

AN ANNOTATED LIST OF SEPTATE GREGARINES (APICOMPLEXA :
SPOROZOEAE) FROM INSECTS IN INDIA

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ABSTRACT

The present paper brings together all the species of septate gregarines (Apicomplexa : Sporozoea) so far described from insects in India, which comprise 94 species belonging to 27 genera and 9 families.

It is hoped that the present paper will be of great help for the future workers in this line.

INTRODUCTION

One of the major groups of protozoan parasites in the gut of insects is the septate gregarines which is at present included in the Phylum Apicomplexa and the Class Sporozoea (Levine *et. al.*, 1980). The adults of these parasites have an anchoring organ known as the epimerite, in addition to the protomerite and the deutomerite, the latter being the largest segment of the body and containing the single vesicular nucleus.

Extensive researches on the group have been made in our country as well as outside India as a result of which a number of species have been established. These gregarines were generally believed to be harmless to their hosts. But interest in them increased when Lipa (1967) reported that some of these gregarines are harmful to their hosts and may be used for biological control of harmful and noxious insects. We have undertaken to

compile all the septate gregarines described from insects in India which will help future workers carrying out researches on the problems of biological control. In a recent communication we (Haldar *et al.*, 1984) gave a list of gregarines from arthropod hosts. In the present paper the list has been prepared on the basis of the hosts.

A BRIEF HISTORY OF RESEARCH ON THE
SEPTATE GREGARINES IN INDIA

The history of the gregarines may be traced from the time of Redi who, in 1708, made the discovery of what was possibly a gregarine (Watson, 1916). However, Dufour (1828) gave an authentic report of 'gregarinosis' in an arthropod host and established the genus *Gregarina*. The history of research on gregarines was summarised by Watson (1916), Lipa (1967) and Nelson (1970). It is, however, not our intention to review the

literature on the subject but only to mention some salient points of research on the group in India.

Bhatia and Setna (1924) first carried out researches on septate gregarines in India. In his "Fauna of British India", Bhatia (1938) listed several species. In a series of publications, Chakravarty (1934, 1935, 1936, 1938, 1939) described many new species including a new family Monoductidae. Chakravarty (1959) also proposed a new classification of the sub order 'Cephalina'.

LIST OF SEPTATE GREGARINES FROM
INDIAN INSECTS

A list has been presented in the following pages giving the names of the insect hosts with their orders and families (where available) and their gregarine parasites with their families and the author(s). At the end of the list detailed references have also been compiled. For insects, the classification of Mani (1974) and for the gregarines the classification of Chakravarty (1959) have been followed in the preparation of the list.

Host (s)	Order	Family of Host	Parasite	Family	Author (s)
Order—COLEOPTERA					
<i>Aulacophora foveicollis</i>	Coleoptera	Chrysomelidae	<i>Caulocephalus crenata</i>	Didymophyidae	Bhatia and Setna (1924)
<i>Gallerucida bicolor</i>	Do	Do	<i>Quadruhyalodiscus gallerucidae</i>	Do	Kundu and Haldar (1984)
<i>Gonocephalum brachyelytra</i>	Do	Tenebrionidae	<i>Stylocephalus bahli</i>	Stylocephalidae	Misra (1941)
<i>Opatroides vicinis</i>	Do	—	<i>S. indicus</i>	Do	Misra (1942)
<i>Gonocephalum brachyelytra</i>	Do	Tenebrionidae	<i>S. gonocephali</i>	Do	Bhushana Rao (1962)
<i>Alphitobius piceus</i>	Do	Do	<i>S. alphitobiusae</i>	Do	Sarkar and Chakravarty (1969)
<i>Anoplogenius microgonius</i>	Do	—	<i>S. microgonusae</i>	Do	Do
<i>Mesomorphus velliger</i>	Do	Tenebrionidae	<i>Gregarina mesomorphi</i>	Gregarinidae	Devdhar and Deshpande (1971a)
Do	Do	Do	<i>G. cylindrica</i>	Do	Do
<i>Gonocephalum hoffmannseggi</i>	Do	Do	<i>Stylocephalus serper-</i> <i>tula</i> (Subgenus— <i>Xiphocephalus</i>)	Stylocephalidae	Devdhar and Amoji (1977)
<i>Gonocephalum hoffmannseggi</i>	Coleoptera	Tenebrionidae	<i>S. karnatakanensis</i> (Subgenus— <i>Xipho-</i> <i>cephalus</i>)	Stylocephalidae	Devdhar and Amoji (1977)
Do	Do	Do	<i>S. hoffmannseggi</i> (Subgenus— <i>Styloce-</i> <i>phalus</i> S. Str.,	Do	Do

Host (s)	Order of Host	Family	Parasite	Family	Author (s)
<i>Amblyrrhinus</i> sp.	Coleoptera	Curculionidae	<i>Gregarina crescentica</i>	Gregarinidae	Haldar and Chakraborty (1978b)
<i>Alcides</i> sp. nr. <i>leopardus</i>	Do	Do	<i>Gregarina alcidessi</i>	Do	Do
An unidentified beetle	Do	Do	<i>G. sprague</i>	Do	Do
<i>Rhytinota impolita</i>	Do	Tenebrionidae	<i>Cystocephalus dev-dharii</i>	Stylocephalidae	Patil and Amoji (1979a)
<i>Gonocephalum</i> sp.	Do	Do	<i>Stylocephalus apapillatus</i>	Do	Haldar and Chakraborty (1979a)
<i>Rhytinota impolita</i>	Do	Do	<i>Leidyana gnyana-gangai</i>	Leidyanaidae	Patil and Amoji (1979b)
<i>Myllocerus</i> sp. 1	Do	Curculionidae	<i>Hirmocystis bengalensis</i>	Didymophyidae	Haldar and Chakraborty (1979b)
<i>Xanthoprochilus</i> sp.	Do	Do	<i>H. pitcharis</i>	Do	Do
<i>Myllocerus</i> sp. 2	Coleoptera	Curculionidae	<i>H. pseudoductis</i>	Didymophyidae	Haldar and Chakraborty (1979b)
<i>Rhytinota tristis</i>	Do	Tenebrionidae	<i>Cystocephalus rhytinotus</i>	Stylocephalidae	Patil and Amoji (1980)
<i>Longitarsus</i> sp.	Do	Chrysomelidae	<i>Gregarina bilobosa</i>	Gregarinidae	Kundu and Haldar (1981a)
<i>Hoplasoma unicolor</i>	Do	Do	<i>Hirmocystis hoplasomae</i>	Didymophyidae	Kundu and Haldar (1981b)
<i>Stethorus</i> sp.	Do	—	<i>Brustiospora indicola</i>	Brustiosporidae	Kundu and Haldar (1981c)
<i>Lepropus</i> sp.	Do	Curculionidae	<i>Hirmocystis lepropi</i>	Didymophyidae	Haldar and Chakraborty (1981)
<i>Raphidopalpa</i> (=Aulacophora) <i>foveicollis</i>	Do	Chrysomelidae	<i>Retractocephalus raphidopalpae</i> (Haldar and Chakraborty, 1976)	Do	Haldar, Chakraborty and Kundu (1982)
<i>Monolepta signata</i>	Do	Do	<i>R. spinosus</i>	Do	Do
<i>Haltica</i> sp.	Do	Do	<i>R. halticus</i>	Do	Do
<i>Aulacophora intermedia</i>	Do	Do	<i>R. aulacophorae</i>	Do	Do
<i>Lema</i> sp.	Coleoptera	Chrysomelidae	<i>R. spatulatus</i>	Didymophyidae	Haldar, Chakraborty and Kundu (1982)
<i>Cryptophagus</i> sp.	Do	—	<i>Stylocystis chowdhurya</i>	Actinocephalidae	Sarkar and Majumdar (1983b)
Order—ISOPTERA					
<i>Capritermes incola</i>	Isoptera	—	<i>Hirmocystis capritermis</i>	Didymophyidae	Uttangi and Desai (1961)

Host(s)	Order of Host	Family	Parasite	Family	Author(s)
<i>Capritermes incola</i>	Isoptera	—	<i>H. incola</i>	Didymophyidae	Uttangi and Desai (1961)
Do	Do	—	<i>H. indica</i>	Do	Do
<i>Speculitermes cyclops</i>	Do	—	<i>H. speculitermis</i>	Do	Uttangi and Desai (1962)
Do	Do	—	<i>H. dharwarensis</i>	Do	Do
Do	Do	—	<i>Steinina termitis</i>	Actinocephalidae	Do
<i>Capritermes incola</i>	Do	—	<i>Sphaerocystis termitis</i>	Sphaerocystidae	Desai and Uttangi (1962)
<i>Macrotermis estherae</i>	Do	—	<i>Gregarina macrotermis</i>	Gregarinidae	Kalavati and Narasimhamurti (1978)
<i>Odontotermes</i> sp.	Do	—	<i>Anthorhynchus hanumanthi</i>	Sphaerocystidae	Do
<i>Coptotermes heimi</i>	Isoptera	—	<i>Steinina coptotermi</i>	Actinocephalidae	Kalavati and Narasimhamurti (1978)
<i>Odontotermes</i> sp.	Do	—	<i>Sphaerocystis odontotermi</i>	Sphaerocystidae	Kalavati and Narasimhamurti (1980)
Order—ODONATA					
<i>Ceriagrion coromandelianum</i>	Odonata	Coenagriidae	<i>Actinocephalus ceriagrionae</i>	Actinocephalidae	Sarkar and Chakravarty (1969)
<i>Agriolenemis</i> sp.	Do	Do	<i>Menospora nonacantha</i>	Do	Devdhar and Despande (1971b)
<i>Ceriagrion coromandelianum</i>	Do	Do	<i>Dendrorhynchus keilini</i>	Dactylophoridae	Nazeer Ahamed and Narasimhamurti (1979)
Do	Do	Do	<i>Ancyrophora ceriagrioni</i>	Actinocephalidae	Do
<i>Bradinopyga geminata</i>	Do	Libellulidae	<i>Actinocephalus bradinopygi</i>	Do	Narasimhamurti and Nazeer Ahmed (1980)
<i>Enallagma parvum</i>	Do	Coenagriidae	<i>Menospora enallagmae</i>	Do	Sarkar and Haldar (1980b)
<i>Coenagrion dyeri</i>	Do	Do	<i>M. coenagrii</i>	Do	Do
<i>Agriolenemis pygmaea</i>	Odonata	Coenagriidae	<i>Hoplorhynchus ramidigitus</i>	Actinocephalidae	Sarkar and Haldar (1980c)
<i>Brachythemis contaminata</i>	Do	Libellulidae	<i>Odonaticola hexacantha</i>	Do	Sarkar and Haldar (1981a)
<i>Diplacodes trivalis</i>	Do	Do	<i>O. longicollara</i>	Do	Do
<i>Orthetrum sabina</i>	Do	Do	<i>O. orthetri</i>	Do	Do
<i>Neurothemis t. tulbia</i>	Do	Do	<i>O. rodgii</i>	Do	Do
<i>Ceriagrion coromandelianum</i>	Do	Coenagriidae	<i>Tetractinospora victoris</i>	Do	Sarkar and Haldar (1981b)

Host(s)	Order of Hosts	Family	Parasite	Family	Author(s)
<i>C. cerinorubellum</i>	Odonata	Coenagiidae	<i>Acanthospora bengalensis</i>	Actinocephalidae	Sarkar and Haldar (1981c)
<i>Ischnura senegalensis</i>	Do	Do	<i>Ancyrophora ischnurae</i>	Do	Sarkar and Haldar (1981d)
<i>I. delicata</i>	Do	Do	<i>A. ovoides</i>	Do	Do
<i>I. delicata</i>	Do	Do	<i>Actinocephalus ellipsoidus</i>	Do	Sarkar and Haldar (1981e)
<i>Ceriagrion olivacum</i>	Do	Do	<i>Ramicephalus olivacus</i>	Do	Sarkar and Haldar (1981f)
<i>Enallagma sp.</i>	Do	Do	<i>Mukundaella undulatus</i>	Do	Sarkar (1981)
<i>Crocothemis S. servilia</i>	Odonata	Libellulidae	<i>Odonaticola elliptica</i>	Actinocephalidae	Sarkar (1981)
<i>Crocothemis' servilia</i>	Do	Do	<i>O. crocothemis</i>	Do	Kori and Amoji (1983)
Order—ORTHOPTERA					
<i>Gryllus sp.</i>	Orthoptera	Gryllidae	<i>Gregarina cornwalli</i>	Gregarinidae	Bhatia and Setna (1924)
Do	Do	Do	<i>Leidyana gryllorum</i>	Leidyaniidae	Do
<i>Poecilocerus pictus</i>	Do	Acrididae	<i>Gregarina poecilocerum</i>	Gregarinidae	Ganapati and Mrutyunjaya Devi (1954)
<i>Aelopus sp.</i>	Do	Do	<i>Quadruspinospora aelopii</i>	Actinocephalidae	Sarkar and Chakraborty (1969)
<i>Phleoba antennata</i>	Do	Do	<i>Phleobum gigantinum</i>	Monoductidae	Haldar and Chakraborty (1974)
<i>Spathosternum sp.</i>	Do	Do	<i>Quadruspinospora chakravartyei</i>	Actinocephalidae	Haldar and Chakraborty (1975)
<i>Aiolopus sp.</i>	Do	Do	<i>Q. indoaiolopii</i>	Do	Haldar and Chakraborty (1976)
<i>Acrida exaltata</i>	Do	Do	<i>Q. acridii</i>	Do	Do
<i>Trilophidia annulata</i>	Orthoptera	Acrididae	<i>Quadruspinospora megaspinosa</i>	Actinocephalidae	Haldar and Chakraborty (1976)
<i>Attaractomorpha crenulata</i>	Do	Pyrgomorphidae	<i>Q. attractomorpii</i>	Do	Haldar and Chakraborty (1978a)
<i>Aiolopus tamulus</i>	Do	Acrididae	<i>Q. chakravartyei</i>	Do	Haldar, Sarkar and Datta (1979)
<i>Pteronemobius concolor</i>	Do	Gryllidae	<i>Leidyana linguata</i>	Leidyaniidae	Haldar and Sarkar (1979)
<i>Gryllodes sp.</i>	Do	Do	<i>Gregarina gryllodesii</i>	Gregarinidae	Haldar and Sarkar (1980)
<i>Plebeogryllus guttiventris</i>	Do	Do	<i>G. guttiventra</i>	Do	Do
<i>Pteronemobius 'ascipense</i>	Do	Do	<i>G. levinii</i>	Do	Do

Host (s)	Order of Hosts	Family	Parasite	Family	Author (s)
<i>Gryllotalpa africana</i>	Orthoptera	Gryllotalpidae	<i>Hirmocystis theodoridesi</i>	Didymophyidae	Kundu and Haldar (1981b)
<i>Spathosternum prasini-ferum prasini-ferum</i>	Do	Acrididae	<i>Quadruspinospora dichotoma</i>	Actinocephalidae	Kundu and Haldar (1983)
Order—THYSANURA					
<i>Lepisma saccharina</i>	Thysanura	Lepismatidae	<i>Gregarina aciculata</i>	Gregarinidae	Cornwall (1915)
<i>Ctenolepisma</i> sp.	Thysanura	Lepismatidae	<i>Lepismatophila karnataki</i>	Stylocephalidae	Nimbargi and Rodgi (1974)
<i>C. nigra</i>	Do	Do	<i>L. rhombocephala</i>	Do	Haldar and Chakraborty (1977)
Order—HEMIPTERA					
<i>Pirates quadrinotatus</i>	Hemiptera	—	<i>Schneideria quadrinotata</i>	Sphaerocystidae	Amoji and Rodgi (1973)
<i>Lygus hospes</i>	Do	Lygaeidae	<i>Gregarina lygeusi</i>	Gregarinidae	Haldar, Ray and Gupta (1982)
Order—BLATTODEA					
<i>Supella supellectilium</i>	Blattodea	Blattellidae	<i>Gregarina cylindrosa</i>	Do	Haldar and Kundu (1977)
Nymphal stage of an unidentified insect	Do	Do	<i>G. discocephala</i>	Do	Kundu and Haldar (1981a)
Order—DERMAPTERA					
<i>Forficula ambigua</i>	Dermaptera	Forficulidae	<i>Gregarina megaspora</i>	Do	Amoji and Rodgi (1976)
Do	Do	Do	<i>G. ambigua</i>	Do	Do
<i>Nala lividipes</i>	Dermaptera	Labiduridae	<i>Gregarina nalae</i>	Gregarinidae	Datta and Haldar (1984)
Order—DICTYOPTERA					
Infection found in Nymphal stage of an unidentified Insect	Dictyoptera	Blattellidae	<i>Gregarina mukundai</i>	Do	Haldar and Kundu (1980)
<i>Ischnoptera</i> sp.	Do	Do	<i>G. ischnopterae</i>	Do	Datta and Haldar (1984)
Order—PSOCOPTERA					
<i>Liposcelis</i> sp.	Psocoptera	—	<i>Liposcelis coronatus</i>	Didymophyidae	Sarkar and Haldar (1980a)
Order—HYMENOPTERA					
<i>Xylocopa aestuans</i>	Hymenoptera	Xylocopidae	<i>Leidyana xylocopae</i>	Leidyaniidae	Bhatia and Setna (1924)

ADDENDUM

Since the paper was accepted for publication, a number of new species of gregarines have been described. There are listed below :

Host (s)	Order of Host	Family	Parasite	Family	Author (s)
<i>Gallerucida bicolor</i>	Coleoptera	Chrysomelidae	<i>Quadruhyalodiscus gallerucidae</i>	Didymophyidae	Kundu and Haldar (1984)
<i>Acrotelsa collaris</i> (Fabricius)	Thysanura	Lepismatidae	<i>Lepismatophila cruszi</i>	Stylocephalidae	Do
<i>Tribolium castaneum</i>	Coleoptera	Tenebrionidae	<i>Gregarina basi-constrictonea</i>	Gregarinidae	Ghose, Sengupta and Haldar (1985)
<i>T. castaneum</i>	Do	Do	<i>Hirnocystis oxcata</i>	Didymophyidae	Do
<i>Gonocephalum depressum</i> (F.)	Do	Do	<i>Xiphocephalus gonocephali</i>	Stylocephalidae	Patil and Amoji (1985)
<i>Scleron reitteri</i> G. B.	Do	Do	<i>X. reitterae</i>	Do	Do
<i>S. latipes</i> (GUER)	Do	Do	<i>X. latipes</i>	Do	Do
<i>Palorus</i> sp.	Do	Do	<i>Steinina palorusi</i>	Actinocephalidae	Gupta and Haldar (1986)
Larva of <i>Tribolium castaneum</i>	Do	Do	<i>Eliptocystis triboli</i>	Gregarinidae	Sengupta, Ghose and Haldar (1986)

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