-99	78	95	267	25	157	27	69	70
100-499	122	212	354	108	128	24	64	50
500-999	22	63	53	63	10	0	6	5
1,000 or more	38	152	41	85	4	0	2	2
Not reported	0	0	0	0	0	0	0	2
Total	597	862	1,440	454	844	139	510	328

**B. Responding Operations—
Sheep 2001**

1. Number of responding operations by flock size

	Phase I: general sheep management report		Phase II: VMO initial visit
Flock size (number of sheep)	Number of responding operations	Flock size (number of ewes)	Number of responding operations
1–24	448	Fewer than 100	536
25–99	956	100–499	368
100–999	1,370	500 or more	197
1,000 or more	436	Total	1,101
Total	3,210		

2. Number of responding operations by region

Region	Number Operations	
	Phase I: general sheep management report	Phase II: VMO initial visit
Pacific	416	168
West Central	1,335	436
Central	1,048	340
Eastern	411	157
Total	3,210	1,101

**C. Responding Operations—
Sheep 2011**

1. Number of responding operations by herd size

	Phase Ia: general sheep management questionnaire—fewer than 19 ewes	Phase Ib: general sheep management questionnaire —20 or more ewes	Phase II: VS initial visit questionnaire
Herd size (number of ewes)	Number of responding operations		
1 to 19	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—1 to 19 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 III: Response Rates

A. Sheep 2001

1. Phase I

Response category	Number operations	Percent operations
No sheep on January 1, 2001	468	9.2
Out of business*	159	3.1
Refusal	870	17.1
Survey complete and VMO consent	1,775	34.9
Survey complete, refused VMO consent	993	19.6
Survey complete, ineligible for VMO	442	8.7
Out of scope (prison, research farm, etc.)	51	1.0
Inaccessible	322	6.4
Total	5,080	100.0

*Operations that sold land and/or sheep and had no intention of returning to sheep business.

2. Phase II—20 or more ewes

Response category	Number operations	Percent operations
Survey completed	1,101	62.0
Producer not contacted	149	8.3
Poor time of year or no time	189	11.0
Did not want anyone on operation	6	0.3
Bad experience with government veterinarians	7	0.3
Did not want to do another survey or divulge information	131	7.4
Told NASS they did not want to be contacted	7	0.3
Ineligible (no sheep)	32	1.8
Other reason	40	2.2
Unable to contact	113	6.4
Total	1,775	100.0

B. Sheep 2011**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 completed the questionnaire.

Response category	Number operations	Percent operations	Measurement Parameter		
			Contacts	Usable ¹	Complete ²
Refused GSM questionnaire/ inaccessible	298	21.6	x ³		
Ineligible (no sheep or lambs on January 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 ⁴				60.6	60.6

¹Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).

²Survey complete operation—respondent provided answers to all or nearly all questions.

³The number of operations that refused versus those that were not contacted was not tracked.

⁴Weighted response—the rate was calculated using the initial selection weights.

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

A total of 3,539 operations were selected for the survey. 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.

Response category	Number operations	Percent operations	Measurement Parameter		
			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	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

¹Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).

²Survey complete operation—respondent provided answers to all or nearly all questions.

³Weighted 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 (61.4 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 1,241 operations were not contacted, and 1.0 percent were ineligible because they had no sheep at the time they were contacted by the VMO during Phase II of the study.

Response category	Number operations	Percent operations	Measurement parameter		
			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

¹Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).

²Survey complete operation—respondent provided answers to all or nearly all questions.

³Ineligible—no ewes at time of interview, which occurred from January 1 through February 11, 2011.

⁴Weighted response—the rate was calculated using the initial selection weights.

Appendix IV: 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	Farms with 20 or more head pct. of total	Farms with 1 or more head	Farms with 20 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, 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	6,975	(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	137,602	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**

		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	6,975	(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	137,602	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.

**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 V: 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, September 2013
 - Part IV: Trends in the U.S. Sheep Industry, 1996–2011, March 2014
 - Vaccination Practices on U.S. Sheep Operations, 2011, info sheet, January 2014
 - Sheep and Lamb Losses on U.S. Sheep Operations, 2011, info sheet, December 2013
 - Lambing Management on U.S. Sheep Operations, 2011, info sheet, January 2014
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 2014
 - Parasite Control on U.S. Sheep Operations, 2011, info sheet, expected 2014
 - Producer Disease Awareness, 2011, info sheet, expected 2014
 - Antimicrobial Drug Use on U.S. Sheep Operations, 2011, info sheet, expected 2014
 - Record-keeping Practices on U.S. Sheep Operations, October 2012
3. Estimate the prevalence of gastrointestinal parasites and anthelmintic resistance.
 - Gastrointestinal Parasites and Anthelmintic Resistance, 2011, info sheet, expected 2014

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 2014

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 spring 2014
- Q Fever in Sheep in the United States, 2011, info sheet, expected spring 2014
- *Campylobacter* on U.S. Sheep Operations, 2011, info sheet, expected spring 2014
- *Salmonella* on U.S. Sheep Operations, 2011, info sheet, July 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 spring 2014

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