The Influence of Vegetation on the Oviposition of Mosquitoes in Cans Filled with Water of Varying Salinities

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Abstract

A set-up of 24 cans each containing 250 ml water of varying salinities ranging 0 ppt (rainwater) to 35 ppt (seawater) were randomly arranged in three rows and housed under a plastic roofing in shaded area, heavily populated with banana trees and in open, sunlit area in two localities--Station I (Luinab, Iligan City), located 2.5 kilometers from the seashore, and Station II (Canaway & Saray, Iligan City), a coastal area located 25 meters from the seashores.

***Aedes** spp larvae were collected from cans with 0 ppt and 5 ppt in the shaded area in Station I (Luinab) and Station II (Canaway,). **Mansonia** ssp. larvae were also collected in cans with 5 ppt under shade in Station II (Canaway). No larvae were found in all cans in the area and in cans with 10 ppt, 15 ppt 20 ppt, 25 ppt, 30 ppt and 35 ppt in the shaded areas in both localities.*

Introduction

Mosquitoes are well known important group of flies because they are frequent in human habitation and the female species readily feed on blood. Aside from being the largest group of dipteran pests, mosquitoes also serve as efficient vectors for such human disease as malaria, dengue fever, yellow fever, enciphalitis and filariasis (Chen, 1973).

Most mosquitoes oviposit in practically all sort of natural or artificial habitat collection of water, fresh or polluted, except the open sea. Some species seem to be choosy while others have very little or no preference at all. There are species which breed in the swamps, pools, slow-flowing streams, river margins, lagoons, ponds and ditches. Other species, however, prefer to oviposit in water-filled artificial containers around houses like flooded basements, broken bamboo stems, coconut shells, jars, flower vases,

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unused toilets, old tires, animal drinking pans, barrels, sagging roof gutters and tin cans. Also there are species which oviposit in shaded areas under heavy vegetation (Chandlet, and Read, 1961).

Nowadays, when almost all kinds of preserved food and beverages are canned, empty cans constitute a large bulk of our garbage in the household and even in picnic areas. Without knowing it, these empty cans can be filled with water either due to rain or to the action of the waves in the seashore, and thus provide an artificial breeding ground for mosquitoes. This fact triggered the interest of the reseacher to conduct a study to find out what genera of mosquito breed in cans filled with water of varying salinities set-up in two different habitats in two separate localities. One in a banana plantation which is shaded, heavily vegetated area and the other in an open, sunlit, grassland area.

In general, behavior of organisms show that location of a favorable environment is necessary for them to survive and prosper. For some kinds of organisms a favorable environment is largely a matter of chance. In the case of mosquitoes which are highly motile organisms, the initial stage in habitat selection would be to first visit an area on the basis of their appearance, structure and with finer details or factors being examined. In a heavily vegetated shady habitat, a mosquito has to reckon with reduced wind movement, high humidity, moderate temperature and low light level. In an open, sunlit grassy area, wind movement is increased, intensity maximal, temperature is high and easily fluctuating with light intensity (Brewer, 1979). In addition to the salinity of water, factors inherent to each type of habitat mentioned might be an important factor in breeding of mosquitoes in filled cans of varying salinities set-up in different habitats.

The results of this study hope to contribute to the body of knowledge on the biology of mosquitoes which are of public health importance. In addition, findings can significantly help change city ordinances regarding disposal of waste empty cans, thus, minimizing the number of possible breeding grounds for mosquitoes.

Objectives of the Study

The study primarily aimed at focusing on two factors, namely: salinity and vegetation, which could influence the breeding of the different, species of mosquitoes in water filled cans. This study further considered the following specific objectives:

1. To determine what salinity favors most in the breeding of

mosquitoes in cans;

2. To identify the genera of mosquitoes that oviposit in water filled cans;
3. To know the temperature of water in cans in both habitats in the two localities at particular times of the day during the conduct of the study; and
4. To quantify and record larval type (genus) collected from a particular can.

Review of Literature

Mosquitoes, comprising the family Culicidae of the diptera, are available in their breeding habitats. Choices of breeding places, taste in blood, extent of travels and willingness to come inside houses to bite or to rest (Chandler and Read, 1961).

These dipteran pests generally oviposit in water. According to Chandler and Read (1961) some species of mosquitoes are unreasonably choosy while others show little preference. Some species breed only in sunlit water, others only in shades; some require calm and quiet water, others breed only in slow flowing water.

To mention a few of these species preferences of breeding places, *Culex pipens, Culex territans* and *Culex quinquenfasciatus* breed in any body of stagnant water, no matter how small, around houses and in backyard according to Borror, Delong and Triplehorn (1961); *Culex* also breed in artifical containers. In the case of *Aedes,* eggs could be laid in moist soil but hatching takes place when the area is flooded. Female *Aedes nexans* lay eggs along the edges of the rivers and ponds which are flooded over when water overflows. Chandler & Read, 1961; Cheng, 1973 also mentioned that larvae of *Aedes dosalis* have been found in salt pools in Oklahoma where salt content was 0.07% NaCl. He also noted that some other species of *Aedes* which are marsh breeders, namely: rarely *Aedes sollicitants* and *Aedes talniorhynchus Aedes Cantator. Aedes aegypt,* on the other hand, is a freshwater breeder species which oviposits in treeholes, axil banana leaves and artificial containers (Chandler, 1961). Furthermore, a certain species of mosquito *Aedes sollicitants* oviposit in salt marshes (Borror, *et al.*, 1964). The Philippine anopheline species *Anopheles minimus falvirostus* and *Anopheles manganus* oviposit in forthill streams, ditches, wells and stream beds and irrigation ditches respectively (Cheng, 1973). According to Chandler (1961), certain species of *Anopheles* breed in stagnant water, some, however, breed in flowing streams. He noted that some species breed in brackish water, some in shaded water and some only in sunlight, and a few in artificial containers around houses.

Attempts have been made to correlate the preferences exhibited by various species of mosquitoes with food, acidity or alkalinity and oxygen concentration (Chandler, 1961). Based on available literature, no studies have been done yet on the breeding preferences of certain species of mosquitoes in artificial containers with regard to salinity, shade and sunlight. This study, therefore, hopes to shed light on this aspect of the biology of mosquitoes.

Materials and Methods

Saline solution with salinity 5 ppt, 10 ppt, 15 ppt, 20 ppt, 25 ppt, 30 ppt, and 35 ppt were prepared in the laboratory either by adding distilled water to seawater or by adding salt to distilled water. A refractometer was used to measure the desired salinity.

The experimental phase of the study was conducted in two different habitats within chosen localities in Iligan City. The localities chosen were in Luinab, approximately 2.5 kilometers from Iligan Bay and Canaway, approximately 25 meters from Iligan Bay.

In each of these localities two habitats were established, namely: an open, sunlit, less vegetated area with grasses and bushes and a shady area thickly populated by banana trees. In Luinab, these habitats were located approximately 10 meters away from each other. In Canaway, the open sunlit habitat was an open residential lot and the shady habitat was a banana plantation at the back of MSU-Iligan Intitute of Technology. The latter is approximately 15 meters away from the former.

Each set-up consisted of a total of twenty four (24) cans randomly arranged in 3 rows of eight (8) cans in each row and housed under a 1 sq. meter transparent plastic roofing. Each of the eight (8) cans in a row contained two hundred fifty (250) ml water of varying salinities ranging from zero (0) ppt to thirty five (35) ppt. There were three (3) replicates for each salinity.

The experimental phase was carried out for 31 days. The researcher visited the area every other day to monitor the temperature of the water in cans in each designated habitat and collected mosquito larvae from any of the cans. All larvae collected were preserved in 10% formalin solution in labelled vials for identification in the laboratory.

Identification of larvae was carried out to generic level only using the key to the identification of mosquito larvae by Chandler and Read (1961) and Cheng (1973). Samples collected from each can were counted and recorded.

Results and Discussion

In the history of mosquitoes, fresh and brackish water habitat is required. However, no two species have identical requirements. A knowledge about their breeding preferences maybe essential in controlling any particular species of mosquito (Cameron, 1956).

In general, the eggs are laid on the water. Hatching of the eggs give rise to active larvae called "wrigglers" which breathe air by means of terminal siphon or dorsal spiracles. Some species of *Aedes* specifically *Aedes aegypti*, have completely forsaken its ancestral breeding places than any other mosquito. *Aedes aegypti* rarely breed in tree holes or broken bamboo stems but utilize rain-filled coconut shells usually found in native villages as well as artificial containers like tin cans. Inside the houses the most important breeding places are drinking water jars, water plants, neglected flower vases, unused toilet and ice box drains; in residential yards they prefer cistern, grease traps, tin cans, wide-mouthed jars, old tires, animal drinking pans, rainwater barrels and occasionally sagging roof gutters (Chandler and Read, 1961). Hatching of mosquito occurs 12 hours after the eggs are oviposited while others require several days because they need a period of incubation.

Results of the study confirm that mosquitoes have preferences in choosing bodies of water where they could possibly breed. In Table 1, it is shown that in open sunlit areas both in Luinab and Canaway, no larvae developed in cans with water of varying salinities from 0 ppt to 35 ppt. On the other hand, there were a total of 57 larvae collected from the shaded areas in both localities. In the same table, it is shown that 42 larvae or approximately 73.7 % of the total larvae collected from the coastal locality in Canaway. Meanwhile, there were fifteen larvae of approximately 26.3 % collected from a more interior locality, Luinab. Also, the data show that of the 42 larvae collected in Station II (Canaway), 25 larvae were recovered from the cans with salinity of 5 ppt and 17 larvae in rainwater with 0 ppt. All the 15 larvae collected from the set-up in Luinab developed in the cans with rain water. No larvae was observed to develop in cans with rain water of salinities 5 ppt and higher.

Table 2 shows that of the total 57 mosquito larvae collected from all stations, 53 were identified as *Aedes* spp larvae. Of these 53 larvae, 15 were taken from the rain-filled cans in the heavily vegetated shady area in Luinab, and other 38 larvae were taken from the shady area of Canaway; 17 larvae from the rain-filled cans and 21 larvae from the cans with 5 ppt saline. Four (4) larvae of the genus *Mansonia* spp. were also collected. *Culex* and *Anopheles* were absent from all cans.

Table 1. Total number of mosquito larvae in cans with varying saline solutions in the shaded and unshaded habitats, Luinab and Canaway, Iligan City.

Salinity Water	LUINAB	CANAWAY		
	Sunlit	Shaded	Sunlit	Shaded
0 ppt	-	15	-	17
5 ppt	-	-	-	25
15 ppt	-	-	-	-
20 ppt	-	-	-	-
25 ppt	-	-	-	-
30 ppt	-	-	-	-
35 ppt	-	-	-	-
Total	0	15	0	42 = 57

Legend : -, no larva

Table 2. Generic composition of larvae mosquitoes collected form tin cans with water of varying salinities in the shaded habitats in Luinab and Canaway, Iligan City.

Salinity of water	LUINAB					CANAWAY				
	Culex	*Anopheles*	*Aedes*	*Mansonia*	*Oth.*	*Culex*	*Anopheles*	*Aede*	*Mansonia*	*Oth.*
0 ppt	-	-	15	-	-	-	-	17	-	-
5 ppt	-	-	-	-	-	-	-	21	4	-
10 ppt	-	-	-	-	-	-	-	-	-	-
15 ppt	-	-	-	-	-	-	-	-	-	-
20 ppt	-	-	-	-	-	-	-	-	-	-
25 ppt	-	-	-	-	-	-	-	-	-	-
30 ppt	-	-	-	-	-	-	-	-	-	-
35 ppt	-	-	-	-	-	-	-	-	-	-
Total	0	0	15	0	0	0	0	38	4	0

Legend : (-), no larva

The main distinguishing features *Aedes* and *Mansonia* larvae are presented in Appendix A. *Aedes* species larvae can be identified by the presence of short breathing siphon bearing single pair of posteroventra tuft of hair. On the other hand, *Mansonia* spp. larvae can be identified by its spinelike breathing siphon at the tip.

In Canaway, the first batch of larvae were collected twelve days after putting up the set-up in the area (Table 3). During this collection there were 6 *Aedes* spp larvae taken form the rain-filled can, 7 *Aedes* spp larvae and 4 *Mansonia* spp larvae from the can with 5 ppt saline or a total of 17 larvae. The second collection in the same station was done 22 days after the first day of experimentation. A total of 9 *Aedes* spp. larvae were collected; 4 were taken from the rain-filled can and 5 larvae from the 5ppt saline. The third collection was on the 31st day of experimentation. There were a total of 16 *Aedes* larvae from the rain-filled can and the can with 5 ppt saline. Thereafter, no larvae were observed in all areas.

In Station I (Luinab), the first batch of larvae were collected 19 days of first experimentation, 8 days behind the first collection from the rain-filled cans and none in all saline solutions.

All of the above mentioned results can be very well accounted for by the existing literature on hand.

The genus *Aedes* has salt marsh representation like *Aedes sollicitans* and *A. dorsalis* (Chandler & Read, 1973.)

According to Harrison and Shoenig (1972), *Aedes aegypti* in Cebu City is limited to low coastal areas not penetrating inland more than five kilometers and higher than an altitude of 300 meters. Also Shoenig's (1972) work shows that artificial containers constitute 47.69% of the breeding places close to the seashore in Cebu City. In another work of Schoenig (1971), it was reported that in Cebu City discarded tin cans and broken bottles in backyards filled with rainwater were populated by *Aedes Aegypti* and *Aedes albopictus*. This is usually favored by moist and cool climate. The foregoing data support the results of the study in that *Aedes* larvae that was collected in rain-filled tin cans under dense shade. Although there were also *Mansonia* larvae which were collected from the cans with 5 ppt saline under shade in Canaway, still that larvae constitute a minority as compared to the number of *Aedes* larvae that were collected. *Mansonia* species usually prefer to breed in pools populated with lettuce or water hyacinth.

The reason why no larvae were observed in cans in the two sunlit open stations is that in these areas it was shown that the temperature of the aquatic media in cans during the day fluctuated greatly. In the open sunlit areas in Canaway, the temperature of the water in cans increased by an average range of 13°C-16°C from 6:00 AM to 12:00 noon and decreased by an

Table 3. Number of mosquito larvae collected in cans with salinity 0 ppt in the entire duration of the study.

Days	LUINAB				CANAWAY			
	0 ppt		5 ppt		0 ppt		5 ppt	
	Aedes	*Manson*	*Aedes*	*Manson*	*Aedes*	*Manson*	*Aedes*	*Manson*
1st	-	-	-	-	-	-	-	-
2nd	-	-	-	-	-	-	-	-
3rd	-	-	-	-	-	-	-	-
4th	-	-	-	-	-	-	-	-
5th	-	-	-	-	-	-	-	-
6th	-	-	-	-	-	-	-	-
7th	-	-	-	-	-	-	-	-
8th	-	-	-	-	-	-	-	-
9th	-	-	-	-	-	-	-	-
10th	-	-	-	-	-	-	-	-
11th	-	-	-	-	-	-	-	-
13th	-	-	-	-	6	-	7	4
14th	-	-	-	-	-	-	-	-
15th	-	-	-	-	-	-	-	-
16th	-	-	-	-	-	-	-	-
17th	-	-	-	-	-	-	-	-
18th	-	-	-	-	-	-	-	-
19th	-	-	-	-	-	-	-	-
20th	15	-	-	-	-	-	-	-
21st	-	-	-	-	-	-	-	-
22nd	-	-	-	-	-	-	-	-
23rd	-	-	-	-	-	-	-	-
24th	-	-	-	-	4	-	5	-
25th	-	-	-	-	-	-	-	-
27th	-	-	-	-	-	-	-	-
28th	-	-	-	-	-	-	-	-
29th	-	-	-	-	-	-	-	-
30th	-	-	-	-	-	-	-	-
31th	-	-	-	-	-	-	-	-
Total	15	0	0	0	17	0	21	4

Legend : (-), no larva

average range of 11.4°C - 14°C from 12:00 noon to 6:00 PM; while under dense shade, temperature increased by 0.4°C between 12:00 noon and 6:00 PM. In the open sunlit area of Luinab, the temperature increased by an average of 14-15°C between 6:00 PM and 12:00 noon and decreased by 12.3-13.3° C between 6:00 PM, whereas in shaded area, temperature increased at noon-time by 0.4-0.8°C and decreased by 0.8-0.6°C at 6:00 PM. It is also shown in the same figure that temperature of water in cans in two shaded areas did not go beyond 30°C. Most often, temperature beyond 30°C are harmful to mosquito larvae and usually is fatal (Schoenig, 1972). Furthermore, the water in small tin cans under open sunlit area evaporated quickly because of the heating up of the containers and the water they contained. This often resulted to the drying-up of the containers. In this study, it was observed that water in the tin cans started to dry up in the third visit equivalent to the sixth day of experimentation. Wind velocity is another factor which accounts for the absence of larvae in the cans set up under sunlit area. In general, wind movement is greater in the grassland than in heavily vegetated area. Thus the latter usually is a moist area. Generally, mosquitoes do not inhabit grassland or meadows (Cheng, 1973).

Recommendations

Based on these results, the following are recommended:

1. Conduct an information drive regarding breeding places of mosquitoes through mass media, public health workers and school teachers.

2. Empty cans, bottles, old tires and pans must be in inverted position so as not to catch water.

3. Artificial containers which would possibly be utilized by mosquitoes as breeding places must be burned and buried or sold.

4. It is also suggested that garbage should be thrown in open fields or sunlit areas where light intensity is maximized.

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Appendix A

Distinguishing Features of *Aedes* spp. Larvae and *Mansonia* spp. Larvae

A. Larva of *Aedes* attached to the surface.
B. Larva of *Aedes aegypti* x10 (after Howard, Dyar and Knab, Carnegie Inst. of Wash. publ., 159, 1912-1917).
C. C. *Mansonia perturbanc* posterior end.
D. Larva of *Mansonia* spp. getting oxygen from air cells of plant roots.