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A Search for the Natural Vectors of Avian Malaria in Iowa, with Notes on Other Mosquito Parasites

By JEAN L. LAFFOON

The study of avian malaria has received much attention in recent years because of the recognition that knowledge concerning it is often very helpful in the understanding of human malaria.

While many investigators have dissected wild *Anopheles* mosquitoes in a search for the vectors of human malaria and culicine mosquitoes for the vectors of human filariasis, there apparently has been little effort to find the natural vectors of bird malaria, although numerous species of mosquitoes have been shown to be capable of transmitting the disease under laboratory conditions.

Cantrell and Jordan (1945) dissected 10 wild-caught *Aedes* (*Aëdimorphus*) *voxans* (Meigen), 5 *A. (Ochlerotatus) trivittatus* (Coq.) and 5 *A. (O.) stimulans* (Walker) and found them to be negative for malaria. Taylor (1930), during a search for vectors of filariasis in Northern Nigeria, found a "very heavy infection with small oocysts" in *Culex (Lutzia) tigripes* Grandpré and Charmoy, which he questionably identified as *Plasmodium praecox*, presumably believing this to represent an avian malaria infection. Mayne (1928) reported infections in 2 out of 48 *Anopheles (Myzomyia) subpictus* Grassi which "were captured 'wild' from a room where several malaria-infected birds were kept for experimental purposes." These are apparently the only reports of natural infections of bird malaria in mosquitoes.

Mayne (1928) and Hurlbut and Hewitt (1941) have pointed out that the demonstration that several species of *Anopheles* are susceptible to infection by avian malaria tends to invalidate the general assumption that all natural malarial infections of *Anopheles* can be considered as human malaria. Thus it is entirely possible that some of the reports of human malarial infections in *Anopheles* were actually based on cases of avian malaria.

The main purpose of the present work was to search for malarial infections in mosquitoes, observations on other parasites being secondary. All mosquitoes used were collected in or near Ames, Iowa, between June and October, 1947. Only specimens which could be accurately identified were dissected. Each mosquito was examined for the presence of external parasites such as mites, and for the occurrence of mermithids in the body cavity. The stomach

and salivary glands of each female were searched for the presence of malarial parasites and flagellate protozoans. No systematic examinations were made for other parasites.

Since the technique for dissection and examination for malaria has been described in detail by many authors, including Wilcox and Logan (1941), it is not redescribed here. This method was employed, with one modification. After nicking the integument near the posterior end of the abdomen, the entire abdomen was severed just behind the thorax. By doing this, the digestive tract was severed anterior to the stomach, and the latter was easily removed from the abdomen by gentle traction on the terminal segments.

A list of the species and numbers of mosquitoes examined is presented in Table 1. No malaria infections were observed in any of the females dissected. The failure to find any malaria-infected mosquitoes in the course of this study might be due to any of several factors, some of which are obscure. The most probable explanation is that sufficient dissections were not made of the local vector or vectors. It is also possible that the important carrier in Iowa is one of the mosquitoes not studied in this survey.

The negative results of this study suggest that the discovery of natural avian malaria vectors by dissecting mosquitoes collected at

Table I
 Mosquitoes examined.

Species	Females	Males
<i>Anopheles (Anopheles) punctipennis</i> (Say)	90	22
<i>Uranotaenia sapphirina</i> (Osten Sacken)	11	3
<i>Culiseta (Culiseta) inornata</i> (Williston)	27	1
<i>Psorophora (Psorophora) ciliata</i> (Fabricius)	7	1
<i>P. (Janthinosoma) horrida</i> (Dyar and Knab)	33	0
<i>Aedes (Ochlerotatus) canadensis</i> (Theobald)	12	1
<i>A. (O.) sticticus</i> (Meigen)	17	0
<i>A. (O.) trivittatus</i> (Coquillett)	19	0
<i>A. (Finlaya) triseriatus</i> (Say)	37	6
<i>A. (Aedimorphus) vexans</i> (Meigen)	355	181
<i>Culex (Culex) restuans</i> Theobald	33	24
<i>C. (C.) salinarius</i> Coquillett	13	3
<i>C. (C.) tarsalis</i> Coquillett	39	8
<i>C. (Melanoconion) erraticus</i> (Dyar and Knab)	72	43
<i>C. (Neoculex) territans</i> Walker	108	46
Totals	873	339

random is a time-consuming and discouraging task. It is thought that future work on this subject be directed towards the dissection of mosquitoes captured in the vicinity of bird concentrations.

Four female *Aedes vexans* were found to be infected with *Crithidia fasciculata* Léger, a protozoan of the family Trypanosomatidae. Two of these specimens were collected on July 6th and two on September 22nd. Since 355 female *Aedes vexans* were examined, the rate of infection in this species was 1.1 percent. All other females examined were negative. The parasites were identified by Dr. E. R. Becker of Iowa State College. This record of *Crithidia fasciculata* is apparently the first from any member of the genus *Aedes*.

Six *Aedes vexans* were found to be parasitized by a mermitid nemotode, as yet unidentified. Four parasitized females and one male were collected on June 24th, and one female on June 27th, each mosquito containing a single worm. A seasonal distribution of the parasite may be indicated, as 6 of the 38 (15.8 percent) of the *A. vexans* dissected during June were parasitized, and no further infections were observed.

A single larval mite was collected from a female *Culex restuans* on September 1, 1947. Dr. I. M. Newell of the University of Oregon has identified this mite as a larva of the family Trombiidiidae. The mite was attached to the intersegmental membrane between the first and second abdominal tergites. This was the only external parasite seen in the 1,212 specimens dissected. It is possible that additional ectoparasites may have been present at the time of collection and escaped before dissection.

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