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RESEARCH ARTICLE

Evolution of Anthropophagic Mosquitoes

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ABSTRACT

Important scientific discoveries are made through close observations of nature around us. Everything in nature is changing regularly. It is adapting itself to new environment which is due to changes in behaviour of each other. The biological species around us provide a wonderful opportunity to learn from their evolution and adaptations. One such species living closely with us since ages is mosquito. Although, research on mosquitoes span into decades and centuries, the continuous metamorphosis of these tiny hunters entice the researchers to comprehend their abilities. In one such pursuit, we tried to test our hypotheses based on first hand experiences. Mosquitoes are unique species which continues to pester human beings while living with them. They have remained a challenge to control and continue to carry many diseases to us. This small study on their behaviour may help other researchers to control their abilities to thwart the control and containing measures in various forms. We carried out the observations under different test scenarios and realized that mosquitoes have evolved a lot. And a lot of similarities in their attack and defence mechanism are similar to fighting practices of modern armies. However, it is felt, that they can also be played psychologically.

KEYWORDS

Mosquito, Biting Behaviour, Mosquito Psychology, Mosquito Herd

INTRODUCTION

A Long time back, Charles Darwin suggested theory of evolution based on the theory of survival of fittest. The visible and measurable sign of this evolution is present in almost every species alive today. However, it is very fascinating to read through these changes. One such species which is both a hunter and survivor and has to live under constant threat of visibility is “Mosquito”. It has no protection of forests or caves and has to face the most evolved species “Human” every day and night as hunter and yet bluff him while it hunts human back.

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It has become an amazing game of wits and tactics, much like we practice at war ourselves. Humans have learned a lot from animal behavior. Earlier civilizations have imitated the hunting aggressiveness from Lion, speed and patience for hunting from cat family, and many other such skills from different birds, animals and reptiles too in their everyday life of survival and evolution. Few things can certainly be improved in human skills by carefully observing the present day behavior of mosquitos at home or office.

Mosquitoes are insects of the family *Culicidae*. There are about 3500 species present in almost every country of the world. Ordinarily, the life span of male mosquito is from 10 days to 21 days

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while females can live up to 30 days, but in some cases (arctic) mosquitoes may live up-to an year. A lot of research is still going on as to how do female insect selects the mate for procreation. But a female gives eggs every three days and after it has sucked blood to get necessary nutrients for development of eggs. A mosquito can carry blood up to three times its weight, which does not clot due to special chemicals present in their saliva. They can sense changes in moisture, heat, movement and vibrations, as well as the levels of chemicals in the air like carbon dioxide and lactic acid[6]. Eggs, which are laid over a period of several days, are resistant to desiccation and can survive for six months. When rain floods the eggs with water, the larvae hatch. Females, of many mosquito species, including *Aedes Aegypti*, feed on blood in order to lay eggs. They mostly bite during the day but can do so at night in well-lit spaces[3].

It is believed that most of the sporozites discharged by an infected mosquito at the moment of biting are expelled into the interior of a capillary, but in some cases, sporozites can be found in inter-vascular tissues a few minutes after biting[1]. According to Chaves et. al.[4], "understanding adult mosquito blood foraging patterns on a community of hosts is essential for the identification of species that could be involved in the transmission of vector-borne pathogens in nature". Various control measure at genetic levels to control the biting abilities of harmful vector mosquitoes is proving less effective due to monogamy in female mosquitoes[5].

Observed Behaviour Pattern and Deductions

Thirty years back, in most cities and towns of India, where electricity was intermittently available at nights, facing an attack from these straw bearing blood suckers was a nightmare for any common man. With the dusk they would launch their attack like earlier humans did: In groups making huge noise to scare their hunt. And it worked. They evoked a fear in humans as they felt themselves largely helpless against the swarm of tiny night invaders. Smoke coils, Odomos (a cream to be used on body, poisonous and not to be applied on face lest eyes, nose, mouth may have to bear the brunt of protection) and Baygon spray were commonly used deterrents and mosquito nets were the only reliable and practiced protective measures. The protection would usually last little past mid-night, by then the people would have fallen sleep soundly. From here on, it was again the time of hunt for these small persistent hunters with unquenchable thirst. They would launch their attack again in single and team on the sleeping person, figuratively more like dead one now. The droning near the ear of person sleeping was the only indictor of their presence which would merely evoke a wave of lazy hand at best to fend them off rather than to kill them. Often a person may have to stay, awake whole night if, he takes it upon him to eliminate all these suckers before going to a sound peaceful sleep.

The traits clearly observed in their behavior then were: a horde tendency of attack, persistent open attack in waves, minimal use of cover, and little fear of staying in open and visible places during the day. A favorite hobby of many including myself was to kill these merciless blood hookers first thing in the morning to avenge the blood lost in the battle last night. The mosquito nets were to tell the tale of such avengers with bodies of mosquitoes smeared with retrieved blood hanged up on the net at various elevations.

Many mosquito species in Africa have been found to alter their timing of bite due to climatic conditions or use of deterrents by human in various forms. The ability to adjust may come from genetic variability in climatic variability. A heritable phenotypic plasticity empowers mosquitoes to adjust easily to the change in day to day environmental conditions. Authors suggest to survey the feeding and resting pattern of each mosquito species using human landing catch to quantify the extent to which each vector species feed on humans[2].

Hypotheses Being Tested

Are the mosquitoes a species under slower evolution category? Are they capable of adjusting themselves to the momentary changes in environment? Do they work as team? And can

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they sense, analyze, update, communicate, team up and alter their approach towards their prey on real time basis?

EXPERIMENTAL WORK

Layout/Settings

A room of size 10' by 10', with 11' ceiling on first floor of the building, with glazed flooring. No furniture, except a mattress to sleep and Wall cabinet on half of one wall.

Location

Latitude- 22.245

Longitude-70.742

Surroundings- Fully constructed and partially constructed buildings

Vegetation- Residential buildings around with sparse decorative vegetation

Atmospheric Conditions

Date/Season- 2/12/15, 3/12/15 and 4/12/15, very mild winters

Weather- Clear sky, little wind on most nights

Temp- 29/16, 29/15 and 30/14

Experimental Setup

Observation Set 1: Free conditions with door and windows closed

Though entries to the room were closed, yet it is easily possible for mosquitoes to enter through small slits above and below the door, and space between the window slides (Figure 1). As was revealed through observation in later hours, both these access were used by the mosquitoes frequently. Surprisingly, a regular ingress of them was seen at frequent interval, as if it were a part of attack tactics. Initially there were only a couple of mosquitoes inside the room at around 9 p.m.

As the time passed, batches of mosquitoes started coming inside. In order to understand their observation and analytical skill of defense, they were hunted by us with bare hands, sometimes by trapping them between two open palms and at other times catching them in the first grip of one hand. They were also struck against the background of wall, bed, body, etc. To assess the rate of their swarming, they were accumulated in two batches: Batch- 1 from 9:30 p.m. to 2:30 a.m. (appx. 160 in numbers) and Batch-2 from 2:30 a.m to 5:00 a.m. (appx. 100 in numbers) as is shown in Figure 2 and 3.

Figure 1: Slit between the window slides

Figure 2: Batch 1 Count

The collected mosquitoes were kept in open visibility. A small effort was seen to test or communicate with them by some live mosquitoes. As first batch was completed, a clear reduction in the attack rate was observed, though many mosquitoes were sitting on the window panes and walls nearby. As we tried to lie down some mosquitoes will test attack us, and on finding no response will communicate the same to others which will result in mass attack. Similar

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phenomenon was observed many times. These were quite clear about their mind-set, and did not try to hit us even when we disturbed them while sitting and waiting us out (Figure 4).

Figure 3: Batch 2 Count

Figure 4: Mosquitoes waiting at window panes

After 5 a.m. as we closed our observation and lied down, a swarm of them launched an angry and persistent attack on all open parts of body, predominantly feet. Even when we tried to move our body around to shoo them away, they were hardly scared and continued their tirade.

Following things were revealed from this set of observations:

1. Mosquitoes have keen sense of sound, presence and smell.
2. They have sharp observation, quick response and premeditated decision making options which they quickly resort to in case of defense.
3. They are apt at using blending and concealment.
4. They can abruptly sit down from their flight.
5. They do make some planning and communicate to update and modify it on real time basis.
6. They come in very large numbers; say around 300 or more in a single night.

Observation Set 2: Use of Mosquito repellent cream, Odomos on the body (with N-N Diethyl benzamide-12%w/w, manufactured by Dabur India Ltd.)

The windows and doors were kept open whole day and night. After applying the cream on the whole body, the body stayed as open invitation to invaders. However following strange behavior were observed:

1. Very few numbers of mosquitoes were seen as compared to last night.
2. Only some mosquitoes tried to bite though they didn't succeed due to cream.
3. After some initial attempts no mosquito came even to try for the rest of the night.
4. Even though the windows and door were open the swarm of mosquitos which kept coming last night was not seen.
5. No mosquito was found dead in the morning due to repellent cream.
6. No ill effects to body were seen or felt.

Observation Set 3: Use of Good Knight Mosquito repellent coil (with Prallethrin-0.04%w/w, manufactured by Godrej Consumer products Ltd.)

One window was kept open and other was closed. Very few mosquitoes came inside both of them. In fact all through the night there were hardly more than 20-30 mosquitoes inside the room. We did not kill or pursue any of them. Repellent coil was burned at midnight after giving them sufficient opportunity to act on their behavior and past recent experiences of two nights. During the night mosquitoes did try and bite us, but we did not try to kill them. The

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morning inspection of room revealed there were only a couple of dead mosquitoes around. It can be deducted that;

1. Due to change in climatic conditions or increase in coldness, the number of mosquitoes has gone down significantly.
2. The recent experiences have made them wiser to try their fate at some other place. But, that would prove they have excellent communication network.
3. The smoke of the coil has little effect on them.
4. As long as the smoke prevails they stay at safe places and avoid flying.

RESULTS

Through this experiment process following results were observed-

1. The resistance to crushing has been increased and they can easily sustain distributed pressure even three four times when caught in a hand and stay alive with good sense and strength
2. Their sense of presence, sound and movement has improved by a great proportion as compared to some decades back.
3. They can also be psychologically affected and their behavior can be altered.
4. Though the study has been carried out in western region of India, the authors has similar experience in Northern and Eastern part of the country.

CONCLUSION

Mosquitoes have undoubtedly evolved much against general belief. In stark contrast to earlier times they are more courageous, persistent, smart, and quicker. Their ability to use concealment through blending, very fast evasion by settling down quickly and suddenly on dark surfaces and nooks and slits have increased their capability to survive and thus pose a greater challenge to mankind in fighting the various diseases they carry. They certainly work as team and communicate the current scenario to decide their approach suitable to any change in a situation.

Whether this evolution process has been catalyzed by paucity of food, changes in environmental conditions or due to medicine used as repellents or all of them, need to be studied in detail. It can be logically accepted that, they have better chances of genetic evolution by nature as they have shorter life span and thus undergo more number of genetic procreation.

The sequence of observations were kept as it is mentioned, so that the mosquitoes don't get deterred on the first day itself and then carry on with same impression on the remaining days. Their true behavior under normal conditions would not have identified then. This study will perhaps help the researchers in understanding the spread of diseases by mosquitoes

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