A FINAL REPORT

of

MINOR RESEARCH PROJECT

On

Seasonal variation study of Mosquito vector and disease burden from Beed; District of Maharashtra (India)

SUBMITTED TO

Planning and Statistic Section,

Dr. Babasaheb Ambedkar Marathwada University

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In the Subject of Zoology

Under the Area of Animal Sciences and Biotechnology

Submitted By

Principal Investigator

Dr. BAPU SITARAM KHAIRE

Head Dept. Of Zoology

Anandrao Dhonde Alias Babaji Mahavidyalaya , Kada

Tq. Ashti Dist. Beed (M.S.) Pin – 414202

Mob. 9422930170 / 9403544591

Email : bapukhaire@rediffmail.com

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INDEX

"SEASONAL VARIATION STUDY OF MOSQUITO VECTOR AND DISEASE BURDEN FROM BEED DISTRICT"

INTRODUCTION

Biodiversity is the variability of both plants and animals. Broadly, it is the 'richness' of an ecological community. The diversity among insects has always been of keen interest, not only to entomologists dealing with structure and function, but also to those who are engaged in different environmental programs. Relating to the biodiversity of insect richness, Prendergast *et al* compared the coincidence of diversity hotspots of some different groups of insects and examined the extent to which species-rich areas for different taxa coincide and whether species-rich areas contain substantial numbers of rare species. It is relevant to note that India has been considered as one of the mega-diversity countries possessing a rich measure of all living organisms when biodiversity is viewed as a whole. The diversity among insects has always been of keen interest to the entomologists but also to those who are engaged in different environmental programme as insects are bio indicators of environment. Mosquitoes among insects are the most important single group of insects in terms of public health importance, which transmit a number of diseases such as malaria, dengue, Japanese encephalitis and filariasis causing millions of deaths every year.

Mosquitoes are common, flying insects belonging to the order Diptera (flies) that live in most parts of the world. Within Diptera, mosquitoes constitute the family Culicidae. Over 3,500 types of mosquitoes can be found worldwide. Mosquitoes have a slender segmented body, one pair of wings, one pair of halteres, three pairs of long hair-like legs, and elongated mouthparts. The mosquito life cycle consists of egg, larva, pupa, and adult stages. Eggs are laid on the water surface; they hatch into motile larvae that feed on aquatic algae and organic material. The adult females of most species have tube-like mouthparts called a proboscis that can pierce the skin of a host and feed on blood.

Now a day mosquito is most problematic arthropod regarding human health. It is not only nuisance but also vector parasites for number of dreaded diseases. So for the better and healthy human health worldwide numbers of worker are working on "mosquito and mosquito borne diseases" but till today we are not got satisfaction. Day by day global change is occurring across a wide range of fields and those changes affect almost every aspect of human societies. There are a number of drivers of global change that are changing the physical and social environment on planate to such an extent that they have the potential to influence the

status of many vector-borne diseases. These complex global phenomenon and natural as well as infrastructural disabilities are favorable for mosquito development and mosquito borne diseases.

In India the major mosquito vectors of these diseases belong to the genera Anopheles, Culex, Aedes and Mansonia. *Anopheles gambiae* and *An. quadrimaculatus* is one of the best known, because of its predominant role in the transmission of the most dangerous malaria parasite species *Plasmodium falciparum* to humans. Chikungunya is an arthropod-borne virus, transmitted to humans by virus-carrying day-active *Aedes aegypti* and *Aedes albopictus* whereas Dengue is transmitted by principally *Aedes aegypti*. *Culex* is another genus of mosquitoes which serve as vectors of important diseases, such as West Nile virus, filariasis, Japanese encephalitis, & avian malaria. The knowledge on biodiversity of mosquitoes in an area provides adequate information on population diversity, distribution pattern and preferential habitat selection which will help to evolve a suitable strategy and implement the same for the meaningful suppression of the mosquito population and in turn to reduce the mosquito menace There is a scarcity of literature on habitat biodiversity hotspots regarding mosquito presence. In fact, reports on mosquito fauna in different regions of India dominate the literature, while information on mosquito biodiversity hotspots is lacking in general, and in the Jalgaon district of Maharashtra state in particular. In last few years cases of dangerous malaria, Chikungunya, dengue and other viral fever were reported in foot hill villages of Satpuda ranges. Hence in the present investigation was taken to study the diversity of mosquitoes in three villages at the foot hill of Satpuda ranges of north Maharashtra, India.

The distribution pattern of adult mosquitoes is related to habitat preference of the immature stages. These habitats may be natural or man-made, temporary or permanent. Climate change, infrastructural disabilities and availability of breeding beds result in surveillance of mosquitoes (Episton, 1998; Gubler, 1998; Reiter, 2001). It provides favorable condition for mosquito distribution and their abundance. It is main cause for spreading of infectious diseases like Malaria, Chikungunia, Yellow, Fever, Elephantiasis, Dengue etc. Day by day global change is occurring across a wide range of fields and those changes affect almost every aspect of human societies. There are a number of drivers of global change that are changing the physical and social environment on planate to such an extent that they have the potential to influence the status of many vector-borne diseases. These complex global

phenomenon and natural as well as infrastructural disabilities are favorable for mosquito development and mosquito borne diseases.

In India the major mosquito vectors of these diseases belong to the genera *Anopheles, Culex, Aedes* and *Mansoni* . The knowledge on biodiversity of mosquitoes in an area provides adequate information on population diversity, distribution pattern and preferential habitat selection which will help to evolve a suitable strategy and implement the same for the meaningful suppression of the mosquito population and in turn to reduce the mosquito menace. In last few decades cases of dangerous diseases like Malaria, Chikungunia, Dengue, Elephantiasis, Yellow fever and other viral fever were reported from villages in Marathwada region of Maharashtra. Hence the present investigation was carried out to morphological identification of mosquito species and their prevalence for planning of mosquito vector control measures in Ashti taluka of Beed district of Maharashtra (India).

Aedes is a genus of mosquitoes originally found in tropical and subtropical zones. It is considered highly invasive in nature and can carry a variety of pathogens that can be transmitted to humans. The species *Aedes aegypti* and *Aedes albopictus* (Skuse) are the primary vectors of concern worldwide. *Ae. a*egypti mosquito is the main vector that transmits the viruses that cause dengue. It is also known to transmit filarial infections of Wuchereria bancrofti and Dirofilaria immitis and avian parasite Plasmodium gallinaceum . Ae. albopictus is primarily a forest species that has become adapted to rural, suburban, and urban human environments. These species commonly transmit dengue virus (DENV) around the globe; an estimated 50–100 million new dengue fever infections occur each year, causing ~500,000 cases of dengue hemorrhagic fever (DHF) and >20,000 deaths. It can also transmit Yellow fever, Chikungunya, and ross river viruses.

Necessity of the work:-

- Generate database for researchers and workers.
- We can prevent outbreak
- Status of vector mosquito from study area.
- Signe of outbreak and control strategies.
- The study area are not develop in proper direction means randomly growth, low sanitation, open drainage, garbage, dung damping and other wastes are open, provide favorable condition for human diseases.

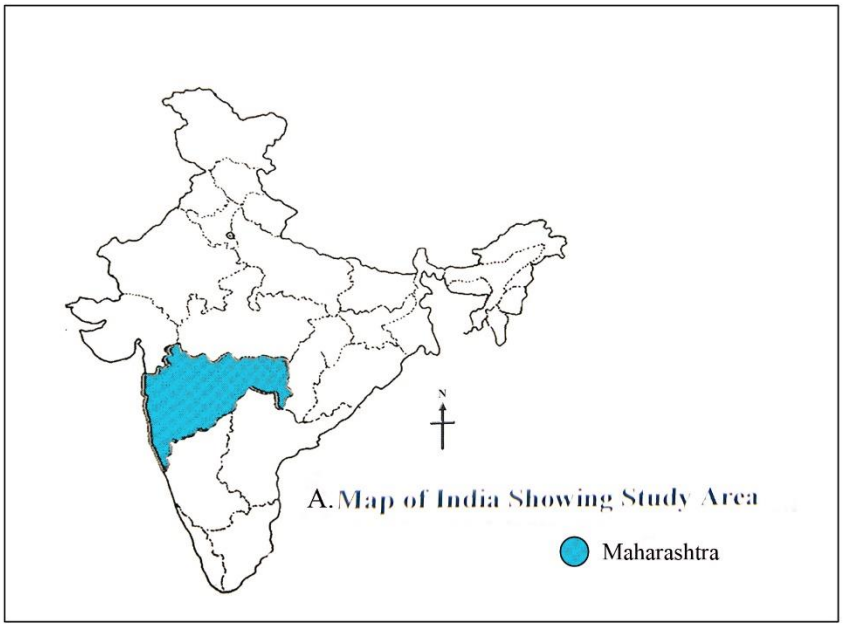
- Preliminary work will helpful for proper development of Beed and keeps away from mosquito and mosquito borne diseases.
- Poverty associated with rapid population growth leads to concentrations of people without the necessary infrastructure for the safe storage and distribution of water and drainage of wastewater

1) STUDY AREA:-

Considerable work has been carried out to morphological identification of mosquito species and their prevalence for planning of mosquito vector control measures in Ashti taluka of Beed district of Maharashtra (India). Beed is one of the eight districts in the Marathwada region of central India. The study area lies between 18°48′19″N and 75°10′22″E. Ashti is one of the taluka in Beed district which is a draught prone area. An average rain fall of Ashti tehsil is 670.2 mm.

Collection of mosquito specimens from different nine geographical regions of Ashti tehsil, District Beed (M.S.) India. This region includes Bus station Ashti, Murshadpur, Kada Dhamangaon, Dhanora, Shirapur and Belgaon which cover the maximum study area. The study area lies between 18°48′19″N and 75°10′22″E.

PLATE-1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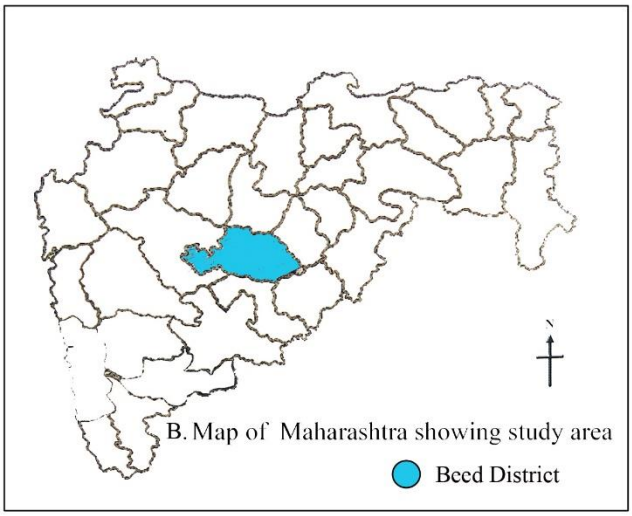
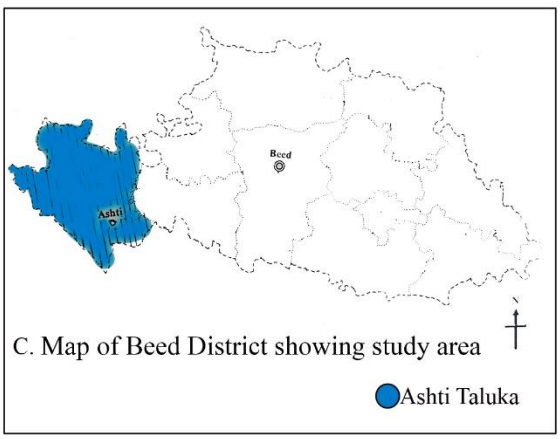
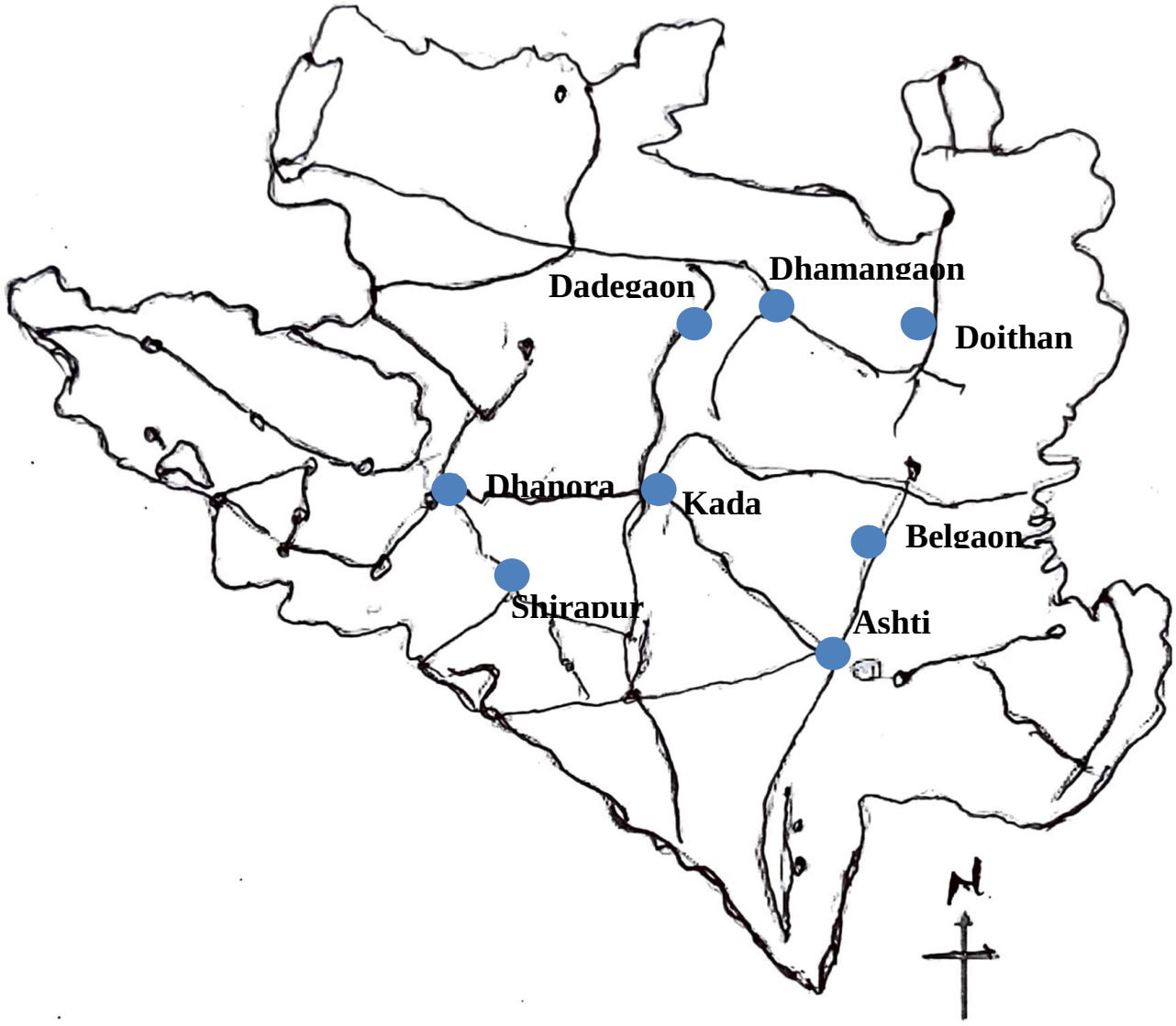
A. Map of India Showing Study Area
Maharashtra


B. Map of Maharashtra showing study area
Beed District


Beed
Ashti
C. Map of Beed District showing study area
Ashti Taluka



Ashti taluka showing study area

HISTORICAL RIVEW:

Throughout the world, there are known to be approximately 2,700 different species of mosquitoes. There are more than 3,000 species of mosquitoes in the world and the India is home to about 404 of them. Dr Kant informed. "The common ones belong to Anopheles, Culex, Aedes and Mansonides." Dr Kant informed that all the 400 mosquito species found in the country are carriers of diseases. One of the first recorded cases of the vector-borne virus, yellow fever, occurred Ashti in 1668 in New York followed by a major epidemic in Philadelphia in 1793 where thousands of people died. Several serious epidemics occurred later in New Orleans, most notably in 1833 and 1853 continuing to 1905.

In 1922 cases of dengue fever were recorded along the Gulf Coast spreading from Texas to Florida and becoming one of the most serious vector-borne viruses of the Americas, Asia, and Africa. During 1934 there were more than 125,500 cases of malaria in the United States and the disease was not effectively controlled until the 1940s. The incidence of malaria peaked during the 1960s and early 1970s as military personnel returned from the war in Vietnam. The largest outbreak of the disease since the 1950s occurred in southern California in 1986.

In the south of Texas 55 cases of dengue were reported in 1999 including one death, 85 people suffered from the virus in Hawaii in 2001, and over 20 Florida Keys residents were confirmed to be infected in 2010. Florida was hit with epidemics of the St. Louis Encephalitis, a disease transmitted from birds to humans, during the years of 1959, 1961, 1962, 1977 and 1990. Over 35 years (1964-1998) a total of 4,478 cases of the virus were recorded in America's history. One of the last confirmed deaths due to St. Louis Encephalitis virus occurred in Louisiana in 2003. Florida was also the location for the Chikungunya virus, which resulted in 2 cases being reported in July 2014.

An annotated catalogue for Indian mosquitoes has been prepared with a view to primarily enlist all the extant taxa, along with simplified field-friendly identification keys for the 4th instar larvae and adults of the major vector species of public health importance in India. This is by far the most complete and comprehensive inventory compiled post-independence in single volume of the entire mosquito faunal wealth in the country. The Catalogue offers many novelties; first, it has inventoried the largest ever number of 404 species and subspecies (which is >12% of the total number of taxa in the world, i.e., 3541), belonging to 50 genera and 2

Subfamilies (12 tribes); secondly, it has organized all the taxa in a more modern and universally acceptable classificatory system proposed by Harbach [(2014). Mosquito taxonomic inventory, http://mosquito-taxonomic-inventory.info/node/11667; accessed 31st July, 2014)], with of course some consideration of the other popular systems earlier used by Christophers (1933) and Barraud (1934) in their respective magnum opuses 'Anophelini', and 'Culicini and Magarhirini' under Culicidae.

Climate change, infrastructural disabilities and availability of breeding beds result in surveillance of mosquitoes (Episton, 1998; Gubler, 1998; Reiter, 2001). It provides favourable condition for mosquito distribution and density, and it is main cause for spreading and outbreak of infectious disease like Malaria, Chikungunia and Dengue. Malaria is caused by some female species of Anopheles; dengue and Chikungunia by Aedes; Elephantiasis by spp. of Culex mosquitoes. Vector born disease is one of the leading causes of sickness. It is reemerging as the number one infectious killer and it is the number one priority tropical disease (WHO- 1989). WHO reported 300 – 500 million people suffered in Africa and South Sahara and 1.1 to 2.7 million people is killed become of it. Epidemiological scenario of malaria differs from state to state and region to region in India (Kochar et al., 2007). India contributes 1282 deaths of world's scenario, including 7.12% death from Maharashtra of Indian scenario (www.nvbdcp.gov.in/). Now Marathwada region as well as Maharashtra is endemic for mosquito disease (Bharagav and Chatterjee, 2007); Parbhani also reported 27.91% density of An. stephansi during 2008 (Shinde and Makne, 2011). Now a day's number of government institution and workers are involved in the control strategy of mosquito and mosquito born disease, but till date we fail to do it. Outbreak of Dengue and Chikungunia are results of control failure to vector mosquito. In India including Maharashtra four states have reemerged with Chikungunia and spend billion rupees to recover it in 2005 – 06. It affect not only on economy but also development and farming practices in rural area. According to WHO tropical countries are facing 30 new emerged diseases since last three decades due to climate change. If we did not control to it, then other way to prevent mosquito-borne diseases viz. monitoring the vector parasites, environmental condition, disease infection and vector habitat. Considering the same all over world each country does the same practice.

Mosquitoes are one of the deadliest animals in the world. Their ability to carry and spread disease to humans causes millions of deaths every year. In 2015 malaria alone caused 438 000 deaths. The worldwide incidence of dengue has risen 30-fold in the past 30 years, and

More Countries are reporting their first outbreaks of the disease. Zika, Dengue, Chikungunya, and yellow fever are all transmitted to humans by the *Aedes aegypti* mosquito. More than half of the world's population live in areas where this mosquito species is present. Sustained mosquito control efforts are important to prevent outbreaks from these diseases. There are several different types of mosquitoes and some have the ability to carry many different diseases.

Aedes is a genus of mosquitoes originally found in tropical and subtropical zones. It is considered highly invasive in nature and can carry a variety of pathogens that can be transmitted to humans. The species *Aedes aegypti L.* and *Aedes albopictus* (Skuse) are the primary vectors of concern worldwide. *Ae. aegypti* mosquito is the main vector that transmits the viruses that cause dengue. It is also known to transmit filarial infections of Wuchereria bancrofti and Dirofilaria immitis and avian parasite Plasmodium gallinaceum. *Ae. albopictus* is primarily a forest species that has become adapted to rural, suburban, and urban human environments.

The incidences of vector-borne diseases are increasing alarmingly due to many factors including uncontrolled urban developments that support breeding of vector mosquitoes. World Health Organization (WHO) in 2010 stratified the current situation of dengue/DHF in India under category A, which means a major public health problem, leading cause of hospitalization and death among children. In India, National Vector Borne Disease Control Programme (NVBDCP) reported 28,055 dengue cases in 2010 from 31 out of 35 states in India (highest ever in a year) [6]. In 2013, a total of 22,092 dengue cases and 74 deaths were reported form the country (of which 23 deaths were from Maharashtra only). In Maharashtra state sporadic cases of dengue were reported in 1973, 1983, and 2000. Morbidity in Barshi, Maharashtra (1973), was about 37.5%. Recently the cases of Chikungunya are reported from villages Mungi, Balamtakli, and Madhi (district Ahamadnagar), Malegaon city (district Nashik), and all 8 districts of Marathwada region and in Vidharbh region 7 districts: Akola, Washim, Buldhana, Yeotmal, Nagpur, Wardha, and Chandrapur. Mumbai, too, had recorded 116, 416, 1008, and 250 dengue cases in 2010, 2011, 2012, and 2013, respectively.

MATERIAL AND METHODS:

The study was carried out for twelve months during August 2019 to July 2020. Collection of mosquito specimens from different nine geographical regions of Ashti tehsil, District Beed (M.S.) India. These regions includes Ashti, Murshadpur, Kada, Dhamangaon, Dhanora, Shirapur and Belgaon which cover the maximum study area. The study area lies between 18°48′19″N and 75°10′22″E. Ashti taluka is draught prone area. An average temperature of Ashti tehsil is near about 33 ^{0}C to 42^{0}C in summer and 19^{0}C to 28^{0}C in winter. A rainfall is moderate in the study area. An average rain fall is 670.2 mm. Whereas humidity ranges from 19 to 83 %.

The adult mosquitoes were collected from nine different habitats localities which covers maximum study area. Overall random sample of Mosquito and mosquito larvae were collected in one year during August 2019 to July 2020. Collections of mosquito were carried out indoor as well as outdoor by Aspirator and Net method. A close search for mosquitoes was made in every possible habitat, such as human dwellings, cattle sheds, mixed dwellings, and other outdoor resting sites, for obtaining the maximum number of specimens from fixed points. Random collection was also made while sampling fixed localities. From the possible water habitats, collection of immature mosquitoes was, also done. The resting adults were collected from the cattle shed using aspirator and from the bushes using sweep net The sample was carried out immediately to laboratory for identification and fixed in insect preservative ie. 70 to 80% alcohol. Each locality was sampled at least once in each month. Information about mosquito species, habitats, geographical location, etc. was recorded on a data sheet Identification of adult and larvae were carried out with the help of Identification key (Christopher, 1933; Sharma et al., 1995), WHO. 1975, Barraud and Nagpal 1995), and also used electronic key developed by NIMR Delhi. Morphological identification of the specimens carried out by using characters like, mouth parts - proboscis, maxillary palps, antennae wing venation, scales on wings and legs.

METEOROLOGICAL DATA:

Monthly average of maximum and minimum temperature and humidity, as well as rainfall data of study period obtained from Meteorological Department (https://knoema.com/aulvzxc/district-wise-rainfall-data-for-india?districts=1002850-beed Maharashtra-India) to analyze the mosquito population dynamic with the abiotic factors.

Table 1: Shows minimum, maximum and average temperature, a rain fall and humidity during the study period (August 2019 to July 2020).

Month	Temperature			Average Rain fall	Average Humidity %
	Min	Max.	Aver.		
Aug. 2019	23	30	27	374.2	77
Sept. 2019	22	28	26	599.4	83
Oct. 2019	22	29	26	244.7	78
Nov. 2019	20	29	25	90.3	67
Dec.2019	19	28	24	21	59
Jan. 2020	19	29	24	4.5	48
Feb. 2020	21	41	36	2.3	36
Mar. 2020	24	41	31	13.7	29
Apr. 2020	28	40	36	2	19
May. 2020	29	41	37	5.5	21
June 2020	27	34	31	170.8	58
July 2020	24	31	28	686	75

A Questionnaire based cross sectional study was conducted from August 2019 to July 2020 to spread the knowledge, awareness and practices regarding mosquito borne diseases. It was conducted in selected semi urban areas which includes Ashti, Murshadpur, Dnyandeep colony Kada, Bus station Kada, Dhamangaon, Dhanora, Shirapur and Belgaon. Ashti taluka experiences climatic condition of minimum temperature 19°C and maximum temperature 41°C and average rainfall is 410 mm. To collect relevant data, Simple random sampling method was used. The sampling was random there were no any special criteria. The gross sample size of study was 695 respondents from Beed rural i.e. Ashti taluka. Survey was done with the help of pre-designed and pre-tested questionnaire.

Questionnaire was formulated with the help of research papers and workers in this field which include,

- Awareness regarding mosquito species
- Awareness about Mosquito Biting time
- Awareness about Precautions undertaken for mosquito bite
- Awareness about Dry day celebration
- whether peoples visited government department
- Awareness about Mosquito egg laying habitat

Respondents were also asked about annual expenditure required for protection from mosquito biting. Data validation checks were performed at regular interval. Collected data was fed in Microsoft Excel and results were tabulated; the frequency and respective percentage were calculated.

RESULTS AND DISCUSSION

Now a day's mosquito **is** most problematic arthropod regarding human health. It is not only nuisance but also vector parasites for number of dreaded diseases. So for the better and healthy human health worldwide numbers of worker are working on "mosquito and mosquito borne diseases" but till today we are not got satisfaction. Day by day global change is occurring across a wide range of fields and those changes affect almost every aspect of human societies. There are a number of drivers of global change that are changing the physical and social environment on planate to such an extent that they have the potential to influence the status of many vector-borne diseases. These complex global phenomenon and natural as well as infrastructural disabilities are favorable for mosquito development and mosquito borne diseases.

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Morphological Structure of Mosquito Species:

I. Anopheles: Anopheles genus dominated with seven species i.e, ***An. culicifacies, An. subpictus , An. annularis, An. barbirostris, An.quadrimaculatus An. vagus, and An. gigas.***

1. ***Anopheles culicifacies (*Giles 1901):**

❖ **Morphology :**

- Small, dark coloured species.
- **Head :**with frontal tuft of white hairs and yellowish with upright scales,
- **Legs:** dark brown, distal extremity of the tibia shows a small spot of yellowish scales.
- **Thorax:** with brown and yellow hairs with median dark longitudinal line.
- **Abdomen:** dark brown color covered with long yellow hairs

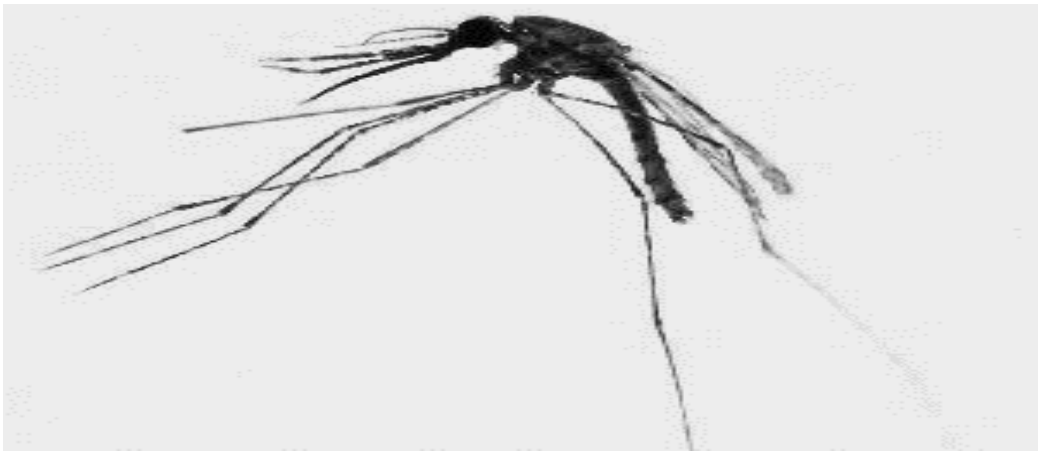
- **Wing:** covered with narrow spindle shaped scales
- **Palpi**: three small almost equal yellow areas
- There are five yellowish-white scaled portions as on the first longitudinal vein
- The 2nd & 4th longitudinal vein has three lighted portions
- The 3rd longitudinal vein is dark scaled throughout except its origin.
- The 5th and 6th longitudinal vein has only one light scaled area.

Fig. 1: ***Anopheles culicifacies*** **Giles 1901**

2. Anopheles subpictus **(Grassi 1899):**

❖ **Morphology :**

- **Head**: well-marked with frontal tuft
- **Thorax**: Lateral areas somewhat darker than the median area covered with short golden curved hairs with white scales and erect black scales.
- **Abdomen:** with golden hairs and somewhat narrow.



Anopheles subpictus **(Grassi 1899)**

- **Wings**: base of costa with three small dark spots. Middle dark spot usually about twice as long as the others.
- Fringe commonly with an additional pale area between terminations of vein 6.
- **Legs**: with femora distinctly swollen. Tibiae mark with a thin pale line on anterior surface.
- **Palpi:** Apical segment about half the pre apical in length, with a broad apical band and two narrow pale bands

***3. An. annularis* (Van der Wulp 1984):**

❖ **Morphology :**

- **Head:** Frontal tuft with long, white slender scales; palpus with 3 pale bands.
- **Thorax:** Anterior promontory with erect white, slender scales; upper proepisternal setae absent.
- **Wing:** Vein CuA with more dark than pale scaling and dark spot at fork with cross vein mcu.
- **Legs:** Fe-III, Ti-III and Ta-III1 without pale speckling; Ta-III3-5 entirely white.

***Fig. 3An. annularis* (Van der Wulp 1984)**

***4. An. Barbirostris* (Van der Wulp 1984):**

❖ **Morphology :**

- **Head:** Proboscis entirely dark-scaled; palpus with dark, numerous and erect scales; pedicel with dorsal and lateral scales; clypeus without scales.

- **Thorax:** Antepronotal scales present (not distinct in photo); pleuron with white scale patches.
- **Abdomen:** Sterna with median patches of pale scales and rows of pale scales on lateral margins; VII-S with a tuft of dark scales.
- **Legs:** Fe-III mostly dark, without pre apical pale band; Ta-II1–5 not banded.
- **Wing:** With three large dark spots on costa (C) and veins R–R1; costa lacking a pre sector pale spot; apex with two small fringe spots.

***An. barbirostris* (Van der Wulp 1984)**

5. An. quadrimaculatus* (Van der Wulp 1984)*:

❖ **Morphology :**

- Anopheles quadrimaculatus is a medium-sized, light-brown mosquito.
- The tips of the wings lack the copper color seen in many other species; instead, the wings are entirely brown and scaly.

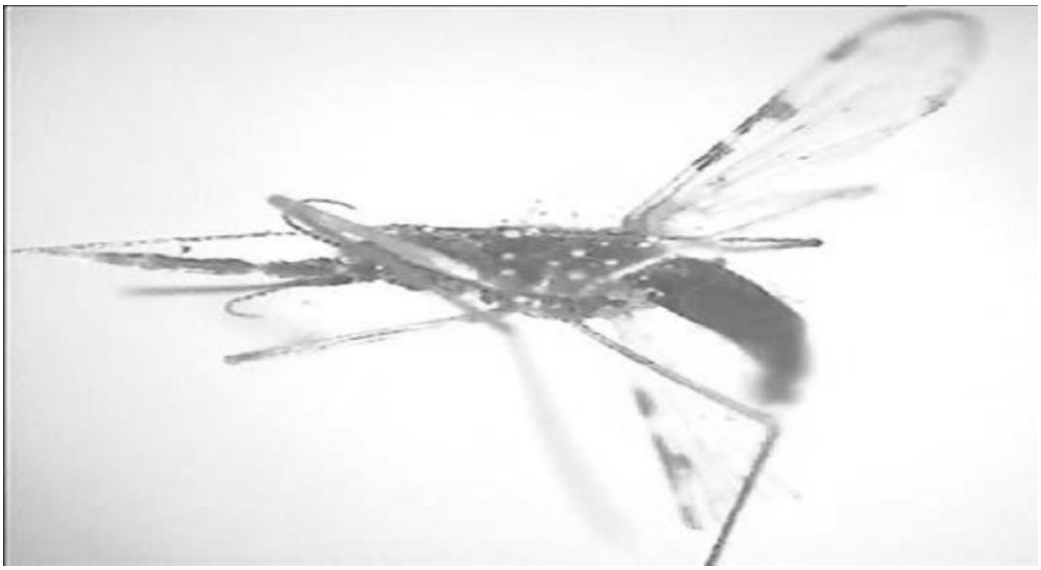
***An. quadrimaculatus* (Van der Wulp 1984)**

- Females have a body length of about 5 mm and a wing length also about 5 mm. Females have a long proboscis and labella with small black setae; palpi are the same length as the proboscis.
- Male have a body length of 5.5 mm and a wing length of 4.5 mm
- The antennae are filiform, and the abdomen is black with many yellow hairs.
- In males the last two joints of the palpi are larger, with many long, brown hairs.

6. ***An. vagus (*****Doenitz 1902):**

❖ **Morphology :**

- Very closely resemblance to *Anopheles subpictus*.
- Sub apical dark band on female palpi much narrower, only about ¼ to 1/5 length of pale apical area; pre humeral dark accessory spot at base of costa
- Dark scales connecting the two portion along inner border of costa; The sub apical dark spot on the costa is usually short



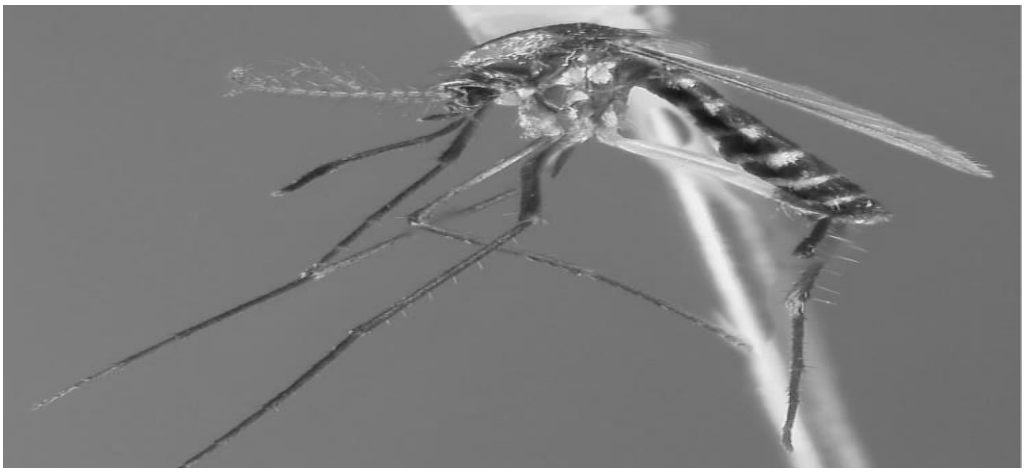
Anopheles vagus **Doenitz 1902**

7. An. gigas (Giles 1901):

❖ **Morphology :**

- A fairly large brown mosquito with conspicuously spotted wings and narrowly banded tarsi.
- **Head**:Vertex largely with erect brown scales

- Antenna about 0.75 length of proboscis; pedicel with mixture of brown and paler scales on mesal, dorsal and lateral surfaces. Labella dark, maxillary palpus slightly shorter than proboscis.
- **Thorax:** Scutum brown laterally, with broad central pale longitudinal stripe consisting of silvery white tomentum and fine golden setae; anterior promontory with erect brownish pale scales medially; scutellum with golden piliform scales.
- **Wing:** humeral cross vein without scales; pale scaling creamy white to yellow, dark scaling dark brown to nearly black.
- **Halte**r: Integument of scabellum pale; pedicel and capitellum dark-scaled.
- **Legs:** Mainly dark-scaled; coxae pale with pale setae; femora narrowly pale at base and less so at apex, mid femur with small dorsal pre apical pale spot; tibio-tarsal and tarsal joints with narrow pale bands, pale scales less distinct or absent at bases of tarsomeres 4 and 5, tarsomere 5 pale at tip.
- Abdomen: Terga brown sterna paler except basomedially; scales absent, setae golden



An. gigas (Giles 1901)

II. ***Aedes:*** **Four species *Aedes aegypti, Ae. albolateralis, Ae. albopictus* and *Ae. vittatus* were recorded from *Aedes*.**

1 ***Aedes aegypti:***

❖ **Morphology :**

- The adult mosquito is a small to medium-sized, approximately 4 to 7 millimeters.
- The adult mosquitoes resemble the Asian tiger mosquito with a slight difference in size and thorax patterns.

- *Aedes aegypti* adults have white scales on the dorsal (top) surface of the thorax that form the shape of a violin.
- Each tarsal segment of the hind legs possesses white basal bands, forming what appear to be stripes.
- The abdomen is generally dark brown to black, but also may possess white scales .

Fig. Aedes aegypti:

2. Ae. albopictus (Skuse 1895):

❖ **Morphology :**

- ***Ae. albopictus is*** less than 10 mm long from end to end with a striking white and black pattern.
- *Aedes albopictus adults* have a white stripe down the middle of the top of the thorax.
- The antennae of the males in comparison to the females are noticeably bushier and contain auditory receptors.
- The maxillary palps of the males are also longer than their proboscis, whereas the females' maxillary palps are much shorter.
- The tarsus of the hind legs of the males is more silvery.
- The proboscis is dark colored, the upper surface of the end segment of the palps is covered in silvery scales.
- The compound eyes are distinctly separated from one another.
- The scute, the dorsal portion of thoracic segment, is black alongside the characteristic white midline.

- The bases of tarsomeres I through IV have a ring of white scales, creating the appearance of white and black rings.
- On the fore legs and middle legs, only the first three tarsomeres have the ring of white scales, whereas tarsomere V on the hind legs is completely white.
- The femur of each leg is also black with white scales on the end of the "knee". The terga on segments II through VI of the abdomen are dark.
- The transparent wings have white spots on the base of the costae.

Fig. Ae. albopictus (Skuse 1895)

3. Ae. vittatus (Bigot 1961):

❖ **Morphology :**

- **Head:** Proboscis dark with median spattering of pale yellowish scales; clypeus with bilateral small patches of narrow white scales; vertex with median stripe of narrow white scales, numerous erect forked scales on vertex and occiput.
- **Thorax:** Mesopostnotum and prespiracular area bare; postspiracular and lower mesepimeral setae present.
- **Scutum:** Acrostichal setae present; 3 pairs of distinct, small, white spots of narrow scales on anterior two-thirds of scutum.
- **Scutellum:** Broad white scales on all three lobes; a few dark scales at apex of mid-lobe.
- **Wing:** Scales mainly dark and narrow on all veins; scattered pale scales on costa.

- **Abdomen:** Tergum I with large median white spot; Tergum II–VII with basal white bands and lateral white curved markings, disparate from the basal bands; segment VIII completely retracted.
- **Legs:** All tibia (I–III) dark, with sub-basal white spot and white band approximately level with basal third of tibia -I, Ti-II, and at mid-point of tibia -III , hind tarsomeres I–IV with basal white bands;

Fig. Ae. vittatus(Bigot 1961)

III. Culex: Genus Culex reported with four species i.*e Cx. quinquefasciatus, Cx. tritaeniorhynchus, Cx.vishnui and Cx. Psedovishnui*

1. Cx. quinquefasciatus (Say 1823):

❖ **Morphology :**

- The adult *C. quinquefasciatus* is a medium-sized mosquito and is brown in colour.
- The body is about 3.90 to 4.20 mm long.
- The main body is brown, the proboscis, thorax, wings, and tarsi are darker than the rest of the body.
- The head is light brown, with the lightest portion in the center.
- The antennae and the proboscis are about the same length, but in some cases, the antennae are slightly shorter than the proboscis.

- The flagellum has 13 segments that may have few or no scales.
- The scales of the thorax are narrow and curved.
- The abdomen has pale, narrow, rounded bands on the basal side of each tergite.

Males can be differentiated from females in having large palps and feathery Antennae.

Fig. Cx. quinquefasciatus (Say 1823):

2. Cx. tritaeniorhynchus (Giles 1901):

❖ **Morphology :**

- **Head:** Proboscis with broad median pale band; vertex with erect brownish scales.
- **Thorax:** Scutum with unicolorous dark scales; acrostichal setae present; pleuron with distinct scale patches; postspiracular scales absent; mesepimeral setae absent; lower mesokatepisternal scales present. **Legs:** Fe-I, II dark anteriorly; Ta-I–III with pale bands.
- **Wing:** Wing dark-scaled; vein R_{2+3} shorter than R_2.
- **Abdomen:** Terga only with basal pale bands.

Fig. Cx. tritaeniorhynchus (Giles 1901)

3. *Cx.vishnui* (Theobald 1901):

❖ **Morphology :**

- **Head:** Erect scales of vertex usually entirely brown, sometimes erect scales in center of vertex slightly pale yellow but not contrasting sharply with dark erect scales on lateral or posterolateral areas.
- **Proboscis:** With a broad pale ring in the middle, the rest completely dark, without scattered pale scales forming streak on ventral or lateral surfaces in basal 0.5mm.

***Fig. Cx.vishnui* (Theobald 1901)**

- Thorax: Anterior 0.7mm of mesonotum, from anterior margin to about the level of wing base usually covered with dark brown scales.
- **Legs:** Anterior surface of hind femur usually without distinct pale stripe or with slightly pale stripe not contrasting with dark scaled area on dorsal surface.
- **Abdomen**: Terga with relatively broad and even basal pale bands.

4. *Cx. Psedovishnui* (Theobald 1901):

❖ **Morphology :**

- **Head**: Color of erect scales in center of vertex pale, creamy or yellow white, contrasting rather sharply with black erect scales on lateral and posterolateral

***Fig. Cx. Psedovishnui* (Theobald 1901)**

- **Thorax**: Scales on anterior 0.7 of mesonotum usually predominantly yellowish white, more or less contrasting with dark scales on posterior 0.3;
- **Legs**: Anterior surface of hind femur with very distinct white stripe from base to near apex.
- **Abdomen**: Terga usually with very narrow basal pale bands which are progressively decreased in width toward posterior segments.
- **Prob**oscis without distinct tuft of setae at base of median pale ring, sometime with a few short setae, not forming a strong tuft.
- Thorax without speculation.

IV. ***Ar. subalbatus* (Theobald 1901):**

❖ **Morphology :**

- **Head:** Male palpus about as long as proboscis; female proboscis laterally compressed and slightly down-turned at tip; palpus long, slender and upturned, three-segmented with the last two segments nearly bare. Eyes separated ventrally by two long rows of scales.
- **Thorax:** Prespiracular setae absent; postspiracular area with scales, seta present or absent; base of small mesomeron more or less even with base of C-III; head scales primarily broad and flat dorsally; acrostichal and dorsocentral setae absent.
- **Wing:** Alula and upper calypter with marginal hair-like scales.

***Fig. Ar. subalbatus* (Theobald 1901):**

***v. Mansonia uniformis*(Theobald 1901):**

- Head: Palpus with apical yellowish scales.
- Thorax: Postpronotum with narrow curved scales; coxae C-I–III not contrasting with pleuron or scutum; scutum with pair of longitudinal greenish stripes, without well-defined round spots.
- Abdomen: III–VII-S mostly pale-scaled; VIII-Te with strong chitinized hooks.
- Legs: Fe-III with approximately five bands of pale scales; Ta-III1–5 pale bands complete posteriorly. Wing: Wing scales broad and asymmetrical, mixed dark and pale.

***Fig. Mansonia uniformis*(Theobald 1901)**

❖ SITE WISE DIVERSITY OF MOSQUITO SPECIES:

Among 16 species, An. culicifacies , *An. barbirostris* , *An. subpictus*, An. gigas *Ae. aegypti, Ae. albopictus, Ae.*vittatus, Cx. quinquefasciatus, Cx.tritaeniorhynchus and *Ar. subalbatus* were constantly distributed in all sites, *An. annularis*, *An. quadrimaculatus An. Vagus, Cx. vi*shnui and *Cx. psuedovishnui* frequently distributed. *Ae. albolateralis* and *Cx. Psedovishnui* moderately, and *Ma. uniformis* sporadically distributed . A significant variation in mosquito density and species richness was observed in the different study sites (Table 2) may be due to the observed differences of breeding sources available, planned and unplanned area of the city and surrounding villages.

Table 2. Site wise diversity of Mosquito species from different localities during Study period

Genus	**Species**	Ashti	Musrshadpur	Kada	Dadegaon	Dhamangaon	Dhanora	Shirapur	Belgaon	Doithan	Distribution Pattern (%)
Anopheles	*An. culicifacies*	*	*	*	*	*	*	*	*	*	100%
	An. annularis	*	*	*	*	*	*	-	*	*	88.9%
	An. barbirostris	*	*	*	*	*	*	*	*	*	100%
	An. quadrimaculatus	*	*	*	*	*	*	*	*	-	88.9%
	An. vagus	*	*	*	*	*	*	-	*	*	88.9%
	An. subpictus	*	*	*	*	*	*	*	*	*	100%
	An. gigas	*	*	*	*	*	*	*	*	*	100%
Aedes	*Aedes aegypti*	*	*	*	*	*	*	*	*	*	100%
	Ae.albopictus	*	*	*	*	*	*	*	*	*	100%
	Ae. vittatus	*	*	*	*	*	*	*	*	*	100%
Culex	*Cx. quinquefasciatus*	*	*	*	*	*	*	*	*	*	100%
	Cx.tritaeniorhynchus	*	*	*	*	*	*	*	*	*	100%
	Cx.vishnui	*	*	*	*	*	*	-	-	*	77.8%
	Cx. Psedovishnui	*	*	*	*	*	*	-	-	-	66.7%
Armigers	*Ar. subalbatus*	*	*	*	*	*	*	*	*	*	100%
Manasonia	*M. uniformis*	*	*	*	-	*	-	-	*	-	55.6%

In previous study conducted in different areas of Maharashtrastate, Sathe and Girhe (2001) observed composition of nine species belonging to three genera *Culex*, *Anopheles* and *Aedes* in Kolhapur district. Shinde *et al.,* (2011) identified three medical important genus *Aedes, Anopheles* and *Culex* in Parbhani district of Marathwada region, while this study identifies four medically important genus and eight vector species. Jaid *et al.,* (2011) observed high density of *Anopheles* species, also reported the genus *Mansonia* sporadically from Jalna district of Marathwada region which is similar to this study

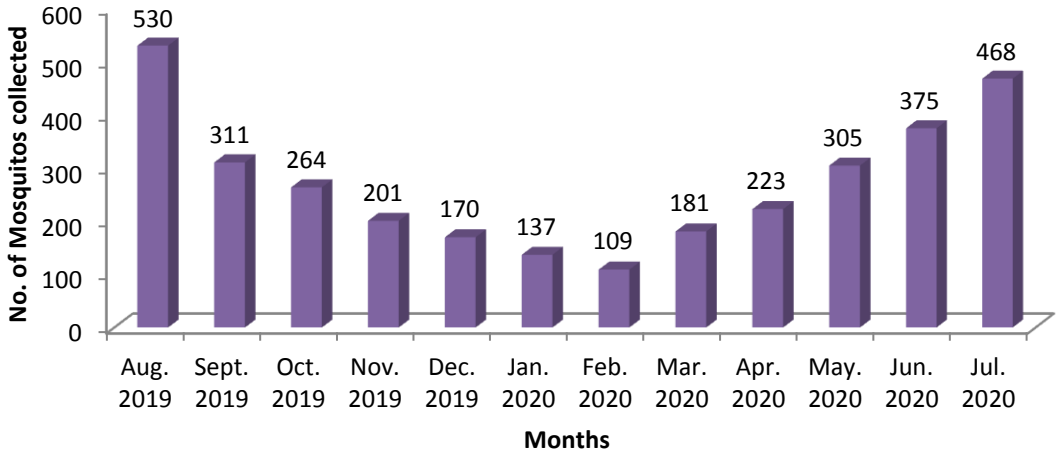
A total number of 3274 mosquitoes were collected from nine different localities (i.e. Ashti, Murshadpur, Kada, Dhanora. Daegaon Dhamangaon, Doithan, Belgaon, and Shirapur) which covers most of the study area (Table 3). The habitat types found during this survey included water storage tanks, plastic vessels, metal vessels, ceramic vessels, barrels, a tucker box, tires, coconut shell, temporary pools, ditches and drainage (gutters). A diverse collection of Mosquitos reveals the presence of sixteen species belonging to five genera i.e. *Anopheles, Aedes, Culex Armigeres* and *Mansonia.* *Anophe*les genus dominated with seven species i.e, ***An. culicifacies, An. subpictus, An. annularis, An. barbirostris, An.quadrimaculatus An. vagus, and An. gigas.***. Genus *Culex* reported with four species i.*e Cx. quinquefasciatus, Cx. tritaeniorhynchus, Cx. vishnui and Cx. Psedovishnui. Aedes aegypti,* and *Ae. vittatus*. These three species were recorded from genus *Aedes* whereas *Armigeres* and *Mansonia* was representing only one species each i.e. *Ar. subalbatus* and *M. uniformis*. The diversity of mosquitoes in these localities showed the availability of resting places for males, and favorable ambient factors like temperature and rainfall. Month wise diversity of collected Mosquito species from different localities during study period is given in table No.2. According to Harbache (2013) a total of 3539 species of mosquitoes belonging to 112 genera are found on this earth. Pandian R. S. (1998) also recorded same results in an urban area in Tamilnadu. Sathe and Girhe (2001) also studied Biodiversity of mosquito in Kolhapur, Maharashtra.

Month wise collected Mosquito species from different localities during study period are shown in table No.2. The habitat types found during this survey included water storage tanks, plastic vessels, ceramic vessels, metal vessels tucker boxes, barrels, tires, coconut shell, pools, ditches and drainage etc.

Table 3. Month wise collected Mosquito species from different localities

Sr. No.	Location	Aug. 2019	Sept. 2019	Oct. 2019	Nov. 2019	Dec. 2019	Jan. 2020	Feb. 2020	Mar. 2020	Apr. 2020	May 2020	June 2020	Jul 2020	Total
1	Ashti	92	44	48	35	32	24	19	38	43	48	56	68	**547**
2	Murshadpur	62	36	37	24	25	16	13	18	33	52	68	77	**461**
3	Kada	82	52	46	32	29	22	20	33	35	41	49	67	**508**
4	Dadegaon	58	33	31	23	21	15	11	23	26	33	32	37	**343**
5	Dhamangaon	62	39	40	26	24	16	10	15	21	38	51	56	**398**
6	Dhanora	67	38	36	34	14	14	10	19	28	35	47	52	**394**
7	Shirapur	28	22	10	8	8	9	11	13	15	18	17	32	**191**
8	Belgaon	38	26	9	9	8	10	8	12	13	19	27	43	**222**
9	Doithan	41	21	7	10	9	11	7	10	9	21	28	36	**210**
	Total	**530**	**311**	**264**	**201**	**170**	**137**	**109**	**181**	**223**	**305**	**375**	**468**	**3274**

Graph 1. Month wise Mosquito species collected

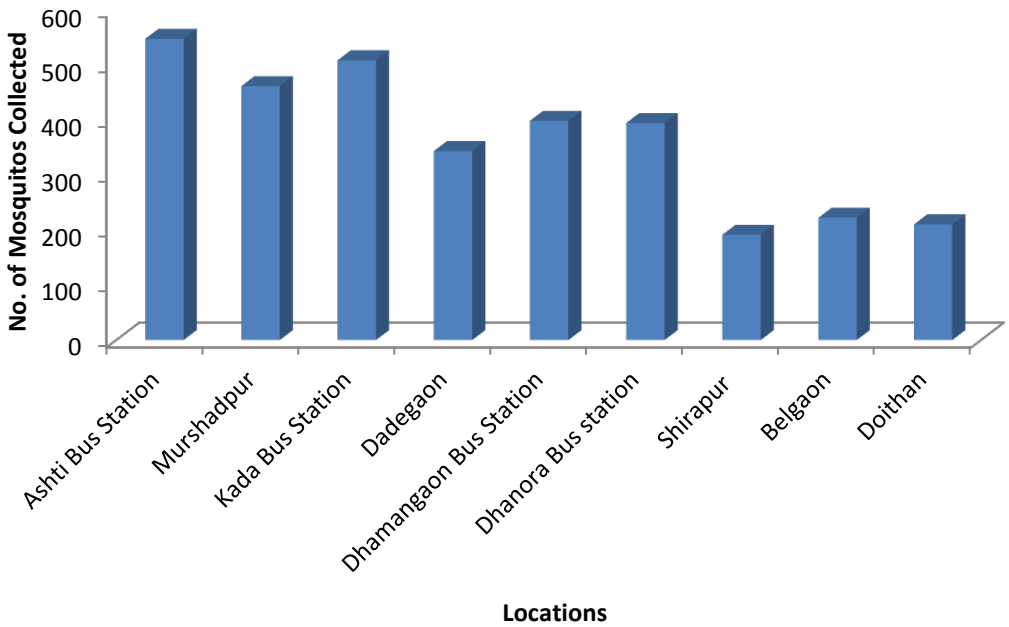


Maximum number mosquito species were collected from Ashti (547) and Kada (508) and lowest number of mosquitos was collected from Shirapur (191) and Doithan (210) villages (Graph 2). A significant variation in mosquito density and species richness was observed in the different study sites (Table 3) may be due to the observed differences of breeding sources available, planned and unplanned area of the city and surrounding villages. Pawar et.al (2016)

also collected and studied Distribution and Diversity of Mosquito Larvae from Kopargaon Teshil, Dist. Ahmednagar (M.S.) India

Maximum Population dynamics of Mosquitos was observed during monsoon and minimum in summer months. Maximum number of mosquitos were collected during the month of August (530), September (311) 2019 and July 2020 (468) Whereas minimum number of mosquitos were collected during the month of January (137) February (109) and march (181)2020 (Table 1). The highest population of mosquito species observed in the rainy season when the maximum and minimum temperature was recorded 22^0C to 28 ^{0}C and average humidity was (83%), and rainfall was 599.4mm in the month of September. While minimum density of mosquito species was observed in the summer i.e. in the month of February, when the maximum and minimum %; temperature was 41^0C/21^0C, average humidity was 36 % and rainfall recorded was 2.3 mm. (Table 1).

Graph 2. Location wise contribution of Collected Mosquitos



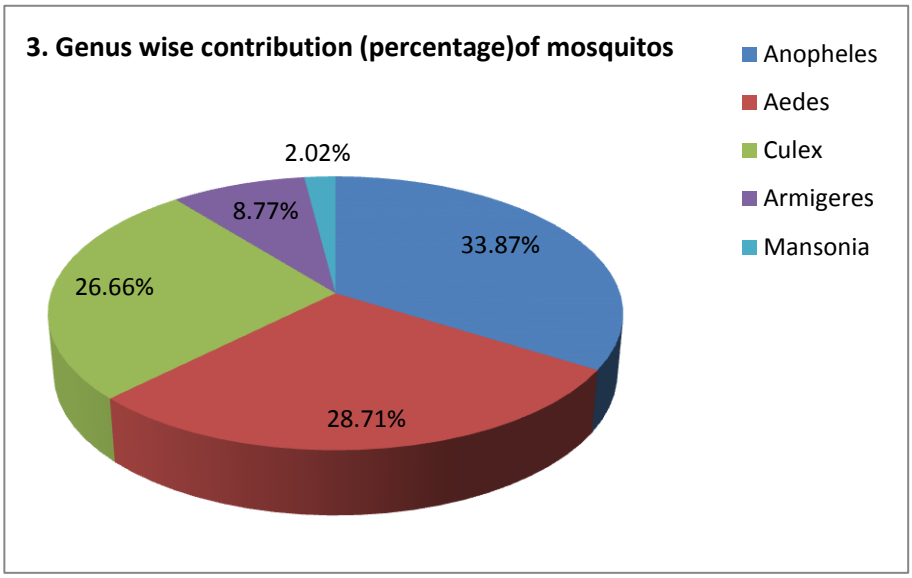
Thus the maximum and minimum temperature, humidity and rainfall is an ideal condition for the proliferation of mosquito species. Environmental parameters around these levels can be used as early warning for the outbreaks of mosquito population which is directly related to mosquito vector borne diseases. These finding indicated that in winter the diversity is

highest because of stagnant water bodies. Sanjay Karlekar, Raymond Andrew (2015) also recorded same results as total number of individual observed are more in rainy season followed by winter and summer. They studied Mosquito diversity and vector species status in and around Nagpur city of Maharashtra state, India. Rudha and Chandra (2008) reported a collection of 2306 mosquitoes belonging to 14 species and 6 genera in three seasons from four villages of Dooars forest in West Bengal, India and also reported that the number of mosquitoes were more in rainy and in winter season. Similary, Amala and Aunradha (2011) noticed the presence of 505 mosquitoes belonging to 4 genera (Anopheles, Aedes, Culex and Armigers) in villages at the foot hill of Sirumalai hills, Dindigul District, Tamilnadu, India.

Table 4. Genus wise Contribution of Collected Mosquitos

Genus	Aug. 2019	Sept. 2019	Oct. 2019	Nov. 2019	Dec. 2019	Jan. 2020	Feb. 2020	Mar. 2020	Apr. 2020	May. 2020	Jun. 2020	Jul. 2020	Total	Percentage
Anopheles	123	95	91	64	56	51	42	74	92	130	133	158	**1109**	33.87
Aedes	157	102	79	61	60	44	31	49	52	79	97	128	**939**	28.71
Culex	174	82	65	47	35	29	26	43	60	69	109	134	873	26.66
Armigeres	71	26	23	23	19	13	10	11	12	18	26	35	287	8.766
Mansonia	5	6	6	6	0	0	0	4	7	9	10	13	66	2.016
Toal	**530**	**311**	**264**	**201**	**170**	**137**	**109**	**181**	**223**	**305**	**375**	**468**	**3274**	**100**

A total of 3274 adults were collected from different sites and in different season. The collected mosquitoes belonged to five genera (*Aedes, Anopheles, Culex, Armigeres* and *Mansonia* and sixteen species. Overall, Genus wise Contribution (percentage) of Mosquitos was dominated by Anopheles *sp.* (33.87%), followed by *Aedes sp*. (28.71%), *Culex sp*. (26.66%), *Armigeres s*p. (8.77%) and *Mansonia Sp* (2.02%) (Graph 3). E. L. Jaid et al (2011) also onserved same results while studying Diversity of Mosquitoes in Jalna urban, Maharashtra State, India. Percentage density of different genera was found as-*Anopheles*-64.71%; *Aedes*- 19.61%; *Culex*-11.61% and *Mansonia*-4.05%.



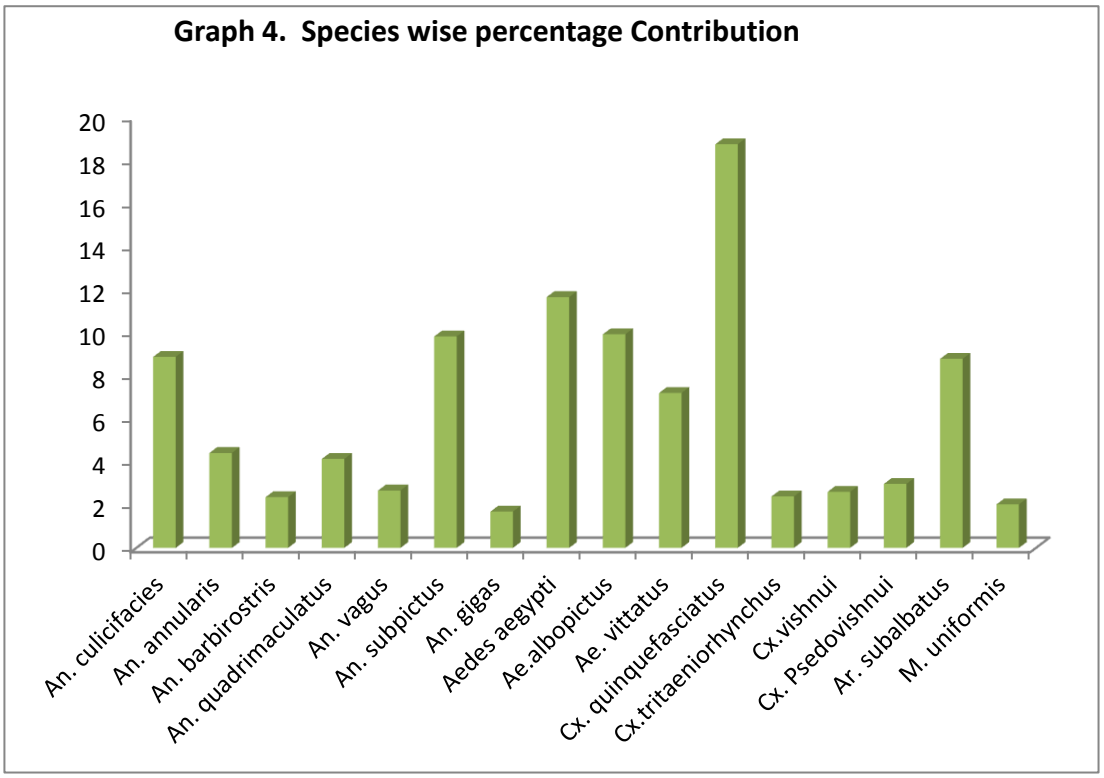
The maximum (158) population of *Anaphele* was recorded in July and it was observed lowest (42) in the month of February. *Aedes* shows very less (31) collection in February maximum (157) August due to availability of much more breeding beds, optimum temperature and humidity for their surveillance. Percentage of *Culex* shows maximum (174) in August and minimum (26) in February. Maximum population of ***Armigeres*** *subalbatus* was recorded during August and Minimum in the month of February. Whereas maximum (13) population of ***Mansonia*** *uniformis* recorded during the month of July (Table 5). Shinde et.al (2011) also studied Vector mosquito diversity in association with environmental factors.

The most dominant species collected from study areas were ***Culex*** *quinquefasciatus* (18.7%) followed by *An. subpictus* (9.8%) , *Aedes aegypti* (9.32%) and *An. culicifacies (8.86 %) and* the least collected species was ***Anopheles*** *gigas (1.68%),* ***Mansonia*** *uniformis (2.02%),* ***Anopheles*** *barbirostris(2.35%) and Cx.tritaeniorhynchus(2.38%).* (Graph 4).

Table 5. Number of collected Mosquito species from different localities during Study period

Genus and Species	Aug. 2019	Sept. 2019	Oct. 2019	Nov. 2019	Dec. 2019	Jan. 2020	Feb. 2020	Mar. 2020	Apr. 2020	May. 2020	Jun. 2020	Jul. 2020	**Total**	**Cont. %**
Anopheles														
An. culicifacies	23	16	21	12	17	18	13	26	31	38	33	42	290	8.86
An. annularis	6	8	11	7	9	11	7	11	11	21	21	21	144	4.4
An. barbirostris	4	10	3	0	0	0	5	9	12	15	9	10	77	2.35
An. quadrimaculatus	18	9	6	8	11	6	8	8	11	18	15	17	135	4.12
An. vagus	11	11	7	8	6	0	0	4	9	13	6	12	87	2.66
An. subpictus	55	36	39	26	13	16	9	11	12	16	41	47	321	9.8
An. gigas	6	5	4	3	0	0	0	5	6	9	8	9	55	1.68
Total	123	95	91	64	56	51	42	74	92	130	133	158	**1109**	**33.87**
Aedes														
Aedes aegypti	73	41	34	22	18	12	10	17	19	30	47	58	381	11.63
Ae.albopictus	54	36	25	21	20	16	9	16	21	29	32	44	323	9.90
Ae. vittatus	30	25	20	18	22	16	12	16	12	20	18	26	235	7.18
Total	**159**	**102**	**79**	**61**	**60**	**44**	**31**	**49**	**52**	**79**	**97**	**128**	**939**	**28.71**
Culex														
Cx. quinquefasciatus	132	57	46	33	26	27	18	23	34	37	81	99	613	18.7
Cx.tritaeniorhynchus	19	10	7	8	0	0	0	4	3	8	10	9	78	2.38
Cx.vishnui	11	9	5	0	0	0	4	6	14	15	8	13	85	2.6
Cx. Psedovishnui	12	6	7	6	9	2	4	10	9	9	10	13	97	2.96
Total	**174**	**82**	**65**	**47**	**35**	**29**	**26**	**43**	**60**	**69**	**109**	**134**	**873**	**26.66**
Armigeres														
Ar. subalbatus	**71**	**26**	**23**	**23**	**19**	**13**	**10**	**11**	**12**	**18**	**26**	**35**	**287**	**8.77**
Mansonia														
M. uniformis	**5**	**6**	**6**	**6**	**0**	**0**	**0**	**4**	**7**	**9**	**10**	**13**	**66**	**2.02**
Total	**530**	**311**	**264**	**201**	**170**	**137**	**109**	**181**	**223**	**305**	**375**	**468**	**3274**	**100**

The density study of Anaphele shows 25.7 % in September and highly recorded 54.56 % in March. Aedes shows very less collection i.e. 11.54 % in May maximum 57.63 % during November due to availability of much more breeding beds, optimum temperature and humidity for their surveillance. Percentage of Culex shows maximum in September and minimum in November i.e. 58.72%.



❖ MOSQUITO BORNE DISEASES:

Vector-borne diseases are human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors. Vectors are living organisms that can transmit infectious pathogens between humans, or from animals to humans. Many of these vectors are bloodsucking insects, which ingest disease-producing microorganisms during a blood meal from an infected host (human or animal) and later transmit it into a new host, after the pathogen has replicated.

Mosquitoes are the most common disease vectors worldwide. They are one of the deadliest Insects in the world. Nearly 700 million people get a mosquito-borne illness each year resulting in over one million deaths.

Worldwide urbanization, industrialization and deforestation are growing phenomenon. It shows adverse effect on climate change (Gubler, 1998 a; Epistan, 1998; Gratz, 1999; Reiter, 2001). Globally in the last three decades number of mosquito born diseases remerged and resulted number of deaths (WHO, Reiter, 2001). In that phenomenon malaria is leading mosquito born disease in tropical and subtropical countries. It is also a burning problem of developing countries, only malaria kills a child every 40 second globally. According to WHO 300-500 million people in Africa and South Sahara between 1.1 to 2.7 million people are killed either with malaria or in contribution with other disease (Joshi et al., 2006). In India malaria is common killer in Kolkata (Pramanik, 2006), North East region (Nagpal and Sharma, 1995), Orissa (Sahu et al., 2008) but now it is widely spread in all the states of India. Simultaneously Chikungunia rported from different states since 2005, it is not reported death but loss the much more amount for recover. And researchers said it is due to climate change (Episton, 1998b; Gubler, 1998; Reiter, 2001; Shinde and Makne, 2011). The year 2008 and 2009 recorded 4500 cases with 935 and 754 deaths respectively (www.pdfmachine.com and NVBDC web). Same time Maharashtra contributes 164 and 106 deaths (NVDBP web).

The burden of these diseases is highest in tropical and subtropical areas, the burden of these diseases is highest in tropical and subtropical areas, and they disproportionately affect the poorest populations. Since 2014, major outbreaks of Dengue, Malaria, Chikungunya, Yellow fever and Zika have afflicted populations, claimed lives, and overwhelmed health systems in many countries. Other diseases such as Chikungunya, Leishmaniasis and Lymphatic filariasis cause chronic suffering, life-long morbidity, disability and occasional stigmatization

List of vector-borne diseases, due to Mosquitos:

The following table showing list of vector-borne disease, due to the mosquitos vector by which it is transmitted. The list also illustrates the type of pathogen that causes the disease in humans.

Vector		**Disease caused**	**Type of pathogen**
Mosquito	*Aedes*	Chikungunya	Virus
		Dengue	Virus
		Lymphatic filariasis	Parasite
		Rift Valley fever	Virus
		Yellow Fever	Virus
		Zika	Virus
	Anopheles	Lymphatic filariasis	Parasite
		Malaria	Parasite
	Culex	Japanese encephalitis	Virus
		Lymphatic filariasis	Parasite
		West Nile fever	Virus

Recently in India mosquito borne diseases have revealed as a big threat to public health specially disease like Dengue fever, yellow fever, Malaria and Chikungunya. Malaria is a parasitic infection transmitted by Anopheline mosquitoes. It causes an estimated 219 million cases globally, and results in more than 400,000 deaths every year. Vector-borne diseases

account for more than 17% of all infectious diseases, causing more than 700 000 deaths annually. Dengue is the most prevalent viral infection transmitted by Aedes mosquitoes. More than 3.9 billion people in over 129 countries are at risk of contracting dengue.

Anopheles mosquitoes are responsible for spreading of Malaria, *Aedes* mosquitoes are vectors for Chickungunya and Dengue fever, *Culex* mosquitoes are vectors for viral Arthritis and Bancroftain filariasis whereas Mansonia are vectors for Malayan filariasis. Bhargava, A. and Chatterjee, B. (2007), Das, N.G., D. Goswami and B. Radha (2007) There is acute need of action to reduce the breeding sites of mosquitoes and public awareness regarding mosquitoes and the diseases caused by them.

All over India female Anopheles is main malaria vector, Aedes for dengue, chikungunia and Culex for elephantiasis keeping these in view the present entomological survey is conducted during 2009 at Parbhani (M. S.) regarding environmental factors. Marathwada region has poor health, transport and irrigation facilities. Parbhani is adjoining district of two geographical region i.e. Marathwad and Vidharba. It is well known place for education and agricultural development due to its good irrigation area. The scenario of Parbhani urban shows that there is no proper development of city, low sanitation facilities, poor road constructions and sewage mismanagement. It provides abundant breeding sites for mosquito. Particularly in post monsoon season, there is more chance to abundant survivals of Anopheles and Aedes in Parbhani because of abundant breeding beds and humid environment; in summer season more activeness of Aedes due to suitable environmental condition viz. temperature and optimum humidity. This survey and monitoring work was carried out in 10 localities. These spots were chosen from the view of residential, educational and public places. Here there were more chances of the transmission of mosquito borne diseases.

Mosquito borne diseases are widespread in over 150 countries around the world. Mosquito related diseases infect over 500 million people resulting in 1 million deaths approximately. Recently in India mosquito borne diseases have revealed as a big threat to public health specially disease like Dengue fever, yellow fever, Malaria and Chikungunya. These diseases can turn out to be deadly if the symptoms are not detected well on time.

Malaria is caused by the parasite Plasmodium transmitted by Anopheline mosquitoes.. Major symptoms of Malaria are shivering, unstructured pimples on the skin, sweating, headache, nausea, vomiting, abdominal pain, diarrhoea, muscle pain, bloody stools, etc. The body temperature might rises as high as 105 degree F, which is accompanied by severe headache and body aches.

Dengue virus is transmitted by female mosquitoes mainly of the species Aedes aegypti and, to a lesser extent, Ae. albopictus. It is also known as the backbone fever. Symptoms of Dengue include headache, high fever, muscle pain, join pain, rashes, etc. It can further lead to excessive bleeding in severe cases, which can be life threatening.

Chikungunya is a viral disease transmitted to humans by infected mosquitoes. It is caused by the chikungunya virus (CHIKV). Its infection causes fever and severe joint pain. Other symptoms include muscle pain, joint swelling, headache, nausea, fatigue and rash.

Yellow fever is a serious, potentially deadly flu-like disease spread by mosquitoes. It's characterized by a high fever and jaundice. Jaundice is yellowing of the skin and eyes, which is why this disease is called yellow fever. This disease is most prevalent in certain parts of Africa and South America.

Elephantiasis is also known as lymphatic filariasis. It's caused by parasitic worms, and can spread from person to person through mosquitoes. Elephantiasis is the enlargement and hardening of limbs or body parts due to tissue swelling. It is characterised by edema, hypertrophy, and fibrosis of skin and subcutaneous tissues, due to obstruction of lymphatic vessels. It may affect the genitalia.

❖ AWARENESS AND PRACTICES REGARDING MOSQUITO BORNE DISEASES:

Mosquitoes have worldwide distribution being found throughout the tropic and temperate region. In recent years, mosquito borne diseases have emerged as serious public health problem in countries of south East Asia region. Earlier the mosquito borne diseases were mainly restricted to urban and sub urban areas of country but now it spread in rural area, because of the availability of favorable breeding sites of disease vectors. Recently in India, vector borne disease have revealed as a serious public health issue. Especially diseases like Dengue fever, Malaria and Chikungunya etc.

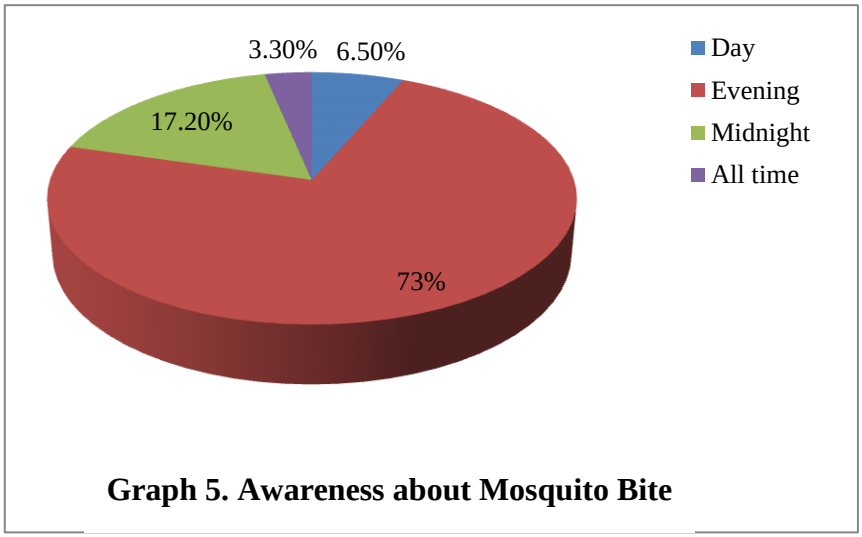
National vector borne disease control program (NVBDCP) under the aegis of National Rural Health Mission includes preventions and control of mosquito borne disease. People's awareness and knowledge play important role in controlling vector borne diseases. In spite of social media and educational things, community participation still far below the expectation. Actually community involvement completely depends on individual knowledge, awareness and attitude towards diseases. With this background the study was conducted to determine people's perception about mosquito and their attitude towards preventions of diseases from Ashti taluka of Beed district.

Survey was done with the help of pre-designed and pre-tested questionnaire during study period from August 2019 to July 2020 to spread the knowledge, awareness and practices regarding mosquito borne diseases. It was conducted in selected areas. To collect relevant data, Simple random sampling method was used. The sampling was random there were no any special criteria. We conducted a study among 695 people about how much people are aware about mosquito related problems, how it has generated and what are the ways by which they can approach government to avoid it.

- **Awareness about Mosquito Bites:**

A survey was conducted on awareness regarding time of mosquito bite. It was shown that, 73% population are aware that mosquito bites only at evening (6-8 pm.) rest of 17.20% people thinks that at midnight only. Few people i.e. 3.30% and 6.5% know that mosquito can bite whole day and on day light respectively.

Awareness about Mosquito Bite	Respondent	%
Day	45	6.5
Evening	508	73
Midnight	119	17.20
All time	23	3.30
Total	695	



Graph 5. Awareness about Mosquito Bite

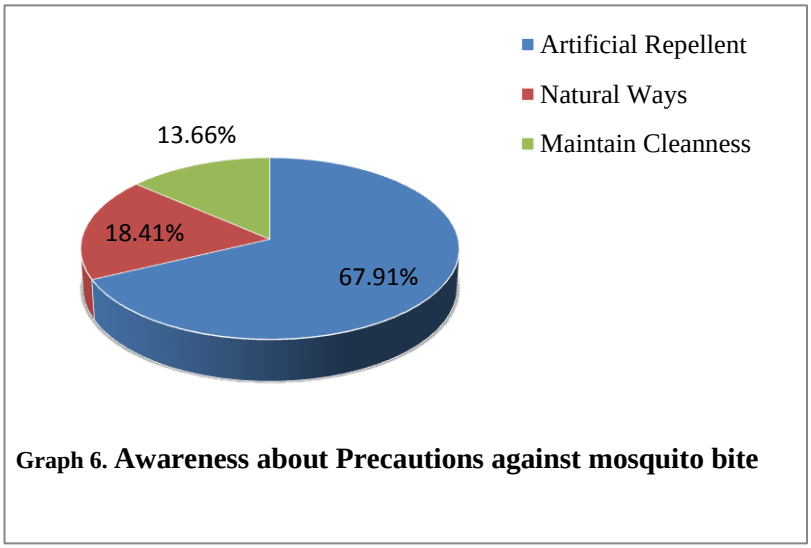
Shinde et.al. (2019) reported that, 73% population are aware that mosquito bites only at evening (6-8 pm.) rest of 17.20% people thinks that at midnight only. Few people i.e. 3.30% and 6.5% know that mosquito can bite whole day and on day light respectively. Potter et al. 2016 reported majority of individuals across WA were bitten at home (76.9%), while 48.6% reported being bitten during recreational activities and 8.9% at work. Niraj Panditet al. 2010 reported almost 99% population had knowledge about breeding places of mosquito, but poor knowledge about biting time 20%. Heymann D. L, 2004reported according to World Health Organization (WHO), Aedes mosquitoes usually bite during the day. Thus based on results of present study and findings of previous researchers indicates that timing of mosquito bites may differ species wise and also geographically.

- **Awareness about Precautions against mosquito bite:**

There are many standard awareness programmes and precautions suggested by WHO against mosquito bite which can prevent serious illness to people. People have adapted different methods to combat it. The present study survey shows 67.91% population of survey i.e. 472 respondents (Table 3) thinks that the artificial repellent can help them to avoid mosquito bite, 18.41% thinks that some of the natural ways can protect them from mosquito bite and very

small population i.e. 13.66% believes that managing breeding beds and cleanliness can be one of the precaution against mosquito bite .We found in our survey that awareness about standard precaution is not prevalent among people; they are more influenced by one another for using methods as precaution against mosquitoes.

Awareness about Precautions against mosquito bite	Respondent	%
Artificial Repellent	472	67.91
Natural Ways	128	18.41
Maintain Cleanness	95	13.66
Total	695	



Graph 6. Awareness about Precautions against mosquito bite

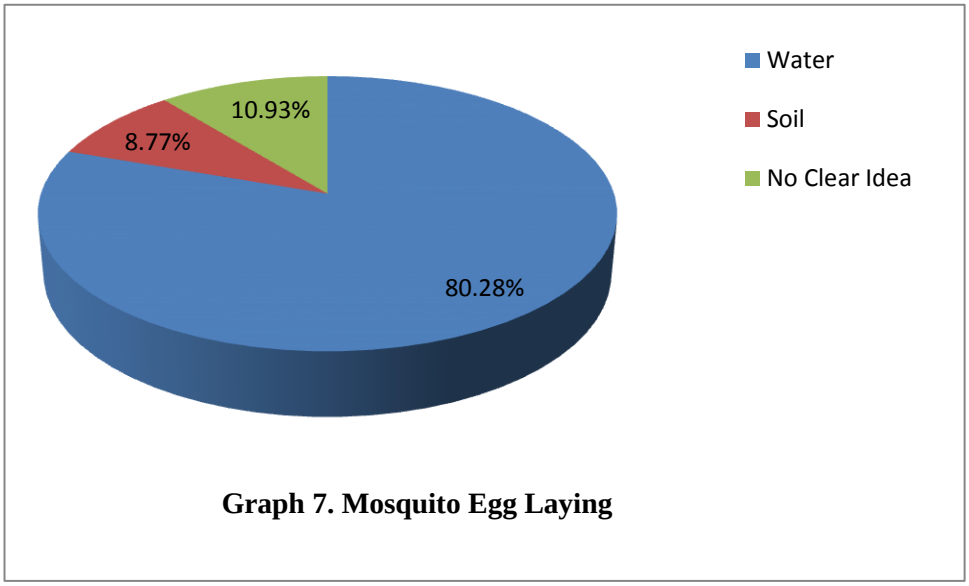
Results of present studies reconfirmed with findings of of Niraj Pandit et al. 2010 are different who reported 39% of households were using mosquito net, 57% mosquito coil while only 10% used insecticide treated bed net as protection against the bite. Almost 97% of study participants were using either one or other personal protective measures. The commercial products like coil, repellent and mat were used more among literate households compared to illiterate families. Snehlatha K. S. 2003 reported 99% and 73% of urban and rural respondents from Pondicherry were found to use some personal protection against mosquito bites. The knowledge and use of personal protective measures had significant association with literacy status (odds ratio=2.32). Literate people were using more commercial products than illiterate. Babu B. V. 2007 reported from Orissa 99% of urban households, 84% of rural households were using at least one measure against mosquito bites and 76% of urban while 58% of rural household using untreated bed net. Boratneet al. 2010 found total 1023 (61.11%) respondents

knew about chemical measures and 348 (20.79%) about environmental measures as the methods for prevention and control of mosquito-borne diseases while 103 (21.24%) male and 241 (20.27%) female respondents did not know about any prevention and control measures. Shinde et.al (2019) shows 66% population of survey i.e. 577 respondents (Table 3) thinks that the artificial repellent can help them to avoid mosquito bite, 18% thinks that some of the natural ways can protect them from mosquito bite and very small population i.e. 16% believes that managing breeding beds and cleanliness can be one of the precaution against mosquito bite. Almost 97% of study participants were using either one or other personal protective measures.

- **Awareness about Mosquito egg laying:**

The present survey showed that more than 80% population are aware clearly that mosquito lay eggs only in water, only few i.e. 8.77% thinks that they can lay eggs on soil as well but there are 10.93% people who don't have clear idea about where actually mosquitoes lay eggs .

Mosquito egg laying	Respondent	%
Water	558	80.28
Soil	61	8.77
No Clear Idea	76	10.93
Total	695	



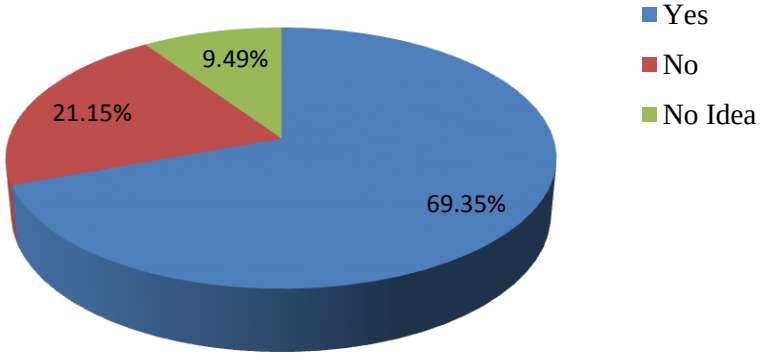
Graph 7. Mosquito Egg Laying

Results of present study are similar with findings of Nanjesh K. S., 2017 who reported 86% of the population thought polluted water as a mosquito breeding place and 76% of them had an idea about growth of mosquito larvae in water. Patel et al. 2011 found 54.2% of the study subjects believed that mosquitoes breed in polluted water. Boratne et al. 2010 when asked regarding mosquito breeding places it was found 290 (59.79%) male and 726 (61.06%) female respondents knew that stagnant water is the breeding place for vectors followed by ditches and ponds in the vicinity. He further reported only about 4% of the respondents stated coconut shells as one of the breeding places for vectors while about 2% respondents knew old tyres as breeding places of mosquitoes. Shinde et al. recorded that most of the population 88% are aware clearly that mosquito can lay eggs only on water, only few i.e. 6% thinks that they can lay eggs on soil as well but there are 6% people who don't have clear idea about where actually mosquitoes lay eggs. Niraj Panditet.et al. 2010 found 20% of studied population still had myths that garbage was the breeding place for mosquito. Sharma S. K. et al.1993 stated majority of individuals in Bastat district of Madhya Pradesh did not know about mosquito breeding places

5. Awareness regarding Dry day celebration:

The present investigation shows that 69.35% population are aware about dry day but they didn't follow dry day and 9.49% population have no idea about it means near about 80% population didn't follow dry day concept. Only 21% celebrate the dry day. Nanjesh et al. 2017 reported43% of study subjects flavored covering containers and 32% preferred scrubbing of water containers once a week for intra-domestic anti larval activities. Joshi and Banjara, 2008 studies from Nepal revealed 66.7% and 48.1% of respondents reported removal of the collected water from ditches and spraying insecticides can control mosquito borne diseases. It is imperative for every household that once a week observes as "dry day" where all the tanks, utensils and pots are emptied and cleaned. Shinde et.al (2019) shows that 60% population are aware about dry day but they didn't follow dry day and 10% population have no idea about it means in all 70% population didn't follow dry day concept. Only 30% celebrate the dry day.

Dry day celebration	Respondent	%
No	482	69.35
Yes	147	21.15
No Idea	66	9.49
Total	695	



Graph 8. Dry day celebration

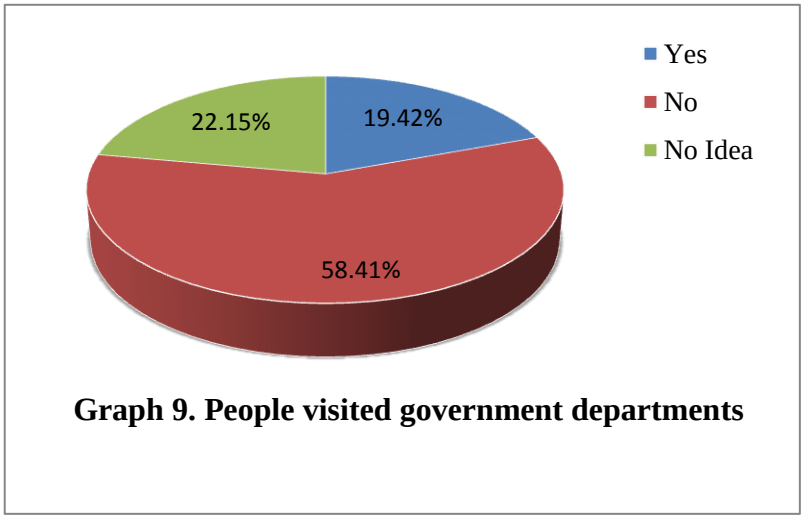
6. People visited government departments:

We found that approximately 58% never visited government departments regarding mosquito problem and 22% people don't have any idea about such certain government of departments which can help them out regarding the problem, only 19% people were aware and approached government department regarding the same problem. The similar observations reported by Nanjesh et al. 2017 who observed48.5% subjects said health authorities didn't come for active surveillance, 41.5% peoples visited general practitioner for consulting on their health issues. Patel et al. 2011 found in Rajkot city 67.8% subjects visited private general practitioner for consulting on their health issues.

Niraj Pandit et.al. 2010 reported major source of mass knowledge about mosquito bite prevention was television (77.5%) followed by newspapers & magazines (35%). It was observed that television was the main source of awareness for the community followed by newspapers, radios, friends and advertisements. It was shocking reported that doctor or health staffs were not mentioned as the source of knowledge. [14] Boratne et al. 2010 found about 75.93% of the study population were aware about mosquito borne diseases through television followed by health care providers (16.43%) and newspapers (12.84%) and only 8.18% through radio. [19] Joshi and Banjara, 2008 study from Nepal showed that respondents labelled radio (58.1%) and television (25.4%) as the major media source for information regarding malaria. Shinde et. al (2019) observed approximately 51% never visited government

departments regarding mosquito problem and 24% people don't have any idea about such certain government of departments

Whether people visited government departments	Respondent	%
Yes	135	19.42
No	406	58.41
No Idea	154	22.15
Total	695	



Graph 9. People visited government departments

CONCLUSION:

The study of mosquitoes providing a primary checklist as an investigation which is necessary to assess the distribution, diversity and density of mosquitoes. It is inferred from the data obtained that different season, localities and available major breeding sources have different effects on mosquito species diversity and abundance. The mosquito species present in this area predispose the inhabitants of this area to risk of infections of mosquito borne diseases. Obtained diversity of mosquito and vector species are not only helpful to the study of mosquito biodiversity in India, but will also help in formulating strategies for the control over mosquito borne diseases.

The present study showed that people from Beed district are limitedly aware about mosquito biting time, as mosquito bites differ species wise and also geographically. Survey also high lightened awareness regarding mosquito eggs laying habitat as most of the people have good knowledge but need to clear confusion of the same. From the survey study, it also understood that regulatory methods implemented by people as control strategies were not well

planned. Most of the people fully relied on repellent and chemical insecticides to get rid of mosquito biting. So, to cope with all such situations it become mandatory that government should undertake active plans to inculcate the habit of cleanliness in surrounding area. Results of this survey also indicate that approximately 50% of population have not visited government department regarding mosquito problems and also more than 70% of people are not aware about the concept of dry day.

RECOMMENDATION AND SUGGESTION:

Basic information related to prevention and control measures of mosquitoes should be taught in schools. Frequent awareness programmes should be conducted by stakeholder, Community volunteers and NGO's to maximize community awareness

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Principal Investigator
(Dr. B. S. Khaire)

Principal
(Dr. H. G. Vidhate)