CHAPTER- I

INTRODUCTION
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Mosquitoes are the most harmful haematophagous insects and directly affect the welfare of mankind. Apart from biting nuisance, mosquitoes are also responsible for transmitting disease to man and animals. Some species of Anopheles act as vector of malaria (Bruce Schwatt, 1985) and also Filariasis (Sasa 1976). Various species of Culicine mosquitoes are involved in the transmission of Filariasis, Japanese Encephalitis, Yellow Fever and Dengue (Manson-Bahr and Bell, 1987). Chikungunya virus disease, caused by a mosquito borne alphavirus is endemic to Africa and Southeast Asia (Laras et al., 2005). More than 3000 species of mosquitoes have been described world wide with several additional subspecies and approximately 150 occur in temperate North America. The ubiquitous insect occurs at elevations of 4300 meters in Kashmir and 1160 meters below sea level in gold mines of South India, and are abundant in species in the tropics, and almost unbelievably large swarms of them occur in the Arctic (Hardwood and James 1979).

Despite of array of control measures taken to suppress the mosquito population the latter flourish unabatedly to take heavy toll of human life every year, particularly in developing countries having poor socio-economic conditions. About 2400 million people i.e. about 40% of world’s population in more than 90 countries are at risk of malaria. WHO’s recent estimates of the annual number of clinical cases vary between 300-500 million and 1.5-2.7 million death case (WHO, 2000). Moreover, nearly 1.2 billion people are at risk of developing lymphatic Filariasis and over 128 million are estimated to have circulating microfilariae or one of the various clinical conditions associated with filarial infection. (Kumaraswami et al., 2000). In India it is estimated that 454 million people are at risk of infection of which 29.7 million are microfilaria carriers and 22.5 million are diseased. India contributes about 40% of the global lymphatic filarial disease burden. Japanese Encephalitis (JE) is wide spread in South and Southeast Asian countries and it has
been positively associated with rice cultivation. In India, the first epidemic was reported and confirmed in 1955-56 from North Arcot district of present Tamilnadu (Work and Shah 1956). The disease has appeared in sporadic outbreaks or epidemic forms in Assam, since 1976. In Assam about 9.35 million persons are at risk, 0.35 million are microfilaria carriers and 0.09 million have chronic disease manifestation (Khan et al., 1999). Climatic conditions, abundance of potential mosquito vectors, amplifying hosts, agricultural practices and the socio-cultural behaviour of the people are conducive to spread JE in the state (Phukan et al., 2004).

From the viewpoint of public health importance relating to study of mosquitoes, it needs no emphasis that malaria has been the most formidable and serious public health problem in NE region of India. Filariasis is another disease of public health importance. Assam is endemic for filariasis while all its neighboring states are not endemic. Japanese Encephalitis (JE), another vector borne disease, is very prevalent in Assam since 1976. JE is common in Dibrugarh, Sonitpur, Darrang, Sibsagar, Nagaon, Lakhimpur, Nalbari and Dhubri districts of Assam. However, Dengue and Chikungunya disease have no public health importance in the North eastern region of India.

Information on the population dynamics of mosquitoes and particularly vectors is necessary for developing control strategies. In any given area common mosquito species occur through out the year but the abundance of any species depends more upon the availability of preferential breeding habitats and survival rates and has direct correlation with disease transmission. The total mosquito species in the world recorded more than 3000 under 34 genera of which about 450 belongs to Anopheles and 800 of Culex species. Indian Anopheline fauna comprise 58 species with 9 of them acting as vectors of malaria (T.R. Rao, 1984). Due to peculiar climate, topography and terrains, the NE region is rich in flora and fauna. As such 130 species comprising of 37 Anopheline and 93 Culicine
mosquitoes belonging to 12 genera have been recorded in this region. (Malhotra and Mahanta, 1994). Environmental changes have a great bearing on the development of various larval stages of different species of mosquitoes as well as on the composition resulting in the appearance, disappearance or reappearance of various mosquito species (Tandon and Hati, 1978). The role of *Anopheles minimus* (Diptera: Culicidae) as a principal vector in the transmission of malaria was established during early forties (Anderson and Viswanathan, 1941). However, studies carried out in the fifties to seventies revealed near elimination of this species from northeastern region of India (Sen et al., 1973; Rajagopal, 1976), due to extensive use of insecticide under the National Malaria Eradication Programme (NMEP) and reappeared in early eighties and its role in malaria transmission is well recognized (Bhatnagar et al., 1982; Jana-Kara, et al., 1995; Prakash et al., 1996).

Ecological changes due to canal irrigation for agriculture increased water logging due to seepage from canals and of proper and adequate drainage have resulted in the creation of extensive mosquitogenic condition. Further, deforestation, rapid urbanization, industrialization and extensive use of insecticides in agriculture and public health may also have contributed towards changes in the ecosystem and in the prevalence of mosquito vectors. (Bhatt et al., 1991). On a global scale, seasonal temperatures and rainfall patterns constitute the major factors that determine the prevalence and distribution of mosquitoes. Rapidly changing environment brings about frequent changes in vector behaviour which necessitate the regular generation of information on prevalence / incidence of vectors.

A detailed mosquito survey, particularly of vector species, assumes significance keeping in view of their occurrence, distribution and species composition in different physiographical zones. Challan (1923) carried out the first anopheline survey in Assam in the year 1923. Christophers (1933) and Barraud
(1934) were among the earliest workers to record mosquitoes from the Indian subcontinent including Assam. During the last two decades several workers, to study the occurrence, distribution, species composition and identification of vectors, have carried out mosquito surveys in NE India. (Malhotra, 1985; Talukdar et al., 1991; Dutta et al., 1993; Das et al., 2004; Nagpal and Sharma, 1995; Baruah et al., 2004.)

Mosquito control, in view of their medical importance, assumes global importance. In the context of ever increasing trend to use more powerful synthetic insecticides to achieve immediate results in the control of mosquitoes, an alarming increase of physiological resistance in the vector species, hazardous effects on environment, increased toxicity to non-target organisms and high costs are noteworthy (WHO, 1995). However, concerns regarding safety and the environmental impact of synthetic pesticides have resulted in an intensified search for alternative strategies for pest control. Hence review of naturalistic methods of control of mosquito larvae is gaining importance. In recent years bio-pesticides having attributes of activity and efficacy, specificity and selectivity, low mammalian toxicity, environmental acceptability, safety to non target and beneficial biota and economic viability have been actively investigated in the field of microbiology, phytochemistry and entomology. For all these reasons increasing attention has been directed toward natural enemies such as predators, parasites and pathogens. Unfortunately, none of the predators and parasites can be mass-produced and stored for a long period. They all must be reared in vivo. It become evident that there is an urgent need for a biological agent that would possess the desirable properties of a chemical pesticide i.e. it must be highly toxic to the target organism, able to be mass produced on an industrial scale have a long shelf-life and be transportable (Margalit and Dean, 1985). Among bio-pesticides naturally occurring pathogenic bacteria constitute a diverse group of biological control agent (Mulla, 1991).
The spore forming bacteria *Bacillus thuringiensis* H-14 (Goldberg and Margalit, 1977) and *Bacillus sphaericus* H-5a 5b (Kellen et al., 1965) have been recognized as the prime candidates for use, because they have demonstrated high activity against a broad spectrum of mosquito larvae (Boike et al., 1988; Gu and Lu, 1987). Endotoxins produced by *Bicillus* species are often species-specific and, unlike chemical insecticides, do not contaminate the environment, as the toxins have lesser residual efficacy and are generally safe for non-target organisms (Lacey et al., 2001; Seigel, 2001) Consequently, there is a need to search for and isolate new indigenous and more effective strains.

It was observed from the literature surveyed that there was no scientific data available at present on the seasonal incidence of vector mosquitoes in Sonitpur district of Assam. This information is very essential for implementation of effective communicable disease control programme. The vast literature pertaining to the two bio-insecticides, points out that efforts directed towards exploiting the natural resources for new bio-control agents would be a productive approach especially in tropical or developing countries to arrive at new and highly effective microbial insecticides for the control of mosquitoes.

Keeping all this in view a detailed survey was carried out in Sonitpur district of Assam to collect information on the seasonal incidence/prevalence, species composition and distribution of vectors of three mosquito borne diseases viz., Malaria, Japanese Encephalitis (JE) and Filariasis. A study on isolation, identification and mosquito larvicidal activities of indigenous entomopathogenic soil bacteria was also carried out to find out an effective control technique for management of mosquito borne diseases in this region. The approach is the first of its kind and not reported earlier from Northeastern region of India.
OBJECTIVES OF THE STUDY

Scientific information on mosquito vectors, their seasonal incidence/prevalence, species composition and distribution are very much essential for designing any control strategy. Control of mosquito population by biological control agents have also indicated that the organisms have certain drawbacks, viz. short residual activities resistance towards target organisms and large quantities of formulations required for control operations which create problems of handling and cost. One of the ways to overcome these problems can be, by looking for highly potent bacterial strains in nature. All these possibilities were examined in this study with the following aims.

1. To collect mosquitoes from various study areas of Sonitpur district of Assam.
2. To identify vector mosquitoes for species composition.
3. To study seasonal incidence and distribution of vector species responsible for spreading mosquito borne diseases in different seasons of the year.
4. To collect soil samples from various mosquito-breeding habitats of Sonitpur district for screening entomopathogenic bacteria.
5. To isolate and identify the entomopathogenic bacteria efficient in controlling mosquito breeding.
6. To evaluate the mosquito larvicidal activity of water dispersible powder of potent isolates under laboratory and field conditions.
7. Comparison of larvicidal efficacy with commercially available biocides.

The outcome of the research work would provide adequate information about the seasonal incidence of vector mosquitoes and would pave way for the entomologist to design a suitable strategy to control the vectors using indigenous entomopathogenic bacteria.