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Lance A. Durden

Georgia Southern University, ldurden@georgiasouthern.edu

Dennis J. Richardson

Quinnipiac University, dennis.richardson@quinnipiac.edu

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Ectoparasites of the Virginia opossum (*Didelphis virginiana*), Raccoon (*Procyon lotor*), and Striped Skunk (*Mephitis mephitis*) from Keith County, Nebraska

Lance A. Durden¹ and Dennis J. Richardson^{2*}

¹Department of Biology, Georgia Southern University, Statesboro, Georgia 30460

²Department of Biological Sciences, Quinnipiac University, Hamden, Connecticut 06518

* Correspondence: Dennis J. Richardson, BC-SCI, Quinnipiac University, 275 Mount Carmel Avenue, Hamden, Connecticut 06518; tel 203-582-8607, email Dennis.Richardson@quinnipiac.edu

Six Virginia opossums (*Didelphis virginiana*), nine raccoons (*Procyon lotor*) and one striped skunk (*Mephitis mephitis*) collected from Keith County Nebraska were examined for ectoparasites. All three host species were parasitized by adults of the American dog tick, *Dermacentor variabilis*. Opossums were also parasitized by the flea *Pulex simulans* and the tiny fur mite *Didelphilichus serrifer*; the latter species represents a new state record for Nebraska. Raccoons were also parasitized by *P. simulans* and by the lagonymph-associated flea *Euhoplosyllus glacialis affinis*, whereas the skunk was also parasitized by the chewing louse *Neotrichodectes mephiditis*.

Key words: *Didelphis virginiana*, *Procyon lotor*, *Mephitis mephitis*, *Dermacentor variabilis*, *Didelphilichus serrifer*, *Pulex simulans*, *Euhoplosyllus glacialis affinis*, *Neotrichodectes mephiditis*, ectoparasites, Nebraska

Introduction

The ectoparasites associated with Virginia opossums (*Didelphis virginiana*), raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*) have been reported from several regions within the United States. For example, ectoparasites of opossums have previously been documented from New York (Hamilton 1958), West Virginia (Karnes and Shoemaker 1966), Indiana (Whitaker et al. 1976), Oregon (1980), Ohio (Rockett and Johnston 1988), Tennessee (Durden and Wilson 1990), Florida (Durden et al. 1993) and Georgia (Pung et al. 1994, Wilson and Durden 2003) and were reviewed, together with other diseases by Potkay (1970). Ectoparasites of raccoons have been reported from Indiana (Whitaker and Goff 1979), Ohio (Rockett and Johnston 1988), Arkansas (Richardson et al. 1994) and Georgia (Pung et al. 1994, Durden and Wilson 2003). Similarly, ectoparasites of striped skunks have been documented from Maryland (Goldberg 1954), California (Mead 1963), West Virginia (Karnes and Shoemaker 1966), Indiana (Whitaker and Goff 1979) and Connecticut (Durden and Richardson 2003). Ectoparasites of all three of these mammal species have been reported from Georgia (Morlan 1952), North Carolina (Harlan and Palmer 1974), New Jersey (Harlan and Kramer 1979), South Carolina (Nelder and Reeves 2005), and North Carolina and Tennessee (Reeves et al. 2007). However, there are relatively few records of ectoparasites of wild mammals from Nebraska and no detailed studies of the ectoparasites of opossums, raccoons and striped skunks in the Great Plains region. This is unfortunate because Nebraska is located centrally in North America and, by virtue of its location, serves as a crossroads for some

eastern and western faunas (Rapp and Gates 1957). Herein, we report on ectoparasites of these three species of mammals from western Nebraska.

Materials and Methods

Between 3 July 2005 and 13 August 2008, six Virginia opossums, nine raccoons, and one striped skunk were live-trapped and killed with a 0.22 caliber rifle. The single striped skunk and six Virginia opossums were collected from the grounds of Cedar Point Biological Station, University of Nebraska-Lincoln, Keith County Nebraska. Eight raccoons were collected on and adjacent to the grounds of Cedar Point Biological Station between 41°12.629'N northward to 41.12.676°N and 101°38.434'W westward to 101°39.626'W along the south side of Lake Keystone and North Platte River, just East of Kingsley Dam and Lake McConaughy. One raccoon was collected from Clearcreek Wildlife Management Area, Keith County, Nebraska, on the North Platte River, west of Lake McConaughy (approximately 41°18.17'N 120°04.35'W).

To collect ectoparasites, the fur was "blown" through and parted with hands. All ectoparasites observed were removed with watchmaker's forceps and placed into vials containing 70% ethanol. The fur was combed over a white pan, and the resultant debris was placed into vials. Adult ticks and female fleas (see Discussion) were identified in alcohol. Male fleas and the single louse were cleared in 10% potassium hydroxide, then dehydrated through an ethanol series, further cleared in xylene and slide-mounted in Canada balsam before they were identified using compound microscopy. Ectoparasite specimens from this study were deposited in the

General Ectoparasite Collection at Georgia Southern University (Department of Biology) under accession numbers L-3533 through L-3547.

Results

Five species of ectoparasites were collected during this study, including 190 American dog ticks (*Dermacentor variabilis* Say, Acari: Ixodidae), 64 fleas [63 *Pulex simulans* Baker, 1 *Euhoplopsyllus glacialis affinis* (Baker), Siphonaptera, Pulicidae], 12 fur mites, (*Didelphilichus serrifer* Fain, Acari: Atopomelidae) and one chewing louse [*Neotrichodectes mephiditis* (Packard), Phthiraptera, Trichodectidae] (Table 1). The American dog tick was collected from all three host species whereas *P. simulans* parasitized opossums and raccoons. The remaining three species of ectoparasites were each collected from just one host species; the fur mite from opossums, the flea *E. glacialis affinis* from a raccoon and the chewing louse on the striped skunk (Table 1).

Discussion

Opossums, raccoons and striped skunks were parasitized by a relatively low diversity of ectoparasites in this study when compared to ectoparasites reported from the same host species in other regions. For example, Morlan (1952) reported 27 species of ectoparasites from opossums in Georgia, Whitaker et al. (1976) reported 23 species of ectoparasites (and another 4 species on non-parasitic arthropods) from opossums in Indiana and Durden and Wilson (1990) reported 13 species of ectoparasites from this host in Tennessee. Similarly, Morlan (1952) reported 15 species of ectoparasites from raccoons in Georgia, Whitaker and Goff (1979) documented 14 species from Indiana and Richardson et al. (1994) reported 9 species from Arkansas. With respect to striped skunks, Morlan (1952) reported 17 species of ectoparasites from this host in Georgia, Mead (1963) recorded 9 species in California, Whitaker and Goff (1979) reported

6 species in Indiana and Durden and Richardson (2003) recorded 7 species in Connecticut. However, it is possible that some ectoparasite species were not sampled by the collecting technique used in the present study or that ectoparasites are more diverse during other seasons. Regardless, some interesting ectoparasite records are evident from these collections.

The American dog tick appears to be abundant in western Nebraska as it parasitized a large percentage of hosts in this study. This tick will also feed on humans and is a vector of zoonotic pathogens, in particular *Rickettsia rickettsii* (Wolbach), the causative agent of Rocky Mountain spotted fever (Cooley 1938, Wells et al. 2004). Some attached females of this tick can also cause tick paralysis, especially in dogs and humans (Wells et al. 2004). Except for a disjunct population in California, western Nebraska appears to represent the western extent of *D. variabilis* in North America (Cooley 1938). Further west in Nebraska, in the counties that border Wyoming, it is replaced by (and could be sympatric with in some areas) the Rocky Mountain wood tick (*Dermacentor andersoni* Stiles), which is also a vector of *R. rickettsii* and a cause of tick paralysis (Cooley 1938, James et al. 2006).

In the USA, the fur mite, *D. serrifer*, has previously been reported from *D. virginiana* in Florida, Georgia, Indiana and Tennessee (Whitaker et al. 2007). It has also been recorded from other species of *Didelphis* in Central and South America (Fain 1979). It has not previously been recorded from Nebraska or the Great Plains but it is probably widespread throughout North America on opossums. It could have been overlooked in some other studies of opossum ectoparasites because of its diminutive size.

The chewing louse, *N. mephiditis*, parasitizes the striped skunk, the hooded skunk (*Mephitis macroura* Lichtenstein) and, curiously, the island fox (*Urocyon littoralis* (Baird)) in North America (Price et al. 2003).

Table 1. Ectoparasites recorded from 6 Virginia opossums, 9 raccoons and 1 striped skunk in Keith County, Nebraska, 2005-2008. Numbers presented are prevalence (percent of hosts infested) and numbers of males (M), Females (F) and Nymphs(N) collected for each ectoparasite species

Ectoparasite species	Virginia opossum	Raccoon	Striped skunk
Tick:			
<i>Dermacentor variabilis</i>	83%, 42M, 44F	100%, 41M, 47F	100%, 5M, 11F
Fur mite:			
<i>Didelphilichus serrifer</i>	17%, 3M, 9F	—	—
Chewing louse:			
<i>Neotrichodectes mephiditis</i>	—	—	100%, 1N
Fleas:			
<i>Euhoplopsyllus glacialis affinis</i>	—	11%, 1M	—
<i>Pulex simulans</i>	83%, 25M, 31F	22%, 1M, 6F	—

Osborn (1896) previously reported it (as *Trichodectes mephiditis*) from Nebraska (Holt County) from *M. mephitis*. This louse appears to be widespread on striped skunks in the United States with previous records from Georgia (Morlan 1952), Maryland (1954), California (Mead 1963), North Carolina (Harlan and Palmer 1974), New Jersey (Harlan and Kramer 1979), Indiana (Whitaker and Goff 1979), Connecticut (Durden and Richardson 2003), South Carolina (Nelder and Reeves 2005) and North Carolina (Reeves et al. 2007). Nevertheless, except for the Nebraska record cited above (Osborn 1896), this louse is poorly documented from the Great Plains region.

Western Nebraska is in the approximate transition zone in North America between *Pulex simulans* and the human flea, *Pulex irritans* L. according to distributional maps presented by Hopla (1980), with the latter species mostly occurring on native mammals north and west of this region. Females of these two flea species cannot be distinguished morphologically (and no molecular method for distinguishing them has been developed yet) and, before 1958, both species were lumped as *P. irritans* as detailed by Smit (1958) who resurrected the taxon *Pulex simulans*. All of the *Pulex* males we examined microscopically were *P. simulans*. Therefore, we assume that the *Pulex* females we collected from the same hosts also belong to this species, which is the usual convention in this situation (Durden et al. 2012). Rapp and Gates (1957) recorded "*P. irritans*" from 7 species of mammals (including *D. virginiana*) in Nebraska and from 10 different counties but they did not record it from Keith County or from *P. lotor*. Almost certainly, some (possibly all) of the collections reported by Rapp and Gates (1957) actually represented *P. simulans*. Therefore, *P. lotor* and Keith County represent new host and distributional records, respectively, in Nebraska for *P. simulans*, and *D. virginiana* could also represent a new host record for Nebraska for this flea. Nevertheless, Hopla (1980) documented *P. simulans* from both of these host species in Oklahoma and Texas, and from opossums and striped skunks in Mexico. *Pulex simulans* is known to parasitize a wide variety of mammalian species, especially carnivores, burrowing mammals and other medium-sized mammals (Hopla 1980, Durden et al. 2012). Interestingly, Pung et al. (1994) found *P. simulans* to be fairly common on opossums in southern Georgia (USA) but absent from *P. lotor* in the same region.

The rabbit and hare-associated flea, *E. g. affinis* is widespread in the mid-western United States from Minnesota to Idaho and south to Texas (Holland 1985). Rapp and Gates (1957) previously recorded this flea (reported as *Hoplopyllus affinis*) in Nebraska from 8 counties (but not from Keith County) and from 4 different host spe-

cies (two lagomorphs, two carnivores) but not from *P. lotor*. Presumably, the raccoon from which this flea was collected had recently eaten a rabbit or a hare because carnivores tend to accumulate fleas from prey animals (Durden et al. 2012).

As evidenced by the arthropod species reported herein, the ectoparasite faunas associated with opossums, raccoons and striped skunks in western Nebraska are noteworthy. This is largely because some species show transitional biogeographical trends between eastern and western North American faunas whereas other ectoparasite species collected are widespread throughout much of North America or in the New World.

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