



# **Biology, Diagnosis and Management of Indian Pestiferous Blackflies**



**Vijay Veer**

**Defence Research & Development Organisation  
Ministry of Defence, New Delhi - 110 011**

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BLACKFLIES

Dr Vijay Veer

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## Foreword

The blackflies of family Simuliidae of insect order Diptera are of medical and veterinary importance and ranked second as the most harmful group of insects after the mosquitoes in affecting the human health. Blackflies unlike mosquitoes attack in silence without making a distinct buzzing. The blood feeding female blackflies are well known pests of humans and animals, as they besides being biting nuisance, also transmit parasites and pathogens, like *Onchocerca* spp. *Mansonella* spp., *Dirofilaria* spp., *Leucocytozoon* spp., *Trypanosoma* sp., vesicular stomatitis virus (VSV), etc., to them. Allergy to blackfly bites can be serious as the fly's saliva is responsible for localised hypersensitivity reactions (swelling and intense itching) and life-threatening systemic hemorrhagic syndromes in humans. The fly bites in animals also cause severe symptoms or even their death through a hypersensitisation, induced by zootoxins depending upon the biting density and the animal's physical and immunological condition. Flies' biting and swarming around birds and mammals reduce their productivity. Onchocerciasis (or *river blindness*) caused by a filarial nematode *Onchocerca volvulus* in tropics of sub-Saharan Africa and Latin America and in Yemen is a major health concern. This disease caused skin nodules, intense itching and ocular lesions that can lead to partial or total blindness; thus it has high impact on health and well beings of endemic communities including economic burden, disabilities, mental health issues and social stigmas. It is prevalent in estimated 21 million people globally and 205 million people are at risk. However, presently this dreaded disease is not occurring in India except one case reported from Assam.

In India, we do not know much about their biodiversity, biology and disease transmission. Presently blackflies are known as biting pests of man and animals especially in northeastern India. Simuliid flies are affecting outdoor activities of army personnel, field workers, wood gatherers, tourists



and fishermen, labourers engaged in road construction and hydro-electrical projects, resulting in loss of huge man-working hours. The fly bites commonly lead to the secondary infections of lesions and allergic reactions in humans. In India 4 species, *S. grisescens*, *S. himalayense*, *S. indicum* and *S. nodosum* are important man biting species. And one of them, *nodosum* is transmitting 3 species of nematode parasites of *Onchocerca* spp. in Thailand where it bites both man and water buffaloes. Further, recently another two filarial vector species, *S. (Simulium) nigrogilvum* and *Simulium (Gomphostilbia) asokae* are reported from Myanmar. There is most likelihood that these species will soon be reported from northeastern India.

Therefore study on biodiversity and disease transmission of blackflies will be of great significance for their better understanding and management. This book provides a base line data on Indian blackflies for future research especially on medically important species of northeastern India; as it provides updated information on taxonomy, diagnosis, identification keys, listing of man biting species and of species occurring in neighbouring countries, epidemiology and management of blackflies. I am sure that this book will be highly appreciated by the army personnel, medical and veterinary practitioners, academicians and researchers and students at large, and will serve an indispensable source of information on blackflies for a long time to come.

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Director General (Life Sciences)  
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New Delhi

## Preface

The blackflies biodiversity in India though rich and of medical and veterinary importance but largely remained underexplored and epidemiologically less understood. Perhaps this situation may be largely due to the difficulty in flies' identification as the family Simuliidae is having high level of homogeneity and morphological similarity in species with one another. The overlapping ranges of morphological characters which often resulting in misidentification of blackfly species. This homogeneity is leading to poor definition of species boundaries and to unstable and problematic supraspecific classification. Now many morphospecies are recognised as species complexes, composite of two or more cryptic or sibling species especially in medically important species. Thus, there is need to study populations of these complexes from different regions by using integrated taxonomical approach involving morphological, ecological, epidemiological, cytological and molecular approaches to distinguish the sibling species. The comprehensive information on blackflies can be obtained only through the foundation of sound taxonomy. The correct identification of the species is of paramount importance in order to provide correct information on distribution, biology and behaviour of a species; it also helps in designing of appropriate control measures.

The blackflies are though known to transmit several pathogenic nematodes, protozoans and viruses to man, domestic animals and wildlife, and causing serious illness in them but we are still lacking information on their disease transmission in India. Blackflies are threatening the public and animal health in the northeastern India where flies are known for biting nuisance and causing localised bacterial infection of itchy scab and allergy, skin inflammation, nausea, headache in the individuals. Among domestic animals, flies are causing biting annoyance and stress; thus affecting their body weight and milk production. Poultry is seriously affected by the flies.

In this monograph 16 species are recognised as pest species of which 6 species as major, 6 species as minor and 4 species as potential pests in India. Recently a human case of onchocerciasis is reported from Assam which was infecting the eye of a local woman. It is a matter of serious concern and needs further confirmation and investigation.

The world blackflies fauna is known by more than 2311 living species in 30 genera. However, only 90 species including 17 unnamed species are discovered so far from India which is about 3.89 % of world fauna. Thus there is opportunity to discover many more species from unexplored regions of the country and to mount programmes on blackflies for regional biodiversity surveys and to study biology, biting behaviour and epidemiology of medically important species.

(Dr Vijay Veer)

## Acknowledgements

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(Dr Vijay Veer)

## CHAPTER 1

### Introduction

The simuliid flies are two winged (dipteran) insects belonging to family Simuliidae which are popularly known as blackflies world over; though all flies are not black in colour as many of them are yellow or orange too. Blackflies are of medical, veterinary and ecological importance and often ranked second as the most harmful group of insects after the mosquitoes in affecting the human health. They are very different in appearance from other biting dipteran insects such as mosquitoes, midges, gnats, stablefly, hornfly, horsefly and deerfly. In India, blackflies are popularly known by different vernacular names such as '*potu*' or '*pipsa*' in Western Indian Himalayan region and '*dim dam*' or '*dam dim*' in northeast India. The common name, '*pipsa*' is used for the common man biting blackfly, '*Simulium indicum*' in Sikkim area.<sup>1</sup> Species '*Simulium indicum*' is also known as '*bhusuna*' in Darjeeling, as '*phisho*' and '*phisniari*' in Western Himalayas, as '*pepsi*' in Aka Hills of Arunachal Pradesh. In Chilas (Kashmir, Gilgit) blackflies are commonly known as '*moi*'. In Myanmar blackflies are commonly known as '*mwachi fly*' and in USA as '*buffalo gnat*' and '*turkey gnat*'. In other parts of the world the blackflies are known by various common names.<sup>2</sup> These local vernacular names of simuliid flies in general are useful for preliminary local enquiries to identify their prevalence in an area.

The flies of Simuliidae family are small and stout bodied usually with horn-like antennae, elongated mouth parts, short legs, broad wings with strong costa, subcosta and radius veins, first tergum of abdomen modified as a basal scale which is fringed with long hairs, eyes in males holoptic and in females dichoptic, head without ocelli. Its pupae are having gills (respiratory organs) on either side of thorax and its larvae are

having long cylindrical body, last abdominal segment bearing a sucking disk for attachment to a substratum and its immature stages live in running water.

Blackflies are well known for their annoyance, biting nuisance and disease transmission and found living near the flowing water in low land and hilly areas, but generally absent in plains. Female flies feed on blood of mammals and birds from their exposed body parts having sparse hairs/feathers and thin skin. They feed on humans, cattle, buffaloes, horses, mules, dogs, cat, sheep, goats, poultry, pigs, wild animals and birds. Simuliid flies are serious pest of poultry, livestock and humans as they besides biting nuisance, transmit various serious diseases among them such as human onchocerciasis (or commonly known as river blindness) and mansonellosis, zoonotic onchocerciasis, avian leucocytozoonosis, simuliotoxicosis and probably several arboviruses.<sup>3</sup>

Human onchocerciasis is an eye and skin disease and responsible for one of the greatest public health problems. This disease is caused by a filarial nematode, *Onchocerca volvulus* (Leuckart) which is prevalent in about 20.9 million people living in the Africa, Yemen, Central and South America as per WHO estimate report of 2017. Of these about 14.6 million people have skin disease and 1.15 million are blind or severely visually impaired. This disease caused severe and chronic sufferings which leads to the serious overall socio-economic impact in humans, and considered second to polio for this impact. Onchocercal blindness is fourth leading cause of preventable blindness after cataract, glaucoma and trachoma in the world.<sup>4</sup> The same parasite, *O. volvulus* is also reported infecting *Gorilla* primate in Congo (Africa)<sup>5</sup>, and chimpanzees and cynomolgus monkeys (*Macaca fascicularis*) were experimentally infected with this parasite and manifestation of disease occurred.<sup>6-8</sup> Blackflies are threat to livestock in Canada, causing weight loss in cattle, loss of milk production and sometimes also cause their death.

In India, especially in northeast India blackflies annoy humans and inflict painful bites during outdoor activities. Bites of blackfly cause irritation, itching, and localised tissue damaged, dermatitis, inflammation, formation of blisters, followed by secondary infection leaving black scars on the body, and allergic reactions. Allergic reactions to human host due to bites of blackflies are collectively known as '*blackfly fever*', which is characterised by headache, fever, nausea, adenitis, dermatitis, and allergic asthma. Field workers without personal protection have to abandon their work due to

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### About the Monograph

This book is about the blackflies which are well known for their biting nuisance and disease transmission and considered second as the most harmful group of insects after the mosquitoes in affecting the human health. Information about blackfly in India is scanty despite of their medical and veterinary importance. This monograph provides summarised and update information on biology, diagnosis, pest status and management of the Indian blackflies. The emphasis has been made on blackflies of northeast India where they are threatening the public and animal health and have negative impact. The introductory chapters deal with the importance of the blackflies in India as human and domestic animals pests and listed man biting species for the first time. Three species namely, *S. himalayense*, *S. indicum* and *S. nodosum* are reported as highly anthropophilic. The subsequent chapters with illustrations deals with biology, collection of blackflies and their preparation, preservation and rearing for species diagnosis by using morphological, cytotaxonomical and molecular characters. The use of DNA taxonomy along with morphology and ecology is emphasised for identification of cryptic or sibling species within the species-complexes especially in species-complexes of medical problem. Identification keys for 73 Indian species are given for the first time. The book ends with a chapter on the lesson learnt, practical tips and future research for study of blackflies in the country. This book is a step-by-step guide for the blackfly study in this region.

### About the Author

**Dr Vijay Veer** after obtaining his doctorate degree in Insect Ecology & Taxonomy of Thysanoptera (thrips, plant disease vectors) joined the Forest Research Institute & Colleges, Dehradun and worked on ecology, taxonomy and control of insect pests of forestry importance. In 1984, he joined DRDO at the Defence Research & Development Establishment (DRDE), Gwalior as Scientist 'B' and superannuated as the Director of Defence Research Laboratory, Tezpur (Assam). He was also tipped as member of the Group for Forecasting of Systems & Technologies (GFAST), New Delhi.

Dr Vijay Veer has more than 38 years research experience in Insect pests, their ecology and management including disease vectors of health & hygiene. He researched on pests of medical, veterinary, forestry and agriculture importance such as thrips, dermestid beetles, cloth-moths, tabanid flies, blackflies and mosquitoes; discovered several new species of insects. Beside this he has also worked in high altitude agriculture, water purification and low intensity conflict. He has developed various technologies. Some of them are converted into products, transferred to industry and being commercialised. Some of those are multi-insect repellent (Diethyl phenyl acetamide, DEPA) and first indigenous long lasting insecticidal mosquito net (LLIN-Defender Net. Water purification systems for removing iron, arsenic and manganese; and Chili (Oleoresin) based products for women protection and mob dispersion.

He made significant contributions in the development of BioSTP (Biological Sewage Treatment Plant) and is currently working on development of ecofriendly technologies for degradation of solid waste and on new generation pest control safe technology. He has published 10 books, 33 patents and about 210 research publications, several book chapters and prepared 02 Indian standards (IS).

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