

# Annual, biological rhythms govern milk production in dairy cows

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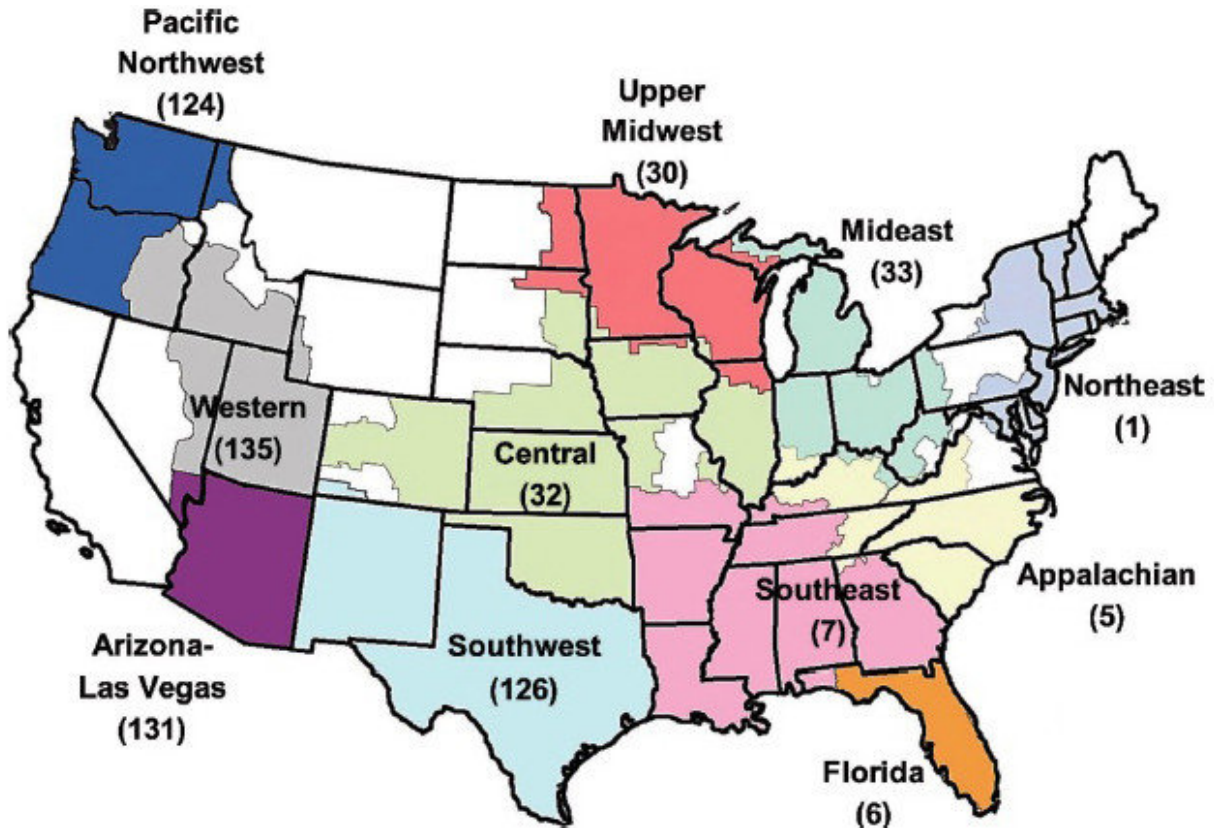
The findings of the study are important because they better inform producers what to expect from their cows, according to researchers in the College of Agricultural Sciences. Being more precisely aware of their cows' rhythms allows dairy farmers to better judge the effectiveness of management strategies. Credit: [Lee Simpson / Flickr](#) / [CC BY-NC-ND 2.0](#)

The amount and composition of milk produced by dairy cows appears to be more regulated by internal, annual biological rhythms than by environmental factors such as heat and humidity, according to Penn State researchers who studied more than a decade of production records from herds across the country.

Although researchers have long recognized an annual pattern of milk composition in dairy cattle—with higher milk fat and protein concentrations observed during the winter and lower levels occurring in the summer—the rhythms of milk yield and composition previously have not been well quantified.

The findings of the research are important because they better inform producers what to expect from their cows, according to Kevin Harvatine, associate professor of nutritional physiology, whose research group in the Penn State College of Agricultural Sciences conducted the study. He noted that being more precisely aware of their cows' rhythms allows dairy farmers to better judge the effectiveness of management strategies.

Researchers employed a statistical method used by scientists in the analysis of biologic time series to demonstrate predictable cycles to reveal the annual rhythms of milk yield and milk fat and protein concentration in two large datasets. They analyzed national milk composition information from 2000 through 2015, obtained from the Agricultural Marketing Service of the U.S. Department of Agriculture, and records collected from 1,684 cows in 11 Pennsylvania dairy herds from 2002 to 2011.



Map of the United States Federal Milk Marketing Orders. Penn State researchers analyzed 15 years of records showing the yield and composition of milk production across the country in their research that revealed the annual rhythm that governs dairy cows' output. Credit: U.S. Department of Agriculture

In general, among all herds studied, peak yield, fat concentration and protein concentration occurred in winter months, when days are shorter, and lowest in summer months, when days are longest. And the amplitude of the rhythms—the amount the highs and lows varied from the mean—were greater in the north and declined depending how far south herds were located.

"On average, milk yield peaked in April, fat and protein yield peaked in

February, fat concentration peaked in January, and protein concentration peaked in December," said lead researcher Isaac Salfer, doctoral student in animal science. "And the yearly rhythms of milk yield and fat and protein concentration consistently occur, regardless of region."

Until recently, dairy producers regarded milk production as governed by seasonal influences, Salfer said. They thought that cows just reacted to their environment and conditions.



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fat and protein yield peaked in February, fat concentration peaked in January, and protein concentration peaked in December. Credit: Issac Salfer / Penn State

"But our research is leading us to believe that cows have predictable changes in their physiology that leads to regular variation in milk production," he said. "It is shifting the way we are thinking about the seasonal changes in milk production from being a response to the environment to actually being a physiological element of the cow."

Better quantification of the annual rhythms shows that fluctuations in milk yield and composition are mainly driven by photoperiod and not strictly by environmental conditions such as heat stress, Salfer pointed out.

"But that remains a hot topic, no pun intended, in the dairy industry," he said.



These findings will keep dairy producers from being misled by seasonal milk fluctuations, seen in milking parlors like this one. This information will allow them to interpret the effects of diet changes or implementation of new technologies on herd performance within the context of the annual rhythm.  
 Credit: Issac Salfer / Penn State

That milk production occurs in rhythms dictated by a physiological response should not be unexpected, Salfer said. Other studies have revealed that milk production of cows is responsive to photoperiod. So, any change in the amount of daylight per day will affect these kinds of rhythms, similar to the way photoperiod changes trigger annual rhythms among wildlife that account for such regular behavior as hibernation, breeding and migration.

The findings, published this month in the *Journal of Dairy Science*, should help prevent dairy producers from being misled by seasonal milk fluctuations, Salfer explained. This information will allow them to interpret the effects of diet changes or implementation of new technologies on herd performance within the context of the annual rhythm.

"For example, 3.6 percent milk fat may indicate suboptimal milk fat in January but normal milk fat in July," he said. "In addition, feeding a dietary supplement in July may appear to improve milk fat percent in the following months, but the increase may be merely a consequence of the annual rhythm of production."

Provided by Pennsylvania State University

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