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THE USE OF CONTRACEPTION AS A DISEASE MANAGEMENT TOOL IN WILDLIFE

Jack C. Rhyan, D.V.M, M.S., Lowell A. Miller, Ph.D., and Kathleen A. Fagerstone, Ph.D.

Abstract: Contraception offers potential as a tool for managing certain diseases in wildlife, most notably venereally transmitted diseases or diseases transmitted at parturition. Brucellosis is an excellent example of an infectious disease present in wild populations that could potentially be managed through immunocontraception. Previous studies in bison (*Bison bison*) suggest that a single injection of GonaCon™ (National Wildlife Research Center, U.S. Department of Agriculture/Animal and Plant Health Inspection Service/Wildlife Services, Fort Collins, Colorado 80521, USA) results in 3 or more yr of infertility. Ongoing studies will determine if the use of GonaCon in bison decreases shedding of *Brucella abortus* from infected animals and will better define the duration of infertility following a single injection

Key words: Bison, *Brucella abortus*, brucellosis, gonadotropin-releasing hormone, immunocontraception.

BRIEF COMMUNICATION

The management of diseases in wild populations presents many challenges, including those of difficult logistics, a paucity of efficacious techniques, effective vaccine or therapeutic delivery systems, and public acceptability. Contraception offers potential as a disease management tool for certain diseases, most notably venereally transmitted diseases or diseases transmitted at parturition. Brucellosis, a group of zoonotic diseases caused by bacteria in the genus *Brucella*, is an excellent example of a group of infections present in wild populations that could potentially be managed through immunocontraception. Swine brucellosis, caused by *Brucella suis*, is transmitted through the venereal route as well as through contact with aborted fetuses and placental membranes and fluids. Bovine brucellosis, caused by *Brucella abortus*, is transmitted among animals, including cattle, bison (*Bison bison*), and elk (*Cervus elaphus*), primarily through contact with infected aborted fetuses, placentas, parturient fluids, or postparturient uterine discharge. Additionally, the organism is shed in the milk from infected dams and can be transmitted to calves through suckling. Following infection, females often abort. Subsequent pregnancies may result in abortion or the birth of weak or normal calves and may result in shedding of the organism. The

occurrence of venereal transmission of brucellosis in bison is unknown; however, based on a single study in bison and studies in cattle, it is not considered likely to be a significant route of transmission.^{1,4,5} Therefore, transmission of disease in cattle, bison, and elk is primarily dependent on the occurrence of pregnancy and abortion or calving of infected animals.

GonaCon™ (National Wildlife Research Center, U.S. Department of Agriculture/Animal and Plant Health Inspection Service/Wildlife Services, Fort Collins, Colorado 80521, USA), a gonadotropin-releasing hormone (GnRH) immunocontraceptive vaccine, is approved for use in wild white-tailed deer (*Odocoileus virginianus*), in which a single injection usually results in 2 or more yr of infertility.² This study reports the results of three small pilot studies examining the use of GonaCon to prevent parturition in bison.

The first study was conducted at Northwest Trek, a zoologic park in the state of Washington (USA). Its purpose was to determine if the GnRH vaccine had any effect on the reproductive success of five breeding-age female bison (age range: 2–8 yr) as compared to the herd's normal reproductive history of over 60% reproduction annually. The five bison received 1,800 µg of the vaccine by intramuscular injection between 21 May and 26 July 2001. The animals were continuously exposed to multiple bulls. Three of the five did not calve in 2002, one had a live calf, and one died because of dystocia. Because of the incomplete contraception of the group, the remaining four bison were boosted with the same dose of vaccine on 30 August 2002. The boosted bison did not calve in 2003, 2004, or 2005. By 2012, at least two of the three bison remaining alive had given birth to one or more calves. These results suggested a

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Table 1. Results of pilot study comparing the reproductive results per year of single-dose gonadotropin-releasing hormone–vaccinated bison (1,800 µg) with nonvaccinated controls.

| Treatment group | 2002 ^a | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | Total calves/RYS ^b |
|-----------------|-------------------|------|------|------|------|------|------|-------------------------------|
| Controls | 5/5 | 4/5 | 4/4 | 1/3 | 2/3 | 3/3 | 2/3 | 16/21 |
| Vaccinates | 4/6 | 0/6 | 0/6 | 0/5 | 0/5 | 0/5 | 0/5 | 0/32 |

^a 4-yr-old bison were vaccinated in June 2002. 4 of 6 were in mid or late pregnancy when vaccinated.

^b Total number of calves produced per reproductive years of cows in the study.

high degree of vaccine efficacy in bison following two vaccinations.

The second study, conducted from 2002 until 2008, was begun at the Idaho Department of Fish and Game wildlife research facility in Caldwell, Idaho (USA). The study utilized bison that were offspring of animals that had been trapped at the border of Yellowstone National Park in 1997 and taken to the Idaho facility for study. In 2004, the bison were moved to the Colorado State University, Animal Population Health Institute's wildlife research facility in Fort Collins, Colorado (USA). The bison were serologically negative for brucellosis throughout the study. This study compared reproductive results of six bison intramuscularly vaccinated with a single dose of 1,800 µg GnRH on 06 June 2002 to those of five sham-vaccinated controls that received the adjuvant only. Breeding season for bison usually begins in July and may continue for several months. Results of the first year of this study have been previously reported.³ Four of the vaccinees were in mid- or late-term pregnancy when vaccinated. Results (Table 1) indicate that the vaccine did not interfere with reproductive success of animals in mid- and late-term pregnancy at the time the vaccine was administered. More importantly, a single dose of

vaccine resulted in infertility in all vaccinees for the duration of the study.

The third study, conducted from 2003 until 2008, evaluated the efficacy of GonaCon in bison at low, medium, and high doses (1,000, 2,000, and 3,000 µg, respectively). That study was conducted on bison purchased from a producer and was begun at a private ranch in Gardiner, Montana (USA). Bison were vaccinated on 20 May 2003; controls received the adjuvant only. After 2 yr, animals were moved to a private ranch in eastern South Dakota (USA). The first year of the study (2003), female bison were pastured with a bull that was later discovered to be infertile; therefore, the first exposure of the study animals to a fertile bull was summer 2004, 14 mo after vaccination. Results of that study (Table 2) indicate the vaccine had increased efficacy at the higher dose, resulting in 3 yr of infertility in three of four bison.

Two ongoing studies are designed to 1) evaluate the duration of infertility in 10 vaccinated bison that received 3,000 µg GonaCon as compared to 10 controls in a range setting; and 2) determine if the use of GonaCon decreases shedding of *B. abortus* from a group of 14 naturally infected bison during the calving season as compared to a similar group of nonvaccinees. If these studies confirm the safety and efficacy of GonaCon in bison and demonstrate its utility in reducing shedding of *B. abortus*, the vaccine could provide a potential nonlethal management tool to prevent transmission of the disease in an infected bison population.

Table 2. Results of dose-response study comparing reproductive results per year of nonvaccinated controls and single-shot low (1,000 µg), medium (2,000 µg), and high (3,000 µg) doses of gonadotropin-releasing hormone vaccine in bison.

| Treatment | 2004 ^a | 2005 | 2006 | 2007 | 2008 | Calves/RYS ^b |
|-------------|-------------------|------|------|------|-----------------|-------------------------|
| Controls | 0/5 | 5/5 | 4/5 | 2/3 | ND ^c | 11/13 |
| Low dose | 0/5 | 2/5 | 3/5 | 2/4 | ND | 7/14 |
| Medium dose | 0/5 | 3/5 | 2/5 | 0/2 | 0/1 | 5/13 |
| High dose | 0/4 | 0/4 | 1/4 | 1/4 | 0/2 | 2/14 |

^a 2-yr-old female bison were vaccinated in May 2003 and were placed with breeding bull in July 2004.

^b Total number of calves produced per reproductive years of cows in the study.

^c ND = not done.

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