ECOLOGY OF MOSQUITOES IN A PHILIPPINE COMMUNITY

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Portion of MS thesis in Biology conducted by the author in the University of San Carlos, Cebu City.

Accepted for publication 5 November 1979.

ABSTRACT

The mosquito fauna of the Visayas State College of Agriculture, Baybay, Leyte was assessed in nine survey stations. In the eight-month survey, 25 species belonging to eight genera were identified. A total of 1,539 mosquitoes were collected; *Aedes albopictus* **was the most abundant and prevalent species.** *Armigeres* **and** *Toxorhynchites* **were abundant in higher elevation. A high percentage (33%) of mosquito larvae were found in bamboo cups, being the most preferred niche especially by** *Armigeres.* **At lower elevation,** *A. albopictus* **was found in tin cans. Mosquito distribution was affected by factors such as adaptability of the mosquito to particular niche, elevation and rainfall and availability of preferred breeding niche.**

Ann. Trop. Res. 1: 142-153.

INTRODUCTION

The distribution and systematics of mosquitoes have been investigated only in few circumscribed areas in the Philippines but no study has been done in and around the Visayas State College of Agriculture (ViSCA). The little attention given to mosquitoes in the area could be due to the absence of any outbreak of mosquito-borne diseases. However, an increase in human population and movement of people in and out of this community may lead to an outbreak of diseases if the vector species are found in the area and susceptible hosts are available.

The occurrence of certain diseases is sometimes associated with an increase in mosquito population. There are also factors inherent in the process of urbanization that favor population increase

and factors intrinsic to the mosquito. Outstanding among the former is the increased use of water for domestic and industrial purposes. The surplus water, under prevailing conditions of rapid growth, is not disposed of properly and later serves as breeding place for mosquito vectors.

This paper presents results on the identity of different mosquito species found in ViSCA and its vicinity, the population densities at different sampling stations and preferred breeding sites of the different species.

MATERIALS AND METHODS

Sampling Areas. — Nine areas were identified as survey stations (Fig. 1) and classified according to type of vegetation, proximity to animal and human habitations, and physical factors. Daily record of rainfall, air temperature, and relative humidity were obtained from the Agro-Meteorological Station of ViSCA. Elevation of collecting sites was taken during each collecting trip by the use of an altimeter.

Method of Collecting. — A water strainer was used in collecting larvae from large bodies of water. A suction bottle provided with long plastic tubing was used to siphon out water from tree holes and leaf axils of plants such as banana *(Musa paradisiaca* L.), elephant's ear *(Alocasia macrorrhiza* (L.) Schott. and taro *(Colocasia esculentum* (L.) Schott.) and similarly inaccessible containers. Roots and stems of aquatic plants were agitated in a basin of water to detach the larvae of *Mansonia* and *Ficalbia* which have the habit of attaching to vegetation.

Adult mosquitoes were caught with an aspirator or an insect net and then killed in cyanide bottle. In every collection site, the approximate number of immatures was recorded. Both larvae and pupae were collected but were collectively referred to as larvae. The larvae were placed in jars for rearing in the laboratory until the adults emerged.

Identification of Specimens. — After emergence, the adults were killed and mounted on points for examination. Duplicate specimens were placed in glass vials provided with tissue paper and napthaline flakes.

The specimens were identified to species using keys by Bohart (1946), Delfinado (1966), and Cagampang-Ramos and Darsie (1969; 1970). All identifications were confirmed by Fr. Enrique Schoenig, a mosquito taxonomist at the University of San Carlos.

Determination of Breeding Preference. — To determine breeding preference of the different species of mosquitoes, additional artificial containers or oviposition traps were set in all stations. Oviposition traps used were empty tin cans, glass bottles, coconut shells and bamboo cups. These containers were filled with water and placed in areas

where mosquitoes were observed to be abundant. These traps were retrieved twice a month and larvae were collected from the containers and reared in the laboratory. Water was replaced when necessary. The adults were also identified to species.

RESULTS AND DISCUSSION

Twenty-five species belonging to eight genera were collected in ViSCA out of the 71 genera and 260 mosquito species reported in the Philippines by Basio (1971). In the eight-month survey, a total of 1,539 specimens were identified. Distribution of mosquitoes was observed to be affected by the adaptability of the mosquito to a particular niche, elevation, rainfall and breeding site preference.

Niche.

One of the striking features of the *Aedes* fauna which accounts for its presence in almost all stations is the preference of the species to small water containers as breeding niches. They breed easily in natural containers such as leaf axils, tree

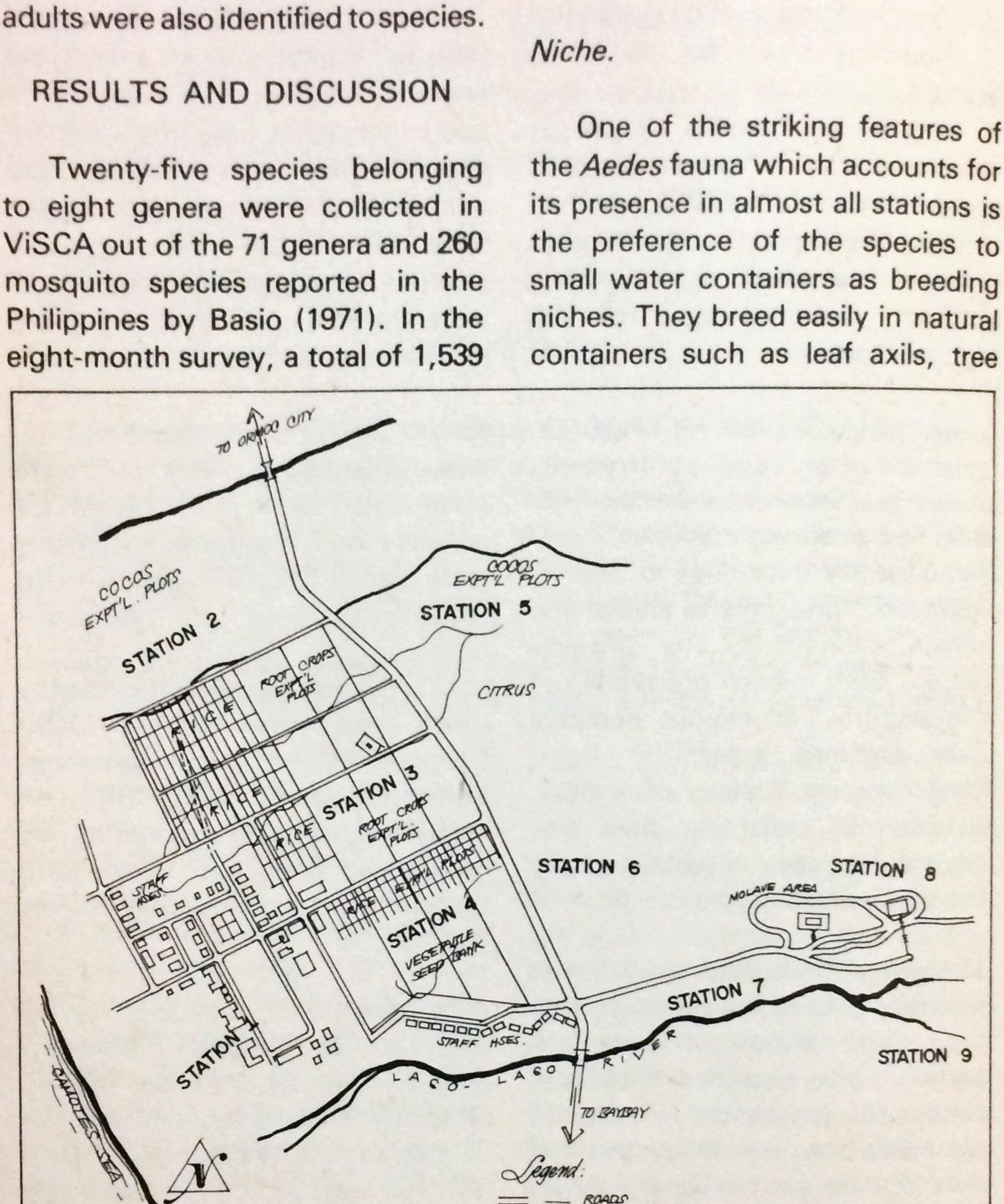

Fig. 1. The Visayas State College of Agriculture (ViSCA) campus site showing the nine survey stations. (Scale 1:10,000).

holes, bamboo cups, etc. and artificial containers such as tin cans, garbage cans, tire and glass containers. Members of the genus *Aedes* are among the worst disease carriers of virus and filariasis diseases (Schoenig, 1970-3). *Aedes vexans* was retrieved only once in a garbage can in Station 1 while Bohart (1946) found this species to breed particularly in temporary ground pools, road-side ditches, foul water and grassy pools. *Aedes poicilius* and *Aedes gardnerii* were collected in banana axils.

Larvae of *Aedes albolineatus* were found in artificial containers and oviposition traps such as tin cans and glass bottles disputing what Bohart (1946) contended that *Aedes albopictus* and *A. albolineatus* rarely breed in artificial receptacles. *Aedes scutellaris* was found to be larger in size compared to *A. albopictus* as previously reported and was most abundant especially in coconut husks, bamboo cups and other small shaded pools with high organic content. This could be due to better adaptive capacity of *A. scutellaris* over *A. albopictus* in the area.

Anopheles kochi larvae were collected from ditch and fishponds, *Anopheles subpictus indefinitus* larvae from clear water of carabao pools and *Anopheles vagus limosus* from muddy water of canals, ditches, ponds and carabao pools.

Armigeres ejercitoi larvae were collected from banana axils and coconut husks in association with other species. *Armigeres* species were found only in small containers of water from bamboos, fallen leaves, coconut shells, tree holes and artificial containers. The water in the breeding sites was often extremely foul.

Members of the genus *Culex* were found more abundant in natural habitat than in the oviposition traps. One species, *Culex quinquefasciatus,* was found in an old seed box containing rotten leaves.

Ficalbia and *Mansonia* larvae were collected in Station 1 only in one habitat (fishpond). The luxurious growth of *Eichornia crassipes* afforded protection for the larvae because the larvae sometimes attach themselves to the roots of aquatic plants (Belkin, 1962).

Of the four species of *Toxorhynchites* known in the Philippines, two species were collected in ViSCA i.e., *Toxorhynchites splendens* and *Toxorhynchites amboinensis. T. splendens* larvae were found in tree holes, bamboo and artificial containers in association with other mosquitoes in a tin can. The larvae of both species were predaceous, feeding chiefly on larvae of other species and were often strongly cannibalistic when confined in small breeding containers. *Tripteroides claggi* was retrieved from one oviposition trap only.

Table 1 shows the distribution of the mosquito genera per station. The percentage of individuals collected in each station was highest for *Aedes* group except in Stations 8 and 9. The abundance and pre-

Table 1. Mosquito genera found in ViSCA, Baybay, Leyte and vicinity and its relative abundance per station.

Station No.	Total No. Collected	Genera	Abundance per Station (%)
1	347	*Aedes*	53
		Anopheles	7
		Armigeres	5
		Culex	33
		Ficalbia	0.3
		Mansonia	1
		Tripteroides	0.9
2		—	0
3	149	*Aedes*	52
		Anopheles	6
		Armigeres	22
		Culex	19
		Tripteroides	1
4	256	*Aedes*	74
		Anopheles	21
		Armigeres	0.8
		Culex	2
		Tripteroides	2
5	55	*Aedes*	56
		Armigeres	16
		Culex	27
6	83	*Aedes*	63
		Anopheles	2
		Armigeres	27
		Culex	24
7	326	*Aedes*	66
		Anopheles	2
		Armigeres	27
		Culex	0.3
		Tripteroides	3
		Toxorhynchites	0.6
8	188	*Aedes*	20
		Armigeres	69
		Culex	3
		Tripteroides	4
		Toxorhynchites	5
9	135	*Aedes*	30
		Anopheles	0.7
		Armigeres	49
		Culex	1
		Tripteroides	7
		Toxorhynchites	12

valence of *Aedes* in most stations shows its adaptability to different environments. Although quite common, not a single specimen of *Aedes* was collected in Station 2. This could possibly be due to several factors: the area was far from human habitation, traps and other natural containers were exposed directly to the sun because of the absence of trees, the continuous drying effect and disturbance caused by wind, and plants were periodically sprayed with pesticides.

The *Armigeres* group was the most abundant genus in Stations 8 and 9. Although not considered as a domestic mosquito, it was found in the other stations with the *Aedes* group.

Elevation.

Fig. 2 shows the graphical distribution of mosquito species according to elevation. There was an increase in the number of *A. joloensis* at an elevation of 220 m. *T.*

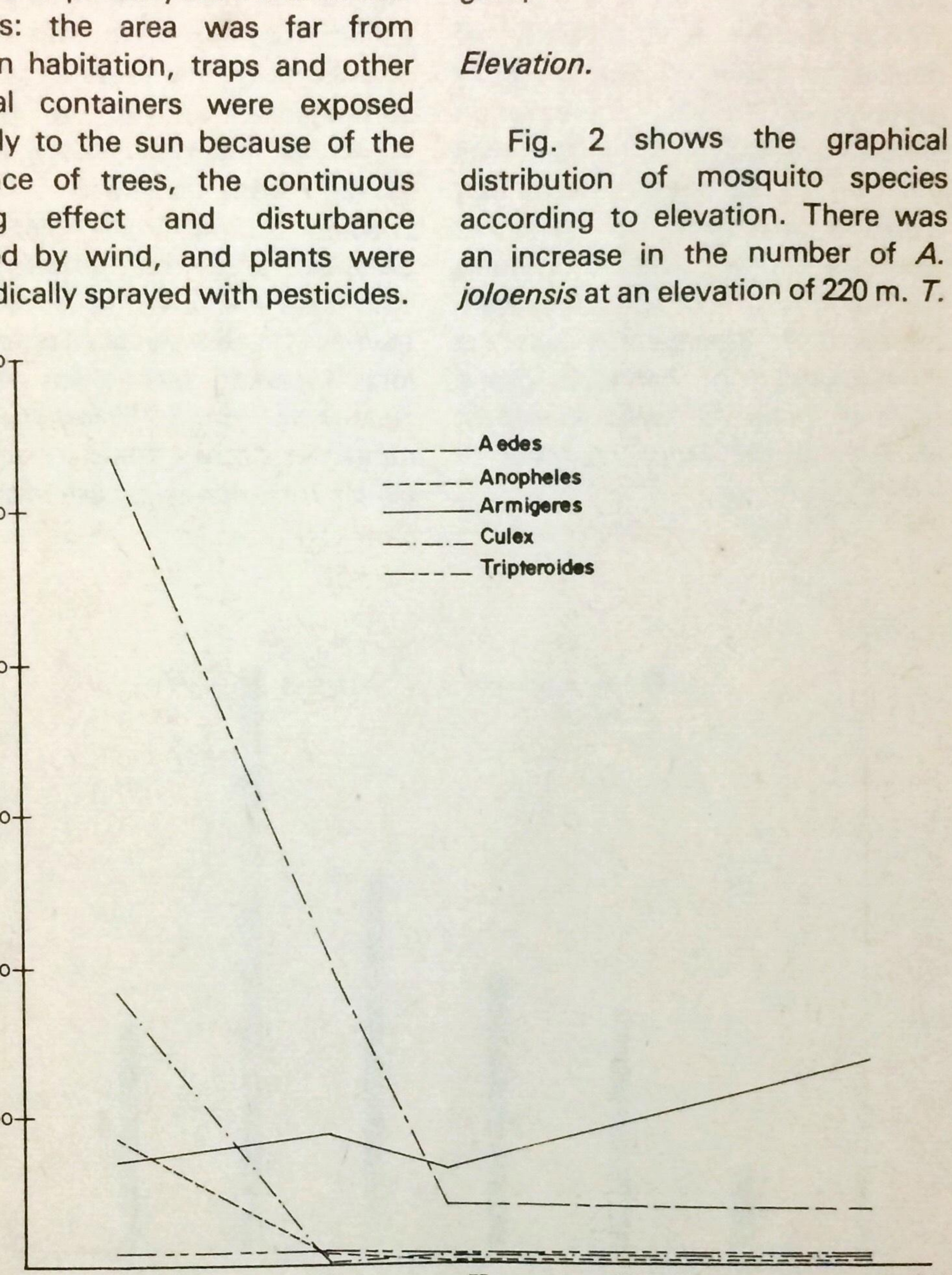

Fig. 2. Graphical distribution of five mosquito genera according to elevation.

amboinensis and *T. splendens* were collected in areas with elevation between 50 to 220 m. Adults of *Toxorhynchites* were collected while resting in coconut trunks in shady areas.

The density and diversity of mosquitoes collected were inversely proportional to the increase in elevation. A total of 890 mosquitoes representing 22 species were collected at lower elevation. At higher elevation, only 188 individuals representing 11 species were retrieved. *A. albolineatus* was the most abundant of the *Aedes* group while *A. joloensis* was the most abundant of the *Armigeres* group at 200 m elevation.

Rainfall.

Fig. 3 shows the graphical distribution of mosquito species in relation to rainfall. A significant number of mosquito species was collected during the months of July and August. The highest peak of abundance occurred in August which had the highest total rainfall of 417 mm. This was expected because during rainy days the potential larval niches were filled with rain water. Tree holes, bamboo stumps and coconut shells provided ideal breeding niches for *Aedes, Armigeres* and *Toxorhynchites;* rain-filled ditches, mud pools and canals for *Anopheles;* artificial con-

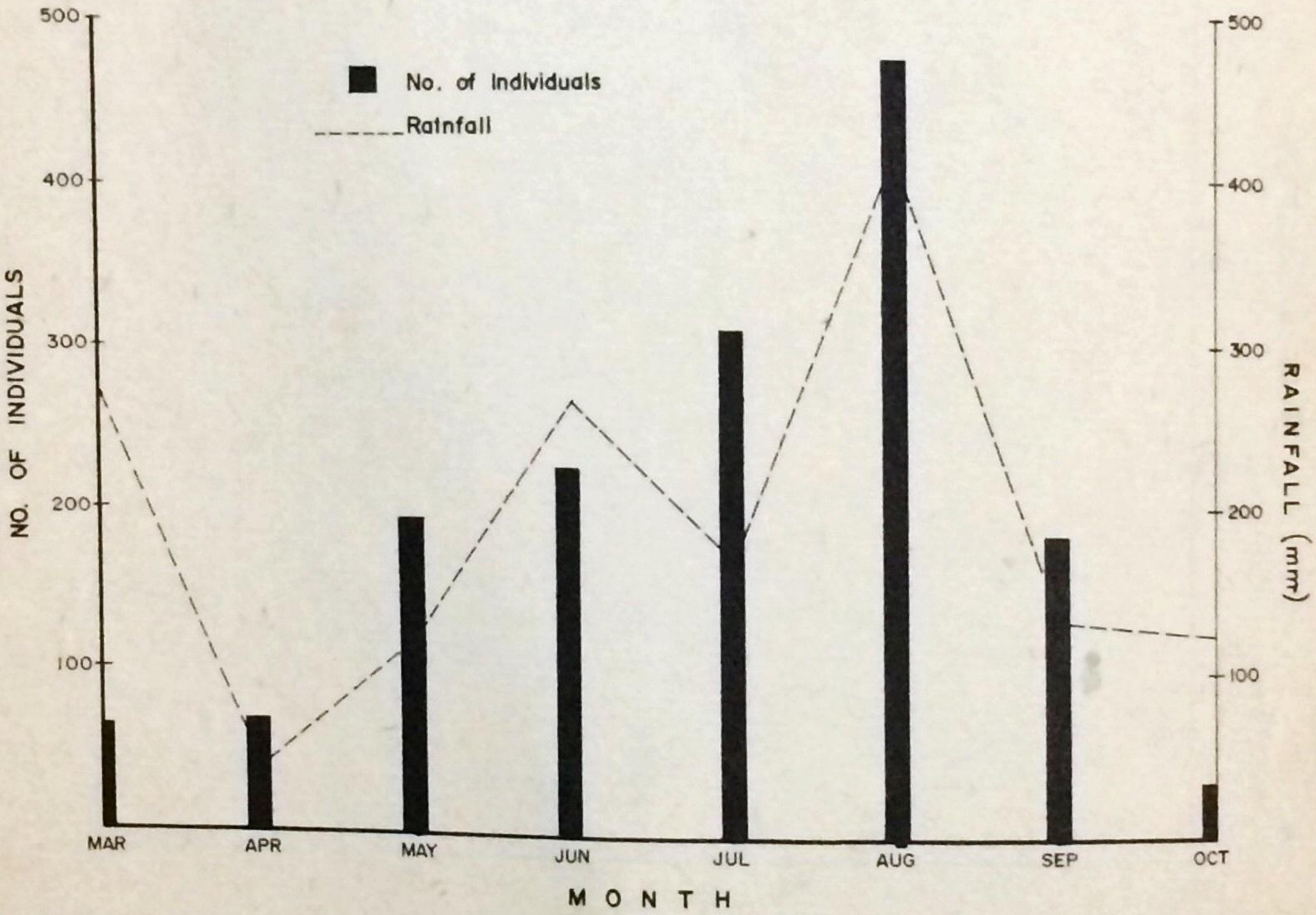

Fig. 3. Seasonal abundance of mosquitoes in ViSCA in relation to rainfall.

tainers such as tin cans and tires for *Aedes* and *Culex* and; fishponds for other genera such as *Mansonia* and *Ficalbia*.

A. albopictus and *A. scutellaris* were prevalent from March to October. The highest number (469) of mosquitoes were collected in August (Fig. 4). The *Aedes* group increased tremendously in August compared to other groups. This could possibly be due to the increased number of rain-filled containers or due to the fact that this group, especially *A. albopictus,* can survive in relatively clean water, a condition avoided by other mosquitoes. *Anopheles* decreased as puddles and ricefields dried up. June, July and August were relatively wet months in the study area after a relatively dry spell in March and April. Abundance of rain-filled containers allowed increased oviposition by mosquitoes during these wet months. The greatest number of species of *Aedes* and *Armigeres* group were collected in July and August with 20 and 19 species, respectively. When coconut husks and bamboo stumps were filled with rain water, *A. albopictus, A. joloensis, A. ejercitoi* and *A. malayi* bred extensively. *Aedes* and *Armigeres* larvae were often found together in breeding niches.

The *Anopheles* group was also abundant in July and August and the *Culex* group in July only. During these months, rice paddies, mud

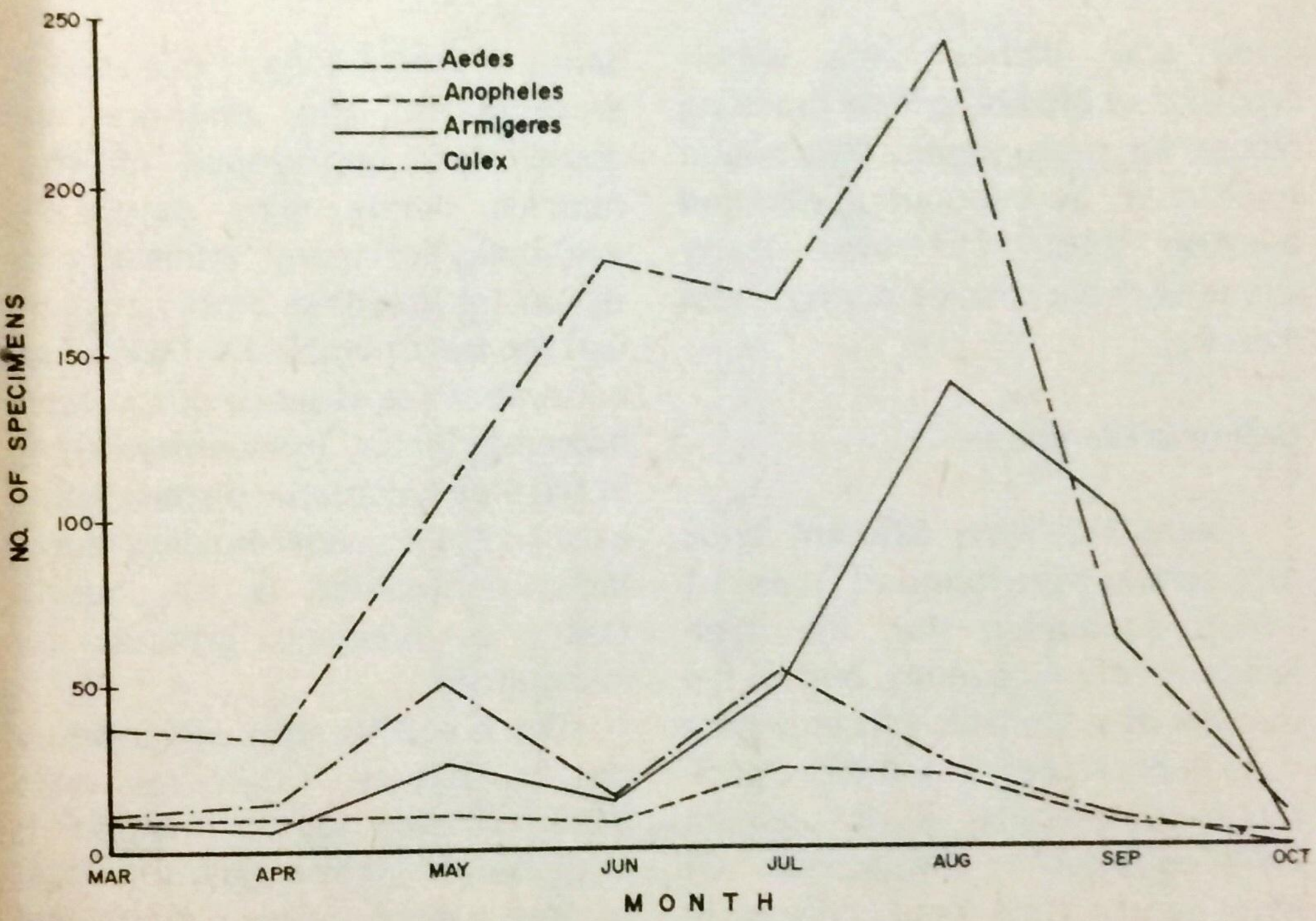

Fig. 4. Seasonal abundance of *Aedes, Anopheles, Armigeres* and *Culex* in ViSCA from March to October, 1976.

Table 2. Breeding places of mosquitoes in ViSCA and vicinity.

Breeding Places	Station Numbers								
	1	2	3	4	5	6	7	8	9
Bamboo	x		x	x		x	x	x	x
Banana axil	x					x	x		
Canal ditch	x		x	x	x	x			
Carabao pool							x		
Coconut shell	x		x	x	x	x	x	x	x
Garbage can	x								
Glass container	x		x	x		x	x		
Pond/Stagnant water	x				x	x			
Rice paddy			x	x	x	x			
Seed box	x								
Tin can	x		x	x		x	x		
Tire					x				
Tree hole							x		x
Total number of breeding places per station	9	0	6	7	4	8	7	2	3

pools and ditches were water-logged thus providing ideal breeding niches for mosquitoes. Oviposition traps such as coconut shells and bamboo cups contained many larvae of these species during these months.

Breeding Preference.

There were nine different kinds of breeding sites found in Station 1 which accounted for the high incidence of mosquitoes, both in the number of individuals and in genera collected (Tables 1 and 2). Specimens representing seven genera were collected in this station. Of eight genera, 87% were collected in this station. The following factors probably contributed to the abundance of mosquitoes in this station: proximity to the seashore and dormitories, appearance of mud puddles during rainy days, and availability of many artificial containers for breeding. Stations 5 and 6 had the least number of mosquitoes because of the absence of favorable breeding places. Frequent weeding of the area and proper disposal of tin cans and other water-holding receptacles contributed to its undesirability as breeding grounds for mosquitoes.

The breeding sites preferred by the mosquitoes, in general, were bamboo cups which yielded a total of 324 larvae and the least favored were glass containers (Table 3 and Fig. 5).

Aedes larvae were found in great

Table 3. Percentage abundance of mosquito larvae in different oviposition traps.

Oviposition Trap	Total No. Collected	Mosquito Genera				
		Aedes	*Culex*	*Armigeres*	*Tripteroides*	*Toxorhynchites*
Bamboo cup	324	54.0	4.0	33.0	7.1	1.9
Coconut shell	235	77.4	3.8	17.9	0.9	0
Tin can	295	86.1	2.4	10.5	0.7	0.3
Glass container	134	97.8	0.7	0.7	0.7	0.1

numbers in all types of oviposition traps. Their ability to breed in any water-filled container is one of their important characteristics. This species prefers tree holes, bamboo stumps and coconut shells and artificial containers but is rarely found in ground pools and rock holes. *A. albopictus* was found in isolated but inhabited areas. In this study, *A. albopictus* was found only in inhabited areas and was closely associated with the human factors.

Other mosquito genera collected in the oviposition traps such as

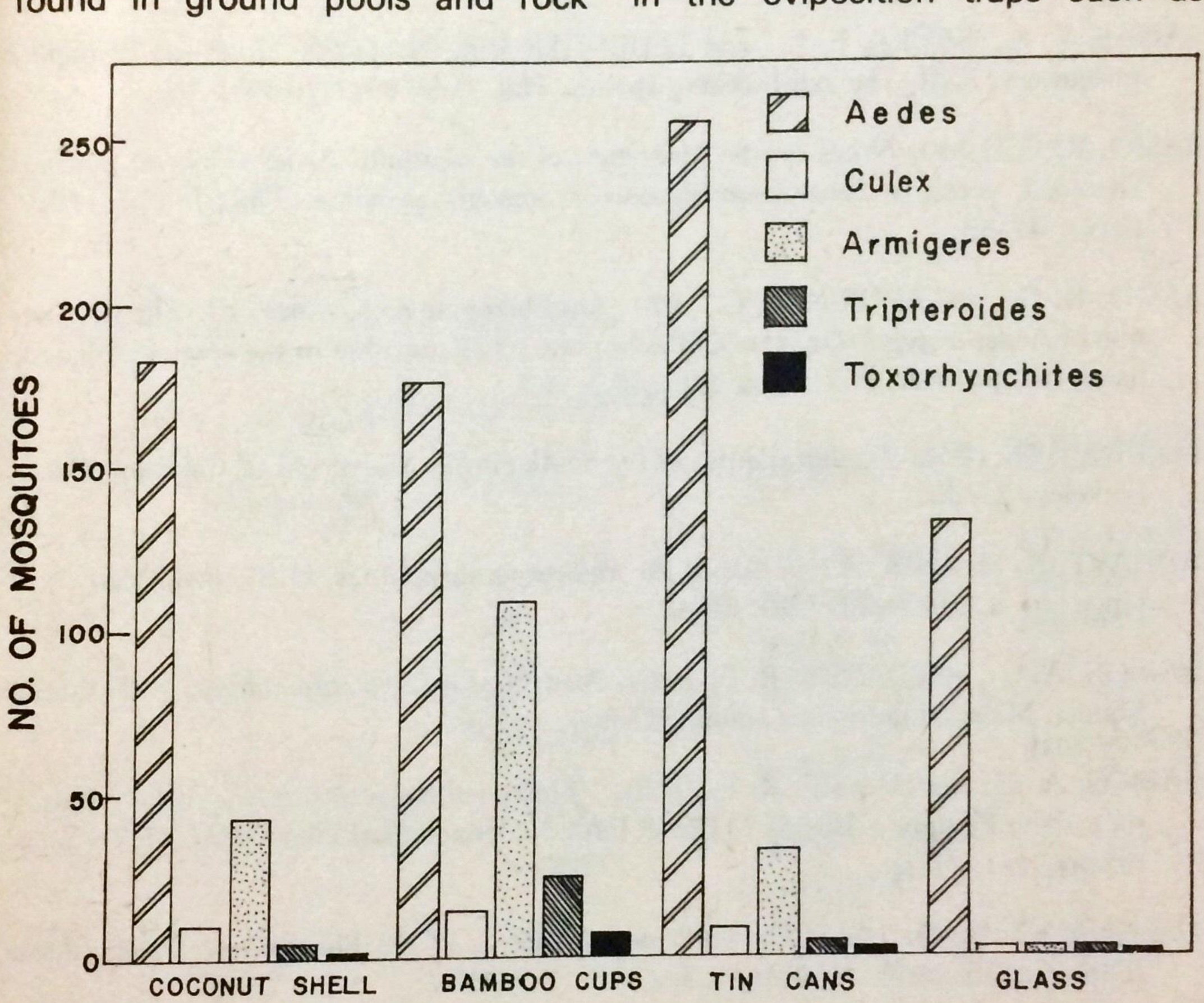

Fig. 5. Graphical representation of larval breeding preferences of mosquitoes in ViSCA.

Culex, Armigeres, Tripteroides and *Toxorhynchites* showed preference for bamboo cups also. The principal breeding places of *Culex* were foul ground pools, ditches and artificial containers such as tin cans. When bamboo stumps and coconut shells collected water during the rainy season, *Aedes* breeds almost immediately. When water started to get foul, *Armigeres* and *Toxorhynchites* set in. *Tripteroides* larvae were also collected mostly in bamboo stumps but never when the water started to get foul. All the species of *Tripteroides* whose immature stages were known have been found breeding in small water collections, principally in tree holes, bamboo, coconut shells and husks, fallen leaves, leaf axils and flower bracts of plants and frequently in pitchers of *Nepenthes.*

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