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Farm and Home Research

South Dakota State University Agricultural  
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## Farm and Home Research: 52-2

Mary Brashier

Lance Nixon

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# Farm & Home RESEARCH

South Dakota State University • College of Agriculture & Mechanical Sciences • Agricultural Experiment Station



*On the trail of the*  
**BIG CATS**

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**South Dakota State University**

Peggy Gordon Elliott *President*

**College of Agriculture & Biological Sciences**

Fred Cholick *Dean*

Kevin Kephart *Associate Dean*

*Director, Agricultural Experiment Station*

Larry Tidemann *Associate Dean*

*Director, Cooperative Extension Service*

Charles McMullen *Associate Dean*

*Acting Director, Academic Programs*

**Farm & Home Research Staff**

Barbara Suhr Hartinger *Executive Editor*

Mary Brashier *Writer*

Lance Nixon *Writer*

Terry Molengraaf *Graphic Designer*

Vergene Clark *Circulation Manager*

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**On the cover:**

Mountain lions appear to be repopulating the Black Hills, and Dorothy Feeske, graduate student in the Department of Wildlife and Fisheries Sciences, is following some of the radio-collared cats to document their travels, foods, and interactions with wildlife and humans.

## Director's comments

BY LARRY TIDEMANN  
Director, South Dakota Cooperative Extension Service

### Science on-site

Director Kephart of the Ag Experiment Station has very kindly asked me to supply the director's comments for this issue of *Farm & Home Research*.

A prominent story in this issue is "Planting questions, harvesting answers." Please pay particular attention to the map that accompanies the story. Isn't one—or more—of those symbols close to where you live?

Be assured that the map could have many, many more circles and squares in all colors, since each one stands for only a kind of research being conducted in a county by Cooperative Extension Service specialists and county educators and not for the number of plots that make up that research.

Those symbols show that SDSU and the College of Agriculture and Biological Sciences have come out into your neighborhood. Research is happening on-site that fits your soils, your weeds, your weather, your local planting systems.

Logical questions arise: Are Extension specialists supposed to be doing research? Isn't that better left to the scientists in the Ag Experiment Station?

And here's my response: Our mix of people is seamless; many research scientists also are Extension specialists. Ultimately that is of greater benefit to you than if we each stuck to our own specialties. Our work in the College is a team effort. The research discovered at the lab bench becomes valuable to producers because it's put out into real locations with specific climatic, environmental, and soil types.

Taking science out into the field and pasture truly fulfills our mission of supporting South Dakota agriculture. But we can't do that alone. We must rely on the other members of our scientific team—farmer-cooperators.

We're not out on their farms in the spring just because it's planting time, even though we enjoy that time of year.



Bob Hall, left, Extension crops specialist, and Larry Tidemann, Cooperative Extension Service director, examine the extent of nodulation on soybeans in a test plot.

We're there because you have expressed needs and asked questions, which often are raised at crop clinics and crop improvement meetings in the winter. In the spring we "plant" those questions in our research and demonstration plots. The "harvest" is our knowledge base for the next winter's meetings and for distribution through newspapers, magazines, publications, radio, and TV.

You don't have to wait for answers; you are welcome to visit the plots at any time. If you missed the summer and fall tours, come anyway; there will be signs that explain what's happening.

Your visits to the plots illustrate what Seamon Knapp, the "father of Extension," believed in: "What a person hears he probably will not believe; what a person sees he may believe. What a person does, he truly believes." When you walk down the rows or ride the hayracks around the plots and compare the plants, you are hearing, seeing, and doing. It becomes easier for you to transfer that knowledge to your own fields.

All this couldn't happen if we didn't have folks willing to volunteer, to let us onto their land and use part of their property for a growing season or more. This is the mark of a truly engaged university—we respond to the needs of producers who provide the plots to harvest knowledge. Engagement is partnering for mutual benefit. It certainly happens here.

We salute our farmer-cooperators for their help—to us and to their community of neighbors. ♦

# The issues in **CARBON SEQUESTRATION**

## **CAN SOUTH DAKOTA FARMERS CASH IN IF CARBON CREDITS ARE OFFERED?**

Gregg Carlson

**M**any of the things that make life comfortable—cars, furnaces, air conditioners, and all sorts of other manufactured products—require large amounts of energy to produce and operate. Most of that energy comes from fossil fuels such as coal and oil. The U.S. economy has developed on abundant and inexpensive fossil energy.

When fossil fuels are burned, greenhouse gases, particularly carbon dioxide (CO<sub>2</sub>) are given off. The U.S. accounts for less than 5% of the world's population and produces over 20% of the world total of carbon emissions generated by human activity.

Before 1850, the level of greenhouse gases in the atmosphere was relatively static. Evidence to support this has been collected from tree rings, pollen records, and air locked into ancient ice.

In recent years, an estimated 6.1 billion tons of carbon are released into the atmosphere each year by the burning of fossil fuels across the globe (Fig 1). This does not seem like much compared to the 55.1 billion tons of carbon that come from decaying vegetation, the 68.3 billion tons from soils through the respiration of roots and soil organisms, or the 112.4 billion tons of carbon from respiration in the Earth's oceans.

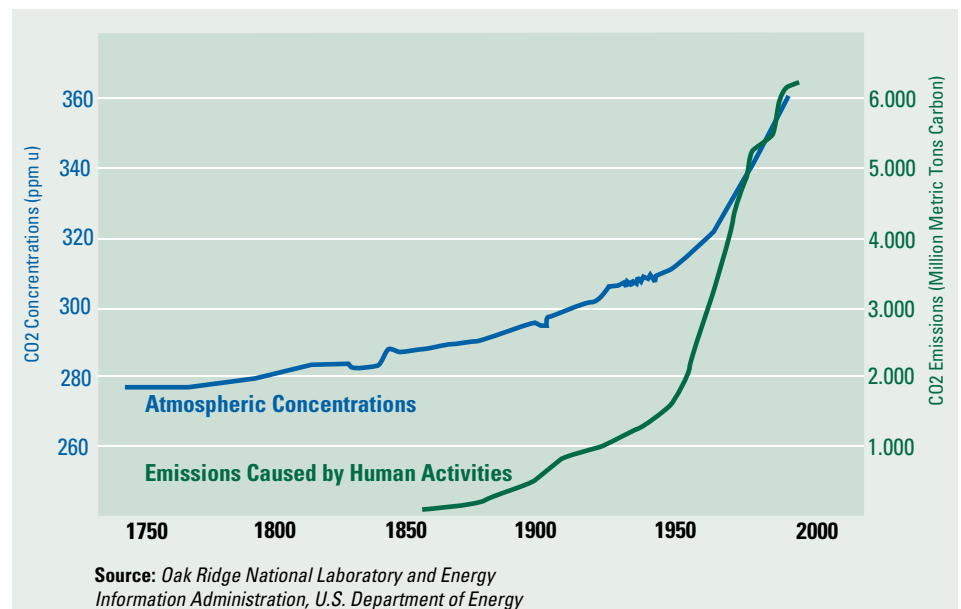


Fig 1. Trends in atmospheric concentrations of CO<sub>2</sub>.

But it is a matter of balance between gains and losses. Even the relatively small amount of carbon burned each year in manufacturing and other human activities is enough to change the natural and long-term relationship of gains and losses between carbon in the atmosphere and carbon tied up in the soil or oceans.

It's like a garden hose and a swimming pool. If the pool is already full, it will overflow even if the hose merely adds a trickle of water.

**W**hile some scientists disagree over the seriousness of global warming, most who are working with atmospheric modeling agree that the computer models that predict global warming are becoming more accurate and believable. Models can predict the science. But when it comes to predicting human behavior, they are not so dependable.

For example:

Computer models cannot predict economic growth in the U.S. and in

the world. Economic growth influences the rate at which greenhouse gases are produced.

Nor can computer models predict the extent of international trading and joint implementation of treaties to lower carbon emissions that have an effect on the rate of greenhouse gas production. International politics also affects the rate of greenhouse gas production and cleanup.

Computer models cannot predict the cost or the efficiency of new technologies, nor can they predict how fast consumers will respond to energy price increases.

The subject of global warming is far more than a scientific debate. It has economic, political, and ethical overtones. There are many unknowns.

**S**outh Dakota farmers can do more to slow global warming than just about anybody else in the country. And what they do benefits themselves as well as others.

One way to reduce the amount of carbon released into the atmosphere is to use the top several feet of the earth surface, the soil profile, to store (sequester) carbon. It is what some farmers already do when they use no-till or low-till methods to improve soil productivity.

Indefinite carbon sequestration in the soil is no permanent solution to global warming. It does, however, buy time—maybe 50 years or so—until technological advances in energy efficiency or renewable sources of energy can come on line.

Until about 1950, farmers did not build up carbon in the soil; they

depleted it. From 1910 to 1920, for example, we lost an average 1,290 lb/acre of carbon per year from fields that were largely in continuous corn or corn in rotations (Fig 2).

About 1950, the curve in the figure began to flatten and the losses and gains of carbon in the profile came into equilibrium. Many Corn Belt farmers were changing their land

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## South Dakota farmers can do more to slow global warming than just about anybody else in the country.

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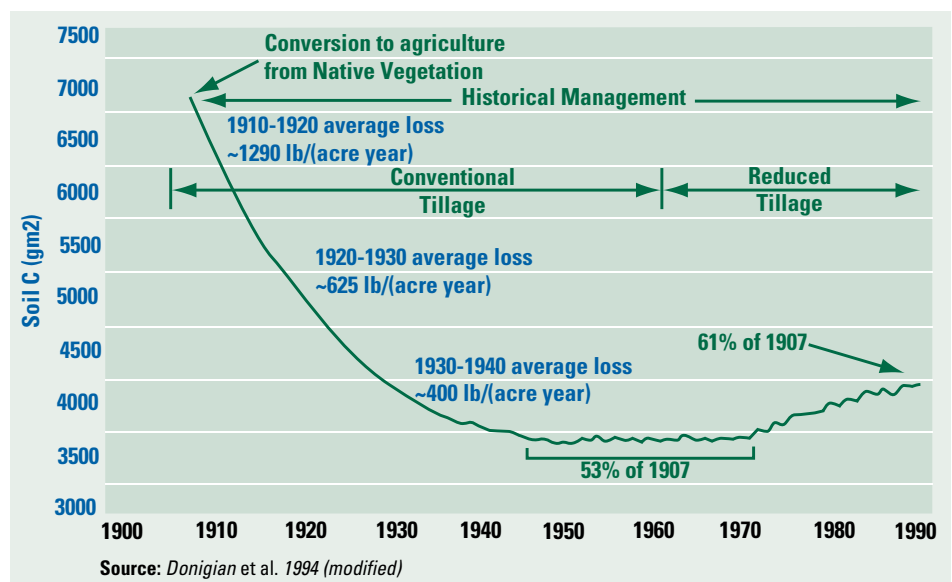
management—reducing tillage, selecting the more productive plant varieties that were becoming available, increasing seeding rates, and using

more fertilizer. Reduced tillage—exposing less decaying plant material to the air and microorganisms—slowed carbon release, and the additional vigorous plant production directed greater amounts of carbon into plants instead of the atmosphere.

Scientific data on the value of no-till farming as a method to sequester carbon is beginning to come in: SDSU scientists reported last year that a more intensive cropping system in South Dakota at 12 no-till cropping sites showed carbon levels increased at rates from 0 to 0.4 ton of carbon/acre/year (0 to 800 lb carbon/acre/year). This range of carbon sequestration rate is similar to that measured by other scientists in the Great Plains.

Another study showed that returning South Dakota cropland to perennial grasslands with fertilization can sequester 500 to 1,000 lb of carbon/acre/year.

Fig 2. Simulated total carbon changes in top 0-7.9 inches of soil from 1907 to 1990 for the central U.S. corn belt.



The research indicates that special circumstances that should accompany no- or reduced-till practices if the primary goal is to sequester carbon. The farming system should produce significant amounts of biomass. The soil profile that will show the best results will be one that has been mined by at least 20 to 50 years of conventional tillage.

Another option is to put cultivated land into perennial grasses and to fertilize for optimum use of precipitation. There is evidence, for example, that soil organic carbon has doubled in the top 7 inches of grass-covered CRP soils since the program went into effect. While South Dakota is not destined to become a permanent grassy carbon sink, where appropriate and where soil productivity needs to be enhanced, farmers know this is a good management choice, whether or not they are also seeking carbon credits.

**T**he Kyoto Protocol to the Framework Convention on Climate Change, negotiated by more than 160 nations in 1997, set the stage for reduction of emissions of six major greenhouse gases into the atmosphere. Today, however, there still is no agreement on how to carry out the charge, specifically to globally reduce emissions to 94.8% of 1990 levels by 2010.

As one of the 38 industrialized nations, the U.S. target was to reduce emissions to 93% of 1990 levels. If, however, the U.S. continues to conduct “business as usual,” emissions will be 33% above 1990 levels by 2010. The U.S. has not approved the treaty, and President G.W. Bush has rejected it.

The Kyoto mechanism allows carbon credit trading among industrial countries. What is important to South Dakota is that, while credit may be offered for other actions that take carbon out of the atmosphere (reforestation, for example), no specific approval and no credits are offered for carbon sequestration in the soil. Scientists are meeting to offer solutions for these difficulties.

A significant obstacle is the absence of a quick, reliable, and inexpensive monitoring system to establish just how much carbon is stored in the soil by agricultural practices and, therefore, how many credits the farmer could claim. In the long run, this problem is not insurmountable.

Without waiting for such answers, however, manufacturers and companies from other countries have started buying carbon credit options from farmers in the Midwest, particularly Iowa. These companies hope to offset their own greenhouse emissions and meet environmental regulations in the Kyoto Protocol by paying farmers to sequester carbon in the soil. It is to the advantage of these companies to lock in lower prices should an active market in carbon credits evolve.

The U.S. and international markets deal in metric tons (1 metric ton = 2,204.6 lb). These are the most common quotes you will see, so be prepared to make a conversion if you feel more comfortable with a 2,000-lb ton.

There probably are lower and upper limits on the value of sequestered carbon. A price below \$3/metric ton is probably not worth the effort for the farmer. The ultimate upper limit appears to be \$100/metric ton; this is the point at which companies offering to buy carbon credits might look for cheaper sources.

Preliminary estimates by Iowa State University put the value of carbon credits between \$14 and \$23/metric ton. A value of \$20/metric ton is considered by some to be a reasonable price.

Table 1 shows estimates of the annual values per acre of sequestered carbon. It is clear that the value of sequestered carbon changes appreciably depending upon the market value of the credit. At this date, there is no wide acceptance about the monetary value of sequestered carbon, outside of its obvious soil-building and productivity-enhancing ability.

Table 1. Gross return/acre for carbon sequestering.

Pounds sequestered/year	Value of carbon sequestered		
	\$3/metric ton*	\$20/metric ton	\$100/metric ton
160 pounds/year	\$0.21/acre/year	\$1.45/acre/year	\$7.26/acre/year
750 pounds/year	\$1.02/acre/year	\$6.81/acre/year	\$34.03/acre/year
2000 pounds/year	\$2.72/acre/year	\$18.15/acre/year	\$90.74/acre/year

\*1 metric ton = 2,204.6 pounds

More questions need to be answered before farmers lock themselves in to a specific contract:

How long will farmers be obligated to store the carbon, once sequestered?

Is this a contract that is tied to the land forever and through future owners?

If a no-till farmer is paid for carbon sequestration credits and chooses to change to a tillage farming system, will his new management be subject to a carbon release tax (fuel and tilled land)?

Who keeps track of the credits?

Can grasslands be managed to support livestock or biomass production and still sequester carbon?

**C**arbon sequestration is more than a scientific debate. There are many unknowns, and scientists at SDSU will continue to conduct research to provide answers to the scientific questions. It is up to the public—consumers, farmers, and ranchers—to use objective, unbiased information in assessing the value of varying political positions and ethical dilemmas and in resolving the issue of carbon sequestration and global warming. ♦

*Gregg Carlson is an Extension specialist in the SDSU Plant Science Department. With David Clay, Doug Malo, and Tom Schumacher, also plant scientists at SDSU, he has written a publication, Issues in Carbon Sequestration (ABS 5-01), with greater discussion of global warming and carbon credits. Ask for it at your county Extension office or read it on the web at [agbiopubs.sdstate.edu](http://agbiopubs.sdstate.edu)*

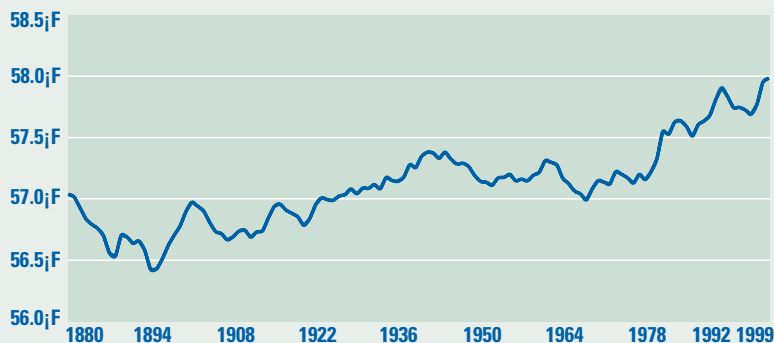
## What are greenhouse gases?

Greenhouse gases are part of an invisible blanket of gases that wraps around our planet high in the atmosphere. The greenhouse effect is a natural phenomenon that for thousands of years has helped regulate the temperature of the planet.

Energy from the sun heats the earth's surface. Some of this heat energy radiates back into space. Greenhouse gases trap some of this outgoing energy and return it to earth, moderating our climate and weather.

If all greenhouse gases (water vapor, CO<sub>2</sub>, methane, nitrous oxide, ozone, and smaller amounts of other gases) were to suddenly disappear, our planet would be colder and most likely uninhabitable. On the other hand, since the beginning of the Industrial Age (roughly 1850), the blanket of greenhouse gases appears to be growing thicker, trapping ever more heat energy (Fig 1).

**Fig 1. Global average temperatures\***



Source: NASA's Goddard Institute for Space Studies and U.S. Environmental Protection Agency, EPA 430-F-00-011

5-year surface annual mean

Atmospheric concentrations of the greenhouse gases CO<sub>2</sub>, methane, nitrous oxide, and some others have increased by 10 to 25% since the start of the Industrial Age. The preponderance of scientific evidence indicates that these gases have changed our climate.

Global mean surface air temperatures have risen between 0.5 and 1.1 degrees F since the late 19th century. Several of the computer models most respected by scientists indicate temperatures may rise an additional 1.8 to 6.3 degrees F by year 2100. Records show that the 10 warmest years on the planet have occurred since 1983, 7 of them since 1990.

These changes in temperatures seem so gradual as to pass unnoticed. However, scientists predict that the consequences of continued warming are rising sea levels that could flood islands and coastal communities, more extreme floods and droughts, and geographic shifts in agricultural production throughout the world. Over the planet, sea level has already risen 4 to 10 inches in the past century.

Most of the U.S. is expected to warm. Some parts will become wetter, others drier. The economics of farming and ranching may change as certain plants become more dominant in response to drought or higher precipitation.

We can't rule out the effects of more frequent heat waves and higher air pollution on human health. Or the effects on energy costs (heating bills may actually decrease if we experience warmer winters). Or the changes in food costs if farmers and processors need to adapt to changing climate patterns by growing less or shipping farther. Greenhouse gases should be of interest to more than scientists; the public, ultimately, will decide acceptable levels of the gases and the action this country will take.





# BIOSECURITY: better safe than sorry

by Mary Brashier

**W**hen his phone rings, says Bill Epperson, “I don’t expect to hear someone saying, ‘Well, Doc, I think I’m ready to start a biosecurity plan now. How do I begin?’”

Epperson, DVM and Extension veterinarian at SDSU, says the person on the other end of the line is more likely in a panic. “It’ll be, ‘Doc, I’ve got this huge mess on my hands. How do I get out of it?’”

The “mess” will be a livestock disease outbreak and the producer has every reason to worry. Disease can lead to:

- death loss and illness, with treatment costs
- chronic problems with poor production
- inability to sell breeding stock from the herd
- massive culling
- loss of consumer confidence, even if the disease did not affect humans.

After he helps bring a livestock disease problem under control comes the “teachable moment,” Epperson says. He has the ears of an attentive producer anxious not to repeat this crisis. On site and with the help of the producer’s nutritionist and veterinarian, they will plan a biosecurity program specific to the goals, facilities, and management of the individual farmer.

“Biosecurity is simply a program aimed to control livestock diseases,” Epperson says. “It’s the methods you use to keep new diseases off the farm and to decrease the impact of disease already in your herd.”

He estimates that less than a third of beef producers practice biosecurity in any significant form. Swine and poultry producers conduct the highest levels of security.

“Beef producers have been able to get away with it successfully, but my thinking is that we will have to tighten up our act pretty soon now. We’re learning that subclinical diseases—like salmonella, Johne’s disease, listeria, and campylobacter—have a more important impact on production and animal value than we once thought.”

The same is true, he adds, for the common “treatable” diseases like pinkeye, calf scours, and respiratory diseases.

Biosecurity is always part of good farm management, he stressed. “It could be even more important now.”

The reference is to foot-and-mouth disease (FMD). Epperson tags it as the most highly contagious animal disease known. Even though new cases of FMD have slowed down in Britain and to date no cases have appeared in the U.S., it’s no time to become complacent.

“The U.K. is out in front of the disease now because they did a fair amount of control—slaughtering infected and neighboring herds and restricting animal movement. But they can expect flare-ups, sporadic new cases,” he says.

“We are right to stay concerned about FMD in the U.S. In one herd, it could be financially disastrous for the producer. If it spreads, it

could be catastrophic for the animal industry. Obviously it also would have impacts on the entire society.”

But Epperson won’t borrow trouble for now. The best defenses against FMD and other livestock diseases, he says, are common sense and biosecurity.

The cornerstone of biosecurity? “Isolation and observation of new animals before you introduce them to your herd.”

**E**pperson names three components of biosecurity—animals, people, and “things.” Think first of the animals, he says, even the neighbor’s cattle or sheep across the fence who can touch noses with your livestock.

“Ninety percent of the diseases your animals are going to acquire are from other animals. This is the case for disease already in your herd that you are trying to control, as well as for disease you don’t have and want to keep out. And don’t forget that semen and embryos also can be disease carriers.

“What can you do about that? Quarantine, test, and know the source of introduced animals.”

He recommends a minimum 30-day quarantine for new animals coming onto the farm. This gives any acute diseases time to show up. “Twice that is much better. Swine producers routinely use 60 days. Allow absolutely no contact between new animals and those already on the farm. That includes direct contact and contact with contaminated feed, facilities,

water, and your boots and clothes. Do some kind of diagnostic testing on the newcomers for the common diseases and pathogens you might be concerned about, depending on the species of animal."

People coming onto the farm may not be likely carriers of disease, but can track things from one farm to the next. At the very least, Epperson says, "ask them to check in. Do something that suggests to them that they should be clean."

The producer has every right to ask for a shower-in, shower-out procedure, the wearing of disposable boots and coveralls, and other precautions on the part of visitors.

Disinfectants can be pretty simple, he says, equal parts vinegar and water or three parts bleach to two parts water, for example. "These can be effective even against FMD."

"Things" are easily overlooked, Epperson says. "One of the best documented cases we have is of spreading salmonella bacteria in a feedlot with oral bolusing guns that weren't cleaned between uses. They were making sick animals sicker.

"It's always the simple things that trip you up."

He urges that producers buy feeds from reliable sources. "Work with your nutritionist and veterinarian if you have any doubts about the safety of the feedstuffs."

If he had to pick and choose among the components of biosecurity, Epperson would choose animals. "No doubt about it. I'd quarantine and test new arrivals and know who they came from. I'd make sure my home herd was vaccinated. Then I'd control human access and sanitation of things like feeds and tools."

**B**iosecurity doesn't come in a box with the recipe on the side, Epperson stressed. "It's a program that can, and should, be tailored to each operation. It depends on the goals and objectives of each producer and each segment of the industry.

"If one producer has confinement units and his objectives are extremely high health and extremely high performance and he sells seed-stock, he has a different view of biosecurity than does the person who purchases feeder pigs from many sources to finish."

Beef producers are less inclined to implement biosecurity because range and pasture environments are less conducive to rapid disease spread, Epperson says. It's also common for cattle to change hands a number of times.

"That can be risky from the biosecurity standpoint, but so far we see limited problems."

One point Epperson makes is that vaccination is not equal to biosecurity. "A lot of people think that if new arrivals come vaccinated against common diseases, that's enough. That does not preclude new diseases from coming in, and in beef cows, most of the pathogens that cause the common diseases are already in the herd."

On the other hand, if a producer has a well vaccinated herd, it will be less affected by any pathogens, internal or external to the herd, than if things were left to chance.

"Vaccination alone is not enough protection. Unfortunately, it's a common misconception."

**A**s animal health professionals at SDSU learn more about the impacts of subclinical disease, they are beginning to take biosecurity even more seriously.

For example, says Epperson, "subclinical respiratory disease is common in cattle, and these animals are never seen as sick. But results from studies we are doing indicate their performance and meat quality are decreased."

Epperson writes articles on biosecurity, makes one-on-one farm visits, and has conducted seminars and workshops that are aired over the internet. County Extension educators "have caught the bug" from him. "The biggest thing they can do is indicate the need for biosecurity and give the very simple steps that are required in a biosecurity plan."



Even the most minimal precautions—a footbath and rubber boots—should be taken before entering animal housing.

One of those educators is Jeff Lounsbury from Lincoln County.

"There is probably no need to push the panic button," Lounsbury says, "but realize that any time you mix animals, walk in your pens or pastures with soiled or manured boots from another animal source, or allow other individuals on your operation without implementing biosecure measures, you run the risk of introducing disease pathogens."

Epperson agrees and adds these final words. "Controlling common diseases—even the ones that have caught the public's attention—doesn't need a rocket scientist. There are, of course, state and federal regulations that cover movement of suspected disease carriers.

"But biosecurity is our first line of defense. It's just plain common sense and it's easy to implement."

To contact Epperson, call him at 605-688-6589 or e-mail at [William\\_Epperson@sdstate.edu](mailto:William_Epperson@sdstate.edu) ♦

# Planting Questions...



**W**hen soybeans became a crop of choice for producers in the northern James River Valley of South Dakota, farmers such as Steve Masat, rural Redfield, encountered a problem: SDSU's best data about soybean varieties came from the state's traditional soybean territory south and east.

"We're right in the heart of the Jim River Valley where the conditions are a lot different," Masat said.

His questions: What varieties and farming techniques would work best in the ancient lake plain of Spink and Brown counties?

Today, Masat's own fields are growing the answers. Masat is one of the farmer-cooperators throughout South Dakota who work closely with Extension specialists to select the particular crop varieties, herbicides, pesticides, fertilizers, and management techniques that fit the different combinations of South Dakota's climate, soils, and other cropping conditions.

Larry Tidemann, director of the South Dakota Cooperative Extension Service, says that in a sense, Extension specialists and the producers who work with them are planting questions to harvest answers. These answers, he says, are then freely shared at more than 35 field tours attended by some 2,700 producers for whom the demonstration plots are outdoor classrooms.

"It's a prime example of SDSU's land-grant mission in action, of being an engaged university that reaches off

the campus to serve people who depend on agricultural science to help them make a living.

"Extension is the information link between research scientists and the public," he says.

Extension specialists define this work as "applied research" as compared to "basic research." Instead of coming up with a new crop variety, as South Dakota Ag Experiment Station plant scientists do, Extension specialists in the field match those varieties with

# ...Harvesting Answers

*by Lance Nixon*

Extension Weeds Specialist Leon Wrage, facing page, applies herbicide for wild oat in spring wheat in one of 8,000 weed control demonstration plots across South Dakota. Below, Rodney Bade, left, Brown County cooperater, Anthony Bly, research associate in soil fertility, and Gary Erickson, Extension agronomy educator headquartered in Aberdeen, check no-till soybean seeding depth.



conditions in different parts of the state.

Their demonstration plot results and recommendations also are available to producers and the public through winter crop clinics, thousands of free publications, and the Internet, where information is posted at [www.sdstate.org/Academics/CollegeOfAgricultureAndBiologicalSciences/PlantScience/](http://www.sdstate.org/Academics/CollegeOfAgricultureAndBiologicalSciences/PlantScience/)

**M**asat has been cooperating with Extension specialists for close to a decade now and finds the work so important that he's hosted test plots on everything from corn and wheat to sunflowers. He's also allowed weed specialists to set up test plots to evaluate herbicides and management techniques.

"I don't want to sound greedy, but it's a good deal for me. I've got a non-biased test plot in my backyard. It's one more tool that I can use in my operation. And it's something I can share with my neighbors.

"A lot of people can get a lot of information from right here instead of the Experiment Station's farm at Watertown, which is quite a bit different in altitude, or Brookings, which is a ways away, or Beresford, which is farther away yet."

**R**obert Clark, Armour, also makes room in his corn and soybean fields for test plots where the crop is measured, not by bushels, but by knowledge—the knowledge it provides about what varieties and cultural practices to use in south-central South Dakota.

Other SDSU test plots across the state also yield localized information about soil fertility, weed control, insect control, plant diseases, or specific management techniques.

Mike Catanguì, entomologist, says Extension's applied research is, by its nature, "all about profitability," since specialists go to where farmers have specific issues such as insects to deal with.

But Clark adds that not all the research he's watched happen on his farm and elsewhere goes to boost production. Extension specialists provide him information he can use to answer input questions, he says. What's the right amount of fertilizer or herbicide to apply? When does it pay, or not pay, to spray for insects?

## Extension specialists and the producers who work with them are planting questions to harvest answers.

**C**Clark sees test plots "as ways of finding out if there's a positive or negative impact to yield. It shows me if there's a way of increasing yield or minimizing input cost," says Rodney Bade of Northville. Like Clark, Bade points out that either of those alternatives—boosting yield or cutting costs—adds to his profitability.

And the crop trials and weed plots give producers hard, unbiased science about what crop varieties and chemicals perform best for specific parts of South Dakota. "I believe the top-yielding farmers are looking for the best of the best," Bade said.

**T**hese men and other farmer-cooperators have a ringside seat as researchers do their work. That shortens or eliminates the round of trials and errors growers will go through in applying a new technology such as precision or no-till farming.

And the benefits of working with landowners are mutual.

West River Extension Agronomist Clair Stymiest points out that researchers need space and research farms can't provide it all.

Stymiest says he and his West River colleagues are carrying out 38 projects. "If we had to go out and get an ag experiment station large enough to accommodate all those experiments, it would have to be very, very large." In addition, Stymiest says, sometimes the land at an experiment station is subjected to a treatment one year that could affect the results of an experiment the next. That makes it all the more important to depend on cooperators, who can often furnish a setting that meets the needs of a scientist.

"Essentially I guess it's what we call a 'mobile lab' concept," Stymiest said. "You get to work in the same conditions the growers have. It validates your research."

**T**hat works for West River producer Mike Arnoldy of Kennebec. He says the research that Leon Wrage, weed specialist, does on his land is all the more important because it concerns crops and herbicides not common in eastern South Dakota. Arnoldy grows sunflowers, chickpeas, corn, milo, millet, spring wheat, and winter wheat.

"Every time he (Wrage) is out here, I learn something new. That's the reason

I do it, I guess. Herbicides to use on sunflowers is our main issue right now.”

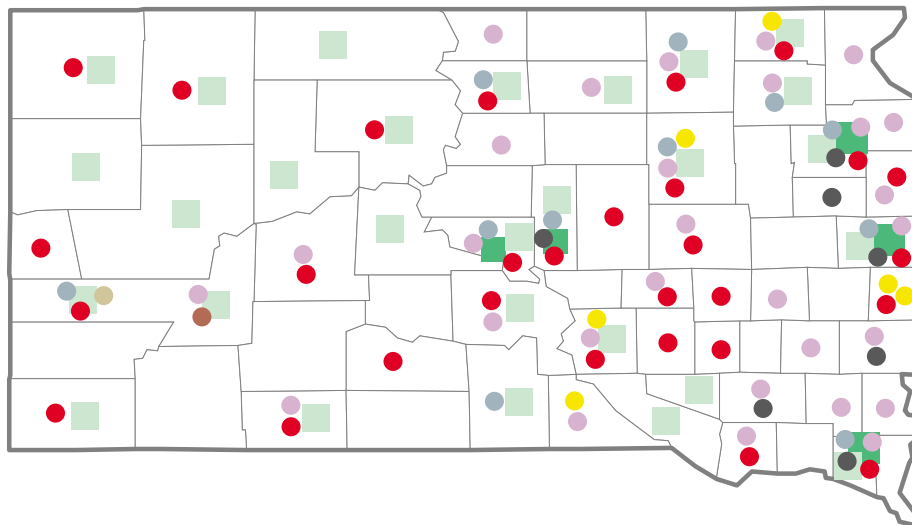
Stymiest adds that in western South Dakota, where cropland is less common, cooperators may be even more important than in eastern South Dakota—and they and their neighbors seem to know it.

“Out here it’s almost an honor for somebody to have SDSU doing research on their land,” Stymiest says, adding that some producers have worked with the state for several decades already, passing that cooperator relationship with SDSU from father to son.

**G**regg Carlson, an Extension precision farming agronomist, says on-farm relationships with cooperators likely will become even more important in the 21st century, as precision farming comes into its own.

Carlson and colleagues Dave Clay and Sharon Clay work closely with producers who are using satellite-assisted global positioning system hardware to monitor yields and fine-tune how they apply nutrients or make other management decisions.

One key difference in precision farming is that evaluation requires an entire field with wide variations in weed problems, soil fertility, and terrain. In contrast, ag experiment farm research needs uniform tracts of land where different applications may be tested side by side. The opportunity to use landowner fields for studies in precision farming adds to the base of knowledge about how yields respond to specific management choices on soils with varying terrain, geography, and history.



- Agricultural Experiment Station farms where plant science research and Extension crop production demonstrations are conducted. All other applied research/demonstration locations are provided by farmer cooperators.
- Biomass energy crop evaluation of former CRP grasslands at six locations.
- Crop performance trials at 58 locations in these counties, 80+ tests, with 1,069 entries x comparisons = 12,000+ plots. Includes alfalfa, barley, corn, chickpea, field pea, flax, oats, proso millet, safflower, soybean, sunflower, winter wheat, spring wheat. Not all crops are tested at all locations.
- Disease control at 32 locations, 17 tests, with 346 treatments x replications = 28,030 plots.
- Insect control at 39 locations, 8 tests, with 83 treatments x replications = 369 plots. Includes 37 sites for corn borer moth flight tracking.
- No-till winter wheat date-of-planting study at one location, with 44 treatments x replications = 176 plots.
- Reduced-tillage crop rotations at one location, with 31 treatments x replications = 124 plots.
- Soil fertility at 11 locations, 26 tests, with 232 treatments x replications = 930 plots.
- Weed control at 47 locations, 190 tests, with 3,800 treatments x replications = 8,800 plots.

“We have not done a tremendously large number of experiments on side hills, on lowlands, or on eroded hilltops,” Carlson says. “The only way we can get a handle on them is to do field-size experiments. And the only way we can do field-size experiments is to work with cooperators who have precision farming equipment.”

Such farmers are pioneers in showing how precision farming can increase profits, Carlson says. He adds that crop commodity groups are interested in the technology and are funding agronomy research at SDSU because of what it could mean to their growers in increased profitability.

**A** quick look at what Extension is doing on several fronts to directly help producers shows the variety of the projects. Some of the work is being done at ag experiment station farms around the state, but much, especially in western South Dakota, relies on private landowners to host trial plots:

**R**otation and tillage studies. Crop rotations that break root disease and weed cycles can increase winter wheat yields and producers’ profits. This is part of the work of Stymiest in his long-term crop rotation studies at Wall.



Checking for sulfur deficiencies are, left to right, Ron Gelderman, SDSU Soil Testing Lab director, Anthony Bly, soil fertility research associate, Jim Gerwing, Extension soils specialist, and Dan Prunty, Hartford area farmer. Upon recommendations from the SDSU team, Prunty added sulfur, left an untreated strip, and increased yield 104% over the control on his treated alfalfa. "Sulfur deficiency is becoming a big issue this year," says Gerwing.

In side-by-side comparisons over four replications and 3 years, his data show that winter wheat in a broadleaf-millet-wheat rotation had a 3-year average of 51 bushels per acre—an average advantage of more than 14 bushels per acre over no-till millet and winter wheat with the same management practices.

"The increased income from the winter wheat, along with the opportunity to produce a broadleaf crop like sunflower in the rotation, increased the net profit of the rotations," said Stymiest.

### **C**rop performance trials.

At 58 locations, more than 80 tests are being done with 1,069 entries and comparisons. This amounts to more than 12,000 test plots.

Bob Hall, crops specialist, says crops entered for testing include both public and private varieties of alfalfa, barley, corn, chickpea, field pea, flax, oats, proso millet, safflower, soybean, sunflower, spring wheat, and winter wheat.

Kathy Grady, oilseeds specialist, conducts trials for flax and for both oil and confectionary sunflowers. Trials for crops specific to western and central South Dakota dryland conditions are conducted out of the West River Ag Center by Stymiest and John Rickertsen, research associate.

Data from crop performance trials suggest that simply using recommended varieties can significantly boost production. Trial data show that the average of the top-yielding varieties is bushels ahead of the test trial average.

By following Extension's variety recommendations, a farmer could potentially reap a 7-bushel advantage for hard red spring wheat; a 21-bushel advantage for oats; 7 bushels for barley; 16 bushels for early-maturity corn; 13 bushels for late-maturity corn; and 5 to 6 bushels for soybeans.

**I**nsect control. Applied research has been proceeding at 39 locations, where eight tests comprise 83 treatments and replications – a total of 369 plots.

It's work as diverse as tracking the flight of corn borer moths to helping farmers deal with alfalfa weevils.

Leroy Smith, Burke farmer, says alfalfa weevils have been a problem in his area for about 20 years. Spraying can cost from about \$3 to \$11 an acre in chemical costs alone. Smith saw the advantage of letting Catangui and his colleagues conduct tests on his land.

"Mike used maybe a half dozen different chemicals for the weevils. Then I visited with him about which one worked best and which one was most economical and how many days' residual there were."

### **P**lant disease control.

Extension specialists have worked at 32 locations, with 17 tests comprising 346 treatments and replications for a total of 28,030 plots.

Marty Draper, plant pathologist, says the tests focus on the particular current or ongoing disease problems producers face. Sunflower head rot caused severe losses to sunflower growers in 1998, so Extension specialists are screening hybrids for reaction to the disease.

Draper is working with commodity groups and farmers to find effective ways to fight scab in wheat or white mold in soybean, also localized problems for growers.

**S**oil fertility. Work has been going on at 11 locations, with 26 tests comprising 232 treatments and replications, for 930 test plots in all.

It's making a difference for producers such as Bob and Roberta Schwartz of rural Aurora. "We just weren't

getting a good crop. We were trying to find out what the imbalance was in the soil," Roberta Schwartz said.

Jim Gerwing, soils specialist, and his colleagues discovered the problem: a potassium deficiency, all but unknown in past decades, that has been showing up more frequently on the eastern fringe of South Dakota in the past 12 years or so.

"It was very beneficial," Schwartz said. "We had to know what to do and why. And now the data is out there for anybody else who wants it."

**W**eed control. Extension's applied research goes on at 47 locations, where 190 tests comprise 3,800 treatments and replications to total 8,800 test plots.

Leon Wrage, weeds specialist, says that his field research is more than evaluating new herbicides.

"It's not really a matter of sorting some product that doesn't work from

those that do," Wrage says. "In this day you just couldn't market something that's ineffective. It's more a situation of fine-tuning to our local conditions."

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—Larry Tidemann  
Cooperative Extension Director

It's also a case of applying known science to new threats as weeds such as waterhemp expand their territory

in South Dakota, Wrage adds. Evaluating biocontrol agents, part of Extension's integrated pest management and weed control program, is coordinated by Darrel Deneke.

**T**he joining of Extension specialists and farmer-cooperators into a problem-solving team is the true mark of an engaged university, Director Tidemann says.

"We measure ourselves against a national model of a superior institution by several criteria: Are we listening and responding to the people of South Dakota? Are we participating with them in joint problem solving? Are we straightforward, can we benefit mutually from our work together?

He finds the answers are "yes."

"These research/demonstration plots and the people who plant the questions, nuture the crop, and harvest the answers truly measure up to the standards of an engaged institution." ♦

Producers help support Extension outreach research-and-demonstration work through taxes and commodity checkoff dollars. In addition to farmer-cooperators and ag industry partners, the agencies and commodity groups that support Extension research demonstration plots include:

**Agricultural Experiment Station**

- Research faculty
- Agronomy Farm, Brookings / Aurora
- Central Research Station, Highmore
- Dakota Lakes Research Farm, Pierre
- Northeast Research Farm, South Shore
- Southeast Research Farm, Beresford

County crop improvement associations

County weed and pest boards and supervisors

Ducks Unlimited

Foundation Seed Stock Division

**National Sunflower Association**

South Dakota Corn Utilization Council

South Dakota Crop Improvement Association

South Dakota Department of Agriculture

South Dakota Department of Game, Fish and Parks

South Dakota Oilseeds Council

South Dakota Soybean Research and Promotion Council

South Dakota Weed and Pest Commission

South Dakota Wheat Commission

SDSU Soil Testing Laboratory

USDA-ARS

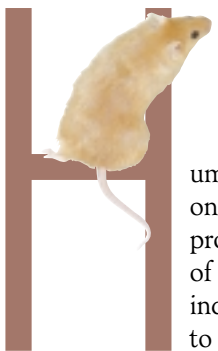
USDA-NRCS





# Gene for lean

by Nancy Grathwohl



**H**umans are not the only ones who have a problem with the battle of the bulge. The swine industry has been trying to produce lean hogs for the past decade.

In that effort to meet consumer demand and increase pork sales, a team of SDSU scientists is concentrating on two genes with strange names—the agouti gene and the agouti-related protein gene. These genes are present in mice and also in humans and the scientists have also found the agouti-related protein gene in swine.

The “yellow mouse” has made history, both here and at a number of other research stations around the world, with the discovery of the agouti gene in its makeup. From the same litter of a special strain, yellow-furred mouse babies grow up to be obese, short-lived, and cancer-prone. Black siblings remain slim and healthy.

In humans, the function of the agouti gene is unknown. The scientists are now characterizing these genes among swine genomes. “We are trying to find forms of the gene that produce lean pigs rather than fat pigs,” says Carl Westby, SDSU microbiologist.

The project is being funded by the South Dakota Agricultural Experiment Station and a separate 3-year grant from the National Institutes of Health. SDSU scientists Nels Granholm in genetics and developmental biology and Don Marshall in livestock breeding are also working with Westby on the project.

**A**nother gene, the leptin, is critical in the laying down of fat in the body. This gene plays a prominent role in the control of appetite, says Granholm.

“The leptin protein acts on certain neurons in the ‘satiety center’ of the hypothalamus. When the leptin protein

is safely attached to receptors on the surface of these neurons, it makes alpha melanocyte stimulating hormone (MSH). The hypothalamus then pours lots of MSH into your system.

“The more MSH, the ‘fuller’ you feel. Your appetite damps down, you stop eating and stay thin.”

Obese genes in mice have been known for years. There are two basic types of leptin mutants, or aberrations from normal, in mice—one where leptin can not be made and the animal is fat, and the other where leptin is made but the receptor is not made and this animal is also fat. They are called the obese mouse (ob/ob) and the diabetic mouse (db/db), Granholm says.

**M**eanwhile, the agouti gene controls pigmentation, the color of the coat. The agouti hair has a black tip, a yellow band and a black shaft. The gene “decides” when the black and yellow pigments will be

synthesized. “In the absence of agouti protein, the mouse grows black hair. Only when agouti protein is present does it get yellow hair,” Granholm says.

Normally, agouti protein shows up only in the hair follicle.

“But in the mutant or yellow mouse, due to an accidental removal of gene parts, agouti protein is expressed in every cell. This is connected to things like yellow fur, obesity, diabetes, and larger body size,” says Granholm.

Among those cells where the excess agouti protein shows up are the neurons in the hypothalamus. The agouti protein, which says “keep eating, you’re still hungry,” and the alpha MSH from the leptin gene, which says “stop eating, you’re full,” are enough alike on their surfaces that they can bind to the same receptors in the hypothalamus. There are just so many receptors to go around. The situation becomes something like musical chairs.

“The yellow mouse makes an excessive amount of agouti protein, and it kicks the alpha MSH off the receptors on the cells in the hypothalamus. All the receptors are occupied by the agouti protein and the animal continues to eat,” says Granholm.

“The MSH caused by the leptin gene doesn’t get a chance to tell the mouse it’s not hungry any more.”

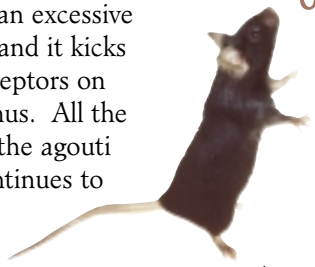
The mice in this project are pampered. They don’t have to hunt for their food or water and they bed down in clean shavings. They are different from wild gray mice mainly in that, when they breed, scientists know that their genomes aren’t altered by infusion of “wild” or unknown genes. Generation to generation, Granholm knows he won’t have any surprises.

He knows something else. In nature, if something works well in one place, it probably can be found in other locations, too. Mouse genes, whether in coddled or wild rodents, can be very similar to those in other animals.

“So we can use mice genes to find out about pigs and cattle. This is that amazing thing called ‘conservation of genetic structure’ in mammals. If the mouse has a given gene, probably pigs, cows, and humans have some variation of that gene,” he says.

“If the mouse has a given gene, probably pigs, cows, and humans have some variation of that gene.”

—Nels Granholm  
SDSU Microbiologist



How the agouti-related protein genes actually work in pigs, cattle, and humans isn’t known, since no studies have been done. Complicating an already complex picture is gene expression: A gene for a specific trait is either switched on (expressed) or off. In the lining of the belly, for example, a gene responsible for digestion will be active while a gene responsible for eye color will be dormant.

But many of these genes can no longer hide from scientific scrutiny. Granholm,

Westby, and Marshall are finding them in the swine genome. They expect there will be differences among breeds of swine in how the genes function. “What we are hoping is that there will be a correlation between specific genes and specific production parameters—rate of gain, milk production, and other economic traits,” Marshall says.

They are examining the agouti-related protein genes of 18 different types of pig DNA from different breeds and breed crosses. “We’ll see if there are any differences in the sequence of genes among these breeds that could serve as a markers leading us to the particular genes we’re interested in,” says Marshall.

If differences are found, then they will look for the causes. “Maybe those differences are correlated with commercially important traits. Then we want to see if the gene might be correlated to appetite suppression, appetite control, or exercise level.”

Such a job is only attempted by scientists today, but Granholm envisions a simple diagnostic test in the future that will allow producers to take hair samples from an animal and get a “read-out” on its genetic makeup.

The scientists hope to identify pigs that have the lean form of the agouti related protein gene. “We could make breeding recommendations to hog farmers and help point them to breeds to use,” says Westby.

And then there’s the chance their work might be extremely valuable to medical science.

“Obesity is a big problem in the U.S. now—a lot of overweight people could probably benefit from the work we are doing,” says Westby.◆



On the trail of the **Big  
Cats**

*by Jerry Leslie*

**A**n SDSU student is on the adventure of a lifetime—chasing mountain lions in the Black Hills of South Dakota.

It's all in the name of science. She is conducting research in fulfillment of a doctorate in biological sciences from SDSU. The study is also a personal fulfillment.

“It is a childhood dream come true to work with large cats,” says Dorothy Fecske, a native of Bethel Park, Pa., now living in Rapid City. She is advised by Jon Jenks, professor in the Department of Wildlife and Fisheries.

Fecske is more than halfway through a 5-year project funded by the South Dakota Department of Game, Fish and Parks (GF&P) that will give the state reliable knowledge to help carry out its Mountain Lion Action Plan. A companion study looks at the American pine marten, a species indicator of forest health.

Mountain lions were placed on the state's list of threatened species in 1978, but since then, sightings of the tawny cat with the long tail have jumped. Because mountain lions can potentially harm humans and because they feed on deer, which in the Black Hills are already declining from habitat modification, the GF&P Division of Wildlife needed an action plan to manage interactions among mountain lions, other wildlife, and humans.

So how many mountain lions can the Black Hills safely hold? As with any other project involving animal populations, Fecske's research started with a sample: she and her crew tracked down and radio-collared 12 of the big cats.

That, exciting as it was, was only the first step in learning about the mountain lion population in the Black Hills. Following the collared cats is the next step, along with maintaining careful records of their movements, food habits, and habitat preferences.

Fecske is determining the amount of area each cat needs and how the animals space themselves relative to each other. The information will be used to determine how many cats can live in the Black Hills. Mapping favored habitats could also assist potential cabin owners in selecting safe vacation sites.

From the territorial and spacing data collected so far, it looks like the Hills are supporting 40 to 50 male and

female cats of breeding age, Fecske says. That's up from a former estimate of 15 to 25.

The difference is that the earlier figures were based on anecdotal evidence from occasional sightings, interviews with landowners, and "best available information." The preliminary population estimates from the current study are based on actual biological data collected systematically over a period of 3 years.

Fecske has learned that graduate work is not "all library and laboratory." It sometimes requires a desire to go into unknown territory and a degree of physical fitness that can stand up under some severe physical punishment. While a daring and resourceful young woman doing the work she loves, Fecske understands this and is not foolhardy. She works with a team—humans and dogs.

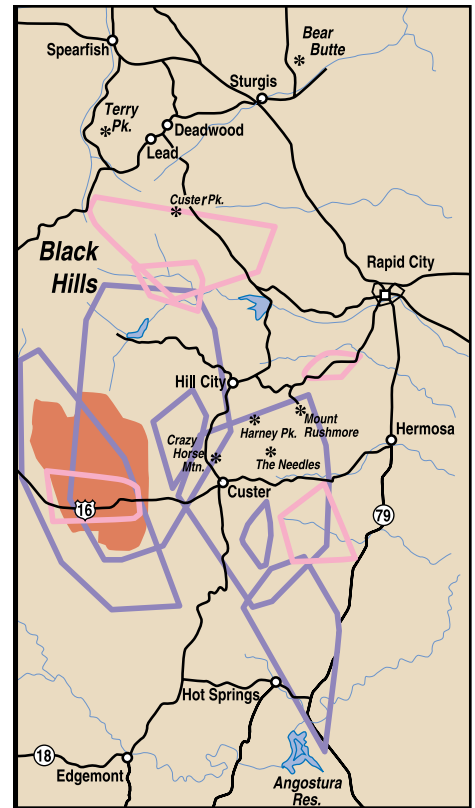
Fecske, her advisor, and the team began in January 1999 in fresh snow and on foot with hounds in search of lion tracks, centering their search on remote areas of the southern and central Black Hills.

When hounds catch the scent of a lion, they are off on a dead run.

"Their tracks nearly always go straight up a mountain and over the most difficult of terrain," Fecske says.

The cat normally trees when it tires, and then comes the tricky part of the hunt. The animal must be immobilized, usually from the ground with a loaded dart from a CO<sub>2</sub> pistol.

"On every chase my adrenaline is up, mainly because every capture situation is different, so you never quite know what to expect. A cat may choose to stay in the tree after we dart it with



**Figure 1.** Home ranges of 11 research animals. The six blue ranges are radio-collared males. The five pink ranges are radio-collared females. (The 12th cougar in the study is a recently-collared male whose home range in the southern Black Hills has not yet been programmed.) Collared research animals are used to estimate total number of cougars in the Black Hills, currently projected to be 40 to 50. The red area is the 2000 Jasper fire.

the immobilizing drug, or jump out of the tree after we dart it, or wait until we set up our net and get our equipment out and then jump out of the tree and run away. You just never know."

For the safety of a threatened species, the team first secures a net at the base of the tree, should the lion take a fall. But if the cat is wedged into the branches and falls asleep in the tree, a team member climbs up and lowers the immobilized animal—weighing from about 80 pounds for a female to 150 pounds for a male—to earth.

Every animal reacts differently to the immobilizing drug Telazol. Some go to sleep immediately; some fight the effects of the drug; some remain asleep longer and some shorter than expected. While tranquilized, a cat is fitted with a radio collar and weighed, and hair and blood samples are taken for later DNA testing. When the lion revives, the team sees it back on its feet and safely into the wild.

Every tick of the clock matters. Since the majority of captures are during winter months, a cat too long under anesthesia can become hypothermic. If a family group is the object of the chase, the team must work fast to ensure the family can reunite as quickly as possible. All techniques of capture, restraint, and immobilization are those developed over years and accepted by professional biologists as humane treatment.

**F**ecske feels "lucky" in that she is trekking in beautiful surroundings, conducting research on a species that is a symbol of wildness, and working with other scientists and volunteers who share her ecological values. But she admits to weariness at the end of the day. Her experimental subjects were named "mountain" lions for a reason. Their favorite habitat in the Hills is mixed forest and rocky canyons and draws.

"What drives you to keep hiking toward the end of the chase is sheer will, because you're exhausted from carrying heavy backpacks up and down and up again. But it's fascinating to follow the tracks of the animals and learn firsthand how they move and act."

During one chase, the team trailed an older male cat around the edges of its home range, counting nine scrapes where he had stopped to mark the boundary of his territory.

The team has seen where cats have rested and the kinds of habitat they prefer. Also discovered are sites the cats judge to be safe places to feed on prey.

"We've seen a cat jump out of a tree from about 30 feet up and take off running, giving us a clue as to how easily they can surprise and take down their prey."

If the capture can't be safe for the animal, the team abandons the chase.

Although she doesn't discount the dangers of the chase, Fecske said that the lions have a natural fear of humans.

*The study is revealing that a mountain lion, however strong or feared it may be, is often in mortal danger itself, both from humans and from its own kind.*

"I have personally been over 30 feet high in a tree with an un-tranquilized lion 12 feet above me, and the only thing she did was urinate on me because she was so scared."

**S**ince the project started, the crew has tagged or collared 12 mountain lions. After the cats are captured, the job changes to monitoring the signals transmitting from the radio-collared research animals. The mode of travel switches from foot to aircraft.

Once a week, Fecske and a pilot climb into an antenna-equipped light plane at sunrise and fly low over hills and forest, listening for the radio beeps from the lions' radio collars

that locate their positions and their travels.

"This is actually more dangerous than chasing a lion on foot," Fecske said. "In fact, the number one cause of death of wildlife biologists in the last decade is from airplane crashes."

That has to stick in the back of her mind when flying after lions. Good lion country is rocky canyons and draws in mixed forest types. These areas, scattered throughout the Hills, contain hiding places for the animals who prefer secrecy and use stalking and short bursts of speed to capture prey.

**T**he study is revealing that a mountain lion, however strong or feared it may be, is often in mortal danger itself, both from humans and from its own kind.

Since tagging the 12 mountain lions, three died and two disappeared from the monitoring area.

The first death of a radio-collared lion was that of a young male, about 120 pounds, mortally wounded in a fight with an older male of 148 pounds last March for intruding on his territory. Badly hurt, the younger animal died of infection.

Another lion was shot and killed southwest of Hot Springs by a coyote hunter claiming self defense when the cat answered his predator call.

A third mountain lion, a large female, was found dead from apparent smoke inhalation after the Jasper forest fire which destroyed most of its home range.

At last report, Fecske and crew were monitoring only seven of the original 12 lions collared or tagged; two either wandered out of the surveillance area

or their transmitters malfunctioned. The remaining cats appear to be in good shape.

Capturing mountain lions is a group effort. On any chase, the team consisted of three to five people. These included houndsman Don Morgan of Pringle, Sharon Senezcko, GF&P veterinarian volunteer, Steve Griffin, wildlife biologist, Fecske, and a volunteer or two to help carry equipment. A local taxidermist, Arlin Strattemeyer from Rockerville, and State Trapper Blair Waite also were helpful.

In the aerial telemetry work, Fecske and Jenks fly with Bob Laird, a private pilot from Montana who spots elk for the U.S. Forest Service, and with Civil Air Patrol volunteers.

To date, findings from Fecske's study have given GF&P an estimate of home range size—as much as 400 square miles for males and up to 150 square miles for females, an estimate of population size, information on territoriality and animal spacing within the Black Hills region, and information on animal condition.



In center photo, Dorothy Fecske, graduate student leading the lions study, and Houndsman Don Morgan of Pringle bring a sedated mountain lion from the safety net to a safe area where they will first radio-collar the animal and then weigh and age the cat, draw blood, and monitor its life signs. Below is "Felix," "coming around" and about to make his escape safely back into the wild. At far left are Fecske and Bob Adams, Civil Air Patrol pilot from Box Elder, preparing to fly the Hills to find Felix and his fellow felines. Trailing the big cats has given state biologists new and valuable information on the status of this species.

Because of her work, GF&P has recently requested that the Department of Wildlife and Fisheries Sciences develop a second study to focus on survival of kittens and longevity of adults and to evaluate a technique called probability sampling, which is currently in use in Wyoming, that estimates population size of lions.

Before going into the field, Fecske trained in Wyoming on how to capture and radio-collar study animals safely and effectively. She will follow the cats until January 2002 and then write her Ph.D. dissertation.

What then?

Definitely not a career for the faint-hearted. Fecske has already trapped and released river otters in Pennsylvania. She has followed radio-collared black bear females through their territories much as she is now doing with the Black Hills mountain lions. She has surveyed swift fox on the Pine Ridge Indian Reservation.



Whatever turn this wildlife biologist's career takes, Fecske will have memories and stories like nobody else's—of going face-to-face in the wild with this continent's biggest cats and of coming back to tell about it and, best of all, of knowing that her study has given the state new information on a secretive species once considered to be no longer living in South Dakota. ♦





# PRRS still elusive, shifts its attack

by Nancy Grathwohl

**A**bortions, premature farrowing, stillborns, and mummified pigs are all symptoms of Porcine Reproductive and Respiratory Syndrome (PRRS).

“It can be economically devastating to swine producers,” says Jane Hennings, DVM and associate professor of veterinary science at SDSU.

PRRS was first described in the U.S. in 1987 and was previously referred to as Mystery Swine Disease (MSD). The disease was renamed when it became better understood after research at SDSU, the University of Minnesota, and the Central Veterinary Institute in the Netherlands, says Extension Veterinarian Bill Epperson.

The Netherlands first reported isolation of the disease, adds David Benfield, DVM and professor of veterinary science. “However, in the U.S., industry was the first to isolate PRRS. We at SDSU went on further and discovered that the disease was caused by a virus.”

Breeding animals show different clinical signs than young pigs. In addition, “some herds experience severe disease, while

others apparently have no clinical problems following introduction of the PRRS virus,” says Epperson.

Pig-to-pig contact is the primary way the disease spreads. Pigs infected with the PRRS virus can shed the virus in oral or nasal secretions, urine, and feces. Transmission via semen also can occur. There may be other modes of transmission; airborne spread has been implicated (see accompanying story).

Several different tests can detect PRRS virus infection. The enzyme linked immunosorbant assays (ELISA) test detects antibodies. Virus isolation (VI) detects replicating virus, and the polymerase chain reaction (PCR) test detects PRRS virus RNA. Two other tests that reveal virus proteins or RNA in tissues or cells are immunohistochemistry (IHC) and in situ hybridization (ISH).

ELISA is the most economical test, at \$5.00 for the first test and \$4.00 for additional tests. However, the test may be given before antibodies have built up, says Hennings. In such instances, the disease could be overlooked.

Knowing the length of time the animal sheds the virus is important for producers trying to eradicate the PRRS virus from their herds, says Hennings. “In experimentally infected pigs, the virus may clear in approximately 150 days—or more—after infection.”

However, she warns, there is no definite timeline that works on the farm since not all animals will be infected at the same time.

Nor is there a dependable timeline in more controlled circumstances. “In one of our more recent boar studies, we had one of eight boars appear to ‘clear’ the virus by 88 days post inoculation, since we could not detect the virus in serum, semen, or 21 other tissues,” Hennings says.

In a recent report, one of 60 sows was positive for PRRS virus in lymph node tissue almost 2 years after an initial PRRS field outbreak. “It may be easier to prevent PRRS infection than to get rid of it once it has infected pigs, since some of these pigs may be carriers of the virus.”

A couple of strategies may help prevent PRRS. The virus is easily destroyed in the environment, and it is also susceptible to disinfectants and heat, Hennings says. She urges that farmers introduce only seronegative animals—meaning they have no detectable antibodies to the PRRS virus—to their herds. Even then, she says, quarantine the newcomers before turning them in with a herd not infected with PRRS.

Once an animal is infected, it may be given antibiotics to help decrease death loss from secondary bacterial infections, says Epperson. The antibiotics will have no direct effect on viral agents such as the one responsible for PRRS.

Although a vaccine is available, vaccination does not prevent the pig from becoming infected. It only lessens the clinical signs following infection. Epperson says he might use vaccines in herds that have a problem with PRRS or that might be at high risk of infection.

However, some people are wary of using the vaccine in PRRS-negative herds, says Benfield. "Part of their reasoning is that this vaccine, like a lot of others, replicates to a certain extent in the pig. Some people think it could revert to causing the disease instead of suppressing it. That's one of the dangers of using a modified live vaccine."

Benfield says that PRRS is still a problem in swine herds. But it has shifted somewhat. "We're seeing more respiratory disease now than reproductive. We're not seeing full-blown abortions at the levels we saw in the late 80s and the early 90s.

"Part of that is probably because people have better biocontainment and isolation procedures now. Now that we know the disease is due to a virus, we know how to keep it out of the herds." ♦

## Will 'right' diet delay onset of PRRS?

Brent Christopherson, graduate student in animal and range sciences, has gained firsthand knowledge about the Porcine Reproductive and Respiratory Syndrome (PRRS) virus through work at the Southeast Research Farm near Beresford.

Christopherson checked for airborne transmission of the virus and also looked at the immunological responses associated with feeding high-oil corn. He fed one room of pigs high-oil corn while another mirror-image room of pigs got conventional corn. He inoculated half of the pigs in each room with the PRRS virus. "We wanted to see if transmission occurred from the one side of the barn, from the inoculated pigs, to the other side of the barn, to pigs that weren't inoculated," he explains.

That would prove that airborne transmission is possible. "The only way the control pigs could get the virus would be through the air because they did not have direct contact with the other pigs," he says.

High-oil corn has higher oil concentrations than conventional corn, 7% vs. 3.5%. "You would expect the room with the pigs fed high-oil corn to have less dust. That would give the virus less opportunity to attach to dust particles and transfer from the inoculated pigs to the control pigs."

Dust filters were used to catch virus particles in the air, and a polymerase chain reaction (PCR) test was performed to verify the presence of virus on the filters. "When pigs show they have the virus on the side of the barn that wasn't inoculated and we also find the virus on the dust filters, we can confidently say that the virus transferred by air over to the control pigs."

Since the PRRS virus is an RNA virus, it can not live long outside a host. "There is little evidence of airborne transmission. However, I think that we have shown that it is possible by finding the virus on the dust filters," Christopherson says.

Besides showing that the PRRS virus can be spread by airborne transmission, Christopherson's research has also made another discovery. "Diet seems to make the difference on how long it takes pigs to become viremic. The high-oil corn group had about a 3-week delay in clinical signs of viremia, even though we challenged or gave them the virus on the same day," says Christopherson.

This delay in clinical signs may be due to different compounds in the high-oil corn, which may influence the immunological response of the animal. "High-oil corn has higher concentrations of linoleic acid, a precursor of arachidonic acid. Arachidonic acid affects prostoglandin E2 which functions as an inflammatory mediator."

Now Christopherson is interested in finding out what exactly high-oil corn does to delay the susceptibility of pigs to the PRRS virus.





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