

Contraceptive Technologies for Use in Wildlife Population and Disease Management



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Groups Affected:

- Airports, airlines, airline passengers
- Electric utility companies
- Farmers
- Landscapers
- Motorists
- Natural resource managers
- Pet owners
- Ranchers/Livestock producers
- Urban and suburban residents

Major Cooperators:

- APHIS, Veterinary Services
- Colorado State University
- CSIRO and the Invasive Animal Cooperative Research Centre, Australia
- Koret School of Veterinary Medicine at the Hebrew University of Jerusalem
- National Park Service
- Navajo Nation, AZ
- Spay FIRST!
- The Animal and Plant Health Agency, UK

National Wildlife Research Center Scientists Study Wildlife Contraception

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research organization devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective, and socially responsible methods, tools, and techniques.

Research on the reproductive management of birds and mammals, which cause damage or threaten public health and safety, is a high priority for WS. The severity of human-wildlife conflicts often exacerbates as wildlife populations increase. For example, in many urban and suburban settings, overabundant deer create safety hazards for motorists, eat ornamental shrubs, harbor and transmit diseases and parasites (e.g., Lyme-disease-bearing ticks), and degrade natural habitats. Rodents carry a variety of diseases and damage rangelands and crops, resulting in the loss of millions of dollars in agricultural production. Overabundant feral horses degrade habitats and create ecological problems. In many countries, stray dogs are a public health risk due to bite injuries and the potential spread of rabies.

The goal of NWRC's wildlife contraceptive research is to develop injectable and oral contraceptives to manage overabundant wildlife populations and reduce the spread of zoonotic diseases. In 2009, APHIS successfully registered the first immunocontraceptive vaccine for wildlife with the U.S. Environmental Protection Agency (EPA). The single-shot, multi-year vaccine called GonaCon Immunocontraceptive Vaccine (GonaCon) was developed by NWRC scientists and initially registered for use in female white-tailed deer in urban and suburban areas. In 2013, GonaCon-Equine was registered for use in feral horses and burros. GonaCon vaccines target a key reproductive hormone found in all mammals called gonadotropin-releasing hormone (GnRH). Research has shown GonaCon to be an effective reproductive inhibitor in a wide range of mammal species including elk, bison, prairie dogs, ground squirrels, cats and kangaroos. Future NWRC research with GonaCon will determine how best to use the vaccine as a wildlife management tool to reduce animal populations and prevent the transmission of disease. Efforts will also be made to expand registrations and develop new GnRH vaccines for other species, such as free-roaming dogs.

Research interest is also focused on developing direct-acting reagents, chemosterilants, and vaccines that can be delivered orally and cause permanent sterility. APHIS views fertility control as a complementary tool, not an alternative, to current wildlife management methods. Although fertility control does not address immediate damage and disease concerns, it may be useful as part of a long-term management strategy or when lethal methods are impractical or infeasible. The greatest benefits from wildlife contraceptives are realized when they are used in conjunction with other tools in an integrated program to manage local, overabundant wildlife species.

Applying Science and Expertise to Wildlife Challenges

Oral Vaccine Development. — Current wildlife contraceptive vaccines must be administered by injection, either by hand or by remote darting. This limits the ability to deliver these vaccines and can often be cost prohibitive. NWRC researchers are developing a new technology for the oral delivery of contraceptive vaccines. This technology uses bacterial cell wall fragments that are modified to present a reproductive peptide or protein to the immune system and stimulate an immune response. In collaboration with researchers at the Animal and Plant Health Agencies (APHA) in the United Kingdom and an industry partner, NWRC researchers have produced a vaccine that stimulates an immune response against the reproductive hormone GnRH and reduces fertility in rats. This is the first successful demonstration of an oral vaccine suppressing fertility in a female mammal. A patent application has been filed for this technology.

One Hit, Permanent Sterility. — Successful reproduction in female mammals depends on an adequate supply of healthy oocytes (eggs). Only a finite number of oocytes are contained in the ovaries of mammals which, if destroyed, would leave the animal permanently sterile. In collaboration with university researchers, NWRC scientists are investigating different oocyte survival mechanisms and

signaling processes between cells in the ovaries. The goal is to identify a single-injection compound that destroys the oocytes and causes permanent sterility in target animals, such as feral swine and free-roaming dogs.

Use of GonaCon in Wild Horses. — Overabundant, free-ranging horses can negatively affect native plant communities and ecosystems, and may lead to competition with native ungulates. In response, many land management agencies have reduced free-ranging horse populations through periodic roundups and adoption or sale of excess animals. These methods are time- and resource-intensive, and can result in injuries to animals and people. Consequently, more efficient and effective approaches are desired. One alternative is controlling the fertility of female wild horses through contraception.

NWRC scientists and Theodore Roosevelt National Park in North Dakota are evaluating the long-term effects of GonaCon-Equine on fertility, behavior and safety in free-ranging female horses. While a single vaccination is often preferred, GonaCon may prove to be more effective if booster treatments are given on a periodic basis. In the current study, previously treated mares that had returned to full fertility were given a booster vaccination of GonaCon-Equine four years after the first injection. Results showed it is safe to give the vaccine to pregnant animals, and fertility in the second and third years following a booster treatment was reduced to 0 and 12 percent, respectively. Ongoing research is also investigating the use of remote vaccine delivery via darting and identifying the optimum time for booster vaccinations.

Licensing GonaCon-Equine. — GonaCon-Equine is a contraceptive vaccine developed by APHIS and registered with the EPA for use in wild and feral female horses and burros. In 2010, the U.S. Patent and Trademark Office issued a patent for this vaccine technology under the title “Vaccine Composition and Adjuvant” (US 7,731,939 B2). Spay FIRST!, a non-profit organization based in Oklahoma, licensed GonaCon-Equine under this patent in 2016. The license allows Spay FIRST! to market the vaccine within the United States and internationally. In addition, it sets the groundwork for Spay FIRST! to partner with other organizations to develop new applications and markets for GonaCon-Equine.

Use of GonaCon in Feral Cattle. — In Hong Kong, an estimated 1,250 South China feral cattle exist as free-roaming animals. They are not actively managed and cause traffic disturbances and accidents, as well as damage to crops and natural habitats. NWRC experts are collaborating with international scientists to test the effects of GonaCon on fertility in feral cattle. Results showed that fertility was 100 percent in control feral cattle, but was reduced to only 33 percent in feral cattle treated with a single shot of GonaCon. In addition, animal weight, body condition, temperature, and feeding behaviors were monitored for 1 year to

determine whether the vaccine had any adverse health effects. Researchers concluded that GonaCon did not compromise the animals' welfare and effectively reduced cattle fertility. Therefore, GonaCon may be a viable way to help manage feral cattle populations in Hong Kong. Further research is being conducted to determine the effect of a second shot of GonaCon in feral cattle, and is also being expanded to test the efficacy of GonaCon in water buffalo that inhabit the same regions of Hong Kong.

Selected Publications:

Yoder, C.A., R.E. Mauldin, J.P. Gionfriddo, K.A. Crane, D.A. Goldade and R.M. Engeman. 2017. DiazaCon reduces black-tailed prairie dog reproduction in Colorado. *Wildlife Research*, online:13Feb2017. <http://dx.doi.org/10.1071/WR15210>

Evans, C.S., A.J. DeNicola, J.D. Eisemann, D.C. Eckery, and R.J. Warren. 2015. Administering Gona-Con™ to white-tailed deer via hand-injection versus syringe-dart. *Human-Wildlife Interactions* 9(2):265-272.

Massei, G., K-K. Koon, S. Benton, R. Brown, M. Gomm, D.S. Orahoad, S. Pietravalle, and D.C. Eckery. 2015. Immunocontraception for managing feral cattle in Hong Kong. *PLoS One* 10(4):e0121598. doi: 10.1371/journal.pone.0121598.

Massei G., D. Cowan and D. Eckery. 2014. Novel management methods: immunocontraception and other fertility control tools. In: R. Putman and M. Apollonio (Eds.), *Behaviour and Management of European Ungulates*, Whittles Publishing, Dunbeath.

Miller, L.A., K.A. Fagerstone and D.C. Eckery. 2013. Twenty years of immunocontraceptive research: lessons learned. *Journal of Zoo and Wildlife Medicine* 44(4S): S84-S96. Doi: 10.1638/1042-7260-44.4S.S84.

Major Research Accomplishments:

- WS researchers and partners have filed a patent application for the use of bacterial cell wall fragments in the development and delivery of oral contraceptive vaccines.
- APHIS licensed GonaCon-Equine to the non-profit organization Spay FIRST!, in 2016. The license allows the organization to market and sell GonaCon-Equine within the United States and internationally.
- WS researchers, in collaboration with international colleagues, demonstrated that fertility control through the use of GonaCon may be a viable way to help manage feral cattle populations in Hong Kong.