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Polluted Water Bodies: A Breeding Ground For Culicine Mosquito

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ABSTRACT
Water pollution is a major problem because it encourages the growth of Culicine mosquitoes, which spread illnesses including dengue, chikungunya, and filariasis. Mosquitoes like these flourish in dirty, standing water, which is common in both rural and urban regions with poor drainage and sanitation. Industrial waste, agricultural runoff, and inappropriate waste disposal are some of the causes that contribute to water pollution, which in turn encourages the reproduction of Culicine mosquitoes. This link is examined in this review study. In order to address both water contamination and mosquito-borne illnesses, this analysis stresses the need of community engagement, stronger environmental regulations, and sustainable urban development. To address this pressing public health issue, it suggests that academics and policymakers work together to enhance water quality and health outcomes.

Keywords: Culicine mosquitoes, polluted water bodies, mosquito-borne diseases, dengue, chikungunya, filariasis, water pollution, vector control, public health.

1. INTRODUCTION

Many regions of the globe are now facing the devastating issue of water contamination. Water bodies like rivers, lakes, and ponds get contaminated when dangerous items like chemicals, garbage, or germs make their way into them. Both people and animals are at danger from the pollution of these water sources, which is bad for the ecosystem. In particular, the Culicine mosquito's ability to spawn in these contaminated bodies of water is a big cause for alarm.[1]
Stagnant, dirty water is the ideal breeding ground for the culicine mosquito. These mosquitoes are responsible for spreading filariasis, dengue fever, and chikungunya, among other dangerous illnesses. Pestilent water is ideal for mosquito larvae to hatch and thrive. There is a danger to public health since these mosquitoes are more likely to transmit diseases in places where the water is not clean.[2]

1.1. Culicine mosquitoes

There are mosquito species on every continent (with the exception of Antarctica), but the tropical regions are home to the greatest concentration of the Culicine, the most numerous subfamily of the Culicidae. Most people think of mosquitoes as disease vectors and parasites of many vertebrate species. For the advantage of their aquatic larval stage, the majority of these holometabolous insect species lay their eggs in still water.

1.1.1. Lifecycle

There are four phases of development in the life cycle of the holometabolous culicine mosquito: egg, larva, pupa, and adult. All Culicine mosquitoes are multivoltine, however the length of each stage varies per species. Every step of development—from egg to pupa—occurs in water. Adults take flight from the water in search of food, which can be in the form of plants or animals.Sites of oviposition are typically immobile, however they might take place in natural saltwater or freshwater reservoirs or in artificial pools. Until they are inundated, the eggs laid by all Psorophora and certain Aedes species stay on the soil. In industrialized places, many species lay their eggs in the pooled groundwater, a sign of how closely they engage with people. Several species deposit their eggs in hollows found in plants. While still larvae, many species are able to get air by drilling into plants.[3]

1.1.2. Eggs

Adult female culicines often lay clutches of eggs that exceed one hundred in number. Eggs are laid on the surface of still water by the majority of species. The female lays her eggs in a row, with the head end down. She uses a sticky material she excretes to hold the eggs together. The resulting egg raft is convex below and concave above, with the ends usually turned up. Species that deposit their eggs in this way usually have first-instar larvae that hatch within a few hours after the eggs are laid. While most mosquito species lay their eggs on the surface of still water, all Psorophora species and a few Aedes species lay their eggs in places that may eventually flood. Although fertilization and embryonic development take place, the eggs will not hatch until they are submerged in water. Within two or three days following inundation, the eggs will begin to hatch.

1.1.3. Larvae

Except for regions with huge bodies of open water and rushing streams, culicine larvae may adapt to almost every aquatic habitat on Earth. The three parts of a larval body are the head, the thorax, and the abdomen. On top of that, they have antennae and complex eyes. Even though the adult Culicine has the same general outline as the larvae, the shape of each body part is drastically different. Larvae go through four stages, or instars, between hatching and pupation, which takes from a week to two weeks. The posterior siphon is a telltale sign of a culicine larva, setting it apart from larvae of other subfamilies. The larvae are able to breathe because the siphon breaks the water's surface and allows air to enter the body.

1.1.4. Pupae

Even though culicine pupae don't eat, they nevertheless need to breathe air. Except for the Mansonia and Coquillettidia species, all pupae need to get air by rising to the water's surface. The exposed abdomen may be moved by the pupae because they are exaggerated. As soon as the thrashing of the abdomen ends, the pupae will swim back to the water's surface, but they may be moved swiftly laterally or downwards. Because it is lighter than water because to an air pocket between its wing cases, the pupa will naturally float to the water's surface.

1.1.5. Adults

Although there are about as many males as females among adult mosquitoes, the transition from the pupal to adult stage occurs first for the males. After the females emerge from the nest, the males remain close by to mate. Once a female mates, she may store sperm for later use. The adults depart the breeding place after mating and are capable of remarkable aerial flight. Adult culicines feed on plant sugars and may be found in almost any habitat. Additionally, in order for the majority of species to produce eggs, the female must consume animal blood. It takes at least two days for a female to digest a blood meal before she lays her eggs. The females start looking for a new host to feed off of once they deposit their eggs. Mosquitoes may feed on a wide variety of hosts, while some have clear predilection for certain types of blood meal. Adults are between two and fifteen millimeters long and feature a triangular body plan with thin membranes connecting the segments.

1.1.6. Feeding

Culicine adults use plant sugars, including nectar, for sustenance. To ensure a sufficient supply of protein for their eggs, only females will consume blood as a food source. Males lack the adaptations necessary to pierce skin, whereas females' oral parts are well suited for this task. For the first step in their blood feeding process, females locate a host with the help of their enormous compound eyes. By sensing changes in both light and smell, females may locate hosts. Their probosces let them to land and locate an ideal biting site. They make punctures in the skin and inject anticoagulant and anesthetic-laced saliva in order to eat. While the anticoagulant keeps the host's blood from clotting, the anesthetic lessens discomfort, allowing the host to continue feeding. It doesn't take long for illnesses to spread when female mosquitoes inject themselves with saliva that contains pathogenic organisms.

1.2. Water Pollution and Mosquito Breeding

Mosquito populations are exacerbated by water pollution. Mosquito larvae will find an ideal environment to feed in water that is polluted with organic substances like sewage, dead animals, and plants. Furthermore, natural mosquito predators, such as fish and other aquatic creatures, are typically absent in contaminated water. Because mosquito larvae may multiply uncontrollably in the absence of predators, mosquito populations become bigger and more hardy as a result.[4]

Stagnant water is ideal for mosquitoes, especially Aedes and Anopheles. Untreated, dirty, or stagnant water provides a perfect environment for aquatic life to flourish. Such situations are common in both man-made and natural water features, such as ponds, ditches, flowerpots, and even blocked gutters.

Most water pollution originates from unsanitary conditions and poor waste management. The buildup of stagnant water in abandoned containers, old tires, and other refuse is a direct result of improper waste disposal.

1.3. Diseases Associated with Culicine Mosquitoes

Multiple deadly illnesses may be transmitted to humans by culicine mosquitoes. Because these mosquitoes thrive in stagnant and dirty water, poorly managed water sources are a breeding ground for illness. Their bites may spread filariasis, chikungunya, and dengue fever, among other illnesses.

The Culicine mosquito is responsible for many illnesses, the most famous of which being dengue. A high temperature, intense headache, discomfort behind the eyes, aches and pains in the muscles and joints, and even rashes might appear suddenly. Without appropriate treatment, dengue hemorrhagic fever, a severe form of dengue, may be fatal.[5]

These mosquitoes also transmit the virus chikungunya. Some of the symptoms include a high temperature, intense joint pain, and a rash. Affected individuals may find it difficult to go about their regular lives because to the extreme joint pain, which may last for weeks at a time.

The culicine mosquito is a key vector for the transmission of filariasis, a parasitic worm-borne illness. Untreated swelling from this condition may leave a person permanently disabled; it most often affects the legs, arms, or genitalia. A other name for it is lymphatic filariasis.

Because mosquitoes need stagnant water to lay their eggs, the presence of contaminated bodies of water is strongly associated with the prevalence of these illnesses. Inadequate sanitation, overpopulation, and areas with poor drainage tend to be the most hit. Reducing mosquito populations and making water bodies better are two ways to stop the development of these illnesses.

1.4. Control and Prevention Strategies

A multi-pronged strategy centered on environmental changes is necessary to lessen the effect of low water quality on mosquito reproduction. The following are some tactics that have been suggested by experts:[6]

- **Regular Monitoring of Water Quality:** Early detection of pollution allows for prompt intervention and remedial actions, which may be achieved by consistent testing and monitoring of water bodies.
- **Enhanced Waste Management:** Water contamination and the elimination of mosquito breeding grounds caused by stagnant water may be prevented with the implementation of strong waste disposal systems.
- **Community Education and Involvement:** Communities may learn to cover water containers and remove standing water more effectively if they are educated about the significance of water quality maintenance and the value of avoiding water stagnation.
- **Infrastructure Development:** To avoid urban mosquito breeding grounds, it is important to invest in better drainage systems and make sure there is enough water flow.

2. LITERATURE REVIEWS

Changes in the environment and land use are leading to the emergence of mosquito-borne illnesses (MBDs). Researchers have shown that water quality affects mosquito larval habitats, which is significant since mosquito (Diptera: Culicidae) habitat selection is often dependent on water availability for egg and larval development. In order to better understand how mosquito-borne disease (MBD) risks have expanded around the world, this systematic review and meta-analysis set out to find, describe, evaluate, and synthesize all available data on the connections between water quality and mosquito presence and abundance (MPA). In order to find research that looked at the connections between MPA and water quality characteristics, a systematic review was done. The relationship between MPA and the most reported water quality parameters was estimated using pooled data from random-effects meta-analyses where applicable. Nitrogen concentrations(56%), turbidity(56%), electrical conductivity(54%), dissolved oxygen(43%), phosphorus concentrations(30%), and alkalinity (10%) were the water quality metrics most often reported. pH was next on the list. In general, there were significant positive pooled correlations between “MPA and pH ($P = 0.05$), turbidity ($P < 0.0001$), electrical conductivity ($P = 0.005$), dissolved oxygen ($P < 0.0001$), nitrogen ($P < 0.0001$), and phosphorus ($P < 0.0001$), but alkalinity showed no significant correlation ($P = 0.85$).” Most meta-analyses showed substantial levels of heterogeneity, and the authors found that climatic zonation affected the combined estimates. Our ability to foretell the hazards of MBD in the face of shifting environmental and land use conditions will be improved by establishing connections between MPA and water quality characteristics.[7]

“Filarial worms and several arthropod-borne viruses (arboviruses)” are among the human disease-causing diseases that culicine mosquitoes may transmit. Public health officials are quite worried about the recent uptick in cases of vector-borne illnesses along Kenya's coast. In Taita-Taveta County, Coastal Kenya, this research set out to catalog the variety and quantity of culicine mosquito species as well as their host feeding habits. The long-dry season (June to October) and the long-wet season (March and May) of 2016–2018 were used for entomological sampling. Indoor and outdoor mosquito populations were sampled with the use of CDC light traps and backpack aspiration. Morphological analysis and physiological classification were used to classify all culicine mosquitoes that were collected. The ELISA was used to determine the bloodmeal source in culicine mosquitoes that were fed blood. Bloodmeals derived from numerous hosts accounted for 51.6%, while those from a single host accounted for 41.3% and those from an unknown source accounted for 7.2%. The results of this research show that culicine mosquitoes come in a wide variety and have different eating habits.[8]

Various mosquito species (Aedes, Anopheles, Armigeres, Culex, and Culiseta) were studied in various settings at the University of Peshawar's Entomology Research Laboratory to establish species composition, relative abundance, and seasonal change. Using the dipping approach, monthly samples were taken from selected breeding sites across a range of permanent and transitory habitats for two years in a row. The survey locations were found to have a diverse range of species. The total number of immature stages collected from these seventeen different kinds of possible larval environments is 42,430. This number includes 41,556 larvae and 874 pupae. Only 19,651 insects reached adulthood, including 8,139 males and 11,512 females. There were 15,333 mosquito larvae from permanent breeding sites and 4,318 from transitory ones, for a total of 78%. According to this research, fifteen different species of Aedes, Anopheles, Armigeres, Culex, and Culiseta are present in the Peshawar valley. Culex quinquifasciatus was determined to be the most common and consistently distributed species when all species densities were considered. Most often seen in tree holes and water cisterns, Aedes albopictus was the most common species in the temporary habitats. In June and November, the number of emerging adults was the greatest at 2,243 and 26,67, respectively, while in January, it was the lowest at 203. A temperature-mosquito population correlation of 0.8 was discovered with a degree of freedom of 10 and a significance level of 0.05. Mosquito species diversity indexes stayed within the range of 0.12 to 1.76. Bamboo traps had a very low Margalef's richness component of 0.2, but rice fields, percolating water, and animal trails had relatively high values of 1.3, indicating that these habitats were rich in mosquito species.[9]

Measuring individual physicochemical characteristics is the standard method for assessing the water quality of mosquito breeding areas. However, when contaminants are present in complex mixes, it may be challenging to interpret or get a clear image of the breeding habitats' water quality based on a number of metrics. The water quality in breeding habitats of Anopheles, Aedes, and Culex mosquitoes in Cape Coast, Ghana's urban regions was evaluated in this research using Laser-Induced Fluorescence (LIF) spectroscopy. Laboratory water samples were used to measure the LIF spectra, which were acquired using a 445 nm diode laser. The breeding environments were found to include chlorophyll and dissolved organic matter (DOM), according to the LIF spectra. To find out how good the water was in each environment, we used the Raman vibrational signals to normalize the fluorescence signals of DOM and chlorophyll. In comparison to breeding grounds for Anopheles and Culex, water quality in Aedes was generally superior. The breeding grounds for Anopheles and Culex were contaminated with chlorophyll and fulvic acid, two indicators of pollution from human activities. As a result, the water quality was poor. Culex species were recognized to the genus level, while Anopheles and Aedes habitats were mostly composed of An. coluzzii and Aedes aegypti, respectively. This study adds to the mounting evidence that propagating Anopheles in contaminated environments is a major public health hazard. This research was the first to show that LIF spectroscopy may be used to determine the quality of water in mosquito breeding grounds.[10]

From October 2008 to March 2009, researchers in southern Khouzestan Province, Iran, sampled the “culicine mosquito fauna (Diptera: Culicidae: Culicinae) of the Shadegan wetland using New Jersey light traps, total capture, and manual catch”. The researchers caught 2664 culicine mosquitoes in all. Out of the seven genera and five species that were found, one belonged to Culiseta and the others to Culex pipiens L., Cx. sinaiticusKirkpatrik, Ochlerotatuscaspius Pallas, and Cx. modestus Ficalbi. These newly-recognized species, some of which have major medicinal uses, were all discovered in the Shadegan swamp in Khouzestan Province.[11]

Finding mosquito breeding grounds is critical for controlling mosquito-borne illnesses. It is crucial to regularly monitor the bionomics of disease vectors in light of the current global context of quickly changing ecological and climatic variables. Mosquitoes will lay their eggs in any stagnant body of water. The presence of eggs, larvae, and pupae indicates a breeding place. When mosquitoes are still larvae, they are much easier to manage than when they are adults. To do this, accurate information on where mosquitoes lay their eggs is crucial. Pandharpur is home to a network of Nallas, or streams, that serve as both wastewater conveyance and locations for solid waste disposal. To break out of the rut, it's essential. This kind of area might be a mosquito breeding place. Eliminating or changing breeding locations is one method of controlling Aedes and Culex because of their inclination of reproducing in a broad variety of containers.[12]

The malaria-carrying Anopheles culicifacies is often seen breeding in crystal clear water in Sri Lanka. The variety of An. culicifacies breeding habitats was the primary aim of the research. From January 2011 to June 2012, researchers in Sri Lanka's Trincomalee District investigated four distinct sample sites—Murthankulam, Kommnaimottai, Paranamadawachchiya, and Kokmotawewa—to determine the potential larval habitats of Anopheles mosquitoes. From 16 distinct breeding sites, 2,996 larval specimens of 13 Anopheles species were documented. Anopheles culicifacies, Anopheles subpictus, Anopheles barbirostris, Anopheles peditaeniatus, and Anopheles nigerrimus were the most common species, as determined by the density criteria. Regarding their distribution, Anopheles peditaeniatus, Anopheles subpictus, and Anopheles nigerrimus were shown to be stable. Drains stocked with sewage in outlying regions were the most fruitful breeding grounds for An. culicifacies, whereas man-made wells ranked second. While it was previously believed that An. culicifacies could only reproduce in very pure water, our findings show that the species has evolved to breed in a variety of habitats, including waste water collecting.[13]

3. CONCLUSION

One of the key causes for the growth in Culicine mosquito populations, according to the literature study, is contaminated water bodies. Urban settings with inadequate sanitation and drainage systems are perfect breeding grounds for these mosquitoes because they prefer standing, polluted water. Water contamination encourages mosquito breeding, according to studies. Major contributors to this problem include inadequate waste management, industrial effluents, and agricultural runoff. Additionally, studies have shown that culicine mosquitoes are a significant source of human-harming illnesses such filariasis, dengue, and chikungunya. There is an immediate need to take action to minimize mosquito populations and water pollution since several studies have shown a correlation between the two and the development of these illnesses. A variety of control strategies have been investigated, such as chemical spraying, biological interventions, and awareness initiatives. Community involvement and government backing are crucial for these strategies to succeed, despite their encouraging outcomes. Integrated vector management, which combines many tactics to obtain better outcomes, is also emphasized in the literature. According to these findings, keeping water bodies clean is very important for lowering mosquito populations and stopping the transmission of illnesses. There may be a marked improvement if we work to better manage garbage, encourage sustainable urban development, and inform people of the dangers of standing water. This analysis highlights the need of implementing stronger regulations and finding new ways to deal with the issue of water pollution and the health dangers posed by Culicine mosquitoes.

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