MOSQUITO LARVAE (CULICIDAE) AND OTHER DIPTERA ASSOCIATED WITH CONTAINERS, STORM DRAINS, AND SEWAGE TREATMENT PLANTS IN THE FLORIDA KEYS, MONROE COUNTY, FLORIDA

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MOSQUITO LARVAE (CULICIDAE) AND OTHER DIPTERA ASSOCIATED WITH CONTAINERS, STORM DRAINS, AND SEWAGE TREATMENT PLANTS IN THE FLORIDA KEYS, MONROE COUNTY, FLORIDA

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ABSTRACT

We investigated the larval dipteran fauna of artificial and natural containers, sewage treatment plants, and storm drains in the Florida Keys. Mosquitoes collected were *Aedes aegypti*, *Ae. albopictus*, *Anopheles crucians*, *Culex atratus*, *Cx. nigripalpus*, *Cx. peccator*, *Cx. quinquefasciatus*, *Deinocerites cancer*, *Ochlerotatus taeniorhynchus*, and *Wyeomyia vanduzeei*, as well as an unidentified *Culex* (*Melanoconion*) species and an unidentified *Anopheles* species. Other Diptera collected included a chironomid species in the *Chironomus decorus* Johannsen group; the filter fly, *Clogmia albipunctata*; an undescribed psychodid in the genus *Austropericoma*; a ceratopogonid midge, *Dasyhelea pseudoincisurata*; and a phorid fly, *Megaselia scalaris*.

Key Words: larvae, larval habitat, medical entomology, mosquito control

RESUMEN

Se investigaron la fauna dipterana de recipientes, de plantas de tratamiento de aguas residuales, y de drenajes pluviales en los Cayos de la Florida. Los mosquitos recogidos fueran *Aedes aegypti*, *Ae. albopictus*, *Anopheles crucians*, *Culex atratus*, *Cx. nigripalpus*, *Cx. peccator*, *Cx. quinquefasciatus*, *Deinocerites cancer*, *Ochlerotatus taeniorhynchus*, y *Wyeomyia vanduzeei*, asi como una especie no identificada de *Culex* (*Melanoconion*) y otra especie no identificada de *Anopheles*. Otros dipteros colectados incluyeron una especie de chironómido en el grupo *decorus* Johannsen de *Chironomus*; la mosca del filtro, *Clogmia albipunctata*; una especie de psycódido en el género *Austropericoma;* un ceratopogónide, *Dasyhelea pseudoincisurata*; y el fórido, *Megaselia scalaris*.

The Florida Keys are islands that lie south and southwest of the southernmost tip of the Florida peninsula. Although some islands lie within Dade County, most are located within Monroe County (Pritchard et al. 1949). The Florida Keys Mosquito Control District conducts larval mosquito surveillance in natural areas and in domestic situations. Domestic surveillance includes examination of artificial and natural containers near houses, inspection of sewage treatment plants, and monitoring mosquito larval development in storm water catch basins. These inspections are an important part of the District's mission, because container-inhabiting mosquitoes can serve as vectors for a number of human pathogens. Laboratory studies have incriminated several container- inhabiting mosquitoes as potential vectors of the recently introduced West Nile virus (Sardelis et al. 2001; Turell et al. 2001). This virus recently has been detected in mosquito pools collected in the Florida Keys (Hribar et al. 2003). A previous study of container-inhabiting mosquito larvae was conducted during the summer of 2000 on some of the western most islands (Hribar et al. 2001). This study was conducted to determine the species of mosquitoes and other aquatic Diptera inhabiting containers, storm drains, and sewage treatment plants throughout the Florida Keys.

MATERIALS AND METHODS

Collections were made daily from 1 January 2002 to 31 December 2002, exclusive of weekends and holidays, from 31 islands (Fig. 1). Upon entering a residential yard, a business, or other collec-

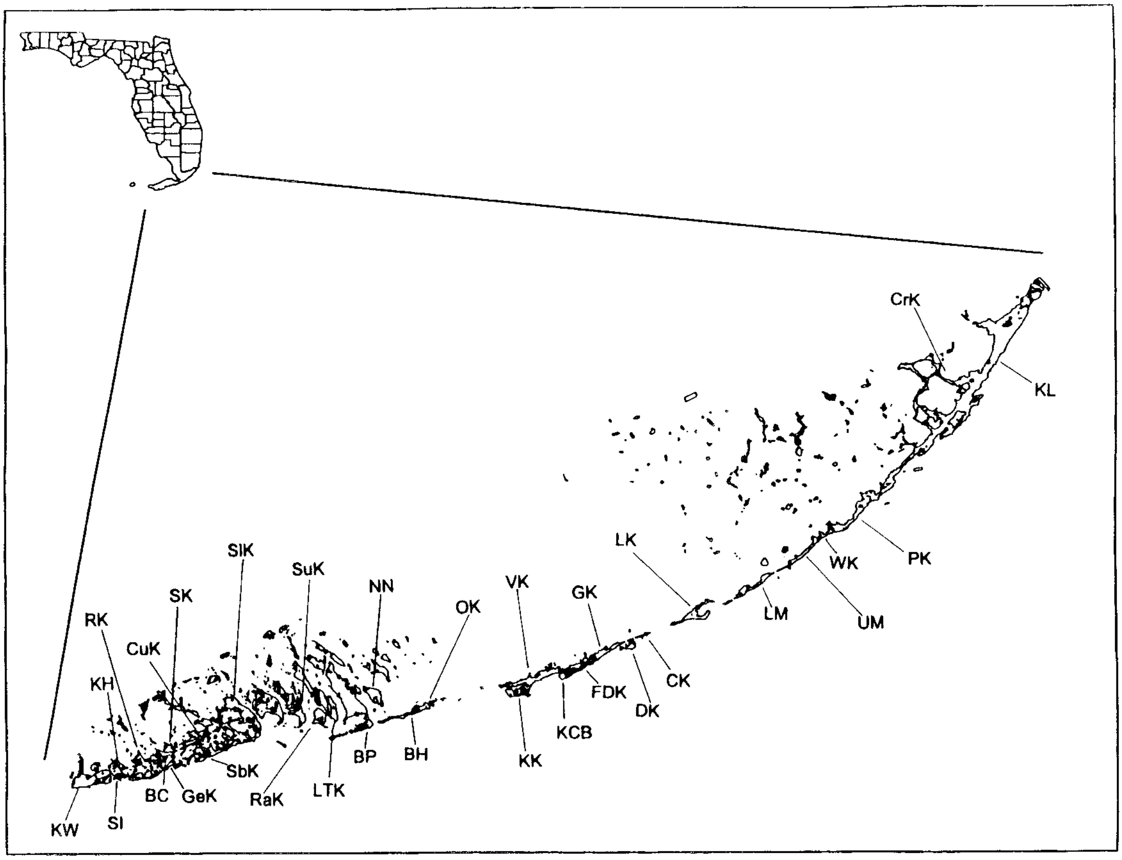

Fig. 1. Major islands of the Florida Keys: Bahia Honda Key (BH), Big Coppitt Key (BC), Big Pine Key (BP), Conch Key (CK), Cross Key (CrK), Cudjoe Key (CuK), Duck Key (DK), Fat Deer Key (FDK), Geiger Key (GeK), Grassy Key (GK), Key Colony Beach (Shelter Key) (KCB), Key Haven (Raccoon Key) (KH), Key Largo (KL), Key West (KW), Knight's Key (KK), Little Torch Key (LTK), Long Key (LK), Lower Matecumbe Key (LM), No Name Key (NN), Ohio Key (OK), Plantation Key (PK), Ramrod Key (RaK), Rockland Key (RK), Saddlebunch Keys (SbK), Shark Key (SK), Stock Island (SI), Sugarloaf Key (including Lower Sugarloaf Key) (SlK), Summerland Key (SuK), Upper Matecumbe Key (UM), Vaca Key (VK), and Windley Key (WK).

tion site, inspectors visually scanned the area for containers. All containers were examined for larvae. Due to time constraints on the inspectors (each inspector was responsible for all residences and businesses on one or more islands), no attempt was made to count containers without larvae. When larvae were found, they were collected either by use of a half-pint dipper or a turkey baster, depending on the container. Storm drains and sewage treatment plants were sampled with dippers. Inspectors collected a sample of larvae from each collection site. No attempt was made to collect all larvae from a given container. All larvae collected from the same individual container were considered to be one sample. Larval samples were placed into 150-ml plastic jars and returned to the laboratory daily. Larvae were identified with the aid of the keys by Darsie and Morris (2000). Some observations on other Diptera co-occurring with mosquitoes are reported.

Results

A total of 4, 777 collections was processed during calendar year 2002. Ten different mosquito species were encountered: *Aedes aegypti* (Linn.), *Ae. albopictus* (Skuse), *Anopheles crucians* Wiedemann, *Culex atratus* Theobald, *Cx. nigripalpus* Theobald, *Cx. peccator* Dyar and Knab, *Cx. quinquefasciatus* Say, *Deinocerites cancer* Theobald, *Ochlerotatus taeniorhynchus* (Wiedemann), and *Wyeomyia vanduzeei* Dyar and Knab. Larvae of an unidentified *Culex* (*Melanoconion*) species and an unidentified *Anopheles* species also were collected. *Aedes aegypti* was most commonly collected (2,296 collections). *Culex quinquefasciatus* was next most commonly collected (1,796 collections). These two species alone accounted for over 85% of total collections. A variety of containers was used for oviposition. Sewage treatment plants, septic tanks, and cesspits were larval development sites for *Cx. quin-*

quefasciatus, *Cx. nigripalpus*, and *Ae. aegypti*. Storm drains were developmental sites for *Cx. quinquefasciatus* and *Cx. nigripalpus*. *Wyeomyia vanduzeei* was collected only from Bromeliaceae, occasionally cohabiting with *Ae. aegypti* or *Cx. quinquefasciatus*. Some collections (547, or 11.5%) contained more than one species of mosquito (Table 1). *Culex* (*Melanoconion*) *atratus* Theobald was found in an old refrigerator during this study, cohabiting with *Ae. albopictus*. On Big Pine Key and Vaca Key, mosquito larvae were most often collected from tires, whereas on Key West most collections were made from flowerpots, planters, and trivets. During this study *Ae. albopictus* was found to have infested Big Pine Key (Vlach & Fussell 2003). Voucher specimens were labeled as follows: FL, Monroe Cnty./Big Pine Key/24 Jul 2002/C. Samul, coll./ex: tire//*Aedes albopictus*/L. Hribar, det.

Dry, point-mounted specimens were deposited in the following collections: Florida Department of Agriculture and Consumer Services, Florida State Collection of Arthropods, Gainesville, Florida—4 females (accession number E2002-4265-601); Yale University, Peabody Museum of Natural History, New Haven, Connecticut—2 males, 2 females (accession numbers YPM169239 to YPM169242); University of Florida, Florida Medical Entomology Laboratory, Vero Beach, Florida—3 males, 1 female.

Five other species of Diptera occurred commonly in containers along with mosquitoes. A chironomid (Diptera: Chironomidae) species in the *Chironomus decorus* Johannsen group was collected from artificial containers such as buckets and birdbaths. The filter fly, *Clogmia albipunctata* (=*Telmatoscopus albipunctatus*) (Williston) (Diptera: Psychodidae), was recovered from containers and sewage treatment plants. Another psychodid fly, an undescribed species in the genus *Austropericoma*, also was recovered from container habitats. The ceratopogonid midge, *Dasyhelea pseudoincisurata* Waugh and Wirth (Diptera: Ceratopogonidae) was very common in a variety of artificial containers. A phorid fly, *Megaselia scalaris* (Loew) (Diptera: Phoridae), was found in tires and buckets with putrid, brown, or black water.

Discussion

The results of this study corroborate the findings of our earlier, smaller study (Hribar et al. 2001). Both surveys revealed *Ae. aegypti* as the most common container-inhabiting mosquito in the Florida Keys, with *Cx. quinquefasciatus* second most common. We made fewer collections of two or more mosquito species cohabiting a container than we did in our previous study, but again the most common association was between *Ae. aegypti* and *Cx. quinquefasciatus*. Other workers have found this to be true in other subtropical and tropical Caribbean areas such as New Providence, Bahamas (Dyar & Knab 1915), and Havana, Cuba (Aguilera et al. 2000). We also found *Ae. albopictus* cohabiting with *Cx. nigripalpus* and *Cx. quinquefasciatus*, as did Marquetti et al. (2000) in Havana, Cuba. Cohabitation of containers by two or more mosquito species is not unexpected, but the relatively small number of such collections in this study suggests that the mosquito species are distributed independently of each other, possibly due to oviposition behavior of adult females (Beier et al. 1983).

The collections of *Culex* (*Melanoconion*) species from containers are unusual. Reports of *Oc. taeniorhynchus*, *De. cancer*, and *Anopheles* spp. larvae collected from containers are uncommon but not unknown. Marquetti et al. (1999) and Hribar et al. (2001) collected *Oc. taeniorhynchus* from artificial containers, whereas several authors have collected *Anopheles* spp. larvae in artificial containers (Gater & Rajamoney 1929; Komp 1942; Harrison & Scanlon 1975; Faran 1980; Bradshaw & Holza-

Table 1. Collections of more than one mosquito species within the same container.

Species	N
Aedes aegypti & *Aedes albopictus*	15
Aedes aegypti & *Culex quinquefasciatus*	435
Aedes aegypti & *Culex* (*Melanoconion*) sp.	1
Aedes aegypti & *Wyeomyia vanduzeei*	1
Aedes albopictus & *Culex atratus*	1
Aedes albopictus & *Culex quinquefasciatus*	3
Culex nigripalpus & *Culex quinquefasciatus*	65
Culex quinquefasciatus & *Wyeomyia vanduzeei*	2
Aedes aegypti, *Aedes albopictus*, & *Culex nigripalpus*	1
Aedes aegypti, *Aedes albopictus*, & *Culex quinquefasciatus*	5
Aedes aegypti, *Anopheles crucians*, & *Culex quinquefasciatus*	1
Aedes aegypti, *Anopheles* sp., & *Culex quinquefasciatus*	1
Aedes aegypti, *Culex nigripalpus*, & *Culex quinquefasciatus*	15
Culex nigripalpus, *Culex quinquefasciatus*, & *Ochlerotatus taeniorhynchus*	1

pfel 1985; Marquetti et al. 1999; Carreira-Alves 2001). Our sole collection of *De. cancer* in a container was most unexpected. Larvae of this species are almost always found in the burrows of terrestrial crabs (Crustacea: Decapoda). However, records from artificial container habitats, septic tanks, and tree holes are published (Dyar 1928; Porter 1964; Peyton et al. 1964). Our discovery of *Ae. albopictus* on Big Pine Key was an unpleasant surprise. This species has the potential to become locally abundant (Moore 1999). Denial of oviposition sites to female *Ae. aegypti* (by dumping or covering containers) may increase dispersal by forcing them to fly further to find suitable containers (Edman et al. 1998). If this is also true for *Ae. albopictus*, routine control measures may exacerbate the problem. In some areas *Ae. albopictus* has displaced *Ae. aegypti*, but in parts of southern Florida they coexist, perhaps due to differential temperature tolerance by immature stages (Honório & Lourenço-de-Oliveira 2001; Juliano et al. 2002).

Storm drains and their associated catch basins can be a significant source of both pest and vector mosquitoes (Lauret 1953; Munstermann & Craig 1977). In the Florida Keys generally, and particularly within the city limits of Key West, these drains can produce large numbers of pest mosquitoes, especially those drains that are clogged with litter and receive organic matter via rain runoff and lawn watering. In addition to the *Culex* spp. collected during this study, storm drains in Key West also rarely may produce *Ae. aegypti* (SSJ, unpublished). Regular surveillance of these mosquito developmental sites should be an integral part of every mosquito control program.

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