4-29-1998

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MITE PARASITISM OF MOSQUITOES IN CENTRAL WYOMING

Margo Frost Spurrier

As scientific information has revealed environmental and health consequences of chemical control of mosquitoes, natural control of mosquitoes has become an ongoing area of study. Mosquitofish, Gambusia affinis, and bacterial agents, such as Bacillus thuringiensis var. israelensis and Bacillus sphaericus, have been developed and are widely applied to control mosquito larvae.

Larval water mites of the group Hydrachnida (order Acariformes) are parasitic on aquatic insects, including mosquitoes (Smith 1988). In a review of all known records of mosquitoes parasitized by mites, both Aedes dorsalis and Culiseta inornata are listed as hosts for mites whose identities have not been determined. Culex tarsalis has been parasitized by Piona sp. (Mullen 1975). Tsai et al. (1969) collected ectoparasitic red larval mites (Arrenurus spp.) from Ae. inreceptus, Ae. pustulatus, and Cs. impatiens in southwestern Wyoming.

Smith and McIver (1984) noted that host-seeking Coquillettidia perturbans consistently had a lower abundance and prevalence of parasitic mites than newly emerged mosquitoes. It also appeared that the abundance of larval mites did not closely match the abundance of available hosts.

This study was conducted to investigate the prevalence and abundance of larval water mites on different species of female mosquitoes collected in Natrona County, Wyoming, to determine the potential for utilizing mites for mosquito control. Mite prevalence, abundance, and mean intensity (Margolis et al. 1982) were investigated for Cx. tarsalis, Cs. inornata, and the genus Aedes. Seasonal and yearly patterns were compared. Additional comparisons were made between data collected from light traps and data collected from mosquito landings on human subjects.

METHODS

Mosquitoes were trapped every night from the 1st week of June through the middle of September 1991–1996 in 5 New Jersey light traps at 4 locations in Natrona County: Casper (106°16′53″W, 42°50′05″N), Evansville (106°15′58″W, 42°51′52″N), Vista West II (106°26′30″W, 42°51′52″N), and Natrona County Airport (106°27′54″W, 42°53′35″N and 106°27′24″W, 42°54′00″N) where 2 traps were located. The Evansville and Casper traps were located in residential areas. The Vista West II trap, which was in a rural irrigated subdivision, was not included in the 1991 study. One airport trap was placed next to an irrigation pond and irrigated pasture, the other next to a service building with no irrigation activity on the grounds surrounding the building. Mosquitoes were collected from the traps every Monday, Wednesday, and Friday and were sorted by sex. No male mosquitoes were included in the study. Female Cx. tarsalis and Cs. inornata were identified to species and counted. Due to time constraints and difficulty identifying some specimens to species, female members of the mosquito genus Aedes were grouped for counting purposes. Female
mosquitoes with mites were separated and the parasite load noted. All female host mosquitoes were identified to species, including *Aedes*. Other species of mosquitoes in Natrona County are not numerous enough to be included in the study. Collections ceased the 2nd full week of September when the weather became too cold for mosquito activity.

Additionally, in 1996 mosquitoes were collected in a New Jersey light trap and during landings at another location in the county (106°16'47''N, 42°52'51''W). Landings were conducted the day following a trap night during which it was likely that parasitized mosquitoes would be captured. A Hausherr mosquito vacuum collector was used by a human subject to gather mosquitoes landing on his skin and clothing.

Statistical software in Epi Info Version 5 was used to analyze mite prevalence on mosquitoes landing on individuals versus those collected in the New Jersey light trap. This study was conducted in conjunction with the routine mosquito surveillance program of the City of Casper–Natrona County Health Department.

**RESULTS**

Table 1 summarizes results for 1991–1996. *Aedes dorsalis*, *Cx. tarsalis*, and *Cs. inornata* are the 3 most abundant species of mosquitoes in Natrona County. Within the *Aedes* genus *Ae. dorsalis* is most abundant, comprising approximately 90–95% of this group in Natrona County (unpublished data). For *Aedes* the only species found to be parasitized was *Ae. dorsalis*. Mean parasitic intensities for the 3 groups were *Aedes*, 1.81; *Cx. tarsalis*, 1.14; and *Cs. inornata*, 3.00. Mite intensity varied from 1 to as many as 9 mites per host. *Cs. inornata* had the greatest mean intensity and is the largest mosquito in size. No other species of mosquitoes were parasitized by mites. Larval mites were observed attached to male mosquitoes when sorting collections, but these were not included in the study.

Two larval mites collected from *Ae. dorsalis* were identified as *Thyasides sphagnorum* by Bruce P. Smith. Mites were most commonly found attached to the posterovertral region of the thorax near the junction of the abdomen (89%), followed by attachment at the neck region.

For each year of the study both mite prevalence and mite abundance were greatest on *Aedes* spp. Although all *Aedes* species were grouped for counting purposes, only *Ae. dorsalis* were found to be parasitized by mites; therefore, actual prevalence and abundance figures for *Ae. dorsalis* are somewhat greater than indicated in Table 1. Statistical analysis of host selection demonstrated significantly higher parasitism by mites on *Ae. dorsalis* ($\chi^2 = 76.69$, $P < 0.0001$).

Over the 6 yr of the study, mites were collected from mosquitoes as early as 20 May and as late as 18 September. However, parasitism by mites tended to occur over a 2-mo period each summer, with the time of onset varying from late May to July. Overall, 50% of the mites were recovered during June; however, in 1993, when the smallest number (17) of mites was collected, 70% (12) of those were found on mosquitoes in August. Mite specimens collected early each year tended to be engorged, whereas those collected later in the season tended to be smaller and not engorged.

Prevalence of mites collected from mosquitoes captured while landing on human subjects was significantly greater than from mosquitoes in New Jersey light traps at the same location (Table 2). Prevalence was 2.5% from the light trap and 14.6% from landings. The Fisher exact $P$ value = 0.0001728.

### Table 1. Combined results from 5 traps recorded from the 1st week of June through mid-September 1991–1996.

<table>
<thead>
<tr>
<th>Mosquito species/group</th>
<th>Number of ♀ mosquitoes</th>
<th>Number of ♀ hosts</th>
<th>Number of mites</th>
<th>Mite prevalence</th>
<th>Mite abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aedes</em></td>
<td>36,514</td>
<td>240</td>
<td>434</td>
<td>0.66%</td>
<td>1.19%</td>
</tr>
<tr>
<td><em>Cx. tarsalis</em></td>
<td>16,861</td>
<td>7</td>
<td>8</td>
<td>0.04%</td>
<td>0.08%</td>
</tr>
<tr>
<td><em>Cs. inornata</em></td>
<td>8,356</td>
<td>10</td>
<td>30</td>
<td>0.12%</td>
<td>0.38%</td>
</tr>
<tr>
<td>Total</td>
<td>61,731</td>
<td>257</td>
<td>472</td>
<td>0.42%</td>
<td>0.76%</td>
</tr>
</tbody>
</table>
Table 2. Mite prevalence on female *Ae. dorsalis* captured in New Jersey light traps versus mite prevalence on female *Ae. dorsalis* captured during landings. Landings were conducted the day following the trap night.

<table>
<thead>
<tr>
<th>Trial</th>
<th><em>Ae. dorsalis</em></th>
<th>Hosts</th>
<th>Mites</th>
<th><em>Ae. dorsalis</em></th>
<th>Hosts</th>
<th>Mites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>215</td>
<td>2</td>
<td>2</td>
<td>36</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>3</td>
<td>8</td>
<td>13</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>241</td>
<td>6</td>
<td>11</td>
<td>82</td>
<td>12</td>
<td>27</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Results of this study indicate that larval water mites, including *T. sphagnorum*, may prefer *Ae. dorsalis* as a host and that the mite population may be dependent upon a large host population of *Ae. dorsalis*. Because *Ae. dorsalis* is the most abundant mosquito species in Natrona County and this species is multivoltine, the likelihood of mites attaching to emerging members of this species is high. Females of this species would also be expected to return to aquatic oviposition sites in a single season, whereas both *Cx. tarsalis* and *Cs. inornata* overwinter as females (Harmston and Lawson 1967), returning the subsequent season to aquatic sites for oviposition. Consequently, larval mites selecting *Ae. dorsalis* as a host would have greater success returning to an aquatic environment. All 3 mosquito species have been collected from the same aquatic habitat, although seasonal differences in species abundance occur (unpublished data).

Mite prevalence on *Aedes* in 1993 was the lowest of the 6-yr study. However, in 1993 *Aedes* spp. were only 41% of the total counted mosquito population compared to an average of approximately 60% for all years combined. Additionally, most mites were collected from hosts in August and September 1993 when *Cs. inornata* and *Cx. tarsalis* comprised greater percentages of the mosquito population. A reduced population of the preferred host and a later appearance of larval mites may have reduced successful attachment.

Mosquito numbers were highest in 1994, likely due to the large number of *Aedes* (78% of all mosquitoes trapped). The greatest number of mites was also collected that year. Interestingly, during 1994 no water mites were collected from either *Cx. tarsalis* or *Cs. inornata*, perhaps due to the greater abundance of *Ae. dorsalis* available to serve as hosts. In 1994 precipitation was low (National Weather Service data), which led to increased irrigation activity (Alcova Irrigation District personal communication). *Aedes dorsalis* is often associated with irrigated crops and pastures (Denke and Spackman 1990).

Mite prevalence and abundance figures reported in this study may be low if mite specimens were dislodged from hosts while in the collecting jars. It is suspected this occurred, especially on nights when mosquito collection numbers were high.

Mullen (1977) also reported the prevalence of parasitism by *Thyasides sphagnorum* in the northeastern United States to be very low (<1.0%) on the 4 species of *Aedes* and 1 species of *Culiseta* parasitized by *T. sphagnorum* in New York.

Mosquitoes that were collected as they landed on humans, presumably to feed, had a higher prevalence of mites than those collected from light traps at the same location. There are 2 possible explanations for this. One is that the flight of parasitized mosquitoes is hindered by attached mites, and consequently these mosquitoes are more easily captured. Alternatively, parasitized mosquitoes are feeding more frequently to compensate for nutritional loss due to mites. *Anopheles crucians*, when parasitized by the water mite *Arrenurus pseudotenuicolis*, was found to feed more frequently than non-parasitized mosquitoes (Lanciani and Boyt 1977).

If the initial hypothesis is correct, parasitized mosquitoes may suffer increased mortality due either to a slower response by the mosquito to its host defense mechanism or to predation. If the latter is true, the nuisance capability of an individual parasitized mosquito may be greater than that of a non-parasitized mosquito.
Last, if parasitized female mosquitoes need more blood meals to compensate for nutritional loss to mites, they may be visiting more hosts, making them more effective disease vectors. *Aedes dorsalis* is considered a vector of California encephalitis (Crane et al. 1977, Moore et al. 1993). It may be that parasitized mosquitoes bite more frequently but also have a lower survivorship than non-parasitized mosquitoes.

Low mite prevalence and abundance demonstrated in this study indicate no potential for successfully utilizing mites as a control agent.

ACKNOWLEDGMENTS

Bruce P. Smith identified larval mites. I am grateful to Robert S. Seville and Kenneth L. Hoff for their support and advice. The Mosquito Control Program of the City of Casper–Natrona County Health Department is funded by the City of Casper, Wyoming, and the Natrona County Weed and Pest District.

LITERATURE CITED


Received 28 April 1997
Accepted 25 November 1997