Uttar Pradesh J. Zool. 9(1) : 99-106, 1989

OBSERVATIONS ON BIONOMICS OF *AEDES ALBOPICTUS* (SKUSE) (DIPTERA : CULICIDAE) IN CALCUTTA AREA, WEST BENGAL

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Aedes (Stegomyia) albopictus is known to be continuously displaced from urban towards rural areas of Calcutta The basic ecological profile of this less studied species is presented in the context of changing landscape pattern in the peripheral areas of the city of Calcutta. Simultaneous occurrence of closely related species, *A. albopictus* and *A. aegypti* was noticed in a periurban area of Calcutta. Field and laboratory observations extending on the life history provided an insight into the biology of *A. albopictus*. The adults spend much of their life at resting places, preferably among bushy vegetation in shaded places. Males form 'swarms' during evening over bushes. Females bite mostly at twilight. Male and female take venter-to-venter position during mating. Oogenesis is completed by 4 days after blood meal. Eggs are deposited in earthenware containers, natural depressions, discarded cans and domestic water-tubs close to rich vegetation. Larval development from eclosion to pupation is completed as early as 6 days but is retarded when food is inadequate in the breeding medium. Larvae are responsive to stimuli like, sound movement of water and sudden changes of light. Adults emerge mostly at night. Certain co-existence of this primarily sylvicolous species in or near human residence, perhaps indicates its propensity to adapt man-made ecological changes.

INTRODUCTION

Aedes albopictus (Skuse) causes considerable nuisance through biting man in the hot-humid seasons of the year in the semirural areas around Calcutta. This species was described by Skuse (1894) from specimens collected from the Botanical garden, Calcutta (Shibpur Botanical garden). Barraud (1934) noted that tree-holes, leaf axils were the main breeding habitats of this species and rarely were artificial receptacles and rock-pools utilized. *A. albopictus* is a common species throughout the Indian subcontinent including Assam, Burma, Andaman Islands, Sri Lanka and occurs up to altitudes of 1500-1800 m. (Barraud, 1934; Stone, 1973). Recently Gilotra *et al.* (1967) noted the presence

of *A. albopictus* in suburban and rural areas, although Skuse (1894) and Senior–White (1934) has implied previously that it was the predominant species in Calcutta. Gilotra *et al.* (1967) and Bhattacharya & Dey (1969) concluded that certain distributional changes have taken place subsequent to the introduction of *A. aegypti* (Linnaeus) Very little of the life pattern of this species has been published in the Calcutta area, although Bhattacharya & Dey (1969), Gubler (1970) and Gubler & Bhattacharya (1971) conducted investigations on reproductive history, developmental success of *A. albopictus* in laboratory.

In course of larval survey in the periurban area of Calcutta I found the presence of larvae of *A. aegypti* with those of *A. albopictus* in many occasions indicating zone of overlap of these species, though *A. albopictus* is known to be gradually being displaced by *A. aegypti*. Thus I decided to study the ecological profile of *A. albopictus* in the present environment created by the introduction *A. aegypti* and expanding city area of Calcutta. An understanding of the biology of *A. albopictus* was developed by observations at certain nodal points of its life history, thus to make a statement on adult's flight time, biting, mating and oviposition behaviour, habits of immatures and, adult's emergence and resting sites. The objective of this study is rather to describe than to explain, same of the basic features of eco-biology of this species.

Study Area

Most of the field observations were made at the Garden Reach area (ca. 9 km^2) of Calcutta, situated at the bank of river Bhagirathi opposite the Shibpur Botanical Garden. Northern and eastern parts of Garden Reach are industrial areas with dense human population and remaining green areas are scarce. The south–western portion is sparsely populated and has more vegetation. Ponds and ditches are common and a large area (ca. 1.5 km^2) of swampy land lies southwards.

MATERIAL AND METHODS

The prevalence of *A albopictus* were determined by making collections of larvae and pupae from as many water–holding containers as possible. Immature stages were reared to adults for identification. Dead larvae or pupae were not taken into consideration.

Adult behaviour *viz.* time of flight, biting behaviour and preovipositional habit was primarily observed during extensive field work. Afterwards, particular phenomenon was observed intensively at the place and time of primary observation. Human baits were not placed in this study to indicate hourwise biting incidence. But personal experience during field study reflects well the

periodicity. Swarm-groups were captured by insect net ca. 30 cm diameter and number of individuals counted. Solitary resting mosquitoes were captured by putting test tubes over them.

Mating, oviposition and behaviour of immature were observed mainly in the laboratory. Adults were housed in cages ($15 \times 20 \times 15$ cm^3). I volunteered to feed the mosquitoes and they oviposited on soaked (with aqueous glucose solution) cotton-wool over petridishes. For specific observations single pair was isolated in cages and noticed. Eggs were collected every morning. Larvae were maintained in 1-ltr glass jars with water (plus disintegrated green leaf and powdered biscuits).

Behaviour of immatures against predators was observed by placing 30 IV instar larvae to a 1-ltr glass jar plain tap water plus one aquatic predator *e. g. Sphaerodema annulatum*, *S. rusticum* (Belostomatidae); *Laccotrephes griseus* (Nepidae); *Laccophilus anticatus* (Dytiscidae) for eight hours.

OBSERVATIONS

Breeding sites : Breeding sites of *A. albopictus* were found near houses close to

Table 1. Occurrence of *A. albopictus* larvae in different breeding sites.

Types of breeding sites	No. sampled	Occurrence	With *A. aegypti*	Total larvae (*A. albopictus*)
Water tub (Domestic)	38	28	28	616 +
Earthen container	78	57	26	456
Metal/Plastic cans	42	7	3	18
Natural depressions	71	37	11	111
Miscellaneous (Bamboo grooves, log holes etc)	37	18	7	29

natural vegetation. Partly shaded water-tubs with dense algal growth were found to be the common breeding sites. Additional sites included earthenware containers, discarded metal and plastic cans, natural depressions in areas with rich vegetation (Table 1).

Time of flight of adults : During day time I never saw any good number of this mosquito out of their resting places. About the time of sunset there was an increase in activity of adults During sunset when it was little dark I saw against clear northwestern sky, the mosquitoes were actively flying The swarms of the male were not very distinct Sometimes a group of 10–15 mosquitoes were seen to move over low bush of 1 5–2 m high in a patch of unmanaged garden. These so-called 'swarms' were best seen in peak season (August–September) in calm weather. If there was wind the group came a little down behind the bush against the direction of wind. The swarms were sensitive to light and the group dispersed with a bright beam from a flash light. The swarm usually lasted for 15–20 minutes. Subsequently, the number of individuals gradually decreased and ultimately the group dispersed.

Biting habit of adults : Crepuscular (twilight) feeding (17 30–18 30 hrs) of the female was common. Rarely, they were seen to imbibe blood from human host during day time at dark shaded places of human dwellings. They could bite even through socks and fine shirts. The females were more attracted when the skin surface was moistened with sweat. If the biting females were not disturbed they could bite even for 2 minutes.

Mating of adults : Mating rarely was observed in nature or in the laboratory. However, *A. albopictus* mated readily in the laboratory The females were unfed. The female took up position, in flight, on dark coloured clothing mostly on the lower limbs of a person sitting without distinct movement The male approached a female flying towards human host and grasped her with the help of his legs. In laboratory, taking the female in a convenient position, the male flexed his abdomen to connect with the female genitalia In flight the contact is venter-to-venter and they remained in coition for about 10 seconds The age at which mating occured in nature was not clear; in the laboratory the males and females were seen to copulate within 30 hrs of emergence

Development of eggs of adults : In laboratory this species took four days to complete oogenesis with oviposition started on fifth day.

Oviposition of adults : The females were attracted particularly to containers of water with a thin covering of algae on the sides. Oviposition was not seen in nature but preovipositional behaviour of different extent was observed in ten occasions. In one instance (30th June, 1987), at about 19–30 hrs, when it was

quite dark, the gravid females were seen to hover in group of 4 to 5 on the water-tub With a bright torch light, in close vision, the abdomen of females were seen to be distended with ova giving them pale appearance. They were seen to fly around one another and occassionally went little up and down. The flight of the gravid female was much slower than that of an unfed one, probably due to the heavy weight of the abdomen. Gravid females were not seen to bite on the exposed hands. After preparatory flight some females settled down on the inner side of tub, just above the water level and which was adequately moist. After alighting the females moved their hind legs up and down, rapidly at first but then slowed down and then ceased almost completely. Although I could not actually see the mosquitoes lay eggs, oviposition was verified the next morning when eggs were seen to be adhered to the surface of the tub wall. Later, I observed the oviposition by captive females in the laboratory on moist cotton-wool. The gravid females, after a certain up and down exploratory flight, settled on cotton, moved its hind legs for a few minutes and then bent its abdomen-tip close to the cotton. The female then moved a short distance, and repeated the act. Oviposition lasted for 8-15 minutes. 20 to 60 eggs were laid singly over about 20 to 30 mm^2 area (for 25 observations).

Developmental stages : The eggs were hatched when inundated or splashed by water. The period of time to hatching as determined from 200 eggs, in the laboratory, ranged from 10 to 16 days. Hatching of a batch of eggs was almost synchronous. With enough food in the medium first instar larvae transformed into second instars in 22 to 25 hours, the second instar larvae developed into third instars in 24 to 26 hours and third instar larvae moulted to fourth instars in 24 to 40 hours. The fourth instar larvae pupated in 72 to 96 hours. Developmental time from hatching of the egg to pupation, determined on a daily basis. After taking out the moulted skin and transferring the larvae into new container, was as early as 6 days. The retardation of development of larvae up to 28 days was observed when the breeding medium was supplied with inadequate food material.

Behaviour of larvae and pupae : First instar larvae and partially the second instar larvae spent most of the time close to bottom and rarely came close to the surface of water except to breath. The larger third and fourth instar larvae came to the surface of water more often Larvae of *A. albopictus* had a tendency to congregate at certain corners of the container, these parts were often exposed to sunlight during certain hours of the day In laboratory the larvae did not show any marked diving or retreat movement in front of swift predators and were often easily caught by the predators.

Larvae reacted clearly to three different stimuli : sound, movement of water and changes of light (both shadow and beam of bright light in darkness).

The alarm response consisted of swimming to the bottom followed by continuous swimming activity until subsidence of alarm when the larvae floated slowly to surface. Rapid repitition of any of these stimuli led to habituation within short time and the alarm response gradually decreased. For example, the larvae in a glass jar, alarmed by a sudden beam of bright light from the side, dropped to bottom and returned to surface after about 2 minutes. Yet when the beam of light was thrown and withdrawn repeatedly to the jar, the larvae showed less response and ultimately almost without any effect.

Emergence of adults : Emergence lasted for 22 to 48 hours. The adults emerged during night but occasionally (ca. 5%) emergence took place during day time Mortality of the adult associated with emergence also were observed. These mortalities ranged from a state where the pupal skin split longitudinally alor g thorax but the adult was unable to come out, to a situation when legs of almost fully emerged adult adhered to the pupal exuvia and the emerging adult was trapped on the water surface. After emergence, the adult rested for 5 to 15 minutes on the skin or surface film of water, after which it flew away.

Following emergence, the adults selected resting places where they remained inactive until host seeking or mating. Teneral adults were exophillic and rarely observed them resting indoors. Females rested in grass and other places near ground, especially inside bushes. Relatively dark humid situations, free from wind were very attractive to these mosquitoes. Beating such bushes with a net could collect many so during day time.

DISCUSSION

Though author like Barraud (1934) reported that *A. albopictus* has been shown to be the carrier of dengue in some parts of the world and Bhattacharya & Dey (1969) suspected it as a vector of arbovirus, this does not represent an important species so far as the epidemiology in our country is concerned It however, draws attention as an allied species of *A. aegypti* with which hybridization even was made possible by Toumanoff (1937, 1938 & 1939)

The get-together of male mosquito at twilight to form swarms is a common scene which they develop a little high over ground on a 'swarm-marker'. The swarm of *A. albopictus* is not well defined as in *A. cantans* (Nielsen & Greve, 1950) or *A. taeniorhynchus* (Nielsen & Nielsen, 1953) but certain physical aspects *viz.* dispersion against light or defensive manner against rapid wind are comparable to those of *A. taeniorhynchus*. The conditions affecting commencement and duration of swarming and relation with mating, are however, need to be better understood in the field.

The crepuscular feeding habit of *A. albopictus* in study area indicates a

difference with day biting habit of *A. aegypti* as noted by Roy (1946). The epigamic behaviour of *A. albopictus* appears to be very similar to *A. aegypti* (Roth, 1948). This perhaps facilitated to hybridize them experimentally.

Gubler & Bhattacharya (1971) have noticed a single female to lay 113 to 20 eggs in thirteen gonotrophic cycles, indicating variability in fecundity of *A. albopictus*.

The tendency of younger instar larvae to spend most time on the bottom arises perhaps from the relatively large surface area to body mass ratio and thinner cuticle of the younger larvae which permits sufficient intake of oxygen through cuticular respiration (Nielsen & Nielsen, 1953). The tendency of the larvae to congregate in certain places of the breeding site is a common feature though its extent varies and they may even be clustered to form ball in *A. taeniorhynchus* (Nielsen & Nielsen, 1953).

Nielsen & Nielsen (1953) observed responses of *A. taeniorhynchus* larvae to different physical stimuli The larvae have the inherent capacity to be accustomed with stimuli under repeated exposure. But Mellanby (1958) pointed out that larvae which have habituated to vibration will respond immediately to visual stimulus Bates (1949) has shown that behaviour of larvae to different stimuli varies greatly from species to species, always being appropriate to the habitat. Clements (1963) opined that whatever the nature and directon of the stimulus producing alarm response, the direction taken by the larvae is always governed by light and gravity.

Although not too much can be concluded from the observation made on a modest scale, there is enough ground to believe that the selection of dark hides in bushy vegetation by the adults of *A. albopictus* as resting place reminds of a primitive sylvicolous habit, but its larvae are specialized to co-exist in or near human residence indicate its propensity to adapt ecological man-made changes, forest clearance resulting in human settlement.

ACKNOWLEDGEMENTS

I am grateful to the Director, Zoological Survey of India for providing necessary facilities, to Drs. S. K. Bhattacharya, S. K. Tandon and M Datta, for encouragement; to Dr. M. W. Service of Liverpool School of Tropical Medicine, England, and E. W. Cupp of Cornell University, Ithaca for providing with pertinent literature. I am indebted to Dr. W K. Reisen of School of Public Health, University of California, Bakersfield, USA who offered valuable literature and comments on the manuscript.

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