

A WORLD LIST OF PARASITES OF COCCINELLIDAE¹J. V. RICHEYSON²

ABSTRACT

The parasitic organisms attacking Coccinellidae of the world are presented in two lists: parasites of a given host, and hosts of a known parasite. Parasites listed include: 9 fungi, 1 bacterium, 8 protozoans, 9 nematodes, 2 mites, and 83 insects. Forty-three genera and 125 species of coccinellid hosts are included. Two hundred and three references are cited.

INTRODUCTION

The current interest in biological control or integrated control programs against insect pests requires a full understanding of the organisms being used. Coccinellids, a widely used group of predators, are attacked by various parasitic or pathogenic organisms. These organisms may reduce the effectiveness of predators or even prevent their establishment. The following lists are compiled from published reports of parasitic organisms on all stages of coccinellids of the world.

The first list contains coccinellid species listed alphabetically with their parasites. The numbers refer to literature citations. The second list contains the parasites found attacking coccinellids. The parasites are listed phylogenetically and the genera alphabetically. An asterisk against names of parasites in second list indicates synonymy. A list of synonyms is given. The parasites are coded as follows: F-Fungi, B-Bacteria, G-Gregarinidae, M-Microsporidia, N-Nematoda, A-Acarina, DP-Diptera Phoridae, DT-Diptera Tachinidae, HB-Hymenoptera Braconidae, HC-Hymenoptera Ceraphronidae, HCH-Hymenoptera Chalcididae, HEN-Hymenoptera Encyrtidae, HEU-Hymenoptera Eulophidae, HEP-Hymenoptera Eupelmidae, HI-Hymenoptera Ichneumonidae, HP-Hymenoptera Proctotrupidae, HPT-Hymenoptera Pteromalidae.

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¹ Part of this work was completed at the University of Missouri, supported by the USDA, and the National Research Council of Canada.

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PARASITES ATTACKING

COCCINELLIDS

FUNGI

Beauveria bassiana Vuillman — *Adalia bipunctata*,*Adonia undecimnotata*, *Coccinella quinquepunctata*, *C. septempunctata*, *C. trifasciata*, *Epilachna varivestis*, *Harmonia quadripunctata*.**B. tenella** (Del.) Siemasko — *Epilachna vigintioctopunctata***Cladosporium** sp. — *Cycloneda sanguinea***Hesperomyces virescens** Thaxter — *Chilocorus bipustulatus***Laboulbenia** sp. — *Coccinella undecimpunctata***Laboulbeniaceae** — *Chilocorus bipustulatus***Metarrhizium anisopliae** (Metchnikoff) —*Epilachna vigintioctopunctata***Myrothecium roridum** Tode — *Epilachna varivestis***Phyllactinia suffulta** (Reb.) Sacc. — *Halyzia duodecimguttata*, *H. sedecimguttata*, *H. vigintiduopunctata*Unidentified Fungi — *Olla abdominalis*

BACTERIA

Bacterial or Viral — *Stethorus punctillum*Unidentified Bacteria — *Cycloneda sanguinea*, *Hippodamia convergens*

Protozoa

Gregarinidae

Gregarina sp. — *Adonia variegata*, *Coccinella septempunctata*, *Harmonia conglobata*, *H. quatuordecimpunctata*, *Pullus impexus***G. coccinellae** Lipa — *Coccinella quinquepunctata*, *C. septempunctata*, *Myrrha octodecimguttata*Unidentified Gregarinidae — *Hippodamia convergens*, *Coccinella undecimpunctata*

Microsporidia

Nosema coccinellae Lipa — *Coccinella septempunctata*, *Hippodamia tredecimpunctata*, *Myrrha octodecimguttata***N. hippodamiae** Lipa — *Anatis rathvoni*, *Hippodamia convergens*, *Olla abdominalis*

N. tracheophila Cole and Briggs — *Coccinella septempunctata*
Rickettsia stethorae Hall — *Stethorus* sp., *S. gilvifrons*, *S. punctum*, *S. punctillum*
Unidentified Microsporidia — *Hippodamia convergens*

NEMATODA

Agameris decaudata Christie — *Coleomegilla maculata*
Hexameris sp. — *Aphidecta obliterata*
Mermis sp. — *Adonia undecimnotata*, *A. variegata*, *Coccinella septempunctata*, *Harmonia quatuordecimpunctata*
M. coccinellae Dies. — *Coccinella septempunctata*
M. nigrescens Duj. — *Coccinella septempunctata*
Nematodeum scymni glacialis Dies. — *Scymnus glacialis*
Parasitylenchoides sp. — *Harmonia conglobata*, *H. quatuordecimpunctata*
Parasitylenchus coccinellae Ipert and Waerebeke — *Adalia bipunctata*, *Adonia variegata*, *Harmonia conglobata*, *H. quadripunctata*, *H. quatuordecimpunctata*.
Unidentified Mermithidae — *Pullus impexus*
Unidentified Nematode — *Coccinella trifasciata*, *Coleomegilla maculata*

ACARINA

Tetrapolipus hippodamiae McDaniel and Morrill — *Hippodamia convergens*
Typhlodromus fallacis (Garman) — *Stethorus punctillum*
Unidentified Acarina — *Chilocorus bipustulatus*

INSECTA

Diptera — Phoridae
Megaselia sp. — *Epilachna varivestis*
Phalacrotophora sp. — *Adonia variegata*, *Coccinella septempunctata*
P. berolinensis Schmitz — *Aphidecta obliterata*, *Coccinellidae*
P. fasciata Fall. — *Adalia* sp., *A. bipunctata*, *Adonia* sp., *A. undecimnotata*, *A. variegata*, *Anatis ocellata*, *Calvia quatuordecimguttata*, *Chilocorus* sp., *C. bipustulatus*, *Coccinella* sp., *C. septempunctata*, *C. undecimpunctata*, *Coccinellidae*, *Cydonia* sp., *Harmonia quatuordecimpunctata*, *Hippodamia* sp., *Neomysia* sp., *N. oblongoguttata*, *Semiadalia* sp., *S. undecimnotata novempunctata*, *Thea* sp., *T. vigintiduopunctata*, *Vibidia* sp., *V. duodecimguttata*
P. netae Schmitz — *Coccinellidae*
Tachinidae
Clistomorpha triangulifera (Loew) — *Adalia undecimpunctata*, *Coccinella trifasciata*, *Coc-*

cinellidae, *Coleomegilla* sp., *Coleomegilla maculata*, *Epilachna* sp., *E. varivestis*
Degeeria collaris Fall. — *Coccinellidae*
D. luctosa Meigan — *Adalia decimpunctata*, *Semiadalia undecimnotata*
Exoristoides slossonae Coq. — *Coccinellidae*, *Epilachna varivestis*
Doryphorophaga doryphorae Ril. — *Coccinellidae*
Lydinolydella brucki Blanch. — *Coccinellidae*
L. metallica Townsend — *Coccinellidae*, *Epilachna* sp., *E. eusema*, *E. marginella*
Nemorilla maculosa Mg. — *Coccinellidae*, *Epilachna varivestis*
Paradexodes epilachnae Aldrich — *Epilachna varivestis*, *E. defecta*, *E. philippinensis*
Phorocera doryphorae Riley — *Epilachna varivestis*
P. claripennis Macquart — *Epilachna varivestis*
Sarcophaga latisternus Park. — *Coccinellidae*, *Epilachna varivestis*
S. rapax Walk. — *Coccinellidae*, *Epilachna varivestis*
S. reinhardi Hul. — *Coccinellidae*, *Epilachna varivestis*
Stomatoyia edwarsi Will. — *Coccinellidae*
Unidentified Tachinidae — *Adalia undecimpunctata*, *Adonia undecimnotata*, *A. variegata*, *Epilachna varivestis*, *Harmonia conglobata*, *H. quatuordecimpunctata*
Unidentified Diptera — *Adalia bipunctata*
Hymenoptera — Braconidae
Centistes scymni Ferriere — *Pullus impexus*
Perilitus sp. — *Adalia flavomaculata*, *Chilomenes lunata*, *Exochomus nigrimaculata*
P. coccinellae (Schrank) — *Adalia bipunctata*, *A. decimpunctata*, *A. undecimpunctata*, *A. frigida*, *Adonia* sp., *A. undecimnotata*, *A. variegata*, *Anatis quinquecimpunctata*, *Coccinella arcuata*, *C. divaricata*, *C. novemnotata*, *C. quinquepunctata*, *C. repanda*, *C. septempunctata*, *C. transversoguttata*, *C. trifasciata*, *C. undecimpunctata*, *Coccinellidae*, *Coelophora biplagiata*, *C. inaequalis*, *Coleomegilla maculata*, *Cycloneda munda*, *C. sanguinea*, *Epilachna quatuordecimnotata*, *Halyzia quatuordecimguttata*, (= *sedecimguttata*), *H. quatuordecimpunctata*, *Harmonia conglobata*, *H. quadripunctata*, *H. quatuordecimpunctata*, *Hippodamia convergens*, *H. glacialis*, *H. parenthesis*, *H. quinquesignata*, *H. sinuata*, *H. transversoguttata*, *H. tredecimpunctata*, *Leis dimidiata*, *Macronaemia hauseri*, *Olla abdominalis*, *Propylea quadrdecimpunctata*, *Psyllobora vigintiduopunctata*, *Semiadalia undecimnotata*, *Verania discolor*
P. stuardoi Porter — *Adalia bipunctata*, *A.*

- deficiens*, *Eriopsis connexa*, *Cryptolaemus montrouzieri*
- Synaldis** sp. — *Epilachna varivestis*
- Unidentified Braconidae** — *Leis conformis*
- Ceraphronidae
- Aphanogmus** sp. — *Chilocorus bipustulatus*
- Chalcididae
- Brachymeria** sp. — *Epilachna chrysomelina*
- B. carinatifrons** Gahan — *Epilachna defecta*, *E. varivestis*
- Unidentified Chalcididae** — *Epilachna vigintioctopunctata*
- Encyrtidae
- Achrysoptophagus aegypticus** Mercet — *Chilocorus bipustulatus*
- Anisotylus** sp. — *Coccinellidae*, *Hyperaspis* sp., *Scymnus* sp.
- A. albifrons** Ishii — *Scymnus* sp.
- A. similis similis** (Ashmead)* — *Scymnus cervicolis*
- A. similis texanus** Timberlake — *Coccinellidae*, *Hyperaspis bigeminata*
- A. similis utahensis** Timberlake — *Scymnus americanus*, *S. collaris*, *S. lacustris*, *S. melshiemeri*
- Homalotyloides latiscapes** Mali — *Chilocorus bipustulatus*
- Homalotylus** sp. — *Adalia flavomaculata*, *Adonia* sp., *Chilocorus* sp., *C. bipustulatus*, *Chilomenes* sp., *C. lunata*, *Coccinella* sp., *C. septempunctata*, *Coccinellidae*, *Cycloneda sanguinea*, *Cydonia* sp., *Exochomus* sp., *E. nigrimaculata*, *E. quadripustulatus*, *Hippodamia* sp., *Hyperaspis* sp., *H. guttulata*, *H. lateralis*, *Nephus* sp., *Scymnus* sp., *Sidis* sp., *Vibidia* sp.
- H. affinis** Timberlake — *Hyperaspis osculans*
- H. albitarsus** Gahan — *Coccinellidae*
- H. brevicauda** Timberlake — *Scymnus* sp.
- H. cockerelli** Timberlake — *Hyperaspis trimaculata*, *H. vittigera*
- H. flaminus** Dalman* — *Adonia variegata*, *Chilocorus* sp., *C. bipustulatus*, *C. kuwanae*, *Chilomenes lunata*, *Coccinella brucki*, *C. quinquepunctata*, *C. repanda*, *C. septempunctata*, *Coccinellidae*, *Egleis kingi*, *Exochomus* sp., *E. flavipes*, *E. quadripustulatus*, *Harmonia conglobata*, *H. quatuordecimpunctata*, *Hippodamia tibialis*, *H. tredecimpunctata*, *Hyperaspis campestris*, *H. senegalensis*, *Orcus chalybaeus*, *O. janthinus*, *O. laferti*, *O. nummularis*, *Rodalia cardinalis*, *Scymnus* sp., *S. ornatus*, *S. soudanensis*, *Thea vigintiduopunctata*, *Verania frenata*
- H. hyperaspidius** Timberlake — *Hyperaspis undulata*
- H. oculus** Girault — *Scymnus bipunctatus*
- H. quaylei** Timberlake — *Scymnus* sp., *S. fenestratus*, *S. includens*, *S. quadrimaculata*, *S. suturalis*
- H. terminalis californicus** Girault* — *Adalia bipunctata*, *Chilomenes sexmaculata*, *Coccinella novemnotata*, *C. quinquepunctata*, *Hippodamia convergens*
- H. terminalis terminalis** (Say)* — *Anatis quinquepunctata*, *Chilocorus similis*, *Coccinella novemnotata*, *Coccinellidae*, *Coleomegilla* sp., *C. innotata*, *C. maculata*, *Cycloneda* sp., *C. munda*, *C. sanguinea*, *Hippodamia convergens*, *Neomysia pullata*, *Psyllobora vigintimaculata*, *Scymnus* sp., *S. lacustris*
- H. vicinus** Say — *Nephus vetustus*
- Isodromus niger** Ashmead — *Chilocorus similis*
- Lepidaphycus bosqui** Blanch — *Cycloneda sanguinea*, *Eriopsis connexa*
- Mestocharis lividus** Girault — *Epilachna vigintioctopunctata*
- Ooencyrtus johnsoni** (Howard) — *Coccinellidae*
- Stomatoceras colliscutellum** Girault — *Epilachna vigintioctopunctata*
- Zeteticontus** sp. — *Chilocorus bipustulatus*
- Eulophidae*
- Pediobius epilachnae** Rohwer* — *Epilachna* sp., *E. chrysomelina*, *E. philippinensis*, *E. varivestis*, *E. vigintioctopunctata*
- P. mediopunctata** Wtstn. — *Coccinella* sp.
- P. foveolatus** Crawford — *Epilachna* sp.
- Syntomosphyrum taprobanes** Wtstn. — *Scymnus* sp.
- Tetrastichus** sp. — *Adalia* sp., *Adonia variegata*, *Chilocorus* sp., *Chilomenes lunata*, *Coccinella* sp., *Epilachna* sp., *E. indica*, *Exochomus* sp., *Hyperaspis senegalensis*, *Nephus* sp., *Scymnus ornatus*, *S. soudanensis*, *Sidis* sp.
- T. coccinellae** Kurdjumov — *Adalia bipunctata*, *Calvia quatuordecimpunctata* (= *sedecimguttata*), *Chilocorus bipustulatus*, *C. renipustulatus*, *Chilomenes sexmaculata*, *Coccinella quinquepunctata*, *C. septempunctata*, *C. undecimpunctata*, *Coccinellidae*, *Harmonia quatuordecimpunctata*, *Synharmonia conglobata*
- T. epilachnae** Giard* — *Adalia bipunctata*, *Chilocorus bipustulatus*, *Coccinella septempunctata*, *Epilachna* sp., *E. argus*, *E. chrysomelina*, *Exochomus flavipes*, *E. quadripustulatus*, *Subcoccinella vigintiquatropunctata*
- T. melanis** Burks — *Coccinella* sp., *C. quinquepunctata*, *C. quinquepunctata*
- T. minutus** (Howard)* — *Adalia bipunctata*, *Chilocorus similis*, *Coccinella* sp., *Coccinellidae*, *Cycloneda sanguinea*
- T. neglectus** Domenichini — *Chilocorus bijugus*, *C. bipustulatus*, *Coccinella septempunctata*, *Exochomus quadripustulatus*, *Scymnus subvillosus*
- T. sempronius** Erdoes — *Chilocorus bipustulatus*

T. thanasimi Ashmead*—*Chilocorus stigma*
T. tibialis (Ashmead)*—*Coccinella novemnotata*
T. ovulorum Laboulbene — *Epilachna chrysomelina*, *E. vigintioctopunctata*
 Eupelmidae
Anastatus disparis Ruschka — *Chilocorus bipustulatus*
Eupelmus sp. — *Chilocorus bipustulatus*
 Ichneumonidae
Unidentified Ichneumonidae — *Coccinella septempunctata*
 Prototrupidae
Lygocerus sp. — *Chilocorus bipustulatus*, *Coccinella septempunctata*
Unidentified Proctotrupidae — *Epilachna admirabilis*
 Pteromalidae
Metastenus townsendi (Ashmead)*—*Azya lutipes*, *Hyperaspis* sp., *H. lateralis*, *H. senegalensis*, *H. undulata*, *Scymnus* sp., *S. guttulatus*, *S. lacustris*
Pachyneuron sp. — *Adonia variegata*, *Chilomenes lunata*, *Hippodamia tredecimpunctata*, *Hyperaspis senegalensis*, *Scymnus kiesewetteri*, *S. ornatus*, *S. soudanensis*
P. chilocori Domenichini — *Chilocorus bipustulatus*
P. siphonophorae (Ashmead)* — *Hippodamia tibialis*, *H. tredecimpunctata*
P. syrphi (Ashmead) — *Coccinella septempunctata*
Pseudocatalaccus sp. — *Chilocorus bipustulatus*
Scymnophagus (= *Metastenus*) *mesnili* Farriere — *Pullus impexus*
Tripolycystus cryptognathae Girault — *Cryptognatha nodiceps*

Unidentified Pteromalid — *Hyperaspis lateralis*
Unidentified Parasite — *Chilomenes sexmaculata*, *Olla abdominalis*

SYNONYMY PARASITES

Anisotylus similis similis (Ashmead) (HEN) — *Homalotylus similis*
Homalotylus flaminus Dalman (HEN) — *Homalotylus flaminus*, *Homalotylus flaminus*
Homalotylus terminalis californicus Girault (HEN)—*Homalotylus obscurus* var. *californicus*, *Homalotylus terminalis*
Homalotylus terminalis terminalis (Say) (HEN) — *Eutelus scymnae* Shimer, *Homalotylus terminalis*, *Homalotylus obscurus*, *H. scymni*, *H. terminalis*
Metastenus townsendi (Ashmead) (HPT) — *Scymnophagus secundus*, *S. townsendi*, *Xenocrepis mexicana*
Pachyneuron siphonophorae (Ashmead) (HPT) — *Pachyneuron aphidiorum*
Pediobius epilachnae Rohwer (HEU) — *Pleurotropis epilachnae*
Tetrastichus epilachnae Giard (HEU)—*Lygellus epilachnae*, *Tetrastichus jablonowski*
Tetrastichus minutus (Howard) (HEU) — *Epomphaloides minutus*, *Syntomosphyrum esurus*, *Tetrastichus blephyria*, *T. blephyria*, *Tetrastichodes detrimentosus*
T. thanasimi Ashmead (HEU) — *Tetrastichodes thanasimi*
T. tibialis (Ashmead) (HEU) — *Tetrastichodes tibialis*

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DRIFT PERIODICITY AND UPSTREAM DISPERSION OF STREAM INSECTS¹

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ABSTRACT

Drift periodicity and upstream dispersion by larval and nymphal insects from two north Idaho streams were investigated. Drift was determined with drift nets sampling at 2-hour intervals over 24-hour periods. Upstream dispersion was evaluated using a marking-release-recapture technique. Mayflies demonstrated nocturnal drift as did the corixid *Sigara (Vermicorixa) grossolineata* Hungerford and dipteran *Simulium* sp.; chironomids showed continuous drift as opposed to behavioral drift for most of the other insects studied. Both nocturnal and diurnal drift occurred with species in the order Trichoptera. Stoneflies showed little tendency to drift. Mid-summer upstream dispersion by mature nymphs and larvae of selected species was found to be insignificant as a means of recolonizing insect-decimated riffle habitats and offsetting downstream displacement by drift.

INTRODUCTION

Knowledge of recolonization processes of insect-decimated streams is a matter of increasing importance in understanding stream ecology. The presence or absence of certain species of insects often reflects the quality of a stream. Insects also constitute an important trophic link in food chains and play an important role in secondary production. Maintenance of unpolluted, high-quality streams and rehabilitation of those that have been rendered unproductive are vital considerations in stream management.

Population dynamics of stream insects, particularly dispersion by drift, has been investigated by Anderson (1967), Elliot (1967), Müller (1954), Pearson (1968), Waters (1962, 1968) and others.

Upstream dispersion of benthic invertebrates has been studied to a much lesser extent. Neave (1930) reported nymphs of the mayfly *Blasturus cupidus* Say to annually move up newly formed tributaries. Studying energy flow in a stream, Ball *et al.* (1963) detected upstream dispersion of radiophosphorus and suggested it was possibly transported by invertebrates. Bishop and Bishop (1968) reported no upstream movement of nymphs labeled with P³². Studying dispersal patterns of the mayfly nymph, *Baetis* sp. and a crustacean, *Gammarus* sp., Waters (1965) concluded that major movements in an experimental enclosure occurred in a downstream direction and at night, but did not exclude the possibility of some upstream movement. Roos (1967) reported the flight of egg-bearing, adult insects was principally upstream.

MATERIALS AND METHODS

Downstream dispersion by drift was studied

¹ Published with the approval of the Director of the Idaho Agricultural Experiment Station as Research Paper No. 833.

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