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MOSQUITOES OF FORT CAMPBELL, KENTUCKY (DIPTERA: CULICIDAE)

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ABSTRACT. A survey of the mosquito fauna of Fort Campbell, Kentucky (Christian County, Kentucky, and Montgomery County, Tennessee) was conducted from May 1996 to May 1998. A total of 528 mosquito collection sites were sampled in the most comprehensive mosquito collection effort on the military installation since 1976. A total of 42 mosquito species were identified, including new locality records for 14 species.

KEY WORDS Distribution, new records, military, Tennessee, U.S. Army

INTRODUCTION

Fort Campbell, Kentucky, an active U.S. Army installation, is located on the Tennessee–Kentucky border, 70 km northwest of Nashville, TN. The installation includes more than 425 km^2 and is located within 4 counties, 2 in Kentucky and 2 in Tennessee. Fort Campbell is home to several large military units, including the 101st Airborne Division (Air Assault), the 5th Special Forces Group (Airborne), and the 160th Special Operations Aviation Regiment (Airborne). The mission profiles of Fort Campbell military units include frequent trips to distant locations, including Africa and Latin America. For that purpose, the installation is also the home of more than 300 military aircraft. The potential for introduced species of mosquito, and their pathogens, must be considered a public health threat. Despite this situation, little effort has been made in recent years to document the species of mosquito that reside on Fort Campbell.

From May 1996 to May 1998, a survey was conducted of the mosquito fauna of Fort Campbell. This survey included 387 larval and pupal and 141 adult collection sites within a 50-km^2 area of the installation (Christian County, Kentucky, and Montgomery County, Tennessee). This study area was selected for its diversity of habitat, its proximity to human activities, and its lack of overhead artillery fire or other hazardous military operations. The study area included the cantonment area, family housing areas, open fields, wooded areas, marshes, streams, and lakes. Larval mosquito habitats included permanent and temporary surface waters, tree holes, rock holes, and artificial containers.

MATERIALS AND METHODS

Larval and pupal collections were made by several methods based on the habitat, including dipper, direct pour from small artificial containers, and the siphon technique. Adult mosquitoes were collected using sweep net; Centers for Disease Control (CDC)-style light traps (incandescent white light, Model 1012, and fluorescent ultraviolet light, Model 1212, John W. Hock Co., Gainesville, FL), with or without dry ice; and mechanical aspirator (Hausherr's Machine Works, Toms River, NJ). Some larvae and pupae were reared to adults for identification. Larval and pupal specimens were examined whole, or slide-mounted using CMC-10 media (Masters Chemical Co., Bensenville, IL) or Canada balsam. Adult specimens were examined unmounted or pin-mounted on paper points. Identification to species level was made using standard light microscopy and the taxonomic references of Darsie and Ward (1981), Darsie (1986), Harrison and Whitt (1996), and Reinert et al. (1997).

Locations of collection sites and solar and lunar data were determined by Global Positioning Satellite (GPS) receivers. Additional solar and lunar data were provided by the 19th Air Support Operations Squadron, U.S. Air Force, Fort Campbell. Field meteorological data were measured using a variety of instruments. Soil and water temperatures at a depth of 10 cm and air temperatures at a height of 1 m were obtained using digital maximum–minimum thermometers. Relative humidity readings at a height of 1 m were taken using a sling psychrometer. Measurements of accumulated rainfall were made using a rain gauge.

RESULTS

Forty-two species belonging to 8 genera of mosquitoes (Table 1) were collected during this survey, confirming the continued presence of 28 species and establishing new locality records for an additional 14 species of mosquito. The survey failed to confirm the presence of 11 other species that were expected based on prior collections (U.S. Army Center for Health Promotion and Preventive Medicine [CHPPM], personal communication; Bruce Harrison, North Carolina Department of Environment and Natural Resources [NCDENR], personal communication), the report of Carpenter (1952), information cited by Saugstad (1977), or the geographical distribution maps of Darsie and Ward (1981) and Reinert et al. (1997).

The first major mosquito egg hatch of 1997 occurred during the first week of February, following a 77-mm rainfall episode. Field conditions for the

Table 1. Mosquito taxa (Diptera: Culicidae) collected from May 1996 to May 1998, Fort Campbell, Kentucky.

Aedes (*Aedes*) *cinereus* Meigen[1]
Aedes (*Aedimorphus*) *vexans* (Meigen)
Aedes (*Ochlerotatus*) *canadensis canadensis* (Theobald)
Aedes (*Ochlerotatus*) *dorsalis* (Meigen)
Aedes (*Ochlerotatus*) *dupreei* (Coquillett)[1]
Aedes (*Ochlerotatus*) *fulvus pallens* Ross[1]
Aedes (*Ochlerotatus*) *grossbecki* Dyar and Knab[1]
Aedes (*Ochlerotatus*) *infirmatus* Dyar and Knab[1]
Aedes (*Ochlerotatus*) *sticticus* (Meigen)
Aedes (*Ochlerotatus*) *tormentor* Dyar and Knab
Aedes (*Ochlerotatus*) *trivittatus* (Coquillett)
Aedes (*Protomacleaya*) *hendersoni* Cockerell[1]
Aedes (*Protomacleaya*) *triseriatus* (Say)
Aedes (*Stegomyia*) *aegypti* (Linnaeus)[1]
Aedes (*Stegomyia*) *albopictus* (Skuse)
Anopheles (*Anopheles*) *barberi* Coquillett
Anopheles (*Anopheles*) *crucians* Wiedemann
Anopheles (*Anopheles*) *perplexens* Ludlow[1]
Anopheles (*Anopheles*) *punctipennis* (Say)
Anopheles (*Anopheles*) *quadrimaculatus* Say
Anopheles (*Anopheles*) *smaragdinus* Reinert[1]
Anopheles (*Anopheles*) *walkeri* Theobald[1]
Culex (*Culex*) *pipiens* Linnaeus[2]
Culex (*Culex*) quinquefasciatus Say[2]
Culex (*Culex*) restuans Theobald
Culex (*Culex*) salinarius Coquillett
Culex (*Melanoconion*) *erraticus* (Dyar and Knab)
Culex (*Melanoconion*) *peccator* Dyar and Knab[1]
Culex (*Neoculex*) *territans* Walker
Culiseta (*Climacura*) *melanura* (Coquillett)[1]
Culiseta (*Culiseta*) *inornata* (Williston)[1]
Orthopodomyia alba Baker
Orthopodomyia signifera (Coquillett)
Psorophora (*Grabhamia*) *columbiae* (Dyar and Knab)
Psorophora (*Grabhamia*) *discolor* (Coquillett)
Psorophora (*Janthinosoma*) *cyanescens* (Coquillett)
Psorophora (*Janthinosoma*) *ferox* (von Humboldt)
Psorophora (*Janthinosoma*) *horrida* (Dyar and Knab)
Psorophora (*Psorophora*) *ciliata* (Fabricius)
Psorophora (*Psorophora*) *howardii* Coquillett[1]
Toxorhynchites (*Lynchiella*) *rutilus septentrionalis* (Dyar and Knab)
Uranotaenia (*Uranotaenia*) *sapphirina* (Osten Sacken)

[1] New locality record.
[2] Using the taxonomic reference of Darsie and Ward (1981), the larvae and adults of *Cx. pipiens* and *Cx. quinquefasciatus* cannot be separated based on morphology. Fort Campbell, Kentucky, is located in a region of overlapping distributions for these species.

week included a photoperiod of 10.5 h, air temperature from −1.8 to 17.2°C, relative humidity from 60 to 73%, soil temperature from 5.5 to 9.0°C, and water temperature from 2.3 to 11.8°C. The initial species produced was *Aedes vexans* (Meigen), which appeared in biting collections from late March until mid-November. Other larval species produced during the first week of February included *Aedes sticticus* (Meigen), *Aedes canadensis canadensis* (Theobald), *Aedes infirmatus* Dyar and Knab, and *Aedes grossbecki* Dyar and Knab.

The most pestiferous species of mosquito on Fort Campbell, based on human-biting collections, were *Ae. vexans, Aedes triseriatus* (Say), *Culex restuans* Theobald, and *Psorophora ferox* (von Humboldt). Bloodfeeding on humans by at least one of these 4 species occurred from late March until mid-November.

At 70 tree hole collection sites, *Ae. triseriatus* was the sole culicid occupant of 49% of the sites. *Aedes triseriatus* shared its habitat with other species of mosquitoes in another 6% of the sites. *Orthopodomyia signifera* (Coquillett) and *Toxorhynchites rutilus septentrionalis* (Dyar and Knab) were present in 16 and 14% of the tree holes, respectively. *Aedes albopictus* (Skuse) was present in only 7% of the tree holes.

DISCUSSION

Based on literature review, 11 species of mosquitoes were expected but not collected during this survey. Two species, *Coquillettidia perturbans* (Walker) (as *Mansonia perturbans*) and *Culex tarsalis* Coquillett, had been collected by the U.S. Army during 1944 and 1945 (Carpenter 1952) and by New Jersey light traps during 1963 to 1987 (CHPPM, personal communication). Four of the 11 species had been collected by New Jersey light traps during 1963 to 1987 (CHPPM, personal communication), including *Aedes mitchellae* (Dyar), *Aedes sollicitans* (Walker), *Aedes taeniorhynchus* (Wiedemann), and *Culex nigripalpus* Theobald. Three species have never been collected on Fort Campbell but were expected based on the geographical distribution maps of Darsie and Ward (1981). These species include *Aedes atropalpus* (Coquillett), *Aedes thibaulti* Dyar and Knab, and *Psorophora mathesoni* Belkin and Heinemann. One species, *Aedes atlanticus* Dyar and Knab, was expected based on the maps of Darsie and Ward (1981), and U.S. Army collection records. A portion of the military records for *Ae. atlanticus-tormentor* was obtained under the Freedom of Information Act (CHPPM, personal communication), with additional records cited by Saugstad (1977) or provided by Bruce Harrison (personal communication). Additionally, *Anopheles maverlius* Reinert, a newly described species, was expected based on the geographical distribution noted by Reinert et al. (1997).

Several factors increase the need for a comprehensive continuous mosquito surveillance program on Fort Campbell. The operational missions of Fort Campbell military units often require the use of aircraft, both rotary-wing and fixed-wing, to conduct extended flights to other parts of the world, including tropical and subtropical areas. Many of these areas are infested with mosquito species that may harbor human and veterinary pathogens. Fort

Campbell-based aircraft may be an avenue for the introduction of foreign pest species to the United States. An introduced species of mosquito on Fort Campbell can only be detected if a specimen is captured and recognized as morphologically different from the expected native species. Military personnel, because of the nature of their duties and their frequent deployments to foreign countries, may return to Fort Campbell infected with malaria parasites or other pathogens. These pathogens may be transmitted to native mosquitoes on Fort Campbell before the onset of recognized symptoms in the soldier.

Mosquito surveillance on Fort Campbell has been neglected in recent years. The last larval collection on the installation occurred in 1974. From 1977 to September 1987, New Jersey light traps were the sole method of collection. The traps operated for a cumulative total of 3 months during that 11-year period (CHPPM, personal communication). Since that time, the only collection effort has been oviposition cup sampling for *Ae. albopictus* in 1988. A comprehensive mosquito surveillance program is essential to the maintenance of public health. However, disease control and the reduction of annoyance are not the only purposes of a managed program. The widespread use of pesticides to control mosquitoes, without the incorporation of a comprehensive surveillance program, may be both inefficient and a danger to personal and environmental health.

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