

## REPORT OF THE COMMITTEE ON BRUCELLOSIS

Chair: Dr. Sam D. Holland, Pierre, SD  
Vice Chair: Dr. Claude E. Barton, Nashville, TN

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The Committee met on Tuesday, November 8, 2005, from 12:30 p.m. to 5:30 p.m. There were 36 members and 40 guests in attendance. The meeting was chaired by Dr. Holland, and a total of 11 presentations were given. It was noted by the Chairman that a related scientific paper, entitled, "Enhanced Immune Response of *Cervus elaphus* to Live Vaccine Strains of *Brucella abortus* through Microencapsulation," was presented by Dr. Allison Ficht, Texas A & M University at the AAVLD Bacteriology Scientific Session on Sunday, November 6, at 8:00 a.m. There were 11 reports, resolutions and recommendations submitted to the Committee for action.

Drs. Debra Donch and Arnold Gertonson, United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS), presented the cooperative brucellosis program status report for FY 2005. Dr. Donch reported that the states of Texas and Wyoming were the only two brucellosis Class A states remaining during 2005. There was a total of three brucellosis affected herds during the year, with two in Texas and one in Wyoming. Currently, there are 16% of cattle herds in the U.S. located in Class A states. Approximately nine million cattle were identified and blood tested at slaughter under the Market Cattle Identification (MCI) program. A successful closure rate of 98.6% on reactors disclosed by market and slaughter testing was reported. A total of four million calves were reported as being officially vaccinated against brucellosis during the year. Dr. Gertonson gave an update on the status of brucellosis program activities in the Greater Yellowstone Area (GYA). The complete text of the national status report is included in these proceedings.

Dr. Guillermina Anduaga, Director of the Brucellosis Campaign in Mexico, presented a status report of the campaign to eradicate brucellosis from livestock in Mexico. Dr. Anduaga presented data over several years showing a steady decline in brucellosis prevalence in cattle and goats. Also, there has been a steady decline in reported cases of human brucellosis in recent years, with only about 1,000 cases reported in the past year. The Mexico brucellosis program uses vaccination extensively in cattle and goats. Efforts are underway for standardization of the Mexico Mexican Norma Oficial Mexicana (NOM) and the U.S. Uniform Methods and Rules (UM&R).

Dr. Glenn Plumb, Supervisory Wildlife Biologist, Yellowstone National Park, presented a time specific paper entitled, "An Initiative to Enhance Brucellosis Vaccine, Vaccine Delivery, and Surveillance Diagnostics for Bison and Elk in the Greater Yellowstone Area". This was a companion presentation to the one given by Dr. Bret Marsh, Indiana State Veterinarian, at the USAHA/AAVLD Scientific Session on Monday, November 7. The complete text of this co-authored paper is included in the proceedings of the USAHA/AAVLD Scientific Session.

Dr. Frank Galey, Dean, College of Agriculture, University of Wyoming, and Chair, Wyoming Governor's Brucellosis Coordination Team, presented a report on the activities of the Wyoming Governor's Brucellosis Coordination Team and of the Laramie Symposium on *Brucella* vaccines, vaccine delivery systems, and surveillance diagnostics for elk and bison in the Greater Yellowstone Area. A synopsis of Dr. Galey's PowerPoint presentation follows:

The Wyoming Governor's Brucellosis Coordination Team presented its final report to Governor Dave Freudenthal in January, 2005. The team addressed best management practices (BMP's) and made recommendations about four areas of concern related to brucellosis in Wyoming. Those areas included: regaining brucellosis Class Free status in the Wyoming cattle herd and reducing risk of interspecies transfer of the disease, development of a roadmap about how the state should respond to any new cases of brucellosis in cattle, addressing public health issues, and how to reduce and eliminate brucellosis in wildlife with special attention to the winter elk feed grounds. The team made 28 recommendations. Two of the recommendations covered all four topics and the rest were divided according to those topics of concern. The top overall recommendation was to develop a Brucellosis Management Action Plan (BMAP) for each elk herd unit being fed in the winter in northwest Wyoming. Those plans involve planning between local land owners, local land managers, local and state/federal regulatory veterinarians, and the Wyoming Game and Fish Department. The second recommendation was to conduct research to answer many of the questions about brucellosis in wildlife and livestock. USAHA has become a very valuable partner in developing brucellosis research priorities via a recent workshop held in Laramie, Wyoming, which addressed needs in diagnostics, vaccine development, and vaccine delivery to wildlife.

Mr. Keith Aune, Montana Department of Fish, Game, and Parks, and Dr. Tom Linfield, Montana State Veterinarian, gave the Greater Yellowstone Area Brucellosis report which included a progress report on the bison quarantine facility being developed in Montana. The complete text of this report is included in these proceedings.

Mr. Rick Wallen, Wildlife Biologist, National Park Service, Yellowstone National Park, presented a feasibility assessment on remote vaccination of bison against brucellosis in the Yellowstone National Park. The complete text of this report is included in these proceedings.

Dr. Duane Oldham, Wyoming State Veterinarian gave a Class A status report for the State of Wyoming. It included a summary of procedures implemented to deal with the recent outbreaks of brucellosis that resulted in the loss of Class A status. He reported also that APHIS, VS had conducted a brucellosis program review in August 05, but the review report has not been distributed as yet, so he could not comment on it. All affected cattle herds involved were epidemiologically associated with feedground elk.

Dr. Phillip Mamer, Idaho State Veterinarian, gave a report of the circumstances surrounding the detection of a brucellosis affected cattle herd, apparently associated with wild elk, in the State of Idaho during FY 2005. The affected cattle herd, consisting of 41 breeding animals and 25 calves, was detected through brucellosis surveillance testing in the national MCI program. The herd test disclosed additional positive animals. Disposition of this herd will be made on receipt of pending confirmatory laboratory results. The last case of brucellosis in Idaho cattle was in 2002. It was also associated with brucellosis affected wild elk.

Dr. Max Coats, Texas Animal Health Commission (TAHC), gave a Class A status report for the State of Texas which included a case presentation of one brucella affected herd disclosed in FY 2005. Dr. Coats noted that there has been a marked decrease in the incidence of brucellosis in Texas concurrent with a high ongoing level of trace-back activity. The herd disclosed in FY 2005 was a good quality commercial beef herd of approximately 20 animals. Field strain *Brucella abortus*, biovar 1, was isolated from the herd. At the time of the report, epidemiologic activities and area testing associated with the herd were being completed. The only likely source disclosed thus far is a neighboring herd that was affected in the recent past.

Dr. Michael Gilsdorf, USDA, APHIS, VS, presented a scientific paper entitled, "Protocol for Collecting, Submitting, Processing and Handling of suspected *Brucella* spp. Diagnostic specimens and cultures for the United States Department of Agriculture (USDA) Brucellosis Investigations" during the AAVLD Bacteriology Scientific Session. The purpose of this paper is to describe the regulations and recommendations of the USDA, APHIS, VS, brucellosis eradication program for collecting, submitting, processing and handling suspected *Brucella* spp. diagnostic samples and cultures during brucellosis investigations. The protocol provides guidelines for APHIS, VS, and individual state animal health officials, as well as for veterinary diagnostic laboratories throughout the U.S. The full text of this paper is included in the Scientific Paper Section of these Proceedings.

Dr. Betsy Bricker, National Animal Disease Center, Agricultural Research Service, USDA, Ames, Iowa, presented a paper entitled, "HOOF-Printing: Identification of Brucella Strains by DNA Finger Printing". The complete text of this paper is included in these proceedings.

Dr. Max Coats, TAHC, gave a progress report from the Feral Swine Working Group on the harmonization of the Swine Brucellosis Uniform Methods and Rules (UM&R) and the Pseudorabies (PRV) Program Standards. The proposed changes were approved by the Committee.

A paper by Dr. Thomas J. Roffe, Biological Resources Division, U.S. Geological Survey was scheduled late for presentation to the Committee, but was not presented due to time constraints. Dr. Roffe graciously agreed to waive its presentation. However, copies of the paper were distributed to all attending Committee members and the complete text is included in the report of the Committee.

## **RESOLUTIONS AND RECOMMENDATIONS**

Dr. Claude Barton, Committee Vice Chair, reported that appropriate responses to recommendations from the 2004 meeting have been received from involved agencies. Copies of the responses have been reproduced for distribution to committee members.

Two resolutions were approved by the Committee and forwarded to the Committee on Nominations and Resolutions.

As brucellosis is eradicated from the U.S. cattle herd the majority of the MCI reactor investigations are due to false positive tests. However, each case must be fully investigated and closed.

Brucellosis Eradication Uniform Methods and Rules 2003 defines how an Market Cattle Identification (MCI) case is successfully closed (Chapter 1, Part 11, Section 7D). The epidemiological investigation requires a herd blood test unless the investigation indicates that the reactor was not caused by field strain brucellosis. In the definitions section of 9 CFR, Section 7u8.1, there is an option to close low titer MCI cases traced to a 100% vaccinated dairy herd that tested negative on the most recent brucellosis ring test.

Other options should be available to evaluate a herd's brucellosis status, in addition to a whole herd blood test. Similar changes were recently made to the procedures for qualifying a herd as Certified Free, giving the producer other options than blood sampling each animal.

MCI investigations require a thorough epidemiological investigation; these alternate procedures should reduce the disruption caused to the cattle industry and enhance brucellosis surveillance.

The Committee recommends changing the MCI case closure code, Traced and Test Recommended (TTR), to include alternative methods to a whole herd blood test for evaluating a herd. We suggest that, together with the Designated Brucellosis Epidemiologist's review of the herd, the TTR classification can be achieved by at least three options:

- a. Whole herd blood test.
- b. Herd milk surveillance test and individual test of all eligible cattle not represented in the herd milk sample. The milking strings should be segmented if the herd is greater than a defined number. If the milk surveillance test is suspicious, further individual animal testing is required.
- c. Sequential milk surveillance testing. Based on herd management, test at least three consecutive monthly herd milk samples, representing the whole herd over time. The milking strings should be segmented if the herd is greater than a defined number. Any eligible cattle not represented in the milk samples should be individually tested. If the milk surveillance test is suspicious, further individual animal testing is required.

Confidence is now high that all infection for swine brucellosis and pseudorabies has been eliminated from commercial swine in the United States. These diseases occur and will continue to occur in specific feral swine populations.

The Committee recommends that USDA, APHIS, VS, change surveillance strategies for swine brucellosis and pseudorabies in U.S. commercial swine as follows:

- a. Target the majority of surveillance resources for pseudorabies and swine brucellosis to commercial swine which originate from geographic areas where disease risk from feral swine is highest.
- b. Alter the major packer surveillance program for pseudorabies and swine brucellosis to target cull sows and boars which originate from geographic areas where risk of disease is highest.
- c. Feral swine should not be included in national surveillance studies.
- d. Implementation processes should include input from state regulators and industry representatives to best accomplish risk assessment and methodology.

The purpose of recommendation is to synchronize the testing of cervid herds for both tuberculosis accreditation and brucellosis certification in order to minimize handling of individual animals.

To encourage whole herd testing of cervids and promote certified brucellosis-free herds, the Committee recommends modifying the UM&R, part VIII, Qualifying Methods, to allow certification after two consecutive tests 9 to 15 months apart. Conditions for recertification require that all test-eligible animals in the herd must have a negative test between 21 and 27 months after the last certification date. Following the first recertification test of a herd, status may be maintained with a negative official brucellosis herd test conducted between 33 and 39 months from the anniversary date.

To create harmonization with the pseudorabies program standard.

The Committee recommends that USDA, APHIS, VS implement the suggested changes to the UM&R as presented by the Feral Swine Working Group.

In response to Dr. Holland's request, USDA, APHIS addressed issues surrounding diagnostic culture technique.

The Committee recommends that USDA, APHIS, VS finalize and distribute as policy the guidelines document presented by Dr. Michael Gilsdorf entitled, "Protocol for Collecting, Submitting, Processing and Handling of Suspected Brucella Diagnostic Specimens and Cultures for USDA Brucellosis Investigations".

Reports were presented from the Brucellosis Scientific Advisory Subcommittee and the Feral Swine Working Group on Brucellosis and Pseudorabies. Reports for these two subcommittees are included in these proceedings. The Education Subcommittee was inactive during the year; therefore, there is no report for 2005.

## REPORT OF THE BRUCELLOSIS SCIENTIFIC ADVISORY SUBCOMMITTEE

November 7, 2005  
1:00 p.m. – 4:00 p.m.  
Chair: Dr. Philip H. Elzer

Subcommittee members: Dr. Don Davis (TX), Dr. Don Evans (KN), Ms. Barb Martin (IA), Dr. Steve Olsen (IA), Dr. Jack Rhyan (CO), Dr. Gerhardt Schurig (VA).

Attendees: Six subcommittee members and 20 guests.

Agenda:

1. Introduction of subcommittee members.
2. Presentations:
  - a. William Laegreid (USDA/ARS) presented a talk on single nucleotide polymorphism markers as a DNA-based identification technology to audit animal identification systems and facilitate trace-backs in disease surveillance systems.
  - b. Alison Fitch (TAMU) presented a talk on the use of microencapsulation of *Brucella abortus* vaccines in elk to enhance their immune responses.
  - c. P. Ryan Clark (USDA, APHIS, VS) presented a talk on the validation of the FPA and BAPA tests for elk. Dr. Clark was seeking advice on the experimental design of his proposed project.
3. Old Business:
  - a. Review the state of the science and determine the level of confidence of recently developed techniques for DNA finger-printing (genotyping) *B. abortus*.
  - b. Review the feasibility and capabilities for establishing a bulk milk brucellosis surveillance test for *B. melitensis* in goats.
  - c. Review the feasibility and capability of matching DNA from sero-positive blood to DNA from hair on corresponding back-tags of MCI reactors.
4. Other business (official charge to review request/documentation and recombination for full committee).
  - a. Review of new instrumentation for use with FPA diagnostics (Instrument Equivalency Study).
5. CLOSED SESSION:
  - a. Charge from Dr. Holland – Review large ruminant outdoor research facilities check list provided by Dr. Lee Ann Thomas (USDA/APHIS/VS).

Committee actions:

FPA Instrument Equivalency Study: Due to the increased number of positive samples using the PHERAstar and Safire machines vs. the S1000 and S100 machines the data needs to be analyzed by correlating serology and culture results. Therefore, the committee recommends that this issue be tabled until further data is obtained and reported to the committee. It should be noted that culture is still the gold standard; therefore, a majority of the samples should have culture data associated with them.

The committee suggested minor changes/clarifications and approved the draft checklist for outdoor brucellosis research facilities for bison and elk/red deer.

The subcommittee requests approval of the draft checklist by the Committee.

The report was unanimously accepted.

**REPORT OF THE FERAL SWINE SUBCOMMITTEE ON  
BRUCELLOSIS AND PSEUDORABIES**

November 6, 2005

1:00 p.m.

Co-Chairs: Drs. Max Coats & Carter Black

Attendees: There were 46 attendees at this years meeting.

Agenda:

Dr. Joe Corn presented a Time Specific Paper entitled, "Expansion of Feral Swine in the U.S. and Potential Implications for Domestic Swine". He presented information on the tremendous expansion of feral swine that occurred between 1982 and 2004. Maps that were developed to show the distribution and density of feral and domestic swine were presented. His presentation clearly described why the potential for disease exposure and transmission between domestic swine and feral swine continues to increase. The complete text of this report is included in these proceedings.

Dr. John Korslund gave a presentation entitled "Feral Swine: The View from USDA, APHIS, VS". Three swine brucellosis cases occurred this year; one each in Texas, Georgia and Iowa. All were feral swine related. Veterinary Services funded three feral swine projects this year. One project at SCWDS, an educational program in Iowa, and some contraceptive research studies made at the Wildlife Services Laboratories. Dr. Korslund discussed some possible changes that would act to harmonize the Swine Brucellosis UM&R with PRV Program Standards.

Edward Stephens gave a presentation entitled "Wild Boar Hunting – a Market Analysis". Mr. Stephens produces wild boars for hunting preserves at his operation located in Illinois and he is endeavoring to promote raising wild boars with a known health status. His experience indicated that there was no reliable production and market information routinely compiled that related to the wild boar hunting business. He has observed that in the process of distribution of Eurasian and feral swine for hunting, that the animals are often transported on the same vehicles with no cleaning between loads and that many haulers employ no routine bio-security measures. He commented that both individual states and USDA need to recognize the wild boar industry as a legitimate business.

State reports were given by the states of Iowa, Georgia and Texas, each of which had one swine brucellosis case in FY 2005.

Iowa – Dr. John Schiltz reported to 50% of a 99 sow breeding swine herd was positive for brucellosis. The exposure was from infected feral swine. As the results of this case, Iowa has developed an ad hoc feral swine task force to work towards feral swine eradication.

Georgia – Dr. Black reported on the Georgia case which involved a show pig producer that had been a vaccinated/qualified herd for 9 years. The index animal was detected on a quarterly test. The required whole herd test disclosed 19 brucellosis positive animals in the herd of 120. There were inadequate bio-security measures in place to prevent exposure to feral swine. This herd was classified as a transitional herd and was depopulated with indemnity.

Texas – Dr. Jeffery Musser reported on a brucellosis affected cattle herd that was detected by market testing. The index cow was culture positive for *B. abortus*. The balance of herd test revealed another reactor which was found to be culture positive for *B. suis*. There was no other infection found in any of the contact herds. The *B. abortus* was likely in the animal when it was purchased. Collection of samples from feral swine on the ranch disclosed culture confirmed feral swine indicating that the *B. suis* infection was likely contracted from swine in the area after the replacement cow was added to the herd.

Mr. Seth Swofford reported on Wildlife Services and the USDA Wildlife Services Feral Swine Disease Monitoring Plan. In addition to providing a brief overview of his agency and their roles, he more specifically detailed some of their activities in support of the National Wildlife Disease Surveillance and Emergency Response Program.

Specifics were provided on some of the activities relating to feral swine. Approximately 11,000 feral swine will be killed this year in conducting their control operations while the disease monitoring activities are to be centered on CSF, PRV and SB surveillance. There will be monitoring and testing of a targeted 1,355 animals from 18 states.

Dr. William Stoffregen reported on swine brucellosis vaccine research activities at USDA, ARS, National Animal Disease Center that indicated that RB 51 has been tried in feral swine on several occasions and was shown not to be of significant value. They are currently evaluating products derived from a *B. suis* rough mutant. Results indicate that significant increases in cell mediated immunity have been produced using *B. suis*, strain 353-1 derived vaccine.

Dr. Max Coats led the discussion on the proposed changes needed to harmonize the Swine Brucellosis UM&R and the PRV Program Standards. The meeting was ended prior to the completion of the discussions but the full recommendations are to be proposed to the Committee on Brucellosis for their consideration. The proposed changes will accomplish harmonization with the current PRV Program Standards. A copy of the revised UM&R is included with this Subcommittee Report. These UM&R changes are identified by marking through the language that is recommended to be removed and the new language is underlined.

The report was unanimously accepted.

The Committee adjourned at 5:30 p.m.

United States Department of Agriculture

Animal and Plant Health Inspection Service

APHIS 91-55-042

# **Swine Brucellosis Control/Eradication**

State - Federal - Industry  
Uniform Methods and Rules

March 1, 2005

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Issued March 2005

This publication supersedes APHIS 91B55B023, under the same title, issued originally in March 1990 and last revised in April 1998.

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- Part VI**                  **Laboratory Procedures and Test Interpretation**
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## Introduction

These Uniform Methods and Rules (UM&R) were adopted for the eradication of swine brucellosis from all domestic swine in the United States. These are minimum methods and rules developed by the Veterinary Services division of the Animal and Plant Health Inspection Service (APHIS), an agency of the U.S. Department of Agriculture (USDA), through recommendations from the swine health practitioners at the annual United States Animal Health Association meeting in October 2004.

The following list highlights changes adopted in this version of the swine brucellosis UM&R. Numbers in parentheses represent page numbers in this typescript.

### ***Part I - Definitions***

*Definitions for commercial production swine and transitional swine have been added, and the definition for feral swine was changed. (5, 6, 8)*

### ***Part V – Validated Swine Brucellosis – Free Herds.***

*Section A.4., A new subsection was added for validation or revalidation of swine grow-out premises on which no adult breeding swine are maintained. (14)*

### ***Part VII, Program Stages***

*Stage II. Sec. A.2.b., Now specifies commercial breeding swine instead of just breeding swine which previously could have included feral/transitional swine. (19)*

*Stage II. Sec. A.3., A new subsection was added that requires each State to develop and adopt a management plan for separating and controlling the interface of feral and transitional swine with commercial swine. (19)*

*Stage III. Sec. A.2., Now specifies commercial breeding swine instead of just breeding swine which previously could have included feral/transitional swine. (20)*

*Stage III. Sec. A.4., A new subsection was added that requires each State to develop and adopt a management plan for separating and controlling the interface of feral and transitional swine with commercial swine. (20)*

*Stage III. Sec. C.4., Now specifies disclosure of infection in commercial production swine with evidence of spread to other commercial swine herds. (20)*

The minimum uniform methods and rules described in this publication do not preclude the adoption of more stringent methods and rules by any geographic or political subdivision of the United States.

## **Part I – Definitions**

### **Accredited veterinarian**

A veterinarian approved by the Deputy Administrator of Veterinary Services (VS), Animal and Plant Health Inspection Service (APHIS), U.S. Department of Agriculture (USDA), to perform functions required by cooperative State–Federal animal disease control and eradication programs.

### **Approved all-class market**

A market approved by the APHIS Administrator and listed in Title 9 of the Code of Federal Regulations (CFR) at which breeding, feeding, or slaughter swine may be sold in accordance with Federal interstate regulations.

### **Approved slaughter market**

A swine-only market approved by the APHIS Administrator and listed in Title 9 CFR at which interstate shipments of slaughter swine only are permitted in accordance with applicable State and Federal regulations. No swine may be released from an approved slaughter market unless consigned directly to another approved slaughter market, or to a recognized slaughtering establishment for immediate slaughter.

### **Area Veterinarian-in-Charge (AVIC)**

The veterinary official of VS, APHIS, USDA, who is assigned by the Deputy Administrator to supervise and perform official APHIS animal health work.

### **Boar**

An un-castrated male swine 6 months of age or over that is, or has been, capable of being used for breeding purposes.

### **Breeding swine**

Swine that are 6 months of age or older and that are used or intended to be used for breeding.

### **Certificate**

An official document issued for and prior to interstate movement of swine not known to be infected with or exposed to swine brucellosis (SB) by a VS representative, a State representative, or an accredited veterinarian, which states: (1) the number, individual identification, and description of the swine to be moved; (2) that the swine to be moved are not known to be infected with or exposed to SB; (3) the purpose for which the swine are to be moved; (4) the points of origin and destination; (5) the consignor and consignee; and (6) additional information as required by applicable State and Federal laws and regulations.

### **Commercial production swine**

Those swine that are continuously managed and have adequate facilities and practices to prevent exposure to either transitional production or feral swine.

### **Complete herd test (CHT)**

An official SB test of all breeding swine 6 months of age and older in a herd. Swine being fed for slaughter that are not in contact with breeding swine may be exempted from CHT requirements.

### **Deputy Administrator**

The Deputy Administrator, VS, APHIS, USDA, or any other VS official to whom authority has been delegated to act in his or her stead.

### **Designated brucellosis epidemiologist**

An epidemiologist selected by the State animal health official and the AVIC. The regional brucellosis and swine disease epidemiologists and the VS Regional Director should concur in the selection of the designated brucellosis epidemiologist.

### **Domestic Swine**

~~Swine that are owned, managed, and have never been exposed to wild or feral swine.~~

### **Direct shipment**

Movement without unloading en route and without contact with swine of lesser SB status.

**Farm of origin**

A farm where the swine were born, or on which they have resided for at least 60 consecutive days immediately prior to movement.

**Feral swine**

Those swine that are free-roaming.

**Herd**

All swine under common ownership or supervision on a premises or all swine under common ownership or supervision on two or more premises among which swine have been interchanged.

**Herd of origin**

(See Farm of origin.)

**Herd plan**

A written management and/ or testing agreement designed by the producer and designated brucellosis epidemiologist to control and eradicate SB from an infected herd.

**Interstate**

From any State into or through any other State.

**Intrastate**

Within a State.

**Known infected herd**

A herd in which one or more swine have been classified an SB reactor and which has been determined by a designated brucellosis epidemiologist to be infected. (See Part VI, Lab Procedures and Test Interpretation.)

**Monitored negative feral swine population**

~~The designated brucellosis epidemiologist may classify feral swine originating from areas that have been geographically defined and under continuous surveillance yielding no evidence of infection as a monitored negative feral swine population.~~

**Market Slaughter Test (MST) negative**

A swine that is negative to one or more official SB presumptive tests. (See Part III, Epidemiology.)

**MST program**

The identification of sows and boars to their farm of origin by official identification device and collection of blood samples from these swine at markets or slaughter establishments for official SB testing at a designated laboratory.

**MST reactor**

A swine that is positive to an SB confirmatory test or positive to the card test alone and not subjected to a confirmatory test.

**MST suspect**

A swine that is positive to a presumptive test but is negative to a confirmatory test. (See Part III, Epidemiology.)

**Official backtag**

A VS-approved paper or plastic tag applied to the head or poll region of slaughter sows and boars that provides farm of origin identification of blood samples collected at markets and slaughter establishments.

**Official slaughter sow/boar identification eartag**

A VS-approved identification eartag for the identification of sows and boars in slaughter channels.

**Official swine brucellosis test**

Any serologic test approved by the Deputy Administrator for diagnosis of brucellosis in swine.

**Permit**

An official document required to accompany all intrastate and interstate shipments of SB-infected or -exposed swine. It may be issued by a VS representative, State representative, or an accredited veterinarian and states: (1) the number of swine and individual identification of swine to be moved, (2) the purpose for which the swine are to be moved, (3) the points of origin and destination; (4) the consignor and consignee, and (5) additional information required by applicable State and Federal regulations

**Qualified Pseudorabies-Negative (QN) herd**

For definition, refer to the current edition of *Pseudorabies Eradication–State–Federal–Industry Program Standards, Part IV – Participation in Herd Plans and Release of Quarantines, Subpart I – The Qualified Pseudorabies-Negative (QN) Herd*

**Quarantined herd**

A herd in which SB-infected or -exposed swine are bred, reared, or fed under the supervision and control of the State animal health official and from which swine must be moved under permit directly to a recognized slaughtering establishment or directly through no more than one slaughter market and then directly to a recognized slaughtering establishment. Owners are required to notify potential buyers of the SB quarantine status of their herd prior to offering animals for direct~~ly~~ or indirect~~ly~~ movement for slaughter. 

**Recognized slaughtering establishment**

A slaughtering establishment operated under the provisions of the Federal Meat Inspection Act (21 U.S.C. 601 et seq.) or a State-inspected slaughtering establishment that meets the minimal requirements of Title 9 CFR.

**Sow**

A female swine that is parturient or post parturient.

**State**

Any State or Territory of the United States, including the District of Columbia, Puerto Rico, the U.S. Virgin Islands, Guam, and the Northern Mariana Islands.

**State animal health official**

The State official who is responsible for the livestock and poultry disease control and eradication programs in a State.

**Swine brucellosis (SB)**

The contagious, infectious, and communicable disease of swine caused by *Brucella suis* (*B. suis*) biovars 1 or 3.

**Swine brucellosis-exposed**

Swine that are not known to be SB infected but are part of a known SB-infected herd or that have been in contact with reactor or feral swine.

**Swine not known to be infected with or exposed to swine brucellosis**

All swine *except* those that are part of a known infected herd or are known to have been exposed to brucellosis-infected swine and/or feral swine.

**Transitional swine**

Those feral swine that are captive or swine that have reasonable opportunities to be exposed to feral swine.

**Validated swine brucellosis-free herd**

Any swine herd not known to be infected with or exposed to SB that is located in an SB-free State or a swine herd in a nonvalidated SB-free State which meets the specific provisions of a validated SB-free herd. (See Part V, Validated Swine Brucellosis-Free Herds.)

**Veterinary Services (VS)**

The Veterinary Services branch of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS).

**Veterinary Services representative**

A person employed by VS, APHIS, USDA, who is authorized to perform official SB eradication activities.

## Part II – Administrative Procedures

### A. Supervision of the Cooperative State-Federal Swine Brucellosis Eradication Program

The Cooperative State–Federal Swine Brucellosis Eradication Program must be supervised by full-time animal health veterinarians employed by the State or Federal Government.

### B. Entering premises

State and Federal representatives participating in the National Swine Brucellosis Eradication Program must be authorized by the State to enter premises to carry out program procedures. While on such premises, these representatives must use commonly accepted sanitary procedures to minimize the risk of physically transmitting diseases among groups of swine on the farm being investigated, as well as to other premises.

### C. Providing services to livestock owners

Owners are responsible for handling their animals. Program administrators may contract with accredited veterinarians, paraprofessionals, other State and Federal agencies, or with the management of privately owned firms as needed, to assist State and Federal representatives in collecting blood or tissue samples, identifying animals, and performing other Program activities.

### D. Notifying the community of swine brucellosis-infected herds

State or Federal program officials shall notify swine owners within a ~~2 mile~~~~1.5 mile (2.4 km)~~ radius of the infected herd within 15 days after a swine herd has been quarantined for SB. When the herd quarantine is released, the same herd owners shall be notified within 30 days by an informational letter.

### E. Dealers – Registration and record keeping

The following dealers (individuals or other legal entities) of swine should be registered or licensed with the appropriate State agency:

- Dealers who purchase, trade, or sell swine
- Dealers who act as commission representatives or brokers;
- Dealers who operate and conduct an auction where swine are sold.

Registered or licensed dealers must maintain records required by the licensing agency to make it possible for State authorities to trace swine to their herds of origin and destination.

1. Registering dealers - After giving due notice and opportunity for a hearing to the dealer involved, the State agency must have the authority to deny an application for registration or to suspend or cancel the registration when the agency is satisfied of either or both of the following:
  - a. There is adequate evidence to establish that the dealer had intent to violate or circumvent the recordkeeping requirements of this section and/or other animal health regulations;
  - b. The dealer has repeatedly demonstrated failure to keep records adequate to permit tracing his or her swine sales and purchases.
2. Keeping records - Each registered or licensed swine dealer must keep sufficient records of all swine purchased to enable the State agency to trace such swine satisfactorily to their farms of origin and destination. The records should be kept for a minimum of 1 year.
3. Dealing with violations - Provisions should exist so that State animal health officials may institute any action at law or in equity that appears necessary to enforce compliance with dealer registration and recordkeeping requirements. This includes the authority to subpoena appropriate records and/or persons that allegedly violate these minimum standards. The appropriate State officials should also have authority to petition the local court that has venue for an order to enforce these subpoenas.

**F. Administrative review of Program activities**

Appropriate VS and swine industry personnel will review State SB control/eradication program progress periodically to ensure compliance with the Uniform Methods and Rules as outlined in this publication.

**G. Application for Program status**

Application for program entry and advancement in status will be jointly signed by the State animal health official and AVIC and be submitted to the ~~Chief Staff Veterinarian of the Swine Health Staff~~, [National Center for Animal Health Programs, Aquaculture, Swine, Equine, and Poultry group](#).

**Part III – Epidemiology**

**A. General considerations**

The requirements of Part III apply to establishing and maintaining Program status for all States in Program Stages I, II, and III.

**B. Traceback of market swine test (MST) reactors**

All tracebacks of MST reactors require a thorough epidemiologic investigation, including completion of VS Form 4-106 or a similar document. 

1. A successful traceback occurs when or if:
  - a. The farm of origin of the MST reactor is identified; and
    - (1) A complete herd test (CHT) is conducted or
      - (2) Upon review of the herd's health status and all other epidemiologic information, a designated epidemiologist determines that a CHT is not necessary. The designated epidemiologist will provide an alternative testing plan if needed and a detailed explanation of measures taken to ensure that the herd does not have SB 
  - b. All swine on the farm of origin are verified to have been sold for slaughter.
2. An unsuccessful traceback occurs when the MST reactor cannot be traced to its herd of origin or is only traceable to a dealer, commission firm, etc.

**C. Records**

An electronic and/or written record will be maintained for all MST reactors including at least the following information:

1. Identification of the MST reactor. (Include sex, breed, and ID numbers.)
2. Consignor's name and address.
3. Date and location bled.
4. Presumptive test and confirmatory test results.
5. Epidemiologic data, including results of farm-of-origin ~~CHT~~ [testing](#).

**D. Traceback of MST suspects**

Traceback investigations are generally recommended but may be waived when, in the professional judgment of the designated brucellosis epidemiologist, one is not required.

#### E. Other epidemiology

Tracing sales from infected herds and testing swine exposed to SB by "boar borrowing," broken fences, across-fence contact, etc., are basic to the efficient eradication of SB. MST alone cannot be expected to identify all infected swine herds rapidly and efficiently.

A VS Form 4-108 (Epidemiologic Investigation), VS 4-108A (Origin of Reactor/Herd Addition), VS 4-108B (Animals Removed From Infected Herd), VS 4-108C (Epidemiology Report-Suspect Herd), or similar document is required for all herds determined to be infected and should be completed within 30 days of a positive diagnosis. All exposed herds should be located as rapidly as possible. A ~~CHT~~ epidemiologically appropriate sampling of the exposed herds should be conducted within 30 days of locating the index herd, as determined by the designated brucellosis epidemiologist. 

A successful epidemiologic investigation of a traceback of an MST reactor to a "sold out" herd requires further work even when all swine are determined to have been slaughtered. Potential sources of infection must be investigated as well as potentially infected exposed herds.

#### F. Bacteriology

Prior to the slaughter of SB reactors, arrangements should be made for tissue collection. The tissues will be frozen and submitted to a State-approved diagnostic laboratory or the National Veterinary Services Laboratories (NVSL) for bacteriologic culture per applicable VS memoranda. Preferred tissues in order of priority include mandibular, gastrohepatic, internal iliac, suprathyroid, and superficial inguinal lymph nodes. In addition, any tissues showing inflammatory lesions such as abscesses should be cultured. These are most likely to be seen in the reproductive organs—testes, epididymis, and seminal vesicles in males and uterus and ovaries in females—and in the bones and joints of either sex. 

#### G. Reclassification of reactors and suspects

Swine classified as SB reactors or suspects may be reclassified by the designated brucellosis epidemiologist when there is sufficient bacteriologic, serologic, and/or epidemiologic justification.

Swine herds with a brucellosis reactor must be maintained under quarantine until the designated brucellosis epidemiologist makes a final decision and classification.

#### H. Surveillance

All **Stage I and Stage II** States must require change of ownership testing for all commercial, transitional and feral breeding swine. All livestock markets in **Stage I and Stage II** States must require first-point testing on all commercial, transitional and feral breeding swine.

All **Stage III** States must require change of ownership testing for all ~~transitional and feral~~ breeding swine. All livestock markets in **Stage III** States must require first-point testing on all ~~transitional and feral~~ breeding swine.

### Part IV – Herd-Cleanup Plans

#### A. General considerations

1. Identification – All swine from which a blood sample is collected for official SB testing must be identified, when bled on the farm, with externally visible, permanent, individual identification. Acceptable identification includes official eartags, visible tattoos, or ear notches when the ear notch has been recorded in the book of record of a purebred registry association. 

Reactor swine must be identified with an approved reactor tag in the left ear, unless euthanized on-farm or shipped off farm in a sealed transport vehicle 

2. Retesting reactors – The herd owner or designated brucellosis epidemiologist may request a retest of SB reactors within 3 days following notification of test results.
3. Cleaning and disinfection – The premises of a known infected herd must be cleaned and disinfected under State or Federal supervision within 15 days after reactors have been removed for slaughter. The time may be extended another 15 days for reasons mutually acceptable to the cooperating State and Federal officials in charge. The requirements of 9 CFR Part 51.8 must be met to qualify for Federal indemnity.
4. Quarantines – All swine in infected herds must be confined to the premises under State quarantine until the the reactors have been euthanized and the test negative members of the herd have been sold to slaughter under permit or declared eligible for release in accordance with the approved herd plan.

~~Three negative CHT's are required for quarantine release, with the first conducted at least 30 days following removal of all SB reactors for slaughter. The second CHT must be conducted 60-90 days after the first one. A third CHT is required 60-90 days following the second CHT.~~
5. Movement of reactor and exposed swine – SB reactors must be euthanized on the farm or identified with an official reactor tag in their left ear and be removed from the infected herd under State or Federal permit within 15 days of owner notification of reactor classification. Reactor and exposed swine must receive permits only for immediate slaughter directly to a recognized slaughtering establishment, or to an approved slaughter market for resale to a recognized slaughtering establishment. During shipment, reactor and exposed swine must be transported separate and apart from all swine that will subsequently be used as breeding animals.

#### B. Herd-Cleanup Plan 1. Depopulation/Repopulation

This plan is recommended for commercial herds and seed stock producers who wish to eliminate SB from their herd rapidly:

1. Sell the entire herd for slaughter as soon as practicable.
2. Clean and disinfect buildings and equipment.
3. Restock premises with animals from validated SB-free herds, placing them in facilities approved by Federal and State personnel and empty a sufficient period to insure no survival of B. suis in the environment, on ground that has been free of swine for at least 30 days. 

#### C. Herd-Cleanup Plan 2. Offspring segregation

This plan is recommended only when the owner wants to preserve genetic qualities in the herd:

1. Separate gilt pigs from their dams at 28 days of age or less and isolate the gilts from other swine. These gilts form the nucleus for establishing the free herd.
2. Completely isolate infected breeding animals. Infected sows and boars should be slaughtered as soon as possible.
3. Test the isolated gilts about 30 days before breeding. Save only the gilts that are negative. Breed them only to negative boars.
4. Retest gilts after farrowing and before removing them from individual farrowing pens or crates. If reactors are found, they should be segregated from the remainder of the herd and slaughtered as soon as possible. Select only pigs from negative sows for breeding gilts.
5. If reactors are found in step 4, repeat the process, beginning with step 1.

6. After three consecutive negative CHT's, the herd is eligible for release from quarantine. The first CHT must be administered at least 30 days after all reactors have been removed and slaughtered, and the second CHT must take place 60 – 90 days after the first test. A third CHT is required 60 – 90 days following the second CHT.

#### ~~D. Herd Cleanup Plan 3. Test and removal of reactors~~

~~This plan is not generally recommended but may be useful in herds with only a few reactors and no observed clinical signs of SB:~~

- ~~1. Sell reactors for slaughter.~~
- ~~2. Retest the breeding herd at 30 day intervals, removing reactors for slaughter, until the entire herd is negative.~~
- ~~3. If the herd is not readily freed of infection, abandon this plan in favor of Plan 1 or Plan 2.~~
- ~~4. After four consecutive negative CHT's, the herd is eligible for release from quarantine. The first CHT must be administered at least 30 days after all reactors have been removed and slaughtered, and the second CHT must take place 60 – 90 days after the first test. A third CHT is required 60 – 90 days following the second CHT. A fourth CHT is required 6 months after the third CHT.~~

## Part V – Validated Swine Brucellosis – Free Herds

### A. Initial validation or revalidation

1. Swine herds may be validated or revalidated as SB free by conducting a CHT that has negative results, or
2. By subjecting all breeding swine over 6 months of age to an incremental CHT through testing 25 percent of the swine over 6 months of age every 80 – 105 days and finding all swine so tested negative, or by testing 10 percent of the swine over 6 months of age each 25 – 35 days and finding all swine so tested negative. No swine may be tested twice in 1 year to comply with the 25-percent requirement, nor twice in 10 months to comply with the 10-percent requirement. A herd may be validated as SB free when all its breeding swine have been tested and found negative, or
3. Swine herds may be validated or revalidated as SB free if all samples are tested SB negative when establishing a Qualified Pseudorabies-Negative (QN) ~~or Qualified Negative Gene Altered Vaccinated (QNV) breeding herd.~~
4. Swine grow-out premises on which no adult breeding swine are maintained may be validated or revalidated as Swine Brucellosis free if all samples are tested by the same schedule described for establishing a pseudorabies Qualified Negative grow-out premises on which no adult breeding swine are maintained.

### B. Maintaining validation

1. Validation is good for a maximum of 12 months without further testing. At the end of this time, the herd must be revalidated. There is no grace period.
2. Validation may be continuously maintained by testing 25 percent of the swine over 6 months of age every 80 – 105 days and finding all swine so tested negative, or by testing 10 percent of the swine over 6 months of age each 25 – 35 days and finding all swine so tested negative. No swine may be tested twice in 1 year to comply with the 25-percent requirement nor twice in 10 months to comply with the 10-percent requirement, or
3. Validation may be maintained by testing SB negative all samples submitted to maintain QN ~~or QNV~~ herds in the PRV program.

## C. General considerations

1. Duration of validated swine brucellosis-free status—A herd may maintain its SB-free status for a maximum of 12 months. There is no grace period.
2. Clinical signs – There must be no evidence of infection at the time of initial validation or revalidation.
3. Suspects – Swine that are positive to an official SB presumptive test and negative to a confirmatory test should be evaluated by a designated brucellosis epidemiologist.
4. Reactors – When an animal that reacts positively to the card test is found in a validated herd, the infection status of that animal, and ultimately the herd, must be determined by a designated brucellosis epidemiologist. Once a herd is determined to be infected, the herd will be held under quarantine until it meets the quarantine release requirements of Part IV. Card-positive reactors that are classified as suspect by the DBE may be retested once within 45 days of the original test. If they remain card positive the suspect should be slaughtered and samples taken for culture examination in accordance with Part III, F. Bacteriology unless otherwise directed by the Designated Brucellosis Epidemiologist. 
5. Movement of swine into a validated swine brucellosis-free herd
  - a. Movements between validated SB-free herds do not require an official SB test.
  - b. Movement of breeding swine from a nonvalidated SB-free herd requires one negative presumptive test within 30 days prior to movement. These animals must be isolated and retested 30–60 days after arrival.
  - c. Breeding swine are not permitted to enter SB-free herds from feedlots or slaughter consignments.
6. Use of swine semen in swine brucellosis-free herds – All semen used must come from boars in validated SB-free herds.

## Part VI – Laboratory Procedures and Test Interpretation Not reviewed yet by Steve Hennager

### A. Laboratories

All official SB tests must be conducted in State–Federal laboratories that have been specifically approved for conducting SB serology.

All blood samples that have been tested for SB at a market or other site as part of an official State program must be submitted to a laboratory designated by local program animal health officials within 24 hours of testing at the market or other site.

Approved laboratories and personnel will be monitored annually to ensure quality of laboratory procedures. A cooperative system among the States and NVSL will be utilized to assist approved laboratories in ensuring quality control through employee training and performance evaluation, including an annual series of check tests.

### B. Diagnostic reagents

Antigens used for conducting SB serology will be distributed to approved laboratories, approved State and Federal personnel, and accredited veterinarians designated to conduct SB serology at markets.

### C. Tests

All serums that are positive to a standard card test must be confirmed by one or more confirmatory tests.

1. Presumptive tests

- a. Buffered acidified plate antigen (BAPA) test – The BAPA test is used to identify sera to be tested with the standard card test. A test will be interpreted as positive whenever any agglutination is observed. All sera positive to a BAPA test should be subjected to a standard card test.
- b. Standard card test (SCT) – The SCT is used to classify swine as positive or negative. All swine positive to an SCT should be subjected to a confirmatory test.
- c. Rapid Automated Presumptive (RAP) test. An automated serologic test to detect the presence of Brucella antibodies in test-eligible swine. RAP test results are interpreted as either positive or negative; the results are interpreted and reported by a scanning autoreader that measures agglutination based on alterations in light transmission through each test well. Swine negative to the RAP test are classified as brucellosis negative; swine positive to the RAP test shall be subjected to other official tests to determine their brucellosis disease classification.

2. Confirmatory tests

- a. Standard tube test (STT) – If all of the following apply:

- (1) The swine are part of a herd not known to be infected,
- (2) no swine tested, individually or as part of a group, has a complete agglutination reaction at a dilution of  $\geq 1:100$ , and
- (3) the swine are tested as part of a herd blood test or are part of a validated brucellosis-free herd, then the swine are classified according to the following agglutination reactions:

				<u>1:25</u>	<u>1:50</u>	<u>1:100</u>	
I	–	–					Negative
+	–	–					Negative
+	I	–					Negative
				+	+	–	
+	+	I					Negative

– = No agglutination  
 I = Incomplete agglutination  
 + = Agglutination

If any of the following apply: (1) The swine are part of a herd known to be infected, (2) any swine tested, individually or as part of a group, has a complete agglutination reaction at a dilution of  $\geq 1:100$ , or (3) the swine are not part of a validated brucellosis-free herd and are not being tested as part of a herd blood test, then the swine are classified according to the following agglutination reactions:

<u>1:25</u>	<u>1:50</u>	<u>1:100</u>					
I	–	–	Negative				
				+	–	–	Reactor
+	I	–	Reactor				
+	+	–	Reactor				
+	+	I	Reactor				
+	+	+	Reactor				

- b. Particle concentration fluorescence immunoassay (PCFIA) test – The results of the PCFIA test are interpreted as follows:

$< 5$  = reactor

5 – 7 = suspect  
 > 7 = negative

c. Fluorescence polarization assay (FP assay). An automated serologic test to determine the brucellosis status of test-eligible swine when conducted according to instructions approved by APHIS. FP assays are interpreted as either positive, negative, or suspect. A 40-microliter sample is used. If a sample reads <10 millipolarization units (mP) above the mean negative control, the sample is considered negative. If a sample reads >20 mP above the mean negative control, the sample is considered positive. Samples that read between 10 and 20 mP above the negative control mean must be retested using 40 microliters of sample. If the 40-microliter sample is >20 mP above the mean negative control, the sample is considered positive. If the 40-microliter sample is still in the 10 to 20 mP range above the mean negative control, the sample is considered suspect. If the 40-microliter sample is <10 mP above the mean negative control, the sample is considered negative. Swine with negative FP assay results are classified as brucellosis negative. Swine with positive FP assay results are classified as brucellosis reactors, while swine with suspect FP assay results are classified as brucellosis suspects.

3. Confirmatory tests not standardized nor official (to be used and have their results evaluated by the designated brucellosis epidemiologist)

a. Rivanol test

*Interpretation of the rivanol test*

Negative I @ 1:25 or less  
 Positive + @ 1:25 or greater

b. Complement fixation (CF) test (manual)

*Interpretation of manual CF test results*

Negative 1+ @ 1:10 or less  
 Suspect 2+ @ 1:10 through 1+ @ 1:20  
 Positive 2+ @ 1:20 or greater

Degree of fixation of complement:

1+ = 25 percent                      3+ = 75 percent  
 2+ = 50 percent                      4+ = 100 percent

c. Semen plasma test – The semen plasma test is approved as an official test in boars used for artificial insemination when used in conjunction with the card test and/or the standard tube test. The classification of such animals shall be based on the maximum agglutination titer of either test.

d. Standard plate test – Interpretation of results of the standard plate test in an infected herd is made in accordance with the following chart:

<u>1:50</u>	<u>1:00</u>	<u>1:200</u>	
–	–	–	Negative
I	–	–	Suspect
+	–	–	Suspect
+	I	–	Suspect
+	+	–	Reactor
+	+	I	Reactor
+	+	+	Reactor

## Part VII – Program Stages

### Stage I (Preparation and Control)

#### A. Establishment of status

The application for Stage I status shall certify and include documentation that the following standards are met:

1. The State has legal and regulatory authority to:
  - a. Place and maintain a quarantine on any premises on which swine are infected with or exposed to SB;
  - b. Regulate intrastate movement of swine that are infected with or exposed to SB;
  - c. Perform the necessary tests and epidemiologic investigations to determine the presence or absence of brucellosis in swine;
  - d. Require proper identification and disposal of brucellosis-infected and exposed swine;
  - e. Require cleaning and disinfection of premises, vehicles, and equipment that may have been contaminated by SB-infected swine;
  - f. Control procedures for conducting and reporting results of all SB tests;
  - g. Require herd-of-origin identification of slaughter sows and boars moving intrastate. The identification should be compatible with the farm-of-origin externally visible identification methods approved for swine moving interstate;
  - h. Require records that facilitate tracing slaughter sows and boars to their farms of origin;
  - i. Require that all breeding swine sold or transferred originate from validated SB-free herds or are negative to an official SB test within 30 days prior to change of ownership;
  - j. First-point testing shall be required on all breeding swine passing through markets;
  - k. Control the intrastate movement and importation of feral swine; )
  - l. Require that all herds that market swine semen be validated SB free and be subjected to an annual CHT;
2. A State SB eradication committee or swine disease committee is established, and its membership includes swine producers and representatives of other swine industry groups.
3. A validated SB-free herd program is in effect.
4. States in Stage I must carry out the following additional procedures:
  - a. Quarantine and promptly test all MST reactor herds. When the designated brucellosis epidemiologist determines that a herd is infected, the herd should be depopulated within 30 days, or a herd- cleanup plan should be implemented.
  - b. Tag and slaughter reactors within 30 days of confirming a herd as infected with SB.
  - c. Distribute available SB-eradication literature to the swine industry.
  - d. A designated brucellosis epidemiologist should determine whether or not to investigate MST suspects and the extent of testing required on a case-by-case basis.

5. Swine importation is controlled as follows:
  - a. Breeding swine: Must have a negative 30-day presumptive test or originate in a validated SB-free herd or State.
  - b. Feeding and slaughter swine: All movements are permitted as long as there is no contact with breeding swine.
6. Transmission of disease from ~~wild or~~ feral swine shall be controlled as follows:
  - a. ~~Wild or~~ Feral swine may be moved to immediate slaughter. Movement to hunting preserves or game farms is not classified as shipment to slaughter.
  - b. ~~Wild or~~ Feral swine moved to hunting preserves, game farms, exhibitions, or feeding areas, etc., ~~are from monitored free populations or~~ are found negative to an official SB screening test conducted 30 days or less prior to interstate shipment, and these ~~wild or~~ feral swine are imported by permit of the State animal health official.
  - c. ~~Wild or~~ feral swine moved for breeding purposes must be held separate and apart from all domestic commercial production and transitional production swine and be found negative to two official SB tests conducted at least 60 days apart.
  - d. Any commercial production and transitional production swine that have had known exposure to ~~wild or~~ feral swine must be separated from ~~wild or~~ feral swine and quarantined until release according to subsection c. immediately above.
7. All hunting preserves and game farms that include any **resident** swine must be under surveillance by State animal health officials.

## B. Maintenance of status

~~Thirty-six to 40~~ Twelve (12) months following assignment of Stage I status by VS, a State may indicate that it continues to meet Stage I requirements utilizing the Stage I certification procedure or certify that it meets the requirements of a subsequent Program stage. States failing to recertify as required will automatically lose their Stage I status.

## Stage II (Surveillance)

### A. Establishment of status

States may apply for Stage II status whenever they feel the requirements are met.

The application for Stage II status shall certify that the following standards are met:

1. Stage I standards are implemented;
2. An active program to locate and eliminate SB has been instituted. Current statistics on breeding swine population provided by the USDA, National Agricultural Statistics Service, will be used to calculate surveillance data unless a farm-by-farm survey of all swine producers that provides more accurate data is conducted. The surveillance program must be random and must be representative of all herds in the State. One of the following surveillance programs has been implemented:
  - a. Complete herd (area) testing. An official SB test of all breeding swine 6 months of age and older in the State was conducted within the 2-year period prior to the Stage II status request; or
  - b. During the 2-year period prior to the request for Stage II status, the State's commercial breeding swine population, at a rate of 10 percent annually, was subjected to an official SB test with successful annual traceback of at least 80 percent of MST reactors to their farm of origin. Blood samples may be collected at markets and/or slaughter establishments from breeding swine identified to their farms of origin by official

backtags or other specifically approved slaughter sow/boar identification devices or when farm-of-origin identity is otherwise available. All MST reactor herds must be subjected to a CHT or DBE-directed appropriate surveillance method within 30 days following the laboratory report date; or

- c. An analysis of the results of all SB testing conducted during the 2-year period (MST, diagnostic, change of ownership, herd validation, etc.) demonstrates a surveillance level equivalent or superior to the above two surveillance programs.

3. States must develop and adopt a management plan that adequately separates and addresses control of the interface of feral swine with commercial swine. The plan is to be reviewed by the National Center for Animal Health Programs Staff.

## **B. Maintenance of status**

~~Every 12 months, simultaneous to reporting its PRV status Thirty-six to 40 months following assignment of Stage II status by VS;~~ a State may indicate that it continues to meet Stage II requirements utilizing the Stage II certification requirements or certify that it meets the requirements of a subsequent Program stage. States failing to recertify as required will automatically lose their Stage II status.

## **Stage III (Free)**

### **A. Establishment of status**

States may apply for Stage III status whenever they feel the requirements are met.

The application for Stage III (free) status shall certify and document that the following standards are met:

1. Stage II standards are implemented, and its requirements are fulfilled.
2. Herd infection rate

During the 2-year qualification period, no more than one SB-infected commercial breeding swine herd was identified; and any SB-infected herd found during the 2-year qualification period was depopulated or tested and determined free of SB by a designated brucellosis epidemiologist. If more than one SB-infected herd was disclosed during the 2-year qualification period, a new qualification period must be established.

3. Epidemiology – See part III.
4. States must develop and adopt a management plan that adequately separates and addresses control of the interface of feral swine with commercial swine. The plan is to be reviewed by the National Center for Animal Health Programs Staff.

### **B. Maintenance of status**

~~Every 12 months, simultaneous to reporting its PRV status, Thirty-six to 40 months following assignment of Stage III status by VS;~~ a State shall report ~~may indicate~~ that it continues to meet Stage III requirements. States failing to recertify as required will automatically lose their Stage III status. During the revalidation period, State and Federal officials are responsible for continuously monitoring Program activity. To maintain Stage III status, a State must survey on a random basis at least 5 percent of its breeding swine annually and demonstrate traceback of 80 percent or more of all MST reactors to their herds of origin.

### **C. Termination of status**

Stage III status may be terminated at any time during the validation period with 10 days' notice if:

1. The State does not maintain adequate surveillance; or
2. The State fails to comply with quarantine requirements and testing schedules; or

3. The State permits improper disposal of reactors; or
4. Infection is disclosed in a commercial production swine herd with evidence of spread to other commercial production swine herds.

**D. Reinstatement of terminated status**

When Stage III status is lost due to deficiencies in surveillance or in procedures necessary for locating infected herds, in controlling infected and exposed swine, or in eliminating infected swine, as prescribed under the various plans and procedures, Stage III status shall be reinstated when State and Federal officials present sufficient evidence that the procedural deficiencies have been corrected.

**Part VIII - ~~Quarterly~~ Monthly Reports**

All SB program States will submit a ~~quarterly~~ monthly report to the APHIS, VS, NCAHP Staff. The report must provide basic Program data, including infected herd information.

The national SB ~~quarterly~~ monthly and annual reports will be compiled from data provided by the State ~~quarterly~~ monthly reports. These reports will be used by State-Federal-Industry SB Program managers in conducting the national SB eradication program.

**STATUS REPORT – FISCAL YEAR 2005**  
**COOPERATIVE STATE-FEDERAL BRUCELLOSIS ERADICATION PROGRAM**

Debbi A. Donch – National Brucellosis Epidemiologist  
Arnold A. Gertonson – Yellowstone Brucellosis Activities Coordinator  
Jack C. Rhyan – Senior Staff Veterinarian – Wildlife  
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Fiscal Year (FY) 2005 was beleaguered by the increasing threat of transmission of brucellosis from infected wildlife reservoirs to domestic livestock herds. Brucellosis affected wildlife are considered the most likely source of infection for three of the five brucellosis affected herds disclosed in FY 2005. In keeping with recommendations in the Brucellosis Emergency Action Plan (BEAP) of 1997, Wyoming focused its epidemiologic investigation and testing activities on community and contact herds associated with the brucellosis affected herds found in FY 2004. This resulted in finding one additional brucellosis affected cattle herd in Wyoming in FY 2005. Brucellosis affected wildlife in the area have been epidemiologically linked to these Wyoming brucellosis affected cattle herds. Iowa and Georgia disclosed one brucellosis affected swine herd each in FY 2005. Brucellosis affected feral swine in the area were identified as the most likely source of infection for both of these herds. Again, in keeping with recommendations in the BEAP of 1997, Texas continued its vigilance in both primary and secondary surveillance activities which led to the disclosure of two brucellosis affected cattle herds in FY 2005. Ultimately, the overall status of the Cooperative State-Federal Brucellosis Eradication program for cattle remained status-quo in FY 2005 with forty-eight states classified as Brucellosis Class Free and two states, Texas and Wyoming, classified as Class A. All states except Texas were classified as Stage III (Free) for swine brucellosis in FY 2005; Texas remains at Stage II for swine brucellosis.

A total of three new brucellosis affected cattle herds were disclosed in FY 2005. This compares to seven new brucellosis affected cattle herds disclosed in FY 2004, two new affected cattle herds disclosed in FY 2003, nine new affected cattle herds in FY 2002, six in FY 2001, and fourteen in FY 2000. Two of the three FY 2005 brucellosis affected cattle herds were found in Texas, the only state yet to achieve Class Free state status. The third brucellosis affected cattle herd was found in Wyoming. It was a herd which commingled and shared common grazing ground with one of the brucellosis affected cattle herds found in Wyoming in FY 2004. Wyoming is nearing completion of a twelve-consecutive month period without disclosing any additional brucellosis affected cattle herds and may be eligible to apply for reinstatement of Class Free state status.

The first of the two brucellosis affected cattle herds disclosed in Texas in FY 2005 was located in Jack County, Texas. It was identified through MCI testing (reactor animal identified via first-point testing at market) in December 2004. *Brucella abortus* biovar 1 was cultured from milk from the reactor cow. Pursuant to the culture confirmation, the herd was officially classified as a brucellosis affected herd in January 2005. Serology testing of the herd of origin, a small beef herd, revealed an additional reactor animal which subsequently cultured positive for *Brucella suis* biovar 1. The entire herd was depopulated with indemnity; no additional brucellosis affected cattle herds were disclosed as associated with this herd. The second brucellosis affected cattle herd was disclosed in Hardin County, Texas in August 2005, again via first-point testing at market. *Brucella abortus* biovar 1 was isolated from both milk and tissue from the reactor cow. The herd of origin, a small beef cattle herd, was tested; all cattle were negative on all serology tests. This herd remains under quarantine; the herd plan stipulates herd depopulation if additional reactor animals are found on subsequent whole herd serology testing. The epidemiologic investigation revealed no additional brucellosis affected cattle herds associated with this herd. No conclusive source of infection was identified for either brucellosis affected cattle herd disclosed in Texas; the reactor animals were possibly exposed prior to purchase.

The brucellosis affected cattle herd disclosed in Wyoming in FY 2005 was located in Teton County, Wyoming. This herd, a contact herd associated with a brucellosis affected cattle herd disclosed in FY 2004, was tested in November 2004 pursuant to an MCI traceback. Four brucellosis reactor cattle were identified on the herd test. *Brucella abortus* biovar 4 was cultured from the reactor cattle. The herd, a large purebred and commercial beef cattle herd, was depopulated with indemnity. A thorough epidemiologic investigation disclosed no additional brucellosis affected cattle herds associated with this herd. The index herd had contact with both elk and bison in the Greater Yellowstone Area. Infected wildlife previously confirmed to be infected with the same biovar of *Brucella* are the most likely source of infection.

FY 2005 Brucellosis Program activities also focused on training and on area level program reviews. Three Basic Brucellosis Epidemiology (BBE) courses, two in the U.S. and one in Mexico, and two Designated Brucellosis Epidemiologist (DBE) Refresher courses were conducted in FY 2005, expanding the knowledge base and expertise of over 140 U.S. animal health officials and over 70 animal health officials, including SAGARPA, in Mexico. This training improved our capabilities to eradicate brucellosis, maintain the economic viability of the U.S. cattle industry, and effectively execute risk mitigation actions to assure equivalency of brucellosis eradication and surveillance program efforts across international borders. Two thorough state brucellosis program reviews, one in California and one in Wyoming, and a series of mini-program reviews in Texas were conducted to assure compliance with program regulations and program standards, review resource needs, and insure that program management at all levels is held accountable for proper and expedient execution of all aspects of the Brucellosis program.

USDA APHIS VS continued to support projects to evaluate potential brucellosis vaccine candidates in FY 2005. Two of these projects were conducted at Louisiana State University's (LSU) AgCenter. They include the evaluation of a rough vaccine candidate of *Brucella suis* in cattle for potential use in wildlife, primarily elk. Previous data in mice and swine demonstrated that this vaccine strain provides protective immunity against virulent smooth strains of *Brucella* species. The purpose of this project is to determine if the vaccine candidate, VTRS-1, can lead to sufficient colonization of cattle without any adverse pathology, primarily abortions. Preliminary results indicate that non-pregnant cattle are transiently colonized with the strain and it does not cause any abortions in pregnant animals. The second project conducted at LSU in FY 2005 involved the evaluation of two rough vaccine strains, RB51 and VTRS-1, in swine to protect against brucellosis and pseudorabies. These vaccine strains have been modified to express glycoprotein D of the pseudorabies virus. The purpose of this project was to determine immune responses, safety, and efficacy of the vaccines. Thus far the vaccines induce measurable humoral immune responses and have proven to be non-pathogenic in pregnant sows. Currently, efficacy studies are being evaluated. Also in FY 2005, the Brucellosis program partnered with USDA Agricultural Research Services' National Animal Disease Center on a project to assess various *Brucella* species found in feral swine. Feral swine populations in Florida and Texas are being evaluated for brucellosis to enhance our understanding of the risks posed by this wildlife population in regards to sustaining and possibly transmitting brucellosis to domestic livestock herds.

#### Brucellosis in the Greater Yellowstone Area (GYA):

During the winter and spring of 2004/05, the Bison Quarantine Facility (BQF) in Corwin Springs, Montana, was upgraded with double fencing and working facilities to meet the requirements listed for bison quarantine in the UM&R. In March and April of 2005, the Montana Department of Livestock provided 17 bison calves to the study. The calves were captured on State land after migrating out of YNP. These animals tested seronegative on initial screening tests (FPA and/or card test). Since April the bison have been tested four times and three animals have been eliminated due to positive titers. One was initially positive on tests other than the card test. Two animals seroconverted after being placed in quarantine. Additional animals will likely be added to the initial cohort in the spring of 2006.

In other ongoing developmental work, APHIS VS and ARS are conducting an efficacy trial in elk of an experimental RB51 vaccine with two plasmid inserts to enhance immunogenicity. The vaccine was developed and provided by Dr. Gerhardt Schurig. The elk were parenterally vaccinated in September, one group orally boosted in October, and all will be challenged in January '06.

APHIS VS and Wildlife Services continue to develop a GnRH vaccine for use in preventing brucellosis transmission in bison and elk. Bison work has demonstrated two to three years of infertility following a single injection. APHIS is collaborating with the State of Wyoming and Colorado State University (CSU) on the project in elk; preliminary results show efficacy for at least one year.

In a pilot study conducted by APHIS VS and CSU APHI to examine the potential role of venereal transmission of brucellosis in bison, three of eight females in which strain 19 was instilled in the anterior vagina, developed humoral antibody to *B. abortus*.

A Greater Yellowstone Interagency Brucellosis Committee (GYIBC) Memorandum of Understanding (MOU) draft was agreed upon by the U.S. Departments of Agriculture (USDA) and Interior (USDI). The draft was submitted to

the Governors of the Greater Yellowstone Area (GYA) states (Montana, Idaho and Wyoming) in June 2005 for their review and concurrence. USDA has received no response from the GYA states to date.

The Grand Teton National Park (GTNP) National Elk Refuge (NER) Bison and Elk Management Plan and Environmental Impact Statement (EIS) draft was released for public comment. There are six alternatives in the draft EIS. USDA APHIS VS has commented in support of adopting alternative 6. This alternative would best meet the goal of prevention, control and eradication of diseases in the GYA.

The validation of the fluorescent polarization assay for brucellosis testing of elk sera is proceeding. The goal is to have 50 percent of the elk serum samples necessary for validation collected during fiscal year (FY) 2006 and validation completed during FY 2007.

The GYA states, Idaho, Montana, and Wyoming, began developing herd plans for livestock and wildlife in the GYA in FY 2005. All three states have designated personnel to accomplish this task. The development of these herd plans is also a recommendation of the Wyoming Brucellosis Coordination Team (BCT).

APHIS VS personnel assisted Interagency Bison Management Plan (IBMP) bison management operations. Hazing operations (116) of 2648 bison were performed. All but 78 bison were successfully hazed back into Yellowstone National Park. Capture operations (nine) resulted in the capture of 134 bison. Sixty-six of the bison tested brucellosis positive and were sent to slaughter. Sixty-eight bison tested brucellosis negative and were released or placed in the bison quarantine feasibility study facility.

Brucellosis Program Surveillance Activities:

*[The following surveillance statistics for the cattle and swine brucellosis eradication programs are based on data available as of October 31, 2005. Normal reporting time allowances for states to gather and submit monthly data preclude ascertainment of all data for FY 2005.]*

Throughout Fiscal Year 2005, 48 States and three Territories remained classified at Brucellosis Class Free status, and two States, Texas and Wyoming, continued their Brucellosis Class A status classification for bovine brucellosis. Cattle inventories in the U.S. for FY 2005 were distributed as follows: 15.81% of all cattle and 15.75% of all cattle herds were located in the two Brucellosis Class A states; 53.34% of all cattle and 46.52% of all cattle herds were located in states that have held Brucellosis Class Free status for at least ten years (16.90% of all cattle and 17.17% of all cattle herds were located in states that have held Brucellosis Class Free status for five years or less; 36.44% of all cattle and 29.35% of all cattle herds were located in states that have held Brucellosis Class Free status for six to ten years). Approximately 30.92% of all cattle and 37.73% of all cattle herds were located in states that have held Brucellosis Class Free status for at least eleven years or more (with 15.25% of all cattle and 18.72% of all cattle herds residing in states that have held Brucellosis Class Free status for greater than 20 years).

Three brucellosis affected cattle herds, two in Texas and one in Wyoming, were identified via Market Cattle Identification (MCI) surveillance testing in FY 2005. The national herd prevalence rate for bovine brucellosis was 0.00029% in FY 2005. Two brucellosis affected swine herds, one in Georgia and one in Iowa, were identified via herd validation and swine brucellosis surveillance program testing in FY 2005. Per the Brucellosis Emergency Action Plan (BEAP) recommendation, four of the five brucellosis affected herds were depopulated with indemnity and thorough epidemiologic investigations were completed on all five herds, disclosing no additional brucellosis affected herds.

Maintaining brucellosis state status focuses on continual surveillance activities. Two primary surveillance activities are conducted for bovine brucellosis, Market Cattle Identification (MCI) testing and Brucellosis Milk Surveillance Testing (BMST). During FY 2005, APHIS tested approximately 8.061 million head of cattle under the MCI surveillance program. Brucellosis program standards require testing of a minimum of 95% of all test-eligible slaughter cattle. In FY 2005, approximately 96.42% of all test-eligible slaughter cattle were tested. First-point testing at livestock markets is required in Brucellosis Class A states. Twelve Brucellosis Class Free states continue to conduct first-point testing at markets to enhance their surveillance activities. Brucellosis program standards require a minimum of 90% successful traceback of all MCI reactor cattle. In FY 2005, approximately 98.6% of all MCI reactors were successfully traced and investigated resulting in successful case closures. Approximately 640,000 additional head of cattle were tested on farms or ranches during FY 2005, bringing the total cattle tested for brucellosis in FY 2005 to approximately 8.701 million head. BMST surveillance is conducted

in all commercial dairies - twice in Class Free states and four times in Class A States. Suspicious BMSTs are followed up with an epidemiologic investigation. 2004 National Agricultural Statistics indicate there were 81,440 dairy operations in the U.S. There were approximately 171,000 BMST conducted in FY 2005; approximately 200 of those BMSTs yielded suspicious results on initial screening. All suspicious BMSTs in FY 2005 were confirmed negative by subsequent epidemiologic investigations and additional herd testing.

There were approximately 4.061 million calves vaccinated for brucellosis in FY 2005. The national calfhood vaccination policy recommends proper calfhood vaccination in high risk herds and areas. It also recommends the elimination of mandatory vaccination in all states.

There are two main swine surveillance activities directed at validating state's swine brucellosis status. These activities include Market Swine Testing (MST) and herd validation (required of all commercial herds in some states). MST surveillance is conducted on cull sows and boars. There were approximately 60,000 cull sows and boars eligible for MST surveillance in FY 2005. Approximately 103,000 additional swine were tested on farm, mainly for herd validation purposes.

USDA, APHIS' focus continues to center on finding and eliminating the last remnants of brucellosis in the United States domestic cattle, bison, and swine herds.

## GREATER YELLOWSTONE AREA BRUCELLOSIS

Keith Aune and Thomas F. T. Linfield

**Proposal to Conduct Bison Quarantine Feasibility Study (BQFS).** The Montana-Yellowstone National Park Interagency Bison Management Plan (IBMP) did not include specific provisions to establish a bison quarantine facility. However, it did consider whether a quarantine facility would be an appropriate component of the plan and concluded that bison removed from the population could be used for approved research or sent to quarantine. It also indicated that further environmental review would be completed to determine the design, location and operation parameters for a bison quarantine facility. Montana Fish, Wildlife and Parks and USDA/APHIS jointly developed a quarantine feasibility research proposal. The project was designed to be an adaptive research effort with several phases associated with the step-wise development of appropriate temporary quarantine facilities and progressive hypothesis testing. The goals of the BQFS are: (1) Development of scientific procedures that could lead to successful quarantine, (2) Species and genetic conservation in North America-Prevent listing under ESA, and (3) To develop a new tool for population management in the GYA. Developmental objectives of the BQFS include: (1) Implement a 3-phased study under an adaptive framework, (2) Carefully measure uncertainty-data will be critical for risk assessment, (3) Attempt to keep initial investment temporary and minimal, (4) Remain consistent with IBMP, (5) Include conservation education as a component, and (6) Provide opportunities for Native American participation in restoration efforts.

Implementation of phase I of the study was initiated the winter of 2005. Seventeen sero-negative bison calves captured through the winter-spring by the agencies while implementing the IBPM were introduced into the study. Of these, three sero-converted on subsequent testing and were removed from the study. *Brucella abortus* biovar 1 was subsequently isolated from all three of these bison calves that sero-converted. Capture will occur during the 2005-06 winter to assemble the first test group of 100 animals (including these first 14) and assembly of a second test group of 100 animals is anticipated during the 2006-07 winter.

To continue this feasibility study into Phase II and III it is necessary to complete an additional joint NEPA/MEPA compliance document and to conduct an appropriate public review and decision process. The environmental assessment (EA) will evaluate impacts to the human environment associated with several alternatives and any decision to proceed to Phase II and III. Work is progressing on a draft EA, which will include at least four alternatives. The anticipated date for a decision is December 16, 2005. A decision to advance this feasibility research will incorporate the findings from the Phase I study and construction associated with Phase II and III will be dependent upon the evaluation of results from Phase I. Construction may start on a Phase II site in the summer of 2006, after a decision notice is released and a land lease obtained. Several potential private partners remain interested in lease arrangements and public lands are being further examined for Phase III site if it becomes necessary.

### **Interagency Bison Management Plan (IBMP)**

A partnership of state and federal agencies (National Park Service, USDA Forest Service, USDA Animal and Plant Health Inspection Service, Montana Department of Livestock, and Montana Fish, Wildlife and Parks) that manage bison in and around Yellowstone National Park recently completed a five-year status review of the Interagency Bison Management Plan (IBMP), implemented in December 2000. The review looked at the accomplishments to date and evaluated them against the adaptive management procedures outlined in the IBMP. Under the IBMP's adaptive management strategy, future management actions can be adjusted based on feedback from implementation of the proposed risk management actions. This allows the agencies to gain experience and knowledge before proceeding to subsequent management steps. The review was done to determine if the goals of the IBMP are being met, evaluate the status of the objectives outlined in Step 1 of the plan over the first five years of operations, determine if those tasks have been completed, and assess whether the agencies can progress to the next step as outlined in the IBMP. Step 1 encompasses a set of fourteen tasks, including cooperation among the five agencies, maintenance of spatial and temporal separation between cattle and bison, protection of private property, and conservation of wild, free-ranging bison. The report determined that the agencies are not yet ready to move to Step 2 of the IBMP. All 14 tasks in Step 1 must be completed before moving to Step 2. In addition, Step 2 in the West Special Management Area (SMA) will begin when a safe and effective remote delivery mechanism is available and the state of Montana is in a position to implement a remote vaccination program there. Step 2 in the northern SMA begins when cattle no longer graze private lands outside Yellowstone National Park on portions of lands known as the Royal Teton Ranch (RTR) in Zone 2 during the winter and when a bison management plan has been developed by the agencies in cooperation with RTR. Several Step 1 tasks that are required before moving to Step 2 have been initiated, but not yet completed. The

development of a remote vaccination program for bison inside Yellowstone is underway, with an Environmental Impact Statement issued and a Record of Decision expected in late 2006. In addition, a bison management plan for the RTR property adjacent to the northern boundary of the park has not been completed. The five state and federal agencies will continue to work together to accomplish the remaining Step 1 objectives, implement the basic goals of the IBMP, and focus on key adaptive management elements that will improve the agencies' ability to meet those goals. One hundred thirteen calf and yearling bison were vaccinated at the Northern SMA during February and March 2004 and another 9 yearling animals were vaccinated at the Western SMA in spring 2005.

### **The Greater Yellowstone Interagency Brucellosis Committee (GYIBC)**

The GYIBC was formally established in 1995, when a Memorandum of Understanding (MOU) was signed by the Secretaries of Interior and Agriculture and the Governors of Montana, Wyoming, and Idaho, in an effort to collectively address the problems caused by brucellosis in elk and bison in the Greater Yellowstone Area (GYA). Member agencies represented in GYIBC include the State and Federal agencies responsible for management of wildlife, livestock, and lands in the GYA. The Goal of the GYIBC is to protect and sustain the existing free-ranging elk and bison populations in the GYA and protect the public interests and economic viability of the livestock industries of the States of Idaho, Wyoming, and Montana. A major focal point of the GYIBC is to facilitate the development and implementation of brucellosis management plans to control and eventually eliminate brucellosis from the wildlife in the GYA. The GYIBC produced the **2004 GYIBC Annual Report**, its second annual report. The Report highlights GYIBC activities from January 1, 2004 thru June 30, 2005. Future GYIBC reports will be published for annual GYIBC activities from July through June.

The 1995 enabling **Memorandum of Understanding (MOU)** established the framework for the state and federal agencies to address the issues relevant to brucellosis in the GYA. The MOU was intended to be a dynamic agreement among the member agencies, with a term of five years, and subject to review and renewal. Review and proposed revisions to the MOU began in September 2003. The most significant proposed revisions included: (1) Native American Tribal representation on the GYIBC, appointing the President of the Board of Directors of the InterTribal Bison Cooperative (ITBC) as the Tribal representative on the Executive Committee; and (2) stronger and more explicit commitment to elimination of brucellosis in the GYA, including the development of Cooperative Brucellosis Elimination Plans by the Technical Subcommittee. In May 2005, the U.S. Departments of Interior and Agriculture agreed upon a "federal" draft MOU for the States of Idaho, Montana, and Wyoming to consider. The "federal" draft MOU included additional provisions focusing on efforts to eliminate brucellosis from bison and elk in the GYA, including: (1) necessary agency development of adaptive management disease elimination plans for each affected bison or elk herd unit or population; (2) establishment of measures to evaluate incremental progress in disease elimination efforts; and (3) timelines for plan development and progress evaluation. The states of Idaho, Montana, and Wyoming are in the process of reviewing and analyzing the "federal" draft MOU, and at this time, agreement on a "state" draft MOU, if different than the "federal" draft MOU, has not been reached. If the "state" draft MOU differs from the "federal" draft MOU, additional review by the federal agencies and negotiations between the state and federal agencies to resolve any differences will be necessary before a final revised MOU can be signed.

A study is being conducted by Montana Fish, Wildlife and Parks to determine the **spatial dynamics of elk in the Upper Madison**. About 5,000 elk winter on private and public lands east of the upper Madison River near Ennis, Montana. Most of these wintering elk occupy private lands that support domestic livestock, primarily cattle. Since the mid 1960s, numbers of elk wintering in the upper Madison Valley increased about 400%. Much of that increase is associated with changes in private land ownership and subsequent changes in tolerance for wintering elk and restricted hunter access to private lands. Hunter harvested elk were collected (n=142) from various locations in the Madison Valley in the 2002-03 elk seasons. Sero-prevalence to *Brucella abortus* occurred in 4.9% of those samples. And, in the 2004-05 elk seasons, the sero-prevalence in hunter-harvested elk, along with elk captured during research activities was 6.9% (n=174). Montana's Elk-Brucellosis Management Plan calls for assembling an Epidemiological Review Team when serologic surveys in one or more Elk Management Units (EMUs) indicate a sero-prevalence of 5% or greater in any one year. The brucellosis sero-prevalence in the Madison EMU underscores the need to collect additional information regarding the movement of these wintering elk to and from the valley. Also important is the dynamics of elk movement within the Madison Valley during late fall to early spring. Much of this movement occurs on private lands that support cattle. In February 2005, thirty-seven elk were captured and radio-collared, twenty of which were fitted with Lotek GPS collars, as part of the spatial dynamics of elk study. The study objectives include:

1. Define the various elk herd subunits in the upper Madison River.
2. Define movements toward, on and away from winter ranges, including locations of calving areas.

3. Identify variation, if any, in sero-prevalence relating to elk summer range, age, sex or wintering habitats.
4. Further understand elk movements on the winter range as they relate to private lands and publicly owned wildlife management areas.
5. Further understand movements and distribution of elk on public lands grazing allotments.
6. Identify critical wintering areas on the east side of the upper Madison Valley in an effort to understand how elk distribution relates to domestic livestock operations in the valley.
7. Gather site-specific information about livestock grazing patterns from landowners in the Madison study area.

Initial data regarding the movement and distribution of these collared elk is currently being analyzed. And, additional elk will be captured and collared in the winter of 2006 as this study continues to seek explicit temporal and spatial information about these elk. The data will contribute to mapping the elk winter/spring distribution to enhance agency planning and to identify areas critical for livestock management and wintering elk habitat.

**A draft bison and elk management plan and environmental impact statement** for the National Elk Refuge and Grand Teton National Park was published in July 2005 by the U.S. Fish and Wildlife Service and National Park Service, as the lead agencies, in cooperation with Wyoming Game and Fish Department, U.S. Forest Service, Animal and Plant Health Inspection Service, and Bureau of Land Management. The agencies developed four goals for the plan to address the many legal and policy directives of the U.S. Fish and Wildlife Service and National Park Service as well as the significant issues identified during the extensive public input that has been received during the process. These goals address: 1) habitat conservation for elk and bison as well as other native species; 2) sustaining a healthy population of bison and elk on the National Elk Refuge and Grand Teton National Park while minimizing the risks of irreversible or long-term adverse impacts to the herd or other species; 3) contributing to Wyoming Game and Fish Department's herd objectives for the Jackson bison and elk herd to the extent it is compatible with the other goals; and 4) addressing the risk of brucellosis and other non-endemic infectious diseases to protect the economic interests of the livestock industry within the State of Wyoming and the long-term viability of the Jackson bison and elk herds. While supplemental winter feeding of elk and bison on the National Elk Refuge has been the focal point of many of the significant issues raised in the planning process, the core problem is that there is an insufficient amount of winter range for the numbers of elk that have been sustained in the Jackson Hole area and the growing bison population.

Six alternatives or actions for management are identified in the plan including a proposed action. The alternatives examine different approaches to managing the habitat and the bison and elk herds in order to meet the four management goals of the project. The following summarizes the six alternatives:

**Alternative 1:** No Action

**Alternative 2:** Minimal Management of Habitat and Populations, with Support for Migrations

**Alternative 3:** Restore Habitat, Support Migration, and Phase Back Supplemental Feeding

**Alternative 4:** Restore Habitat, Improve Forage, and Phase Back Supplemental Feeding (Proposed Action)

**Alternative 5:** Restore Habitat, Improve Forage, and Continue Supplemental Feeding

**Alternative 6:** Restore Habitat, Adaptively Manage Populations, and Phase Out Supplemental Feeding.

The deadline for public comment on the Draft Plan/EIS is November 7, 2005. A final plan/EIS is expected to be completed by October 30, 2006, with publication in the Federal Register anticipated by November 30, 2006.

## **Remote vaccination of YNP Bison - Feasibility Assessment**

By Rick Wallen, John Treanor, Doug Blanton and Chris Geremia

### **Introduction**

The fundamental strategy of the Interagency Bison Management Plan is spatial and temporal separation of bison and cattle. This strategy minimizes the likelihood that bison moving from summer ranges in the interior of Yellowstone National Park would commingle with cattle on their low elevation winter ranges or, more importantly, shed bacteria that will survive until cattle return to common range used by livestock during the summer months. The IBMP also directs the agencies to insure the vaccination of all cattle that will occupy areas bison may have occupied during the previous winter.

In addition, the vaccination of bison, through time, will further minimize any risk of brucellosis transmission from bison to cattle. The management approach toward vaccination of bison has been to first initiate a program in special management areas near the National Park boundary where bison are captured in pens for intensive testing and sorting. Vaccination at these locations been initiated and is ongoing each winter if bison are captured and tested for brucellosis.

The IBMP directed the National Park Service to implement an in park vaccination program following further environmental planning and public disclosure. The charge here is to develop a program for the vaccination of free ranging bison without rounding up and handling each individual. The goals are to decrease the risk of transmission of brucellosis and diminish the overall sero-prevalence of brucellosis in the population.

### **Exploring Uncertainties Through Adaptive Management**

Several uncertainties were identified in the original management decision. Besides the uncertainties about the pathogenesis of brucellosis, decision makers were uncertain about the feasibility of a safe and effective delivery system for available vaccines and how remote vaccination of bison could be applied on the Yellowstone landscape.

While the IBMP utilizes an adaptive management approach to addressing uncertainties, this concept is not clearly defined within the text of the plan. The conceptual approach presented by "Adaptive Management" is backed by the principle that learning is valuable, and that uncertainties exist in resolving many resource management issues. Although management of natural resources is generally characterized by uncertainty and often requires resolution to conflicting information, administrators are asked to choose the "best" approach.

The National Park Service has adopted a definition for adaptive management endorsed by the National Research Council (NPS draft policy revisions 2005)

Adaptive Management is a decision process that promotes flexible decision-making, and that can be adjusted as results from management actions become better understood. Careful monitoring of outcomes both advances scientific understanding and helps to adjust policies or operations as part of an iterative learning process. Adaptive management recognizes the importance of natural variability in contributing to ecological processes. Adaptive management does not represent an end product, but rather a means to more effective decision making and enhanced benefits for resource conservation.

The most effective adaptive management programs are those where decision adjustments based on results from monitoring of project implementation are made by a single decision maker (Lee 1999). While the nature and probability of future ecological surprises discovered through the adaptive management process is rarely publicized, these surprises are inevitable and in many cases lead to improved resource management (Gunderson et al 1995).

The current state of technology provides for limited number of vaccines available for use in brucellosis management. Likewise, the most feasible option currently available for remote delivery of vaccine is the ballistic delivery of darts or bio-absorbable projectiles (Aune et al 2002, US Animal Health Asso. Brucellosis Workshop 2005). However, the possibilities for technological advances in this arena are very promising with oral delivery across a mucus membrane identified as a high priority for further development. Thus, adaptive management

strategies for decision making while faced with the uncertainty of how these techniques will perform in the Yellowstone landscape seems a most effective approach under the circumstances.

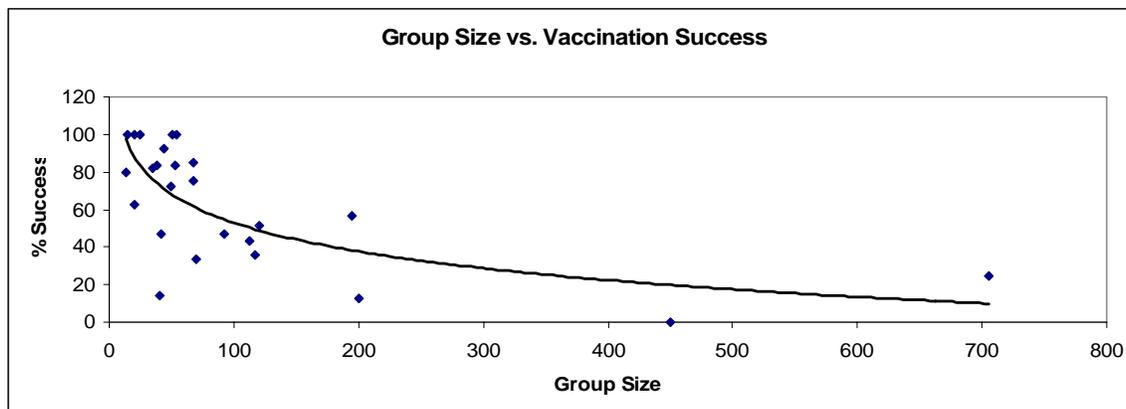
### **EIS for Remote Delivery of Brucellosis Vaccine to Free Ranging bison inside YNP**

Yellowstone National Park began gathering necessary information for conducting an environmental impact study shortly after the decision to implement the IBMP (December of 2000). An extensive literature review of information available to describe vaccines, delivery mechanisms and the ecology of bison was conducted. Field studies of the ecology of Yellowstone bison have offered insight in to possible methods for implementing a field vaccination program. Most importantly, a better understanding of the movement patterns, group dynamics and habitat distribution of bison provide a better understanding of where and when we are most likely to be successful.

#### Movement patterns on the landscape

Bison are the most congregated in the summer when they coalesce in to very large groups. By September they begin to redistribute on the landscape. Group size decreases from Dec (ave = 62) to Apr. (ave = 24). In addition to smaller group size during winter and spring the population is spread out over a much larger area. Annually, bison range across 220,000 acres of habitat in Yellowstone National Park. While bison occupy an expansive range and move about that range in a semi-random way, the habitat is dispersed in to six large patches and connected by rather narrow corridors.

The probability of successfully implementing a remote delivery vaccination program is dependent on our ability to work closely around groups of bison. We have found that successful approach to groups of bison is somewhat correlated with group size. The smaller the groups, the more likely we will be to work in close proximity to the individuals within a group for effective delivery of vaccine in the interior of Yellowstone. We are more likely to approach within 30 meters of 80% of the calves and yearling bison within a group if the size of the group is less than about 40 individuals.



shooters. Consequently, there may be benefits in designing a scope for more accurate delivery at greater than 20 meters.

A multiple analysis of variance test on our accuracy data provided some interesting results.

- The longer light weight bullet provides the most accurate projectile for vaccine delivery, but we found no significant difference between this bullet and the heavier, metal impregnated bullet
- The lower pressure regulator (1200 psi vs 1500 psi) provided a more accurate delivery of shots over all distances, with all shooter data incorporated.
- While accuracy decreases with greater distance from the target (there was no significant difference in accuracy between shots at 20 vs 30 meters)

This data set provides a baseline for evaluation of improvements to this type of delivery equipment.

#### Development of brucellosis analysis model for draft EIS

Modeling the dynamics of a brucellosis infected population is a challenge. Several models have been constructed to evaluate, in a general sense, the relative impacts of two different management options, test and slaughter of positive reactors or vaccination of an infected population, either separately or in combination (Peterson et al 1990, Dobson and Meagher 1996, Gross et al 1998, Gross et al 2002, Angliss 2003). Gross et al (1998) concluded that vaccination of 30% of the annual calf production would reduce sero-prevalence by half. Gross et al (2002) applied their earlier model to the conditions of the IBMP and concluded that the synergistic effects of vaccination in combination with capture test and removal of test positive individuals more than doubled the effectiveness of the program to reduce the number of infectious exposures in a population than either program alone. Even at relatively low levels of implementation (ie. test and remove bison at the boundary capture facilities and vaccinate 30 percent of the population. The results of these models imply that vaccination is feasible if bison can be approached to a distance close enough to utilize the available technology.

We have used the principles of the previous models to construct an analysis model for evaluating the alternatives to remote vaccination. The parameters with the highest levels of uncertainty include the number of additional bison infected by each exposure event, and the probability of latent infected bison shedding enough *B. abortus* bacteria to infect other individuals. While our modeling effort is still evolving its reliability, it seems to track well with the conclusions of past authors. We are still conducting sensitivity analyses and expect the outputs to provide decision makers with a reasonable expectation of how feasible remote vaccination may be. The model outputs should provide a foundation for initiating an adaptive management program that includes monitoring of sero-prevalence in our population to detect how successful a field vaccination program may be at delivering vaccine to free ranging bison.

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## HOOF-Printing: Identification of *Brucella* strains by DNA Fingerprinting

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The currently used technology for typing *Brucella* strains for epidemiological trace back is time consuming and the resulting discriminatory power is limited. Biotyping of strains requires the examination of more than 20 phenotypic traits (1); but identifies only a small number of biovars for most species, and no biovar classes for some species. In the case of *B. abortus*, 7 biovars are recognized world wide, but only biovars 1, 2, and 4 occur in the US. As a result, biotyping for epidemiological use often provides little assistance.

Molecular typing has the advantage of good specificity and excellent sensitivity and is usually rapid to perform. However, most conventional strategies used for molecular typing of bacteria have failed for typing *Brucella* strains because of the high level of genomic homology among species. (4, 5, and 6).

We have recently developed a new strategy for strain typing *Brucella* isolates that we call HOOF-Printing, an acronym for Hypervariable Octameric Oligonucleotide Finger-Printing (2 and 3). The basis for strain differentiation with this method exploits the elevated mutation rates associated with strings of short DNA sequences arranged as tandem repeats. In the case of HOOF-Prints, the repeated sequence is eight nucleotides (octameric). The increase in mutation rates found among tandem repeats is due to two processes: recombination and step-wise mutation. Most people are familiar with recombination. Step-wise mutation occurs during chromosomal replication. Occasionally, either the template strand or the polymerizing strand will slip and mispair so that 1 repeat unit loops out resulting in the addition or loss of a single repeat unit. This slipped-strand mispairing has significance for interpretation of the data produced by the assay (see below).

We have been able to increase the discriminatory power of the assay by examining multiple chromosomal loci containing strings of tandem repeats. So far, we have incorporated into the assay 10 loci that contain polymorphic tandem repeats. The method for detecting the polymorphisms involves PCR, using primers that anneal to the conserved sequences flanking the tandem repeat units. The tandem repeats and a small amount of the flanking DNA are amplified and the number of repeats present is deduced from the size of the amplified product. The possible products (alleles) for each locus are identified by the number of repeat units deduced to be present, so that each fingerprint can be transcribed as a series of numbers. For example, the fingerprint pattern for S19 is 5-4-4-2-2-2-8-2-13-6 while the pattern for strain 2308 is 4-4-6-2-2-2-10-2-10-4.

The data obtained from characterizing a diverse group of isolates has shown that the assay is highly discriminating (3). From 97 isolates taken from different outbreak herds with no known association, we obtained 92 unique fingerprints. As part of an ongoing retrospective study of an outbreak within a single herd, we have examined 398 individual bacterial colonies cultured from 21 infected animals. A total of 31 different genotypes have been identified. We found a dominant fingerprint pattern that occurred in 54% of the colonies tested, while 37% of the colonies varied at 1 locus and the remaining isolates varied at 2 loci. Of the isolates that varied from the consensus at 1 locus, 87% varied by a single repeat unit. Of the isolates that varied at 2 loci, 77% varied by 1 repeat unit at each of the loci. These results are consistent with a step-wise mutation mechanism. Most of the variation occurred at the loci with the largest numbers of repeats, namely, Locus-7, Locus-9 and Locus-10. We also examined the DNA fingerprints from colonies obtained from 2 elk that were captured in the same region as the cattle outbreak. The fingerprint patterns were similar but not identical to each other and to the dominant fingerprint pattern found in the cattle herd.

In summary, the HOOF-Print technique is highly discriminating, significantly more discriminating than conventional biotyping of *Brucella* isolates. The technique is easy and rapid to perform. Within an outbreak, minor variations of the dominant genotype are seen, but most often these involve changes of a single repeat unit at one or two loci. It is important to be aware that the results do not identify any *Brucella* species or biovar directly and should be used as a supplement to validated diagnostic tests and conventional epidemiological investigation.

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## Alternative Management for Brucellosis in Elk of the Greater Yellowstone Area

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### Introduction

Brucellosis has been endemic in Greater Yellowstone Area (GYA) bison and elk for almost a century. Though the disease has been nearly eradicated from livestock, applying domestic animal methods to wildlife for brucellosis elimination has been challenging. That wildlife can reintroduce brucellosis to cattle is without doubt. Publicly much of the focus is on bison, however the entire ecosystem contains approximately 6000 bison as compared to perhaps 20,000-25,000 elk on feedgrounds all affected by brucellosis. Four transmissions from wildlife to cattle in Wyoming and two in Idaho (one still under investigation at this writing) have occurred in the last 3 years, resulting in loss of Wyoming's brucellosis free status on 2/13/04. Every one of these transmissions has been traced to affected feedground elk. Historically, 7 other transmission events have occurred to cattle, 3 concluded to be the result of elk, the other 4 either elk or bison was implicated. Clearly the major risk to livestock for transmission of brucellosis is infected feedground elk.

Management tools for wildlife are limited but we generally try to develop and use "all tools in the toolbox" to address disease issues. One tool has been consistently absent in the management of brucellosis in elk – elimination of feedgrounds. That feedgrounds perpetuate brucellosis is not debated. Cheville et al (1998) in summarizing the status of brucellosis in the GYA concluded "elk would not serve as reservoirs for brucellosis without feedgrounds". Over a decade ago, the Greater Yellowstone Interagency Brucellosis Committee (GYIBC) concluded "The evidence is overwhelming that winter feeding of elk has proven to perpetuate and enhance the spread of diseases, especially brucellosis". Yet removing feedgrounds has not been pursued because of perceived difficulties and benefits afforded by those feedgrounds. At the GYIBC meeting of Oct 26, 2005, two conservation organizations, the Greater Yellowstone Coalition and Wyoming Outdoor Council (hereafter referred to as non-governmental organizations or NGO), provided an idea for an experimental pilot project in the Gros Ventre valley which addresses the concerns over elimination of feedgrounds, tests the effect of management, monitors effectiveness at decreasing brucellosis, and provides the option for emergency feeding should the project fail.

### Why Have Feedgrounds

The reluctance to address elk feedgrounds is based on their purported benefits. These benefits are outlined in the Wyoming Game and Fish Feedground Report (2004) and the Wyoming Brucellosis Coordination Team Report (2005) to the Governor on brucellosis. Specifically feedgrounds:

1. Mitigate for loss of winter range normally occupied by elk. Feedgrounds permit maintenance of a higher population of elk than would be possible without feedgrounds. Estimates have been provided that 40-80% of the elk population would be lost in the absence of feedgrounds.
2. Prevent massive starvation of elk
3. Prevent co-mingling of elk and livestock
4. Prevent depredation on livestock feed. (One argument suggests feeding is easier and less costly than keeping elk out of haystacks, though it is doubtful such calculations take into account the continued presence of brucellosis on state and national economies.)
5. Provide the opportunity to vaccinate elk against brucellosis.

### The Proposal

The NGO proposal specifically addresses only the 3 Gros Ventre valley feedgrounds – Alkali, Patrol Cabin and Fish Creek. These 3 feedgrounds are relatively isolated from other feedgrounds, and with the National Elk Refuge (NER) are the only feedgrounds used by the Jackson elk herd. The NER is in the midst of evaluating elk and bison management through an Environmental Impact Statement analysis of alternative management strategies. The Jackson elk herd currently numbers in excess of 13,000 animals, well over the management goal

of 11,029. The Gros Ventre winter population contributes somewhat over 4000 elk to this number. The February 2005 elk count in the Gros Ventre was 4,335. The average winter elk count from 1997-2004 was 3,837 in the valley while feeding was conducted on the 3 feedgrounds. In contrast, from 1912 to 1952 the average annual winter elk count was 4554 to 4705 despite the fact that Gros Ventre feedgrounds were established in 1956. Recognizing the apparent historic ability of elk to winter in the Gros Ventre without feeding, the NGOs researched the potential for the Gros Ventre to serve as a pilot project on the elimination of feeding to determine its effect on brucellosis prevalence.

Using data from Wyoming, USGS (particularly modeling and research data on snow-water equivalent across the landscape), Forest Service and others, the NGOs found that the Gros Ventre valley has in excess of 106,000 acres of available winter range for wild ungulates and grazing livestock. Wyoming Game and Fish surveys show elk using all areas of this winter range throughout winter months suggesting the models predicting winter range based on snow-water equivalent are conservative.

Livestock using public land grazing allotments amounted to an average of 5,371 animal unit months (AUM) from 1937-1941 when livestock grazing was at a peak (Forest Service data) and elk feeding was absent. Currently permitted AUMs for the Gros Ventre valley are less than 1,507, suggesting even greater forage availability for wildlife. Nine livestock grazing allotments exist in the Gros Ventre. Five of these are either unused or closed, 2 graze from June 11 to October 15, and the remaining two each have 30 cow-calf pairs. Private property in the valley is minimal on 4 ranches. These ranches winter less than 70 cow-calf pairs and 200 horses.

The NGOs calculated what a winter population of 4419 elk in the Gros Ventre would need to sustain itself over a 6 month winter cycle. Consumption and productivity estimations came from Hobbs et al (2003) model of 2% of body mass consumed per day and productivity data over 5 different vegetation classification areas in the Gros Ventre (using used USGS, US Fish and Wildlife Service and National Park Service data). Based on the February 2005 elk classification counts a winter elk population of 4419 elk would consume 38,533 lbs of forage daily.

Assuming a conservative estimate that two-thirds of the winter range was unavailable for elk due to snow conditions reduces the 106,000 acres to 35,454 truly available winter range. Total forage production on this remaining available habitat using the Hobbs data is 17,816,408 lbs. Assuming that an additional 35% of this forage is unpalatable or otherwise unavailable reduces available forage to 11,580,655 lbs. Elk needs over 183 days of winter are 7,051,539 lbs, which is about 60% of the conservative estimate of availability. Even a population estimate of over 6000 elk would still only consume about 64% of this available forage.

Feedgrounds in the Gros Ventre have provided an average of 825 tons (1,650,000 lbs) of forage yearly for the last decade. This supplies less than 25% of the needs of a 4400 elk population at the cost of maintaining brucellosis. Economically feedground operational costs exceed \$150,000 yearly.

The data suggest closing the Gros Ventre feedgrounds should be feasible and scientifically sound. The NGOs suggest this be done on a pilot experimental basis and recommend an steering committee comprised of wildlife professionals, ranchers, sportsmen, landowners, recreationists and others with wildlife interest to oversee the project. The project will be extensively monitored with contingencies for unacceptable elk movement, mortality, or depredation (including the option of emergency feeding). Protocols have been established to monitor forage use, elk distributions, and snow conditions. Assistance will be provided to landowners to manage comingling and prevent hay depredations. Their data suggest it is less expensive to fence off haystacks than feed elk. Long term monitoring of brucellosis prevalence will be the key criterion for success of the project. In addition, the NGOs have suggested several sources of potential funding for the project, and point out that the \$150,000 savings from not feeding could mitigate a considerable portion of the project cost.

### **Why Have Feedgrounds Revisited**

Several reasons have been provided suggesting that elk feedgrounds are needed and cannot be disbanded. In the Gros Ventre, this may not be true. Changing management to eliminate feedgrounds while maintaining the viability of free-ranging wildlife and the agricultural community on an experimental basis would be a tool that might significantly address brucellosis in the GYA. The proposed action is a research project into an alternative brucellosis management strategy that specifically addresses the list of needs for feedgrounds:

1. Winter habitat would appear to be well in excess of what is needed to maintain a population of 4400 wintering elk. Pre-feedground average elk population exceeded the average annual elk count in the last 9 years (1997 to present). No decrease in elk population would be expected.
2. If adequate forage is available for elk, mass starvation should not be an issue. However the proposal does require extensive monitoring, and includes an option for emergency feeding if it becomes necessary. Likely the major short-term issue will be for elk to learn about the forage availability on native winter range.
3. The winter population of livestock is very small and manageable. Many of the horse operations are already fenced, and fencing around feeding areas can minimize co-mingling. NGOs have offered to provide landowner assistance with co-mingling issues.
4. The proposal shows the economic advantage of fencing haystack yards compared to feeding elk.
5. The vaccine is relatively ineffective. Data from the Grey's River feedground elk population, where vaccination has been carried out since 1985, show brucellosis prevalences in the mid 50%. Regardless, the need for vaccination is moot if management by elimination of feedgrounds removes the disease.

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## IMPLICATIONS OF FERAL SWINE EXPANSION: EXPANSION OF FERAL SWINE IN THE UNITED STATES AND POTENTIAL IMPLICATIONS FOR DOMESTIC SWINE

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The distribution of feral swine in the United States has expanded greatly in the past 22 years. Documentation of this expansion is provided in national feral swine distribution maps produced by the Southeastern Cooperative Wildlife Disease Study (SCWDS). Data for these maps were collected by SCWDS from each of the state wildlife management agencies in the United States during 1982, 1988, and 2004. Each state provided data on the distribution of feral swine for the given year, and the states' data were collated into national maps (Figure 1). In 1982, 17 states reported feral swine in a total of 475 counties. In 2004, 28 states reported feral swine in 1014 counties. This represents an increase of 11 (165 %) states and 539 (213%) counties and over a period of 22 years.

The expansion of the feral swine distribution is the result of a number of natural and human-associated factors. Natural dispersal of feral swine from extant populations probably is responsible for spread in localized areas where feral swine were present previously. New populations occurring in areas distant to other feral swine populations are the result of

localized escape of domestic swine, localized but intentional release of domestic swine, or the intentional transport and release of wild-caught or captive feral swine. Newly established populations in areas distant to the previous feral swine distribution are a result of the escape or release of domestic or feral swine as feral swine are not capable of dispersing across entire states on their own.

The presence of swine diseases in feral swine populations presents a risk for domestic swine, and the expanding distribution of feral swine provides increased opportunities for contact between feral and domestic swine. Surveys for selected disease agents in feral swine have demonstrated the presence of pseudorabies virus (PRV), *Brucella suis*, and other agents of veterinary importance in feral swine populations throughout their range in the United States (Nettles and Erickson 1984, Corn et al. 1986, Van der Leek et al. 1993). Disease agents may be maintained in feral swine populations over time, or may be transient. Corn et al. (2004) showed that once PRV is introduced into a population, it continues to circulate in the population indefinitely. In contrast, Nettles et al. (1989) found that classical swine fever was not maintained in feral populations in the absence of infected domestic swine, nor had it been maintained in two island populations where the disease had been introduced as a feral swine population control measure.

Disease agents may be transmitted both from domestic to feral populations, and from feral to domestic populations. Escape or release of infected domestic swine into a feral situation may result in transmission of disease agents into the feral population. Disease agents also may move from domestic to feral swine via contaminated water, feed, sewage and through nose to nose contact at fences or via aerosols to nearby animals. Disease agents may be introduced from feral populations into a domestic herd via contamination of feed or water, direct contact through fences, entry of feral swine into domestic swine pens, and by intentional introduction of feral animals into a domestic situation. In addition, transport and release of feral swine into new areas can result in transport of any associated disease agents.

With the continuing geographic expansion of feral swine populations, more states and areas of domestic swine production are being confronted with a feral reservoir for swine diseases. To assess the geographic association of feral and domestic swine we developed overlay maps of the distributions of feral swine and commercial swine production in the United States. These overlays were based on a model for targeting surveillance for PRV in feral swine as presented by George et al. (2003). The national feral swine distribution map was used to determine which states to include in the assessment. Domestic swine production maps were prepared for all states where feral swine were reported during 2004 as described by George et al. (2003) using data on the number of domestic swine farms and number of domestic swine per county from the 2002 Census of Agriculture (USDA, 2004). Feral swine maps were overlaid with the domestic swine ranking maps, and counties where both feral swine and high levels of domestic swine production occurred were identified (Figure 2, Table 1). Nationwide, the 50 counties within the reported distribution of feral swine with the highest rankings for domestic swine production were spread out among 14 states, but 16 (32%) of the highest ranked counties, including the top eight, were in North Carolina.

The expansion of feral swine in the United States and the associated increase in potential contacts with domestic swine presents a growing risk for disease transmission. The maps provided herein present a geographic description of the expansion of the feral swine range in the United States, and delineate the overlap of the feral swine and high density domestic swine production distributions. Risks for transmission of disease agents, such as PRV and *B. suis*, from feral to domestic swine, and for transmission of domestic or foreign animal disease agents from domestic to feral swine exist where the two distributions overlap. Targeted surveillance for PRV, *B. suis* or other disease agents can be used to determine if

selected disease agents are present where both commercial swine production and feral swine occur. Similar mapping and surveillance may be used to assess other risks, including disease transmission between transitional, backyard or other domestic swine and feral swine.

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