RESEARCH REPORT
PORK SAFETY

Title: An Economic Analysis of Integrated Rodent Control in Swine Production Facilities, **NPB# 99-235**

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Date Received: **4/29/2002**

I. Abstract

We conducted a comprehensive economic analysis of rodent control in swine production facilities. An interdisciplinary working group was assembled to identify all necessary input variables and values associated with rodent damage and control. We incorporated data from production models, scientific literature, product literature, and personal experience into an interactive STELLA systems model. The model generates cost-benefit analyses and predicts outcomes of various levels of house mouse control for site-specific swine confinement facilities. We developed a website on rodent control (http://itg3.unl.edu/rodent) (username-rodent, password-tnedor) to promote use of the model, increase producer awareness of the costs associated with rodent damage, and provide information on integrated strategies for managing rodents. Although the model is relatively robust and comprehensive, we noted important gaps in research-based information, particularly associated with the economic impacts of rodents on diseases, food safety, quality assurance, and human dimensions. We will continue to improve the model and website as new information becomes available.

II. Introduction

In the Nebraska pork industry alone, Norway rats and house mice cause estimated annual losses of 6.35 million due to structural damage (Johnson and Timm 1987). In addition, the value of livestock feed consumed annually was estimated at $0.75 million. The cost of rodent damage has increased in recent years as the use of insulated confinement structures has become more prevalent. House mice, in particular, can be very destructive, causing damage to all types of building insulation (Hygnstrom 1995). Additionally, rats and mice are also reported to serve as reservoirs and vectors of swine diseases including swine dysentery, encephalomyocarditis, porcine rotaviruses, trichinosis, and pseudorabies (Henzler 1997). Producer awareness of the potential impacts of rodents is limited, and recent data show producer adoption of rodent control methods to be unchanged (USDA 1997). Integrated approaches to rodent control are effective and recommended (Corrigan et al. 1992, Timm et al. 1996),

but little is known about the overall cost-effectiveness of various methods of rodent control. A comprehensive economic evaluation of rodent control in swine production facilities is needed to increase producer efficiency and aid in decision-making processes. Our goal is to increase their awareness of swine producers and others in the swine industry regarding the potential costs associated with rodent damage and cost-effective strategies for controlling rodent damage.

III. Objectives

1. Identify the costs of rodent damage in various types of swine production facilities.
2. Identify the costs and benefits of various levels of rodent control.
3. Develop an interactive systems model that conducts cost-benefit analyses and predicts best management practices.
4. Distribute the systems model through the Internet and (later) by CD-ROM.
5. Provide information on the economics of rodent control to producers and industry professionals through presentations and scientific publications (and via a future proposal for printing a series of brochures).

IV. Procedures

We assembled an interdisciplinary group of experts to identify all necessary input variables and values associated with rodent damage and control in swine facilities. In addition to the Principle Investigators, the working group included:

Mike Brumm, University of Nebraska, Concord (swine production)
Dan Meyer, Iowa State University, Ames, IA (facilities management)
Larry Bitney, University of Nebraska, Lincoln (agricultural economics)
Bob Wills, University of Nebraska, Lincoln (swine health)
John Beller, PestTech, Columbus, NE (private pest control)
Kurt VerCauteren, National Wildlife Research Center, Fort Collins, CO (modeling)
Dallas Virchow, University of Nebraska, Lincoln (distance education)

The working group met twice and attempted to identify and prioritize all known variables that affect the economics of rodent control in swine facilities. We incorporated information from existing models, scientific literature, product literature, producers, and personal experience. Information was shared through a closed list serve (nppc@unl.edu).

An interactive systems model was developed, using STELLA 6.0 simulation software (High Performance Systems, Inc., Hanover, New Hampshire, USA) to conduct cost-benefit analyses based on prioritized variables and associated values. The model consists of three layers: an interactive controls layer, a model diagram layer, and an equations layer. In the controls layer, model users can run simulations under varying scenarios (Figure 2). The diagram layer shows the layout of the model variable sin the form of stocks (rodent population, cumulative dollars spent on control, cumulative dollars of damage), flows (death, damage, spending on sanitation), converters (damage, death fraction, total cost), and connectors (single-lined arrows). Draft models were reviewed by working group members and revised to increase simplicity and accuracy. We ran several simulations of the model to determine the effects of various levels of rodent control on house mouse population levels, subsequent damage, and benefit-cost ratios. We developed a website using Director html programming software. We visited three Midwest farms to collect digital images for the outreach components of the project.

V. Results

During the first meeting of the working group, we generated six pages of single-spaced notes on variables and values associated with rodent control in swine facilities. Through discussions and a prioritization process, we identified the most important factors associated with this project (Table 1) and identified research gaps that impeded the inclusion of some variables in the model (Table 2).

Table 1. Variables included in the interactive STELLA systems model on rodent control in swine facilities.

Facility type	Stochastic events
Facility condition	Value of assets
Structural damage	Cost amortization
Insulation damage	Monitoring
Wiring damage	Rodent density
Equipment damage	Rodent population dynamics
Repair costs	Density-dependent cost functions
Energy costs	Levels of rodent control
Feed consumption	Costs of rodent control
Animal performance	Benefits of rodent control
Risk probability	Operating costs
Time sequence analysis	Benefit-cost ratios

Table 2. Variables not included in the interactive STELLA systems model on rodent control in swine facilities.

Feed contamination	Down time
Disease transmission	Community/social issues
Opportunity costs	Human dimensions

Food safety-certification, accountability, quality assurance

We identified producers with confinement facilities as our primary audience. Additional groups include veterinarians, pest control operators, Cooperative Extension educators, engineers, and building contractors. The project is national in scope, and was limited to house mice, with additional variables for Norway rats to be added later.

The STELLA model that was generated which provides interactive input, value defaults and sliders, feedback loops, and variable crosslinks. It generates cost-benefit analyses and predicts outcomes of various levels of rodent control. The STELLA company has been working on an internet platform but has yet to release it for public use. We created a website on rodent control (http://itg3.unl.edu/rodent) (username-rodent, password-tnedor) and uploaded a static copy of the model. As soon as an Internet platform of STELLA is available (anticipated 1-2 months) we will upload the full interactive version of the model. Once the model is fully interactive, producers will be able to input information on their own facilities and generate economic analyses that will assist them in their decision-making process. The website also includes five, two-to six-minute videos and a series of stills on rodent control. We intend to hotlink the rodent control website to the NPPC website (http://www.nppc.org) and to the Internet Center for Wildlife Damage Management (http://wildlifedamage.unl.edu).

We presented a poster of the interactive model (Figure 1) at two national conferences (8th Eastern Wildlife Damage Conference, Economic Considerations in

Wildife Damage Management) and submitted a paper for publication in the proceedings of the later conference (VerCauteren et al. 2001). We will promote the model among swine producers through Cooperative Extension specialists, county agents and educators, and others by means of presentations, media (newsletters, radio spots), and personal contacts. Informational brochures should be developed and distributed as a follow-up to the current project to increase producer awareness of the consequences of rodent infestations, rodent control options, and the availability of the cost-benefit model.

Gaps in research-based knowledge inhibited our modeling efforts in three areas: feed contamination, disease transmission, and human dimensions. The one study that we located on the effects of rodent feces and urine on feed consumption indicated negligible effects. Although rodents have been implicated in the transmission of diseases to swine, few studies have confirmed direct responsibility and few studies have itemized the economic effects of diseases at the farm level. We were unable to identify any research-based information on the presence to rodents on employee health and morale, product value and quality assurance. We encourage NPPC and USDA to support further research in these areas.

We will continue to develop and fine-tune the model as more research-based information becomes available. We will conduct a thorough review of the model through pork producers, Extension educators, NPPC affiliates. We will conduct a thorough evaluation of the project approximately one year after the fully interactive STELLA model has bee released to the public. Evaluation subjects will include a sample of swine producers who use the model and responses will provide information on web hits, knowledge gained, behavior changed, economic impacts and IPM practices implemented.

VI. Literature Cited

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