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PARASITES, DISEASES, AND HEALTH STATUS OF SYMPATRIC POPULATIONS OF SIKA DEER AND WHITE-TAILED DEER IN MARYLAND AND VIRGINIA[1]

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ABSTRACT: In July 1981, investigations on parasites, diseases, and herd health status were conducted on sympatric populations of sika deer (*Cervus nippon*) and white-tailed deer (*Odocoileus virginianus*) from Blackwater National Wildlife Refuge (Maryland) and Chincoteague National Wildlife Refuge (Virginia) on the Delmarva Peninsula. Five adult deer of each species were collected from each location and subjected to thorough necropsy examinations and laboratory tests. White-tailed deer at both locations harbored protozoan, helminth, and arthropod parasites typically associated with this species throughout the southeastern United States. In contrast, sika deer at both locations harbored only light burdens of ticks, chiggers, and sarcocysts. Serologic tests for antibodies to seven infectious disease agents revealed evidence of exposure to bovine virus diarrhea (BVD) virus, infectious bovine rhinotracheitis virus, and parainfluenza$_3$ virus in white-tailed deer, but only BVD virus in sika deer. At both locations the general health status of sika deer was superior to that of white-tailed deer.

INTRODUCTION

White-tailed deer are the most widely distributed and abundant wild cervids in North America (Halls, 1978), and in many regions, they coexist with other native cervids, domestic livestock, and a variety of introduced exotic ungulates. As a result, numerous investigations have been made on the potential for cross-transmission of infectious agents between white-tailed deer and these hosts. In some instances, e.g., cerebrospinal parelaphostrongylosis, these disease potentials have far-reaching implications (Anderson and Prestwood, 1981).

Although many species have been investigated with regard to disease interactions with white-tailed deer, others including sika deer have not. The single report by Robinson et al. (1978) on elaeophorosis in sika deer in Texas provides the only suggestion of disease interaction between sika and white-tailed deer. This report presents an evaluation of the health status, diseases, and parasites of two sympatric populations of sika and white-tailed deer.

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MATERIALS AND METHODS

This study was conducted at two locations: Blackwater National Wildlife Refuge (NWR), Dorchester County, Maryland, and Chincoteague National Wildlife Refuge, Accomack County, Virginia, both of which are on the Delmarva Peninsula. Both locations support sympatric wild populations of white-tailed and sika deer. The history of these sika deer populations has been documented elsewhere (Flyger and Warren, 1958; Flyger, 1960; Flyger and Davis, 1964; Feldhamer et al., 1978; Feldhamer, 1982). Five adult animals (≥ 1 yr of age) of each species were collected at each location by shooting in July 1981. Blood samples were obtained by cardiac puncture immediately after death, and the carcasses were refrigerated prior to necropsy within 12 hr. Detailed necropsy examinations, including parasite recovery and abomasal parasite counts (APC) (Eve and Kellogg, 1977; Nettles, 1981), were performed on each animal. Sarcocyst-infected muscle was fed to laboratory-reared dogs and cats to confirm the identity of the species present as described by Crum and Prestwood (1982). Physical condition was assessed by the method of Stockle et al. (1978). Serum samples were tested for antibodies to a number of infectious disease agents. Where appropriate, lesion specimens were obtained for pathogen isolation attempts. Sections of major organs along with gross lesions were obtained for histopathologic study.

RESULTS

The overall physical condition of sika deer at both locations was superior to that of white-tailed deer. All sika deer were rated in good physical condition, with some approaching the excellent category. White-tailed deer from each location had physical condition ratings of fair,

TABLE 1. Number of reactors to serologic tests for selected infectious agents in sika and white-tailed deer from two locations on the Delmarva Peninsula.[a]

Disease agent	Blackwater NWR Sika deer	Blackwater NWR White-tailed deer	Chincoteague NWR Sika deer	Chincoteague NWR White-tailed deer
Bovine virus diarrhea virus	2/5[b]	0/5	0/5	2/5
Infectious bovine rhinotracheitis virus	0/5	0/5	0/5	1/5
Parainfluenza$_3$ virus	0/5	0/5	0/5	1/5

[a] All tests for antibodies to the etiologic agents of leptospirosis, brucellosis, epizootic hemorrhagic disease and bluetongue were negative. Leptospirosis testing included the *pomona*, *grippotyphosa*, *hardjo*, *icterohemorrhagiae*, and *canicola* serotypes. Titers considered positive were: BVD and PI$_3$ ≥ 1:50 and IBR ≥ 1:2.

[b] No. positive/no. tested.

except at Chincoteague NWR where one was rated poor and one was rated good.

Serologic tests for seven infectious agents revealed evidence of exposure to bovine virus diarrhea (BVD) virus, infectious bovine rhinotracheitis (IBR) virus, and parainfluenza$_3$ (PI$_3$) virus in white-tailed deer, but only BVD virus in sika deer (Table 1). Necropsy examinations revealed gross lesions in a single sika and a single white-tailed deer. A 7-yr-old female sika deer from Blackwater NWR had enlarged iliac, inguinal, and cervical lymph nodes, enlarged and hemorrhagic tonsils, and a 1 cm diameter nodule extending from the surface into the parenchyma of the spleen. Histologically, all of these lesions were compatible with a necrotizing granulomatous lymphadenitis. Microbiologic cultures yielded *Staphylococcus aureus* and a beta-*Streptococcus* sp. from lymph nodes and a beta-*Streptococcus* sp., *Sarcina* sp. and *Serratia* sp. from the tonsil. Acid fast stains were negative. A 5-yr-old female white-tailed deer from Chincoteague NWR had massive disseminated abscesses involving the entire left psoas, the left longisimus dorsi and overlying skin, the pelvic cavity, the liver, the right dorsal lobe of the lung, and the right parotid lymph node. Microbiologic cultures of these abscesses revealed mixed infections of beta-*Streptococcus*, *Staphylococcus* sp., and *Aeromonas hydrophila*.

Parasitologic studies revealed 16 species of parasites, including three protozoans, two cestodes, seven nematodes, and four arthropods

TABLE 2. Parasites recovered from sika and white-tailed deer from two locations on the Delmarva Peninsula.[a]

Parasite	Blackwater NWR Sika	Blackwater NWR White-tailed	Chincoteague NWR Sika	Chincoteague NWR White-tailed
Protozoans				
Sarcocystis odocoileocanis	20%, L, L[b]	60%, L, L-M	0	60%, M, L-M
Theileria cervi (77521)[c]	0	100%, L, L-M	0	80%, L, L-M
Trypanosoma cervi (77521)	0	60%, L, L-M	0	60%, L, L
Cestodes				
Taenia hydatigena (77522)	0	20%, 1, 1	0	0
Moniezia benedeni (77523)	0	0	0	20%, 3, 3
Nematodes				
Apteragia odocoilei (77524)	0	100%, 577, 363–834	0	100%, 768, 317–1,361
Ostertagia dikmansi (77525)	0	20%, 49, 49	0	80%, 49, 48–76
Ostertagia mossi (77526)	0	100%, 201, 92–486	0	80%, 112, 48–305
Oesophagostomum venulosum (77527)	0	20%, 1, 1	0	0
Dictyocaulus viviparus (77528)	0	80%, 3, 1–9	0	60%, 1, 1–2
Parelaphostrongylus tenuis (77529)	0	60%, 3, 1–11	0	20%, 1, 1
Setaria yehi (77530)	0	40%, 3, 4–9	0	20%, 1, 1
Protostrongylid larvae	0	80%, L, L-M	0	80%, L, L-M
Arthropods				
Tricholipeurus parallelus	0	20%, L, L	0	20%, L, L
Amblyomma americanum	60%, L, L	100%, L, L-M	100%, M, L-M	100%, M, L-H
Dermacentor variabilis	0	0	40%, L, L	0
Eutrombicula splendens (1983.328)	0	0	80%, L, L	60%, L, L

[a] Figures in columns are prevalence, mean number per infected animal, and maximum intensity of infection.

[b] Actual counts not made; intensities rated as low (L), moderate (M), or high (H).

[c] U.S. National Parasite Collection (Beltsville, Maryland) accession number (protozoans and helminths) and Bishop Museum (Honolulu, Hawaii) Collection number (chiggers).

(Table 2). White-tailed deer harbored 15 species, whereas sika deer harbored only four species. Abomasal parasite counts (APC) for white-tailed deer on Blackwater NWR and Chincoteague NWR were 788 and 928, respectively. Only mild lesions were associated with parasitism in white-tailed deer. One had a mild diffuse fibrinous peritonitis due to infection by *Setaria yehi*. Eight had scattered microgranulomas surrounding protostrongylid eggs and larvae in alveolar capillaries. One other had slightly cropped ears and subcutaneous inflammation associated with an infestation of *Amblyomma americanum*. Significant lesions attributable to parasitism were not found in sika deer.

DISCUSSION

Populations of sika deer at both locations could be considered "the picture of health" with substantial reserves of endogenous fat, limited evidence of infectious diseases, and a virtual absence of parasitism. This is in marked contrast to the only previous health investigation conducted on sika deer on the Delmarva Peninsula over two decades earlier. At that time, a large scale die-off of sika deer occurred on James Island due to overpopulation, malnutrition, and subsequent pine oil poisoning when the deer resorted to consuming the needles, bark, and roots of pines (Hayes and Shotts, 1959). Interestingly, examinations for endoparasites by Hayes and Shotts (1959) were also negative.

White-tailed deer at both locations were at a reasonable health status, although compared to sika deer they had limited endogenous fat reserves, evidence of exposure to more infectious diseases, and parasite faunas typical of white-tailed deer in the southeastern United States (Davidson et al., 1981). Abomasal parasite counts (Eve and Kellogg, 1977) and other herd health parameters (Eve, 1981) suggested that white-tailed deer herds at both locations were near carrying capacity and that natural mortality due to disease was of a covert nature (Eve, 1981).

Of particular interest was the occurrence of the meningeal worm (*Parelaphostrongylus tenuis*) in white-tailed deer at both locations. This helminth produces neurologic disease in numerous other wild ungulates (Anderson and Prestwood, 1981); however, its effects in sika deer have not been studied. Fish and Wildlife Service personnel reported that sika deer with signs of neurologic disease occasionally had been encountered at Chincoteague NWR but no such observations were known for Blackwater NWR. Subsequent to this study, formalin fixed brains and spinal cords of two sika deer with neurologic disorders from Chincoteague NWR were examined. In neither case was evidence of cerebrospinal parelaphostrongylosis found; however, considering the range of cervid hosts in which *P. tenuis* causes clinical disease, the pathogenicity of *P. tenuis* in sika deer deserves further investigation.

General observations made during this study, the history of sika deer population growth on the Delmarva Peninsula (Flyger and Warren, 1958; Flyger, 1960; Flyger and Davis, 1964; Feldhamer et al., 1978; Feldhamer, 1982), and studies on interspecific competition between sika deer and white-tailed deer (Harmel, 1979; Armstrong and Harmel, 1981), all indicate that sika deer routinely outcompete white-tailed deer. Although previous studies (Harmel, 1979; Armstrong and Harmel, 1981) have focused on the importance of nutritional competition between these species, our findings suggest that differential susceptibilities to infectious diseases and parasitism also may be important factors in the interspecies equation.

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