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Short Communication

Productivity of container habitats for pupal *Culex quinquefasciatus* Say and *Culex nigripalpus* Theobald (Diptera: Culicidae) in the Florida Keys

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ABSTRACT

The kinds of containers that produce pupae of the mosquito *Culex quinquefasciatus* were investigated in the Florida Keys, Florida USA in 2010. Over 900 houses were surveyed in February and again in July. Discarded plastic containers, rain barrels, and tarpaulins were more productive in February than in July. Garbage cans and plant trivets were less productive in February but more productive in July. Flower pots were equally productive in February and July.

KEYWORDS: Culicidae, *Culex*, pupal habitat, container, Florida

INTRODUCTION

The Florida Keys are an archipelago surrounding the southeastern and southern peninsula of Florida. Although many islands in Florida are called “keys” the Florida Keys proper extend from Soldier Key near Miami in the northeast to Key West in the southwest. Most of the Florida Keys lie below 2 meters above sea level; the highest point in the Florida Keys is about 5.5 meters above sea level [1].

Culex nigripalpus Theobald and *Cx. quinquefasciatus* Say are common mosquitoes in the Florida Keys and are vectors of viruses such as West Nile virus and St. Louis encephalitis virus [2]. Previous surveys for mosquito larvae in the Florida Keys have been limited in scope, presenting neither detailed data on seasonality nor larval indices [3, 4]. Although a previous survey enumerated the number and kinds of containers used by larval *Culex* spp. mosquitoes in the Florida Keys, no evaluation of pupal productivity of various container types was made [5]. Recently a study was undertaken to more accurately determine the distribution of *Aedes aegypti* (Linnaeaus) in the Florida Keys. During that study, data were collected for *Culex nigripalpus* Theobald and *Cx. quinquefasciatus* Say as well as for *Ae. aegypti*. Data for *Ae. aegypti* are presented elsewhere [6]. This report concerns seasonal distribution, relative abundance, and habitat use of *Cx. quinquefasciatus* and *Cx. nigripalpus*.

MATERIALS AND METHODS

Census tracts defined by the Bureau of the Census of the United States Department of Commerce were used to define sampling areas because of their small size and relative homogeneity of population data such as income and general living conditions [7]. Ten census tracts were chosen throughout the island chain; two tracts were chosen randomly in each of the five major population centers of the Florida Keys (Key West, Big Pine Key, Marathon, Islamorada, Key Largo). One hundred addresses within each census tract were chosen randomly for study.

Teams composed of two inspectors were assigned a list of addresses within census tracts. Each team

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inspected the grounds of the properties on the list, recording total number of containers capable of holding water, total number of wet containers (holding a quantity of water), and whether wet containers were positive or negative for mosquito larvae and pupae. A representative sample of larvae in each positive container was collected, identified in the field, and discarded. Pupae were collected with the aid of aquarium nets. For smaller containers all pupae were collected. For larger containers like as rain barrels and hot tubs, four passes of the aquarium net were made through the container, two along the edge and two at the bottom and coming up through the center after swirling the water within the container, each pass separated from the next by at least one minute. This technique removes an average of 85% of the larvae present [8]. No attempt was made to collect all pupae in the larger positive containers as it would be too labor-intensive and time consuming to do so [9]. All pupae collected were placed into a Whirl-Pak® bag, which was marked with a unique code. Bags were transported to the laboratory and pupae identified to species.

The survey was conducted twice during 2010, in February and in July [6]. The percentage of wet containers, house index, container index, Breteau index, and total number of pupae were calculated for all ten census tracts combined. The house, container, and Breteau indices originally were developed for quantifying infestation by *Ae. aegypti*. The house index is the percentage of houses and surrounding grounds infested by *Ae. aegypti* [10]. The container index is the percentage of wet containers positive for *Ae. aegypti* [10]. The Breteau index is the number of containers positive for *Ae. aegypti* per 100 houses [11]. Indices were calculated for the entire ten tracts overall for *Culex quinquefasciatus*.

Rank order of containers used by *Culex quinquefasciatus* pupae in February and July was investigated via Kendall's tau coefficient [12]. Additionally, rank order of number of pupae per container type in February and in July was examined via Kendall's τ. Statistical references were consulted for proper analysis [13, 14, 15].

RESULTS AND DISCUSSION

Nearly 1,000 addresses were inspected in each phase of the survey; 998 in February and 965 in July. Most *Culex* spp. pupae were *Cx. quinquefasciatus* Say; only three *Cx. nigripalpus* Theobald pupae were collected. House and Breteau indices declined from February to July, as did total number of pupae collected, whereas container index rose slightly (Table 1). The container types that produced the most pupae differed from February to July ($\tau = 0.139$, $P = 0.453$). Discarded plastic containers, rain barrels, and tarpaulins produced the most *Culex* pupae in February but produced very few in July. Garbage cans were less important in February but produced the most pupae in July. Flower pots were equally important as pupal producers in

Table 1. Seasonal abundance of *Culex quinquefasciatus* larvae and pupae in containers in the Florida Keys.

Month	February	July
House index	7.0	6.5
Container index	2.1	2.9
Breteau index	10.3	7.25
Total pupae	205	171

Table 2. Number of *Culex quinquefasciatus* pupae found in containers by season.

Container	February	July
Plastic container	43	2
Rain barrel	26	2
Tarpaulin	25	4
Garbage can	23	105
Flower pot	20	19
Ornamental pond	14	7
Bird bath	14	1
Boat / Jet ski	11	1
Wheel barrow	8	5
Bromeliad	6	0
Metal container	4	0
Cooler	4	0
Pool / Jacuzzi	3	1
Dumpster	2	1
Fountain	1	7
Tree hole	1	0
Aquarium	0	2
Plant trivet	0	12
Standing water	0	2

February and July; whereas plant trivets increased in importance in July relative to February (Table 2). The rank order of different kinds of containers found positive for *Cx. quinquefasciatus* pupae did not change from February to July (τ = 0.405, P = 0.047). Plastic containers, flower pots, and garbage cans were the most common collection sites (Table 3).

The small number of *Cx. nigripalpus* pupae collected is no surprise. *Culex nigripalpus* typically are less than 10% of *Culex* larvae collected from containers in the Florida Keys [5]. There appears to be a seasonal shift in the kinds of containers that are most productive for *Cx. quinquefasciatus* pupae in the Florida Keys. Although plastic containers (usually discarded food or drink containers) were most productive in the dry season, in the wet season garbage cans were most productive (Table 2). The other major container types changed in order of importance during the surveys except for flower pots, which remained relatively constant (Table 2).

Table 3. Number of containers positive for *Culex quinquefasciatus* pupae by season.

Container	February	July
Flower pot	4	3
Garbage can	4	12
Ornamental pond	4	2
Plastic container	4	2
Boat / Jet ski	3	1
Bromeliad	3	0
Rain barrel	3	1
Tarpaulin	3	1
Metal container	2	0
Pool / Jacuzzi	2	1
Bird bath	1	1
Cooler	1	0
Dumpster	1	1
Fountain	1	1
Tree hole	1	0
Wheel barrow	1	1
Aquarium	0	1
Plant trivet	0	1
Standing water	0	1

Culex quinquefasciatus can develop almost anywhere there is stagnant water [16]. Although highly contaminated water (organic solids in excess of 1000 ppm) is preferred [17], this species can utilize cleaner water, and larvae can be found in all manner of discarded or neglected containers [18]. These containers that can produce many mosquitoes are in many instances unnecessary and their destruction would do a lot toward eliminating the mosquito problem [19].

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