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Disease Surveillance of Wild Hogs in Great Smoky Mountains National Park – A Focus on Pseudorabies

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DISEASE SURVEILLANCE OF WILD HOGS IN GREAT SMOKY MOUNTAINS NATIONAL PARK - A FOCUS ON PSEUDORABIES

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ABSTRACT: Great Smoky Mountains National Park (GRSM) has received credible reports of individuals obtaining feral hogs from other states and illegally releasing them near the park boundary. These reports have been supported by the removal of hogs with physical and behavioral characteristics not common of wild hogs in GRSM. In 2001, GRSM established a partnership with the North Carolina Department of Agriculture and Consumer Services to survey for wild hog diseases and, in 2005, similar partnerships were established with the Tennessee Department of Agriculture and the United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services. From 2001 to 2007, 497 wild hog serological samples (28.4% of all hogs removed) were collected and tested for swine brucellosis and pseudorabies. All samples were negative for swine brucellosis. Since 2005, 16 wild hog samples (3.2%) tested positive for pseudorabies and the most recent sampling indicates that the prevalence and distribution of the disease may be increasing in GRSM. The occurrence of pseudorabies in GRSM is thought to be directly related to the illegal release of feral hogs near the park boundary.

KEY WORDS: diseases, Great Smoky Mountains, National Park Service, pseudorabies, wild hog.

INTRODUCTION

European wild boar (*Sus scrofa*) were first introduced into the southern Appalachian Mountains in 1912 for private hunting purposes (Stegeman 1938, Jones 1957). In 1920, about 100 of these wild boars escaped, scattered throughout the surrounding area, and interbred with free ranging domestic swine, resulting in a hybrid “wild hog”. By the late 1940’s, wild hogs migrated into the southwestern portion of Great Smoky Mountains National Park (GRSM), and by the 1970’s inhabited the entire park.

Wild hog rooting damages natural and cultural resources in GRSM, impacting native vegetative communities, populations, succession patterns, and nutrient cycles (Bratton 1974, Bratton 1975, Howe and Bratton 1976, Huff 1977, Howe et al. 1981, Bratton et al. 1982, Singer et al. 1984).

Wild hogs affect native wildlife through predation, habitat alteration, and competition for available food resources (Matschke 1965, Henry and Conley 1972, Ackerman et al. 1978, Singer et al. 1984). Because wild hogs are non-native (exotic) and threaten the protection and interpretation of resources being preserved, National Park Service Management Policies (2006) state they should be controlled or eradicated. Since 1959, GRSM staff has used a combination of trapping, shooting and limited fencing to control wild hogs (National Park Service 1993).

Wild hogs are also a host for infectious and parasitic diseases that may affect other wildlife, livestock and people (Wood and Barrett 1979, Davidson and Nettles 1997). Psuedorabies (PRV), caused by porcine herpes virus type 1, and swine Brucellosis, caused by the bacterium *Brucella suis*, affect reproduction, and therefore are significant concerns for the domestic swine industry. Brucellosis also has public health implications, since it can be potentially fatal if contracted by humans. Although previous serological surveys of wild hogs in GRSM revealed no evidence of PRV or brucellosis (Smith 1979, Zygmont et al. 1982, New et al. 1994), both diseases are found in wild hog populations throughout the southeast (Davidson and Nettles 1997).

The distribution of feral hogs is increasing in the United States (Mayer 2004), partly due to illegal relocations, which may also increase the distribution of PRV and brucellosis. In recent years, GRSM has received credible but unconfirmed reports of hunters illegally releasing feral hogs obtained from other states (e.g., Florida, Georgia and South Carolina), near the National Park boundary. These reports have been supported by the removal of hogs that have exhibited unusual behavioral (e.g., reduced fear of people) and physical characteristics (e.g., white or spotted coloring, curly tail, short snout) that are more indicative of feral hogs from other regions.

The concern for the introduction of pseudorabies and swine brucellosis to the GRSM area, along with state regulatory demands, prompted a partnership in 2001with the North Carolina Department of Agriculture and Consumer Services (NCDACS) to monitor for wild hog diseases in the North Carolina portion of GRSM. In 2005, partnerships were also established with the Tennessee Department of Agriculture (TDA) and the United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services (APHIS) to monitor for wild hog diseases in the Tennessee portion of GRSM. The objective of the disease monitoring program was to survey for the presence of PRV and swine brucellosis in the GRSM wild hog population. Results of the cooperative wild hog disease monitoring program are compiled and reported.

METHODS

We collected blood samples from hogs that were shot or trapped and humanely euthanized according to the American Veterinary Medical Association guidelines (Beaver et al. 2001). Approximately 10 milliliters (ml) of blood were collected from the thoracic cavity (preferable the heart) of dead hogs, as soon as possible. Blood samples were centrifuged (228 centrifuge, Fisher Scientific, Atlanta, Georgia, USA) to separate the serum and samples were frozen and stored at 4 degrees C. For each animal removed,

location (UTM), sex, estimated age, condition, color and other notable observations were recorded. We used topographic maps or global positioning systems (Garmin Ltd, Olathe, Kansas, USA) to determine UTM locations and ArcGIS (ESRI, Redlands, California, USA) to map location data.

Serum samples were sent to the Rollins Animal Disease Diagnostic Laboratory in North Carolina and the C.E. Kord Animal Disease Diagnostic Laboratory in Tennessee. For PRV, an enzyme-linked immunosorbent assay (ELISA) was used to detect antibodies to the pseudorabies virus; the latex agglutination test (LAT) was used to confirm the result. For swine brucellosis, there are a variety of presumptive tests used by State animal health agencies for serologic samples. In North Carolina, the Buffered Acidified Plate Antigen (BAPA) assay test was used, followed by the Card Test (CT). In Tennessee, the Rapid Automative Presumptive (RAP) test was used, followed by the Standard Plate Test (SPT).

RESULTS

From 2001 to 2007, 1,747 wild hogs were removed from GRSM; serum samples were collected from 497 of these (28.4%) and tested for PRV and brucellosis (Table 1). No hogs tested positive for brucellosis; however, 16 (3.2%) tested positive for PRV (Table 1). All samples collected from 2001 to 2004 were negative for PRV; however, in 2005, 2006 and 2007 the number of PRV positive samples were two (3.8%), four (2.7%) and 10 (6.6%), respectively (Fig. 1). Fifteen PRV positive samples (93.8%) were collected from the southwestern corner of GRSM (Fig. 2).

DISCUSSSION

Previous serological surveys of wild hogs in GRSM revealed evidence of porcine parvovirus, leptospirosis, and toxoplasmosis, but no evidence of PRV or brucellosis (Smith 1979, Zygmont et al. 1982, New et al. 1994, Diderrich et al. 1996). However, these studies may have been hampered by limited sampling, particularly from the southwest portion of GRSM. The current disease monitoring program has been more intensive resulting in larger and a more widespread distribution of sampling, and since 2005 has confirmed the presence of PRV in the GRSM wild hog population.

The higher number of PRV positive hog samples in the southwestern portion of GRSM (93.8%) may be due to increased sampling in this area. The southwestern portion of GRSM has better hog habitat and therefore more hogs are removed from this area (Keller et al. 2003). However, the southwest portion of GRSM is the primary location where wild hogs with feral characteristics, including 18 semi-tame hogs in 1996 and two semi-tame white hogs in 2000 (Fig. 2) have been removed. A serological survey conducted from 1998 to 2000 found one wild hog sample (0.5%) suspected to be PRV positive (titer 1:8; J. New, University of Tennessee, unpublished data) in the southwest portion of GRSM (Fig. 2). The southwestern GRSM boundary is easily accessible by roadway or boat and traditionally has been an area with significant challenges to patrol by GRSM Rangers and State Wildlife Officers. It is an area of concern regarding the illegal releases of feral hogs. The higher occurrence of PRV in the southwestern portion of GRSM is thought to be due to the illegal

release of diseased feral hogs from other southern states, where the disease is endemic.

The prevalence and distribution of PRV in GRSM's wild hog population may be spreading. The number of wild hog PRV positive samples has increased from two (3.8%) in 2005 to 10 (6.6%) in 2007 (Fig. 1). In addition, one positive sample collected in 2007 was from the southeastern portion of GRSM (Fig. 2). Wild hogs in GRSM move seasonally in response to food and these movements may be spreading the disease. However, the occurrence of a PRV positive sample in the extreme southeastern portion of GRSM is more likely due to additional illegal releases of feral hogs. In fact, GRSM staff recently received credible but unconfirmed reports of hunters illegally releasing feral hogs near the southeastern portion of the park that were originally captured in South Carolina. Given seasonal movements of wild hogs and additional illegal releases of feral hogs, PRV may eventually spread throughout GRSM.

MANAGEMENT IMPLICATIONS

Historically, wild hogs from GRSM were donated to the Tennessee Wildlife Resources Agency (TWRA) and the North Carolina Wildlife Resource Commission (NCWRC) for relocation to specifically designated lands that were open to public hunting. From 1959 to 2005, over 4,000 wild hogs were donated to the two states. However in 2003, the wild hog general agreement with TWRA was not renewed for several reasons, including the concern of spreading swine diseases such as pseudorabies and swine brucellosis; additional environmental damage caused by relocated wild hogs; and the lack evidence that relocated animals increase or improve hunting opportunities. In 2005, the wild hog cooperative agreement with NCWRC was terminated as a result of a new NCWRC regulation that prohibited the unregulated transport of swine in the state. The primary concern was to reduce the potential spread of swine diseases throughout the State of North Carolina.

PRV positive wild hogs in GRSM are a potential threat to native wildlife. Although natural infections of PRV in non-swine hosts are not common, several wildlife species can be infected including black bears (*Ursus americanus*; Pirtle et al. 1986) and coyotes (*Canis latrans*;Raymond et al. 1997). Particularly for carnivores, disease transmission is thought to occur by ingestion of tissues containing PRV or bite wounds. Symptoms of PRV infection are similar to rabies and usually cause death. Disposed wild hog carcasses in GRSM are frequently scavenged by other wildlife, sometimes within hours. Black bears and coyotes are most notable for scavenging wild hog carcasses, and could become infected with PRV by ingesting virus containing tissues. Park staff has also observed evidence of coyotes killing and eating wild hogs, particularly piglets, which could expose them to PRV via bite wounds and/or ingesting contaminated tissues.

PRV-positive wild hogs in GRSM are also a potential health threat to livestock outside the park and therefore a concern to the NCDACS and TDA. North Carolina, in particular, is one of the largest producers of pork in the U.S. and could incur large economic costs should they loose their pseudorabies-free status. Although, the U.S.

Department of Agriculture has practically eliminated PRV from U.S. domestic swine populations, wild hog populations serve as a significant reservoir that threaten the industry (Gresham et al. 2002, Witmer et al. 2003, Corn et al. 2004). Given the presence of PRV in GRSM wild hogs, the potential environmental and economic impacts of PRV, and the potential to spread other significant swine diseases (i.e., swine brucellosis) from illegal releases of feral hogs, continuation of this cooperative wild hog disease surveillance program will be necessary.

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Table 1. Number and percent of wild hogs removed and tested for pseudorabies and swine brucellosis in Great Smoky Mountains National Park, 2001–2007.

Year	No. of pigs removed	No. tested	Percent tested	No. PRV positive	Percent PRV positive	No. Brucella positive
2001	241	25	10.37	0	0	0
2002	256	39	15.23	0	0	0
2003	347	70	20.17	0	0	0
2004	140	13	9.29	0	0	0
2005	235	52	22.13	2	3.85	0
2006	254	146	57.48	4	2.74	0
2007	274	152	55.47	10	6.58	0

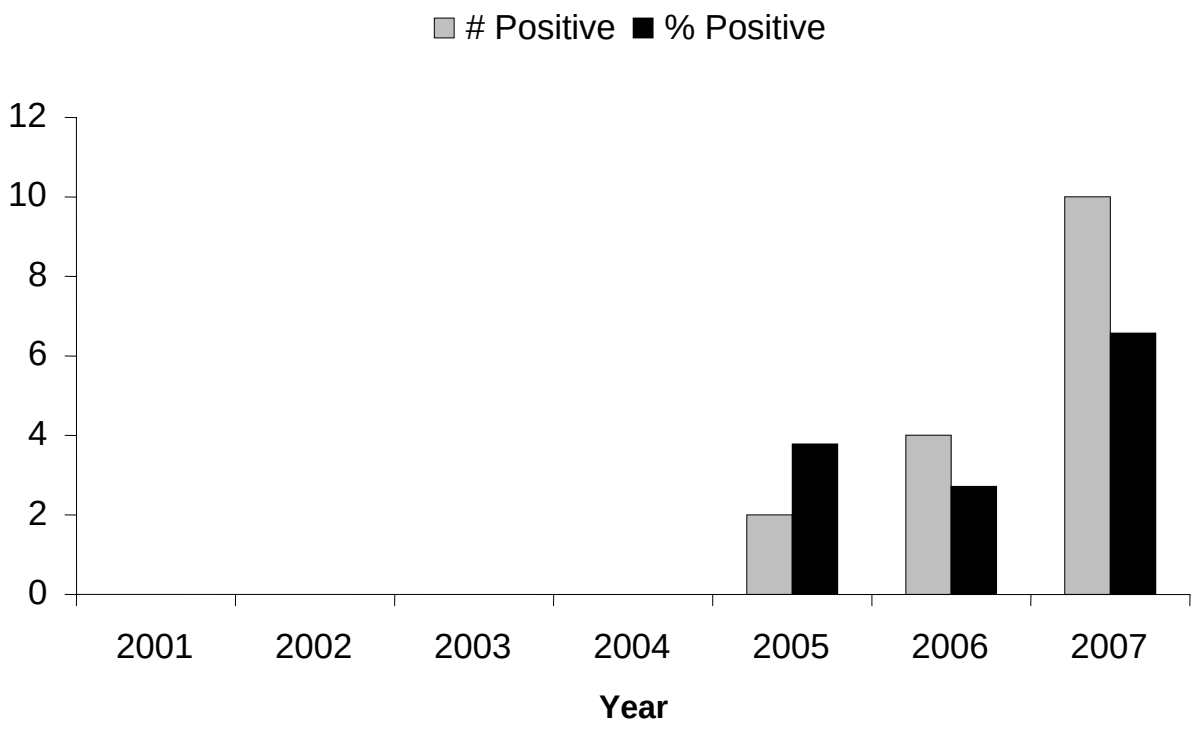

Figure 1. Number and percent of wild hogs removed from Great Smoky Mountains National Park that tested positive for pseudorabies, 2001-2007.

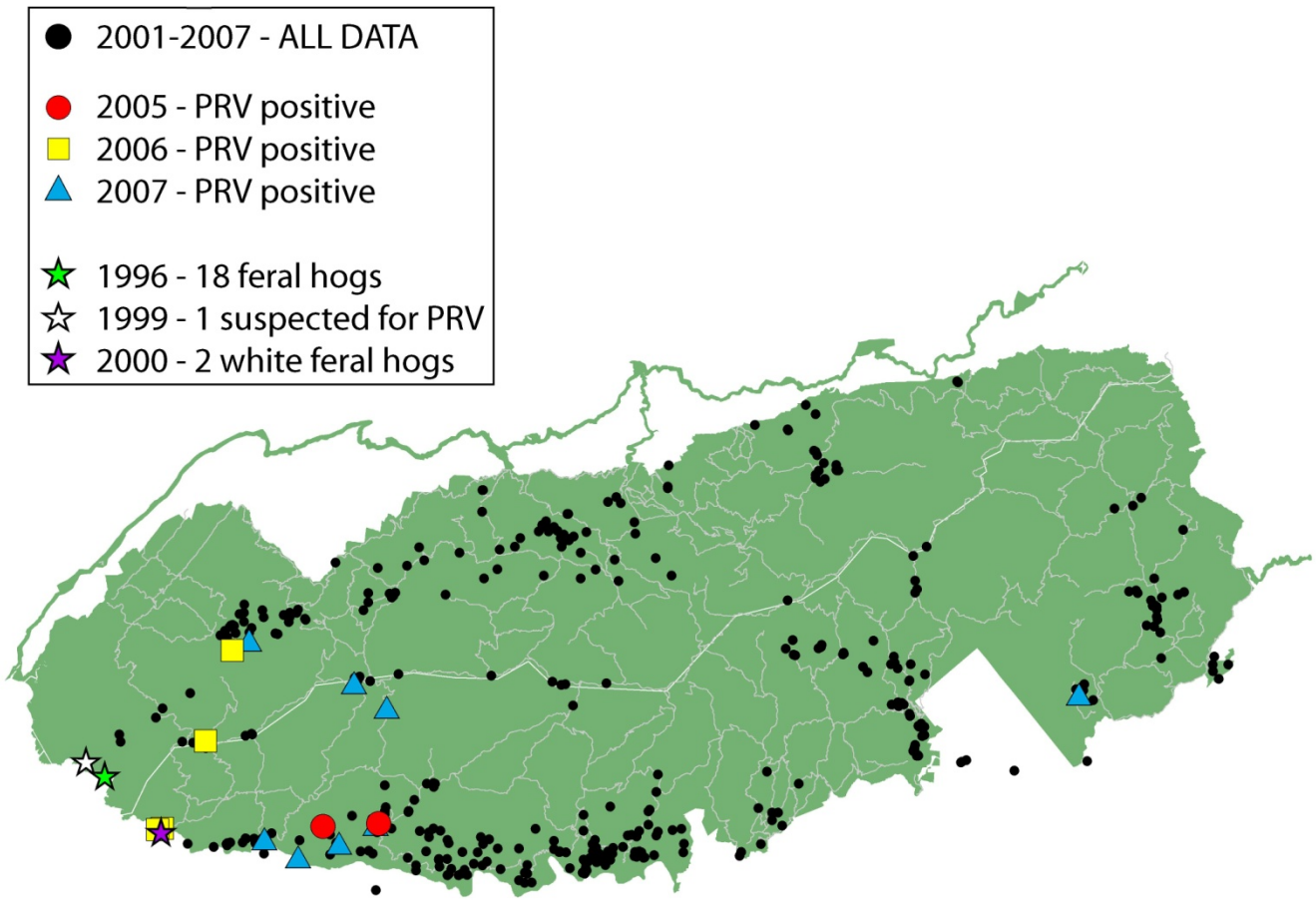

Figure 2. Locations of wild hogs tested for pseudorabies (PRV) in Great Smoky Mountains National Park (GRSM), 2001-2007 (black dots). Locations of wild hogs that tested positive for PRV in GRSM, in 2005 (red circles), 2006 (yellow squares), and 2007 (blue triangles). Also shown are locations of feral hogs known to be illegally released (green and blue stars) and of a hog suspected to be positive for PRV (white star).