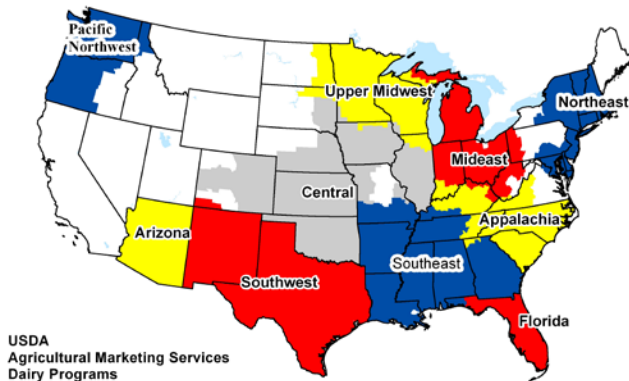


## Determining U.S. Milk Quality Using Bulk-Tank Somatic Cell Counts, 2015

The USDA's Animal and Plant Health Inspection Service's Center for Epidemiology and Animal Health, in conjunction with USDA's Agricultural Marketing Service (AMS) and the National Mastitis Council's Milk Quality Monitoring Committee, monitor U.S. milk quality using data from bulk-tank somatic cell counts (BTSCCs) provided by 4 of the Nation's 10 Federal Milk Marketing Orders (FMOs\*): Upper Midwest, Central, Mideast, and Southwest (figure 1). The remaining six FMOs did not collect BTSCC data.

**Figure 1. Federal Milk Marketing Order areas**



BTSCCs are the number of white blood cells (primarily macrophages and leukocytes), secretory cells, and squamous cells per milliliter of raw milk.<sup>1</sup> BTSCCs are used as measures of milk quality and as indicators of overall udder health. There is an inverse relationship between BTSCCs and cheese yield and the quality/shelf-life of pasteurized fluid milk.<sup>2,3,4</sup> Numerous studies have also shown that operations with increased BTSCCs are more likely to have milk that violates antibiotic residue standards.<sup>5,6,7</sup> The most frequently cited reason for antibiotic residues in milk is placing

cows treated with antibiotics in the milking string before the recommended withdrawal period.<sup>6</sup>

To ensure high-quality dairy products, BTSCCs are monitored in milk shipments using standards outlined in the U.S. Pasteurized Milk Ordinance (PMO).<sup>8</sup> In the United States, the legal maximum BTSCC for Grade A milk shipments is 750,000 cells/mL. If a producer has two out of four shipments that test above the maximum (usually tested 30 to 45 days apart) a written notice is issued and an additional sample is tested within 21 days. If three of the last five counts exceed the maximum, regulatory action is required, which includes

- 1) Suspending the producer's permit,
- 2) Foregoing permit suspension, provided the milk in violation is not sold as Grade A, or
- 3) Imposing a monetary penalty in lieu of permit suspension, provided the milk in violation is not sold or offered for sale as Grade A.

Maximum BTSCC levels for other countries include 400,000 cells/mL in the European Union (EU),<sup>9</sup> Australia, New Zealand,<sup>10</sup> and Canada.<sup>11</sup> The maximum BTSCC level in Brazil is 1,000,000 cells/mL.<sup>12</sup>

Although support for lowering maximum BTSCCs for Grade A milk in the United States to 400,000 cells/mL has increased in the last few years, changes to the PMO have yet to be made. In April 2015, the National Conference on Interstate Milk Shipments did not lower the U.S. limit, even though in January 2012 the EU implemented regulations that require milk products exported to the EU have a maximum BTSCC of 400,000 cells/mL.<sup>13,14</sup> A few States, however, have reduced or are in the process of reducing the BTSCC limit for producers in their States. These States are California, Idaho, Oregon, and Washington.<sup>15</sup>

U.S. producers that have four consecutive rolling 3-month BTSCC geometric means greater than the 400,000-cells/mL limit cannot export milk to the EU unless a derogation<sup>◇</sup> is requested and approved. If the derogation is not approved, the milk supplier must suspend, segregate, or discontinue certification.<sup>14</sup>

\* FMOs are administrative units made up of groups of States and were established under the authority of the Agricultural Marketing Agreement Act of 1937, as amended. Their purpose is to stabilize markets by placing requirements on the handling of milk; data are collected to provide accurate information on milk supplies, utilization,

and sales. Monitored FMOs were Central, Mideast, Southwest, and Upper Midwest.

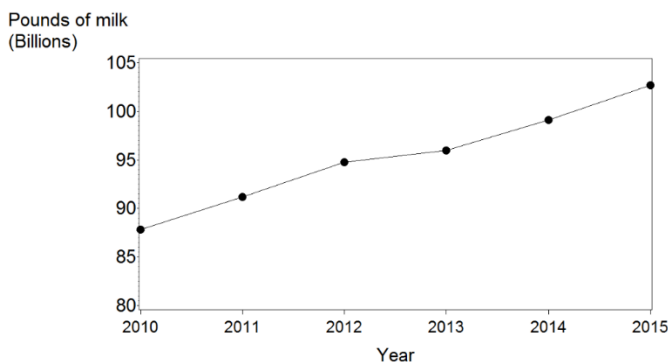
◇ A derogation is a provision in an EU legislative measure that allows for all or part of the legal measure to be applied differently, or not at all, to individuals, groups, or organizations.

The EU also regulates bacterial standard plate counts. For these regulations, a 2-month geometric mean is used based on a minimum of two standard plate counts performed per month. The bacterial limit for the EU is 100,000 cells/mL, which is also the limit for Grade A milk in the United States; however, the United States and the EU calculate compliance differently.<sup>8,14,15</sup>

### Monitored FMOs

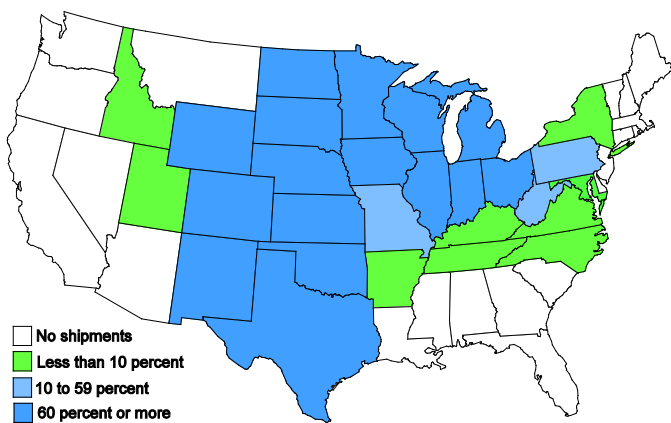
In 2015, milk from the Upper Midwest, Central, Mideast, and Southwest FMOs was monitored. In total, these FMOs monitored milk from 26,931 producers located in 28 States and accounted for 102.7 billion pounds (49.2 percent) of the 208.6 billion pounds of milk produced in the United States in 2015.<sup>16</sup> The pounds of milk monitored by the four FMOs have increased every year since 2010 (figure 2).

**Figure 2. Total pounds of milk shipped through the four monitored FMOs, by year**



Producers in 28 States marketed at least 1 milk shipment through the 4 monitored FMOs during 2015 (figure 3).

**Figure 3. Percentage of total milk production shipped through the four monitored FMOs during 2015, by State**



In 2015, 277,468 milk shipments were monitored (table 1). The Upper Midwest FMO accounted for 46.1 percent of milk monitored by the four FMOs and 22.7 percent of all milk produced in the United States. The Upper Midwest and Mideast FMOs had a higher percentage of shipments relative to the amount of monitored milk. Conversely, in the Central and Southwest FMOs, 12.9 and 2.5 percent of shipments accounted for 16.4 and 17.9 percent of the monitored milk, respectively, reflecting that larger herds supply milk to these two FMOs.

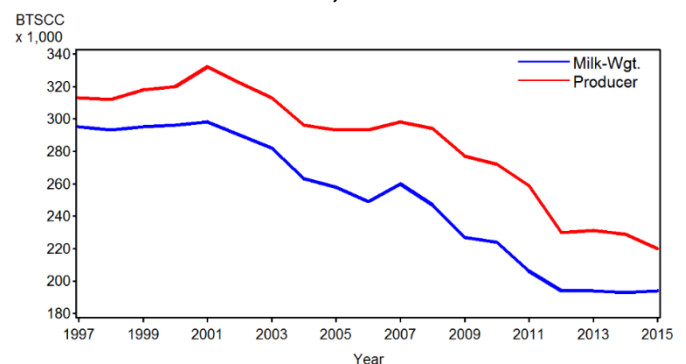
**Table 1. Percentage of milk and shipments marketed through the four monitored FMOs during 2015**

FMO	Billion pounds	Milk		Shipments	
		Pct. monitored	Pct. of U.S. production	Number (x1,000)	Pct.
Upper Midwest	47.3	46.1	22.7	167.3	60.3
Central	16.9	16.4	8.1	35.8	12.9
Mideast	20.1	19.6	9.6	67.5	24.3
Southwest	18.4	17.9	8.8	6.9	2.5
Total	102.7	100.0	49.2	277.5	100.0

### 2015 BTSCC trends

In 2015, the milk-weighted geometric BTSCC mean in the United States was 194,000 cells/mL, essentially unchanged since 2012 (figure 4). Milk-weighted BTSCCs take into account the amount of milk shipped by a producer, resulting in an overall BTSCC mean of monitored milk. The producer shipment BTSCC—which is a geometric, nonmilk-weighted mean of all shipments—was 220,000 cells/mL, lower than the 229,000 cells/mL in 2014.

**Figure 4. Milk-weighted and producer BTSCCs for the four monitored FMOs, 1997–2015**



## Evaluating BTSCC levels

In 2015, over 99 percent of milk and shipments monitored met the current PMO limit of 750,000 cells/mL (table 2). During all months monitored, BTSCCs in 96.0 percent of milk produced was below 400,000 cells/mL; 68.8 percent of producers shipped milk below this limit for the entire year. Of 26,931 producers, 96.6 percent (all but 916) shipped milk with BTSCCs below 750,000 cells/mL during all months monitored.

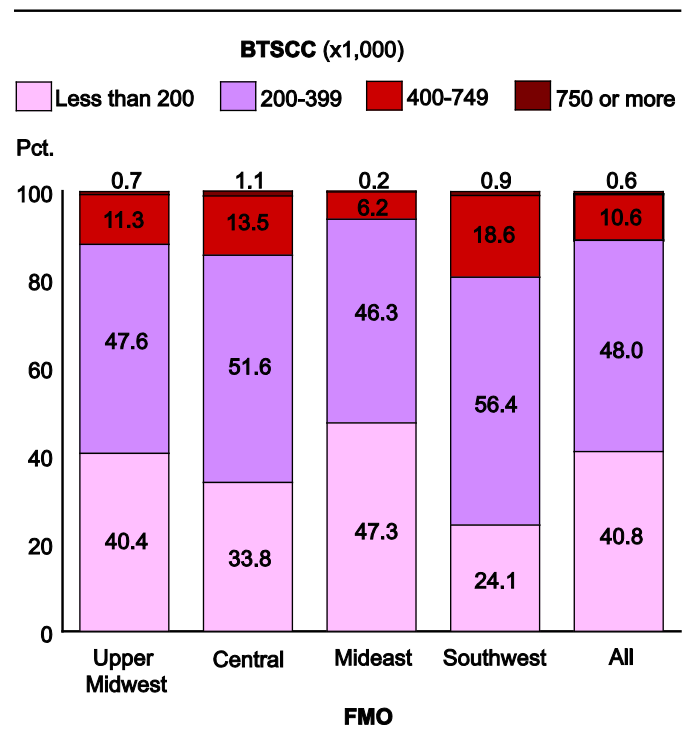
**Table 2. Percentage of milk, shipments, and producers for the four monitored FMOs, by BTSCC level during 2015**

BTSCC (x1,000 cells/mL)	Milk (102.7 billion lb)	Percent	
		Shipments (277,468)	Producers*
Less than 100	5.5	6.3	1.3
Less than 200	52.5	40.8	18.1
Less than 400	96.0	88.8	68.8
Less than 650	99.7	98.7	93.9
Less than 750	99.8	99.4	96.6

\*All shipments for the entire year met criteria.

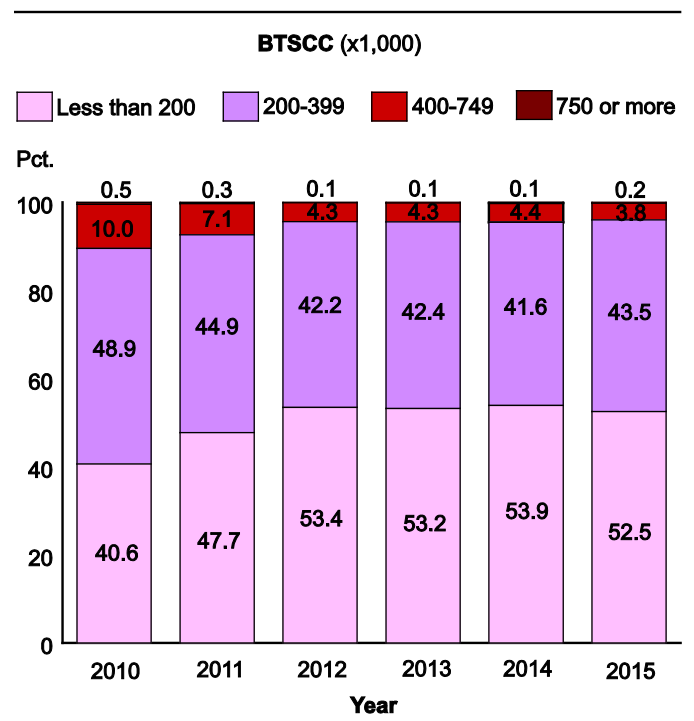
In 2015, about 50 percent of shipments in all monitored FMOs had BTSCCs between 200,000 and 399,000 cells/mL. More than 90 percent of shipments in the Mideast FMO and more than 80 percent of shipments in the other three FMOs were below 400,000 cells/mL (figure 5).

**Figure 5. Percentage of shipments, by FMO and by BTSCC, 2015**



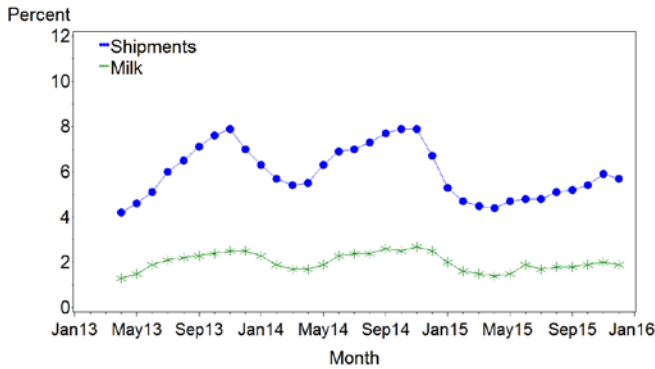
Since 2010, the percentage of total milk shipped with BTSCCs less than 200,000 cells/mL has increased from 40.6 to 52.5 percent (figure 6). The percentage of total milk with counts less than 400,000 cells/mL also increased from 89.5 to 96.0 percent over the 6-year period.

**Figure 6. Percentage of total milk shipped through the four monitored FMOs, by BTSCC and by year**



Criteria for the EU Health Certification Program from USDA-AMS is based on a 3-month geometric mean BTSCC. Shipments for which the 3-month geometric mean is above 400,000 cells/ml for 4 consecutive months are considered to be noncompliant. Less than 6 percent of U.S. shipments and 2 percent of milk would have been noncompliant during 2015 (figure 7).

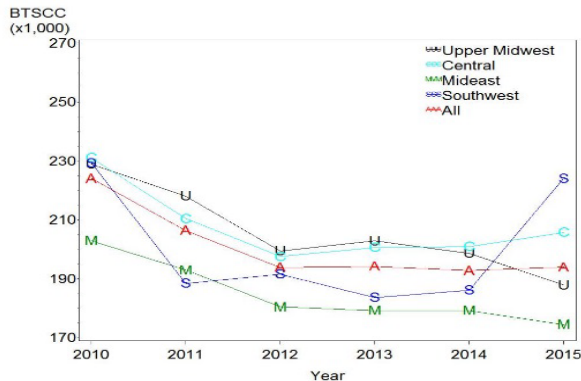
**Figure 7. Percentage of milk and shipments through the four monitored FMOs from 2013 to 2015 that would not have met the EU Health Certification Program's BTSCC criteria, by month**



### FMO and State BTSCC trends

Although overall BTSCCs have decreased since 2010 and plateaued since 2012, BTSCCs for the Central and Southwest FMOs increased in 2015 (figure 8).

**Figure 8. Milk-weighted BTSCCs, by FMO and by year**



Sixteen States marketed 60 percent or more of the milk produced in their States through the monitored FMOs and accounted for 96.8 percent of the monitored milk in the four FMOs (table 3). Wisconsin, Texas, Michigan, Minnesota, and New Mexico accounted for 69.1 percent of all FMO-monitored milk. Compared with 2014, 11 of the 16 States had decreased BTSCCs in 2015; 4 States had increased counts, and 1 State was unchanged.

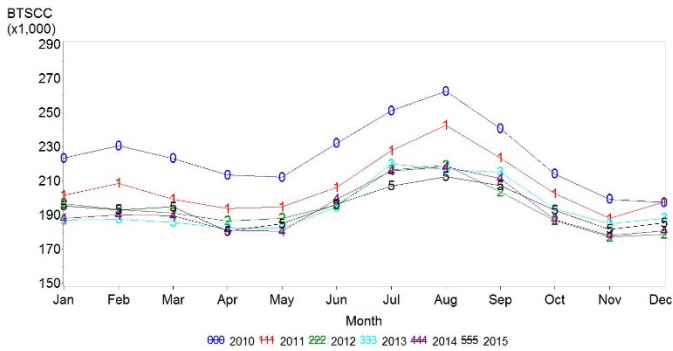
**Table 3. Milk-weighted BTSCCs for States shipping 60 percent or more of their total milk production through the four monitored FMOs**

State	BTSCC (x1,000) by Year						
	Percent total monitored milk—						
		2015	2010	2011	2012	2013	2014
CO	3.6	196	186	168	184	193	189↓
IL	1.6	258	241	214	215	209	205↓
IN	3.1	225	204	197	198	201	200↓
IA	7.1	241	228	206	211	214	204↓
KS	2.1	256	205	204	199	199	212↑
MI	11.2	174	167	156	158	160	156↓
MN	9.4	236	227	205	210	207	196↓
NE	1.6	184	182	182	177	171	171
NM	9.2	207	167	175	166	170	209↑
ND	0.2	271	276	243	237	222	182↓
OH	5.2	226	220	202	198	195	187↓
OK	0.5	334	326	322	288	287	302↑
SD	2.6	248	247	220	226	232	207↓
TX	11.3	253	208	207	199	196	235↑
WI	28.0	230	218	199	202	196	185↓
WY	0.1	139	127	124	143	147	128↓
16 States	96.8	223	206	193	193	192	194↑

### Seasonal BTSCC trends

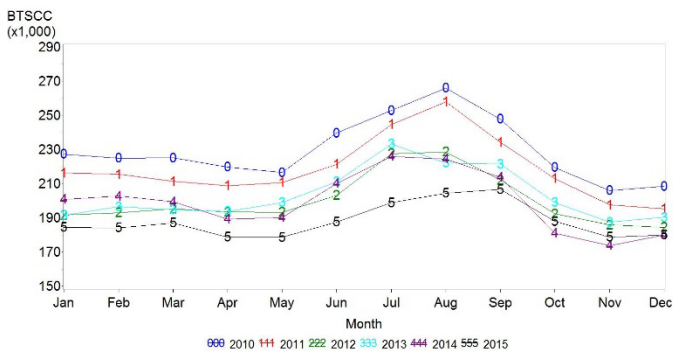
Monthly monitoring continues to show that BTSCCs peak during summer (June through September) when higher temperatures and humidity increase stress on cows and provide conditions more favorable for bacterial growth (figure 9). In 2015, monthly milk-weighted BTSCCs were highest during August (212,000 cells/mL) and lowest in April (180,000 cells/mL).

**Figure 9. Milk-weighted BTSCCs for the four monitored FMOs, by year and by month**

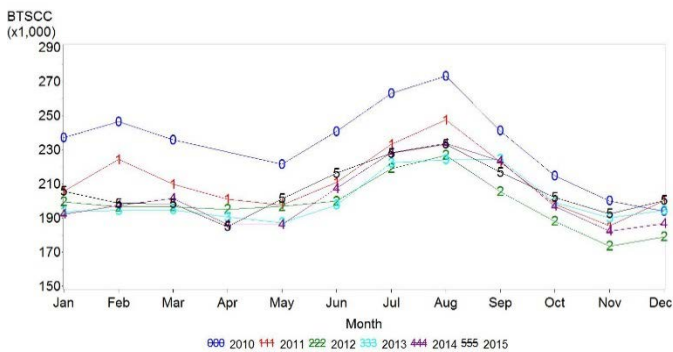


Figures 10 to 13 represent seasonal fluctuations in BTSCCs for each FMO by month and year. Monthly BTSCCs were generally lower in 2015 compared with 2010 through 2014 for the Upper Midwest and Mideast FMOs, but was consistently higher than 2011 through 2014 for the Southwest FMO.

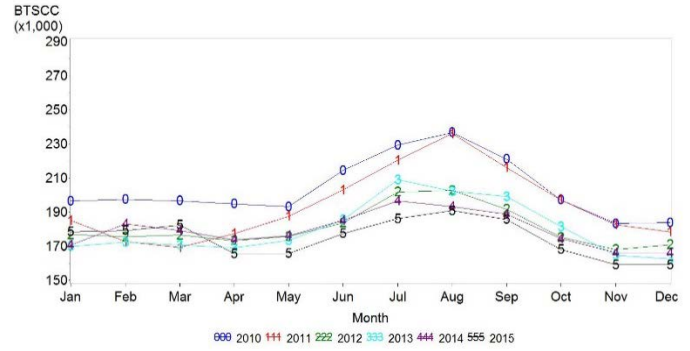
**Figure 10. Upper Midwest Order milk-weighted BTSCCs, by year and by month**



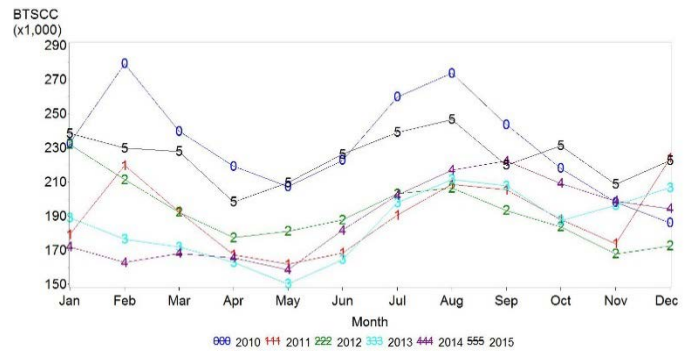
**Figure 11. Central Order milk-weighted BTSCCs, by year and by month**



**Figure 12. Mideast Order milk-weighted BTSCCs, by year and by month**



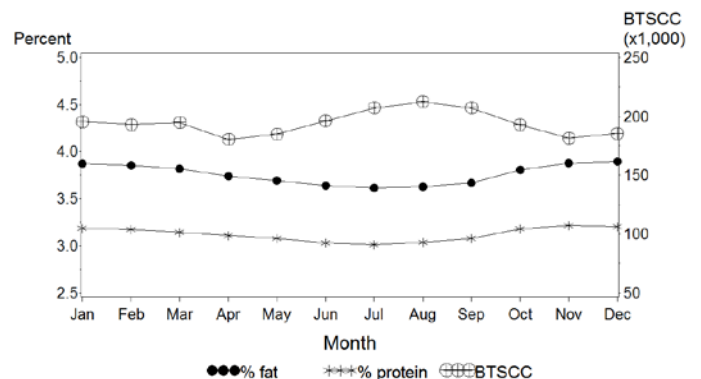
**Figure 13. Southwest Order milk-weighted BTSCCs, by year and by month**



**Fat and Protein**

Whereas BTSCCs peaked during summer in 2015, the percentages of fat and protein in monitored milk were at their lowest values in summer (figure 14).

**Figure 14. Percentage of fat and percentage of protein in monitored milk and BTSCC for the four monitored FMOs during 2015, by month**



## Summary

BTSCCs from monitored FMOs are indicative of the quality of the Nation's milk supply. The milk-weighted mean BTSCC from the four monitored FMOs was 194,000 cells/mL in 2015. Overall BTSCCs have decreased since 2010 and plateaued since 2012. The BTSCCs for two of the four FMOs decreased between 2014 and 2015. Twelve of the 16 States shipping 60 percent or more of their milk through the four FMOs had the same or lower BTSCCs in 2015 compared with 2014. BTSCC increased in the summer months, whereas the percentages of fat and protein in milk decreased. In addition to influencing improvements in U.S. dairy management practices, the current EU import regulations may be partially responsible for the decrease in BTSCCs and the corresponding improvement in milk quality since 2010.

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