USDA
United States Department of Agriculture

Catalog of Species Introduced into Canada, Mexico, the USA, or the USA Overseas Territories for *Classical Biological Control of Arthropods*, 1985 to 2018

Roy Van Driesche, Matthew J.W. Cock, Rachel L. Winston,
Richard Reardon, and Ronald D. Weeks, Jr.

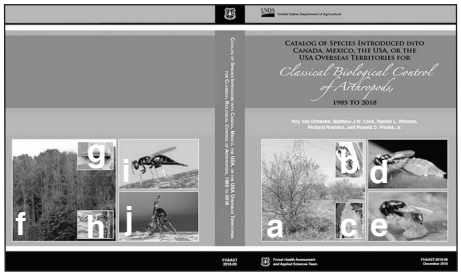
Forest Health Assessment
and Applied Sciences Team

FHAAST-2018-09
December 2018

The Forest Health Technology Enterprise Team (FHTET) was created in 1995 by the Deputy Chief for State and Private Forestry, USDA Forest Service, to develop and deliver technologies to protect and improve the health of American forests.

FHTET became Forest Health Assessment and Applied Sciences Team (FHAAST) in 2016. This booklet was published by FHAAST as part of the technology transfer series.

http://www.fs.fed.us/foresthealth/technology/



Cover Photos: a. dying citrus trees infected with citrus greening disease, transmitted by the invasive Asian citrus psyllid, *Diaphorina citri* (Credit: Mark Hoddle, UC Riverside); b. citrus psyllid adult (Credit: Mike Lewis, Center for Invasive Species Research, UC Riverside); c. citrus leaf with symptoms of citrus greening disease (Credit: Mark Hoddle, UC Riverside); d. adult *Tamarixia radiata* parasitizing citrus psyllid (Credit: Mike Lewis, Center for Invasive Species Research, UC Riverside); e. adult *Diaphorencyrtus aligarhensis* parasitizing citrus psyllid (Credit: Mike Lewis, Center for Invasive Species Research, UC Riverside); f. typical damage to native ash trees caused by an infestation of the invasive Asian emerald ash borer, *Agrilus planipennis* (Credit: USDA FS); g. emerald ash borer adult (Credit: Debbie Miller, USDA FS, bugwood.org); h. emerald ash borer larva feeding under the bark of ash, causing extensive phloem damage and tree girdling (Credit: USDA FS); i. adult *Tetrastichus planipennisi*, a larval parasitoid of emerald ash borer (Credit: USDA ARS); j. adult *Spathius galinae*, a larval parasitoid of emerald ash borer (Credit: USDA ARS)

Federal Recycling Program
Printed on Recycled Paper

Catalog of Species Introduced into Canada, Mexico, the USA, or the USA Overseas Territories for

Classical Biological Control of Arthropods, 1985 to 2018

Roy Van Driesche, Department of Environmental Conservation, University of Massachusetts, Amherst

Matthew J. W. Cock, CABI, Egham, Surrey, United Kingdom

Rachel L. Winston, MIA Consulting, Shelley, Idaho

Richard Reardon, USDA Forest Service, FHAAST, Morgantown, West Virginia

Ronald D. Weeks, Jr., USDA APHIS PPQ, Raleigh, North Carolina

FHAAST-2018-09
December 2018

How to cite this publication:

Van Driesche, R., M. J. W. Cock, R. L. Winston, R. Reardon, and R. D. Weeks, Jr. 2018. Catalog of Species Introduced into Canada, Mexico, the USA, or the USA Overseas Territories for Classical Biological Control of Arthropods, 1985 to 2018. USDA Forest Service, Forest Health Assessment and Applied Sciences Team, Morgantown, West Virginia. FHAAST-2018-09.

This publication is available online at:

https://www.fs.fed.us/foresthealth/technology/pdfs/FHAAST-2018-09_Catalog_Bio_Control_Arthropods.pdf

For additional copies of this publication, contact:

Richard Reardon FHAAST, USDA Forest Service, 180 Canfield Street, Morgantown, WV 26505. 304.285.1566; rreardon@fs.fed.us

Carol Bell Randall USDA Forest Service, Forest Health Protection, 2502 E. Sherman Ave, Coeur d'Alene, ID 83814 208.769.3051; crandall@fs.fed.us

Acknowledgments

The authors express thanks to the many people who answered emails about aspects of the releases documented in this publication. These include H. C. Arredondo-Bernal, Pedro Barbosa, Leah Bauer, Julio Bernal, Enrique Ruiz Cancino, Dick Casagrande, Ron Cave, Matthew Cock, Kent Daane, Andrea Diss-Torrance, Jian Duan, Alan Eaton, Joe Elkinton, Kathy Flanders, Howard Frank, H. B. Glenn, John Goolsby, Juli Gould, Elizabeth Grafton-Cardwell, Gitta Grosskopf-Lachat, David Hall, Nathan Havill, George Heimpel, Kevin Heinz, John Heraty, Stephen Hight, Mark Hoddle, Kim Hoelmer, Mike Hoffmann, Keith Hopper, Marshal Johnson, Peter Krauter, Zachary Lahey, Doug Landis, Stephen Lapointe, Lynn LeBeck, Norm Lepla, T. E. Marler, Mark Mayer, Albert Mayfield, Dick McDonald, Russell Messing, Jean Paul Michaud, Jocelyn Millar, Nick Mills, Michael Montgomery, David Morgan, Rangaswamy (Muni) Muniappan, Steve Naranjo, Jim Nechols, Ru Nguyen, Kelly Oten, Bill Overholt, Tim Paine, Jorge Peña, Charlie Pickett, Sanford Porter, Gadi Reddy, William Roltsch, Scott Salom, Don Sands, Phil Stansly, Fred Stephen, Lynell Tanigohsi, Liza Tewksbury, Robert Tichenor, Serguei Triapitsyn, Mike Ulyshen, Roger Vargas, Don Weber, Jim Woolley, Mark Wright, Robert Wright, Juliana Yalemar, Ken Yeargan, Greg Zolnerowich, and Robert Zuparko, who answered many emails and supplied otherwise unobtainable details.

Biocat and Matthew Cock's inputs were supported by CABI. CABI is an international intergovernmental organization that gratefully acknowledges the core financial support from their member countries (and lead agencies) including the UK (Department for International Development), China (Chinese Ministry of Agriculture), Australia (Australian Centre for International Agricultural Research), Canada (Agriculture and Agri-Food Canada), The Netherlands (Directorate-General for International Cooperation) and Switzerland (Swiss Agency for Development and Cooperation). See https://www.cabi.org/about-cabi/who-we-work-with/key-donors/ for details. The layout of this publication was designed by Rachel Winston (MIA Consulting).

Contents

Introduction

Purpose and Scope of Catalog

This catalog was created to complement the sister publication *Biological control of weeds: a world catalogue of agents and their target weeds* (www.ibiocontrol.org/catalog/), which has long provided a summary of agents introduced worldwide for the biocontrol of invasive plants. This new catalog focuses on insects introduced against arthropod pests since 1985. It differs further by being limited to North America (including Canada, Mexico, and the continental United States), Hawaii, and the USA overseas territories of Guam, Puerto Rico, the Northern Mariana Islands, and the U.S. Virgin Islands. The purpose of this catalog is to create a permanent, publicly accessible (both print and web-based) record of such releases, their outcomes, and the level of host specificity of the agents released. No such record currently exists within the literature or government records. Anticipated use of the catalog will be to review details of particular agents' history and, from the website, to extract information for analysis of trends in success, agent specificity, or other factors.

Description of Catalog Content

The catalog consists of four parts: (1) a table of released parasitoids, (2) a table of released predatory insects or mites, (3) text versions of the tabled information for better readability, and (4) references cited as documentation of details presented. The tables present information on the following topics:

1. **Scientific name and family of the agent,** including a partial discussion of synonyms of the agent that are used in the literature on its use in biocontrol.
2. **Year and location of first release and the country from which the agent was sourced**
    a. **Year:** Generally, only first releases of a new species are recorded. Second attempts to release a species that follow an earlier failed attempt are tracked in some cases. Releases made before 1985 are not included in this catalog.
    b. **Location of release:** The country or place of a release is given, including the state or province of first release if available. Primary geographic units include Canada, Mexico, and the USA as well as the USA overseas areas of Hawaii, Puerto Rico, Guam, the Northern Mariana Islands, and the U.S. Virgin Islands. Generally, no attempts are made to track state-by-state releases within the USA. Some releases in California are tracked separately in addition to releases in the eastern USA because California is a distinct ecoregion with a strong history of biological control activity.
    c. **Source population:** The country or region of origination for the released biocontrol agent is given if it could be determined. When the release material was not obtained directly from the agent's native range, the countries or regions from where it was obtained are given, preceded by "via". For example, "from Thailand via California for release in Mexico" indicates a species originally from Thailand and released in California was subsequently obtained in California for release in Mexico.
3. **Name and family of the target pest**
4. **List of recorded hosts or prey species for each agent,** either from host/prey range testing or the general entomological literature. Each entry in this section is headed by the acronym HRT for Host-range testing. "HRT+" indicates formal laboratory-based host range resting ***was*** conducted before release of the agent. "HRT-" indicates formal laboratory-based host-range testing ***was not*** done before the agent's release.
5. **Statement of the general level of the agent's specificity.** The taxonomic level listed is the smallest taxonomic unit that encompasses all known hosts or prey of the agent. This does not imply that ***all*** species within that taxonomic unit are hosts, but rather that it contains all the known hosts, and therefore

likely contains the host range. In general, the classification levels available for use in characterization of host specificity of agents are species, genus, family, two or more families in one order, or several orders. Following the taxonomic level selected to characterize the host range are further notes (given in parentheses) on the range of known hosts, including the number of host species and their respective number of genera . Additional notes on the agent's specificity are given in some cases.

   a. When the stated classification level is preceded by a "Possibly", the specificity of the agent may be at the indicated classification level; however, there are too few reports on the species to have confidence in it having that narrow of a host range.
   b. When the stated classification level is followed by a question mark (?), the host range appears to be confined to the single named classification level, but there are a small number of host records that fall outside the classification level, but for which the validity of the records seems uncertain or needs confirmation.
   c. The reader should bear in mind that host records based solely on laboratory tests without field confirmation indicate that the species is a physiological host, but it may not be attacked in nature due to the agent not overlapping with the species' range or being unable to find it in its normal habitat. Also, literature host records reported may in some cases be in error due to misidentification of the host (or prey) or the parasitoid (or predator).

6. **Statements on project outcome.** References are provided, where they exist, to document the agent's release, whether it established, and what impacts were recorded on the target pest that were ascribed to the agent. Each entry in this section is headed by the acronym R/E/I for quick referencing of Release, Establishment, and Impact.
   a. A plus sign "+" indicates the successful release or establishment of the agent or a measurable impact of the agent on its target organism.
   b. A negative sign "-" indicates the agent did not establish or that it has no measurable impact on the target.
   c. A question mark "E?" alone indicates it remains unknown if the agent established, while "I?" indicates that its impact on the target pest remains unknown. In these cases, no information on outcomes is available.
   d. A question mark in combination with a plus or minus sign, such as "E+?", indicates there is some evidence supporting the listed conclusion, but the evidence is either too limited or otherwise subject to some doubt.

Method of Obtaining Data

Names of species in tables. The list of species released (and thus included in tables) was generated from personal files of the first author, the CABI database *Biocat* (filtered for the relevant years and locations by Matthew Cock), and relevant records from a previous review article (Van Driesche and Hoddle, 2016). Information for Canada was particularly obtained from Mason and Huber (2002) and Mason and Gillespie (2013). Information for Mexico was particularly obtained from Arredondo Bernal and Rodríguez del Bosque (2008, 2015). For the United States, reviews from which records of new species releases were obtained included Nechols et al. (1995) for the western United States, Frank and McCoy (1993, 2007) for Florida, Barbosa et al. (1994) for Maryland, Funasaki et al. (1988) for Hawaii, and Nafus and Schreiner (1989) for the Northern Mariana Islands. In addition, email communication with biocontrol scientists led to discovery of many other released species. These sources are thanked in the Acknowledgments, but include especially H. C. Arredondo-Bernal, Enrique Ruiz Cancino, Kent Daane, Jian Duan, Alan Eaton, Joe Elkinton, Howard Frank, H. B. Glenn, Juli Gould, Nathan Havill, George Heimpel, Mike Hoffmann, Keith Hopper, Peter Krauter, T. E. Marler, Mark Mayer, Dick McDonald, Russell Messing, Jocelyn Millar, Nick Mills, Michael Montgomery, David Morgan, Steve Naranjo, Bill Overholt, Tim Paine, Jorge Peña, Sanford Porter, G. Reddy, William Roltsch, Don Sands, Phil Stansly, Serguei Triapitsyn, and Juliana Yalemar, who answered many emails and supplied otherwise unobtainable details.

Literature records for agents. For each agent whose first release was identified as being within the scope of the catalog, a CAB search was run (for all years, generally starting about 1910) without filters, and all abstracts under the agent's name were examined. Key articles were obtained and read fully. Information on synonyms for Chalicidoidea species were checked in the Universal Chalcidoidea Database (Noyes, 2017). The CAB abstracting service inserts modern names into old literature records, and therefore experience determined that separate searches using old synonyms were not required. Synonyms are nevertheless presented in this catalog as some biocontrol literature refers to agents by old names, and thus the species is likely more widely known under an outdated name. Names of scales (as hosts) were checked in ScaleNet. For agents introduced under names that were later changed because they later proved to be members of a species complex, taxonomic help was obtained to assure that statements were correctly ascribed to species names as currently understood. Help of this sort was received especially from K. Hopper for parasitoids of Russian wheat aphid (*Diuraphis noxia* [Kurdjumov]) and from Serguei Triapitsyn for parasitoids of glassy-wing sharpshooter (*Homalodisca vitripennis* [Germar]). Literature host or prey records were accepted at face value, recognizing that some may be erroneous due to incorrect identification of either the parasitoid (or predator) or its host (or prey). When records seemed to need confirmation before acceptance, that was stated in the tables. Particular care was taken to associate supporting references with each factual statement. Errors remaining are the first author's and can be corrected if recognized in the future via the web version of this catalog (northamericanbiocontrol.org). New species released in future years can also be added to the web version.

Table 1. Parasitoids introduced into Canada, Mexico, the USA, or the USA Overseas Territories between 1985 and 2018.

Note: Parasitoid host range may be erroneously expanded by misidentifications of either the host or parasitoid by original authors.

Acerophagus papayae Noyes and Schauff Encyrtidae

For species description, see Noyes and Schauff (2003). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED	2000 USA, Florida (from Mexico) (UF/IFAS factsheet, not dated)
TARGET PEST	*Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range estimation done before release. No other host records in literature. Noyes (2017) lists no other hosts.
HOST SPECIFICITY	**Family or lower** **Pseudococcidae** (known only from the target pest)
PROJECT OUTCOMES	**R+/E+/I+** **Release:** Released in Florida, USA (UF/IFAS factsheet, not dated; Amarasekare et al., 2009). **Establishment:** Established in Florida (UF/IFAS factsheet, not dated; Amarasekare et al., 2009). **Impact:** In a cage exclusion test after parasitoid establishment, a cohort of mealybugs was reduced by exposure to parasitism by 58% in the open-sleeve cage (vs. closed cage) and by 73% in the no-cage treatment. Two parasitoids contributed to control (*A. papayae* and *Anagyrus loecki* Noyes and Menzes), but 93% of parasitism was due to *A. papayae* (Amarasekare et al., 2009).

PUERTO RICO

YEAR/PLACE RELEASED	2000 USA, Puerto Rico (from Mexico via Florida USA quarantine) (UF/IFAS factsheet, not dated)
TARGET PEST	*Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range estimation done before release. No other host records in literature. Noyes (2017) lists no other hosts.
HOST SPECIFICITY	**Family or lower** **Pseudococcidae** (known only from the target pest)
PROJECT OUTCOMES	**R+/E+/I+** **Release:** Released in Puerto Rico (UF/IFAS factsheet, not dated). **Establishment:** Established in Puerto Rico (UF/IFAS factsheet, not dated). **Impact:** A group of 5 parasitoids were released and suppressed the mealybug density by 97%, with parasitism levels of 35–58% (Mani et al., 2012 [original sources unpub.]). The dominant parasitoid was *Acerophagus* sp. (Mani et al., 2012 [original sources unpub.]), later described as *A. papayae* (Noyes and Schauff, 2003).

GUAM

YEAR/PLACE RELEASED	2002 USA, Guam (from Mexico via Florida USA quarantine via Puerto Rico) (G. Reddy, pers. comm.; Meyerdirk et al., 2004)
TARGET PEST	*Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range estimation done before release. No other host records in literature. Noyes (2017) lists no other hosts.
HOST SPECIFICITY	**Family or lower** **Pseudococcidae** (known only from the target pest)
PROJECT OUTCOMES	**R+/E+/I+** **Release:** Released in Guam (G. Reddy, pers. comm.; Meyerdirk et al., 2004). **Establishment:** Established in Guam (G. Reddy, pers. comm.; Meyerdirk et al., 2004). **Impact:** In Guam, within 1 year, the mealybug density was reduced by 99% due to the group of parasitoids released (Meyerdirk et al., 2004).

Adelencyrtus oceanicus Doutt Encyrtidae

Noyes (2017) lists two synonyms: *Adelencyrtus oceanica* (Doutt]) and *Anabrolepis oceanica* Doutt.

GUAM

YEAR/PLACE RELEASED 1988–1989 USA, Guam (from two of the western Caroline Islands, Ulithi and Koror, [Muniappan and Marutani, 1989]; see also Doutt [1951] for original location of species detection and description)

TARGET PEST *Furcaspis oceanica* (Lindinger) Diaspididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. No other host records in literature. Noyes (2017) lists no other hosts.

HOST SPECIFICITY **Unknown**

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Guam (Muniappan and Marutani, 1989).
Establishment: Established in Guam (Lali and Muniappan, 1996).
Impact: In a 2002 survey (Muniappan et al., 2003), the released parasitoid, *A. oceanicus*, was found throughout Guam and the red coconut scale, *F. oceanica*, was at very low levels compared to a similar survey done in 1996 (Lali and Muniappan, 1996), and high rates of parasitism by *A. oceanicus* were detected in 2002 (Muniappan et al., 2003).

Ageniaspis citricola Logvinovskaya Encyrtidae

For species description, see Logvinovskaya (1983). The Taiwanese population known as *A. citricola* is likely a distinct species within a cryptic species complex (Hoy et al., 2000). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1994 USA, Florida (from Thailand via Australia) (Smith and Hoy, 1995)

TARGET PEST *Phyllocnistis citrella* Stainton Gracillariidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done relative to U.S. species before release. Specificity assumed based on testing in Australia against that fauna. For Australia, 0 non-target species were attacked from a test list including 1 *Phyllocnistis* leafminer, 4 gracillariid leafminers in other genera, and 14 other foliovores, leafminers, or gall makers in other families (Neale et al., 1995). No other host records in literature. Noyes (2017) lists no other hosts.

HOST SPECIFICITY **Unknown in relation to North American fauna**

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Florida, USA (Smith and Hoy, 1995; Hoy and Nguyen, 1997).
Establishment: Established in Florida (Pomerinke and Stansly, 1998).
Impact: Life table analysis showed that overall mortality was about 89% for the pest, dominated by ant predation on younger larvae. *Ageniaspis citricola* was the dominant parasitoid on older larvae (8–29%) but this was insufficient to check pest population growth in citrus, with a remaining innate rate of increase of about 2.8-fold per generation (Xiao et al., 2007). A similar study in Alabama (USA) again found predators to play a larger role than parasitoids in lifetables for this pest (Xiao and Fadamiro, 2010). However, a study by Hoy et al. (2007a) in central Florida citrus found that this parasitoid caused 33–39% mortality in leafminers in the summer flush and was an important mortality factor in the system. See also Michaud (2002a) for more on separating contributions of native predators and introduced parasitoids in this system.

MEXICO

YEAR/PLACE RELEASED 1997–1999 Mexico: Colima (1997), Veracruz (1999) (from Thailand via Australia via Florida USA) (Bautista-Martínez et al., 2008)

TARGET PEST *Phyllocnistis citrella* Stainton Gracillariidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done relative to Mexican species before release. Specificity assumed based on testing in Australia against that fauna. For Australia, 0 non-target species were attacked from a test list including 1 *Phyllocnistis* leafminer, 4 gracillariid leafminers in other genera, and 14 other foliovores, leafminers, or gall makers in other families (Neale et al., 1995). No other host records in literature. Noyes (2017) lists no other hosts.

HOST SPECIFICITY **Unknown in relation to North American fauna**

Ageniaspis citricola (continued)

MEXICO (continued)

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Mexico (Bautista-Martínez et al., 2008).
Establishment: Established in Colima, but not in Veracruz (Bautista-Martínez et al., 2008).
Impact: In Colima, rates of parasitism of 6–12% resulted, but it was judged that the introduction had limited impact on the pest's density (Bautista-Martínez et al., 2008).

Ageniaspis fuscicollis (Dalman) ENCYRTIDAE

Noyes (2017) lists various synonyms, principally (1) *Ageniaspis praysincola* Silvestri, (2) *Encyrtus cyanocephalus* (Bouché), (3) *Encyrtus cyanocephalus* Goureau, (4) *Encyrtus fuscicollis* Dalman, (5) *Holcothorax fuscicollis* (Dalman), (6) *Pteromalus cyanocephalus* Bouché, and other minor variations on the above.

CANADA

YEAR/PLACE RELEASED 1987–1990 Canada, British Columbia (from Switzerland) (Cossentine and Kuhlmann, 2002)

TARGET PEST *Yponomeuta malinellus* (Zeller) YPONOMEUTIDAE
(given formerly as *Hyponomeuta malinellus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Known literature hosts include twelve yponomeutids and one acrolepiid: (1) *Yponomeuta padella* L. (Hamiti et al., 2011); (2) *Prays oleae* (Bernard) (Kos and Trdan, 2011); (3) *Yponomeuta evonymellus* (L.) (Lee and Pemberton, 2009); (4) *Yponomeuta malinellus* Zeller (Lee and Pemberton, 2007); (5–8) as laboratory hosts: *Yponomeuta cagnagellus* (Hübner), *Yponomeuta rorellus* (Hübner), *Yponomeuta evonymellus*, and *Yponomeuta padellus* (probably *padella*) (Cleary and van Ginkel, 2004); (9) *Yponomeuta mahalebellus* Gershenzon (Slavgorodskaya-Kurpieva, 1986); (10) *Argyresthia pruniella* (Cl.) (Govoni, 1982); (11–12) *Yponomeuta irrorellus* (Hübner) and *Yponomeuta plumbellus* (Denis & Schiffermüller) (Mamedov and Makhmudova-Kurbanova, 1982); (13) *Yponomeuta cagnagella* (Hubner) (=*Yponomeuta cognatellus*) (Nenon, 1976); and (14), as a laboratory host, the acrolepiid moth *Acrolepiopsis assectella* (Zell.) (Pralavorio et al., 1977). Noyes (2017) lists 18 species of yponomeutids in 7 genera: 2 species of tortricids, 1 noctuid, and 2 coccids. The coccid records may need confirmation.

HOST SPECIFICITY **Family?**
Yponomeutidae (12 species in 3 genera, plus 1 species in another family used in laboratory mass-rearing)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in British Columbia, Canada (Cossentine and Kuhlmann, 2002).
Establishment: Established in British Columbia (Cossentine and Kuhlmann, 2002).
Impact: A correlative study showed an inverse relationship between parasitism by this species and pest density (Cossentine and Kuhlmann, 2000), with parasitism of the target pest up to 23% (Cossentine and Kuhlmann, 2007).

UNITED STATES

YEAR/PLACE RELEASED 1988–1991 USA, Washington state (from France, South Korea, China, and Russia) (Unruh et al., 2003)

TARGET PEST *Yponomeuta malinellus* (Zeller) YPONOMEUTIDAE
(given formerly as *Hyponomeuta malinellus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Known literature hosts include twelve yponomeutids and one acrolepiid: (1) *Yponomeuta padella* L. (Hamiti et al., 2011); (2) *Prays oleae* (Bernard) (Kos and Trdan, 2011); (3) *Yponomeuta evonymellus* (L.) (Lee and Pemberton, 2009); (4) *Yponomeuta malinellus* Zeller (Lee and Pemberton, 2007); (5–8) as laboratory hosts: *Yponomeuta cagnagellus* (Hübner), *Yponomeuta rorellus* (Hübner), *Yponomeuta evonymellus*, and *Yponomeuta padellus* (probably *padella*) (Cleary and van Ginkel, 2004); (9) *Yponomeuta mahalebellus* Gershenzon (Slavgorodskaya-Kurpieva, 1986); (10) *Argyresthia pruniella* (Cl.) (Govoni, 1982); (11–12) *Yponomeuta irrorellus* (Hübner) and *Yponomeuta plumbellus* (Denis & Schiffermüller) (Mamedov and Makhmudova-Kurbanova, 1982); (13) *Yponomeuta cagnagella* (Hubner) (=*Yponomeuta cognatellus*) (Nenon, 1976); and (14), as a laboratory host, the acrolepiid moth *Acrolepiopsis assectella* (Zell.) (Pralavorio et al., 1977). Noyes (2017) lists 18 species of yponomeutids in 7 genera: 2 species of tortricids, 1 noctuid, and 2 coccids. The coccid records may need confirmation.

Ageniaspis fuscicollis (continued)

UNITED STATES (continued)

HOST SPECIFICITY **Family?**
Yponomeutidae (12 species in 3 genera, plus 1 species in another family used in laboratory mass-rearing)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Washington state, USA (Unruh et al., 2003).
Establishment: Established in Washington state (Unruh et al., 2003).
Impact: Parasitism of the pest at 22 monitored sites in Washington increased from <5% in 1989 to nearly 25% after *A. fuscicollis* established and spread (by 1993), with more than 90% of the total parasitism being due to the introduced species. This increase in parasitism was accompanied by a decline in catch of male moths in pheromone traps from 10 per trap per day to about 1 per trap by 1995, suggesting substantial control of the pest over the 1989–1995 period (Unruh et al., 2003).

Ageniaspis testaceipes (Ratzburg) Encyrtidae

Noyes (2017) lists various synonyms, principally (1) *Ageniaspis nepticulae* (Mayr), (2) *Encyrtus testaceipes* Ratzeburg, (3) *Holcothorax nepticulae* Mayr, (4) *Holcothorax testaceipes* (Ratzeburg), (5) *Holcothorax vellutatus* Askew, and other minor variations on the above.

UNITED STATES

YEAR/PLACE RELEASED 1988 USA, Connecticut (from Japan via Canada) (Maier, 1993, 1994)

TARGET PEST *Phyllonorycter crataegella* (Clemens) Gracillariidae (formerly in *Lithocolletis*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Limited to the ecological niche of leafminers on deciduous trees. Most literature records are gracillariid leafmining moths in *Phyllonorycter*, including *P. blancardella* (F.) (Kadubowski, 1981), *P. ringoniella* (Matsumura) (Sun et al., 1987), and *P. pyrifoliella* (Gerasimov) (Kharchenko and Ryabchinskaya, 1995). However, one record is of the gelechiid (Lepidoptera) leafminer *Recurvaria syrictis* Meyrick (Cao and Guo, 1987). This last record needs verification. Noyes (2017) lists as hosts 22 species in Gracillariidae: 17 species of *Lithocolletis* and 5 species of *Phyllonorycter* that are not also listed as species of *Lithocolettis*, as well as 1 in Lyonetiidae and 1 in Nepticulidae.

HOST SPECIFICITY **Family?**
Gracillariidae (22 species in 2 genera, plus 3 records in other families). This is a parasitoid of leafmining moth larvae in mines on deciduous trees, especially gracillariid moths in *Lithocolletis* or *Phyllonorycter*.

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Connecticut, USA (Maier, 1993, 1994).
Establishment: Established in Connecticut, USA (Maier, 1993).
Impact: *Ageniaspis testaceipes* caused 12–22% parasitism but only in unsprayed orchards (Maier, 1993) and so did not reduce target pest in most commercial orchards.

Aleiodes nr *circumscriptus* (Nees) Braconidae

A species from the target pest in India on mango was later described as *A. circumscriptus* (Rajeshwari and Chacko, 1992). But the *circumscriptus* species group poses taxonomic problems, and issues may remain.

GUAM

YEAR/PLACE RELEASED 1986–1987 USA, Guam (from India) (Nafus, 1991)

TARGET PEST *Penicillaria jocosatrix* Guenée Noctuidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release.

HOST SPECIFICITY **Unknown**

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Guam (Nafus, 1991).
Establishment: This species did not establish in Guam (Nafus 1991).
Impact: This parasitoid, since it failed to establish, had no impact on the target pest. But other species of parasitoids introduced in this project did reduce the pest damage: (1) *Blepharella lateralis* Macquart (Tachinidae) and (2) *Euplectrus* nr *parvulus* Ferrière (Eulophidae) (Nafus, 1991).

Allotropa nr *mecrida* (Walker) PLATYGASTRIDAE

Species identity is uncertain.

UNITED STATES

YEAR/PLACE RELEASED 2003 USA, California (from Egypt, where it was the most common parasitoid of the pest [Gonzalez et al., 2003]) (Roltsch et al., 2006)

TARGET PEST *Maconellicoccus hirsutus* (Green) PSEUDOCOCCIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Four non-target species tested; no parasitism in 4 mealybugs from 3 other genera (*Pseudococcus*, *Paracoccus*, and *Phenacoccus*); 1 non-target species affected by host feeding (Roltsch et al., 2007). The related *Allotropa mecrida* is known from several mealybugs (e.g., *Planococcus citri* [Risso] [Niyazov, 1969], *Planococcus ficus* Signoret [Yasnosh et al., 2001], and *Phenacoccus mespili* Signoret [Ibadova, 1985]). However, it is not certain if the introduced species and *A. mecrida* are the same.

HOST SPECIFICITY **Genus?**
Pseudococcidae (species composition unknown due to uncertainties with agent identification)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (Roltsch et al., 2006).
Establishment: This species did not establish in California (Roltsch et al., 2006).
Impact: Not applicable

Amitus bennetti Viggiani & Evans PLATYGASTERIDAE

Species described from *Bemisia tabaci* (Viggiani and Evans, 1992).

UNITED STATES

YEAR/PLACE RELEASED 1990–1994 USA, Florida and later in the western USA (from Puerto Rico) (Hoelmer and Goolsby, 2003)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No field hosts recorded other than *Bemisia tabaci*.

HOST SPECIFICITY **Family or lower**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+?/I?**
Release: Released in Florida, USA (Nguyen, and Bennett, 1995).
Establishment: Potentially established in Florida (Nguyen, and Bennett, 1995).
Impact: In California, in field cages (stocked with parasitoids from Florida), *A. bennetti* caused 20–54% mortality on cotton and beans, respectively (Joyce and Bellows, 2000).

Anagyrus californicus (Compere) ENCYRTIDAE

Native to Central America and Mexico. Noyes (2017) lists two synonyms: *Apoanagyrus californicus* Compere and *Epidinocarsis californicus* (Compere).

UNITED STATES

YEAR/PLACE RELEASED 2000 USA, Florida (from Mexico) (UF/IFAS factsheet, not dated)

TARGET PEST *Paracoccus marginatus* Williams and Granara De Willink PSEUDOCOCCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Field host records include *Maconellicoccus hirsutus* Green in Cuba (Ceballos Vázquez et al., 2016) and *Phenacoccus solani* Ferris (Poinar, 1964). Noyes (2017) lists no other hosts.

HOST SPECIFICITY **Family**
Aleyrodidae (3 species in 3 genera)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Florida, USA (see UF/IFAS, undated, and grey literature cited therein; same information repeated in Mani et al. [2016]).
Establishment: Establishment in Florida is not recorded.
Impact: Impact in Florida is not recorded.

Anagyrus californicus (continued)

PUERTO RICO

YEAR/PLACE RELEASED 2000 USA, Puerto Rico (from Mexico via Florida USA quarantine) (UF/IFAS factsheet, not dated)

TARGET PEST *Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Field host records include *Maconellicoccus hirsutus* Green in Cuba (Ceballos Vázquez et al., 2016) and *Phenacoccus solani* Ferris (Poinar, 1964). Noyes (2017) lists no other hosts.

HOST SPECIFICITY **Family**
Aleyrodidae (3 species in 3 genera)

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Puerto Rico (see UF/IFAS factsheet, not dated, and grey literature cited therein; same information repeated in Mani et al. [2016]).
Establishment: Established in Puerto Rico (see UF/IFAS factsheet, not dated, and grey literature cited therein; same information repeated in Mani et al. [2016]).
Impact: As a group, the parasitoids released into Puerto Rico for control of papaya mealybug were highly successful, causing a 97% reduction at research sites in Puerto Rico, with parasitism levels between 35.5% and 58.3%. However, most of this impact was due to *Acerophagus papayae* Noyes and Schauff (UF/IFAS factsheet, not dated) and the role of *A. californicus*, if any, is unrecorded.

Anagyrus kamali Moursi Encyrtidae

For species description, see Moursi (1948). Noyes (2017) lists six synonyms: (1) *Anagyrus comperei* Subba Rao and Rai; (2) *Anagyrus flavidus* Shafee, Alam and Agarwal; (3) *Anagyrus flavus* Agarwal; (4) *Anagyrus hayati* Sushil and Khan; (5) *Anagyrus mohani* Sushil and Khan; and (6) *Anagyrus nigroradiclatus* Subba Rao and Rai.

PUERTO RICO

YEAR/PLACE RELEASED 1998 USA, Puerto Rico (from China and Hawaii USA—mixed colony) (W. Roltsch, pers. comm., California Department of Food and Agriculture)

TARGET PEST *Maconellicoccus hirsutus* Green Pseudococcidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Of 8 non-target mealybugs tested (*Planococcus citri* Risso, *Planococcus halli* Ezzat and McConnell, *Dysmicoccus brevipes* Cockerell, *Pseudococcus elisae* Borchsenius, *Saccharicoccus sacchari* [Cockerell], *Puto barberi* [Cockerell], *Nipaecoccus nipae* [Maskell], and *Plotococcus neotropicus* Williams & Granara de Willink), 2 non-target species of *Planococcus* were attacked but failed to support complete development (Sagarra et al., 2001). Noyes (2017) lists 6 additional mealybugs as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Formicococcus robustus* (Ezzat & McConnell), (3) *Naiacoccus serpentinus* Green, (4) *Nipaecoccus vastator* (Maskell), (5) *Nipaecoccus viridis* (Newstead), and (6) *Phenacoccus solenopsis* Tinsley.

HOST SPECIFICITY **Family**
Pseudococcidae (9 species in 7 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Puerto Rico (Kairo et al., 2000; Michaud and Evans, 2000).
Establishment: Established in Puerto Rico (Kairo et al., 2000).
Impact: Control of the pest was successful in Puerto Rico (Kairo et al., 2000; Michaud and Evans, 2000; W. Roltsch, pers. comm., California Department of Food and Agriculture).

Anagyrus kamali (continued)

UNITED STATES

YEAR/PLACE RELEASED 1999–2006 USA: California (1999), Florida (2000), Louisiana (2006) (from China, Hawaii USA, and Egypt—mixed colony) (W. Roltsch, pers. comm., California Department of Food and Agriculture; see also Roltsch et al., 2006)

TARGET PEST *Maconellicoccus hirsutus* Green PSEUDOCOCCIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Of 8 non-target mealybugs tested (*Planococcus citri* Risso, *Planococcus halli* Ezzat and McConnell, *Dysmicoccus brevipes* Cockerell, *Pseudococcus elisae* Borchsenius, *Saccharicoccus sacchari* [Cockerell], *Puto barberi* [Cockerell], *Nipaecoccus nipae* [Maskell], and *Plotococcus neotropicus* Williams & Granara de Willink), 2 non-target species of *Planococcus* were attacked but failed to support complete development (Sagarra et al., 2001). Noyes (2017) lists 6 additional mealybugs as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Formicococcus robustus* (Ezzat & McConnell), (3) *Naiacoccus serpentinus* Green, (4) *Nipaecoccus vastator* (Maskell), (5) *Nipaecoccus viridis* (Newstead), and (6) *Phenacoccus solenopsis* Tinsley.

HOST SPECIFICITY **Family**
Pseudococcidae (9 species in 7 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, Florida, and Louisiana in the USA (W. Roltsch, pers. comm., California Department of Food and Agriculture; Roltsch et al., 2006).
Establishment: Established in southern California (Rolsch et al., 2006). Establishment in Florida and Louisiana not recorded.
Impact: Control of the pest was successful in California, due to several released natural enemies (95% reduction); *A. kamali* was the dominant summer parasitoid with up to 50% parasitism; *Gyranusoidea indica* Shafee, Alam & Agarwal was an important winter parasitoid (Roltsch et al., 2006).

U.S. VIRGIN ISLANDS

YEAR/PLACE RELEASED 1999 USA, U.S. Virgin Islands (from China and Hawaii USA—mixed colony) (W. Roltsch, pers. comm., California Department of Food and Agriculture)

TARGET PEST *Maconellicoccus hirsutus* Green PSEUDOCOCCIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Of 8 non-target mealybugs tested (*Planococcus citri* Risso, *Planococcus halli* Ezzat and McConnell, *Dysmicoccus brevipes* Cockerell, *Pseudococcus elisae* Borchsenius, *Saccharicoccus sacchari* [Cockerell], *Puto barberi* [Cockerell], *Nipaecoccus nipae* [Maskell], and *Plotococcus neotropicus* Williams & Granara de Willink), 2 non-target species of *Planococcus* were attacked but failed to support complete development (Sagarra et al., 2001). Noyes (2017) lists 6 additional mealybugs as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Formicococcus robustus* (Ezzat & McConnell), (3) *Naiacoccus serpentinus* Green, (4) *Nipaecoccus vastator* (Maskell), (5) *Nipaecoccus viridis* (Newstead), and (6) *Phenacoccus solenopsis* Tinsley.

HOST SPECIFICITY **Family**
Pseudococcidae (9 species in 7 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in the U.S. Virgin Islands (Kairo et al., 2000).
Establishment: Established in the U.S. Virgin Islands (Kairo et al., 2000).
Impact: Control of the pest was successful in the U.S. Virgin Islands (Kairo et al., 2000; W. Roltsch, pers. comm., California Department of Food and Agriculture).

MEXICO

YEAR/PLACE RELEASED 1999 Mexico, Baja California (from China and Hawaii USA—mixed colony via Puerto Rico) (W. Roltsch, pers. comm., California Department of Food and Agriculture; Santiago-Islas et al., 2008)

TARGET PEST *Maconellicoccus hirsutus* Green PSEUDOCOCCIDAE

Anagyrus kamali (continued)

MEXICO (continued)

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Of 8 non-target mealybugs tested (*Planococcus citri* Risso, *Planococcus halli* Ezzat and McConnell, *Dysmicoccus brevipes* Cockerell, *Pseudococcus elisae* Borchsenius, *Saccharicoccus sacchari* [Cockerell], *Puto barberi* [Cockerell], *Nipaecoccus nipae* [Maskell], and *Plotococcus neotropicus* Williams & Granara de Willink), 2 non-target species of *Planococcus* were attacked but failed to support complete development (Sagarra et al., 2001). Noyes (2017) lists 6 additional mealybugs as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Formicococcus robustus* (Ezzat & McConnell), (3) *Naiacoccus serpentinus* Green, (4) *Nipaecoccus vastator* (Maskell), (5) *Nipaecoccus viridis* (Newstead), and (6) *Phenacoccus solenopsis* Tinsley.

HOST SPECIFICITY **Family**
Pseudococcidae (9 species in 7 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Baja California, Mexico (Santiago-Islas et al., 2008).
Establishment: Established in Mexico (Santiago-Islas et al., 2008).
Impact: Consequences of local mass releases of *A. kamali* (in combination with *Cryptolaemus montrouzieri* [Mulsant]) on *M. hirsutus* density were monitored in Mexico in several crops, and pest declines were observed that were at least in part due to *A. kamali* (Santiago-Islas et al., 2009).

Anagyrus loecki Noyes and Menzes Encyrtidae

Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 2000 USA, Florida (from Mexico) (UF/IFAS factsheet, not dated; Amarasekare et al., 2009)

TARGET PEST *Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists 2 additional mealybugs as hosts: (1) *Dysmicoccus* sp. and (2) *Phenacoccus madeirensis* Green.

HOST SPECIFICITY **Family**
Aleyrodidae (3 species in 3 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Florida, USA (UF/IFAS factsheet, not dated; Amarasekare et al., 2009).
Establishment: Established in Florida (UF/IFAS factsheet, not dated; Amarasekare et al., 2009).
Impact: In a cage exclusion test after establishment of several papaya mealybug parasitoids, a cohort of mealybugs was reduced by exposure to parasitism by 58% in the open-sleeve cage (vs. closed cage) and by 73% in the no-cage treatment. Two parasitoids contributed to control (*Acerophagus papayae* and *Anagyrus loecki*), but 93% of parasitism was due to *A. papayae* (Amarasekare et al., 2009).

PUERTO RICO

YEAR/PLACE RELEASED 2000 USA, Puerto Rico (from Mexico via Florida quarantine)

TARGET PEST *Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists 2 additional mealybugs as hosts: (1) *Dysmicoccus* sp. and (2) *Phenacoccus madeirensis* Green.

HOST SPECIFICITY **Family**
Aleyrodidae (3 species in 3 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Puerto Rico (UF/IFAS factsheet, not dated).
Establishment: Established in Puerto Rico (UF/IFAS factsheet, not dated).
Impact: A group of 5 parasitoids were released and suppressed the mealybug density by 97%, with parasitism levels of 35–58% (Mani et al., 2012 [original sources unpub.]). However, the dominant parasitoid was *Acerophagus* sp. Mani et al., 2012 [original sources unpub.]), later described as *A. papayae* (Noyes and Schauff, 2003). While *A. loecki* established, its value to control is not reported.

Anagyrus loecki (continued)

GUAM

YEAR/PLACE RELEASED 2002 USA, Guam (from Mexico via Florida quarantine via Puerto Rico) (Meyerdirk et al., 2004)

TARGET PEST *Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists 2 additional mealybugs as hosts: (1) *Dysmicoccus* sp. and (2) *Phenacoccus madeirensis* Green.

HOST SPECIFICITY **Family**
Aleyrodidae (3 species in 3 genera)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Guam (Meyerdirk et al., 2004).
Establishment: Establishment not recorded in Guam.
Impact: The complex of parasitoids released reduced the pest by 99% within one year, but most of the impact was due to *Acerophagus papayae* Noyes and Schauff (Meyerdirk et al., 2004). The contribution of *A. loecki* to control is not reported.

Anagyrus pseudococci Girault Encyrtidae

This species was described as *Epidinocarsis pseudococci* by Girault (1915) and appears to be identical with the species introduced in about 1999 to California from Argentina (Tryapitzyn and Tryapitzyn, 1999; Triapitsyn et al., 2007). Other forms in the literature under this name are a separate entity (Triapitsyn et al., 2007). "*Anagyrus pseudococci*" was introduced in the 1948–1956 period to California from Brazil against *Planococcus citri* and later recovered (Bartlett and Lloyd, 1958) and this is now believed to be a distinct, unnamed species (Triapitsyn et al., 2007). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms or literature hosts.

UNITED STATES

YEAR/PLACE RELEASED About 1999 USA, California (from Argentina) (Tryapitzyn and Tryapitzyn, 1999)

TARGET PEST *Planococcus ficus* (Signoret) Pseudococcidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Testing was done with *A.* nr *pseudococci* against its co-evolved native host, *Planococcus ficus*, the Afrotropical *Planococcus citri* (Risso), the Australasian *Pseudococcus calceolariae* (Maskell), the Neotropical *Pseudococcus viburni* Signoret, and the Neotropical *Phenacoccus peruvianus* Granara de Willink. The parasitoid completed development in all species to varying degrees, with the lowest rates in *P. viburni* and *P. peruvianus* (Bugila et al., 2015). Field hosts of entities given as "*A. pseudococci*" or "*A.* nr *pseudococci*" but not "the *A. pseudococci* group" include (1) *Rastrococcus iceryoides* Green (Tanga et al., 2016); (2) *Planococcus citri* (Risso) (Attia and Awadallah, 2016); (3) *Pseudococcus cryptus* Hempel (Yigit and Telli, 2013); (4) *Nipaecoccus viridis* Newstead (Ghanbari et al., 2013); (5) *Lecanodiaspis africana* Newstead (Lecanodiaspididae) (Morsi, 2010); (6) *Pseudococcus comstocki* (Kuwana) (Guerrieri and Pellizzari, 2009); (7) *Delottococcus confusus* (DeLotto) (Pseudococcidae) (Leandro et al., 2008); (8) *Planococcus vovae* (Nasonov) (Lotfalizadeh and Ahmadi, 2000); (9) *Saccharicoccus sacchari* (Cockerell) (Abd-Rabou, 2000a); (10) *Pseudococcus affinis* (Maskell) (Islam and Jahan, 1992); (11) *Antonina graminis* (Maskell) (Gabriel, 1983); (12) *Phenacoccus gossypii* Townsend & Cockerell (Coquis and Salazar, 1975); (13) *Nipaecoccus vastator* (Maskell) (El-Haidari et al., 1974).

HOST SPECIFICITY **Family?**
Pseudococcidae (16 species in 8 genera, plus one record in the Lecanodiaspididae). Note also that the named species (*Anagyrus pseudococci*, as used here for the entity introduced in 1999 to California by Tryapitzyn and Tryapitzyn [(1999]) is confused in the literature with other forms also given as *Anagyrus pseudococci*. Therefore, the breadth of host range of the entity introduced in 1999 to California is not certain.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in California, USA (Tryapitzyn and Tryapitzyn, 1999).
Establishment: Established in California (Tryapitzyn and Tryapitzyn, 1999).
Impact: No information available.

Anagyrus nr *pseudococci* Girault Encyrtidae

This undescribed species is not the same as *A. pseudococci* and is recognized by place of origin, being either Spain or Israel, in contrast to *A. pseudococci*, which is originally from Argentina, but also is adventive in parts of Italy (Sicily) (S. Triapitsyn, pers. comm.). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms or literature hosts.

MEXICO

YEAR/PLACE RELEASED 2001 Mexico, Sonora (from a commercial insectary in Spain) (Klotz et al., 2002; Fu-Castillo, 2008)

TARGET PEST *Planococcus ficus* (Signoret) Pseudococcidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Testing was done with *A.* nr *pseudococci* against its co-evolved native host, *Planococcus ficus*, the Afrotropical *Planococcus citri* (Risso), the Australasian *Pseudococcus calceolariae* (Maskell), the Neotropical *Pseudococcus viburni* Signoret, and the Neotropical *Phenacoccus peruvianus* Granara de Willink. The parasitoid completed development in all species to varying degrees, with the lowest rates in *P. viburni* and *P. peruvianus* (Bugila et al., 2015). Field hosts of entities given as "*A. pseudococci*" or "*A.* nr *pseudococci*" but not "the *A. pseudococci* group" include (1) *Rastrococcus iceryoides* Green (Tanga et al., 2016); (2) *Planococcus citri* (Risso) (Attia and Awadallah, 2016); (3) *Pseudococcus cryptus* Hempel (Yigit and Telli, 2013); (4) *Nipaecoccus viridis* Newstead (Ghanbari et al., 2013); (5) *Lecanodiaspis africana* Newstead (Lecanodiaspididae) (Morsi, 2010); (6) *Pseudococcus comstocki* (Kuwana) (Guerrieri and Pellizzari, 2009); (7) *Delottococcus confusus* (DeLotto) (Pseudococcidae) (Leandro et al., 2008); (8) *Planococcus vovae* (Nasonov) (Lotfalizadeh and Ahmadi, 2000); (9) *Saccharicoccus sacchari* (Cockerell) (Abd-Rabou, 2000a); (10) *Pseudococcus affinis* (Maskell) (Islam and Jahan, 1992); (11) *Antonina graminis* (Maskell) (Gabriel, 1983); (12) *Phenacoccus gossypii* Townsend & Cockerell (Coquis and Salazar, 1975); (13) *Nipaecoccus vastator* (Maskell) (El-Haidari et al., 1974).

HOST SPECIFICITY **Family?**
Pseudococcidae (16 species in 8 genera, plus one record in the Lecanodiaspididae). The host range of *Anagyrus* nr *pseudococci* is not certain due to confusion with another entity given in the literature as *Anagyrus pseudococci*.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Sonora, Mexico (Klotz et al., 2002; Fu-Castillo, 2008).
Establishment: Established in Mexico (Fu-Castillo, 2008).
Impact: No information available.

Anaphes nitens (Girault) Mymaridae

Noyes (2017) lists five synonyms: (1) *Anaphes gonipteri* (Ferrière), (2) *Anaphoidea gonipteri* Ferrière, (3) *Anaphoidea nitens* Girault, (4) *Patasson nitens* (Girault), (5) *Yungaburra nitens* (Girault), and some related variations of these names.

UNITED STATES

YEAR/PLACE RELEASED 1994 USA, California (from Australia; proximal source not clear)

TARGET PEST *Gonipterus scutellatus* Gyllenhal Curculionidae
See Mapondera et al. (2012) for notes on cryptic species in this genus.

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. The only other literature host records are *Gonipterus gibberus* Boisduval (Sanches, 2000) and *Gonipterus platensis* (Noyes, 2017).

HOST SPECIFICITY **Genus**
Curculionidae (3 species in 1 genus, *Gonipterus*)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Hanks et al., 2000).
Establishment: Established in California (Hanks et al., 2000).
Impact: In California, this parasitoid caused 95% egg parasitism and controlled the pest (Hanks et al., 2000).

Apanteles murinanae Čapek and Zwölfer BRACONIDAE

CANADA

YEAR/PLACE RELEASED 1990 eastern Canada (from Europe)

TARGET PEST *Choristoneura fumiferana* (Clemens) TORTRICIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. This species was collected from the closely related species, *Choristoneura murinana* (Hűbner), and, after confirming its ability to develop in the target host, was released in Canada as a single release (Smith et al., 2002). The only other known field host is *Eucosma nigricana* (H.-S.), another tortricid of similar biology as *C. murinana*, with which it shares a common tree host and habitat (Čapek, 1961).

HOST SPECIFICITY **Family**
Tortricidae (3 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in eastern Canada (Smith et al., 2002).
Establishment: Did not establish in eastern Canada (Smith et al., 2002).
Impact: Not applicable

Aphantorhaphopsis samarensis (Villeneuve) TACHINIDAE
(formerly in *Ceranthia*)

CANADA

YEAR/PLACE RELEASED 1991 Canada, Ontario, New Brunswick (from Europe) (Nealis and Quednau, 1996; Nealis et al., 2002)

TARGET PEST *Lymantria dispar* (L.) EREBIDAE: LYMANTRIINAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Apart from the target host, only one literature record exists: *Orgyia recens* (Hübner) (Lymantriinae) (Fuester et al., 2014). Based on laboratory host-range testing and field collections in Europe, Fuester et al (2001) describe the host range as limited to 2 genera, *Lymantria* and *Orgyia*.

HOST SPECIFICITY **Subfamily**
Erebidae (Lymantriinae) (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in eastern Canada (Mills and Nealis, 1992; Nealis and Quednau, 1996).
Establishment: Did not establish in Canada (Fuester et al., 2014).
Impact: Not applicable

UNITED STATES

YEAR/PLACE RELEASED 1992 USA, northeastern states (from Europe) (Fuester et al., 2014)

TARGET PEST *Lymantria dispar* (L.) EREBIDAE: LYMANTRIINAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release (Fuester et al., 2001). Apart from the target host, only one literature record exists: *Orgyia recens* (Hübner) (Lymantriinae) (Fuester et al., 2014). Based on laboratory host-range testing and field collections in Europe, Fuester et al. (2001) describe the host range as limited to 2 genera, *Lymantria* and *Orgyia*.

HOST SPECIFICITY **Subfamily**
Erebidae (Lymantriinae) (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in the northeastern United States (Fuester et al., 2014).
Establishment: Did not establish in North America (Fuester et al., 2014).
Impact: Not applicable

Aphelinoidea anatolica Nowicki Trichogrammatidae

Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1995 USA, California (from Iran) (Walker et al., 1997)

TARGET PEST *Circulifer tenellus* (Baker) Cicadellidae (formerly in *Neoaliturus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts are recorded in the literature. Noyes (2017) lists no additional species as hosts.

HOST SPECIFICITY **Unknown**

PROJECT OUTCOMES **R+/E+/I-**
Release: This species was first released in the United States in 1951 (Huffaker et al., 1954), but establishment did not occur. A second release was made in 1995 (Walker et al., 1997).
Establishment: Established in California (Bayoun et al., 2008).
Impact: Levels of parasitism of beet leafhopper eggs from *A. anatolica* were too low to contribute significantly to control (Bayoun et al., 2008).

Aphelinoidea turanica Trjapitzin Trichogrammatidae

For species description, see Trjapitzin (1994). Noyes (2017) lists one synonym: *Aphelinoidea scythica* Fursov.

UNITED STATES

YEAR/PLACE RELEASED 1993 USA, California (from Turkmenistan) (Walker et al., 1997)

TARGET PEST *Circulifer tenellus* (Baker) Cicadellidae (formerly in *Neoaliturus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts are recorded in the literature. Noyes (2017) lists no additional species as hosts.

HOST SPECIFICITY **Unknown**

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in California, USA (Walker et al., 1997).
Establishment: Established in California (Bayoun et al., 2008).
Impact: Levels of parasitism of beet leafhopper eggs from *A. turanica* were too low to contribute significantly to control (Bayoun et al., 2008).

Aphelinus asychis Walker Aphelinidae

Species identity of *A. asychis* relative to other closely related populations was initially unknown but was determined after introduction in further studies (Kazmer et al., 1996; Zhu and Fang, 2009). Because of confusion as to which species within *Aphelinus* were released against Russian wheat aphid (RWA), statements made here on species identities (and as a consequence, literature hosts) were confirmed by Jim Woolley, Texas A&M and Keith Hopper, USDA directly, rather than relying on Noyes (2017). That clarified events as follows: only two species of *Aphelinus* are known to have been released against RWA in the USA: (1) *Aphelinus asychis*, which may have been present in the United States from the 1960s, but regardless, it turned out not to be very important; and (2) *Aphelinus atriplicis*, which established and is the most abundant introduced RWA parasitoid, but which is widely misreported in field studies in the literature as *Aphelinus albipodus* (Hayat & Fatima). Species that were not released, but whose names appear in the USA RWA literature were *Aphelinus albipodus* and *Aphelinus varipes* (Foerster). The former species does not occur geographically in the areas from which RWA parasitoids were collected for use in the USA, and the latter species does not attack RWA (Hopper et al., 2017). Another species, *Aphelinus hordei* (Kurdjumov), is a highly specific parasitoid of RWA (Hopper et al., 2017) that may have been accidentally included in shipments of RWA parasitoids to the USA but misidentified at the time. As such, it may have been released, but there is no clear evidence to prove that or of its current presence in the USA (K. Hopper, pers. comm.).

UNITED STATES

YEAR/PLACE RELEASED 1990–1992 USA: Texas (1990) (Michels and Whitaker-Deerberg, 1993); many western states (1992) (Elliott et al., 1995; Burd et al., 2001) (from France, China, and Kazakhstan)

TARGET PEST *Diuraphis noxia* (Kurdjumov) Aphididae (Russian wheat aphid, RWA)

Aphelinus asychis (continued)

UNITED STATES (continued)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Older literature host records may be unreliable due to confusion in separating members of the species complex. Hosts recorded under this name since Kazmer et al. (1996)'s definition of the species include the following species listed here; however, some of these records may still refer to other closely related parasitoids: (1) *Myzus persicae* (Sulzer) (Milevoj, 1996); (2) 14 or 15 aphid species of 16 tested were attacked and supported development in laboratory trials (Elliott et al., 1999); (3) *Schizaphis graminum* (Rondani) (Rao et al., 1999); (4) *Chromaphis juglandicola* (Kaltenbach) (Talebi et al., 2002); (5) *Macrosiphum euphorbiae* Thomas) (Snyder et al., 2004); (6) *Aphis gossypii* Glover (Schirmer, 2006); (7) *Nasonovia ribisnigri* (Mosley) (Valério et al., 2006); (8) *Aphis glycines* Matsumura (Kaiser et al., 2007); (9) *Aulacorthum solani* (Kaltenbach) (Sanchez et al., 2011). Safe to non-aphids, but many non-target aphids in Aphididae are attacked, on a variety of plants (Hopper et al., 2017). Population impacts on these non-target aphids unknown.

HOST SPECIFICITY **Family**
Aphididae

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Colorado and other western U.S. states (Elliott et al., 1995; Burd et al., 2001) and in Texas, USA (Michels and Whitaker-Deerberg, 1993).
Establishment: Appears to be established in Colorado and surrounding states (Elliott et al., 1995; Burd et al., 2001), in Texas (Michels and Whitaker-Deerberg, 1993), and in Washington state (Pike et al., 1997). However, given that *A. asychis* from Europe was released in Texas and Oklahoma in the 1960s for control of *Schizaphis graminum*, it is not clear that the *A. asychis* released against *D. noxia* established. It (regardless of origin) was not recovered in high numbers from RWA in sampling by K. Hopper or others (K. Hopper, pers. comm.).
Impact: While present, this species was only a minor parasitoid of Russian wheat aphid in the northcentral USA plains in 2001–2002, ca 9–10 years after release (Noma et al., 2005; see also Burd and Puterka, 2012). It was infrequently detected by Brewer et al. (2005) in the USA Great Plains region, suggesting it is of minor or no importance for control of RWA in that area.

Aphelinus atriplicis Kurdjumov Aphelinidae

Because *Aphelinus atriplicis*, after its release and collection in the western USA, was routinely misidentified as *Aphelinus albipodus* (Hayat & Fatima), much of the documentation of *A. atriplicis*' effect on Russian wheat aphid (RWA) populations is reported under the name *A. albipodus*, a species that likely has never been released in the USA (K. Hopper, pers. comm.). Because of confusion as to which species within *Aphelinus* were released against Russian wheat aphid (RWA), statements made here on species identities (and as a consequence, literature hosts) were confirmed by Jim Woolley, Texas A&M and Keith Hopper, USDA directly, rather than relying on Noyes (2017). That clarified events as follows: only two species of *Aphelinus* are known to have been released against RWA in the USA: (1) *Aphelinus asychis*, which may have been present in the United States from the 1960s, but regardless, it turned out not to be very important; and (2) *Aphelinus atriplicis*, which established and is the most abundant introduced RWA parasitoid, but which is widely misreported in field studies in the literature as *Aphelinus albipodus* (Hayat & Fatima). Species that were not released, but whose names appear in the USA RWA literature were *Aphelinus albipodus* and *Aphelinus varipes* (Foerster). The former species does not occur geographically in the areas from which RWA parasitoids were collected for use in the USA, and the latter species does not attack RWA (Hopper et al., 2017). Another species, *Aphelinus hordei* (Kurdjumov), is a highly specific parasitoid of RWA (Hopper et al., 2017) that may have been accidentally included in shipments of RWA parasitoids to the USA but misidentified at the time. As such, it may have been released, but there is no clear evidence to prove that or of its current presence in the USA (K. Hopper, pers. comm.).

UNITED STATES

YEAR/PLACE RELEASED 1992 USA, many western states (from Central Asia) (Hopper et al., 1998; Prokrym, 1998; Heraty et al., 2007)

TARGET PEST *Diuraphis noxia* (Kurdjumov) Aphididae (Russian wheat aphid, RWA)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records unreliable due to confusion in separating members of species complex. Safe to non-aphids, but many non-target aphids in Aphididae are attacked, on a variety of plants (Hopper et al., 2017). Population impacts on these non-target aphids are unknown.

HOST SPECIFICITY **Family**
Aphididae

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in the western United States (Hopper et al., 1998; Prokrym, 1998; Heraty et al., 2007).
Establishment: This species is widely established in the western United States on Russian wheat aphid (K. Hopper, pers. comm. and references cited for release).
Impact: This is the most important introduced, established parasitoid of RWA in the western USA. However, much of the literature has misidentified it as *Aphelinus albipodus* (K. Hopper, pers. comm.).

Aphelinus glycinis Hopper and Woolley Aphelinidae

UNITED STATES

YEAR/PLACE RELEASED 2012 USA, Minnesota (from China) (Hopper and Diers, 2014)

TARGET PEST *Aphis glycines* Matsumura Aphididae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. No non-target attacks on aphids outside of the genus *Aphis* (based on testing 5 species in 4 other genera) (Hopper, 2010; USDA APHIS, 2012). Of 7 non-target *Aphis* species, 4 were suitable for parasitism, while 3 were not (Hopper, 2010; USDA APHIS, 2012).

HOST SPECIFICITY **Genus**
Aphididae (4 species in 1 genus, *Aphis*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Minnesota, USA (Hopper and Diers, 2014).
Establishment: Did not establish in Minnesota (G. Heimpel, pers. comm.).
Impact: Not applicable

Aphelinus spiraecolae Evans & Schauff Aphelinidae

For species description, see Evans et al. (1995). Noyes (2017) lists no other synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1995 USA, Florida (from Guangdong Province, China) (see Table 2, p. 159 of Frank and McCoy, 2007)

TARGET PEST *Aphis spiraecola* Patch Aphididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Other literature hosts include *Aphis gossypii* Glover and *Toxoptera aurantii* (Boyer de Fonscolombe) (Yokomi and Tang, 1995). Noyes (2017) lists no additional species as hosts.

HOST SPECIFICITY **Family**
Aphididae (3 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Florida, USA (see Table 2, p. 159 of Frank and McCoy, 2007).
Establishment: No evidence for establishment in Florida (see Table 2, p. 159 of Frank and McCoy, 2007).
Impact: Not applicable

Aphidius colemani Viereck Braconidae

HAWAII

YEAR/PLACE RELEASED 1999 USA, Hawaii (from Australia) (R. Messing, pers. comm.; Acebes and Messing, 2013a)

TARGET PEST *Aphis gossypii* Glover Aphididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. The species is known to attack only aphids, which provides adequate specificity for use in Hawaii, as Hawaii has no native aphids. Literature host records are summarized by Benelli et al (2014) and include 21 aphid species, in 13 genera, especially species in the genus *Aphis*.

HOST SPECIFICITY **Family**
Aphididae (21 species in 13 genera, especially *Aphis*). This is a polyphagous pantropical aphid parasitoid, commonly used for augmentative biocontrol of aphids in greenhouses in many countries (van Lenteren, 2012).

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Hawaii (Acebes and Messing, 2013a).
Establishment: Established in Hawaii (Acebes and Messing, 2013a; Messing and Klungness, 2001).
Impact: On taro (*Colocasia esculenta* L.), *A. colemani* parasitism of *A. gossypii* was very low (<3%), likely due to high levels of hyperparasitism and high levels of fungal infections in aphids (Rhainds and Messing, 2005).

Aphidius rhopalosiphi de Stefani-Perez BRACONIDAE

UNITED STATES

YEAR/PLACE RELEASED	1988–1992 USA, Washington state (from Turkey and Morocco) (Tanigoshi et al., 1995)
TARGET PEST	*Diuraphis noxia* (Kurdjumov) APHIDIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release. Biotypes of this species may exist that have different host ranges (Höller, 1991). Hosts recorded in the literature include (1) *Schizaphis graminum* (Rondani) (Gruber et al., 1994) and (2–4) *Rhopalosiphum padi* (L.), *Sitobion avena* (Fabricius), and *Metopolophium dirhodum* (Walker) (Rakhshani et al., 2008).
HOST SPECIFICITY	**Family** **Aphididae** (5 species in 5 genera; perhaps just species in the Aphidini and Macrosiphini [Cameron et al., 2013])
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in Washington state, USA (Tanigoshi et al., 1995). **Establishment:** Assumed not to have established in Washington state. **Impact:** Not applicable

Aphytis sankarani Rosen and DeBach APHELINIDAE

For species description, see Rosen and DeBach (1986). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED	2002 USA, Florida (from Thailand) (see Table 4, pp. 153 & 164 of Frank and McCoy, 2007)
TARGET PEST	*Pseudaulacaspis cockerelli* (Cooley) DIASPIDIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release. Noyes (2017) lists 2 additional species as hosts: *Aonidiella aurantii* Maskell and *Parlatoria pergandii* Comstock.
HOST SPECIFICITY	**Family** **Diaspididae** (3 species in 3 genera)
PROJECT OUTCOMES	**R+/E+/I?** **Release:** Released in Florida, USA (see Table 4, pp. 153 & 164 of Frank and McCoy, 2007). **Establishment:** Established in Florida (H. Glenn, pers. comm. [TREC, Homestead] to Howard Frank [Univ. Florida, Dept. Entomology and Nematology]). **Impact:** No information available.

Aphytis yanonensis DeBach & Rosen APHELINIDAE

For species description, see DeBach and Rosen (1982). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED	1990–1995 USA, Massachusetts, New Jersey (from China) (Van Driesche et al., 1998a; Matadha et al., 2003)
TARGET PEST	*Unaspis euonymi* (Comstock) DIASPIDIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release. Known field hosts include *Unaspis yanonensis* (Kuwana) (Diaspididae) (DeBach and Rosen, 1982) and the target pest, from which it is was reared in quarantine from *U. euonymi* collected in China (Van Driesche, unpub. data), while *Quadraspidiotus perniciosus* (Comstock) (Diaspididae) is a laboratory host (Matadha et al., 2005). Noyes (2017) lists no additional species as hosts.
HOST SPECIFICITY	**Genus?** **Diaspididae** (2 species in 1 genus [*Unaspis*], plus 1 species in another genus used as a laboratory-rearing host)
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in Massachusetts (Van Driesche et al., 1998a) and New Jersey, USA (Matadha et al., 2003). **Establishment:** Not established in Massachusetts (O'Reilly and Van Driesche, 2009) or New Jersey. (Matadha et al., 2005). **Impact:** Not applicable

Aprostocetus vaquitarum (Wolcott) Eulophidae

Previously misidentified in the literature as *Tetrastichus gala* (Walker) or *Aprostocetus gala*, a different species attacking leafhopper or cecidomyiid fly eggs. Noyes (2017) lists one synonym: *Tetrastichus vaquitarum* Wolcott.

UNITED STATES

YEAR/PLACE RELEASED 2000 USA, Florida (from the Dominican Republic) (Peña et al., 2004; Jacas et al., 2005)

TARGET PEST *Diaprepes abbreviatus* (L.) Curculionidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Wolcott (1924) describes this parasitoid and records it as parasitizing eggs of the weevil *Lachnopus coffeae* Marshall in Puerto Rico. Post-release studies determined that the native root weevil *Pachnaeus litus* (Germar), a minor pest of citrus, is a suitable host (in the laboratory) for *A. vaquitarum*, but another native weevil and minor pest of citrus in Florida, *Artipus floridanus* Horn, was not. Both weevils have oviposition habits similar to *D. abbreviatus* (Jacas et al., 2010). Noyes (2017) lists one additional host species, *Donacivola saccharella* (Lepidoptera: Elaschisidae), which needs confirmation.

HOST SPECIFICITY **Family?**
Curculionidae (3 species in 3 genera, plus 1 record in another family that is in need of confirmation). It is believed this parasitoid attacks eggs of weevils whose eggs are concealed in plant tissues.

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Florida, USA (Peña et al., 2004; Jacas et al., 2005).
Establishment: Established in southern Florida (Peña et al., 2004; Jacas et al., 2005).
Impact: At release sites in the Miami/Dade County area of southern Florida, levels of parasitism of the pest's eggs were 70–90% (Peña et al., 2004).

Aroplectrus dimerus Lin Eulophidae

Noyes (2017) lists no synonyms.

HAWAII

YEAR/PLACE RELEASED 2010 USA, Hawaii (from Taiwan) (J. Yalemar, pers. comm., Hawaii Department of Agriculture)

TARGET PEST *Darna pallivitta* (Moore) Limacodidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing was done before release. None of the 25 non-target Lepidoptera tested in Hawaii were attacked. There are no native limicodids in Hawaii. Tests included species in 13 families with 2 endemic species and 19 immigrant pests (HDOA, 2007). *Aroplectrus dimerus* has been recorded attacking 6 limacodids in the Philippines (Cock et al., 1987): (1) *Darna mindanensis* Holloway, (2) *Penthocrates albicapitata* Holloway, (3) *Penthocrates rufa* Holloway, (4) *Penthocrates rufofascia* Holloway, (5) *Penthocrates styx* Holloway, and (6) *Penthocrates zelaznyi* Holloway. In India, the limacodid *Parasa bicolor* Walker is also a recorded host (Singh et al., 1988). Noyes (2017) lists no additional species as hosts.

HOST SPECIFICITY **Family**
Limacodidae (7 species in 3 genera). In Hawaii there are no native limacodids.

PROJECT OUTCOMES **R+/E+/I+**
Release: Released widely in Hawaii from 2010–2013 (J. Yalemar, pers. comm., Hawaii Department of Agriculture).
Establishment: The parasitoid is now established throughout Hawaii (J. Yalemar, pers. comm., Hawaii Department of Agriculture).
Impact: By 2011, pest larval numbers had declined by 80–100% in HDOA survey sites (J. Yalemar, pers. comm., Hawaii Department of Agriculture).

Banacuniculus utilis (Beardsley) Figitidae: Eucoilinae

One synonym: *Ganaspidium utilis*, which is the name under which literature appears.

GUAM

YEAR/PLACE RELEASED 1985 USA, Guam (from Texas USA via Hawaii USA) (Beardsley, Jr. 1988; Johnson and Wilson, 1995)

TARGET PEST *Liriomyza trifolii* (Burgess) Agromyzidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. The only other host recorded in the literature is *Liriomyza sativae* Blanchard (Beardsley, Jr. 1988). All species in *Ganaspidium* are parasitoids of agromyzids (Buffington, 2004, 2010).

Banacuniculus utilis (continued)

GUAM (continued)

HOST SPECIFICITY **Genus**
Agromyzidae (2 species in 1 genus, *Liriomyza*)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Guam (Johnson and Wilson, 1995).
Establishment: Established in Guam (Johnson and Wilson, 1995).
Impact: "It became the dominant parasitoid on beans, where it parasitizes up to 78% of all the *L. trifolii* larvae infesting the crop. Leafminer densities decreased dramatically and are no longer a problem in unsprayed bean plantings" (Johnson and Wilson, 1995).

Binodoxys brevicornis (Haliday) BRACONIDAE: APHIDIINAE

(formerly in *Trioxys*)

UNITED STATES

YEAR/PLACE RELEASED 1989–1990 USA, California (from the former Czechoslovakia) (Starý, 1990)

TARGET PEST *Brachycorynella asparagi* (Mordvilko) APHIDIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Hosts from the literature include aphids in several genera: (1) *Myzus cerasi* (F.) (Wimshurst, 1925); (2) *Cavariella* sp. (Tremblay, 1975); and (3) *Hyadaphis coriandri* (Das) (Mescheloff and Rosen, 1993).

HOST SPECIFICITY **Family**
Aphididae (4 species in 4 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Daane et al., 1992, 1995a).
Establishment: Established in some counties in California (Daane et al., 1992, 1995a).
Impact: Impact limited (about 10% parasitism, shortly after release) (Daane et al., 1992).

Binodoxys communis (Gahan) BRACONIDAE: APHIDIINAE

For separation from other members of species complex see Desneux et al. (2009a).

UNITED STATES

YEAR/PLACE RELEASED 2006 USA, Minnesota (from China) (Wyckhuys et al., 2009)

TARGET PEST *Aphis glycines* Matsumura APHIDIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. In laboratory host-range testing related to work in Minnesota, Desneux et al (2009b) found that 8 *Aphis* species and 1 non-*Aphis* aphid species tested were suitable for parasitism (Desneux et al., 2009). See also Desneux et al. (2012) for information on determinants of host specificity in *B. communis*. In laboratory host-range testing in Hawaii, 2 non-native *Aphis* species were highly suitable while 4 non-native, non-*Aphis* species were either not suitable or marginally so (Acebes and Messing, 2013b). Hosts from the literature include (1) *Aphis gossypii* Glover (Shi, 1980); (2) *Aphis citricola* van der Goot (Ng and Starý, 1986); (3) *Toxoptera citricidus* (Kirkaldy) (Calilung, 2008); and (4) *Pentalonia nigronervosa* Coquerel (Lomerio and Calilung, 2008).

HOST SPECIFICITY **Family**
Aphididae (15 species [including the target] in 4 genera [*Aphis*, *Rhopolosiphum*, *Toxoptera*, and *Pentalonia*], with most species [10] being in *Aphis*). For native *Aphis* spp, risk modeling based on ant-tending and phenological overlap suggest high exposure for *Aphis asclepiades* Fitch, but low exposure for *Aphis oestlundi* Gillette; ant tending suggests medium exposure for *Aphis monardae* Oestlund (Wyckhuys et al., 2007).

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Minnesota, USA (Wyckhuys et al., 2009).
Establishment: Not established in Minnesota, likely due to loss of effective diapause mechanisms (Gariepy et al., 2015).
Impact: Not applicable

Binodoxys communis (continued)

HAWAII

YEAR/PLACE RELEASED 2010 USA, Hawaii (from China via Minnesota USA) (R. Messing, pers. comm.; Acebes, 2011)

TARGET PEST *Aphis gossypii* Glover Aphididae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. In laboratory host-range testing in Hawaii, 2 non-native *Aphis* species were highly suitable while 4 non-native, non-*Aphis* species were either not suitable or marginally so (Acebes and Messing, 2013b). In laboratory host-range testing related to work in Minnesota, Desneux et al (2009b) found that 8 *Aphis* species and 1 non-*Aphis* aphid species tested were suitable for parasitism (Desneux et al., 2009). See also Desneux et al. (2012) for information on determinants of host specificity in *B. communis*. Hosts from the literature include (1) *Aphis gossypii* Glover (Shi, 1980); (2) *Aphis citricola* van der Goot (Ng and Starý, 1986); (3) *Toxoptera citricidus* (Kirkaldy) (Calilung, 2008); and (4) *Pentalonia nigronervosa* Coquerel (Lomerio and Calilung, 2008).

HOST SPECIFICITY **Family**
Aphididae (15 species [including the target] in 4 genera [*Aphis*, *Rhopolosiphum*, *Toxoptera*, and *Pentalonia*], with most species [10] being in *Aphis*). Safe for use in Hawaii because there are no native aphids or weed biocontrol aphids in Hawaii.

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Hawaii (Acebes, 2011).
Establishment: Established in Hawaii (Acebes, 2011).
Impact: Parasitism remained low, perhaps due to high levels of hyperparasitism, and there was no change in the pest's density (Acebes, 2011).

Blepharella lateralis Macquart Tachinidae

GUAM

YEAR/PLACE RELEASED 1986–1987 USA, Guam (from India) (Nafus, 1991)

TARGET PEST *Penicillaria jocosatrix* Guenée Noctuidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Hosts recorded in the literature include (1) *Euproctis lunata* (Walker) (Erebidae) (Battu and Dhaliwal, 1977); (2) *Spilosoma obliqua* Walker (Erebidae) (Kumar and Yadav, 1987); and (3) *Olepa* (formerly *Pericallia*) *ricini* (Fabricius) (Arctiidae) (Venkatesha et al., 1993).

HOST SPECIFICITY **Order**
Lepidoptera: Noctuidae (the target pest), **Arctiidae** (1 species), **Erebidae** (2 species in 2 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Guam (Nafus, 1991).
Establishment: Established in Guam (Nafus, 1991).
Impact: "The wasps *Aleiodes* sp. [given here as *Aleiodes* nr *circumscriptus*] and *Euplectrus* sp. [given here as *Euplectrus* nr *parvulus*] and the fly *Blepharella lateralis* were released. *Aleiodes* sp. did not establish, but *Euplectrus* sp. and *B. lateralis* did. [Due to the 2 established species,] populations of the pest fell to 25% of their pre-release levels. Parasitism rates ranged from 20 to 99%. *Euplectrus* sp. was the most abundant parasitoid …[and] was more abundant in the dry season, whereas *B. lateralis* was more common in the wet season. Fruit production on monitored trees increased significantly" (Nafus, 1991). Positive foodweb effects also occurred that benefitted other mango-feeding Lepidoptera after decline of the pest species (Schreiner and Nafus, 1992, 1993).

Bracon compressitarsis Wharton BRACONIDAE

UNITED STATES

YEAR/PLACE RELEASED	1988 USA, Texas (from Mexico) (P. Krauter, pers. comm., Texas A and M University, Dept Entomology)
TARGET PEST	*Anthonomus grandis* Boheman CURCULIONIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release. Hosts recorded in the literature are species of *Anthonomus* weevils in Mexico (Wharton, 1983).
HOST SPECIFICITY	**Genus** **Curculionidae** (various species in 1 genus, *Anthonomus*)
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in Texas, USA (P. Krauter, pers. comm., Texas A and M University, Dept Entomology). **Establishment:** Did not establish in Texas (P. Krauter, pers. comm., Texas A and M University, Dept Entomology). **Impact:** Not applicable

Callibracon limbatus (Brullé) BRACONIDAE

UNITED STATES

YEAR/PLACE RELEASED	1995 USA, California (from Australia) (Paine et al., 1995)
TARGET PEST	*Phoracantha semipunctata* (F.) CERAMBYCIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release. No other hosts are known from the literature. It is reputed to be limited to wood-boring larvae in species of eucalyptus trees (Hanks et al., 2001).
HOST SPECIFICITY	**Unknown** Too little research exists on this species to predict the host range, which may be Cerambycidae or some lower level within the family.
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in California, USA (Paine et al., 1995). **Establishment:** Did not establish in California (J. Millar, pers. comm.). **Impact:** Not applicable

Cephalonomia stephanoderis Betrem BETHYLIDAE

For species description, see Betrem (1961).

MEXICO

YEAR/PLACE RELEASED	1988 Mexico (from Ivory Coast, West Africa) (Barrera et al., 1990a, 2008)
TARGET PEST	*Hypothenemus hampei* (Ferrari) CURCULIONIDAE: SCOLYTINAE (formerly in *Stephanoderes*)
HOST RANGE EVIDENCE	**HRT+** Laboratory host-range testing was done before release to determine which species might be suitable alternative hosts for laboratory rearing. Two alternative laboratory-rearing species, *Caulophilus oryzae* (Gyllenhal) and *Sitophilus* sp., successfully supported parasitoid development (Pérez-Lachaud and Hardy, 2001).
HOST SPECIFICITY	**Genus?** **Curculionidae** (1 species in 1 genus [*Hypothenemus*], plus 2 species in 2 genera used as laboratory-rearing hosts)
PROJECT OUTCOMES	**R+/E+/I?** **Release:** Released in Mexico (Barrera et al., 1990a, 2008). **Establishment:** Established in Mexico (Barrera et al., 1990b). **Impact:** In Guatemala (near to release areas in Mexico), large releases of *C. stephanoderis* reduced berry infestation from 2.7–5.3% (1993) to 0.4–0.9% (1994), and 1.6–2.4% (1995), compared to control plot infestations of 2.8, 2.8, and 3.5%, a reduction of 75 and 48% from year to year (García and Barrios, 1996). However, field evaluations are based on augmentative releases and so do not measure effects of self-reproducing populations.

Ceranisus menes (Walker) Eulophidae

Noyes (2017) lists nine synonyms: (1) *Asecodes aculeo* (Walker), (2) *Ceranisus brui* (Vuillet), (3) *Ceranisus rosilloi* De Santis, (4) *Ceranisus vinctus* (Gahan), (5) *Epomphale menes* (Walker), (6) *Euderomphale menes* (Walker), (7) *Pteroptrix menes Walker*, (8) *Thripoctenus brui* Vuillet, and (9) *Thripoctenus vinctus* Gahan.

UNITED STATES

YEAR/PLACE RELEASED
1992–1993 USA, Florida (two strains, from Thailand and Japan) (Loomans and van Lenteren, 1995, based on R. Baranowski, pers. comm., Prof. Emeritus, Dept. of Entomology and Nematology, University of Florida, Gainesville). These two strains were introduced into Florida to improve the biocontrol of the target pest, despite the fact that the species *C. menes* was already in Florida at the time (Frank and McCoy, 2007).

TARGET PEST
Thrips palmi Karny Thripidae

HOST RANGE EVIDENCE
HRT-
No laboratory host-range estimation done before release. This is a cosmopolitan parasitoid known to attack thrips species in at least 12 genera (see pp. 103–104 of Loomans and van Lenteren, 1995). Noyes (2017) lists 18 species of Thripidae as hosts: (1) *Ceratothripoides claratris* (Shumsher), (2) *Frankliniella intonsa* Trybom, (3) *Frankliniella occidentalis* (Pergande), (4) *Frankliniella schultzei* Trybom, (5) *Isoneurothrips fullawayi* Moulton, (6) *Kakothrips pisivorus* (Westwood), (7) *Kakothrips robustus* (Uzel), (8) *Megalurothrips sjostedti* Trybom, (9) *Megalurothrips usitatus* (Bagnall), (10) *Microcephalothrips abdominalis* (Crawford), (11) *Pseudodendrothrips mori* (Niwa), (12) *Scirtothrips citri* (Moulton), (13) *Scirtothrips perseae* Nakahara, (14) *Taeniothrips alliorum* Priesner, (15) *Taeniothrips longistylus* Karny, (16) *Thrips flavus* Schrank, (17) *Thrips tabaci* Lindeman, and (18) *Toxothrips ricinus* L.

HOST SPECIFICITY
Family
Thripidae (at least 18 species in 12 genera). In addition, Noyes (2017) lists one species of cecidomyiid fly and one cynipid wasp, both of which seem unlikely hosts without confirmation.

PROJECT OUTCOMES
R+/E?/I?
Release: Released in Florida, USA (Loomans and van Lenteren, 1995, based on R. Baranowski, pers. comm., Prof. Emeritus, Dept. of Entomology and Nematology, University of Florida, Gainesville).
Establishment: Some recoveries were made in Florida at release sites, but establishment of released strains could not be determined due to prior existence of the species in Florida and lack of molecular markers to separate the new and old strains (Frank and McCoy, 2007).
Impact: No information available.

Ceratogramma etiennei Delvare Trichogrammatidae

For species description, see Delvare (1998). Noyes (2017) lists one synonym: *Szelenyia etiennei* (Delvare).

UNITED STATES

YEAR/PLACE RELEASED
1998 USA, Florida (from Guadeloupe in the Caribbean) (Hall et al., 2001; see p. 159 of Frank and McCoy, 2007)

TARGET PEST
Diaprepes abbreviatus (L.) Curculionidae

HOST RANGE EVIDENCE
HRT+
Laboratory host-range testing was done before release. No parasitism of 7 non-target species of lepidopteran eggs or those of 1 non-target species of weevil (Peña et al., 2010). Noyes (2017) lists no other species as hosts.

HOST SPECIFICITY
Possibly Genus or higher
Curculionidae (known only from the target pest). *Diaprepes abbreviatus* likely parasitizes eggs of various weevils concealed in plant tissues. Insufficient work has been done to know for sure that this species has genus-level specificity.

PROJECT OUTCOMES
R+/E-/I-
Release: Released in Florida, USA (Hall et al., 2001; see p. 159 of Frank and McCoy, 2007).
Establishment: While some initial recoveries were made, long term establishment did not occur in Florida (Frank and McCoy, 2007; Peña et al., 2010; see also Amalin et al., 2004).
Impact: Not applicable

Cirrospilus ingenuus Gahan EULOPHIDAE

For species description, see Gahan (1932). Noyes (2017) lists three synonyms: *Cirrospilus quadristriata* (Subba Rao and Ramamani), *Cirrospilus quadristriatus* (Subba Rao and Ramamani), and *Scotolinx quadristriata* Subba Rao and Ramamani.

UNITED STATES

YEAR/PLACE RELEASED	1994 USA, Florida (from Thailand, and from Taiwan via Australia) (Smith and Hoy, 1995; LaSalle et al., 1999)
TARGET PEST	*Phyllocnistis citrella* Stainton GRACILLARIIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done relative to U.S. species before release; specificity was assumed based on testing in Australia against that fauna. For Australia, 0 non-target species were attacked from a test list including 1 *Phyllocnistis* leafminer, 4 gracillariid leafminers in other genera, and 14 other foliovores, leafminers, or gall makers in other families (Neale et al., 1995). The weevil *Rhynchaenus mangiferae* Marshal (Curculionidae) (Peter and Balasubramanian, 1984) is listed as a field host, but this record may be a misidentification and needs confirmation. In addition to the target pest, Noyes (2017) lists as hosts one unspecified agromyzid fly and one lyonetiid leafminer, *Leucoptera coffeella* (Guérin-Mèneville).
HOST SPECIFICITY	**Unknown in relation to North American fauna**
PROJECT OUTCOMES	**R+/E+/I-** **Release:** Released in Florida, USA (Smith and Hoy, 1995; LaSalle et al., 1999). **Establishment:** Established in Florida (LaSalle et al., 1999; Hoy, 2005). **Impact:** *Cirrospilus ingenuus* had no apparent effect on the target's density; another parasitoid released in the same project, *Ageniaspis citricola*, became the dominant introduced-parasitoid attacking citrus leafminer in Florida (Hoy, 2005).

Citrostichus phyllocnistoides (Narayanin) EULOPHIDAE

Noyes (2017) lists four synonyms: *Cirrospiloideus phyllocnistoides* (Narayanan), *Cirrospilus phyllocnistidis* Narayanan, *Cirrospilus phyllocnistoides* Narayanan, and *Tetrastichus phyllocnistoides* (Narayanan).

UNITED STATES

YEAR/PLACE RELEASED	2006 USA, Florida (from Southeast Asian via Spain) (P. Stansly, pers. comm.)
TARGET PEST	*Phyllocnistis citrella* Stainton GRACILLARIIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done relative to U.S. species before release; specificity was assumed based on testing in Australia against that fauna. For Australia, 0 non-target species were attacked from a test list including 1 *Phyllocnistis* leafminer, 4 gracillariid leafminers in other genera, and 14 other foliovores, leafminers, or gall makers in other families (Neale et al., 1995. Field hosts of *Citrostichus phyllocnistoides* listed in the literature include (1) the psyllid *Trioza obsoleta* (Buckton) (Dash and Das, 1997), but this record may be a misidentification and needs confirmation; (2) a *Stigmella* sp. leafminer (Nepticulidae) (Massa et al., 2001), after the parasitoid's introduction to Europe and the Middle East; and (3–4) *Cosmopterix pulcherimella* Chambers (Cosmopterigidae) and a *Liriomyza* leafminer (Agromyzidae) (Rizzo et al., 2006). Noyes (2017) also lists one additional species as a host, *Acalyptris minimella* (Scoble) (Nepticulidae).
HOST SPECIFICITY	**Two Orders?** **LEPIDOPTERA** (1 leafminer in each of **Gracillariidae**, **Nepticulidae**, and **Cosmopterigidae**) and **DIPTERA** (1 leafminer in **Agromyzidae**); plus 1 record of a psyllid (*Trioza obsoleta*) in the Hemiptera in need of confirmation
PROJECT OUTCOMES	**R+/E+/I-** **Release:** Released in Florida, USA (P. Stansly, pers. comm.). **Establishment:** Established in Florida (P. Stansly, pers. comm.). **Impact:** *Citrostichus phyllocnistoides* had little impact on citrus leafminer in Florida, as another biocontrol agent released in the same project, *Ageniaspis citricola*, became the dominant introduced-parasitoid attacking citrus leafminer in Florida (Hoy, 2005).

Coccobius fulvus (Compere and Annecke) Aphelinidae

Noyes (2017) lists three synonyms: *Coccobius mcdonaldi* Shafee, Siddiqui and Rizvi; *Physcus albipodus* Agarwal; and *Physcus fulvus* Compere and Annecke. For a revision of the genus *Coccobius*, see Wang et al. (2014).

UNITED STATES

YEAR/PLACE RELEASED 1997–1998 USA, Florida (from Thailand) (Howard and Weissling, 1999)

TARGET PEST *Aulacaspis yasumatsui* Takagi Diaspididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. In addition to *A. yasumasui* (Howard and Weissling, 1999), *C. fulvus* is reported from additional diaspidid scales: (1) *Unaspis yanonensis* (Takagi, 1991; Matsumoto et al., 2004) and (2) *Unaspis euonymi* (Van Driesche et al., 1998a). A literature record also exists of *Parthenolecanium corni* Bouché (Coccidae) (Basheer et al., 2011). In addition, Noyes (2017) lists 4 more diaspidids as hosts: (1) *Aonidiella orientalis* (Newstead), (2) *Lepidosaphes beckii* (Newman), (3) *Aulacaspis crawii* (Cockerell), and (4) *Pinnaspis strachani* (Cooley).

HOST SPECIFICITY **Family?**
Diaspididae (7 species in 6 genera, plus 1 record of a host in the Coccidae that needs confirmation since it is not found in Noyes [2017])

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Florida, USA (Howard and Weissling, 1999).
Establishment: Established in Florida (Howard and Weissling, 1999).
Impact: *Coccobius fulvus* did not suppress cycad scale (the target pest) in Florida.

GUAM

YEAR/PLACE RELEASED 2002 USA, Guam (from Thailand via Florida USA) (G. Reddy, pers. comm.)

TARGET PEST *Aulacaspis yasumatsui* Takagi Diaspididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. In addition to *A. yasumasui* (Howard and Weissling, 1999), *C. fulvus* is reported from additional diaspidid scales: (1) *Unaspis yanonensis* (Takagi, 1991; Matsumoto et al., 2004) and (2) *Unaspis euonymi* (Van Driesche et al., 1998a). A literature record also exists of *Parthenolecanium corni* Bouché (Coccidae) (Basheer et al., 2011). In addition, Noyes (2017) lists 4 more diaspidids as hosts: (1) *Aonidiella orientalis* (Newstead), (2) *Lepidosaphes beckii* (Newman), (3) *Aulacaspis crawii* (Cockerell), and (4) *Pinnaspis strachani* (Cooley).

HOST SPECIFICITY **Family?**
Diaspididae (7 species in 6 genera, plus 1 record of a host in the Coccidae that needs confirmation since it is not found in Noyes [2017])

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Guam (G. Reddy, pers. comm.).
Establishment: Establishment in Guam not confirmed (T. Marler, pers. comm.).
Impact: No known effect on the scale on Guam.

Coccobius nr *fulvus* Aphelinidae

Also given as *Physcus* nr *fulvus*. *Coccobius* nr *fulvus* may be the same as *Coccobius fulvus*. This is consistent with a recent revision of Chinese *Coccobius* (Wang et al., 2014). However, direct genetic comparisons have not been made. For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1990–1995 USA, Massachusetts (from China) (Van Driesche et al., 1998a)

TARGET PEST *Unaspis euonymi* (Comstock) Diaspididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. For lack of confirmed species identity, Noyes (2017) could not be consulted for literature hosts.

HOST SPECIFICITY **Family?**
Diaspididae (species composition unknown due to uncertainties with agent identification)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Massachusetts, USA (Van Driesche et al., 1998a).
Establishment: Established in Massachusetts (O'Reilly and Van Driesche, 2009).
Impact: An average of 21% parasitism was observed 12–16 years after release (O'Reilly and Van Driesche, 2009).

Cosmocomoidea spp.

In the literature, five species of *Gonatocerus* (now all *Cosmocomoidea*) seem to have been released in California against *Homalodisca vitripennis*, the glassy-wing sharpshooter (GWSS). However, subsequent development of molecular information showed that some species were native species or otherwise were already present there. The five species found in the literature in relation to introductions against GWSS in California are (1) *Cosmocomoidea* (*Gonatocerus*) *ashmeadi*, (2) *C.* (*G.*) *fasciata* (*fasciatus* if combined with *Gonatocerus*), (3) *C.* (*G.*) *triguttata* (*triguntatus* if combined with *Gonatocerus*), (4) *C.* (*G.*) *morrilli* Howard, and (5) *C.* (*G.*) *walkerjonesi* S. Triapitsyn. In summary, for these, we can note that:

C.* (*G.*) *ashmeadi was found in California before it was released there. It may be a native species in California, or it may have invaded California as early as 1978 on nursery plants (as parasitized sharpshooter eggs on plants), where it adapted to *Homalodisca liturata* Ball (Vickerman et al., 2014; Triapitsyn, 2006) before the GWSS invasion. In either case, it is included here as an introduction. It is widespread and important. The southern and southeastern USA strains of *C. ashmeadi* were released in California against *H. vitripennis* (Morgan et al., 2002; Pilkington et al., 2005; Triapitsyn, 2006).

C.* (*G.*) *fasciata was found as a pre-existing species in northern California but not in southern California. It was released in the southern part of the state from the southeastern USA but did not establish (S. Triapitsyn, pers. comm.; D. Morgan, pers. comm., California Department of Food and Agriculture).

C.* (*G.*) *morrilli populations from Texas and Tamaulipas (Mexico) were supposedly introduced into California (Triapitsyn, 2002; Pilkington et al. 2005) although a later report (de León and Morgan 2007) indicated that it was a native species (i.e., *G. walkerjonesi* sp. n. described below) that actually had been released in California due to contamination of the cultures of the insectary-reared *G. morrilli* with this similarly looking species (narrative by S. Triapitsyn).

C.* (*G.*) *triguttata was introduced into California against *H. vitripennis* (initially from Tamaulipas, Mexico and then from Texas) and established in California (Morgan et al., 2000; Morgan et al., 2002; Triapitsyn, 2002; Pilkington et al., 2005; Triapitsyn, 2006).

C.* (*G.*) *walkerjonesi is the dominant parasitoid of GWSS in coastal areas of California (Lytle and Morse, 2012). It was not introduced into California, but in some earlier reports, it was mis-reported as *C.* (*G.*) *morrilli* (S. Triapitsyn, pers. comm.). It is believed to be a species native to the state.

Cosmocomoidea ashmeadi (Girault) MYMARIDAE

The change from *Gonatocerus* to *Cosmocomoidea* follows Huber (2015). Noyes (2017) lists three synonyms: *Gonatocerus ashmeadi* Girault, *Gonatocerus dolichocerus ashmeadi* Girault, and *Lymaenon ashmeadi* (Girault).

UNITED STATES

YEAR/PLACE RELEASED
2001 USA, California (from Louisiana USA and Mexico) (D. Morgan, pers. comm., California Department of Food and Agriculture; Boyd and Hoddle, 2007)

TARGET PEST
Homalodisca vitripennis (Germar) CICADELLIDAE (glassy-wing sharpshooter, GWSS) (formerly *Homalodisca coagulata*)

HOST RANGE EVIDENCE
HRT-
No laboratory host-range estimation done before release. Retrospective host-range testing done in California found that *Homalodisca liturata* Ball was a physiologically acceptable host, but that *Draeculacephala minerva* Ball and *Graphocephala atropunctata* (Signoret) were not (Boyd and Hoddle, 2007). Field surveys found no parasitism of *G. atropunctata* or *D. minerva* eggs by *C. ashmeadi* in native habitats in southern California (Boyd and Hoddle, 2007). Noyes (2017) lists 5 additional hosts: (1) *Cuerna costalis* (Fabricius), (2) *Homalodisca lacerta* (Fowler), (3) *Oncometopia clarior* (Walker), (4) *Oncometopia orbona* Hopper, and (5) *Oncometopia undata* (Fabricius).

HOST SPECIFICITY
Family
Cicadellidae (7 species in 3 genera)

PROJECT OUTCOMES
R+/E+?/I+?
Release: Released in California, USA (Boyd and Hoddle, 2007; but see also Vickerman et al. [2014] and Triapitsyn [2006] for context as either a native species or an earlier natural invasion).
Establishment: Large numbers were released in California by the joint USDA-APHIS and CDFA program, mainly in the San Joaquin Valley. *Cosmocomoidea ashmeadi* is found widely in California (Vickerman et al., 2014), but since we cannot separate what was introduced from what was already there, we cannot say if the introduced population established.
Impact: Now the dominant parasitoid of this pest in interior areas of southern California (Lytle and Morse, 2012), causing up to 100% parasitism in samples (Vickerman et al., 2014). It is less abundant in the spring host generation for phenological reasons (Triapitsyn and Phillips, 2000; Vickerman et al., 2014).

Cosmocomoidea fasciata (Girault) Mymaridae

The change from *Gonatocerus* to *Cosmocomoidea* follows Huber (2015). Noyes (2017) lists two synonyms: *Gonatocerus fasciatus* Girault and *Lymaenon fasciatus* (Girault).

UNITED STATES

YEAR/PLACE RELEASED 2006 USA, California (from southeastern USA) (D. Morgan, pers. comm., California Department of Food and Agriculture; S. Triapitsyn, pers. comm.)

TARGET PEST *Homalodisca vitripennis* (Germar) Cicadellidae (glassy-wing sharpshooter, GWSS) (formerly *Homalodisca coagulata*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. However, retrospectively, host-range testing done in California found that *Homalodisca liturata* Ball and *Draeculacephala minerva* Ball were physiologically acceptable hosts, but that *Graphocephala atropunctata* (Signoret) was not (Boyd and Hoddle, 2007). Field surveys failed to reveal parasitism of *G. atropunctata* or *D. minerva* eggs by *C. fasciata* in native habitats in southern California (Boyd and Hoddle, 2007). Literature host records include *Oncometopia orbona* (Fabricius) (Triapitsyn et al., 2003). Noyes (2017) lists 2 additional species as hosts: (1) *Homalodisca liturata* Ball and (2) *Paraulacizes irrorata* (Fabricius).

HOST SPECIFICITY **Family**
Cicadellidae (4 species in 3 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: This species was present as a native species in northern California USA, but not present at the time of release in southern California, where it was released (S. Triapitsyn, pers. comm.).
Establishment: Establishment did not occur in southern California (S. Triapitsyn, pers. comm.; D. Morgan, pers. comm., California Department of Food and Agriculture).
Impact: Not applicable

Cosmocomoidea triguttata (Girault) Mymaridae

The change from *Gonatocerus* to *Cosmocomoidea* follows Huber (2015). Noyes (2017) lists two synonyms: *Gonatocerus triguttatus* Girault and *Gonatocerus triguttus* Girault.

UNITED STATES

YEAR/PLACE RELEASED 2000 USA, California (from southeastern USA and northeastern Mexico) (D. Morgan, pers. comm., California Department of Food and Agriculture; S. Triapitsyn, pers. comm.)

TARGET PEST *Homalodisca vitripennis* (Germar) Cicadellidae (glassy-wing sharpshooter, GWSS) (formerly *Homalodisca coagulata*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Triapitsyn and Phillips (2000) state that hosts are likely limited to the genera *Homalodisca* and *Oncometopia*. Literature hosts include *H. vitripennis* in Tamaulipas, Mexico (Triapitsyn and Phillips, 2000) and *Oncometopia nigricans* Walker in Florida (USA) (Triapitsyn et al., 2002). Noyes (2017) lists 5 additional species as hosts: (1) *Homalodisca lacerta* (Fowler), (2) *Homalodisca liturata* Ball, (3) *Oncometopia clarior* (Walker), (4) *Pseudometopia amblardii* (Signoret), (5) and *Pseudometopia phalaesia* (Distant).

HOST SPECIFICITY **Family**
Cicadellidae (7 species in 3 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in California, USA (S. Triapitsyn, pers. comm.).
Establishment: Established in California (S. Triapitsyn, pers. comm.; D. Morgan, pers. comm., California Department of Food and Agriculture).
Impact: No information available.

Cotesia flavipes (Cameron) Braconidae

This species was formerly known as *Apanteles flavipes*. It is a member of a four-species complex (Polaszek and Walker, 1991; Muirhead et al., 2012).

UNITED STATES

YEAR/PLACE RELEASED 1985–1987 USA, northern Texas (from the Indo-Australian region) (Overholt and Smith, Jr., 1990)

TARGET PEST *Diatraea grandiosella* Dyar Crambidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. From literature records, *C. flavipes* is known to attack many noctuid and crambid stemborers in grasses (Rutledge and Wiedenmann, 1999), including (1) *Sesamia inferens* (Walker) (Noctuidae) (Rothschild, 1970); (2–3) *Diatraea saccharalis* (F.) and *Diatraea impersonatella* (Walker) (Crambidae) (Galichet, 1971); (4) *Chilo sacchariphagus* (Bojer) (Crambidae) (Betbeder-Matibet, 1971); (5) *Chilo partellus* (Swinhoe) (Crambidae) (Varma and Bindra, 1974); (6) *Chilo polychrysus* (Meyrick) (Crambidae) (Ooi, 1974); (7) *Scirpophaga incertulas* (Walker) (Crambidae) (Nath and Hikim, 1978); (8) *Bissetia steniellus* (Hampson) (Crambidae) (Varma et al., 1981); (9) *Cnaphalocrocis medinalis* (Guenée) (Crambidae) (Rajapakse and Kulasekare, 1982); (10) *Diatraea dyari* Box (Crambidae) (Willink, 1982); (11–12) *Chilo orichalcociliellus* (Strand) (Crambidae) and *Sesamia calamistis* Hampson (Noctuidae) (Overholt et al., 1994); (13) *Chilo tumidicostalis* Hampson (Crambidae) (Borah and Sarma, 1995); (14–15) *Sesamia poephaga* Tams & Bowden (Noctuidae), *Coniesta ignefusalis* (Hampson) (Crambidae) (Hailemichael et al., 1997); (16) *Chilo infuscatellus* Snellen (Crambidae) (Cheng et al., 1999); and (17) *Diatraea centrella* (Möschler) (Crambidae) (Haynes et al., 2001).

HOST SPECIFICITY **Two Families**
Noctuidae (3 species in 1 genus, *Sesamia*) and **Crambidae** (14 species in 6 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: This species was first released, pre-1985, in the USA in southern Texas, in the Rio Grande Valley, where it established (Fuchs et al., 1979). In 1985–1987, a second release was made in northern Texas (Overholt and Smith, Jr., 1990).
Establishment: In contrast to outcomes in southern Texas, releases in 1985–1987 in northern Texas did not lead to the establishment of *C. flavipes* (Overholt and Smith, Jr.,1990).
Impact: Not applicable

MEXICO

YEAR/PLACE RELEASED 1985 Mexico, Tamaulipas (from the Indo-Australian region) (Rodríguez-del-Bosque and Smith, Jr., 1997)

TARGET PEST *Diatraea saccharalis* (F.) Crambidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Known to attack many noctuid and crambid stemborers in grasses (Rutledge and Wiedenmann, 1999), including (1) *Sesamia inferens* (Walker) (Noctuidae) (Rothschild, 1970); (2–3) *Diatraea saccharalis* (F.) and *Diatraea impersonatella* (Walker) (Crambidae) (Galichet, 1971); (4) *Chilo sacchariphagus* (Bojer) (Crambidae) (Betbeder-Matibet, 1971); (5) *Chilo partellus* (Swinhoe) (Crambidae) (Varma and Bindra, 1974); (6) *Chilo polychrysus* (Meyrick) (Crambidae) (Ooi, 1974); (7) *Scirpophaga incertulas* (Walker) (Crambidae) (Nath and Hikim, 1978); (8) *Bissetia steniellus* (Hampson) (Crambidae) (Varma et al., 1981); (9) *Cnaphalocrocis medinalis* (Guenée) (Crambidae) (Rajapakse and Kulasekare, 1982); (10) *Diatraea dyari* Box (Crambidae) (Willink, 1982); (11–12) *Chilo orichalcociliellus* (Strand) (Crambidae) and *Sesamia calamistis* Hampson (Noctuidae) (Overholt et al., 1994); (13) *Chilo tumidicostalis* Hampson (Crambidae) (Borah and Sarma, 1995); (14–15) *Sesamia poephaga* Tams & Bowden (Noctuidae), *Coniesta ignefusalis* (Hampson) (Crambidae) (Hailemichael et al., 1997); (16) *Chilo infuscatellus* Snellen (Crambidae) (Cheng et al., 1999); and (17) *Diatraea centrella* (Möschler) (Crambidae) (Haynes et al., 2001).

HOST SPECIFICITY **Two Families**
Noctuidae (3 species in 1 genus, *Sesamia*) and **Crambidae** (14 species in 6 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Tamaulipas, Mexico (Rodríguez-del-Bosque and Smith, Jr., 1997).
Establishment: Established in Tamaulipas, Mexico (Rodríguez-del-Bosque and Smith, Jr., 1997).
Impact: No information available.

Cotesia rubecula (Marshall) Braconidae

This species was formerly known as *Apanteles rubecula*. The parasitoid imported from Beijing, China by Van Driesche was identified as *C. rubecula*, but may be a distinct species (given as *C.* nr. *rubecula* by You et al. [2012]), though this needs confirmation.

UNITED STATES

YEAR/PLACE RELEASED 1988 USA, Massachusetts, (from China) (Van Driesche and Nunn, 2002). Three different populations have been released or spread naturally in North America, two of these before 1985.

TARGET PEST *Pieris rapae* L. Pieridae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. In the laboratory, in Holland, local *C. rubecula* attacked local *Pieris rapae*, *P. brassicae*, and *P. napi*; this parasitoid population developed successfully in *P. rapae* and *P. brassicae*, but not in *P. napi* (Geervliet and Brodeur, 1992). In Massachusetts, USA, in the laboratory, both the local *Pieris oleracea* Harris (formerly *P. napi*) and *Pieris virginiensis* Edwards were suitable physiological hosts for *C. rubecula* (Van Driesche et al., 2003) but were not attacked in the field (*P. virginiensis* [Benson et al., 2003a]; *P. napi* [Benson et al., 2003b; Van Driesche et al., 2003]). In New Zealand, in laboratory host range tests with 9 species, 2 non-target species received ovipositions (*Plutella xylostella* [L.] [Plutellidae] and *Graphania mutans* [Walker] [Noctuidae]), but neither of these 2 hosts supported larval development (Cameron and Walker, 1997).

HOST SPECIFICITY **Genus in laboratory; Species in field**
Pieridae (1 field host in 1 genus, *Pieris*)

PROJECT OUTCOMES **R+/E+/I+**
Release: (1) A *Cotesia rubecula* population of unknown origin naturally invaded British Columbia, Canada (Wilkinson, 1966) and later spread naturally into the northwestern USA in the 1970s (Biever, 1992) as well as being released in the eastern United States in the 1960s (Puttler et al., 1970). (2) A second *C. rubecula* population was collected from Yugoslavia and released in the eastern United States in the 1960s (Puttler et al., 1970). (3) A third *C. rubecula* population was introduced from China into Massachusetts, USA in 1988 (Van Driesche and Nunn, 2002).
Establishment: Releases of population (#1), made in the 1960s in the eastern United States, of *C. rubecula* collected from British Columbia (Puttler et al., 1970), or later of population (#2) from Yugoslavia, did not result in establishment (McDonald and Kok, 1992), except perhaps in eastern Canada (Corrigan, 1982; Godin and Boivan, 1998). In 1988, *C. rubecula* imported from China (#3) established readily in Massachusetts and spread throughout the northeastern and north central USA (Van Driesche and Nunn, 2002).
Impact: Damage was significantly reduced per larva by *C. rubecula* because hosts were killed as 4th instars, before the majority of larval feeding (Rahman, 1970). In the northwestern United States, the Vancouver, BC population of the parasitoid (#1) became the dominant parasitoid of *P. rapae* in Washington state (Biever et al., 1992). The Chinese population of *C. rubecula* (#3) proved highly effective and caused 75% parasitism in spring cole crops on organic vegetable farms in Massachusetts and displaced its competitor, the introduced *Cotesia glomerata* (L.) (Van Driesche, 2008). Cohorts of *P. rapae* established on collards in Massachusetts for lifetable studies suffered 62% parasitism by *C. rubecula*, the largest source of larval mortality (Herlihy and Van Driesche, 2013).

Cotesia vestalis (Kurdjumov) BRACONIDAE

This species was formerly known as *Cotesia plutellae*, and an earlier generic placement was in *Apanteles*.

UNITED STATES

YEAR/PLACE RELEASED 1990–1992 USA, Florida (from Malaysia) (see p. 20 of Frank and McCoy, 1993; Mitchell et al., 1999). This species was also released in Hawaii USA in 1983–84, where it established (Lai and Funasaki, 1986; Funasaki et al., 1988).

TARGET PEST *Plutella xylostella* (L.) PLUTELLIDAE (diamondback moth)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release in Florida. Laboratory host range studies were done in New Zealand by Cameron and Walker (1997) who found successful reproduction (to the cocoon stage) in 8 of 13 species presented, in 5 families: Plutellidae, Pyralidae, Nymphalidae, Arctiidae, and Noctuidae. In laboratory tests, parasitism of the weed biological control agent *Nyctemera amica* (Arctiidae) ended the consideration of *C. vestalis* for introduction to Australia (Endersby and Cameron, 2004), and for the same reason it was decided not to introduce it to the Cook Islands (Walker et al., 2004). Laboratory-rearing hosts recorded in the literature include *Corcyra cephalonica* (Stainton) (Pyralidae) (Wang et al., 1972) and *Helicoverpa armigera* (Hübner) (Noctuidae) (Yadav et al., 2010). Field host records include (1) *Trichoplusia ni* (Hübner) (Noctuidae) (Joshi and Sharma, 1974); (2) *Spodoptera litura* (F.) (Noctuidae) (Chiu and Chou, 1976); (3) *Ocnogyna baetica* (Rambur) (Arctiidae) (Lipa et al., 1993); (4–5) *Autographa gamma* (L.) (Noctuidae) and *Autographa nigrisigna* (Walker) (Noctuidae) (Kaneko, 1993); (6) *Spodoptera exigua* Hübner (Noctuidae) (Guimarães et al., 1995); (7) *Proclossiana eunomia* (Esper) (Nymphalidae) (Waeyenbergh and Baguette, 1996); (8) *Nyctemera amica* (White) (Arctiidae) (Endersby and Cameron, 2004); and (9) *Simyra dentinosa* Freyer (Noctuidae) (Karimpour et al., 2005).

HOST SPECIFICITY **Five Families**
Plutellidae (1 species, the target pest), **Noctuidae** (7 species in 5 genera), **Pyralidae** (1 species), **Arctiidae** (2 species in 2 genera), and **Nymphalidae** (1 species)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Florida, USA (see p. 20 of Frank and McCoy, 1993; Mitchell et al., 1999).
Establishment: Establishment in Florida was not determined (see p. 20 of Frank and McCoy, 1993), but may have occurred (see Mitchell et al., 1999).
Impact: Augmentative releases achieved 37% parasitism in field trials (Mitchell et al., 1999), but the impact of self-sustaining populations was not determined.

Dacnusa sibirica Telenga BRACONIDAE

No synonyms reported in the literature.

MEXICO

YEAR/PLACE RELEASED 1995 Mexico (from Koppert and other commercial insectaries) (Cortez Mondaca and Valenzuela Escoboza, 2015)

TARGET PEST *Liriomyza trifolii* (Burgess) AGROMYZIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature records note the following agromyzid leafminers as hosts: (1) *Liriomyza bryoniae* (Kaltenbach) (Zucchi and van Lenteren, 1978); (2) *Liriomyza trifolii* (Burgess) (van de Veire, 1988); (3) *Chromatomyia horticola* (Goureau) (Garrido et al., 1992); (4) as a laboratory-rearing host: *Phytomyza caulinaris* Hering (van der Linden, 1992); (5) *Liriomyza huidobrensis* (Blanchard) (Leuprecht, 1993); and (6) as a laboratory-rearing host: *Chromatomyia syngenesiae* Hardy (Croft and Copland, 1994).

HOST SPECIFICITY **Family**
Agromyzidae (6 species in 3 genera)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Mexico (Cortez Mondaca and Valenzuela Escoboza, 2015).
Establishment: The release in Mexico was for use in greenhouses and its establishment was not intended nor looked for.
Impact: No pest was being targeted for permanent, areawide suppression; no report of establishment outside of greenhouses.

Diachasmimorpha kraussii (Fullaway) Braconidae

HAWAII

YEAR/PLACE RELEASED 2003 USA, Hawaii (from Australia) (Bokonon-Ganta et al., 2013)

TARGET PEST *Bactrocera latifrons* (Hendel) Tephritidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing was done before release. Under laboratory conditions, of 4 non-target tephritids (*Procecidochares utilis* Stone, *Eutreta xanthochaeta* Aldrich, *Ensina sonchi* [L.], and *Trupanea dubautiae* [Bryan]) exposed to *D. kraussii* in each species' plant substrate (stem galls of *Ageratina adenophora* [Spreng.] King & H. Rob. and *Lantana camara* L. and flowerheads of *Sonchus oleraceus* L. and *Dubautia raillardioides* Hillebrand, respectively), only *E. xanthochaeta* supported successful parasitism (Duan and Messing, 2000). Of 3 pest fruit flies offered as hosts, *D. kraussii* successfully parasitized *Ceratitis capitata* (Wiedemann), but not *Bactrocera dorsalis* (Hendel) or *Bactrocera cucurbitae* (Coquillett) (Messing and Ramadan, 2000). Among Australian tephritids offered under laboratory conditions, *D. kraussii* successfully developed in *Bactrocera jarvisi* (Tryon) and *B. tryoni* (Froggatt), but not *B. cacuminata* (Hering) or *B. cucumis* (French) (Ero et al., 2010). Field hosts recorded in the literature include only *Bactrocera oleae* (Rossi) (Argov et al., 2009).

HOST SPECIFICITY **Family**
Tephritidae (6 species in 3 genera)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Hawaii (Bokonon-Ganta et al., 2013).
Establishment: Established in Hawaii (Bokonon-Ganta et al., 2013).
Impact: In Hawaii, *D. kraussi* had little impact on the target pest, *B. latifrons*, with rates of field parasitism of about 1.0% (Bokonon-Ganta et al., 2013).

Diadegma armillata (Gravenhorst) Ichneumonidae

Formerly given as *Campoplex armillatus*, *Angitia armillata*, *Nythobia armillata*, and *Diadegma armillatum*. Other synonyms include *Diadegma pseudocombinatum* (Szepligeti) and *Diadegma tibiale* (Gravenhorst) (Yu, 2017). See Wagener et al. (2006) for notes on phylogeny of the genus *Diadegma*.

UNITED STATES

YEAR/PLACE RELEASED 1989–1991 USA, Washington state (from France and Korea) (Unruh et al., 2003)

TARGET PEST *Yponomeuta malinellus* (Zeller) Yponomeutidae
(given formerly as *Hyponomeuta malinellus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Post-release host range studies showed 3 species of *Yponomeuta* to be suitable hosts (*Y. evonymellus*, *Y. rorellus*, *Y. padellus*), while 4 others were not (*Y. vigintipunctatus* [Retzius], *Y. cagnagellus* [Hübner], *Y. mahalebellus* Guenée, and *Y. plumbellus* [Denis & Schiffermüller]) due to encapsulation (Dijkerman, 1990; Hérard and Prévost, 1997). Literature field host records include 8 species in 4 families: **Yponomeutidae**: (1) *Y. rorellus* (Hübner) (Koehler and Kolk, 1971); (2) *Yponomeuta evonymella* L. (Bartninkaite, 1996); (3) *Yponomeuta padella* (L.) (formerly *Hyponomeuta padellus*) (Servadei, 1930); **Tortricidae**: (4) *Grapholita molesta* (Busck) (formerly *Cydia molesta*) (Grandi, 1937); (5) *Choristoneura murinana* (Hübner) (formerly in *Tortrix*) (Franz, 1941); **Coleophoridae**: (6) *Coleophora laricella* (Hübner) (Jahn, 1948); **Plutellidae**: (7) *Plutella xylostella* (L.) (Khristova, 1957); (8) *Prays oleae* (Bernard) (Agrò et al., 2009).

HOST SPECIFICITY **Four Families**
Yponomeutidae (4 species in 1 genus, *Yponomeuta*), **Tortricidae** (2 species in 2 genera), **Coleophoridae** (1 species), and **Plutellidae** (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Washington state, USA (Unruh et al., 2003).
Establishment: Did not establish in Washington state (Unruh et al., 2003).
Impact: Not applicable

Diadegma semiclausum Hellén ICHNEUMONIDAE

Formerly given as *Angitia semiclausa* Hellen. Other synonyms include *Diadegma eucerophagum* Horstmann and *Diadegma xylostellae* Kusigemati (Yu, 2017). See Wagener et al. (2006) for notes on phylogeny of the genus *Diadegma*.

HAWAII

YEAR/PLACE RELEASED 1985 USA, Hawaii (from Pakistan) (Funasaki et al., 1988)

TARGET PEST *Plutella xylostella* (L.) XYLOSTELLIDAE (diamondback moth)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing was done before release. No other hosts are reported in the literature, and the species shows a strong response to cabbage odor, particularly to cabbage infested by *P. xylostella* (Rossbach et al., 2005).

HOST SPECIFICITY **Possibly Species**
Xylostellidae (known only from the target pest)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Hawaii (Funasaki et al., 1988).
Establishment: Establishment in Hawaii was never assessed. Given the establishment of this species in many other locations, it is likely to have established in Hawaii.
Impact: Impact has not been evaluated. However, given successful control of this pest in many other locations, *D. semiclausum* may have reduced diamondback moth densities in Hawaii, but that needs confirmation.

Diadromus pulchellus Wesmael ICHNEUMONIDAE

No synonyms have been reported (Yu, 2017).

CANADA

YEAR/PLACE RELEASED 2010 Canada, Ontario (from Switzerland and surrounding countries) (Mason et al., 2013)

TARGET PEST *Acrolepiopsis assectella* (Zeller) ACROLEPIIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release (Jenner, 2008). Host range studies done before release (Jenner, 2008) but published after release (Jenner et al., 2014) found that 3 of 12 non-target species tested were suitable hosts: (1) *Plutella xylostella* L. (Plutellidae) (also known as a field host), (2) *Acrolepiopsis incertella* (Chambers) (Acrolepiidae), and (3) *Plutella porrectella* (L.) (Plutellidae). Literature records of field hosts include only *Plutella xylostella* (Thibout, 1988). Host acceptance for oviposition is stimulated by compounds in the host cocoon (Bénédet et al., 1999; Gauthier et al., 2004).

HOST SPECIFICITY **Two Families**
Acrolepiidae (2 species in 1 genus, *Acrolepiopsis*) and **Plutellidae** (2 species in 1 genus, *Plutella*)

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Ontario, Canada (Mason et al., 2013).
Establishment: Recovered in Ontario at release sites in year following release (Mason et al., 2013).
Impact: Little impact observed in Canada after release, perhaps due to hyperparasitism by *Conura albifrons* (Walsh) (Chalcididae) (Miall et al., 2014). Native range impact studies done in Europe before release in Canada suggest potential high efficacy (Jenner et al., 2010).

Diaeretiella rapae (M'Intosh) BRACONIDAE

Given earlier as *Diaeretus rapae* Curtis and *Aphidius brassicae* Marshall.

UNITED STATES

YEAR/PLACE RELEASED 1986 USA, California (from Switzerland) (Daane et al., 1995a). This species is apparently native to the USA. Before this introduction, a species with this name was reported from *Lipaphis erysimi* (Kaltenbach) (Davis and Satterthwait, 1916; Pimentel, 1961), including in California (Oatman and Platner, 1971).

TARGET PEST *Brachycorynella asparagi* (Mordvilko) APHIDIDAE

Diaeretiella rapae (continued)

UNITED STATES (continued)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing was done before release. Literature host records for *D. rapae* exist for many aphids (Aphididae), including (1) *Lipaphis erysimi* (Kaltenbach) (Paddook, 1916); (2) *Myzus persicae* (Sulzer) (Wheeler, 1923); (3) *Brevicoryne brassicae* L. (Newton, 1934); (4–5) *Sitobion avenae* (Fabricius) and *Aphis craccivora* C. L. Koch (Atwal et al., 1969); (6) *Schizaphis graminum* (Rondani) (Walker et al., 1973); (7) *Hayhurstia atriplicis* (L.) (Nemec and Starý, 1984); (8) *Diuraphis noxia* (Kurdjumov) (Reed et al., 1991); (9–14) *Acyrthosiphon lactucae* (Passerini), *Phorodon humuli* (Schrank), *Dysaphis plantaginea* Passerini, *Brachycaudus tragopogonis* (Kaltenbach), *Uroleucon ivae* Robinson, and *Braggia* sp. (Pike et al., 1999); and (15) *Brachycaudus helichrysi* Kaltenbach (Nebreda et al., 2005).

HOST SPECIFICITY **Family**
Aphididae (15 species in 13 genera)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in California, USA (Contra Costa County) as a single release of 115 individuals (Daane et al., 1995a).
Establishment: *Diaeretiella rapae* was subsequently recovered from asparagus aphid (*B. asparagi*) in California from counties near the release sites (but not in Contra Costa Co.) (Daane et al., 1995a). Because the released population could not be separated from the form already present, it could not be determined if the introduced form established.
Impact: No separable impact due to the released population of the parasitoid could be measured. In Washington state, a parasitoid of the same name commonly attacked asparagus aphid (*B. asparagi*) but did not regulate it to economically acceptable levels (Wright and Cone, 1988).

Diaparsis jucunda (Holmgren) Ichneumonidae

UNITED STATES

YEAR/PLACE RELEASED 2003 USA, Rhode Island (from Switzerland, France, and other parts of Europe) (Tewksbury, 2014, Tewksbury et al., 2017)

TARGET PEST *Lilioceris lilii* (Scopoli) Chrysomelidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing was done before release (Gold, 2003; Kenis et al., 2003; Casagrande and Kenis, 2004; USDA APHIS, 2017). Of 2 non-target European species of *Lilioceris* tested, both were attacked. Of 8 species of North American non-*Lilioceris* species (6 in the same family; 2 in other families), none were attacked (Casagrande and Kenis, 2004).

HOST SPECIFICITY **Genus**
Chrysomelidae (3 species in 1 genus, *Lilioceris*). Functionally monophagous in North America, where there are no native *Lilioceris* species.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Rhode Island and other New England states in the USA (Tewksbury, 2014, Tewksbury et al., 2017).
Establishment: Established in various New England states and spreading (Tewksbury, 2014, Tewksbury et al., 2017).
Impact: Not yet determined.

Diaphorencyrtus aligarhensis (Shafee, Alam & Agarwal) Encyrtidae

Noyes (2017) lists seven synonyms and some further minor variants: (1) *Aphidencyrtus aligarhensis* Shafee, Alam and Agarwal; (2) *Aphidencyrtus diaphorinae* Myartseva and Trjapitzin; (3) *Aphidencyrtus sacchari* Kaul and Agarwal; (4) *Diaphorencyrtus aligarensis* (Shafee, Alam and Agarwal); (5) *Diaphorencyrtus diaphorinae* (Lin and Tao); (6) *Psyllaephagus diaphorinae* Lin and Tao; and (7) *Syrphophagus aligarhensis* (Shafee, Alam and Agarwal).

UNITED STATES

YEAR/PLACE RELEASED 2000–2014 USA: (1) Florida: 2000–2002 (from Taiwan) (Hoy, 2005); 2007–2009 (from China) (Rohrig et al., 2012); (2) California: 2014 (from Pakistan) (USDA APHIS 2014; Milosavljević et al., 2017)

TARGET PEST *Diaphorina citri* Kuwayama Liviidae

Diaphorencyrtus aligarhensis (continued)

UNITED STATES (continued)

HOST RANGE EVIDENCE

HRT+
Laboratory host-range testing was done before release (Bistline-East et al., 2015). Seven non-target psyllids in 4 families were used in host range tests: (1) *Bactericera cockerelli* (Sulc) (Triozidae), (2) *Heteropsylla* sp. (Psyllidae: Ciriacreminae), (3) *Arytainilla spartiophylla* (Forester) (Psyllidae: Psyllinae), (4) *Euphyllura olivina* (Costa) (Liviidae: Euphyllurinae), (5) *Heteropsylla texana* Crawford (Psyllidae: Ciriacreminae), (6) *Diclidophlebia fremontiae* (Klyver) (Liviidae: Liviinae), and (7) *Boreioglycaspis melaleucae* Moore (Aphalaridae). Parasitism occurred on only one species, the adventive pest the potato psyllid (*B. cockerelli*), which showed 14% parasitism (Bistline-East et al., 2015). No species other than the pest *D. citri* are listed in the literature as hosts of *D. aligarhensis*. However, Noyes (2017) lists 2 additional species as hosts: *Diaphorina cardiae* Crawford and *Psylla* sp.

HOST SPECIFICITY

Three Families in the Superfamily Psylloidea or Genus?
Liviidae (2 species in 1 genus, *Diaphorina*), **Triozidae** (1 species in *Bactericera* under laboratory conditions), and **Psyllidae** (1 unnamed species of *Psylla*)

PROJECT OUTCOMES

(1) Florida: R+/E-/I-
(2) California: R+/E+/I+
Release: (1) Florida: *Diaphorencyrtus aligarhensis* from Taiwan were released in Florida, USA in 2000–2002 (Hoy, 2005) and ones from China in 2007–2009 (Rohrig et al., 2012). (2) California: Released in California, USA from Pakistan in 2014 (USDA APHIS 2014; Milosavljević et al., 2017).
Establishment: (1) Florida: Not established in Florida (Rohrig et al., 2012). (2) California: Recoveries have been made at 13 of 15 release sites (Milosavljević et al. , 2017).
Impact: (1) Florida: Not applicable. (2) California: Rates of parasitism at release sites in California range from 0.2–37.5% (Milosavljević et al. , 2017).

Diglyphus isaea (Walker) BRACONIDAE

This species may be a complex of many cryptic species, four having been suggested from China alone (Sha et al., 2007). Synonyms include *Solenotus isaea*.

MEXICO

YEAR/PLACE RELEASED

1995 Mexico (from Koppert or other commercial insectaries) (Cortez Mondaca and Valenzuela Escoboza, 2015)

TARGET PEST

Liriomyza trifolii (Burgess) AGROMYZIDAE

HOST RANGE EVIDENCE

HRT-
No laboratory host-range testing done before release. Literature hosts include various agromyzid (unless other family is given) leafminers: (1) *Pseudonapomyza dianthicola* Venturi (Ciampolini, 1949); (2) *Phytomyza syngenesiae* (= *Chromatomyia syngenesiae*) (Hardy) (Burges, 1974); (3) *Napomyza cichorii* Spencer (Sant et al., 1975); (4) *Phytomyza horticola* Gourea (Takada and Kamijo, 1979); (5–6) *Agromyza frontella* (Rondani) and *Liriomyza trifoliearum* Spener (Hendrickson and Barth, 1979); (7) *Stigmella malella* (Stainton) (Nepticulidae) (Navone and Vidano, 1983); (8) *Liriomyza strigata* (Meigen) (Villevieille, 1987); (9) *Liriomyza cicerina* (Rondani) (Weigand, 1990); (10) *Liriomyza huidobrensis* (Blanchard) (Leuprecht, 1992); (11) *Liriomyza bryoniae* (Kaltenbach) (Boot et al., 1992); (12) *Phytomyza caulinaris* Hering (van der Linden, 1992); (13) *Liriomyza trifolii* (Burgess) (Beitia et al., 1994); (14) *Phyllocnistis citrella* Stainton (Gracillariidae) (González Tirado et al., 1996); (15) *Agromyza hiemalis* Becker (Massa and Rizzo, 2000); (16) *Paraphytomyza populi* (Kaltenbach) (Georgiev and Boyadzhiev, 2002); (17) *Agromyza nigrella* (Rondani) (El-Serwy, 2003); (18) *Liriomyza sativae* Blanchard (Niranjana et al., 2005); (19–20) *Liriomyza brassicae* (Riley) and *Liriomyza chenopodii* (Watt) (Bjorksten et al., 2005); and (21) *Liriomyza chinensis* Kato (Tokumaru, 2006).

HOST SPECIFICITY

Three Families (leafminers in two orders)
DIPTERA: Agromyzidae (17 species in 7 genera, of which 8 species are in *Liriomza*)
LEPIDOPTERA: Nepticulidae (1 species) and **Gracillariidae** (1 species)

PROJECT OUTCOMES

R+/E-/I-
Release: Released in Mexico (Cortez Mondaca and Valenzuela Escoboza, 2015).
Establishment: The release in Mexico was for use in greenhouses, and its establishment was not intended or looked for.
Impact: No pest was being targeted for permanent, areawide suppression; no report was found of establishment outside of greenhouses.

Digonogastra kimballi Kirkland Braconidae
(formerly known as *Iphiaulax kimballi*)

UNITED STATES

YEAR/PLACE RELEASED 1985–1987 USA, northern Texas (from Mexico) (Overholt and Smith, Jr., 1990)

TARGET PEST *Diatraea grandiosella* Dyar Crambidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include *Eoreuma loftini* (Dyar) and 6 species of *Diatraea* (all are Crambidae) (Wharton et al., 1989; Rodríguez-del-Bosque and Smith, 1990).

HOST SPECIFICITY **Family**
Crambidae (7 species in 2 genera; 6 in *Diatraea*)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in northern Texas, USA (Overholt and Smith, Jr., 1990).
Establishment: Establishment was not demonstrated conclusively, but some ability to overwinter was observed (Overholt and Smith, Jr., 1990).
Impact: Not applicable

Doryctobracon trinidadensis (Gahan) Braconidae
(formerly in *Opius*)

UNITED STATES

YEAR/PLACE RELEASED 1985 USA, Florida (from Trinidad) (Baranowski et al., 1993)

TARGET PEST *Anastrepha suspensa* (Loew) Tephritidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include *Anastrepha serpentina* (Wiedemann) and *Anastrepha striata* Schiner (Gahan, 1919).

HOST SPECIFICITY **Genus**
Tephritidae (3 species in 1 genus, *Anastrepha*)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Florida, USA (see Table 1 of Baranowski et al., 1993).
Establishment: Some initial recoveries were made but establishment could not be confirmed (Baranowski et al., 1993).
Impact: Not applicable

Encarsia aurantii (Howard) Aphelinidae
Noyes (2017) lists three synonyms: (1) *Coccophagus aurantii* Howard, (2) *Prospalta aurantii* (Howard), and (3) *Prospaltella aurantii* (Howard).

UNITED STATES

YEAR/PLACE RELEASED 1988 USA, California (from Texas USA) (Ehler, 1995, 1997, 2005). This Asian species, self-introduced to the United States, was collected from Texas, part of the scale's native range, and then later released in 1988 in California, a different ecoregion.

TARGET PEST *Melanaspis obscura* (Comstock) Diaspididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing was done before release. Literature host records include 11 species of diaspidids in 8 genera: (1) *Quadraspidiotus perniciosus* Comstock (Diaspididae) (Nakayama, 1921); (2) *Chrysomphalus aonidum* (L.) (Anon., 1929); (3) *Lepidosaphes gloveri* (Packard) (Wasser, 1938); (4) *Aspidiotus rigidus* Reyne (Reyne, 1948); (5–6) *Lepidosaphes newsteadi* (Sulc) and *Leucaspis loewi* Cockerell (Mesnil, 1949); (7) *Aonidomytilus espinosai* (Porter) (Matta and Hichins, 1979); (8) *Aonidiella aurantii* Maskell (Terán et al., 1985); (9) *Aonidiella orientalis* (Newstead) (Khalaf and Sokhansanj, 1993); (10) *Parlatoria oleae* (Colvée) (Abd-Rabou, 2001); and (11) *Chrysomphalus dictyospermi* (Morgan) (Chkhaidze and Yasnosh, 2001). Noyes (2017) lists an extensive set of hosts, including 1 in Aleyrodidae, 3 in Coccidae, 52 in Diaspididae, and 1 in Kermesidae.

HOST SPECIFICITY **Family?**
Diaspididae (64 species in 28 genera; plus 5 other records in need of confirmation, including 3 species in 1 genus in the Coccidae, and 1 species in each of the Kermesidae and Aleyrodidae)

Encarsia aurantii (continued)

UNITED STATES (continued)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Sacramento, California, USA (Ehler, 1995, 1997, 2005).
Establishment: Established at release site (Ehler, 1995, 1997, 2005).
Impact: By 2002 (4 years after release), the scale was under complete biological control and chemical pesticides were no longer needed to protect the trees (Ehler, 1995, 2005).

Encarsia bimaculata Heraty and Polaszek APHELINIDAE

For species description see (Heraty and Polaszek, 2000). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1994–1997 USA: (1) Texas, Arizona, California (from India) (Hoelmer and Goolsby, 2003; Gould et al., 2008; W. Roltsch, pers. comm., California Department of Food and Agriculture); (2) Florida (from Guatemala, India, and Sudan) (Nguyen and Bennett, 1995)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other literature hosts are listed. Noyes (2017) lists one additional host: *Trialeurodes vaporariorum* Westwood.

HOST SPECIFICITY **Family**
Aleyrodidae (2 species in 2 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: (1) western USA: Released in the western USA (Hoelmer and Goolsby, 2003). (2) Florida: Released in Florida, USA (Lahey 2014; Lahey et al., 2016).
Establishment: (1) western USA: Not established in the western USA (Gould et al., 2008). (2) Florida: Successfully established in Florida (Lahey, 2014; Lahey et al., 2016).
Impact: (1) western USA: Not applicable. (2) Florida: Impact not determined.

Encarsia diaspidicola (Silvestri) APHELINIDAE

Noyes (2017) lists one synonym: *Prospaltella diaspidicola* Silvestri.

HAWAII

YEAR/PLACE RELEASED 2013 USA, Hawaii (from the USA, France, and Tonga—mixed colony via Samoa [Sands et al., 1990]) (Follett et al., 2015)

TARGET PEST *Pseudaulacaspis pentagona* (Targioni-Tozzetti) DIASPIDIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing was done before release (Neumann et al., 2010). Of 7 non-target insects tested by Neumann et al. (2010), none were parasitized or killed. These non-target species examined included three diaspidids (*Pseudaulacaspis cockerelli* [Cooley], *Aspidiotus destructor* Signoret, *Aulacaspis yasumatsui* Takagi), and the Hawaiian endemic palm scale, *Colobopyga pritchardiae* (Stickney) (Halimococcidae) (Neumann et al., 2010). Literature hosts for *Encarsia diaspidicola* are 2 diaspidid scales: (1) *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Sands et al., 1990) and (2) *Quadraspidiotus perniciosus* (Comstock) (Matadha et al., 2005). In addition, Noyes (2017) lists 3 other diaspidid hosts: (1) *Aspidiotus hederae* (Vallot), (2) *Chrysomphalus dictyospermi* (Morgan), and (3) *Lepidosaphes beckii* (Newman).

HOST SPECIFICITY **Family**
Diaspididae (5 species in 5 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Hawaii (Follett et al., 2015).
Establishment: Established in Hawaii (Follett et al., 2015).
Impact: Established populations of *E. diaspidicola* are causing 5–12% parasitism of the target pest, *P. pentagona* (Follett et al., 2015).

Encarsia nr *diaspidicola* (Silvestri) Aphelinidae

Taxonomic identity of this entity is unclear. For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms. This species may be the same or different from *E. diaspidicola* discussed above.

UNITED STATES

YEAR/PLACE RELEASED 1990–1995 USA, Massachusetts (from China) (Van Driesche et al., 1998a)

TARGET PEST *Unaspis euonymi* (Comstock) Diaspididae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Diaspidids that were not parasitized by *E. diaspidicola* in laboratory host-range testing (see entry above) were *Pseudaulacaspis cockerelli* (Cooley), *Aspidiotus destructor* Signoret, and *Aulacaspis yasumatsui* Takagi (Neumann et al., 2010). If this entity is the same as *E. diaspidicola*, then literature hosts, both diaspidids, are (1) *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Sands et al., 1990) and (2) *Quadraspidiotus perniciosus* (Comstock) (Matadha et al., 2005). For lack of confirmed species identity, Noyes (2017) could not be consulted for host records.

HOST SPECIFICITY **Unknown, or Family (if same entity as *E. diaspidicola*)**
Diaspididae (if same as *E. diaspidicola*) (2 species in 2 genera, but see also entry *Encarsia diaspidicola* for additional hosts)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in several states in the northeastern United States (Van Driesche et al., 1998a; Matadha et al., 2003).
Establishment: Recoveries were initially made in Massachusetts, but long-term establishment was not demonstrated (Van Driesche et al., 1998a); no evidence for establishment was obtained following releases in New Jersey (Matadha et al., 2003).
Impact: No observed impact on pest by *E.* nr *diaspidicola*, but see records for *Coccobius* nr *fulvus* and *Chilocorus kuwanae* (Silvestri) that indicate successful control of pest by project.

Encarsia formosa Gahan Aphelinidae

Noyes (2017) lists one synonym: *Trichaporus formosus* (Gahan).

UNITED STATES

YEAR/PLACE RELEASED 1992–1995 USA, California and Arizona (from Greece, Egypt, and Thailand) (Goolsby et al., 1998; Kirk et al., 2000; W. Roltsch, pers. comm., California Department of Food and Agriculture)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release (species already present in USA). Literature host records include the following whiteflies: (1) *Trialeurodes vaporariorum* Westwood (Speyer, 1927); (2) *Dialeurodes chittendeni* Laing (Wilson, 1935); (3) *Aleyrodes spiraeoides* Quaintance and *Bemisia tabaci* (Gennadius) (Gerling, 1966); and (4) *Trialeurodes ricini* (Misra) (Shishehbor and Brennan, 1995). Noyes (2017) lists 12 additional species as hosts: (1) *Aleuroglandulus subtilis* Bondar, (2) *Aleurothrixus floccosus* Maskell, (3) *Aleurotrachelus trachoides* Back, (4) *Aleyrodes lonicerae* Walker, (5) *Aleyrodes proletella* L., (6) *Aleyrodes singularis* Danzig, (7) *Dialeurodes citri* (Ashmead), (8) *Lipaleyrodes atriplex* (Froggatt), (9) *Lipaleyrodes euphorbiae* David & Subramaniam, (10) *Tetraleurodes mori* Quaintance, (11) *Trialeurodes abutiloneus* Haldeman, and (12) *Trialeurodes variabilis* (Quaintance).

HOST SPECIFICITY **Family**
Aleyrodidae (16 species in 9 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in southwestern United States (Gould et al., 2008, Kirk et al., 2000; W. Roltsch, pers. comm., California Department of Food and Agriculture).
Establishment: *Encarisia formosa* strains from Greece, Egypt, and Thailand did not establish (Goolsby et al., 1998; Kirk et al., 2000).
Impact: Not applicable

Encarsia formosa (continued)

MEXICO

YEAR/PLACE RELEASED	1992–1993 Mexico, Baja California (from Egypt and Texas USA) (Arredondo-Bernal, 1999; Martínez Carillo et al., 2015)
TARGET PEST	*Trialeurodes vaporariorum* Westwood ALEYRODIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release (species already present in USA). Literature host records include the following whiteflies: (1) *Trialeurodes vaporariorum* Westwood (Speyer, 1927); (2) *Dialeurodes chittendeni* Laing (Wilson, 1935); (3) *Aleyrodes spiraeoides* Quaintance and *Bemisia tabaci* (Gennadius) (Gerling, 1966); and (4) *Trialeurodes ricini* (Misra) (Shishehbor and Brennan, 1995). Noyes (2017) lists 12 additional species as hosts: (1) *Aleuroglandulus subtilis* Bondar, (2) *Aleurothrixus floccosus* Maskell, (3) *Aleurotrachelus trachoides* Back, (4) *Aleyrodes lonicerae* Walker, (5) *Aleyrodes proletella* L., (6) *Aleyrodes singularis* Danzig, (7) *Dialeurodes citri* (Ashmead), (8) *Lipaleyrodes atriplex* (Froggatt), (9) *Lipaleyrodes euphorbiae* David & Subramaniam, (10) *Tetraleurodes mori* Quaintance, (11) *Trialeurodes abutiloneus* Haldeman, and (12) *Trialeurodes variabilis* (Quaintance).
HOST SPECIFICITY	**Family** **Aleyrodidae** (16 species in 9 genera)
PROJECT OUTCOMES	**R+/E+/I?** **Release:** Released in Baja California, Mexico (Arredondo-Bernal, 1999; Martínez Carillo et al., 2015). **Establishment:** Established in Mexico (Myartseva et al., 2012; E. Ruiz Cancino, pers. comm.). However, whether these observed populations are from releases or due to prior natural occurrence in Mexico is undetermined. **Impact:** No information available.

GUAM

YEAR/PLACE RELEASED	2011 USA, Guam (G. Reddy, pers. comm.) (from a commercial insectary)
TARGET PEST	*Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release (species already present in USA). Literature host records include the following whiteflies: (1) *Trialeurodes vaporariorum* Westwood (Speyer, 1927); (2) *Dialeurodes chittendeni* Laing (Wilson, 1935); (3) *Aleyrodes spiraeoides* Quaintance and *Bemisia tabaci* (Gennadius) (Gerling, 1966); and (4) *Trialeurodes ricini* (Misra) (Shishehbor and Brennan, 1995). Noyes (2017) lists 12 additional species as hosts: (1) *Aleuroglandulus subtilis* Bondar, (2) *Aleurothrixus floccosus* Maskell, (3) *Aleurotrachelus trachoides* Back, (4) *Aleyrodes lonicerae* Walker, (5) *Aleyrodes proletella* L., (6) *Aleyrodes singularis* Danzig, (7) *Dialeurodes citri* (Ashmead), (8) *Lipaleyrodes atriplex* (Froggatt), (9) *Lipaleyrodes euphorbiae* David & Subramaniam, (10) *Tetraleurodes mori* Quaintance, (11) *Trialeurodes abutiloneus* Haldeman, and (12) *Trialeurodes variabilis* (Quaintance).
HOST SPECIFICITY	**Family** **Aleyrodidae** (16 species in 9 genera)
PROJECT OUTCOMES	**R+/E?/I?** **Release:** Released in Guam (G. Reddy, pers. comm.). **Establishment:** Believed to have established, but further survey work is needed to confirm this. **Impact:** No information available.

Encarsia nr *hispida* De Santis Aphelinidae

Taxonomic identity unclear, but it is assumed here to be *E. hispida*. Note, *E. hispida* is no longer considered a synonym of *E. meritoria* (Polaszek et al., 1992). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1995–1996 USA, Texas, Arizona, and California (from Brazil) (Goolsby et al., 1998; Hoelmer and Goolsby, 2003). Release years are for California and Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al. 2008).

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records (for *E.* nr *hispid*a + *E. hispida*) include (1–2) *Trialeurodes vaporariorum* (Westw.) and *Bemisia tabaci* (Gennadius) (Maignet and Onillon, 1997); (3) *Siphoninus phillyreae* (Haliday) (Viscarret et al., 2000); (4–6) *Aleurotrachelus socialis* Bondar, *Tetraleurodes* sp., and *Trialeurodes variabilis* (Quaintance) (Trujillo et al., 2004); (7) *Paraleyrodes minei* Iaccarino (Telli and Yigit, 2012). For lack of confirmed species identity, Noyes (2017) could not be consulted for literature hosts.

HOST SPECIFICITY **Family**
Aleyrodidae (7 species in 6 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release. Released in Texas, Arizona, and California USA (Goolsby et al., 1998; Hoelmer and Goolsby, 2003).
Establishment: Not established in the western United States (Hoelmer and Goolsby, 2003; Goolsby et al. 2005).
Impact: Not applicable

Encarsia inaron (Walker) Aphelinidae

Noyes (2017) lists 14 synonyms: (1) *Aphelinus idaeus* Walker, (2) *Aphelinus inaron* Walker, (3) *Coccophagus inaron* (Walker), (4) *Encarsia aleurodis* (Mercet), (5) *Encarsia aleyrodis* (Mercet), (6) *Encarsia borealis* Hulden, (7) *Encarsia brassicae* Shafee and Bela, (8) *Encarsia indifferentis* Mercet, (9) *Encarsia partenopea* Masi, (10) *Myina idaeus* (Walker), (11) *Trichaporus aleyrodis* Mercet, (12) *Trichaporus partenopeus* (Masi), (13) *Trichaporus parthenopeus* (Masi), and (14) *Trychaporus aleyrodis* Mercet.

UNITED STATES

YEAR/PLACE RELEASED 1989–1990 USA, California (from Europe) (Gould et al., 1992a)

TARGET PEST *Siphoninus phillyreae* (Haliday) Aleyrodidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include (1) *Trialeurodes vaporariorum* Westwood (Hodson and Beaumont, 1929); (2) *Siphoninus granati* Priesner and Hosny (Priesner and Hosny, 1932); (3) *Aleyrodes proletella* (L.) (syn. *Aleyrodes brassicae*) (Butler, 1936); (4) *Asterobemisia avellanae* (Signoret) (Viggiani, 1981); (5) *Bemisia tabaci* (Gennadius) (Mohyuddin et al., 1989); (6) *Pealius azaleae* (Baker and Moles) (Bene et al., 1991); (7–8) *Acaudaleyrodes citri* (Priesner and Hosny) and *Trialeurodes ricini* (Misra) (Abd-Rabou, 2000b); and (9) *Neomaskellia andropogonis* Corbett (Malekmohammadi et al., 2012). Noyes (2017) lists 13 additional species as hosts: (1) *Acaudaleyrodes rachipora* (Singh), (2) *Aleurocanthus woglumi* Ashby, (3) *Aleurothrixus floccosus* Maskell, (4) *Aleyrodes elevatus* Silvestri, (5) *Aleyrodes lonicerae* Walker, (6) *Aleyrodes singularis* Danzig, (7) *Asterobemisia carpini* Koch, (8) *Asterobemisia paveli* (Zahradnik), (9) *Bulgarialeurodes cotesii* (Maskell), (10) *Pealius madeirensis* Martin, Aguiar & Pita, (11) *Pealius quercus* (Signoret), (12) *Siphoninus immaculatus* Heeger, and (13) *Tetraleurodes hederae* Goux.

HOST SPECIFICITY **Family**
Aleyrodidae (23 species in 12 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Gould et al., 1992a).
Establishment: Established readily in California and other states (Bellows et al., 2006).
Impact: Lifetables of cohorts at release sites showed that nymphal mortality (2–4th instars) increased from 51–58% at control sites to 96–98% at release sites (Gould et al., 1992ab). Ash whitefly densities on ash in California were reduced 99.9–99.999% by *E. inaron* (Dreistadt and Flint, 1995). Economic benefits were calculated for California at $220–299 million dollars (Pickett et al., 1996).

Encarsia lutea (Masi) APHELINIDAE

Noyes (2017) lists three synonyms: (1) *Coccophagus sanctus* Girault, (2) *Encarsia sancta* (Girault), and (3) *Prospaltella lutea* Masi.

UNITED STATES

YEAR/PLACE RELEASED

1991–1999 USA: (1) Florida: 1991 (from Israel) (Nguyen and Bennett, 1995); (2) Texas, Arizona, and California: 1993–1999 (from Israel via Florida USA) (Hoelmer and Goolsby, 2003)

TARGET PEST

Bemisia tabaci (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE

HRT-
No laboratory host-range testing done before release. Literature hosts include (1) *Acaudaleyrodes citri* (Priesner & Hosni) (Rosen, 1966); (2) *Asterobemisia avellanae* (Signoret) (Viggiani, 1981); (3) *Trialeurodes vaporariorum* (Westwood) (Kajita, 1981); (4) *Parabemisia myricae* (Kuwana) (Longo et al., 1990); and (5–6) *Aleurolobus* spp. (Abd-Rabou, 1997) and *Siphoninus phillyreae* (Haliday) (Abd-Rabou and Abou-Setta, 1998). Males are parasitoids of moth eggs (Stoner and Butler, 1965), including *Helicoverpa zea* (Boddie) and *Trichoplusia ni* (Hübner) (Noyes, 2017). Noyes (2017) lists 42 whiteflies as additional hosts, plus 1 coccid scale: (1) *Acaudaleyrodes rachipora* (Singh), (2) *Aleurocanthus cinnamomi* Takahashi, (3) *Aleurocanthus zizyphi* Priesner & Hosny, (4) *Aleurolobus marlatti* (Quaintance), (5) *Aleurolobus niloticus* Priesner & Hosny, (6) *Aleurolobus rhododendri* Takahashi, (7) *Aleurolobus setigerus* Quaintance and Baker (Ryberg), (8) *Aleurolobus wunni* (Ryberg) (9) *Aleuroplatus acaciae* Bink-Moenen, (10) *Aleuroplatus pectiniferus* Quaintance & Baker, (11) *Aleurotrachelus jelinekii* (Frauenfeld), (12) *Aleurotrachelus rhamnicola* (Goux), (13) *Aleurotrachelus rubi* Takahashi, (14) *Aleurotuberculatus aucubae* (Kuwana), (15) *Aleurotuberculatus ficicola* Takahashi, (16) *Aleurotuberculatus gordoniae* Takahashi (a synonym of *Aleuroclava gordoniae* [Takahashi]), (17) *Aleurotuberculatus jasmini* Takahashi, (18) *Aleurotuberculatus malloti* Takahashi, (19) *Aleurotuberculatus melastomae* Takahashi, (20) *Aleurotuberculatus psidii* (Singh), (21) *Aleyrodes azaleae* (Baker & Moles), (22) *Aleyrodes lonicerae* Walker, (23) *Aleyrodes proletella* L., (24) *Asterobemisia atraphaxius* (Danzig), (25) *Asterobemisia carpini* Koch, (26) *Bemisia ovata* (Goux), (27) *Bemisia porteri* Corbett, (28) *Bemisia salicaria* Danzig, (29) *Bulgarialeurodes cotesii* (Maskell), (30) *Dialeurodes citri* (Ashmead), (31) *Dialeurodes fici* Takahashi, (32) *Dialeurodes formosensis* Takahashi, (33) *Dialeurodes kirkaldyi* (Kotinsky), (34) *Dialeuropora decempuncta* (Quaintance rind Baker), (35) *Pealius azalea* (Baker and Moles), (36) *Pealius mori* (Takahashi), (37) *Pealius setosus* Danzig, (38) *Singhius hibisci* Kotinsky, (39) *Taiwanaleyrodes meliosmae* Takahashi, (40) *Tetralicia* sp., (41) *Trialeurodes abutiloneus* Haldeman, and (42) *Trialeurodes ricini* (Misra), as well as the only non-whitefly, the coccid *Parthenolecanium corni* (Bouché).

HOST SPECIFICITY

Family
♀**: Aleyrodidae** (48 species in 19 genera)
♂**: LEPIDOPTERAN EGGS**

PROJECT OUTCOMES

R+/E-/I-
Release: (1) Florida: Released in Florida, USA (Nguyen and Bennett, 1995). (2) Texas, Arizona, and California: Released in the western United States (Hoelmer and Goolsby, 2003).
Establishment: (1) Florida: Not established (Nguyen and Bennett, 1995). (2) Texas, Arizona, and California: Not established in the western United States (Goolsby et al., 2005).
Impact: Field evaluation not possible due to lack of establishment in either Florida or the western USA, but see cage evaluation by Goolsby et al., (1998).

Encarsia noyesi Hayat Aphelinidae

Noyes (2017) lists three synonyms: (1) *Encarsiella noyesi* Hayat, (2) *Dirphys noyesi* (Hayat), and (3) *Dyrphis noyesi* (Hayat).

UNITED STATES

YEAR/PLACE RELEASED 1997 USA, California (from Mexico) (Bellows and Meisenbacher, 2000)

TARGET PEST *Aleurodicus dugesii* Cockerell Aleyrodidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Literature records include (1) *Aleurodicus dispersus* Russell (Blanco-Metzler and Laprade, 1998) and (2) *Aleurodicus rugioperculatus* Martin (Boughton et al., 2015). Noyes (2017) lists 4 other whiteflies as hosts: (1) *Aleurodicus cocois* (Curtis), (2) *Aleurodicus maritimus* Hempel, (3) *Aleurodicus pulvinatus* (Maskell), and (4) *Aleurothrixus floccosus* (Maskell), as well as 2 mealybugs (Pseudococcidae): *Nipaecoccus aurilanatus* (Maskell) and *Puto barberi* (Cockerell).

HOST SPECIFICITY **Family? or Genus?**
Aleyrodidae (7 species in 2 genera [6 in *Aleurodicus*], plus records of 2 species in 2 genera of the Pseudococcidae that need confirmation)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in southern California, USA (Bellows and Meisenbacher, 2000).
Establishment: Established in a variety of locations in southern California (Bellows and Meisenbacher, 2000).
Impact: Dense whitefly populations were observed to decline to unimportant levels (complete biological control), due to the action of this parasitoid and that of another parasitoid, *Idioporus affinis* LaSalle, released in the same biocontrol project (Bellows and Meisenbacher, 2000).

Encarsia sophia (Girault & Dodd) Aphelinidae

Noyes (2017) lists nine synonyms: (1) *Coccophagus sophia* Girault and Dodd, (2) *Encarsia bemisiae* (Ishii), (3) *Encarsia shafeei* Hayat, (4) *Encarsia sublutea* (Silvestri), (5) *Encarsia transvena* (Timberlake), (6) *Prospaltella bemisiae* Ishii, (7) *Prospaltella flava* Shafee, (8) *Prospaltella sublutea* Silvestri, and (9) *Prospaltella transvena* Timberlake.

UNITED STATES

YEAR/PLACE RELEASED 1995 USA, Texas, Arizona, and California (from Pakistan) (Hoelmer and Goolsby, 2003). Dates listed are for California and Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008).

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing was done before release. Literature host records include *Trialeurodes vaporariorum* (Westwood) (Kumar and Gupta, 2006) and *Bemisia tuberculata* Bondar (Vásquez-Ordóñez et al., 2015). Noyes (2017) lists 25 other species of whiteflies in 18 genera as primary hosts of this parasitoid: (1) *Acaudaleyrodes rachipora* (Singh), (2) *Aleurocybotus indicus* (Aleyin), (3) *Aleurodicus dispersus* Russell, (4) *Aleuroduplidens eucalyptifolia* Martin, (5) *Aleurolobus niloticus* Priesner & Hosny, (6) *Aleurothrixus floccosus* (Maskell), (7) *Aleyrodes hibisci* Kotinsky, (8) *Aleyrodes proletella* L., (9) *Aleyrodes singularis* Danzig, (10) *Asterobemisia carpini* Koch, (11) *Asterochiton sonchi* (Kotinsky), (12) *Bemisia afer* Priesner & Hosny, (13) *Bemisia hibisci* Visnya, (14) *Parabemisia myricae* (Kuwana), (15) *Chitonaleyrodes* sp., (16) *Dialeurodes citri* (Ashmead), (17) *Dialeuropora decempuncta* Quaintance & Baker, (18) *Parabemisia myricae* (Kuwana), (19) *Pealius hibisci* (Kotinsky), (20) *Pealius longispinus* Takahashi, (21) *Pealius mori* (Takahashi), (22) *Singhius hibisci* (Kotinsky), (23) *Trialeurodes variabilis* (Quaintance), (24) *Vasdavidius indicus* (David & Subramaniam), and (25) *Xenaleyrodes* sp. In addition, Noyes (2017) lists some additional records that seem to need further confirmation: *Aphis sacchari* (Aphididae), *Diaspis* sp. (Diaspididae), and *Diaphorina citri* (Liviidae).

HOST SPECIFICITY **Family**
Aleyrodidae (28 species in 20 genera)
Other records of uncertain accuracy: 3 other less credible records exist that would need confirmation, including 1 each in Aphididae, Diaspididae, and Liviidae.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Texas, Arizona, and California in the USA (Hoelmer and Goolsby, 2003).
Establishment: Established in California (Gould et al., 2008) and Texas (Goolsby et al., 2009).
Impact: Field cage evaluation (Goolsby et al., 1998); no other information on impact.

Encarsia sophia (continued)

PUERTO RICO

YEAR/PLACE RELEASED 1996 USA, Puerto Rico (from Pakistan) (Pantoja et al., 2005; Gould et al., 2008)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing was done before release. Literature host records include *Trialeurodes vaporariorum* (Westwood) (Kumar and Gupta, 2006) and *Bemisia tuberculata* Bondar (Vásquez-Ordóñez et al., 2015). Noyes (2017) lists 25 other species of whiteflies in 18 genera as primary hosts of this parasitoid: (1) *Acaudaleyrodes rachipora* (Singh), (2) *Aleurocybotus indicus* (Aleyin), (3) *Aleurodicus dispersus* Russell, (4) *Aleuroduplidens eucalyptifolia* Martin, (5) *Aleurolobus niloticus* Priesner & Hosny, (6) *Aleurothrixus floccosus* (Maskell), (7) *Aleyrodes hibisci* Kotinsky, (8) *Aleyrodes proletella* L., (9) *Aleyrodes singularis* Danzig, (10) *Asterobemisia carpini* Koch, (11) *Asterochiton sonchi* (Kotinsky), (12) *Bemisia afer* Priesner & Hosny, (13) *Bemisia hibisci* Visnya, (14) *Parabemisia myricae* (Kuwana), (15) *Chitonaleyrodes* sp., (16) *Dialeurodes citri* (Ashmead), (17) *Dialeuropora decempuncta* Quaintance & Baker, (18) *Parabemisia myricae* (Kuwana), (19) *Pealius hibisci* (Kotinsky), (20) *Pealius longispinus* Takahashi, (21) *Pealius mori* (Takahashi), (22) *Singhius hibisci* (Kotinsky), (23) *Trialeurodes variabilis* (Quaintance), (24) *Vasdavidius indicus* (David & Subramaniam), and (25) *Xenaleyrodes* sp. In addition, Noyes (2017) lists some additional records that seem to need further confirmation: *Aphis sacchari* (Aphididae), *Diaspis* sp. (Diaspididae), and *Diaphorina citri* (Liviidae).

HOST SPECIFICITY **Family**
Aleyrodidae (28 species in 20 genera)
Other records of uncertain accuracy: 3 other less credible records exist that would need confirmation, including 1 each in Aphididae, Diaspididae, and Liviidae.

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Puerto Rico (Pantoja et al., 2005; Gould et al., 2008).
Establishment: Established in Puerto Rico (Pantoja et al., 2005; Gould et al., 2008).
Impact: In Puerto Rico, *E. sophia* became the dominant parasitoid of *B. tabaci* (Pantoja et al., 2005).

Encarsia strenua (Silvestri) APHELINIDAE

Noyes (2017) lists one synonym: *Prospaltella strenua* Silvestri.

UNITED STATES

YEAR/PLACE RELEASED 1987–1995? (exact date not stated) USA, California (from Puerto Rico) (Bellows and Arakawa, 1995)

TARGET PEST *Dialeurodes citrifolii* (Morgan) ALEYRODIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include (1) *Bemisia tabaci* (Gennadius) (Goolsby et al., 1998); (2) *Trialeurodes variabilis* (Trujillo et al., 2004); and (3–4) *Dialeurodes citri* (Ashmead) and *Parabemisia myricae* (Kuwana) (Soto et al., 2001). Noyes (2017) lists 8 other whiteflies as primary hosts of this parasitoid: (1) *Aleurolobus subrotundus* Silvestri, (2) *Aleuroplatus* sp., (3) *Asterochiton* sp. (4) *Bemisia giffardi* (Kotinsky), (5) *Dialeurodes eugeniae* Maskell, (6) *Dialeurodes kirkaldyi* (Kotinsky), (7) *Siphoninus phillyreae* (Haliday), and (8) *Trialeurodes packardi* (Morrill).

HOST SPECIFICITY **Family**
Aleyrodidae (13 species in 8 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (Bellows and Arakawa, 1995).
Establishment: Establishment in California not confirmed (Bellows and Arakawa, 1995).
Impact: Not applicable

Encarsia tabacivora Viggiani Aphelinidae

Introduced as *Encarsia* nr *pergandiella* Howard. Relationships in the *E. pergandiella* species complex have been reviewed by Gebiola et al. (2017), who state that the form introduced to the USA from Brazil as *Encarsia* nr *pergandiella* was *E. tabacivora*. Noyes (2017) lists one synonym: *Encarsia bemisiae* De Santis.

UNITED STATES

YEAR/PLACE RELEASED 1995–1996 USA, Texas, Arizona, and California (from Brazil) (Hoelmer and Goolsby, 2003). Dates listed are for California and Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008).

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. *Encarsia tabacivora* is known from few hosts, but this may be due in part to the inability until recently to separate this species from others in the complex (Gebiola et al., 2017). Noyes (2017) lists 4 additional species as hosts: (1) *Aleurodicus dispersus* Russell, (2) *Aleurotrachelus trachoides* Back, (3) *Trialeurodes abutiloneus* (Haldane), and (4) *Trialeurodes vaporariorum* Westwood.

HOST SPECIFICITY **Family**
♀**: Aleyrodidae** (5 species in 4 genera)
♂**: Aphelinidae:** Males develop as hyperparasitoids of whitefly parasitoids, e.g., *Eretmocerus mundus* Mercet (Zhang et al., 2015)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Texas, Arizona, and California in the USA (Hoelmer and Goolsby, 2003).
Establishment: Not established in the western United States (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008).
Impact: Not applicable. See Goolsby et al. (1998) for results of a field-cage trial.

Enoggera reticulata Naumann Pteromalidae

For species description, see Naumann (1991). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 2000 USA, California (native to Australia but obtained from South Africa, where it had been introduced earlier for biocontrol of another species of *Trachymela* [Tribe and Cillié, 2000]) (Millar et al., 1999–2000; Paine and Millar, 2002)

TARGET PEST *Trachymela sloanei* Blackburn Chrysomelidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include only 2 chrysomelids: *Paropsisterna* sp. and *Trachymela tincticollis* (Blackburn) (Naumann, 1991; Tribe and Cillié, 2000). Noyes (2017) lists no other hosts.

HOST SPECIFICITY **Family**
Chrysomelidae (3 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (Millar et al., 1999–2000; Paine and Millar, 2002).
Establishment: *Enoggera reticulata* did not establish in California (J. Millar, pers. comm..; Paine et al., 2015).
Impact: Not applicable

Entedononecremnus krauteri Zolnerowich and Rose Eulophidae

For species description, see Zolnerowich and Rose (1996). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1997 USA, Florida (from California USA, where it was introduced before 1985 from Texas USA, where it was adventitve) (see Table 4, p. 164 of Frank and McCoy, 2007)

TARGET PEST *Aleurodicus dugesii* Cockerell Aleyrodidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. There are no other literature host records. Noyes (2017) lists no other species as hosts.

Entedononecremnus krauteri (continued)

UNITED STATES (continued)

HOST SPECIFICITY
Possibly Species
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES
R+/E+/I?
Release: Released in Florida, USA (see Table 4, p. 164 of Frank and McCoy, 2007).
Establishment: Established in Florida (Frank and McCoy, 2007).
Impact: No information available.

Ephedrus plagiator (Nees) BRACONIDAE: APHIDIINAE

Yu (2017) lists three synonyms: (1) *Ephedrus homostigma* Fahringer, (2) *Ephedrus japonicus* Ashmead, and (3) *Ephedrus parcicornis* (Nees).

UNITED STATES

YEAR/PLACE RELEASED
1988–1992 USA, Washington state and Colorado (from Morocco and the Middle East) (Tanigoshi et al., 1995; Elliott et al., 1995)

TARGET PEST
Diuraphis noxia (Kurdjumov) APHIDIDAE

HOST RANGE EVIDENCE
HRT-
No laboratory host-range estimation done before release. Various aphids are recorded as literature hosts, including (1) *Aphis pomi* de Geer (Cierniewska, 1973); (2) *Aphis glycines* Matsumura (Chang et al., 1994); (3) *Myzus persicae* (Sulzer) (Devi et al., 1999); (4–6) *Schizaphis graminum* (Rondani), *Rhopalosiphum padi* (L.), and *Macrosiphum* (*Sitobion*) *avenae* (F.) (Rakhshani et al., 2008); (7) *Uroleucon nigrotuberculatum* (Olive) (Takada and Nakamura, 2010); and (8) *Aulacorthum solani* (Kaltenbach) (Ji et al., 2014).

HOST SPECIFICITY
Family
Aphididae (8 species in 7 genera)

PROJECT OUTCOMES
R+/E-/I-
Release: Released in the USA in Washington state (Tanigoshi et al., 1995) and in Colorado (Elliott et al., 1995).
Establishment: *Ephedrus plagiator* did not establish in Colorado (Burd et al., 2001). No information is available about establishment in Washington.
Impact: Not applicable

Eretmocerus emiratus Zolnerowich & Rose APHELINIDAE

For species description, see Zolnerowich and Rose (1998). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED
1996–1998 USA, California, Arizona, Texas (from United Arab Emirates) (dates for California and Arizona from W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008; Hoelmer and Goolsby, 2003; Goolsby et al., 2005)

TARGET PEST
Bemisia tabaci (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE
HRT-
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists no field hosts other than *Bemisia tabaci*.

HOST SPECIFICITY
Possibly Species
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES
R+/E+/I-
Release: Released in California, Arizona, and Texas in the USA (Hoelmer and Goolsby, 2003) Goolsby et al., 2005).
Establishment: Established in California and Arizona, but not Texas (Goolsby et al., 2005; Gould et al., 2008).
Impact: For field-cage evaluation see Goolsby et al. (1998) and Hoelmer (2007). In post release monitoring, *E. emiratus* (from United Arab Emirates) was recovered but only in small numbers and did not dominate the parasitoid complex at any of the sites studied by Goolsby et al. (2005).

Eretmocerus emiratus (continued)

MEXICO

YEAR/PLACE RELEASED About 1995 Mexico, Baja California (from United Arab Emirates via USA) (Cota-Gómez, et al., 1998; E. Ruiz Cancino, pers. comm.)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists no field hosts other than *Bemisia tabaci*.

HOST SPECIFICITY **Possibly Species**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Baja California, Mexico (Cota-Gómez, et al., 1998; E. Ruiz Cancino, pers. comm.).
Establishment: Unknown.
Impact: Not applicable

Eretmocerus nr *emiratus* Zolnerowich & Rose Aphelinidae

Taxonomic identity of this species is unclear. For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1997–1999 USA, California, Arizona, Texas (from Ethiopia) (dates for California and Arizona from W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008; Hoelmer and Goolsby, 2003; Goolsby et al., 2005)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Literature host records include *Aleyrodes lonicerae* Walker in China (Yu, 2015). For lack of confirmed species identity, Noyes (2017) could not be consulted for literature hosts.

HOST SPECIFICITY **Family**
Aleyrodidae (2 species in 2 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release. Released in California, Arizona, and Texas, USA (Hoelmer and Goolsby, 2003) Goolsby et al., 2005).
Establishment: Established in California (Roltsch, 2000; Hoelmer and Goolsby, 2003; Goolsby et al., 2005) and Arizona (Goolsby et al., 2005; Gould et al., 2008), but not Texas (Goolsby et al., 2005).
Impact: For field-cage evaluation see Goolsby et al. (1998); *Eretmocerus* nr *emiratus* (from Ethiopia) was the most commonly collected of the *Eretmocerus* species released against *B. tabaci* in the Imperial Valley in California and in the area of Yuma, Arizona in post-release monitoring (Goolsby et al., 2005).

Eretmocerus eremicus Rose & Zolnerowich Aphelinidae

This species is native to the southwestern USA (Goolsby et al., 2005) and may also be native to Mexico. Noyes (2017) lists no synonyms.

MEXICO

YEAR/PLACE RELEASED About 1995 Mexico, Baja California (from commercial insectaries, but originally from Arizona USA) (Cota-Gómez et al., 1998 and E. Ruiz Cancino, pers. comm.)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists, in addition to *B. tabaci*, (1) *Trialeurodes abutiloneus* Haldeman, (2) *Trialeurodes vaporariorum* Westwood, and (3) *Trialeurodes variabilis* (Quaintance) as hosts.

HOST SPECIFICITY **Family**
Aleyrodidae (4 species in 2 genera)

Eretmocerus eremicus (continued)

MEXICO (continued)

PROJECT OUTCOMES **R+/E?/I-**
Release: This species, which may have been naturally occurring in Mexico, was imported from commercial insectaries and released in Baja California, Mexico (Cota-Gómez, et al., 1998 and E. Ruiz Cancino, pers. comm.).
Establishment: The status of this species in Mexico is undetermined.
Impact: Not applicable

Eretmocerus furuhashii Rose and Zolnerowich APHELINIDAE

For species description, see Rose and Zolnerowich (1994). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1993–1999 USA, Texas, Arizona, and California (from Taiwan) (Hoelmer and Goolsby, 2003)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include *Parabemisia myricae* (Kuwana) (Rose and Zolnerowich, 1994). Noyes (2017) lists no other hosts besides *B. tabaci* and *P. myricae*.

HOST SPECIFICITY **Family**
Aleyrodidae (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in the USA in Texas, Arizona, and California (Hoelmer and Goolsby, 2003).
Establishment: Did not establish in the USA.
Impact: For results of field-cage trials with *E. furuhashii* (unnamed and coded as *Eretmocerus* sp. M95026 Taiwan), see Goolsby et al. (1998).

Eretmocerus hayati Zolnerowich & Rose APHELINIDAE

For species description, see Zolnerowich and Rose (1998). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1996–1999 USA, Texas, Arizona, California (from Pakistan) (dates for California and Arizona from W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists no other field hosts.

HOST SPECIFICITY **Possibly Species**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in the USA in Texas, Arizona, and California (Hoelmer and Goolsby, 2003).
Establishment: Established in Texas but not Arizona or California (Hoelmer and Goolsby, 2003; Goolsby et al., 2005).
Impact: For field-cage evaluation see Goolsby et al. (1998). In Texas (Rio Grande River Valley), *E. hayati* was the dominant parasitoid recovered (Goolsby et al., 2005).

Eretmocerus hayati (continued)

MEXICO

YEAR/PLACE RELEASED 1997 Mexico (from Pakistan via USA)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists no other field hosts.

HOST SPECIFICITY **Possibly Species**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Mexico (Gold et al., 2008).
Establishment: No information available.
Impact: No information available.

PUERTO RICO

YEAR/PLACE RELEASED 1997 USA, Puerto Rico (from Pakistan via USA) (Pantoja et al., 2005)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists no other field hosts.

HOST SPECIFICITY **Possibly Species**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Puerto Rico (Pantoja et al., 2005).
Establishment: Established in Puerto Rico (Pantoja et al., 2005).
Impact: Of all parasitoids of *B. tabaci*, only 10% were in *Eretmocerus*, indicating that *E. hayati* did not become a dominant parasitoid of *B. tabaci* on the island (Pantoja et al., 2005).

Eretmocerus melanoscutus Zolnerowich & Rose Aphelinidae

For species description, see Zolnerowich and Rose (1998). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1994–1996 USA: Texas (1994), Arizona and California (1995–1996) (from Thailand and Taiwan) (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts recorded in the literature. Noyes (2017) lists no other field hosts.

HOST SPECIFICITY **Possibly Species**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in the USA in Texas, Arizona, and California (Hoelmer and Goolsby, 2003).
Establishment: Did not establish in Arizona or California (Goolsby et al., 2005); recovered in Texas (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008).
Impact: No information available.

Eretmocerus mundus Mercet APHELINIDAE

Noyes (2017) lists the following synonyms: *Eretmocerus aligarhensis* Khan and Shafee and *Eretmocerus longipilus* Khan and Shafee.

UNITED STATES

YEAR/PLACE RELEASED 1994 USA, Texas, Arizona, and California (from Spain and Israel) (Hoelmer and Goolsby, 2003)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. In the laboratory, 2 species of *Trialeurodes* were attacked (*T. abutilonea* [Haldeman] and *T. vaporariorum* [Westwood]) (Greenberg et al., 2009). Field surveys in California found *E. mundus* only from *B. tabaci*, not from non-target whiteflies (Pickett et al., 2013a). Noyes (2017) lists 12 additional hosts: (1) *Acaudaleyrodes citri* Priesner & Hosny; (2) *Aleuroplatus cadabae* Priesner & Hosny; (3) *Aleyrodes proletella* L. (Onillon et al., 2004); (4) *Asterobemisia avellanae* (Signoret); (5) *Asterobemisia carpini* (Koch); (6) *Bemisia afer* (Priesner & Hosny) (Viggiani and Battaglia, 1983); (7) *Bemisia ovata* (Goux); (8) *Dialeurodes kirkaldyi* (Kotinsky); (9) *Neomaskellia bergii*, (Signoret) (Tiwari et al., 1978); (10) *Rosanovia hulthemiae* Danzig; (11) *Siphoninus phillyreae* (Haliday) (Abd-Rabou and Abou-Setta, 1998); and (12) *Trialeurodes ricini* (Misra) (Kapadia and Puri, 1993).

HOST SPECIFICITY **Family**
Aleyrodidae (15 species in 10 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in the USA in Texas, Arizona, and California (Hoelmer and Goolsby, 2003).
Establishment: Established in Texas (Hoelmer and Goolsby, 2003; Goolsby et al., 2005) and California (Roltsch, 2000; Hoelmer and Goolsby, 2003; Goolsby et al., 2005), but not Arizona (Goolsby et al., 2005).
Impact: For field cage evaluations see Goolsby et al. (1998). In post-release monitoring, *E. mundus* was the dominant parasitoid recovered in the San Joaquin Valley, but not the Imperial Valley of California. Also, it was only a minor parasitoid among those recovered in the Rio Grande Valley of Texas (Goolsby et al., 2005).

MEXICO

YEAR/PLACE RELEASED About 1995 or later Mexico, Baja California (source not stated) (Cervantes and Cota, 1992; Cota-Gómez et al., 1998; E. Ruiz Cancino, pers. comm.)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. In the laboratory, 2 species of *Trialeurodes* were attacked (*T. abutilonea* [Haldeman] and *T. vaporariorum* [Westwood]) (Greenberg et al., 2009). Field surveys in California found *E. mundus* only from *B. tabaci*, not from non-target whiteflies (Pickett et al., 2013a). Noyes (2017) lists 12 additional hosts: (1) *Acaudaleyrodes citri* Priesner & Hosny; (2) *Aleuroplatus cadabae* Priesner & Hosny; (3) *Aleyrodes proletella* L. (Onillon et al., 2004); (4) *Asterobemisia avellanae* (Signoret); (5) *Asterobemisia carpini* (Koch); (6) *Bemisia afer* (Priesner & Hosny) (Viggiani and Battaglia, 1983); (7) *Bemisia ovata* (Goux); (8) *Dialeurodes kirkaldyi* (Kotinsky); (9) *Neomaskellia bergii*, (Signoret) (Tiwari et al., 1978); (10) *Rosanovia hulthemiae* Danzig; (11) *Siphoninus phillyreae* (Haliday) (Abd-Rabou and Abou-Setta, 1998); and (12) *Trialeurodes ricini* (Misra) (Kapadia and Puri, 1993).

HOST SPECIFICITY **Family**
Aleyrodidae (15 species in 10 genera)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Baja California, Mexico (Cervantes and Cota, 1992; Cota-Gómez et al., 1998; E. Ruiz Cancino, pers. comm.).
Establishment: Establishment in Mexico unknown.
Impact: Not applicable

PUERTO RICO

YEAR/PLACE RELEASED 1996 USA, Puerto Rico (from Spain and Israel) (Pantoja et al., 2005)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

Eretmocerus mundus (continued)

PUERTO RICO (continued)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. In the laboratory, 2 species of *Trialeurodes* were attacked (*T. abutilonea* [Haldeman] and *T. vaporariorum* [Westwood]) (Greenberg et al., 2009). Field surveys in California found *E. mundus* only from *B. tabaci*, not from non-target whiteflies (Pickett et al., 2013a). Noyes (2017) lists 12 additional hosts: (1) *Acaudaleyrodes citri* Priesner & Hosny; (2) *Aleuroplatus cadabae* Priesner & Hosny; (3) *Aleyrodes proletella* L. (Onillon et al., 2004); (4) *Asterobemisia avellanae* (Signoret); (5) *Asterobemisia carpini* (Koch); (6) *Bemisia afer* (Priesner & Hosny) (Viggiani and Battaglia, 1983); (7) *Bemisia ovata* (Goux); (8) *Dialeurodes kirkaldyi* (Kotinsky); (9) *Neomaskellia bergii*, (Signoret) (Tiwari et al., 1978); (10) *Rosanovia hulthemiae* Danzig; (11) *Siphoninus phillyreae* (Haliday) (Abd-Rabou and Abou-Setta, 1998); and (12) *Trialeurodes ricini* (Misra) (Kapadia and Puri, 1993).

HOST SPECIFICITY **Family**
Aleyrodidae (15 species in 10 genera)

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Puerto Rico (Pantoja et al., 2005).
Establishment: Established in Puerto Rico (Pantoja et al., 2005).
Impact: Of all parasitoids of *B. tabaci*, only 10% were in *Eretmocerus*, indicating that *E. mundus* did not become a dominant parasitoid of *B. tabaci* on the island (Pantoja et al., 2005).

Eretmocerus rui Zolnerowich and Rose Aphelinidae

For species description, see Zolnerowich and Rose (2004). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED About 1994–1995 USA, Florida (from Hong Kong) (Nguyen and Bennett, 1995)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range estimation done before release. Noyes (2017) lists 2 additional hosts: (1) *Bemisia emiliae* (Chen & Ko) and (2) *Crenidorsum turpiniae* (Takahashi).

HOST SPECIFICITY **Family**
Aleyrodidae (3 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Florida, USA (Zolnerowich and Rose, 2004).
Establishment: While some post-release recoveries were made, it is uncertain if *E. rui* has established in Florida (Zolnerowich and Rose, 2004).
Impact: Not applicable

Eretmocerus staufferi Rose and Zolnerowich Aphelinidae

For species description, see Rose and Zolnerowich (1997). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1994 USA, California and Arizona (from Texas USA, where it is either native or adventitiously introduced [Hoelmer and Goolsby, 2003]) (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include *Trialeurodes abutiloneus* Haldeman (Rose and Zolnerowich, 1997). Noyes (2017) lists no other hosts besides *B. tabaci* and *T. abutiloneus*.

HOST SPECIFICITY **Family**
Aleyrodidae (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in the USA in California and Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008).
Establishment: Not established in California or Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008).
Impact: Not applicable

Eretmocerus tejanus Rose & Zolnerowich APHELINIDAE

Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1994 USA, California and Arizona (from Texas, where it is a native species [Hoelmer and Goolsby, 2003]) (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B ALEYRODIDAE (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists no other hosts apart from *B. tabaci*.

HOST SPECIFICITY **Possibly Species**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in the USA in California and Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture).
Establishment: Not established in California or Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture).
Impact: Not applicable

Euplectrus maternus Bhatnagar EULOPHIDAE

Noyes (2017) lists no synonyms.

GUAM

YEAR/PLACE RELEASED 1999–2001, Guam, USA (from India) (Muniappan et al., 2004)

TARGET PEST *Eudocima* (*Othreis*) *fullonia* (Clerck) NOCTUIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists 2 additional species of underwing moths in the genus *Eudocima* as hosts of *E. maternus*: *Eudocima materna* L. and *Eudocima homaena* (Hübner) (Bhumannavar and Viraktamath, 2000).

HOST SPECIFICITY **Genus**
Noctuidae (3 species in 1 genus, *Eudocima*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Guam (Muniappan et al., 2004).
Establishment: No evidence of establishment was obtained despite weekly monitoring for two years (Muniappan et al., 2004).
Impact: Not applicable

Euplectrus nr *parvulus* Ferrière EULOPHIDAE

Taxonomic identity unclear, but if this is *E. parvulus*, then *Euplectrus plecopterae* Mani is a synonym (Noyes, 2017). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms.

GUAM

YEAR/PLACE RELEASED 1986–1987 Guam, USA (from India, possibly Kerala [Rajeshwari and Chacko, 1992]) (Nafus, 1991)

TARGET PEST *Penicillaria jocosatrix* Guenée NOCTUIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. If this is *E. parvulus*, then Noyes (2017) lists the following additional host species: (1) *Pyrilla* sp. (Hemip.: Lophopidae); (2–3) the geometrid moths *Boarmia selenaria* Schiffermüller and *Tephrina disputaria* Guenée; and (4) the noctuid moth *Plecoptera reflexa* Guenée (Chatterjee, 1945).

HOST SPECIFICITY **Unknown**
The host range of this entity is uncertain due in part to a lack of species identification. For *E. parvulus*, hosts are recorded in two lepidopteran families (Geometridae and Noctuidae) and one hemipteran family (Lophopidae) (Noyes, 2017). The Hemiptera record should be confirmed.

Euplectrus nr *parvulus* (continued)

GUAM (continued)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released on Guam (Nafus, 1991).
Establishment: Established on Guam (Nafus, 1991).
Impact: "The wasps *Aleiodes* sp. [given here as *Aleiodes* nr *circumscriptus*] and *Euplectrus* sp. [given here as *Euplectrus* nr *parvulus*] and the fly *Blepharella lateralis* were released. *Aleiodes* sp. did not establish, but *Euplectrus* sp. and *B. lateralis* did. [Due to the 2 established species,] populations of the pest fell to 25% of their pre-release levels. Parasitism rates ranged from 20 to 99%. *Euplectrus* sp. was the most abundant parasitoid …[and] was more abundant in the dry season, whereas *B. lateralis* was more common in the wet season. Fruit production on monitored trees increased significantly" (Nafus, 1991). Positive foodweb effects also occurred that benefitted other mango-feeding Lepidoptera after decline of the pest species (Schreiner and Nafus, 1992, 1993).

Eurithia consobrina (Meigen) Tachinidae

(formerly in *Ernestia*)

CANADA

YEAR/PLACE RELEASED 1986–1987 Canada, Manitoba (from Germany) (Turnock and Carl, 1995; Mason et al., 2002)

TARGET PEST *Mamestra configurata* Walker Noctuidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Of 5 non-target noctuid species tested by placing a fly maggot on the test larva, 4 (*Agrotis ipsilon* [Hufnagel], *Lacanobia radix* [Walker], *Pseudaletia unipuntata* [Haworth], and *Eruois occulta* [L.]) supported development to pupation (Turnock and Carl, 1995). Literature host records include (1) *Lacanobia oleracea* (L.) (Noctuidae) (Zorin and Zorina, 1928); (2) *Mamestra brassicae* (L.) (Noctuidae) (Yastrebov, 1978); (3–5) *Laconobia splendens* (Hübner), *Laconobia suasa* (D. & S.), *Melanchra persicariae* (L.) (all Noctuidae) (Turnock and Carl, 1995).

HOST SPECIFICITY **Family**
Noctuidae (2 subfamilies, Noctuinae and Hadeninae)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Manitoba, Canada (Turnock and Carl, 1995; Mason et al., 2002).
Establishment: Not established in Canada (Turnock and Carl, 1995; see p. 172 of Mason et al., 2002).
Impact: Not applicable

Eurysthaea scutellaris (Robineau–Desvoidy) Tachinidae

Synonym is *Erythrocera scutellaris*. *Eurystheae* is a misspelling of the generic name in Unruh et al. (2003).

UNITED STATES

YEAR/PLACE RELEASED 1989–1991 USA, Washington state (from France) (see Table 1 of Unruh et al., 2003)

TARGET PEST *Yponomeuta malinellus* (Zeller) Yponomeutidae
(given formerly as *Hyponomeuta malinellus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Hosts recorded in the literature include species in 3 families: (1) the pyralid *Acrobasis consociella* (Hübner) (Lerer and Plugar, 1962); (2) the yponomeutid *Yponomeuta padellus* (L.) (Heusinger, 1981); and (3) the geometrid *Abraxas pantaria* (L.) (Pernek et al., 2015).

HOST SPECIFICITY **Order**
Lepidoptera: Pyralidae, **Yponomeutidae**, and **Geometridae**

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Washington state, USA (Unruh et al., 2003).
Establishment: Not recovered in Washington (Unruh et al., 2003).
Impact: Not applicable

Eurytoma erythrinae Gates and Delvare EURYTOMIDAE

Noyes (2017) lists no synonyms.

HAWAII

YEAR/PLACE RELEASED 2008 USA, Hawaii (from East Africa) (Kaufman and Yalemar, 2017)

TARGET PEST *Quadrastichus erythrinae* Kim EULOPHIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. None of the 7 non-target gall-makers tested—1 native, 4 biocontrol agents, 2 adventive species—were attacked (HDOA, 2008). Species tested were *Josephiella microcarpae* Beardsley & Rasplus, *Tectococcus ovatus* Hempel, *Ophelimus* sp., *Trioza* sp., *Eutreta xanthochaeta* Aldrich, *Procecidochares alani* Steyskal, and *Procecidochares utilis* Stone) (HDOA, 2008). Noyes (2017) lists no other hosts, nor are any recorded in the literature.

HOST SPECIFICITY **Possibly Species**
Eulophidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Hawaii (Kaufman and Yalemar, 2017).
Establishment: Widely established in Hawaii (Kaufman and Yalemar, 2017).
Impact: Widespread reduction of leaf galling documented by Kaufman and Yalemar (2017) but not Bell et al. (2013).

Euxestonotus error (Fitch) PLATYGASTRIDAE

Also given as *Platygaster error.*

CANADA

YEAR/PLACE RELEASED 1995 Canada, Saskatchewan (from Switzerland and surrounding parts of central Europe) (Doane et al. 2002)

TARGET PEST *Sitodiplosis mosellana* (Géhin) CECIDOMYIIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts known from literature.

HOST SPECIFICITY **Possibly Species**
Cecidomyiidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Saskatchewan, Canada (Doane et al. 2002).
Establishment: Establishment in Saskatchewan was not confirmed by Doane et al. (2013) since only three individuals were recovered in the year following release. However, establishment in Canada can be inferred by the subsequent recovery of *E. error* in Montana, in areas not receiving releases, which was attributed to natural spread from Canada (Echegaray et al., 2016).
Impact: Impact in Canada unknown.

UNITED STATES

YEAR/PLACE RELEASED 2015 USA, Montana (from Switzerland and surrounding parts of central Europe via Saskatchewan, Canada) (G. Reddy, pers. comm.)

TARGET PEST *Sitodiplosis mosellana* (Géhin) CECIDOMYIIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts known from literature.

HOST SPECIFICITY **Possibly Species**
Cecidomyiidae (known only from the target pest)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Montana (G. Reddy, pers. comm.).
Establishment: Not recovered at release sites in Montana (G. Reddy, pers. comm.) but recovered in other parts of Montana, due to natural spread from Canada (Echegaray et al., 2016).
Impact: Not applicable for the intentionally-introduced population. No studies have been conducted on the impact of the naturally-spread population in Canada.

Fidiobia asina (Loiacono) Platygastridae

For species description, see Loiacono (1982). Also given as *Platystasius asinus* Loiacono in Frank and McCoy (1993 [see page 30]).

UNITED STATES

YEAR/PLACE RELEASED 1991 USA, Florida (from Chile) (see p. 30 of Frank and McCoy, 1993)

TARGET PEST *Diaprepes abbreviatus* L. Curculionidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include *Naupactus xanthographus* Germar (Loiacono, 1982).

HOST SPECIFICITY **Family**
Curculionidae (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Florida, USA (see p. 30 of Frank and McCoy, 1993).
Establishment: Establishment in Florida undetermined (see p. 30 of Frank and McCoy, 1993).
Impact: Not applicable

Fidiobia dominica Evans and Peña Platygastridae

For species description, see Evans and Peña (2005).

UNITED STATES

YEAR/PLACE RELEASED 2006 USA, Florida (from Dominica in the Caribbean) (Evans and Peña, 2005)

TARGET PEST *Diaprepes abbreviatus* L. Curculionidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include only *Diaprepes doublierii* Guérin (Evans and Peña, 2005); *D. abbreviatus* was parasitized in the laboratory (Duncan et al., 2007).

HOST SPECIFICITY **Possibly Genus**
Curculionidae (2 species in 1 genus). Likely attacks only weevils whose eggs are concealed in plant tissues.

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Florida, USA (Jacas et al., 2007).
Establishment: Unknown if it established in Florida.
Impact: Not applicable

Fopius ceratitivorus Wharton Braconidae

For species description, see Wharton (1999).

HAWAII

YEAR/PLACE RELEASED 2017 USA, Hawaii (from Kenya via Guatemala) (Lopez et al., 2003; R. Messing, pers. comm.)

TARGET PEST *Ceratitis capitata* (Wiedemann) Tephritidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. In laboratory host-range tests, the non-target native Hawaiian tephritid *Trupanea dubautiae* (Bryan), infesting flowerheads of the endemic Asteraceae shrub *Dubautia raillardioides* Hillebrand, was not attacked (Wang et al., 2004). Similarly, 3 other tephritids (*Bactrocera cucurbitae* [Coquillett], *Bactrocera dorsalis* [Hendel], and *Bactrocera latifrons* [Hendel]) were tested and not attacked (Bokonon-Ganta et al., 2005). Environmental assessment of the proposed release is given by Messing (2014).

HOST SPECIFICITY **Possibly Species**
Tephritidae (known only from the target pest, but not tested against other *Ceratitis* species, as none occur in Hawaii)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Hawaii, USA (R. Messing, pers. comm.).
Establishment: Establishment in Hawaii not determined.
Impact: Not applicable

Goetheana shakespearei Girault EULOPHIDAE

Noyes (2017) lists four synonyms: (1) *Dasyscapus parvipennis* Gahan; (2) *Dasyscapus thripsivorous* Narayanan, Subba Rao and Ramachandra; (3) *Goetheana parvipennis* (Gahan); and (4) *Goetheana thripsivora* (Narayanan, Subba Rao and Ramachand).

UNITED STATES

YEAR/PLACE RELEASED 1986 USA, Florida (from Gold Coast in Africa via Trinidad [Adamson, 1936] via Puerto Rico [Bartlett, 1938; see p. 26 of Frank and McCoy, 1993]). Released in California before 1985.

TARGET PEST *Selenothrips rubocinctus* (Girard) THRIPIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists 8 other hosts: (1) *Caliothrips insularis* (Hood), (2) *Ceratothripoides claratris* (Shumsher), (3) *Dinurothrips hookeri* Hood, (4) *Frankliniella occidentalis* (Pergande), (5) *Heliothrips haemorrhoidalis* (Bouché), (6) *Hercinothrips femoralis* (Reuter), (7) *Pseudodendrothrips mori* Niwa, and (8) *Thrips tabaci* Lindeman.

HOST SPECIFICITY **Family**
Thripidae (9 species in 9 genera)

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Florida, USA, after a long history of releases in the Caribbean and California, USA (see sources in p. 26 of Frank and McCoy, 1993).
Establishment: Established in Florida in 1992 (see p. 26 of Frank and McCoy, 1993), but population detected may have spread from earlier establishments in the Caribbean.
Impact: No information found on impact in Florida.

Goniozus pakmanus Gordh BETHYLIDAE

For species description see Gordh (1984).

UNITED STATES

YEAR/PLACE RELEASED 1984–1985 USA: Arizona (1984), California (1985) (from Pakistan) (Gordh and Medved, 1986)

TARGET PEST *Pectinophora gossypiella* (Saunders) GELECHIIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts of *Goniozus pakmanus* are listed in the literature.

HOST SPECIFICITY **Unknown**
Gelechiidae (known only from the target pest. However, because this species is an idiobiont, it is unlikely that it is host specific, but rather that too little information is known for this species to assess its host range.)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Arizona and California, USA (Gordh and Medved, 1986).
Establishment: Establishment in Arizona and California not determined (Gordh and Medved, 1986).
Impact: Unknown

Gyranusoidea indica Shafee, Alam & Agarwal ENCYRTIDAE

Noyes (2017) lists no synonyms.

U.S. VIRGIN ISLANDS

YEAR/PLACE RELEASED 1998 USA, U.S. Virgin Islands, St. Thomas (from Pakistan and Egypt) (W. Roltsch, pers. comm., California Department of Food and Agriculture)

TARGET PEST *Maconellicoccus hirsutus* (Green) PSEUDOCOCCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists 4 other mealybugs species as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Nipaecoccus viridis* (Newstead), (3) *Phenacoccus solenopsis* Tinsley, and (4) *Pseudococcus longispinus* (Targioni Tozzetti). Post-hoc sampling of non-target mealybugs in California following release of the parasitoid (and its establishment there on the target) did not detect any parasitism of either *Phenacoccus solenopsis* Tinsley or *Ferrisia* species (Roltsch et al., 2006).

HOST SPECIFICITY **Family**
Aleyrodidae (5 species in 5 genera, but 2 literature host species were not attacked in the field in California [Roltsch et al., 2006])

Gyranusoidea indica (continued)

U.S. VIRGIN ISLANDS (continued)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released on St. Thomas, U.S. Virgin Islands (W. Roltsch, pers. comm., California Department of Food and Agriculture).
Establishment: Established in the U.S. Virgin Islands (W. Roltsch, pers. comm., California Department of Food and Agriculture).
Impact: Control in the U.S. Virgin Islands is likely as the target pest was controlled by this parasitoid, in combination with *Anagyrus kamali*, wherever released in the Carribean (Kairo et al., 2000).

PUERTO RICO

YEAR/PLACE RELEASED 1999 USA, Puerto Rico (from Pakistan and Egypt) (W. Roltsch, pers. comm., California Department of Food and Agriculture)

TARGET PEST *Maconellicoccus hirsutus* (Green) Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists 4 other mealybugs species as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Nipaecoccus viridis* (Newstead), (3) *Phenacoccus solenopsis* Tinsley, and (4) *Pseudococcus longispinus* (Targioni Tozzetti). Post-hoc sampling of non-target mealybugs in California following release of the parasitoid (and its establishment there on the target) did not detect any parasitism of either *Phenacoccus solenopsis* Tinsley or *Ferrisia* species (Roltsch et al., 2006).

HOST SPECIFICITY **Family**
Aleyrodidae (5 species in 5 genera, but 2 literature host species were not attacked in the field in California [Roltsch et al., 2006])

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Puerto Rico (Michaud and Evans, 2000).
Establishment: Established in Puerto Rico (Michaud and Evans, 2000).
Impact: In less than two years after release, *G. indica* was recovered at 29% of all locations sampled and represented 17% of all natural enemy individuals recovered (Michaud and Evans, 2000).

MEXICO

YEAR/PLACE RELEASED 1999 Mexico, Baja California (from Pakistan and Egypt via Puerto Rico) (Santiago-Islas et al., 2008)

TARGET PEST *Maconellicoccus hirsutus* (Green) Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists 4 other mealybugs species as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Nipaecoccus viridis* (Newstead), (3) *Phenacoccus solenopsis* Tinsley, and (4) *Pseudococcus longispinus* (Targioni Tozzetti). Post-hoc sampling of non-target mealybugs in California following release of the parasitoid (and its establishment there on the target) did not detect any parasitism of either *Phenacoccus solenopsis* Tinsley or *Ferrisia* species (Roltsch et al., 2006).

HOST SPECIFICITY **Family**
Aleyrodidae (5 species in 5 genera, but 2 literature host species were not attacked in the field in California [Roltsch et al., 2006])

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Baja California, Mexico (Santiago-Islas et al., 2008).
Establishment: Established in Mexico (Santiago-Islas et al., 2008).
Impact: Control in Mexico is likely as the target pest was controlled by this parasitoid, in combination with *Anagyrus kamali*, wherever released in the region (Kairo et al., 2000).

UNITED STATES

YEAR/PLACE RELEASED 2000–2006 USA: California (2000) (from Australia); Florida (2002) and Louisiana (2006) (from Pakistan, Egypt, Australia—mixed colony) (W. Roltsch, pers. comm., California Department of Food and Agriculture)

TARGET PEST *Maconellicoccus hirsutus* (Green) Pseudococcidae

Gyranusoidea indica (continued)

UNITED STATES (continued)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists 4 other mealybugs species as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Nipaecoccus viridis* (Newstead), (3) *Phenacoccus solenopsis* Tinsley, and (4) *Pseudococcus longispinus* (Targioni Tozzetti). Post-hoc sampling of non-target mealybugs in California following release of the parasitoid (and its establishment there on the target) did not detect any parasitism of either *Phenacoccus solenopsis* Tinsley or *Ferrisia* species (Roltsch et al., 2006).

HOST SPECIFICITY **Family**
Aleyrodidae (5 species in 5 genera, but 2 literature host species were not attacked in the field in California [Roltsch et al., 2006])

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, Florida, and Louisiana in the USA (Roltsch et al., 2006).
Establishment: Established in California (Roltsch et al., 2006). Establishment in Florida and Louisiana not recorded.
Impact: Successful control of pink mealybug in California was achieved due to several released natural enemies, resulting in >95% reduction of the pest. *Anagyrus kamali* was the dominant summer parasitoid with up to 50% parasitism, while *G. indica* was an important winter parasitoid (Roltsch et al., 2006).

Haeckeliania sperata Pinto TRICHOGRAMMATIDAE

For species description, see Pinto (2005). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 2005 USA, Florida (from Dominica in the Caribbean) (Pinto, 2005)

TARGET PEST *Diaprepes abbreviatus* (L.) CURCULIONIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. No attack on eggs of 2 non-target Lepidoptera or 2 non-target Coleoptera (1 Coccinellidae and 1 non-*Diaprepes* Curculionidae) (Peña et al., 2010). *Pachnaeus litus* Schoenherr (Curculionidae) is a suitable host in the laboratory (Jacas et al., 2010). No other hosts are listed in Noyes (2017).

HOST SPECIFICITY **Family**
Curculionidae (2 species in 2 genera). Likely a parasitoid of weevils whose eggs are concealed in plant tissue.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Florida, USA (Jacas et al., 2008).
Establishment: Established in Florida (Peña et al., 2010).
Impact: No information available.

Herpestomus brunnicornis (Gravenhorst) ICHNEUMONIDAE

UNITED STATES

YEAR/PLACE RELEASED 1989–1991 USA, Washington state (from France [Unruh et al., 2003], Korea and Japan [Lee and Pemberton, 2005])

TARGET PEST *Yponomeuta malinellus* (Zeller) YPONOMEUTIDAE
(given formerly as *Hyponomeuta malinellus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include the following yponomeutids: (1) *Yponomeuta malinellus* (Zeller) (formerly *Hyponomeuta malinellus*) (Mokrzecki, 1913); (2) *Yponomeuta rorellus* (Hübner) (formerly *Hyponomeuta rorella*) (Tudor and Marcu, 1974); (3) *Yponomeuta euonymellus* L. (Miczulski and Anasiewicz, 1976); and (4–5) *Yponomeuta padella* (L.) (formerly *Hyponomeuta padellus*) and *Yponomeuta cagnagellus* (Hübner) (Fischer, 1987).

HOST SPECIFICITY **Genus**
Yponomeutidae (5 species in 1 genus, *Yponomeuta*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Washington state, USA (Unruh et al., 2003; Lee and Pemberton, 2005).
Establishment: Some recoveries of *H. brunnicornis* were made, but establishment in Washington state was not confirmed (Unruh et al., 2003).
Impact: Not applicable

Herpestomus brunnicornis (continued)

CANADA

YEAR/PLACE RELEASED 1990 Canada, British Columbia (from Japan and Europe) (Cossentine and Kuhlmann, 2002)

TARGET PEST *Yponomeuta malinellus* (Zeller) Yponomeutidae
(given formerly as *Hyponomeuta malinellus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include the following yponomeutids: (1) *Yponomeuta malinellus* (Zeller) (formerly *Hyponomeuta malinellus*) (Mokrzecki, 1913); (2) *Yponomeuta rorellus* (Hübner) (formerly *Hyponomeuta rorella*) (Tudor and Marcu, 1974); (3) *Yponomeuta euonymellus* L. (Miczulski and Anasiewicz, 1976); and (4–5) *Yponomeuta padella* (L.) (formerly *Hyponomeuta padellus*) and *Yponomeuta cagnagellus* (Hübner) (Fischer, 1987).

HOST SPECIFICITY **Genus**
Yponomeutidae (5 species in 1 genus, *Yponomeuta*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in British Columbia, Canada (Cossentine and Kuhlmann, 2002).
Establishment: No evidence of establishment in Canada (Cossentine and Kuhlmann, 2002).
Impact: Not applicable

Horismenus elineatus Schauff Eulophidae

For species description, see Schauff (1989). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1990–1992 USA, Florida (from Bolivia via Texas USA or Hawaii USA) (see p. 26 of Frank and McCoy, 1993)

TARGET PEST *Elasmopalpus lignosellus* (Zeller) Pyralidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. There are no other hosts reported in the literature. Noyes (2017) lists no additional species as hosts.

HOST SPECIFICITY **Possibly Species**
Pyralidae (known only from the target pest, but there is almost no literature)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Florida, USA (see p. 26 of Frank and McCoy, 1993).
Establishment: No evidence of establishment in Florida (see p. 26 of Frank and McCoy, 1993).
Impact: Not applicable

Idioporus affinis La Salle et Polaszek Pteromalidae

For species description, see LaSalle et al. (1997). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1998–2000 USA, California (from Central America) (Bellows and Meisenbacher, 2000)

TARGET PEST *Aleurodicus dugesii* Cockerell Aleyrodidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts reported in the literature. Noyes (2017) lists no additional species as hosts.

HOST SPECIFICITY **Possibly Species**
Aleyrodidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Bellows and Meisenbacher, 2000).
Establishment: Established in California (Bellows and Meisenbacher, 2000).
Impact: Dense whitefly populations were observed to decline to unimportant levels (complete biological control), due to the action of this parasitoid and that of another parasitoid, *Encarsia noyesi* Hayat, released in the same biocontrol project (Bellows and Meisenbacher, 2000).

Jarra maculipennis Marsh and Austin BRACONIDAE

For species description, see Austin et al. (1994).

UNITED STATES

YEAR/PLACE RELEASED About 1993 USA, California (from Australia) (J. Millar, pers. comm.)

TARGET PEST *Phoracantha semipunctata* (F.) CERAMBYCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts are listed in the literature.

HOST SPECIFICITY **Unknown**
Cerambycidae (known only from the target pest, but there is almost no literature. The species is likely restricted to borers in eucalyptus trees due to attraction to host plant odors.)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (J. Millar, pers. comm.).
Establishment: No record of establishment in California.
Impact: Not applicable

Jarra phoracantha Marsh and Austin BRACONIDAE

For species description, see Austin et al. (1994).

UNITED STATES

YEAR/PLACE RELEASED 1993 USA, California (from Australia) (Paine and Millar, 2003)

TARGET PEST *Phoracantha semipunctata* (F.) CERAMBYCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts are listed in the literature.

HOST SPECIFICITY **Unknown**
Cerambycidae (known only from the target pest, but there is almost no literature. The species is likely restricted to borers in eucalyptus trees due to attraction to host plant odors.)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (Paine and Millar, 2003).
Establishment: No record of establishment in California.
Impact: Not applicable

Larra bicolor Fabricius CRABRONIDAE

Synonyms include *Larra gastrica*, *L. guiana*, and *L. scapteriscica* (Menke, 1992).

UNITED STATES

YEAR/PLACE RELEASED 1989 USA, northern Florida (from Bolivia) (Frank and Bennett, 1995). Previously, a population of *L. bicolor* was established in southern Florida; it originated from releases in the early 1980s of material from Puerto Rico, where it had been introduced earlier from Brazil (Frank and Bennett, 1995).

TARGET PEST *Neoscapteriscus abbreviatus* (Scudder); *Neoscapteriscus vicinus* (Scudder); and *Neoscapteriscus borellii* (Giglio-Tos) GRYLLOTALPIDAE
(all targets formerly in *Scapteriscus*)

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release in northern Florida in 1989 by Castner (1984). *Larra bicolor* parasitized *Scapteriscus abbreviatus* Scudder, *S. didactylus* (Latreille), *S. imitatus* Nickle & Castner, and *Scapteriscus borellii* Giglio-Tos (previously known as *S. acletus*) in laboratory tests (Castner, 1984). Attack on one native non-target species, *Neocurtilla hexadactyla* (Perty), the only native cricket in the family in the region was unsuccessful in >90% of cases (Castner, 1984; Frank et al., 1995), making *L. bicolor* functionally genus-specific in the USA.

HOST SPECIFICITY **Genus**
Gryllotalpidae (5 species in 1 genus, *Neoscapteriscus*)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in northern Florida, USA (Frank and Bennett, 1995; Frank and Walker, 2006).
Establishment: Established in northern Florida (Meagher and Frank, 1998; Frank and Walker, 2006).
Impact: Complete control of pest in northern Florida. An IPM program using *Steinernema scapterisci* (Nguyen and Smart) and *L. bicolor* suppressed two invasive mole crickets, *N. vicinus* and *S. didactylus*, by 95% (Leppla et al., 2007). *Larra bicolor*, as either the population from Bolivia or the one from Brazil, occurs throughout Florida (Frank et al., 2009). The mole cricket biocontrol program produced a benefit to cost return of 52:1 (Mhina et al., 2016).

Larra godmani Cameron Crabronidae

This species was an accidental contaminant in a shipment of *L. bicolor* (Frank et al., 1995). Synonyms include *Larra braunsii* Kohl and *L. transandina* Williams (Menke, 1992).

UNITED STATES

YEAR/PLACE RELEASED	1988 USA, Florida (from Bolivia) (see p. 32 of Frank and McCoy, 1993)
TARGET PEST	*Neoscapteriscus abbreviatus* (Scudder); *Neoscapteriscus vicinus* (Scudder); and *Neoscapteriscus borellii* (Giglio-Tos) Gryllotalpidae (all targets formerly in *Scapteriscus*)
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range estimation done before release. There are no other hosts recorded in the literature.
HOST SPECIFICITY	**Possibly Species** **Gryllotalpidae** (known only from the main target pest, *Neoscapteriscus abbreviatus*)
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Accidentally released in Florida, USA (see p. 32 of Frank and McCoy, 1993; Frank et al., 1995). **Establishment:** *Larra godmani* did not establish in Florida (see p. 32 of Frank and McCoy, 1993). **Impact:** Not applicable

Lathrolestes ensator (Brauns) Ichneumonidae

Synonyms include *Tryphonopsis ensator* Brauns, *Lathrolestes dilatatus* (Nordenstrom), and *Lathrolestes ensatrix* (Schulz) (Yu, 2017).

CANADA

YEAR/PLACE RELEASED	1995–1999 Canada, Quebec (from Switzerland and surrounding countries) (Vincent et al., 2001a)
TARGET PEST	*Hoplocampa testudinea* (Klug) Tenthredinidae
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release. No literature records exist of other hosts.
HOST SPECIFICITY	**Possibly Species** **Tenthredinidae** (known only from the target pest)
PROJECT OUTCOMES	**R+/E+/I?** **Release:** Released in Quebec, Canada (Vincent et al., 2001a). **Establishment:** Established in Quebec (Vincent et al., 2001b; 2016). **Impact:** Impact in Canada not yet determined (Vincent et al., 2013).

UNITED STATES

YEAR/PLACE RELEASED	2002 USA, New Hampshire (from Switzerland and surrounding countries via Canada) (Vincent et al., 2016)
TARGET PEST	*Hoplocampa testudinea* (Klug) Tenthredinidae
HOST RANGE EVIDENCE	**HRT-** No laboratory host-range testing done before release. No literature records exist of other hosts.
HOST SPECIFICITY	**Possibly Species** **Tenthredinidae** (known only from the target pest)
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in New Hampshire, USA (Vincent et al., 2016). **Establishment:** No evidence of establishment in New Hampshire (A. Eaton, pers. comm.). **Impact:** Not applicable

Lathrolestes thomsoni Reshchikov ICHNEUMONIDAE

For species description, see Reshchikov et al. (2010). The species attacking *Profenusa thomsoni* in Canada that was later introduced into Alaska was initially misidentified as *Lathrolestes luteolator* Gravenhorst, which it is not. No synonyms noted by Yu (2017).

UNITED STATES

YEAR/PLACE RELEASED 2006 USA, Alaska (from Alberta, Canada) (Soper and Van Driesche, 2014; Soper et al., 2015)

TARGET PEST *Profenusa thomsoni* (Konow) TENTHREDINIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Not recorded in literature from any other host besides the target.

HOST SPECIFICITY **Possibly Species**
Tenthredinidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Alaska, USA (Soper 2011; Soper and Van Driesche, 2014; Soper et al., 2015).
Establishment: Established in Alaska (Soper, 2011; Soper and Van Driesche, 2014; Soper et al., 2015).
Impact: Release associated with decline of leafminer density, providing complete control due to this species and two naturally occurring parasitoids (*Lathrolestes soperi* Reshchikov and *Aptesis signis* Provancher) (Soper et al., 2015).

Lemophagus errabundus (Gravenhorst) ICHNEUMONIDAE

UNITED STATES

YEAR/PLACE RELEASED 2003 USA, New England (from Switzerland, France, and other parts of Europe) (Tewksbury, 2014; Tewksbury et al., 2017)

TARGET PEST *Lilioceris lilii* (Scopoli) CHRYSOMELIDAE

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release (Gold, 2003; Kenis et al., 2003; Casagrande and Kenis, 2003; USDA APHIS, 2017). Of 2 non-target European species of *Lilioceris* tested, both were attacked. Of 8 species of North American non-*Lilioceris* species (6 in the same family; 2 in other families), none were attacked (Casagrande and Kenis, 2004). *Lemophagus errabundus* is functionally monophagous in North America, where there are no native *Lilioceris* species, although a species in the genus (*Lilioceris cheni* Gressit and Kimoto) has recently been released in Florida as a biocontrol agent against air potato (*Dioscorea bulbifera* L.) (Featured Creatures, 2017a).

HOST SPECIFICITY **Genus**
Chrysomelidae (3 species in 1 genus, *Lilioceris*). Given there are no native *Lilioceris* in North America, this agent is functionally species-specific in North America.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Rhode Island, USA and other New England states (Tewksbury, 2014, Tewksbury et al., 2017).
Establishment: Established in several New England states and spreading (Tewksbury, 2014, Tewksbury et al., 2017).
Impact: Not yet determined.

Liotryphon caudatus (Ratzburg) ICHNEUMONIDAE

Former generic placements include *Apistephialtes*, *Calliephialtes*, and *Ephialtes*. Yu (2017) lists 3 synonyms: *Liotryphon brevivalvis* (Hensch), *Liotryphon foveolatus* (Constantineanu & Pisica), and *Liotryphon incertus* (Hensch).

UNITED STATES

YEAR/PLACE RELEASED 1992 USA, California and Washington state (from Kazakhstan) (Mills, 2005b)

TARGET PEST *Cydia pomonella* (L.) TORTRICIDAE
(formerly *Laspeyresia pomonella* L.)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Attacks the fruit-boring and cocoon-forming tortricids *Grapholita molesta* (Busck) and *Grapholita funebrana* (Treitschke) (N. Mills, pers. comm.). No other hosts of *L. caudatus* are recorded in the literature.

HOST SPECIFICITY **Family**
Tortricidae (3 species in 2 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in California, USA (Mills, 2005ab).
Establishment: Apparent establishment in California (Mills, 2005b).
Impact: No information on impact in California.

Lipolexis oregmae Gahan Braconidae: Aphidiinae

Synonym is *Lipolexis scutellaris* Mackauer, the name under which it was introduced into the USA (Persad and Hoy, 2003).

UNITED STATES

YEAR/PLACE RELEASED 2000 USA, Florida (from Guam) (Persad et al., 2007)

TARGET PEST *Toxoptera citricida* Kirkaldy Aphididae
(formerly *Toxoptera citricidus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include (1) *Aphis gossypii* Glover (Singh et al., 2009); (2) *Aphis craccivora* Koch (Chang and Youn, 1983); (3) *Toxoptera odinae* (van der Goot) (Starý and van Harten, 1983); (4–5) *Aphis citricola* van der Goot and *Aphis nerii* Boyer de Fonscolombe (Starý and Zeleny, 1983); (6) *Toxoptera aurantii* (Boyer de Fonscolombe) (Muraleedharan et al., 1988); (7) *Toxoptera citricida* (syn. = *Toxoptera citricidus*) Kirkaldy (Hoy et al., 2007b). Post-release field studies in Florida found parasitism of (1) *Toxoptera aurantii* (Boyer de Fonscolombe); (2) *Aphis craccivora* Koch; (3) *Aphis spiraecola* Patch); and (4) *Aphis gossypii* Glover (Persad et al., 2007).

HOST SPECIFICITY **Family**
Aphididae (7 species in 2 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Florida, USA (Persad et al., 2007).
Establishment: Established in Florida (Persad et al., 2007).
Impact: Impact in Florida not determined.

Lixadmontia franki Wood and Cave Tachinidae

For species description, see Wood and Cave (2006).

UNITED STATES

YEAR/PLACE RELEASED 2007 USA, Florida (from Honduras) (Cooper et al., 2011)

TARGET PEST *Metamasius callizona* (Chevrolat) Curculionidae

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. One non-target native Floridian weevil, *Metamasius mosieri* Barber, was tested and found to be attacked at significant rates in choice and no-choice tests (H. Frank, pers. comm.). Literature hosts include *Metamasius quadrilineatus* Champion (Suazo et al., 2006).

HOST SPECIFICITY **Genus**
Curculionidae (3 species, in 1 genus, *Metamasius*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Florida, USA (Cooper et al., 2011).
Establishment: Did not establish in Florida as far as is known (Cooper et al., 2011).
Impact: Not applicable

Lysiphlebia japonica (Ashmead) Braconidae

Synonyms are (1) *Lysiphlebia mirzai* Shujauddin and (2) *Lysiphlebia sacchari* Chen (Yu, 2017). Earlier generic placements include *Lysiphlebus*, *Coelonotus*, and *Aphidius*.

UNITED STATES

YEAR/PLACE RELEASED 1996 USA, Florida (from Taiwan)

TARGET PEST *Toxoptera citricida* Kirkaldy Aphididae
(formerly *Toxoptera citricidus*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include many aphids: (1) *Lachnus tropicalis* (van der Goot) (Watanabe, 1939); (2) *Myzus persicae* (Sulzer) (Watanabe and Takada, 1967); (3) *Aphis gossypii* Glover (Takada, 1976); (4) *Aphis craccivora* Koch (Tian et al., 1981); (5) *Aphis glycines* Matsumura (Gao, 1985); (6) *Toxoptera citricida* (Kirkaldy) (Takanashi, 1990); (7) at least 18 species in 11 genera from Korea (Starý et al., 2002); and (8) *Aphis hederae* Kaltenbach (Kikuchi, 2005).

HOST SPECIFICITY **Family**
Aphididae (at least 21 species in 12 genera, most recorded from Korea by Starý et al. [2002])

Lysiphlebia japonica (continued)

UNITED STATES (continued)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Florida, USA (see p. 532 of Michaud, 2002a).
Establishment: Did not establish in Florida (see p. 532 of Michaud, 2002a).
Impact: Not applicable

Lytopylus rufipes (Nees von Esenbeck) BRACONIDAE

Earlier generic placements include *Agathis*, *Microdus*, and *Bassus*.

UNITED STATES

YEAR/PLACE RELEASED 1995 USA, California and Washington state (from Kazakhstan) (Mills, 2005b)

TARGET PEST *Cydia pomonella* (L.) TORTRICIDAE
(formerly *Laspeyresia pomonella* L.)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include only the target pest and *Archips rosanus* (L.) (Zlatanova, 1970), but several tortricids and pyralids are believed to be used as hosts (N. Mills, pers. comm.).

HOST SPECIFICITY **Two Families**
Tortricidae and **Pyralidae**

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California and Washington, USA (Biocat, 2017).
Establishment: Did not establish in the USA (Biocat, 2017).
Impact: Not applicable

Macrocentrus prolificus Wharton BRACONIDAE

For species description, see Wharton (1984). Yu (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1985–1987 USA, northern Texas (from Mexico) (Overholt and Smith, Jr, 1990)

TARGET PEST *Diatraea grandiosella* Dyar CRAMBIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include *Diatraea considerata* Heinrich (Vejar-Cota et al., 2005) and *Diatraea grandiosella* Dyar, *Diatraea saccharalis* (F.) (W. Overholt, pers. comm.).

HOST SPECIFICITY **Genus**
Crambidae (3 species in 1 genus, *Diatraea*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in northern Texas, USA (Overholt and Smith, Jr, 1990).
Establishment: Did not establish in northern Texas (Overholt and Smith, Jr., 1990).
Impact: Not applicable

Macroglenes penetrans (Kirby) PTEROMALIDAE

Noyes (2017) lists nine synonyms: (1) *Decatoma penetrans* (Kirby), (2) *Ichneumon penetrans* Kirby, (3) *Macroglenes brevicornis* Thomson, (4) *Macroglenes decipiens* (Graham), (5) *Macroglenes oculatus* Westwood, (6) *Macroglennes decipiens* (Graham), (7) *Macroglennes penetrans* (Kirby), (8) *Pirene decipiens* Graham, and (9) *Pirene penetrans* (Kirby).

UNITED STATES

YEAR/PLACE RELEASED 2014 USA, central Montana "golden triangle area" (from Saskatchewan, Canada) (Thompson and Reddy, 2016)

TARGET PEST *Sitodiplosis mosellana* (Géhin) CECIDOMYIIDAE
(former generic placement in *Clinodiplosis*)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Noyes (2017) lists one additional cecidomyiid as a host: *Contarinia tritici* (Kirby).

HOST SPECIFICITY **Family**
Cecidomyiidae (2 species in 2 genera)

Macroglenes penetrans (continued)

UNITED STATES (continued)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in central Montana "golden triangle area", USA (Thompson and Reddy, 2016; G. Reddy, pers. comm.).
Establishment: Established in central Montana "golden triangle area" (Thompson and Reddy, 2016).
Impact: The impact of the released population in central Montana has not been determined. However, it is likely to eventually be substantial because in another part of the state (extreme northeastern Montana), a population of *M. penetrans* that spread on its own from Saskatchewan causes 52% parasitism of *S. mosellana* (Shanower, 2005).

Mallochia pyralidis Wharton Ichneumonidaee

For species description, see Wharton (1985). No synonyms listed by Yu (2017).

UNITED STATES

YEAR/PLACE RELEASED 1985 USA, Texas (from Mexico) (Wharton, 1985)

TARGET PEST *Eoreuma loftini* (Dyar) Crambidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No hosts listed in literature.

HOST SPECIFICITY **Unknown**
Crambidae (known only from the target pest, but there is only one article in literature)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Texas, USA (Wharton, 1985).
Establishment: Unknown if it established or not.
Impact: Unknown

Mastrus ridens Horstmann Ichneumonidae

Mastrus ridibundus is a synonym.

UNITED STATES

YEAR/PLACE RELEASED 1995 USA, California (from Kazakhstan) (Mills, 2005b)

TARGET PEST *Cydia pomonella* L. Tortricidae
(formerly *Laspeyresia pomonella* L.)

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. In New Zealand, some post facto host-range testing showed that of 5 species tested, 1 non-target *Cydia* species (*Cydia succedana* [Haworth]) and 4 non-*Cydia* tortricids (*Argyroploce chlorosaris* Meyrick, *Grapholita molesta* [Busck], *Planotortrix octo* Dugdale, and *Ctenopseustis obliquana* [Walker]) were parasitized, but offspring were small and mostly male; known in native range only from target; but little sampling other than of the target (Charles et al., 2013). Non-target tortricids may be killed by this parasitoid but seem unlikely to support *M. ridens* populations due to a too-rapid death from the paralyzing venom of the parasitoid.

HOST SPECIFICITY **Family**
Tortricidae (6 species in 5 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in California, USA (Mills, 2005ab).
Establishment: Established in California (Mills, 2005a).
Impact: Impact not determined.

Metaphycus flavus (Howard) ENCYRTIDAE

Noyes (2017) lists five synonyms: (1) *Aphycus flavidulus caridei* Brèthes, (2) *Aphycus flavus* Howard, (3) *Aphycus hesperidum* Mercet, (4) *Euaphycus flavus* (Howard), and (5) *Metaphycus mauritanicus* Compere.

UNITED STATES

YEAR/PLACE RELEASED 1987–1996 USA, California: (1) 1987 (from Italy) (Kennett et al., 1995); (2) 1996 *Metaphycus* sp. nr *flavus* (probably *M. flavus*) was collected from *C. pseudomagnoliarum* in Turkey and released in 1996 (Bernal et al., 1999) in the context of an augmentative trial against *C. pseudomagnoliarum* in citrus groves in California (Schweizer et al., 2002).

TARGET PEST *Coccus pseudomagnoliarum* (Kuwana) COCCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records were not separately checked due to the large number of host records in Noyes (2017), which may not be comprehensive, but amply demonstrate the wide host range of this species. Noyes (2017) lists 39 species, other than the target pest, in 5 families as hosts (names updated in ScaleNet): **Cerococcidae** (1) *Cerococcus parahybensis* Hempel; **Coccidae**: (2) *Ceroplastes cirripediformis* Comstock, (3) *Ceroplastes floridensis* Comstock, (4) *Coccus capparidis* (Green), (5) *Coccus hesperidum* L., (6) *Coccus viridis* (Green), (7) *Eulecanium kunoense* (Kuwana), (8) *Eulecanium perinflatum* (Cockerell), (9) *Filippia follicularis* (Targioni Tozzetti), (10) *Megapulvinaria maxima* (Green) (11) *Milviscutulus mangiferae* (Green), (12) *Parasaissetia nigra* (Nietner), (13) *Parthenolecanium corni* (Nuzzaci), (14) *Parthenolecanium persicae* (Fabricius) (15) *Parthenolecanium perlatum* (Cockerell), (16) *Philephedra lutea* (Cockerell), (17) *Philephedra tuberculosa* Nakahara & Gill, (18) *Protopulvinaria pyriformis* Cockerell, (19) *Pulvinaria acericola* (Walsh & Riley), (20) *Pulvinaria elongata* Newstead, (21) *Pulvinaria flavescens* Brethes in Massini & Brethes, (22) *Pulvinaria floccifera* (Westwood), (23) *Pulvinaria iceryi* (Signoret), (24) *Pulvinaria minuta* Brethes in Massini & Brethes, (25) *Pulvinaria platensis* Brethes in Massini & Brethes, (26) *Pulvinaria psidii* Maskell, (27) *Pulvinariella mesembryanthemi* (Vallot) (28) *Saissetia coffeae* (Walker), (29) *Saissetia oleae* (Gómez-Menor Ortega), (30) *Stictolecanium convexum* (Hempel) (31) *Toumeyella liriodendri* (Gmelin); **Diaspididae**: (32) *Chrysomphalus aonidum* (L.), (33) *Chrysomphalus dictyospermi* (Morgan), (34) *Chrysomphalus pinnulifer* (Maskell), (35) *Lepidosaphes beckii* (Newman), (36) *Lepidosaphes gloverii* (Packard); **Eriococcidae**: (37) *Eriococcus joergenseni* Morrison; **Kerriidae**: (38) *Kerria* sp., and (39) *Tachardia* sp.

HOST SPECIFICITY **Five Families**
Cerococcidae (1 species), **Coccidae** (30 species in 14 genera), **Diaspididae** (5 species in 2 genera), **Eriococcidae** (1 species), and **Kerriidae** (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: (1): Released in 1987 in California, USA with population from Italy (Kennett et al., 1995). (2): Released in California in 1996 with population from Turkey (Bernal et al., 1999).
Establishment: (1): The Italian population did not establish in California (Kennett et al., 1995). (2): The Turkish population achieved same season reproduction on target pest in citrus groves, but samples taken a year after release found no evidence of establishment (Schweizer et al., 2002).
Impact: Not applicable

Metaphycus hageni Daane and Caltagirone ENCYRTIDAE

Introduced as *Metaphycus* sp. A (see p. 145 of Daane et al., 1995b). For species description, see Daane and Caltagirone (1999). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1986 USA, California (from Spain) (Daane and Caltagirone, 1999)

TARGET PEST *Saissetia oleae* (Olivier) COCCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts are listed in the literature. Noyes (2017) lists no other hosts.

HOST SPECIFICITY **Unknown**
Coccidae (known only from the target pest, but there is very little literature on this parasitoid)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in California, USA (see p. 145 of Daane et al., 1995b).
Establishment: Established in California (see p. 145 of Daane et al., 1995b).
Impact: Impact on target pest not determined.

Metaphycus orientalis (Compere) Encyrtidae

For species description, see Compere (1924). Noyes (2017) lists one synonym: *Aphycus orientalis* Compere.

UNITED STATES

YEAR/PLACE RELEASED 1985 USA, California (from Japan) (Kennett et al., 1988)

TARGET PEST *Coccus pseudomagnoliarum* (Kuwana) Coccidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature records of other species as hosts include only *Coccus hesperidum* L. (Compere, 1924). Noyes (2017) lists 1 additional species as a host: *Saissetia coffeae* (Walker) (Coccidae).

HOST SPECIFICITY **Family**
Coccidae (3 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (Kennett et al., 1988, 1995).
Establishment: Not established in California, USA (Kennett et al., 1988; Kennett et al.,1995).
Impact: Not applicable

Microctonus hyperodae Loan Braconidae

For species description, see Loan and Lloyd (1974). Yu (2017) gives this species as *Perilitus hyperodae* (Loan) but no literature is found under this name.

CANADA

YEAR/PLACE RELEASED 2002 Canada, Quebec (from Argentina via New Zealand) (Boivin, 2013)

TARGET PEST *Listronotus oregonensis* (LeConte) Curculionidae
A native pest in Quebec

HOST RANGE EVIDENCE **HRT+**
Laboratory host-range testing done before release. Of 24 North American weevils tested in Quebec before release, *Microctonus hyperodae* parasitized 5 species: (1) *Listronotus sparsus* Say, (2) *Listronotus maculcollis* Kirby, (3) *Nedyus flavicaudus* Boheman, (4) *Ceutorhynchus erysimi* Fabricius, and (5) *Gymnetron tetrum* Fabricius (Boivin unpub. data, in Boivin, 2013). Other literature hosts include (1) *Hyperodes bonariensis* Kuschel (Loan and Lloyd, 1974); (2) *Irenimus aequalis* (Broun) (now synonym of *Chalepistes tenebricus*) (Goldson et al., 1992); and (3–6) *Nicaeana cervina* Broun, *Irenimus* (now *Chalepistes*) *egens* (Boun), *Irenimus* (now *Chalepistes*) *aequalis* Broun, and *Irenimus* (now *Chalepistes*) *stolidus* (Barratt et al.,1997). Generic placement revisions based on Brown (2017).

HOST SPECIFICITY **Family**
Curculionidae (11 species in 7 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Quebec, Canada (Boivin, 2013).
Establishment: Not established in Quebec (Boivin, 2013).
Impact: Not applicable

Microplitis mediator (Haliday) Braconidae

Other generic placements include *Microgaster.* Yu (2017 lists three synonyms: (1) *Microplitis halidayi* Fahringer, (2) *Microplitis medianus* (Ruthe), and (3) *Microplitis pseudomedianus* Fahringer.

CANADA

YEAR/PLACE RELEASED 1991–1999 Canada, Saskatchewan and Alberta (from Switzerland) (Mason et al., 2002)

TARGET PEST *Mamestra configurata* Walker Noctuidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature records include various noctuids as hosts: (1) *Mamestra brassicae* (L.) was parasitized in laboratory host range tests, but not *Lacanobia oleracea* (L.), *Mamestra suasa*, or *Agrotis segetum* (Denis and Schiffermüller) (Slovák, 1985); (2) *Mamestra configurata* Walker (Arthur and Mason, 1986); (3) *Mythimna separata* (Walker) (Tanaka, 1987); (4) *Autographa gamma* (L.) (Sengonca and Peters, 1991); (5) *Mythimna sequax* Franclemont (Foerster et al., 2001); and (6) *Helicoverpa armigera* (Hübner) (Ren et al., 2004).

HOST SPECIFICITY **Family**
Noctuidae (6 species in 5 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Saskatchewan and Alberta, Canada (Mason et al., 2002).
Establishment: Not established in Canada (Mason et al., 2002; Erlandson, 2013).
Impact: Not applicable

Microterys okitsuensis (Compere) Encyrtidae

Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1985 USA, California (from Japan) (Kennett et al., 1988; Kennet et al.,1995)

TARGET PEST *Coccus pseudomagnoliarum* (Kuwana) Coccidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include (1) *Pulvinaria aurantii* Cockerell (Ishii, 1932) and (2) *Coccus pseudomagnoliarum* (Kuwana) (Kennett et al., 1988). Noyes (2017) lists 4 additional species of coccids as hosts: (1) *Ceroplastes rubens* Maskell, (2) *Coccus hesperidum* L., (3) *Pulvinaria psidii* Maskell, and (4) *Saissetia oleae* (Olivier).

HOST SPECIFICITY **Family**
Coccidae (6 species in 5 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (Kennett et al., 1988; Kennett et al.,1995).
Establishment: Not established in California (Kennett et al., 1988; Kennett et al.,1995).
Impact: Not applicable

Muscidifurax raptorellus Kogan and Legner Pteromalidae

Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1985–1987 USA, California (from South America [e.g., Chile and Peru]) (Legner et al., 1989; Meyer et al., 1990)

TARGET PEST *Musca domestica* L. Muscidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Host-range testing by Geden and Moon (2009) found all 5 species tested to be successfully parasitized in the laboratory: (1) *Musca domestica* L. (Muscidae), (2) *Haematobia irritans* (L.) (Muscidae), (3) *Hydrotaea aenescens* (Wiedemann) (Muscidae), (4) *Stomoxys calcitrans* (L.) (Muscidae), and (5) *Sarcophaga bullata* (Parker) (Sarcophagidae). Literature field host records include (1) *Musca sorbens* Wiedemann (Muscidae) (Legner et al., 1974); (2–3) *Musca domestica* L. (Muscidae) and *Stomoxys calcitrans* (L.) (Muscidae) (Lysyk, 2004). Noyes (2017) lists 1 additional species as a host: *Calliphora vomitoria* (Calliphoridae).

HOST SPECIFICITY **Three Families**
Muscidae (5 species in 4 genera), **Sarcophagidae** (1 species), and **Calliphoridae** (1 species)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in cattle (Meyer et al., 1990) and poultry (Legner et al., 1989) facilities in southern California, USA.
Establishment: Establishment was not the objective of the augmentative releases of this parasitoid, but sampling in some locations in California found no permanent increase in parasitism of target flies, suggesting *M. raptorellus* did not permanently establish (e.g., Petersen and Currey, 1996).
Impact: Temporary increases in rates of parasitism in California followed releases for several weeks, but within the season rates returned to background levels (Petersen and Currey, 1996). Similarly, mass releases in poultry houses in Florida caused partial suppression of *M. domestica* flies (Geden and Hogsette, 2006), as did releases in dairy calf facilities in New York (Kaufman et al., 2012), but these releases did not result in permanent establishment.

CANADA

YEAR/PLACE RELEASED 1996 Canada, Alberta (Floate et al., 2000) (source uncertain, likely from commercial insectaries, but ecological source was from South America [e.g., Chile and Peru] [Legner et al., 1989])

TARGET PEST *Musca domestica* L. Muscidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Host-range testing by Geden and Moon (2009) found all 5 species tested to be successfully parasitized in the laboratory: (1) *Musca domestica* L. (Muscidae), (2) *Haematobia irritans* (L.) (Muscidae), (3) *Hydrotaea aenescens* (Wiedemann) (Muscidae), (4) *Stomoxys calcitrans* (L.) (Muscidae), and (5) *Sarcophaga bullata* (Parker) (Sarcophagidae). Literature field host records include (1) *Musca sorbens* Wiedemann (Muscidae) (Legner et al., 1974); (2–3) *Musca domestica* L. (Muscidae) and *Stomoxys calcitrans* (L.) (Muscidae) (Lysyk, 2004). Noyes (2017) lists 1 additional species as a host: *Calliphora vomitoria* (Calliphoridae).

Muscidifurax raptorellus (continued)

CANADA (continued)

HOST SPECIFICITY **Three Families**
Muscidae (5 species in 4 genera), **Sarcophagidae** (1 species), and **Calliphoridae** (1 species)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in cattle facilities in southern Alberta, Canada (Floate et al., 2000).
Establishment: Overwintering survival in cattle facilities in southern Alberta was 1–10% (Floate and Skovgård, 2004), suggesting potential for establishment. However, that has not been demonstrated, it being common for mass releases of agents to result in temporary populations that eventually die out.
Impact: Augmentative releases in cattle feed yards in southern Alberta increased parasitism of *M. domestica* to about 34% (versus 1–3% in control feed lots) for a short period (Floate et al., 2000).

Myxexoristop hertingi Mesnil Tachinidae

CANADA

YEAR/PLACE RELEASED 2002–2004 Canada, Ontario (from Italy) (Lyons, 2013)

TARGET PEST *Acantholyda erythrocephala* (L.) Pamphiliidae

HOST RANGE EVIDENCE **HRT-**
No host-range testing done before release. Literature host records include only the target pest, *Acantholyda erythrocephala* (Pamphiliidae) (Herting, 1957).

HOST SPECIFICITY **Possibly Species**
Pamphiliidae (known only from the target pest)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Ontario, Canada (Lyons, 2014).
Establishment: Not established in Canada (Lyons, 2014).
Impact: Not applicable

Nothoserphus afissae (Watanabe) Proctotrupidae

Synonyms include *Disogmus afissae* Watanabe and *Watanabeia afissae* Watanabe.

UNITED STATES

YEAR/PLACE RELEASED 1988 USA, Maryland (source not recorded, but most likely from from Korea or Japan) (see p. 206 of Barbosa et al., 1994)

TARGET PEST *Epilachna varivestis* Mulsant Coccinellidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include (1) *Epilachna niponica* (Lewis) (Ohgushi and Sawada, 1998) (formerly given as *Henosepilachna pustulosa* [Kono] (Nakamura and Ohgushi, 1981); (2) *Henosepilachna vigintioctomaculata* (Motschulsky) (=*Epilachna vigintioctomaculata*) (Lee et al., 1988); and (3) *Epilachna varivestis* Mulsant (Nakamura and Shiratori, 2010).

HOST SPECIFICITY **Genus**
Coccinellidae (Epilachninae) (3 species in 1 genus, *Epilachna*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Maryland, USA (see p. 206 of Barbosa et al., 1994).
Establishment: Not established in Maryland (see p. 206 of Barbosa et al., 1994).
Impact: Not applicable

Oobius agrili Zhang and Huang Encyrtidae

Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 2007 USA, Michigan (from northeastern China) (Duan et al., 2010a)

TARGET PEST *Agrilus planipennis* Fairmaire Buprestidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release. In the laboratory, of 6 non-target *Agrilus*, 3 were attacked (*A. anxius* Gory, *A. bilineatus* [Weber], and *A. ruficollis* [F.]) and 3 were not (*A. cyanescens* [Ratzeburg], *A. egenus* Curtis, and *A. subcinctus* Gory) (Gould, 2007). Of 6 non-target, non-*Agrilus* species tested, none were attacked (Gould, 2007). Noyes (2017) lists no other species as hosts.

Oobius agrili (continued)

UNITED STATES (continued)

HOST SPECIFICITY **Genus**
Buprestidae (4 species in 1 genus, *Agrilus*, but 3 only in the laboratory)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Michigan, USA (Duan et al., 2010a).
Establishment: Established in the USA (Abell et al., 2014).
Impact: Post release surveys in Michigan found 10–20% parasitism of the pest's eggs by *O. agrili* (Abell et al., 2014).

Oobius longoi (Siscaro) Host race #1 ENCYRTIDAE

For species description, see Siscaro (1992). Noyes (2017) lists one synonym: *Avetianella longoi* Siscaro, which is the name in the biocontrol literature.

UNITED STATES

YEAR/PLACE RELEASED 1993 USA, California (from Victoria, Australia) (Paine et al., 1993; Hanks et al., 1996).

TARGET PEST *Phoracantha semipunctata* (F.) CERAMBYCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. This race of *Oobius longoi* attacks both *P. semipunctata* and *Phoracantha recurva* Newman, but prefers the former (Luhring et al., 2000) and does better in it as a host (Luhring et al., 2004) due to lower host encapsulation defenses in *P. semipunctata* (McDonald et al., 2015). Besides *P. recurva* and *P. semipunctata*, Noyes (2017) lists 2 additional cerambycids as hosts of *O. longoi*: *Coptocerus aberrans* (Newman) and *Epithora dorsalis* MacLeay.

HOST SPECIFICITY **Family**
Cerambycidae (4 species in 3 genera). Likely restricted to hosts on eucalypts due to attraction to host plant odors.

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Paine et al., 1993; Hanks et al., 1996).
Establishment: Established in California (Hanks et al., 1996).
Impact: Parasitism in field exceeded 90% (Hanks et al., 1996), controlling the host. See also, Paine and Millar (2003) and McDonald et al. (2015).

Oobius longoi (Siscaro) Host race #2 ENCYRTIDAE

For species description, see Siscaro (1992). This second host race is better adapted to *P. recurva* (Umeda and Paine, 2015). Noyes (2017) lists one synonym: *Avetianella longoi* Siscaro, which is the name in the biocontrol literature.

UNITED STATES

YEAR/PLACE RELEASED 2007 USA, California (from New South Wales, Australia) (Wang et al., 2008)

TARGET PEST *Phoracantha recurva* Newman CERAMBYCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. This race can successfully develop in *P. recurva* (Umeda and Paine, 2015; McDonald et al., 2015). Besides *P. recurva* and *P. semipunctata*, Noyes (2017) lists 2 additional cerambycids as hosts of *O. longoi*: *Coptocerus aberrans* (Newman) and *Epithora dorsalis* MacLeay.

HOST SPECIFICITY **Family**
Cerambycidae (4 species in 3 genera). Likely restricted to hosts on eucalypts due to attraction to host plant odors.

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in California, USA (J. Millar and T. Paine, pers. comm.).
Establishment: Establishment in California not determined. Trap hosts of *P. recurva* were deployed to detect parasitism by this host race, but project funding ended before establishment could be confirmed (J. Millar and T. Paine, pers. comm.).
Impact: Not determined.

Ormia depleta (Wiedemann) Tachinidae

(formerly in *Euphasiopteryx*)

UNITED STATES

YEAR/PLACE RELEASED 1988 USA, Florida (from Brazil) (Frank et al., 1996)

TARGET PEST *Neoscapteriscus abbreviatus* (Scudder); *Neoscapteriscus vicinus* (Scudder); and *Neoscapteriscus borellii* (Giglio-Tos) Gryllotalpidae
(all targets formerly in *Scapteriscus*)

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release. *Ormia depleta* was attracted to 3 of 5 *Scapteriscus* (now *Neoscapteriscus*) species tested, 2 of which were program targets and 1 a non-target invasive species (Fowler, 1987). Based on attraction to host song (the test deemed most reliable, as such attraction must occur for a species to be a field host), Walker (H. Frank, pers. comm.), indicates that the world host range of *Ormia depleta* includes *N. vicinus*, *N. borellii* (Fowler and Kochalka, 1985), *N. imitatus* Nickle & Castner (Fowler, 1987), and occasionally *N. abbreviatus* Scudder (H. Frank, pers. comm., seemingly an error occurring in mixed mole cricket populations) but does not include either *Neocurtilla hexadactyla* (Perty) (Gryllotalpidae) (contrary to Fowler and Garcia, 1987) or a Brazilian cricket given as *Anurogryllus* sp. (Gryllidae) (contrary to Fowler and Mesa, 1987; Fowler, 1988).

HOST SPECIFICITY **Genus**
Gryllotalpidae (4 species [2 being targets] in 1 genus, *Neoscapteriscus*)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Florida, USA (Frank et al., 1996).
Establishment: *Ormia depleta* established successfully in Florida (Frank et al., 1996).
Impact: Percentage reduction in trap catch of the two target mole crickets due to biocontrol introductions in Florida ranged from 25 to 81% of former numbers, depending on place, year, and cricket species (Parkman et al., 1996). The target pests became fully controlled (Frank and Walker, 2006), but this change was due to several parasitoid species (*O. depleta* and *L. bicolor*) and an introduced entomoparasitic nematode (*Steinernema scapterisci* Nguyen & Smart) (Parkman et al., 1996). The mole cricket biocontrol program produced a benefit to cost return of 52:1 (Mhina et al., 2016).

Parallorhogas pyralophagus (Marsh) Braconidae

(formerly *Allorhogas pyralophagus*, the name under which nearly all literature is found). For species description, see Marsh (1984). Yu (2017) lists no other synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1985–1987 USA, northern Texas (from Mexico) (Overholt and Smith, 1990)

TARGET PEST *Diatraea grandiosella* Dyar Crambidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include: (1–3) (as laboratory-rearing hosts) *Maruca vitrata* (Fabricius) (given as *Maruca testulali*) (Crambidae), *Tetramoera schistaceana* (Snellen) (given as *Argyroploce schistaceana*) (Tortricidae), and *Chilo sacchariphagus* (Bojer) (Crambidae) (Rajabalee and Banymadhub, 1986); (4) *Eoreuma loftini* (Dyar) (Crambidae) (Melton and Browning, 1986); (5–9) (as laboratory hosts): *Chilo auricilius* Dudgeon, *Chilo partellus* (Swinhoe), *Chilo tumidicostalis* (Hampson), *Bissetia steniellus* (Hampson) (all above, Crambidae), and *Emmalocera depressella* (Swinhoe) (Pyralidae) (Varma et al., 1987); (10) *Eldana saccharina* Walker (Pyralidae) (Anon., 1987); (11) (as a laboratory host): *Sesamia inferens* (Walker) (Noctuidae) (Ballal and Kumar, 1989); (12) (as a laboratory host): *Diatraea saccharalis* (F.) (Crambidae) (Castilho et al., 1989); (13) *Diatraea centrellus* (Möschler) (Crambidae) (Quashie-Williams, 1991); and (14–17) (as laboratory hosts) *Chilo infuscatellus* Snellen (Crambidae), *Scirpophaga excerptalis* Walker (Crambidae), *Corcyra cephalonica* (Stainton) (Pyralidae), and *Galleria mellonella* (L.) (Pyralidae) (Easwaramoorthy et al., 1992).

HOST SPECIFICITY **Four Families**
Crambidae (10 species in 5 genera), **Tortricidae** (1 species), **Pyralidae** (4 species in 4 genera), and **Noctuidae** (1 species, as a laboratory-rearing host)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in northern Texas, USA (Overholt and Smith, 1990).
Establishment: Did not establish in northern Texas (Overholt and Smith, 1990), but is established from a pre-1985 release in south Texas on *Eoreuma loftini* (Meagher et al., 1998).
Impact: No impact in northern Texas, but impact recorded in south Texas on *E. loftini* (Meagher et al. 1998).

Pediobius foveolatus (Crawford) Eulophidae

Noyes (2017) lists 11 synonyms: (1) *Mestocharis lividus* Girault, (2) *Mestocharomyia lividus* (Girault), (3) *Pediobius epilachnae* (Rohwer), (4) *Pediobius faveolatus* (Crawford), (5) *Pediobius mediopunctata* (Waterston), (6) *Pediobius mediopunctatus* (Waterston), (7) *Pediobius simiolus* (Takahashi), (8) *Pleurotropis epilachnae* Rohwer, (9) *Pleurotropis foveolatus* Crawford, (10) *Pleurotropis mediopunctata* Waterston, and (11) *Pleurotropis simiolus* Takahashi.

NORTHERN MARIANA ISLANDS

YEAR/PLACE RELEASED 1985 USA, Northern Mariana Islands (from India [Clausen et al., 1978] via the USA through the USDA BIRL laboratory in Delaware, USA) (Chiu and Moore, 1993)

TARGET PEST *Epilachna philippinensis* Dieke COCCINELLIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include (1) *Epilachna philippinensis* Dieke (Peterson, 1955); (2) *Epilachna sparsa* (Herbst) (Angelet et al, 1968); (3) *Epilachna varivestis* Mulsant (Nakamura and Shiratori, 2010); (4) *Henosepilachna vigintioctomaculata* Motschulsky (Tachikawa, 1976); (5) *Henosepilachna pustulosa* (Kono) (Nakamura and Ohgushi, 1981); (6) *Epilachna ocellata* Redtenbacher (Dhingra et al., 1986); (7–10) *Epilachna mexicana* (Guérin-Méneville), *Epilachna obscurella* Mulsant, *Mada polluta* Mulsant, *Malata delphinae* (Gorham) (Romero-Nápoles et al., 1987); (11) *Henosepilachna vigintioctopunctata* (F.) (as *Epilachna vigintioctopunctata* (Nakamura et al., 1988); (12) *Epilachna similis* Mulsant (given as *Chnootriba similis*) (Beyene et al., 2007). An unusual record in need of confirmation is as a hyperparasitoid on a braconid wasp (*Cotesia* sp.) (Paulraj and Igacimuthu, 2007). Noyes (2017) lists 15 additional species as hosts, 8 of which are not in Coccinellidae and need confirmation: **Coccinellidae** (1) *Cheilomenes sexmaculata* Fabricius, (2) *Coccinella septempunctata* (L.), (3) *Epilachna chrysomelina* (F.), (4) *Epilachna dodecastigma* Wiedemann, (5) *Epilachna tredecimotata*; **Arctiidae** (6) *Diacrisia punctulata* Wallengren; **Lycaenidae** (7) *Deudorix antalus*; **Noctuidae** (8) *Anomis leona* (Schaus & Clements), (9) *Eublemma gayneri* (Rothschild, (10) *Heliothis armigera* (Hübner), (11) *Spodoptera litura* Fabricius; **Pieridae** (12) *Aporia crataegi* L.; **Pyralidae** (13) *Phycita diaphana* (Staudinger).

HOST SPECIFICITY **Family?**
Coccinellidae (15 species in 4 genera of Epilachninae, dominated by *Epilachna* [10 species], and 2 species in 2 genera of Coccinellinae)
Other records of uncertain accuracy: 8 species in 5 families of Lepidoptera and 1 record as a hyperparasitoid of a braconid.

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in the Northern Mariana Islands (Chiu and Moore, 1993).
Establishment: Established in the Northern Mariana Islands (Chiu and Moore, 1993).
Impact: In a 1989 island-wide survey, 80% of *E. philippinensis* larvae were parasitized by *P. foveolatus*, and pesticide applications on solaneous crops (tomato, eggplant) had declined from twice weekly before introduction to just occasional use (Chiu and Moore, 1993).

Pediobius furvus (Gahan) EULOPHIDAE

Noyes (2017) lists two synonyms: *Pediobius furvum* (Gahan) and *Pleurotropis furvum* Gahan.

UNITED STATES

YEAR/PLACE RELEASED 1985–1987 USA, northern Texas (from Mexico) (Overholt and Smith, Jr., 1990)

TARGET PEST *Diatraea grandiosella* Dyar CRAMBIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Laboratory hosts include (1) *Trachylepidia fructicassiella* Ragworth (Pyralidae) (Vignes, 1991); (2–3) *Chilo sacchariphagus* (Bojer) (Crambidae) and *Sesamia calamistis* Hampson (Noctuidae) (Williams, 1970); (4) *Diatraea grandiosella* Dyar (Crambidae) (Overholt and Smith, 1989); and (5) *Diatraea lineolata* (Crambidae) (Rodríguez-del-Bosque and Smith, 1990). Field hosts include (1–2) *Chilo partellus* (Crambidae) (Oloo, 1992) and *Eoreuma loftini* (Crambidae) (Pfannenstiel et al., 1992); (3) *Busseola fusca* (Fuller) (Noctuidae) (Yitaferu and Gebre-Amlak, 1994); (4) *Sesamia cretica* Lederer (Noctuidae) (Gahan, 1928); (5) *Chilo argyrolepia* Hampson (Crambidae) (La Croix, 1967); (6) *Eldana saccharina* Wilkinson (Pyralidae) (Scheibelreiter, 1980); and (7) *Sesamia grisescens* Walker (Noctuidae) (Kuniata and Sweet, 1994). Noyes (2017) lists several additional species as hosts: **Geometridae** (1) *Thyrinteina arnobia* (Stoll); **Noctuidae** (2) *Anticarsia gemmatalis* Hübner; (3) *Sesamia nonagrioides* (Lefebvre); (4) *Sesamia penniseti* Tams & J. Bowden; (5) *Spodoptera frugiperda* (J. E. Smith); **Crambidae** (6) *Chilo orichalcociliellus* Strand; (7) *Chilo terenellus* Pagenstecher; (8) *Coniesta ignefusalis* (Hampson; (9) *Diatraea dyari* Box; (10) *Diatraea saccharalis* (F.); (11) *Eodiatraea rufescens* (Box); **Pyralidae** (12) *Galleria mellonella* (L.) (presumably a laboratory host).

Pediobius furvus (continued)

UNITED STATES (continued)

HOST SPECIFICITY **Four Families**
Crambidae (12 species in 5 genera), **Noctuidae** (7 species in 4 genera), **Pyralidae** (3 species in 3 genera), and **Geometridae** (1 species). Fields hosts are stem borers in grasses.

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in northern Texas, USA (Overholt and Smith, Jr., 1990).
Establishment: Not established in northern Texas (Overholt and Smith, Jr., 1990).
Impact: Not applicable

Peristenus conradi Marsh Braconidae

Synonym and perhaps current name is *Leiophron conradi* (Marsh) (Yu, 2017), but the biocontrol literature is under *Peristenus*.

UNITED STATES

YEAR/PLACE RELEASED 1986–1990 USA, Delaware (from Europe) (Day et al., 1992)

TARGET PEST *Adelphocoris lineolatus* (Goeze) Miridae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. There are no other literature host records. Post-release surveys in 2 U.S. states found parasitism of only the target mirid (*A. lineolatus*) among 7 phytophagous mirid species sampled (Day, 1999, 2005).

HOST SPECIFICITY **Species**
Miridae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Delaware, USA (Day et al., 1992).
Establishment: Established in Delaware (Day et al., 1992).
Impact: At the study site, *P. conradi* caused 40% parasitism of the target pest (Day et al., 1992) and 22% parasitism of the pest in a later, wider survey (Day, 1999), although reduction of the target pest's density is reported as "slight" (Day 2005).

Peristenus digoneutis Loan Braconidae

Leiophron digoneutis (Loan) is a synonym or may be the current name (Loan) (Yu, 2017), but the biocontrol literature is under *Peristenus*. For species description, see Loan and Bilewicz-Pawinska (1973).

CANADA

YEAR/PLACE RELEASED 1990–2005 Canada: (1) Saskatchewan: 1981 and 1990–1992 (see Table 32.2, p. 156 of Broadbent et al., 2002), and 2005 (1991–1992 and 2005 releases from Europe via northeastern USA via Ontario/Quebec Canada) (Broadbent et al., 2013). (2) Ontario/Quebec: pre-1985 (spread naturally to Quebec from the USA where it was released earlier [Day et al., 1990]; subsequently intentionally redistributed from Quebec to Ontario [Broadbent et al., 2013])

TARGET PEST *Lygus lineolaris* (Palisot de Beauvois) Miridae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Post-release field host records in the northeastern United States showed that *P. digoneutis* parasitized only 1 of 7 mirids found in alfalfa fields, the target pest *L. lineolaris* (Day, 1999; see also Day, 2005). Host literature records from Europe include the following mirid bugs: (1) *Lygus rugulipennis* Poppius (Bilewicz-Pawinska, 1976); (2–3) *Adelphocoris lineolatus* (Goeze) and *Leptopterna dolobrata* (L.) (Haye et al., 2005). Based on European host records and laboratory host-range testing, Mason et al. (2011) suggest that the host range of *P. digoneutis* in North America will be limited to the genus *Lygus*.

HOST SPECIFICITY **Family**
Miridae (4 species in 3 genera). In North America, host range appears to be limited to the genus *Lygus* (Mason et al., 2011).

Peristenus digoneutis (continued)

CANADA (continued)

PROJECT OUTCOMES **(1) Saskatchewan: R+/E-/I-**
(2) Ontario/Quebec: R+/E+/I?
Release: (1) Saskatchewan: Released in 1981, 1990–1992, and 2005 in Saskatchewan, Canada (Broadbent et al., 2013). (2) Ontario/Quebec: Before 1985, *P. digoneutis* spread naturally from the USA to Quebec from where it was intentionally redistributed to Ontario (also pre-1985) (Day et al., 1990; Broadbent et al., 2013).
Establishment: (1): Saskatchewan: Not established at any Saskatchewan release site (Broadbent et al., 2002; Broadbent et al., 2013). (2): Ontario/Quebec: Established pre-1985 in Quebec (Broadbent et al., 1999) and Ontario (Broadbent et al., 2013).
Impact: (1) Saskatchewan: Not applicable. (2) Ontario/Quebec: Impact is "undertermined" in Ontario and Quebec. However, it should be noted that in the northeastern United States, *P. digoneutis* increased parasitism of the target pest in alfalfa from about 15% by native species to 40–50% (*P. digoneutis* + native species), and the density of the pest decreased by 75% (Day, 1996; see also Day, 2005). Release of *P. digoneutis* in the United States occurred before 1985 and so is not recorded separately in this catalog, but events in the United States are referenced because the same degree of impact is likely to occur or have occurred in Ontario and Quebec.

Peristenus relictus (Ruthe) BRACONIDAE

Leiophron relicta is either a synonym or may be the current correct name; other synonyms include *Peristenus stygicus* and *Microctonus relictus* (Yu, 2017). The biocontrol literature on the species is under both *P. relictus* and *P. stygicus*. For species description, see Loan and Bilewicz-Pawinska (1973).

UNITED STATES

YEAR/PLACE RELEASED 1998 USA, California (from Europe) (Pickett et al., 2007). *Peristenus relictus* was released earlier in 1973 in California, where it reproduced but later died out (Van Steenwyk and Stern, 1977).

TARGET PEST *Lygus hesperus* Knight MIRIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Host literature records from Europe include the following mirid bugs: (1) *Lygus rugulipennis* Poppius (Loan and Bilewicz-Pawinska, 1973); (2) *Polymerus unifasciatus* (F.) (Drea et al., 1973); (3) *Lygus hesperus* Knight (Butler and Wardecker, 1974); (4–7) *Lygus lineolaris* (Palisot de Beauvois), *Polymerus basalis* (Reuter), *Labopidicola geminatus* (Johnston), and *Psallus seriatus* (Reuter) (Condit and Cate, 1982); (8) in northern Germany, the field host range of *P. relictus* includes at least 16 species, in the Mirinae, Phylinae, and Bryocorinae (Haye et al., 2006). Based on European host records and laboratory host-range testing, Mason et al. (2011) suggest that the host range of *P. relictus* in North America will include species in the genus *Lygus* and other mirids in other genera.

HOST SPECIFICITY **Family**
Miridae (various species in several subfamilies)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Pickett et al., 2007).
Establishment: Established in California (Pickett et al., 2013b).
Impact: The establishment of *P. relictus* in two locations in central California was associated with reductions in densities of *L. hesperus* in alfalfa (Pickett et al., 2013b). In addition, spread of the parasitoid in central California has occurred (Picket et al., 2013b).

MEXICO

YEAR/PLACE RELEASED 2014 Mexico, Baja California (source not stated, likely California USA) (H. C. Arredondo-Bernal, pers. comm.)

TARGET PEST *Lygus hesperus* Knight MIRIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Host literature records from Europe include the following mirid bugs: (1) *Lygus rugulipennis* Poppius (Loan and Bilewicz-Pawinska, 1973); (2) *Polymerus unifasciatus* (F.) (Drea et al., 1973); (3) *Lygus hesperus* Knight (Butler and Wardecker, 1974); (4–7) *Lygus lineolaris* (Palisot de Beauvois), *Polymerus basalis* (Reuter), *Labopidicola geminatus* (Johnston), and *Psallus seriatus* (Reuter) (Condit and Cate, 1982); (8) in northern Germany, the field host range of *P. relictus* includes at least 16 species, in the Mirinae, Phylinae, and Bryocorinae (Haye et al., 2006). Based on European host records and laboratory host-range testing, Mason et al. (2011) suggest that the host range of *P. relictus* in North America will include species in the genus *Lygus* and other mirids in other genera.

Peristenus relictus (continued)

MEXICO (continued)

HOST SPECIFICITY
Family
Miridae (various species in several subfamilies)

PROJECT OUTCOMES
R+/E?/I?
Release: Released in Baja California, Mexico (H. C. Arredondo-Bernal, pers. comm.).
Establishment: Establishment in Mexico not determined.
Impact: Not determined

Phygadeuon wiesmanni Sachtleben Ichneumonidae

Yu (2017) lists no synonyms for this species.

CANADA

YEAR/PLACE RELEASED
1985–1991 Canada, Ontario (from Austria, Switzerland, and Germany) (Hoffmeister, 2002)

TARGET PEST
Rhagoletis pomonella (Walsh) Tephritidae

HOST RANGE EVIDENCE
HRT-
No laboratory host-range testing done before release. Literature host records include other species of *Rhagoletis*: *R. cerasi* L. (Weismann, 1933) and *R. alternata* Fallén (Rygg, 1979).

HOST SPECIFICITY
Genus
Tephritidae (3 species in 1 genus, *Rhagoletis*)

PROJECT OUTCOMES
R+/E-/I-
Release: Released in Ontario, Canada (Hoffmeister, 2002).
Establishment: Not established after release in Ontario (Hoffmeister, 2002).
Impact: Not applicable

Phymastichus coffea (LaSalle) Eulophidae

Noyes (2017) lists no synonyms. For species description, see LaSalle (1990).

MEXICO

YEAR/PLACE RELEASED
1992 Mexico, Chiapas (from West Africa via Colombia and Guatemala) (Barrera et al., 2008)

TARGET PEST
Hypothenemus hampei (Ferrari) Curculionidae: Scolytinae

HOST RANGE EVIDENCE
HRT-
No laboratory host-range testing done before release. Post-release, host-range testing showed that of the three curculionids tested, all were suitable for parasitism: *Araptus* sp., *Hypothenemus obscurus* (Fabricius), and *Hypothenemus seriatus* (Eichhoff) (López-Vaamonde and Moore, 1998). Also, Castillo et al., (2004) found that of three non-target *Hypothenemus* species tested, 2 species (*H. crudiae* [Panzer] and *H. eruditus* Westwood) were successfully parasitized. at levels of 14 and 6%; *Hypothenemus plumeriae* (Nordlinger) was not parasitized, nor were 2 species in other weevil genera (*Scolytodes borealis* Jordal, and *Arpatus fossifrons* Wood). Noyes (2017) lists no other hosts.

HOST SPECIFICITY
Genus?
Curculionidae (5 species in 1 genus, *Hypothenemus*; the status of *Arpatus* species as hosts needs further investigation)

PROJECT OUTCOMES
R+/E-/I-
Release: Released in Chiapas, Mexico (Barrera et al., 2008).
Establishment: Not established in Chiapas (Barrera et al., 2008), but it did establish in Honduras (Rafael Trejo et al., 2000) and so may spread naturally into Mexico.
Impact: Not applicable. The measurement of the impact of self-reproducing field populations in Mexico has not yet been possible. However, augmentative sleeve-cage trials under field conditions suggest the potential for substantial control (Infante et al., 2013).

Platygaster tuberosula Kieffer Platygasteridae

CANADA

YEAR/PLACE RELEASED 1993 Canada, Saskatchewan (from Switzerland and surrounding parts of central Europe) (Olfert et al., 2003)

TARGET PEST *Sitodiplosis mosellana* (Géhin) Cecidomyiidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include only the target pest, *Sitodiplosis mosellana* (Chavalle et al., 2015).

HOST SPECIFICITY **Possibly Species**
Cecidomyiidae (known only from the target pest, but literature is extremely limited).

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Saskatchewan, Canada (Olfert et al., 2003).
Establishment: Established in Saskatchewan (Olfert et al., 2003).
Impact: Parasitism of target pest in 2011 at one location was measured as 11% (Doane et al., 2013).

UNITED STATES

YEAR/PLACE RELEASED 2015 USA, Montana (from Switzerland and surrounding parts of Central Europe via Saskatchewan Canada) (G. Reddy, pers. comm.)

TARGET PEST *Sitodiplosis mosellana* (Géhin) Cecidomyiidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include only the target pest, *Sitodiplosis mosellana* (Chavalle et al., 2015).

HOST SPECIFICITY **Possibly Species**
Cecidomyiidae (known only from the target pest, but literature is extremely limited).

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Montana, USA (G. Reddy, pers. comm.).
Establishment: Established in Montana (G. Reddy, pers. comm.).
Impact: Not yet evaluated

Prorops nasuta Waterson Bethylidae

MEXICO

YEAR/PLACE RELEASED 1988 Mexico, Chiapas (from Kenya and Togo via Brazil) (Barrera et al., 1990a, 2008)

TARGET PEST *Hypothenemus hampei* (Ferrari) Curculionidae: Scolytinae

HOST RANGE EVIDENCE **HRT-**
No host-range testing done before release. Of 5 species tested by Pérez-Lachau and Hardy (2001), *P. nasuta* parasitized 2 species: *Caulophilus oryzae* (Gyllenhal) and *Sitophilus* sp. (both Curculionidae).

HOST SPECIFICITY **Family**
Curculionidae (4 species in 4 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Chiapas, Mexico (Barrera et al., 1990a, 2008).
Establishment: Not established in Chiapis (Infante et al., 2001; Barrera et al., 2008).
Impact: Not applicable

Pseudacteon cultellatus Borgmeier Phoridae

UNITED STATES

YEAR/PLACE RELEASED 2010 USA, Florida (from northern Argentina or adjacent countries) (Porter et al., 2013)

TARGET PEST *Solenopsis invicta* Buren Formicidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release. This species and all the *Pseudacteon* listed here are specific to the genus *Solenopsis* or specific to particular species within the genus. For *P. cultellatus*, 1 non-target species, *Solenopsis geminata* (F.), was tested and was attacked at about 5% the rate of attack on the target host in the same test (Estrada et al., 2006). This species is more host specific than *P. curvatus* but less than other *Pseudacteon* species released.

Pseudacteon cultellatus (continued)

UNITED STATES (continued)

HOST SPECIFICITY
Genus
Formicidae (2 species in 1 genus, *Solenopsis*)

PROJECT OUTCOMES
R+/E+/I?
Release: Released in Florida, USA (Porter et al., 2013).
Establishment: Established in Florida (Porter et al., 2013).
Impact: Impact not yet determined.

Pseudacteon curvatus Borgmeier Phoridae

UNITED STATES

YEAR/PLACE RELEASED
2000–2003 USA: (1) Biotype one: 2000, Tennessee and Florida (from northern Argentina or adjacent countries) (S. Porter, pers. comm.). (2) Biotype two ("Formosa biotype"): 2003, Florida (from town of Formosa in Argentina) (Vazquez et al., 2006)

TARGET PEST
Solenopsis invicta Buren Formicidae

HOST RANGE EVIDENCE
HRT+
Host-range testing done before release. This species and all the *Pseudacteon* listed here are specific to the genus *Solenopsis* or specific to particular species within the genus. Of 19 non-*Solenopsis* non-target ants tested, none were attacked (Porter, 2000). Two species of non-target *Solenopsis* ants were attacked (*S. geminata* [F.] and *S. xyloni* McCook) but at lower rates than the target species (Porter, 2000; Vazquez et al., 2004). Host specificity confirmed post-release in field (Vazquez and Porter, 2005).

HOST SPECIFICITY
Genus
Formicidae (3 species in 1 genus, *Solenopsis*)

PROJECT OUTCOMES
R+/E+/I?
Release: (1) Biotype one: Released in Florida and Tennessee, USA (Vazquez et al., 2006). (2) Biotype two: Released in Florida, USA, following the failure of the first biotype (S. Porter, pers. comm.).
Establishment: (1) Biotype one: Failed to establish in Florida (S. Porter, pers. comm.) because it did not attack the red imported fire ant (*S. invicta*). Established in Tennessee on related invasive fire ant. (2) Biotype two: The "Formosa" biotype established in Florida (Vazquez et al., 2006; Porter, 2010) and beyond (Callcott et al., 2011).
Impact: (1) Biotype one: Not applicable in Florida where the agent failed to establish. Impact in Tennessee on releated fire ant unknown. (2) Biotype two: Impact not yet determined in Florida.

Pseudacteon litoralis Borgmeier Phoridae

UNITED STATES

YEAR/PLACE RELEASED
1995–2005 USA, Texas (1995), Florida and Louisiana (2003–2006), and Alabama (2005) (from northern Argentina or adjacent countries) (Porter et al., 2011)

TARGET PEST
Solenopsis invicta Buren, *S. richteri* Forel, and hybrids Formicidae

HOST RANGE EVIDENCE
HRT+
Host-range testing done before release. This species and all the *Pseudacteon* listed here are specific to the genus *Solenopsis* or specific to particular species within the genus. There was no attack on 27 non-target non-*Solenopsis* ants (Porter et al., 1995; Porter and Alonso, 1999). One non-target species of *Solenopis* (*S. geminata*) was attacked (at 9% of rate on the target pest), but there was no successful development (Gilbert and Morrison, 1997); in Brazil in a field test, there were no attacks on *S. geminata* (Porter, 1998).

HOST SPECIFICITY
Species Group
Formicidae (2 species in 1 genus, *Solenopsis*)

PROJECT OUTCOMES
R+/E+/I? (Alabama)
Release: Released in the USA in Texas, Florida, Louisiana, and Alabama (S. Porter, pers. comm.; Porter et al., 2011).
Establishment: Establishment failed in Texas, Florida, and Louisiana, but succeeded in Alabama (Porter et al., 2011)
Impact: Impact in Alabama not yet determined.

Pseudacteon nocens Borgmeier PHORIDAE

UNITED STATES

YEAR/PLACE RELEASED	2006–2010 USA, Texas (from northern Argentina or adjacent countries) (Plowes et al., 2012)
TARGET PEST	*Solenopsis invicta* Buren, *S. richteri* Forel, and hybrids FORMICIDAE
HOST RANGE EVIDENCE	**HRT+** Host-range testing done before release. This species and all the *Pseudacteon* listed here are specific to the genus *Solenopsis* or specific to particular species within the genus. A low level of parasitism occurred on one non-target native *Solenopsis* species, *S. geminata* (F.), which was attacked at about 1/5 the rate on the target pest (Estrada et al., 2006).
HOST SPECIFICITY	**Species Group** **Formicidae** (2 species in 1 species group within 1 genus, *Solenopsis*)
PROJECT OUTCOMES	**R+/E+/I?** **Release:** Released in Texas, USA (Plowes et al., 2012). **Establishment:** Established in Texas and spreading (Plowes et al., 2012). **Impact:** Impact not yet determined.

Pseudacteon obtusus Borgmeier PHORIDAE

UNITED STATES

YEAR/PLACE RELEASED	2006–2007 USA, Texas (2006) and Florida (2007) (from northern Argentina or adjacent countries)
TARGET PEST	*Solenopsis invicta* Buren, *S. richteri* Forel, and hybrids FORMICIDAE
HOST RANGE EVIDENCE	**HRT+** Host-range testing done before release. This species and all the *Pseudacteon* listed here are specific to the genus *Solenopsis* or specific to particular species within the genus. One non-target *Solenopsis* (*S. geminata* [F.]) was tested and was not attacked in one assessment (Morrison and Gilbert, 1999), but was at about 10% the rate of attack on the target pest in another assessment (Estrada et al. 2006).
HOST SPECIFICITY	**Species Group** **Formicidae** (2 species in 1 species group within 1 genus, *Solenopsis*)
PROJECT OUTCOMES	**R+/E+/I?** **Release:** Released in Florida and Texas, USA (Porter and Calcaterra, 2013). **Establishment:** Established in Florida (Porter and Calcaterra, 2013). Establishment in Texas is unknown. **Impact:** Impact not yet determined.

Pseudacteon tricuspis Borgmeier PHORIDAE

UNITED STATES

YEAR/PLACE RELEASED	1995–1997 USA, Texas (1995) and Florida (1997) (from northern Argentina or adjacent countries) (Porter et al., 1999)
TARGET PEST	*Solenopsis invicta* Buren, *S. richteri* Forel, and hybrids FORMICIDAE
HOST RANGE EVIDENCE	**HRT+** Host-range testing done before release. This species and all the *Pseudacteon* listed here are specific to the genus *Solenopsis* or specific to particular species within the genus. In quarantine, of 6 non-target, non-*Solenopsis* species in 5 genera offered, none were attacked (Porter and Alonso, 1999). After establishment in Florida, host specificity was confirmed by disturbing fire ant mounds, exposing non-target ants to potential attack. Of 14 species in 12 genera exposed in this manner, none were attacked (Morrison and Porter, 2006). *Solenopsis geminata* (F.) was either attacked at a very low rate (4% of rate on target [Gilbert and Morrison, 1997; Porter and Alonso, 1999]) or not at all (Morrison and Porter, 2006), or without production of fly progeny (Porter, 1998).
HOST SPECIFICITY	**Species Group** **Formicidae** (2 species in 1 species group within 1 genus, *Solenopsis*)
PROJECT OUTCOMES	**R+/E+/I?** **Release:** Released in Texas and Florida, USA (Porter et al., 1999). **Establishment:** Releases in Texas failed, but the parasitoid established in Florida (Porter et al., 1999) and spread (Callcott et al., 2011). **Impact:** Impact in Florida not yet determined.

Pseudleptomastix mexicana Noyes and Schauff Encyrtidae

For species description, see (Noyes and Schauff, 2003). Noyes (2017) lists no synonyms.

GUAM

YEAR/PLACE RELEASED 2002 USA, Guam (likely native to Mexico but collected in Puerto Rico; its release in Puerto Rico is not recorded) (G. Reddy, pers. comm.; Meyerdirk et al., 2004)

TARGET PEST *Paracoccus marginatus* Williams and Granara De Willink Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts are recorded in the literature. Noyes (2017) lists no species other than the target pest as hosts.

HOST SPECIFICITY **Possibly Species**
Pseudococcidae (known only from the target pest, but literature is limited and species only described since 2003)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Guam (Meyerdirk et al., 2004).
Establishment: Establishment of *P. mexicana* in Guam is undetermined.
Impact: The target pest was reduced >99% within one year of the introduction of this parasitoid and another species used in the program, *Acerophagus papaya*. No separate accounting of impact by parasitoid species was found for Guam.

Psyllaephagus bliteus Riek Encyrtidae

Noyes (2017) lists one synonym: *Psyllaephagus quadricyclus* Riek. Note: two parasitoids of two other invasive eucalypt psyllids were self-introduced in the USA: (1) *Psyllaephagus parvus* Riek (Hymenoptera: Encyrtidae) on lemon gum psyllid, *Cryptoneossa triangula* Taylor and (2) *Psyllaephagus perplexans* Cockerell on the lerp-forming spotted gum psyllid, *Eucalyptolyma maideni* Froggatt (Jones et al., 2011). These are not included in this work because they were not deliberately introduced but are referenced here to prevent confusion.

UNITED STATES

YEAR/PLACE RELEASED 2000 USA, California (from Australia) (Dahlsten et al., 2003)

TARGET PEST *Glycaspis brimblecombei* Moore Psyllidae (red gum lerp psyllid)

HOST RANGE EVIDENCE **HRT+**
Host-range testing was done before release. None of 3 non-target eucalyptus-feeding psyllids tested (*Trioza eugeniae* Froggatt, *Ctenarytaina eucalypti* [Maskell], *Boreioglycaspis melaleucae* Moore) were attacked (Dahlsten et al., 2003). Literature hosts include only *Spondyliaspis* cf. *plicatuloides* (Froggatt) (Psyllidae) (Bush et al., 2017). Noyes (2017) lists 4 species as hosts; however, 2 were tested by Dahlsten et al., 2003) and found not to be parasitized (*B. melaleucae* and *C. eucalypti*). Disregarding those, the other psyllids listed as hosts by Noyes (2017) are (1) *Creiis costatus* (Froggatt) and (2) *Glycaspis granulata* (Froggatt).

HOST SPECIFICITY **Family**
Psyllidae* (4 species in 3 genera)
*The family Psyllidae has been recently subdivided into additional families, and the placement of these genera in that new taxonomic arrangement has not been determined here.

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Dahlsten et al., 2003).
Establishment: Established in California (Dahlsten et al., 2003).
Impact: Indications are that control in some parts of California are substantial, with a 50% reduction in female psyllids being observed within a year or so of release at several sites (Dahlsten et al., 2003). Pest suppression by *P. bliteus* is, however, mostly limited to coastal California, and less control has occurred in the inland, hotter areas (Sime et al., 2004; Daane et al., 2012).

Psyllaephagus bliteus (continued)

MEXICO

YEAR/PLACE RELEASED 2001 northern Mexico (from Australia via California USA) (Villa Castillo, 2005)

TARGET PEST *Glycaspis brimblecombei* Moore PSYLLIDAE (red gum lerp psyllid)

HOST RANGE EVIDENCE **HRT+**
Host-range testing was done before release. None of 3 non-target eucalyptus-feeding psyllids tested (*Trioza eugeniae* Froggatt, *Ctenarytaina eucalypti* [Maskell], *Boreioglycaspis melaleucae* Moore) were attacked (Dahlsten et al., 2003). Literature hosts include only *Spondyliaspis* cf. *plicatuloides* (Froggatt) (Psyllidae) (Bush et al., 2017). Noyes (2017) lists 4 species as hosts; however, 2 were tested by Dahlsten et al., 2003) and found not to be parasitized (*B. melaleucae* and *C. eucalypti*). Disregarding those, the other psyllids listed as hosts by Noyes (2017) are (1) *Creiis costatus* (Froggatt) and (2) *Glycaspis granulata* (Froggatt).

HOST SPECIFICITY **Family**
Psyllidae* (4 species in 3 genera)
*The family Psyllidae has been recently subdivided into additional families, and the placement of these genera in that new taxonomic arrangement has not been determined here.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in northern Mexico (Villa Castillo, 2005).
Establishment: Established in ten states in Mexico (Villa Castillo, 2005).
Impact: Outcome not reported.

Psyllaephagus pilosus Noyes ENCYRTIDAE

Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1993 USA, California (from Australia) (Dahlsten et al., 1998a)

TARGET PEST *Ctenarytaina eucalypti* (Maskell) PSYLLIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. This parasitoid is likely a eucalypt specialist, conferring high host specificity where eucalypts are not native. No other hosts are known from the literature. Noyes (2017) lists no other species as hosts.

HOST SPECIFICITY **Possibly Species**
Psyllidae (known only from the target pest, but literature is very limited)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Dahlsten et al., 1998a,b).
Establishment: Established in California (Dahlsten et al., 1998a,b).
Impact: Control of pest was complete within a year (Dahlsten et al., 1998a), and economic benefit ratio to blue gum foliage growers was between 9 and 24 to 1 (Dahlsten et al., 1998b).

Psyllaephagus yaseeni Noyes ENCYRTIDAE

Recorded as *P. rotundifolius* or *P.* nr *rotundiformis* before Noyes (1990) described it as a new species (Beardsley and Uchida, 1990). Noyes (2017) lists no synonyms.

HAWAII

YEAR/PLACE RELEASED 1987 USA, Hawaii (from Tobago) (Nakahara and Funasaki, 1987)

TARGET PEST *Heteropsylla cubana* Crawford PSYLLIDAE

HOST RANGE EVIDENCE **HRT+**
Host-range testing was done before release. Two non-target *Heteropsylla* species (*H. huasachae* Caldwell and *H. fusca* Crawford) were accepted as hosts (Nakahara and Funasaki, 1987). Noyes (2017) lists 1 additional species as a host: *Heteropsylla incisa* (Šulc).

HOST SPECIFICITY **Genus**
Psyllidae (4 species in 1 genus, *Heteropsylla*)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Hawaii (Nakahara and Funasaki, 1987).
Establishment: Established in Hawaii (Beardsley and Uchida, 1990).
Impact: Impact not determined.

Psyttalia carinata (Thompson) Braconidae

Synonyms include *Psyttalia rhagoleticola* (Sachtleben) and a former generic placement as an *Opius* species (Yu, 2017).

CANADA

YEAR/PLACE RELEASED 1985–1991 Canada, Ontario (from Austria, Switzerland, Germany) (Hoffmeister, 2002)

TARGET PEST *Rhagoletis pomonella* (Walsh) and *Rhagoletis cerasi* (L.) Tephritidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Host literature records include *Rhagoletis cingulata* (Loew) in Europe, where this North American species is invasive (Schuler et al., 2016).

HOST SPECIFICITY **Genus**
Tephritidae (3 species in 1 genus, *Rhagoletis*)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Ontario, Canada (Hoffmeister, 2002).
Establishment: Did not establish in Ontario (Hoffmeister, 2002).
Impact: Not applicable

Psyttalia humilis (Silvestri) Braconidae

Formerly in *Opius*; no other synonyms (Yu, 2017). The *Psyttalia concolor* (Szépligeti) species complex has been described, with the species *P. humilis* as a member that is sub-Saharan in distribution (Rugman-Jones et al., 2009).

UNITED STATES

YEAR/PLACE RELEASED 2006–2013 USA, California (from Namibia) (Daane et al., 2017). Releases of "*Opius humilis*" were made in California in 1934 against *Rhagoletis completa*, with next year recoveries (Boyce, 1934). However, this usage of the name can no longer be coordinated with modern taxonomy of the genus. No *Psytallia* species was recovered by Kent Daane from samples of walnut husk fly in California, suggesting it did not establish (K. Daane, pers. comm.).

TARGET PEST *Bactrocera oleae* Gmelin Tephritidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing was done before release. One non-target species (of two tested) was attacked (*Parafreutreta regalis* [Munro]), but one, (*Chaetorellia succinea* [Costa]), was not (Daane et al., 2011). Host literature records include *Ceratitis capitata* (Wiedemann) (Ehrhorn, 1915). *Rhagoletis completa* Cresson (Boyce, 1934) also appears in the literature in association with the name *Opius humilis* but that name's usage in the 1930s cannot be accurately matched to current use of the names in the genus and so is unreliable.

HOST SPECIFICITY **Family**
Tephritidae (3 species in 3 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA (Yokoyama et al., 2011; Daane et al., 2011, 2017).
Establishment: While field reproduction did occur in California following release, the parasitoid apparently failed to overwinter, even at mild coastal sites (Daane et al., 2017).
Impact: Field cage trials done in California from 2006 to 2009 (Wang et al., 2011), but no field population could be established to evaluate the species' impact (Daane et al., 2017).

Psyttalia lounsburyi (Silvestri) Braconidae

Formerly in *Opius*; no other synonyms (Yu, 2017).

UNITED STATES

YEAR/PLACE RELEASED 2006–2013 USA, California (from Kenya and South Africa) (Daane et al., 2017)

TARGET PEST *Bactrocera oleae* Gmelin Tephritidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing was done before release. No attack occurred on the 5 non-target tephritids tested: *Rhagoletis fausta* (Osten Sacken), *Rhagoletis pomonella* (Walsh), *Euphranta canadensis* (Loew), *Parafreutreta regalis* (Munro), and *Chaetorellia succinea* (Costa) (Daane et al., 2008, 2011). In field collections in the native range (Africa), *P. lounsburyi* has been reared only from *B. oleae* (see references in Daane et al., 2008 [Narayanan and Chawla, 1962; Neuenschwander, 1982; Wharton and Gilstrap, 1983; Wharton et al., 2000]). Literature host records include *Ceratitis capitata* (Wiedemann) as a laboratory-rearing host (Billah et al., 2005).

Psyttalia lounsburyi (continued)

UNITED STATES (continued)

HOST SPECIFICITY
Genus?
Tephritidae (2 species in 2 genera, one of which is a laboratory-rearing host)

PROJECT OUTCOMES
R+/E+/I?
Release: Released in California, USA (Daane et al., 2011, 2017).
Establishment: Recoveries were made in California (of parasitoids of South African origin) that were determined to be *P. lounsburyi* (Bon et al. 2017), and establishment has been confirmed (Daane et al., 2017).
Impact: Field cage trials were done in California before release from 2006 to 2009 that showed substantial parasitism (Wang et al., 2011). Post-establishment impact in the field has not yet been determined.

Pteroptrix wanhsiensis (Compere) APHELINIDAE

Noyes (2017) lists one synonym: *Casca wanhsiensis* Compere.

UNITED STATES

YEAR/PLACE RELEASED
1986 USA, Maryland (from Korea) (see p. 230 of Barbosa et al., 1994). Released previously in California, USA in 1948-1949 against *Aonidiella aurantii* Maskell, but did not establish (Flanders, 1956).

TARGET PEST
Unaspis euonymi (Comstock) DIASPIDIDAE

HOST RANGE EVIDENCE
HRT-
No laboratory host-range testing done before release. Literature host records include (1) *Aonidiella aurantii* Maskell (Diaspididae) (Flanders, 1956) and (2) *Quadraspidiotus perniciosus* (Constock) (Diaspididae) (Chumakova, 1964). Noyes (2017) lists no other species as hosts.

HOST SPECIFICITY
Family
Diaspididae (3 species in 3 genera)

PROJECT OUTCOMES
R+/E-/I-
Release: Released in Maryland, USA (see p. 230 of Barbosa et al., 1994).
Establishment: Not established Maryland (see p. 230 of Barbosa et al., 1994).
Impact: Not applicable

Quadrastichus haitiensis (Gahan) EULOPHIDAE

For species description, see Gahan (1929). Noyes (2017) lists former generic placements in *Aprostocetus* and *Tetrastichus*, but no other synonyms.

UNITED STATES

YEAR/PLACE RELEASED
1998 USA, Florida (from the Caribbean) (Peña et al., 2004). Released earlier (1969) in Florida (Sutton et al., 1972), but apparently did not establish on *Diaprepes abbreviatus* (L.) (Beavers and Selhime, 1975; Hall et al., 2001), but the parasitoid was recovered in Florida from *Pachnaeus opalus* (Olivier) (Beavers et al., 1980).

TARGET PEST
Diaprepes abbreviatus (L.) CURCULIONIDAE

HOST RANGE EVIDENCE
HRT-
No laboratory host-range testing was done before release. Literature host records include the following curculionids: (1) *Exophthalmus quadrivittatus* (Olivier) (Gahan, 1929); (2) *Diaprepes abbreviatus* (L.) (Wolcott, 1934); (3–4) *Diaprepes* (*Prepodes*) *vittatus* (L.) and *Exophthalmus similis* Drury (Edwards, 1938); (5) *Pachnaeus litus* (Germar) (Sutton et al., 1972); and (6) *Pachnaeus opalus* (Olivier) (Beavers et al., 1980). Noyes (2017) lists one additional weevil as a host: *Diaprepes famelicus* (Olivier).

HOST SPECIFICITY
Family
Curculionidae (7 species in 3 genera). Attacks eggs of weevils concealed in plant tissues.

PROJECT OUTCOMES
R+/E+/I?
Release: Released in Florida, USA (Peña et al., 2004).
Establishment: Established in Florida (Peña et al., 2004).
Impact: Impact not determined.

Schoenlandella diaphaniae (Marsh) Braconidae

For species description, see (Marsh, 1986). Former generic placement in *Cardiochiles*; no other synonyms (Yu, 2017).

UNITED STATES

YEAR/PLACE RELEASED 1986 USA, Florida (from South America) (Marsh, 1986)

TARGET PEST *Diaphania nitidalis* (Stoll) and *Diaphania hyalinata* (L.) Crambidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing was done before release. Literature hosts include only the 2 target hosts *Diaphania nitidalis* (Stoll) and *Diaphania hyalinata* (L.) (Smith et al., 1994).

HOST SPECIFICITY **Genus**
Crambidae (2 species in 1 genus, *Diaphania*)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Florida, USA (Marsh, 1986).
Establishment: Established in Florida (F. Gallardo pers. comm. to J. Peña).
Impact: Not reported.

Spathius agrili Yang Braconidae

For species description, see Yang et al. (2005). No synonyms given in Yu (2017).

UNITED STATES

YEAR/PLACE RELEASED 2007 USA, Michigan and, later, in many other eastern U.S. states (from China) (Duan et al., 2010b)

TARGET PEST *Agrilus planipennis* Fairmaire Buprestidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing was done before release. Of 17 woodborers collected from the field in China, none other than the target pest produced *Spathius agrili* (Yang et al., 2008). Of 9 non-target *Agrilus* species presented to *S. agrili* in the laboratory in China or the USA, 5 species were attacked, but only 1 (*Agrilus mali* Matsumura) supported successful development to yield adult females (Yang et al., 2008) (see Gould, 2007 for summary of host specificity information).

HOST SPECIFICITY **Genus**
Buprestidae (2 species in 1 genus, *Agrilus*)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Michigan, USA (Duan et al., 2010b; Van Driesche et al., 2016) and other eastern U.S. states (Duan et al., 2010b).
Establishment: Next year recoveries made in Michigan, USA following release, but populations appear to have died out later (J. Duan and J. Gould, pers. comm.). Potential establishment in Maryland, USA has been reported (Jennings et al., 2016).
Impact: No impact on target pest.

Spathius galinae Belokobylskij and Strazanac Braconidae

For species description, see Belokobylskij et al. (2012). No synonyms in literature.

UNITED STATES

YEAR/PLACE RELEASED 2015 USA, New York, Connecticut, Massachusetts (from the Russian Far East) (J. Duan and R. Van Driesche, pers. comm.)

TARGET PEST *Agrilus planipennis* Fairmaire Buprestidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing was done before release. Of 15 wood-boring insects tested, including 5 species of non-target *Agrilus*, only one species was parasitized: *Agrilus auroguttatus* Schaeffer, an important invasive pest of native oaks in California (Duan et al., 2015a).

HOST SPECIFICITY **Genus**
Buprestidae (2 species in 1 genus, *Agrilus*)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in the northeastern United States (J. Duan and R. Van Driesche, pers. comm.).
Establishment: Recovered at 6 of 6 sites in the northeastern USA one year after last release (J. Duan and R. Van Driesche, pers. comm.).
Impact: High levels of parasitism were observed at 3 of 6 sites in the northeastern USA in 2018, one year after last release, with low or medium levels at the other 3 sites. (J. Duan and R. Van Driesche, pers. comm.).

Syngaster lepidus Brullé Braconidae

Synonyms include only *Iphiaulax morleyi* (Austin et al., 1994).

UNITED STATES

YEAR/PLACE RELEASED 1993 USA, California (from Australia) (Paine et al., 1995; Paine and Millar, 2003)

TARGET PEST *Phoracantha semipunctata* (F.) and *Phoracantha recurva* Newman Cerambycidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include (1) *Phoracantha semipunctata* (F.) (Moore, 1963) and (2) *Phoracantha recurva* Newman (Millar et al., 2002).

HOST SPECIFICITY **Genus**
Cerambycidae (2 species in 1 genus). Likely restricted to hosts on eucalypts due to attraction to host plant odors.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in California, USA (Paine et al., 1995; Paine and Millar, 2002).
Establishment: Established in California (Paine et al., 1995).
Impact: Not determined.

Tamarixia dahlsteni Zuparko Eulophidae

(introduced as *Tamarixia* sp.) For species description , see Zuparko et al. (2011). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 1992 USA, California (from Australia) (Dahlsten et al., 1995)

TARGET PEST *Trioza eugeniae* Froggatt Triozidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. No other hosts listed in the literature. Noyes (2017) lists no other species as hosts.

HOST SPECIFICITY **Species?**
Triozidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+I+**
Release: Released in California, USA (Dahlsten et al. 1995).
Establishment: Established in California (Dahlsten et al. 2000).
Impact: "Effectiveness controlling eugenia psyllid has varied from near complete control in most warmer areas [in California] to ineffective control, particularly in cooler areas such as the city of San Francisco" (Dahlsten et al., 2000).

Tamarixia radiata (Waterson) Eulophidae

Noyes (2017) lists three synonyms: (1) *Tamarixia radiatus* (Waterston), (2) *Tetrastichus indicus* Khan and Shafee, and (3) *Tetrastichus radiatus* Waterston.

UNITED STATES

YEAR/PLACE RELEASED 1999–2011 USA: (1) Florida: 1999 (from Taiwan) (Michaud, 2002b); (2) California: 2011 (from Pakistan) (Hoddle, 2012)

TARGET PEST *Diaphorina citri* Kuwayama Liviidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release. Of 7 non-target psyllids (sensu latu) tested, there was no parasitism of 5 native species or 1 adventive species. The second adventive species, *Bactericera cockerelli* Sulc (Triozidae), a common pest species, was attacked at a low rate (5%) (Hoddle and Pandey, 2014). Literature hosts include only *Diaphorina citri* (Husain and Lal, 1920) and *Pallipsylla hyalina* (Mathur) (Psyllidae) (Noyes, 2017). The literature record of *T. radiatus* attacking *Trioza erytreae* (Del Guercio) (Triozidae) (Annecke and Cilliers, 1963) in South Africa has been determined to be in error, as the parasitoid attacking this host was really *Tetrastichus dryi* Waterston (Prinsloo, 1980).

HOST SPECIFICITY **Three Families**
Liviidae (1 species, the target pest), **Psyllidae** (1 species), and **Triozidae** (1 species)

Tamarixia radiata (continued)

UNITED STATES (continued)

PROJECT OUTCOMES **R+/E+/I+**
Release: (1) Florida: Released in Florida, USA (Michaud, 2002b). (2) California: Released in California, USA (Hoddle, 2012).
Establishment: (1) Florida: Established in Florida (Michaud, 2002b). (2) California: Established in California (Hoddle, 2012).
Impact: (1) Florida: In some studies, impact was limited by effect of predators (Michaud, 2004), but in others, significant levels of parasitism (20–56%) were reported in Florida citrus (Qureshi et al., 2009). (2) California: The contribution of this parasitoid in the context of other sources of mortality in California was studied by Kistner et al. (2016), who determined that the net reproductive rate of the pest was reduced 55–95% by *T. radiata* and a complex of generalist predators.

Telenomus remus Nixon Platygastridae

For species description, see Nixon (1937). No synonyms found in literature.

UNITED STATES

YEAR/PLACE RELEASED 1988–1989 USA, southern Florida (from Asia [likely Malaysia] via Puerto Rico and the Cayman Islands) (Bennett, 1994). Released earlier (in 1975) in Florida, but failed to establish (Waddill and Whitcomb, 1982).

TARGET PEST *Spodoptera frugiperda* (J. E. Smith) Noctuidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release. Thirty-nine non-target species were tested. Of those not in the Noctuidae, there were 7 Arctiidae, 1 Ctenuchidae, 5 Geometridae, 1 Mimallonidae, 2 Notodontidae, and 2 Pyralidae. Of these non-noctuids, only 1 species (a pyralid) was parasitized. Of the 21 noctuids tested, 11 species in 11 genera were parasitized (Wojcik et al., 1976). Literature host records include (all Noctuidae unless stated otherwise): (1) *Spodoptera mauritia* Boisduval (Nixon, 1937); (2) *Spodoptera litura* (F.) (Lever, 1943); (3) *Spodoptera littoralis* (Boisduval) (Gerling and Schwartz, 1974); (4) *Spodoptera frugiperda* (J.E. Smith) (Sinha, 1982); (5-7) *Agrotis spinifera* (Hübner), *Agrotis ipsilon* (Hufnagel), and *Spodoptera exigua* (Hübner) (Gautam, 1986); (8) *Plusia signata* F. (Joshi et al., 1989); (9-10) *Helicoverpa armigera* (Hübner) and *Creatonotos gangis* (L.) (Erebidae) (Bughio et al., 1994; (11) *Spodoptera cosmioides* Walker (Goulart et al., 2011); (12) *Spodoptera eridania* (Cramer) (Pomari et al., 2013); and (13) *Anticarsia gemmatalis* Hübner (Erebidae) (Bueno et al., 2014).

HOST SPECIFICITY **Three Families**
Noctuidae (20 species in 11 genera, concentrated in *Spodoptera* with 8 species), **Pyralidae** (1 species), and **Erebidae** (2 species in 2 genera)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in southern Florida, USA (Bennett, 1994).
Establishment: The recovery of several specimens (in 2009–2013) from sentinel egg masses of *S. frugiperda* in Florida that matched (via barcoding) colonies of *T. remus* in Ecuador and Honduras suggest this parasitoid established in Florida (Hay-Roe et al., 2015).
Impact: Undetermined.

Tetrastichus brontispae Ferrière Eulophidae

Noyes (2017) lists one synonym: *Tetrastichodes brontispae* Ferrière.

HAWAII

YEAR/PLACE RELEASED 1986–1991 USA, Hawaii (from Guam in 1986 and Java in 1991)

TARGET PEST *Brontispa chalybeipennis* (Zacher) Chrysomelidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include the following chrysomelids: (1) *Brontispa longissimi* (Gestro) (= *Brontispa froggatti*) (Awibowo, 1934; Lever, 1936); (2) *Brontispa mariana* Spaeth (Lange, Jr., 1950); (3) *Gestronella centrolineata* (Fairmaire) (Appert, 1974); and (4) *Octodonta nipae* (Maulik) (Tang et al., 2014). Noyes (2017) lists one additional host: *Brontispa palauensis* (Esaki and Chujo) (Chrysomelidae).

HOST SPECIFICITY **Family**
Chrysomelidae (6 species in 3 genera of coconut-leafmining beetles)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Hawaii (Funasaki et al., 1988).
Establishment: Established in Hawaii (Culliney and Nagamine, 2000).
Impact: "By 1988, visible damage to coconuts in the areas of infestation in Honolulu had been reduced" (Culliney and Nagamine, 2000).

Tetrastichus planipennisi Yang Eulophidae

For species description, see (Yang et al., 2006). Noyes (2017) lists no synonyms.

UNITED STATES

YEAR/PLACE RELEASED 2007 USA, Michigan (from northeastern China) (Duan et al., 2010b, 2013)

TARGET PEST *Agrilus planipennis* Fairmaire Buprestidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release. Of 6 non-target *Agrilus* species collected in the field in China, none were attacked. Of 5 non-target *Agrilus* and 6 buprestids in other genera examined in laboratory tests, none were attacked (Gould, 2007). Literature host records include only the target pest, *Agrilus planipennis* Fairmaire (Liu et al., 2007). Noyes (2017) lists no other species as hosts.

HOST SPECIFICITY **Species**
Buprestidae (known only from the target pest)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Michigan, USA (Duan et al., 2010b, 2013) and later in many other states.
Establishment: Established in Michigan (Duan et al., 2010b, 2013).
Impact: Rates of parasitism in study plots in Michigan reached 20% in mid-sized ash trees, suggesting partial control of the pest (Duan et al., 2013, 2014, 2015b). Parasitism is substantially higher (40-80%) in sapling-sized ash (Duan et al., 2017).

Tetrastichus setifer Thomson Eulophidae

Noyes (2017) lists one synonym: *Aprostocetus setifer* (Thomson).

UNITED STATES

YEAR/PLACE RELEASED 1999 USA, Rhode Island and other New England states (from Switzerland, France, and other parts of Europe) (Tewksbury, 2014, Tewksbury et al., 2017)

TARGET PEST *Lilioceris lilii* Scopoli Chrysomelidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release (Gold, 2003; Kenis et al., 2003; Casagrande and Kenis, 2004; USDA APHIS, 2017). Of 2 non-target European species of *Lilioceris* (*L. merdigera* [L.] and *L. tibialis* [Villa]) tested, both were attacked. Of 8 species of North American non-*Lilioceris* species (6 in the same family; 2 in other families), none were attacked (Casagrande and Kenis, 2004). No other literature host records were found. Noyes (2017) lists no other species as hosts.

HOST SPECIFICITY **Genus**
Chrysomelidae (3 species in 1 genus, *Lilioceris*). Functionally monophagous in North America, where there are no native *Lilioceris* species, although a species in the genus (*Lilioceris cheni* Gressit and Kimoto) has recently been released in Florida as a weed biocontrol agent of air potato (*Dioscorea bulbifera* L.) (Featured Creatures, 2017a).

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Rhode Island, USA and other New England states (Tewksbury, 2014, Tewksbury et al., 2017).
Establishment: Established in several New England states and spreading (Tewksbury et al., 2005; Tewksbury, 2014, Tewksbury et al., 2017).
Impact: At two monitored *T. setifer*-release sites, pest density declined 50–88% in association with increasing parasitism over an 8–9 year period (Tewksbury et al., 2017).

CANADA

YEAR/PLACE RELEASED 2010 Canada, Ontario (from Switzerland, France, and other parts of Europe via Rhode Island USA) (Cappaccino et al., 2013)

TARGET PEST *Lilioceris lilii* Scopoli Chrysomelidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release (Gold, 2003; Kenis et al., 2003; Casagrande and Kenis, 2004; USDA APHIS, 2017). Of 2 non-target European species of *Lilioceris* (*L. merdigera* [L.] and *L. tibialis* [Villa]) tested, both were attacked. Of 8 species of North American non-*Lilioceris* species (6 in the same family; 2 in other families), none were attacked (Casagrande and Kenis, 2004). No other literature host records were found. Noyes (2017) lists no other species as hosts.

Tetrastichus setifer (continued)

CANADA (continued)

HOST SPECIFICITY **Genus**
Chrysomelidae (3 species in 1 genus, *Lilioceris*). Functionally monophagous in North America, where there are no native *Lilioceris* species, although a species in the genus (*Lilioceris cheni* Gressit and Kimoto) has recently been released in Florida as a weed biocontrol agent of air potato (*Dioscorea bulbifera* L.) (Featured Creatures, 2017a).

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Ontario, Canada (Cappaccino et al., 2013).
Establishment: Established in Ontario (Cappaccino et al., 2013).
Impact: Not yet determined.

Thripobius javae (Girault) Eulophidae

For species description, see Boucek (1976). One synonym: *Thripobius semiluteus* Boucek, the name under which most literature appears. Noyes (2017) does not list this species.

UNITED STATES

YEAR/PLACE RELEASED 1986–1989 USA, California (from Australia) (McMurtry, 1988; McMurtry et al., 1991)

TARGET PEST *Heliothrips haemorrhoidalis* (Bouché) Thripidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Froud et al. (1996) estimated *T. javae*'s host range to be in the Panchaetothripinae in the Thripidae. Evaluation of its potential for non-target effects in New Zealand (Froud and Stevens, 2003) concluded it was safe enough for introduction. No other literature host records. Noyes (2017) does not list this parasitoid species.

HOST SPECIFICITY **Subfamily**
Thripidae (various species of Panchaetothripinae)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in California, USA (McMurtry, 1988; McMurtry et al., 1991).
Establishment: Established in California, USA (McMurtry et al.,1991).
Impact: No information available.

Trichogramma atopovirilia Oatman and Platner Trichogrammatidae

Noyes (2017) lists two synonyms: (1) *Trichogramma atopovirilla* Oatman and Platner and (2) *Trichogramma caiaposi* Brun, Gomez de Moraes and Soares.

UNITED STATES

YEAR/PLACE RELEASED 1985–1987 USA, northern Texas (from Mexico) (Overholt and Smith, Jr., 1990)

TARGET PEST *Diatraea grandiosella* Dyar Crambidae

HOST RANGE EVIDENCE **HRT+**
Host-range testing done before release. Laboratory host testing was done to determine if certain pest crambid borers (formerly part of Pyralidae) were susceptible to parasitism: *Diatraea considerata* Heinrich, *D. saccharalis* (F.), *D. grandiosella* Dyar, and *Eoreuma loftini* (Dyar) (Browning and Melton, 1987). Literature records include the following 16 hosts: (1) *Diatraea grandiosella* Dyar (Crambidae) (Rodríguez-del-Bosque et al., 1989); (2) *Helicoverpa zea* (Boddie) (Noctuidae) (Resende and Ciociola, 1996); (3) *Anticarsia gemmatalis* Hübner (Noctuidae) (Foerster and Avanci, 1999); (4) *Spodoptera frugiperda* (J. E. Smith) (Noctuidae) (Beserra et al., 2002); (5) (as a laboratory-rearing host) *Ephestia kuehniella* Zeller (Pyralidae) (Nicoli et al., 2004); (6) *Sitotroga cerealella* (Olivier) (Gelechiidae) (Morales et al., 2004); (7) *Diatraea considerata* Heinrich (Crambidae) (Vejar-Cota et al., 2005); (8) *Ecdytolopha aurantianum* (Lima) (Tortricidae) (Molina et al., 2005); (9) *Diaphania hyalinata* L. (Crambidae) (Melo et al., 2007); (10) *Stenoma catenifer* Walsingham (Depressariidae) (Nava et al., 2007); (11) *Plutella xylostella* (L.) (Plutellidae) (Pratissoli et al., 2008); (12) *Chrysodeixis includens* (Walker) (Noctuidae) (Bueno et al., 2009); (13) *Trichoplusia ni* (Hübner) (Noctuidae) (Milanez et al., 2009); (14) *Heliothis virescens* (Fabricius) (Noctuidae) (Andrade et al., 2011); (15) *Diatraea saccharalis* (Fabricius) (Crambidae) (Isas et al., 2016); and (16) *Eoreuma loftini* (Dyar) (Crambidae) (Browning and Melton, 1987). Noyes (2017) lists 7 additional species as hosts: (1) *Anarsia geminella* Amsel (Gelechiidae), (2) *Alabama argillacea* (Hübner) (Noctuidae), (3) *Mamestra brassicae* (L.) (Noctuidae), (4) *Spodoptera sunia* (Guenée) (Noctuidae), (5) *Vanessa* sp. (Nymphalidae), (6) (as a laboratory-rearing host) *Corcyra cephalonica* (Stainton) (Pyralidae), and (7) *Erinnyis ello* (L.) (Sphingidae).

Trichogramma atopovirilia (continued)

UNITED STATES (continued)

HOST SPECIFICITY **Order**
Lepidoptera (9 families*): **Crambidae** (5 species in 3 genera), **Noctuidae** (9 species in 8 genera), **Pyralidae** (2 species in 2 genera), **Tortricidae** (1 species), **Gelechiidae** (2 species in 2 genera), **Nymphalidae** (1 species), **Depressariidae** (1 species), **Sphingidae** (1 species), and **Plutellidae** (1 species)
*Many of these host records are based on laboratory tests and thus correspond to the physiological host range, which is expected to be wide given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species. The proportion of these species that are also parasitized in the field is unknown.

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in northern Texas, USA (Overholt and Smith, Jr., 1990).
Establishment: Not established in northern Texas (Overholt and Smith, Jr., 1990).
Impact: Not applicable

Trichogramma ostriniae Pang et Chen Trichogrammatidae

For species description, see Pang and Chen (1974). Noyes (2017) lists one synonym: *Trichogramma ostrinia* Pang et Chen.

UNITED STATES

YEAR/PLACE RELEASED 1991 USA, New York (from China) (M. Hoffmann pers, comm.; Gardner et al., 2013)

TARGET PEST *Ostrinia nubilalis* (Hübner) Crambidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Post-release host-range testing showed that 13 tested species were parasitized (Hoffmann et al., 1995). Adults of *T. ostriniae* showed an innate response to odors of *O. nubilalis*, but not to *Spodoptera frugiperda* J. E. Smith (Yong et al., 2007). Literature host records include (1) *Ostrinia nubilalis* (Hübner) (Crambidae) (Feng et al., 1977); (2) *Leguminivora glycinivorella* (Matsumura) (Tortricidae) (Song et al., 1982); (3) *Corcyra cephalonica* (Stainton) (Pyralidae) (Gou, 1985); (4) *Tetramoera schistaceana* (Snellen) (Tortricidae) (Wang et al., 1985); (5) *Ostrinia furnacalis* (Guenée) (Crambidae) (Gou, 1988); (6) *Lampronadata cristata* Butler (Notodontidae) (Feng, 1988); (7) *Plutella xylostella* (L.) (Plutellidae) (Hirashima et al., 1990); (8) *Chilo sacchariphagus* (Bojer) (Crambidae) (Chen et al., 1998); (9) *Galleria mellonella* (L.) (Pyralidae) (Cassanello et al., 2000); (10) *Sitotroga cerealella* (Olivier) (Gelechiidae) (Hoffmann et al., 2001); (11) *Eublemma amabilis* Moore (Noctuidae) (Bhattacharya et al., 2006); (12) *Chilo suppressalis* (Walker) (Crambidae) (Yuan et al., 2012); (13) *Ephestia kuehniella* Zeller (Pyralidae) (St-Onge et al., 2016); and (14) *Cnaphalocrocis medinalis* (Guenée) (Crambidae) (Tian et al., 2017). Noyes (2017) lists 8 additional species as hosts: (1) *Cnidocampa flavescens* Walker (Limacodidae), (2) *Busseola fusca* (Fuller) (Noctuidae), (3) *Helicoverpa armigera* (Hübner) (Noctuidae), (4) *Heliothis virescens* (Fabricius) (Noctuidae), (5) *Trichoplusia ni* (Hübner) (Noctuidae), (6) *Chilo partellus* (Swinhoe) (Crambidae), (7) *Cadra cautella* (Walker) (Pyralidae), and (8) *Adoxophyes fasciata* Walsingham (Tortricidae).

HOST SPECIFICITY **Order**
Lepidoptera (8 families*): **Crambidae** (6 species in 3 genera), **Pyralidae** (4 species in 4 genera), **Tortricidae** (3 species in 3 genera), **Noctuidae** (5 species in 5 genera), **Notodontidae** (1 species), **Plutellidae** (1 species), **Limacodidae** (1 species), and **Gelechiidae** (1 species)
*Many of these host records are based on laboratory tests and thus correspond to the physiological host range, which is expected to be wide given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species. The proportion of these species that are also parasitized in the field is unknown.

PROJECT OUTCOMES **R+/E+?/I?**
Release: Released in New York, USA (M. Hoffmann, pers. comm.).
Establishment: It is possible that this species has established in New York, given that "positive identification of *T. ostriniae* from naturally occurring *O. nubilalis* eggs collected from field sites where augmentative releases had been made in previous years [has occurred in New York]" (Gardner et al., 2013).
Impact: Augmentative releases of *T. ostriniae* in New York state, USA, reduced damage by *O. nubilalis* by 50% compared to untreated controls (Wright et al., 2002). The extent of impact, if any, of *T. ostrinae* as a classical biological control agent has not been reported.

Trichogramma platneri Nagarkatti Trichogrammatidae

For species description, see Nagarkatti et al. (1975). Noyes (2017) lists no synonyms.

GUAM

YEAR/PLACE RELEASED 1986 USA, Guam (from California USA) (Nafus, 1991)

TARGET PEST *Penicillaria jocosatrix* Guenée Noctuidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include (1) *Boarmia selenaria* Schiffermüller (Geometridae) (Wysoki and Renneh, 1985); Wysoki et al., 1988); (2) *Sabulodes aegrotata* (Guenée) (Geometridae) (Oatman et al., 1983); (3) *Helicoverpa zea* (Boddie) (Noctuidae) (Mansfield and Mills, 2004); (4) *Trichoplusia ni* (Hübner) (Noctuidae) (Manweiler, 1986); (5) *Acrobasis nuxvorella* Neunzig (Pyralidae) (García Nevárez and Tarango Rivero, 2013); (6) *Cryptoblabes gnidiella* Millière (Pyralidae) (Wysocki and Renneh, 1985; Wysoki et al., 1988); (7) *Ephestia kuehniella* (Zeller) (Pyralidae) (Mansfield and Mills, 2004); (8) *Manduca sexta* (L.) (Sphingidae) (Mansfield and Mills, 2004); (9) *Amorbia cuneana* (Walsingham) (Tortricidae) (Oatman et al., 1983); (10) *Choristoneura rosaceana* (Harris) (Tortricidae) (Lawson et al., 1997); (11) *Cydia pomonella* (L.) (Tortricidae) (Nagarkatti et al., 1975); (12) *Cydia caryana* (Fitch) (Tortricidae) (García Nevárez and Tarango Rivero, 2013); (13) *Pandemis limitata* (Robinson (Tortricidae) (Zhang and Cossentine, 1995); and (14) *Plutella xylostella* (L.) (Plutellidae) (Hohmann et al., 1989). Noyes (2017) lists 11 other species as hosts, for which no literature support was found: (1) *Lambdina fiscellaria* (Guenée) (Geometridae), (2) *Atlides halesus* (Cramer) (Lycaenidae), (3) *Orgyia antiqua* (L.) (Erebidae: Lymantriinae), (4) *Orgyia pseudotsugata* (McDunnough) (Erebidae: Lymantriinae), (5) *Agraulis vanillae* (L.) (Nymphalidae), (6) *Amyelois transitella* (Walker) (Pyralidae), (7) *Cadra cautella* (Walker) (Pyralidae), (8) *Plodia interpunctella* (Hübner) (Pyralidae), (9) *Ostrinia nubilalis* (Hübner) (Crambidae), (10) *Adoxophyes orana* (Fischer von Röslerstamm (Tortricidae), and (11) *Pandemis heparana* (Denis & Schiffermüller (Tortricidae).

HOST SPECIFICITY **Order**
Lepidoptera (10 families*): **Pyralidae** (6 species in 6 genera), **Tortricidae** (7 species in 5 genera), **Plutellidae** (1 species), **Erebidae** (2 species in 1 genus), **Lycaenidae** (1 species), **Nymphalidae** (1 species), **Geometridae** (3 species in 3 genera), **Noctuidae** (3 species in 3 genera), **Sphingidae** (1 species), and **Crambidae** (1 species).
*Many of these host records are based on laboratory tests and thus correspond to the physiological host range, which is expected to be wide given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species. The proportion of these species that are also parasitized in the field is unknown.

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Guam (Nafus, 1991).
Establishment: Not established in Guam (Nafus, 1991).
Impact: Not applicable

Trichogrammatoidea bactrae Nagaraja TRICHOGRAMMATIDAE

For species description, see Nagaraja (1978). Noyes (2017) lists one synonym: *Trichogramma bactrae*.

UNITED STATES

YEAR/PLACE RELEASED 1986 USA, California (from Australia) (Naranjo et al., 1995)

TARGET PEST *Pectinophora gossypiella* (Saunders) GELECHIIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include 23 host species: (1) *Helicoverpa armigera* (Hübner) (Noctuidae) Supharngkasen (1979); (2) *Achaea janata* (L.) (Noctuidae) (Rao et al., 1980); (3) *Chilo indicus* (Kapur) (Crambidae) (Nagarkatti, 1980); (4) *Chilo infuscatellus* Snellen (Crambidae) (Nagarkatti, 1980); (5) *Emmalocera depressella* (Swinhoe) (Pyralidae) (Nagarkatti, 1980); (6) *Acrocercops cramerella* (Snellen) (Gracillariidae) (Lim, 1983); (7) *Corcyra cephalonica* (Stainton) (Crambidae) (Lim, 1986); (8) *Plutella xylostella* (L.) (Plutellidae) (Klemm and Schmutterer, 1992); (9) *Arotrophora arcuatalis* (Walker) (Tortricidae) (Röhl and Woods, 1994); (10) *Bactra venosana* (Zeller) (Tortricidae) (Visalakshy and Jayanth, 1995); (11) *Earias insulana* (Boisduval) (Nolidae) (El-Hafez, 1995); (12–13) *Epiphyas postvittana* (Walker) (Tortricidae) and *Ctenopseustis obliquana* (Walker) (Tortricidae) (Stevens, 1995); (14) *Pseudohypatopa pulverea* (Meyrick) (Blastobasidae) (Sushil et al., 1999); (15–18) (as laboratory-rearing hosts): *Pectinophora gossypiella* (Saunders) (Gelechiidae), *Ephestia kuehniella* Zeller (Pyralidae), *Agrotis ipsilon* (Hufnagel) (Noctuidae), *Sitotroga cerealella* (Olivier) (Gelechiidae) (Shalaby et al., 2000); (19) *Opisina arenosella* Walker (Oecophoridae) (Jalali et al., 2002); (20) *Etiella* sp. (Crambidae) (Marwoto and Nasir Saleh, 2003); (21) *Spodoptera littoralis* (Boisduval) (Noctuidae) (Mesbah et al., 2003); (22) *Cnaphalocrocis medinalis* (Guenée) (Crambidae) (Perera et al., 2015); and (23) *Tuta absoluta* (Meyrick) (Gelechiidae) (Goda et al., 2015). Noyes (2017) lists 17 additional species as hosts, for which literature records were not found: (1) *Sepedon sauteri* Hendel (Diptera: Sciomyzidae), (2) *Pectinophora scutigera* (Holdaway) (Gelechiidae), (3) *Pelopidas mathias* (Fabricius) (Hesperiidae), (4) *Chrysodeixis chalcites* (Esper) (Noctuidae), (5) *Earias vittella* (Fabricius) (Noctuidae), (6) *Thysanoplusia orichalcea* (Fabricius) (Noctuidae), (7) *Trichoplusia ni* (Hübner) (Noctuidae), (8) *Pieris rapae* (L.) (Pieridae), (9) *Pieris brassicae* (L.) (Pieridae), (10) *Chilo partellus* (Swinhoe) (Crambidae), (11) *Chilo sacchariphagus* (Bojer) (Crambidae), (12) *Chilo suppressalis* (Walker) (Crambidae), (13) *Parapoynx stagnalis* (Zeller) (Crambidae), (14) *Scirpophaga intacta* (Walker) (Crambidae), (15) *Agrius convolvuli* (L.) Sphingidae, (16) *Eucosma* sp. (Tortricidae), and (17) *Tetramoera schistaceana* (Snellen) (Tortricidae).

HOST SPECIFICITY **Two Orders**
LEPIDOPTERA (13 families*): **Tortricidae**, **Plutellidae**, **Noctuidae**, **Pyralidae**, **Sphingidae**, **Crambidae**, **Gelechiidae**, **Oecophoridae**, **Hesperiidae**, **Gracillariidae**, **Nolidae**, **Blastobasidae**, and **Pieridae**. The host range is dominated by **Crambidae** (10 species), **Noctuidae** (8 species), **Tortricidae** (6 species), and **Gelechiidae** (4 species).
DIPTERA (1 species of **Sciomyzidae**)
*Many of these host records are based on laboratory tests and thus correspond to the physiological host range, which is expected to be wide given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species. The proportion of these species that are also parasitized in the field is unknown.

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in California, USA for augmentative biocontrol (Naranjo et al., 1995).
Establishment: Not established in California (Naranjo et al., 1992; S. Naranjo, pers. comm.).
Impact: Not applicable

Trichomma cnaphalocrocis Uchida ICHNEUMONIDAE

No synonyms given in Yu (2017).

GUAM

YEAR/PLACE RELEASED 1986 USA, Guam (from Taiwan) (D. Nafus, unpub. data)

TARGET PEST *Ostrinia furnacalis* (Guenée) CRAMBIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature hosts include (1) *Ostrinia nubilalis* (Hübner) (Crambidae) (Clark, 1934) and (2) *Cnaphalocrocis medinalis* (Guenée) (Crambidae) (Barrion et al., 1979).

HOST SPECIFICITY **Family**
Crambidae (3 species in 2 genera)

Trichomma cnaphalocrocis (continued)

GUAM (continued)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Guam (D. Nafus, unpub. data).
Establishment: Establishment in Guam unknown.
Impact: No information available.

Trissolcus basalis (Wollaston) Scelionidae

Synonyms are *Microphanurus basalis*, *Asolcus basalis*, *Telenomus megacephalus*, and *Microphanurus megacephalus*.

UNITED STATES

YEAR/PLACE RELEASED 1987–1989 USA, California (from France, Italy, and Spain) (Hoffmann et al., 1991). This parasitoid is native to the eastern United States (Miller, 1928) but was introduced to California from Europe (Hoffmann et al., 1991).

TARGET PEST *Nezara viridula* L. Pentatomidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Hosts records in the literature include at least 26 species, all pentatomids: (1) *Euschistus conspersus* Uhler (Weber et al., 1996); (2–5) *Thyanta pallidovirens* (Stål), *Chlorochroa uhleri* (Stål), *Chlorochroa ligata* (Say), and *Murgantia histrionica* (Hahn) (Hoffmann et al., 1991); (6–7) *Euschistus servus* Say and *Euthyrkynchus floridanus* L. (Miller, 1928); (8) *Eurygaster integriceps* Puton (Shapiro et al., 1975); (9) *Aelia rostrata* Boheman (Gallego et al., 1979); (10–11) *Acrosternum* sp. and *Thyanta perditor* (F.) (Corrêa-Ferreira, 1986); (12) *Axiagastus cambelli* Distant (Johns, 1941); (13–17) *Acrosternum marginatum* (Palisot), *Alcaeorrhynchus grandis* (Dallas), *Murgantia histrionica* (Hahn), *Piezodorus guildinii* (Westwood), and *Podisus maculiventris* (Say) (Buschman and Whitcomb, 1980); (18–19) *Dichelops melacanthus* (Dallas), *Euschistus heros* (F.), (Panizzi and Slansky, 1985); (20–21) *Oechalia schellembergii* (Guérin-Meneville) and *Cermatulus nasalis* (Westwood) (Awan, 1989); (22) *Agonoscelis rutile* Fabricius (Clarke and Walter, 1994); (23) *Plautia affinis* Dallas (Coombs and Khan, 1998); (24) *Atelocera raptoria* Germar (Haddad and Louw, 2006); (25) *Graphosoma lineatum* (L.) (Forouzan et al., 2013); and (26) *Oebalus insularis* Stål (Zachrisson et al., 2014).

HOST SPECIFICITY **Family**
Pentatomidae (27 species in 21 genera)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in California, USA (Hoffmann et al., 1991).
Establishment: Established in California (Ehler, 2002).
Impact: Hoffmann et al., (1991) deployed sentinel egg masses of *N. viridula* to measure field parasitism rates and found, for different months, years, and locations, a range of parasitism from 1–83% for all eggs deployed. Ehler (2002) reports that *T. basalis* was the most common parasitoid of *N. viridula* egg masses deployed as sentinel hosts in northern California.

Uga menoni Kerrich Chalcididae

Noyes (2017) lists one synonym: *Neotainania brevicorpus* Husain and Agarwal.

UNITED STATES

YEAR/PLACE RELEASED 1987–1990 USA: Maryland (1987), Florida (1990) (from Korea) (Lee et al., 1988)

TARGET PEST *Epilachna varivestis* Mulsant Coccinellidae

HOST RANGE EVIDENCE **HRT-**
No laboratory host-range testing done before release. Literature host records include (1) *Henosepilachna vigintioctomaculata* (F.) (Azam et al., 1974) and (2) *Epilachna ocellata* Redtenbacher (Dhingra et al., 1986) (both Coccinellidae). Noyes (2017) lists no other species as hosts.

HOST SPECIFICITY **Family**
Coccinellidae (3 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Maryland, USA (see p. 206 of Barbosa et al., 1994) and Florida, USA (see p. 19 of Frank and McCoy, 1993).
Establishment: Not established in Maryland (see p. 206 of Barbosa et al., 1994) or Florida (see p. 19 of Frank and McCoy, 1993).
Impact: Not applicable

TABLE 2. PREDACIOUS INSECTS INTRODUCED INTO CANADA, MEXICO, THE USA, OR THE USA OVERSEAS TERRITORIES BETWEEN 1985 AND 2018.

Note: Prey range may be erroneously expanded by misidentifications of either the prey or predator by original authors.

Chilocorus circumdatus (Schoenherr) COCCINELLIDAE

No synonyms noted.

UNITED STATES

YEAR/PLACE RELEASED 1996 USA, Florida (from SE Asia via Australia where it invaded naturally) (see Table 1, p. 154 of Frank and McCoy, 2007)

TARGET PEST *Unaspis citri* (Comstock) DIASPIDIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature prey records include the following scales, all in the Diaspididae, unless noted otherwise (1) *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Rutherford, 1914a); (2) *Rutherfordia major* (Cockerell) (Rutherford, 1914b); (3) *Pinnaspis strachani* (Cooley) (Dupont, 1931); (4) *Coccus viridis* (Green) (Coccidae) (Illingworth, 1929); (5) *Chrysomphalus aonidum* (L.) (Das, 1979); (6) *Aspidiotus nerii* Bouché (Houston, 1991); (7) *Unaspis citri* (Comstock) (Smith et al., 1995); (8) *Aulacaspis rosarum* Borchsenius (Chen, 1998); and (9) *Aonidiella orientalis* (Newstead) (Elder and Bell, 1998).

HOST SPECIFICITY **Two Families**
Diaspididae (8 species in 8 genera) and **Coccidae** (1 species)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Florida, USA (see Table 1, p. 154 of Frank and McCoy, 2007).
Establishment: Established in Florida (H. Browning, pers. comm., in Table 1, p. 154 of Frank and McCoy, [2007]).
Impact: Not evaluated.

Chilocorus kuwanae (Silvestri) COCCINELLIDAE

No synonyms noted.

UNITED STATES

YEAR/PLACE RELEASED 1984–1995 USA: 1984 Maryland and Delaware (from Korea) (Drea and Carlson, 1987); 1990–1995, Massachusetts (from China) (Van Driesche et al., 1998a)

TARGET PEST *Unaspis euonymi* (Comstock) DIASPIDIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Field prey include various diaspidid scales: (1) *Unaspis yanonenis* (Kuwana) (Nohara, 1962); (2) *Quadraspidiotus perniciosus* (Comstock) (Chumakova, 1967); and (3) *Quadraspidiotus macroporanus* Takagi (Tachikawa, 1974). Xia et al. (1986) record 28 species in 5 families, including the mealybug *Pseudococcus citriculus* Green (Itioka and Inoue, 1996), the coccid *Protopulvinaria mangiferae* (Green) (Kim and Morimoto, 1998), and the eriococcid *Eriococcus lagerstroemiae* Kuwanae (Luo et al., 2000). See Bull et al. (1993) for other prey.

HOST SPECIFICITY **Order**
HEMIPTERA (5 or more families in the Coccoidea, especially the **Diaspididae**)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in the USA in Maryland and Delaware (Drea and Carlson, 1987) and in Massachusetts (Van Driesche et al., 1998a).
Establishment: Established widely in the northeastern USA (Drea and Carlson, 1987; Van Driesche et al., 1998b).
Impact: Scale infestation levels were significantly reduced (Van Driesche et al., 1998b; Van Driesche and Nunn, 2003).

Chrysoperla carnea (Stephens) Chrysopidae

This name is loosely applied to a species complex of European green lacewings, recognition of whose member species requires both morphological and genetic information and studies of courtship songs (Henry et al., 2002; Lourenço et al., 2006; Bozsik et al., 2014). Since separation of these species have only recently been achieved, names in the non-taxonomic literature are difficult to relate to entities below the complex level.

GUAM

YEAR/PLACE RELEASED 2011 USA, Guam (from unknown source) (G. Reddy, pers. comm.). *Chrysoperla carnea* sl populations from Europe have been mass-reared commercially for augmentative biocontrol of aphids and other Hemiptera in greenhouses, and the origin of *C. carnea* as released in Guam could not be determined for this catalog.

TARGET PEST various aphids and other Hemiptera

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. The species is highly polyphagous on Hemiptera and eggs of insects of various other orders (Bozsik et al., 2014).

HOST SPECIFICITY **Multiple Orders**

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Guam (G. Reddy, pers. comm.).
Establishment: Whether the species established in Guam was not determined.
Impact: Unknown

Clitostethus arcuatus (Rossi) Coccinellidae

One synonym: *Nephus arcuatus*.

UNITED STATES

YEAR/PLACE RELEASED 1989–1990 USA, California (from Israel) (Bellows et al., 1992a)

TARGET PEST *Siphoninus phillyreae* (Haliday) Aleyrodidae

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature prey records (all Aleyrodidae unless indicated otherwise) include (1) *Siphoninus phillyreae* (Haliday) (Golfari, 1937); (2) *Dialeurodes citri* (Ashmead) (Priore, 1969); (3) *Trialeurodes ricini* (Misra) (as *T. desmodii*) (Anon. 1977); (4) *Trialeurodes vaporariorum* (Westwood) (Agekyan, 1977); (5) *Aleurothrixus floccosus* Maskell (Katsoyannos et al., 1997); (6) *Stenaleyrodes vinsoni* Takahashi (Russell and Etienne, 1985); (7) *Aleurodes proletella* L. (Bathon and Pietrzik, 1986); (8) *Bemisia tabaci* (Gennadius) (Hassan, 2001); and (9) *Aleyrodes singularis* Danzig (Yazdani and Zarabi, 2009).

HOST SPECIFICITY **Family**
Aleyrodidae (9 species in 7 genera)

PROJECT OUTCOMES **R+/E+/I-**
Release: Introduced into California, USA (Bellows et al., 1990).
Establishment: Established in some areas of California but not others (Bellows et al., 1992b).
Impact: The pest was controlled by another introduced agent, *Encarsia inaron*, and any potential value *C. arcuatus* might have had became irrelevant.

Cryptolaemus montrouzieri (Mulsant) Coccinellidae

U.S. VIRGIN ISLANDS

YEAR/PLACE RELEASED 1997 USA, U.S. Virgin Islands (from India) (Gautam, 2003; Kairo et al., 2000)

TARGET PEST *Maconellicoccus hirsutus* (Green) Pseudococcidae

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature records exist of prey in over 8 families of Hemiptera (Kairo et al., 2013).

HOST SPECIFICITY **Order**
Hemiptera (8 or more families)

PROJECT OUTCOMES **R+/E+/I+?**
Release: Released in the U.S. Virgin Islands and throughout the Caribbean (Kairo et al., 2000).
Establishment: Established throughout the Caribbean (Kairo et al., 2000, 2013).
Impact: Control of target mealybug resulted throughout the Caribbean and was attributed to combination of *Anagyrus kamali* Moursi and *C. montrouzieri* (Kairo et al., 2000).

Cryptolaemus montrouzieri (continued)

MEXICO

YEAR/PLACE RELEASED 2004 Mexico, Nayarit and Jalisco (from India via the USA and Canada) (Gautam, 2003; Santiago-Islas, 2008)

TARGET PEST *Maconellicoccus hirsutus* (Green) PSEUDOCOCCIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature records exist of prey in over 8 families of Hemiptera (Kairo et al., 2013).

HOST SPECIFICITY **Order**
HEMIPTERA (8 or more families)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Nayarit and Jalisco, Mexico (Santiago-Islas, 2008).
Establishment: Established in Mexico (Santiago-Islas, 2008).
Impact: Control achieved due to several natural enemies, with significant contribution by *C. montrouzieri*, mainly against high density patches (Santiago-Islas, 2008).

Curinus coeruleus Mulsant COCCINELLIDAE

GUAM AND THE NORTHERN MARIANA ISLANDS

YEAR/PLACE RELEASED 1986 USA, Guam and the Northern Mariana Islands (from Hawaii USA) (see p. 82 of Nafus and Schreiner, 1989)

TARGET PEST *Heteropsylla cubana* Crawford PSYLLIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Known prey include species in at least 5 families (including the target pest): (1) aphids (Aphididae), e.g., *Rhopalosiphum maidis* (Fitch) (Nawanich et al., 2013); (2) whiteflies (Aleyrodidae), e.g., *Aleurodicus dispersus* Russell (Villacarlos and Robin, 1992); (3) mealybugs (Pseudococcidae) (see p. 82 of Nafus and Schreiner, 1989), e.g. *Nipaecoccus nipae* (Maskell) (Osborn, 1938); and (4) psyllids (Liviidae), e.g., *Diaphorina citri* Kuwayama (Michaud, 2002b).

HOST SPECIFICITY **Order**
HEMIPTERA (at least 5 families)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Guam and the Northern Mariana Islands (see p. 82 of Nafus and Schreiner, 1989).
Establishment: Established on Guam and Saipan (Northern Mariana Islands) (see p. 82 of Nafus and Schreiner, 1989).
Impact: Not determined (see p. 82 of Nafus and Schreiner, 1989).

Cybocephalus nr *nipponicus* Enrody-Younga NITIDULIDAE

Species is likely *C. nipponicus* (Smith, 2006).

UNITED STATES

YEAR/PLACE RELEASED 1984–1995 USA: 1984 Maryland and Delaware (from Korea) (Drea and Carlson, 1987); 1990–1995 Massachusetts (from China) (Van Driesche et al., 1998a)

TARGET PEST *Unaspis euonymi* (Comstock) DIASPIDIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Known field prey include various diaspidids, e.g., *Quadraspidiotus macroporanus* Takagi (Tachikawa, 1974) and *Unaspis yanonensis* Kuwana (Huang et al., 1981). Oviposition and development occur only in diaspidids, occurring in 6 of 9 species tested (Song et al., 2012). Adults can feed on mite eggs, e.g., *Panonychus citri* (McGregor) (Tanaka and Inoue, 1980) and other prey, in several families.

HOST SPECIFICITY **Family**
Diaspididae (various species in several genera support larval development; adults feed on a wider range of prey, including mite eggs)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Maryland and Delaware, USA (Drea and Carlson, 1987) and later in Massachusetts, USA (Van Driesche et al., 1998a).
Establishment: Established in Massachusetts (Van Driesche et al., 1998a). Establishment in Maryland and Delaware unknown.
Impact: Not separately evaluated from positive impact of *Chilocorus kuwanae* (Silvestri) (Van Driesche et al., 1998b; Van Driesche and Nunn, 2003).

Delphastus catalinae (Horn) Coccinellidae

One synonym: *Delphastus pusillus* (LeConte).

GUAM

YEAR/PLACE RELEASED
2011 USA, Guam (source not stated; likely, the USA mainland) (G. Reddy, pers. comm.)
Native to California, USA (Anon., 1915a); moved from California to Florida, USA (Watson, 1919)

TARGET PEST
Bemisia tabaci (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE
HRT-
No prey-range testing was done before release. Literature prey records include eggs of various whiteflies or spider mites, including the following: **Aleyrodidae:** (1) *Dialeurodes citri* (Ashmead) (Watson, 1923); (2) *Aleurocanthus woglumi* Ashby (Smith, 1945); (3) *Trialeurodes abutilonea* (Haldane) (Watve and Clower, 1976); (4–5) *Aleurothrixus floccosus* Maskell and *Paraleyrodes citri* (Bondar) (Meyerdirk et al., 1980); (6) *Dialeurodes citrifolii* (Morgan) (Nguyen and Hamon, 1985); (7–8) *Aleurotrachelus socialis* Bondar and *Trialeurodes variabilis* (Quaintance) (Gold et al., 1989); (9) *Bemisia tabaci* (Gennadius) (Nelson and Parrella, 1992); and (10) *Trialeurodes vaporariorum* (García González et al., 2005). **Tetranychidae (Acari):** (1) *Tetranychus fijiensis* Hirst (Jing et al., 2003).

HOST SPECIFICITY
Phylum
Insects: Aleyrodidae (10 species in 7 genera)
Mites: Tetranychidae (1 species)

PROJECT OUTCOMES
R+/E?/I?
Release: Released in Guam (G. Reddy, pers. comm.).
Establishment: No information reported.
Impact: No information reported.

Eriopis connexa (Germar) Coccinellidae

No synonyms noted.

UNITED STATES

YEAR/PLACE RELEASED
1988 USA, New Jersey (source not recorded; it appears to be native to Chile and Agentina) (M. Mayer, pers. comm., New Jersey Dept. of Agriculture)

TARGET PEST
Acyrthosiphon pisum Harris Aphididae

HOST RANGE EVIDENCE
HRT-
No laboratory prey-range testing done before release. Literature prey records include mostly aphids, but also whiteflies, psyllids, lepidopteran eggs, mite eggs, and stink bug eggs. **Aphididae:** (1) *Schizaphis graminum* (Rondani) (Aphididae) (Lopez Cristobal, 1937); (2) *Acyrthosiphon pisum* Harris (Anon., 1972); (3) *Metopolophium dirhodum* (Walker) (Carrillo and Mellado, 1975); (4) *Myzocallis coryli* (Goeze)(Aguilera and Pacheco, 1995); (5) *Cinara atlantica* (Wilson) (Oliveira et al., 2004); (6) *Myzus nicotianae* Blackman (Fuentes-Contreras et al., 2004); (7–9) *Myzus persicae* (Sulzer), *Toxoptera aurantii* (Boyer de Fonscolombe), and *Rhopalosiphum maidis* (Fitch) (Duarte Gómez and Zenner de Polanía, 2006); (10) *Lipaphis pseudobrassicae* (Davis) (Resende et al., 2006); (11) *Diuraphis noxia* (Kurdjumov) (Reviriego et al., 2006); (12) *Macrosiphum euphorbiae* (Thomas) (Sarmento et al., 2007). **Aleyrodidae:** (1) *Bemisia tabaci* (Gennadius (Link and Costa, 1980). **Psyllidae:** (1) *Ctenarytaina eucalypti* (Maskell) (Sáiz et al., 2003). **Lepidopteran eggs:** (1) *Colias lesbia* (F.) (Pieridae) (Botto and de Crouzel, 1981); (2) *Rachiplusia nu* (Guenée) (Noctuidae) (Araya et al., 1997); (3) *Spodoptera frugiperda* (J. E. Smith) (Noctuidae) (Tavares et al., 2010). **Mites in several families:** (1) *Eriophyes vitis* (Pagenstecher) (Eriophyidae) (Gartel, 1972); (2) *Tetranychus evansi* Baker and Pritchard (Tetranychidae) (Sarmento et al., 2007). **Pentatomidae eggs:** (1) *Piezodorus guildinii* (Westwood) (Ribeiro and Castiglioni, 2008).

HOST SPECIFICITY
Phylum
Insects: Aphididae (15 species in 14 genera), **Aleyrodidae** (1 species), **Psyllidae** (1 species), **Lepidopteran eggs** (3 species in 3 genera in 2 families), **Pentatomidae eggs** (1 species)
Mites: Mite eggs (2 species in 2 families)

PROJECT OUTCOMES
R+/E?/I?
Release: Released in New Jersey, USA (M. Mayer, pers. comm., New Jersey Dept. of Agriculture).
Establishment: No information reported.
Impact: No information reported.

Harmonia axyridis (Pallas) COCCINELLIDAE

Synonyms include *Ptychanatis axyridis*, *Leis axyridis*, and *Coccinella axyridis*.

MEXICO

YEAR/PLACE RELEASED

1999 Mexico, Quintana Roo (native to China, but proximal source of this introduction not stated, likely the USA)(Munguía, 2002; López-Arroyo et al., 2008).
Note: *H. axyridis* was present in northern Mexico (apparently due to natural dispersal from the USA [H. C. Arredondo-Bernal, pers. comm.]) for several years before release in southern Mexico.

TARGET PEST

Toxoptera citricida Kirkaldy APHIDIDAE

HOST RANGE EVIDENCE

HRT-
No laboratory prey-range testing done before release. Literature prey records include the following: **Aphididae:** (1) *Toxoptera piricola* Matsumura (Aphididae) (Hukusima and Kondô, 1962); (2) *Aphis pomi* de Geer (Savoiskaya, 1970); (3–6) *Rhopalosiphum padi* (L.), *Macrosiphum ibarae* Matsumura, *Hyalopterus pruni* (Geoffroy), *Brevicoryne brassicae* (L.) (Okamoto and Sato, 1973); (7) *Lachnus tropicalis* (van der Goot) (Togoshi, 1976); (8–10) *Schizaphis graminum* (Rondani), *Acyrthosiphon pisum* (Harris), and *Myzus persicae* (Sulzer) (Fye, 1981); (11) *Aphis gossypii* Glover (Choi and Kim, 1985); (12) *Chromaphis juglandicola* Kaltenbach (Li, 1992); (13) *Phorodon humuli* (Schrank) (Trouvé, 1995); (14) *Macrosiphum rosae* (L.) (Ferran et al., 1996); (15) *Aphis spiraecola* Patch (Lucas et al., 1997); (16) *Macrosiphum euphorbiae* Thomas (Lieten, 1998); (17) *Toxoptera citricida* Kirkaldy (Michaud, 1999); (18) *Aphis craccivora* Koch (El-Arnaouty et al., 2000); (19) *Prociphilus tessellatus* (Fitch) (Butin et al., 2004); (20) in the laboratory: *Myzus lythri* (Schrank) (Matos and Obrycki, 2006); (21) *Aphis glycines* Matsumura (Mignault et al., 2006); (22) *Mindarus abietinus* Koch (Berthiaume et al., 2007); (23) *Dysaphis plantaginea* (Passerini) (Brown and Mathews, 2007); (24) *Eriosoma lanigerum* (Hausmann) (Li et al., 2008); (25–27) *Chaitophorus populeti* (Panzer), *Hyalopterus amygdali* (Blanchard), *Lipaphis erysimi* (Kaltenbach) (Zhang et al., 2008); (28) *Microlophium carnosum* Buckton (Alhmedi et al., 2008); (29–30) *Macrosiphum albifrons* (Essig), *Macrosiphum pseudorosae* Patch (Finlayson et al., 2010); and (31) *Cinara cupressobium tujafilina* (Del Guercio) (Glavendekic´ et al., 2013). **Pseudococcidae:** (1) *Phenacoccus azaleae* Kuwana (Xie et al., 2004). **Aleyrodidae:** (1) *Bemisia tabaci* (Gennadius) (Lin et al., 2006); (2) *Pealius akebiae* (Kuwana) (Dang et al., 2010); (3) *Aleurocanthus spiniferus* (Quaintance) (Guo et al., 2013). **Coccoidea:** (1) *Matsucoccus massonianae* Young & Hu (Monophlebidae) (Wang, 1982); (2) *Pseudaulacaspis pentagona* (Targioni Tozzetti) (Diaspididae) (Park and Kim, 1990); (3) *Matsucoccus thunbergianae* Miller and Park (Monophlebidae) (Choi et al., 1995a); (4) *Comstockaspis macroporanus* (Takagi) (Diaspididae) (Choi et al., 1995b); (5) *Quadraspidiotus perniciosus* (Comstock) (Diaspididae) (Shi et al., 1997); (6) *Physokermes shanxiensis* Tang (Coccidae) (Wu and Yu, 2000); (7) *Ericerus pela* (Chavannes) (Coccidae) (Zhao et al., 2003); (8) *Aonidiella citrina* (Coquillett) (Diaspididae) (Chen et al., 2009). **Psyllidae:** (1) *Cacopsylla pyricola* (Forster) (Psyllidae) (Fye, 1981); (2) *Psylla chinensis* Yang et Li (Psyllidae) (Gai et al., 2001); (3) *Diaphorina citri* Kuwayama (Liviidae) (Michaud, 2002b); (4) *Boreioglycaspis melaleucae* Moore (Psyllidae) (Nimmo and Tipping, 2009); (5) *Acizzia jamatonica* (Psyllidae) (Harizanova et al., 2012); (6) *Paratrioza sinica* Yang & Li (Psyllidae) (Wu et al., 2017). **Coccinellidae** (eggs or larvae): (1–2) *Adalia bipunctata* (L.) and *Adalia decempunctata* (L.) (Thomas et al., 2013). **Other groups:** (1) eggs of *Gastrolina thoracica* Baly (Chrysomelidae) (Vasil'Ev, 1963); (2) *Hyphantria cunea* Drury (Erebidae) (Kim et al., 1968); (3) *Tetranychus urticae* C. L. Koch (Tetranychidae) (Lucas et al., 1997); (4) *Ophraella communa* LeSage (Chrysomelidae) (Moriya et al., 2002); (5) *Panonychus citri* (McGregor) (Tetranychidae) (Villanueva et al., 2004); (6) *Adelges tsugae* Annand (Adelgidae) (Butin et al., 2004); (7) eggs and larvae (in laboratory) of *Galerucella calmariensis* L. (Chrysomelidae) (Matos and Obrycki, 2006); (8) *Contarinia nasturtii* Kieffer (Cecidomyiidae) (Corlay et al., 2007); (9) *Tetranychus kanzawai* Kishida (Tetranychidae) (Omata, 2008); (10) *Oides decempunctata* (Billberg) (Chrysomelidae) (Li et al., 2010); (11) *Demotina fasciculata* (Baly) (Chrysomelidae) (Guo et al., 2013); (12) *Daktulosphaira vitifoliae* Fitch (Phylloxeridae) (Kögel et al., 2013); and (13) *Apolygus lucorum* (Meyer-Dür) (Miridae) (Li et al., 2017).

HOST SPECIFICITY

Multiple Orders
A highly polyphagous species with prey in 1 family of mites and 4 orders of insects, dominated by species of aphids. Literature records cited here (an incomplete list) include 63 prey species, of which 3 were eggs of spider mite species (Tetranychidae) and the rest were insects. Insect prey include 31 aphids (Aphididae), 1 mealybug (Pseudococcidae), 3 whiteflies (Aleyrodidae), 2 monophlebid scales, 4 armored scales (Diaspididae), 2 soft scales (Coccidae), 5 psyllids (Psyllidae), 1 psyllid in Liviidae, 2 ladybird beetles (an undercount) (Coccinellidae), 5 leaf beetles (Chrysomelidae), 1 erebid moth, 1 adelgid, and 1 species each in Cecidomyiidae, Miridae, and Phylloxeridae.

PROJECT OUTCOMES

R+/E?/I?
Release: Released in Quintana Roo, Mexico (Munguía, 2002; López-Arroyo et al., 2008).
Establishment: Not determined, but likely.
Impact: Impacts are not reported from Mexico, but are likely, based on earlier impacts on this pest in Florida, USA, where *H. axyridis* arrived before 1985.

Hippodamia undecimnotata (Schneider) Coccinellidae

Synonyms include *Adalia undecimnotata* (Scheider), *Ceratomegilla undecimnotata* (Schneider), *Coccinella undecimnotata* Schneider, and *Semiadalia undecimnotata* Schneider (see https://www.biolib.cz/en/taxon/id10834/)

UNITED STATES

YEAR/PLACE RELEASED 1989 USA, several western states (from former USSR) (Gordon and Vandenberg, 1991)

TARGET PEST *Diuraphis noxia* (Kurdjumov) Aphididae

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature prey records include (1) *Schizaphis graminum* Rondani (Moroshkina, 1930); (2) *Aphis fabae* Scopoli (Iperti, 1965); (3) *Myzus persicae* (Sulzer) (Ferran and Larroque, 1977); (4) *Acyrthosiphon pisum* (Harris) (Ruzicka et al., 1981); and (5) *Toxoptera aurantii* (Boyer de Fonscolombe) (Sikharulidze, 1986).

HOST SPECIFICITY **Family**
Aphididae (5 species in 5 genera)

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in the western United States (Gordon and Vandenberg, 1991).
Establishment: Not determined.
Impact: Not determined.

Laricobius nigrinus Fender Derodontidae

No synonyms.

UNITED STATES

YEAR/PLACE RELEASED 2003 USA, Virginia and north to Massachusetts (from British Columbia, Canada) (Lamb et al., 2006). Inland population from Montana also released in Massachusetts (R. Van Driesche, pers. observ.)

TARGET PEST *Adelges tsugae* Annand Adelgidae

HOST RANGE EVIDENCE **HRT+**
Laboratory prey-range testing done before release. All 3 non-target adelgids tested (*Adelges piceae* [Ratzeburg], *A. abietis* [L.], *Pineus strobi* [Hartig]) elicited predator oviposition, but none supported full larval/pupal development; conifer-feeding aphids and scales tested did not elicit oviposition in paired choice tests. Eggs of all 3 non-target adelgids tested were consumed by adults of *L. nigrinus* (Zilahi-Balogh et al., 2002).

HOST SPECIFICITY **Species**
In the laboratory, no prey other than the target pest sustained complete larval development. In the laboratory, adults fed on eggs of 3 non-target adelgids.

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Virginia, USA (Lamb et al., 2006) and other eastern stataes.
Establishment: Established in many sites in the Appalachian Mountains, from New Jersey south, in the eastern United States (Mausel et al., 2010). An inland population from Montana, USA (Mausel et al., 2011) was released in Massachusetts, USA, but likely did not establish (R. Van Driesche, pers. observ).
Impact: Clear population-level effects on *A. tsugae* by *L. nigricus* have not been demonstrated (Mausel et al., 2010). Effects in cage enclosure studies show prey suppression (Story et al., 2012). Cage exclosure studies are underway in both eastern and western United States (J. Elkinton, pers. comm.).

Laricobius osakensis Montgomery and Shiyake DERODONTIDAE

No synonyms. For species description, see Montgomery et al. (2011).

UNITED STATES

YEAR/PLACE RELEASED	2012 USA, Virginia and West Virginia (from Japan) (Mooneyham et al., 2016)
TARGET PEST	*Adelges tsugae* Annand ADELGIDAE
HOST RANGE EVIDENCE	**HRT+** Laboratory prey-range testing done before release. No, or minimal, oviposition and no complete development on 6 non-target species tested: *Adelges piceae* (Ratzeburg), *A. abietis* (L.), *Pineus strobi* (Hartig) (all Adelgidae), *Prociphilus tessellates* (Fitch) (Aphididae), *Chionaspis pinifoliae* (Fitch) (Diaspididae), and *Fiorinia externa* Ferris (Diaspididae). Some adult feeding on the 3 adelgids and 1 aphid, but not the 2 scales (Vieira et al., 2011).
HOST SPECIFICITY	**Species** In the laboratory, no prey other than the target pest sustained complete larval development. In the laboratory, adults fed on eggs of 3 non-target adelgids and 1 aphid.
PROJECT OUTCOMES	**R+/E?/I?** **Release:** Released in the eastern USA (Mooneyham et al., 2016). **Establishment:** Not yet determined. **Impact:** Not yet determined, but see Story et al. (2012) for results of field branch-cage evaluation studies.

Leucopis atritaris Tanasijtshuk CHAMAEMYIIDAE

No synonyms noted in literature search.

CANADA

YEAR/PLACE RELEASED	1991 Canada, Saskatchewan (from Kazakhstan) (Olfert et al., 2001)
TARGET PEST	*Diuraphis noxia* (Kurdjumov) APHIDIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory prey-range testing done before release. No literature records of other prey were found.
HOST SPECIFICITY	**Unknown** No other prey records were found, but literature was very limited.
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in Saskatchewan, Canada (Olfert et al., 2001). **Establishment:** Not established in Canada (Olfert et al., 2001). **Impact:** Not applicable

Leucopis ninae Tanasijtshuk CHAMAEMYIIDAE

No synonyms noted.

CANADA

YEAR/PLACE RELEASED	1991 Canada, Saskatchewan (from the former Yugoslavia) (Olfert et al., 2001)
TARGET PEST	*Diuraphis noxia* (Kurdjumov) APHIDIDAE
HOST RANGE EVIDENCE	**HRT-** No laboratory prey-range testing done before release. Literature records of prey include 3 additional aphids (Aphididae): (1) *Aphis nerii* Boyer de Fonscolombe (Abdul-Satar et al., 1988); (2) *Rhopalosiphum padi* (L.) (Dabiré et al., 1997); and (3) *Hyalopterus pruni* (Geoffroy) (Duzgunes et al., 1982).
HOST SPECIFICITY	**Family** **Aphididae** (4 species in 4 genera)
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in Saskatchewan, Canada (Olfert et al., 2001). **Establishment:** Not established in Canada (Olfert et al., 2001). **Impact:** Not applicable

Neoseiulus californicus (McGregor) Phytoseiidae

"*Neoseiulus californicus* has a very complex taxonomic history. It was first described by McGregor in 1954 from lemon in California as *Typhlodromus californicus*. After 1954, it was moved to the genus *Amblyseius* and later to the genus *Neoseiulus* or *Cydnodromus*" (Featured Creatures, 2107b).

GUAM

YEAR/PLACE RELEASED 2010 USA, Guam (from mainland USA) (G. Reddy, pers. comm.; Reddy and Bautista, 2012)

TARGET PEST *Tetranychus marianae* McGregor (Acari: Tetranychidae)

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. *Neoseiulus californicus* is rated as a type II selective predator of spider mites that feeds more on spider mites (Tetranychidae) than on pollen or insects (Croft et al., 1998a). Prey species recorded here are not comprehensive, particularly within the Tetranychidae, in which most prey species are found. All non-tetranychid hosts likely to be field hosts, and which support complete predator development, are included. Literature prey records include the following spider mites (Tetranychidae): (1) *Oligonychus pratensis* (Banks) (Gilstrap et al., 1977); (2) *Tetranychus urticae* Koch (Oatman et al., 1977); (3) *Tetranychus evansi* Baker and Pritchard (de Moraes and McMurtry, 1985); (4) *Oligonychus grypus* Hirst (Ramírez et al., 1988); (5) *Panonychus ulmi* (Koch) (Costa-Comelles et al., 1990); (6) *Mononychellus tanajoa* (Bondar) (Smith et al., 1996); and (7) *Oligonychus perseae* Tuttle, Baker and Abbatiello (Hoddle et al., 1999). Other groups of prey in the literature include thrips and eggs of various mites: (1) *Frankliniella occidentalis* (Pergande) (Thripidae) (Rodríguez-Reina et al., 1992); (2) *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) (Castagnoli and Falchini, 1993); (3) *Phytonemus pallidus* (Banks) (Acari: Tarsonemidae) (Croft et al., 1998b); (4) *Eriophyes dioscoridis* Soliman & Abou-Awad (Eriophyidae) (El-Laithy and El-Sawi, 1998); (5) *Aculops lycopersici* (Tryon) (Eriophyidae) (Castagnoli et al., 2003); (6–7) *Thrips palmi* Karny and *Franliniella intonsa* Trybom (both Thripidae) (Mizobe et al., 2005); (8–9) *Lepidoglyphus destructor* (Schrank) (Glycyphagidae) and *Acarus siro* L. (Acaridae) (Simoni et al., 2006); and (10) *Brevipalpus chilensis* Baker (Tenuipalpidae) (Roberto Trincado, 2007).

HOST SPECIFICITY **Phylum**
Mites: Mites are the dominant prey, with 16 species in 6 families (**Tetranychidae**, **Tarsonemidae**, **Eriophyidae**, **Glycyphagidae**, **Acaridae**, and **Tenuipalpidae**)
Insects: Insect prey are limited to thrips (**Thripidae**), including 3 species in 3 genera.

PROJECT OUTCOMES **R+/E?/I?**
Release: Released in Guam (Reddy and Bautista, 2012; G. Reddy, pers. comm.).
Establishment: Not reported if this mite established or not, given that its use was for augmentative biocontrol.
Impact: As an augmentative agent, *N. californicus* contributed to control of spider mites in Guam on eggplant crops (Reddy and Bautista, 2012), but no reports were found of continued impacts by self-sustaining populations of this mite.

Oenopia conglobata (L.) Coccinellidae

One synonym: *Synharmonia conglobata*.

UNITED STATES

YEAR/PLACE RELEASED 1990 USA, western states (The Uzbek Republic within the former USSR) (Gordon and Vandenberg, 1991). Note: this coccinellid was released earlier, in Washington state in 1977–1981, but failed to establish (Fye, 1981).

TARGET PEST *Diuraphis noxia* (Kurdjumov) Aphididae

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Field prey records include (1) *Matsucoccus josephi* Bodenheimer et Harpaz (Monophlebidae) (Bodenheimer and Neumark, 1955); (2) *Altica quercetorum* Foudras (Chrysomelidae) (Plugaru, 1971); (3) *Aphis craccivora* Koch (Aphididae) (Kesten, 1975); (4–5) *Brachycaudus amygdalinus* (Schouteden) and *Brachycaudus helichrysi* (Kaltenbach) (Aphididae) (Talhouk, 1977); (6) *Cacopsylla pyricola* (Förster) (Psyllidae) (Fye, 1981); (7) eggs of *Altica* spp. of flea beetles (Chrysomelidae) (Chen, 1982); (8) *Euphyllura straminea* Loginova (Aphalaridae) (Baki and Ahemed, 1985); (9) *Hyadaphis tataricae* (Aizenberg) (Aphididae) (Toros, 1986); (10) *Eulecanium ciliatum* (Douglas) (Coccidae) (Ülgentürk and Toros, 1999); (11) *Agonoscena pistaciae* Burckhardt and Lauterer (Psyllidae) (Mehrnejad, 2002); (12) *Ceroplastes rusci* (L.) (Coccidae) (Özsemerci and Aksit, 2003); (13) *Chaitophorus leucomelas* (Koch) (Aphididae) (Sadeghi et al., 2004); (14) *Hyalopterus pruni* (Geoffroy) (Aphididae) (Yasar and Özger, 2005); (15) *Acizzia jamatonica* (Kuwayama) (Psyllidae) (Antonucci, 2005); (16) *Dysaphis devecta* Walker (Aphididae) (Bayram, 2009); (17) *Bemisia tabaci* (Gennadius) (Aleyrodidae) (Wu et al., 2011); (18) *Pseudococcus cryptus* Hempel (Pseudococcidae) (Yigit and Telli, 2013); (19) *Phyllocnistis citrella* Stainton (Gracillariidae) (Elekcioglu, 2013); (20) *Aphis punicae* (Passerini) (Aphididae) (Rounagh and Samih, 2014); and (21) *Caloptilia roscipennella* (Hübner) (Gracillariidae) (Öztürk et al., 2015).

Oenopia conglobata (continued)

UNITED STATES (continued)

HOST SPECIFICITY **Three Orders**
HEMIPTERA: Aphididae (8 species in 5 genera), **Monophlebidae** (1 species), **Coccidae** (2 species in 2 genera), **Psyllidae** (3 species in 3 genera), **Aphalaridae** (1 species), **Aleyrodidae** (1 species), and **Pseudococcidae** (1 species)
COLEOPTERA: Chrysomelidae (1 species)
LEPIDOPTERA: Gracillariidae (2 species in 2 genera)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in the western United States (Gordon and Vandenberg, 1991).
Establishment: Not established in the USA (Gordon and Vandenberg, 1991).
Impact: Not applicable

Rhizophagus grandis Gyllenhal RHIZOPHAGIDAE

UNITED STATES

YEAR/PLACE RELEASED 1988 USA, Louisiana (from Europe) (Coulson et al., 2000)

TARGET PEST *Dendroctonus terebrans* (Olivier) CURCULIONIDAE: SCOLYTINAE

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature prey records include 2 bark beetles (Curculionidae): (1) *Dendroctonus micans* (Kugelann) (Palm, 1948; Gregoire, 1976) and (2) *Dendroctonus valens* LeConte (Wei et al., 2010).

HOST SPECIFICITY **Genus**
Curculionidae (Scolytinae) (3 known hosts in 1 genus, *Dendroctonus*)

PROJECT OUTCOMES **R+/E+/I?**
Release: Released in Louisiana, USA (Coulson et al., 2000).
Establishment: Established in the USA (Coulson et al., 2000).
Impact: Undetermined (Coulson et al., 2000).

Rhyzobius lophanthae Blaisdell COCCINELLIDAE

One synonym: *Lindorus lophanthae.*

GUAM

YEAR/PLACE RELEASED 2005 USA, Guam (from Australia via Hawaii USA) (T. Marler, pers. comm.)

TARGET PEST *Aulacaspis yasumatsui* Takagi DIASPIDIDAE

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature prey records include 3 families: **Diaspididae:** (1) *Chrysomphalus dictyospermi* (Morgan) (Martelli, 1915); (2) *Aonidiella aurantia* Maskell (Flanders, 1930); (3) *Hemiberlesia lataniae* (Signoret) (McKenzie, 1935); (4) *Aulacaspis tegalensis* Zehntner (D'Emmerez de Charmoy, 1937); (5) *Chrysomphalus aonidum* (L.) (LaPorte, 1949); (6) *Carulaspis minima* (Signoret) (Bedford, 1949) (misidentified in Bedford as *Carulaspis visci* [Schrank] [Simmonds, 1958]); (7) *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Ferro, 1963); (8) *Aspidiotus destructor* Signoret (Douglas, 1965); (9) *Pseudaulacaspis cockerelli* (Cooley) (Tippins, 1968); (10) *Parlatoria pergandii* (Comstock) (Abbassi, 1975); (11) *Hemiberlesia cyanophylli* (Signoret) (Gaprindashvili, 1975); (12) *Aspidiotus nerii* (Bouché) (Matta, 1979); (13) *Melanaspis glomerata* (Green) (Mishra et al., 1981); (14) *Diaspis bromeliae* (Kerner) (Murray, 1982); (15) *Aulacaspis tubercularis* (Newstead) (Viljoen, 1986); (16) *Carulaspis juniperi* (Bouché) (McNamara, 1991); (17) *Aulacaspis yasumatsui* Takagi (Flores, and Carlson, 2009); (18) *Lepidosaphes beckii* (Newman) (Stathas et al., 2015); and (19) *Diaspis boisduvalii* (Signoret) (Kruidhof et al., 2017). **Coccidae:** (1) *Parasaissetia nigra* (Nietner) (Smith, 1943) and (2) *Ceroplastes japonicus* (Green) (Longo, 1985). **Phoenicococcidae:** (1) *Phoenicococcus marlatti* (Cockerell) (Muñoz Irles et al., 2008).

HOST SPECIFICITY **Three Families**
Diaspididae (19 species in 11 genera), **Coccidae** (2 species in 2 genera), and **Phoenicococcidae** (1 species)

PROJECT OUTCOMES **R+/E+/I+**
Release: Released in Guam (T. Marler, pers. comm.).
Establishment: Established in Guam (T. Marler, pers. comm.).
Impact: The predator suppressed scales on mature cycads (T. Marler, pers. comm.).

Rodolia blackburni Ukrainsky Coccinellidae

One synonym: *Rodolia limbata*; sometimes with the alternative generic placement of *Novius*. See Ukrainsky (2009) for nomenclatural changes.

PALAU

YEAR/PLACE RELEASED 1997 Island nation of Palau* (from Northern Territories, Australia) (ACIAR, 1995; D. Sands, pers. comm., CSIRO [retired])
*Palau became independent of the USA in 1994. The project against the breadfruit 'mealybug' (*Icerya aegyptiaca*) overlapped this date and so is included here.

TARGET PEST *Icerya aegyptiaca* (Douglas) Monophlebidae

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Literature prey-records include several monophlebid scales: (1) *Drosicha contrahens* Walker (Chu, 1933); (2) *Drosicha corpulenta* (Kuwana) (Lü et al., 2002); (3) *Icerya* sp. (Lethane, 1998); and (4) *Icerya purchasi* Maskell (Chen, 1936).

HOST SPECIFICITY **Family**
Monophlebidae (4 species in 2 genera)

PROJECT OUTCOMES **R+/E+I+**
Release: Released in Palau (ACIAR, 1995).
Establishment: Established in Palau (ACIAR, 1995).
Impact: Substantial impact occurred on the target pest (ACIAR, 1995).

Sasajiscymnus tsugae (Sasaji and McClure) Coccinellidae

One synonym: *Pseudoscymnus tsugae*. For species description, see Sasaji and McClure (1997).

UNITED STATES

YEAR/PLACE RELEASED 1994 USA, Connecticut (from Japan) (McClure and Cheah, 1998)

TARGET PEST *Adelges tsugae* Annand Adelgidae

HOST RANGE EVIDENCE **HRT-**
No laboratory prey-range testing done before release. Post-release prey-range studies showed that eggs of 3 non-target adelgids (*Adelges laricis* Vallot, *A. cooleyi* [Gillette], *Pineus strobi* [Hartig]) and 1 non-target aphid (*Prociphilus tessellates* [Fitch]) were fed on by adult beetles but at lower rates than on the target pest. Larvae of *S. tsugae* could not develop when fed only *P. tessellates* (Butin et al., 2004). Literature prey records include several species of adelgids, including (1) *Adelges tsugae* Annand (Cheah and McClure, 1998) and (2) *Adelges piceae* Ratzeburg (Jetton et al., 2011).

HOST SPECIFICITY **Two Families**
Adelgidae (4 species in 2 genera supported larval development and adult feeding) and **Aphididae** (1 species supported adult feeding, but not larval development)

PROJECT OUTCOMES **R+/E+/I-**
Release: Released in Connecticut, USA (McClure and Cheah, 1998).
Establishment: Established in Connecticut (Cheah and McClure, 2000) and the southern Appalachian Mountains (Hakeem et al., 2010).
Impact: No evidence of any population level impact on the target pest has been recorded.

Scymnus coniferarum (Crotch) Coccinellidae

UNITED STATES

YEAR/PLACE RELEASED 2013 USA, North Carolina (from Washington state USA) (Montgomery and McDonald, 2010; M. Montgomery, pers. comm.)

TARGET PEST *Adelges tsugae* Annand Adelgidae

HOST RANGE EVIDENCE **HRI+**
Laboratory prey-range testing done before release (Montgomery and McDonald, 2010). *Scymnus coniferarum* did not feed on any prey offered in the laboratory other than adelgids. Adelgids that were suitable as prey were *Adelges piceae* (Ratzeburg), *Pineus strobi* (Hartig), and *Pineus pini* (Macquart) (Montgomery and McDonald, 2010). Non-target prey that were not attacked were woolly alder aphid (*Paraprociphilus tessellates*) (Aphididae), linden aphid (*Eucallipterus tiliae*) (Aphididae), Taxus mealybug (*Dysmicoccus wistariae*) (Pseudococcidae), and elongate hemlock scale (*Fiorina externa*) (Diaspididae) (Montgomery and McDonald, 2010). Literature prey records include (1) *Pseudococcus pini* (Kuwana) (Pseudococcidae) (Anon., 1915b) and (2) *Adelges tsugae* (Adelgidae) (Darr et al., 2016).

Scymnus coniferarum (continued)

UNITED STATES (continued)

HOST SPECIFICITY **Family**
Adelgidae (4 species in 2 genera). One very old record of feeding on a mealybug exists (Anon., 1915b) but needs to be confirmed before being accepted.

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in the eastern United States (M. Montgomery, pers. comm.).
Establishment: No evidence of establishment in the eastern USA (N. Havill, pers. comm.).
Impact: Not applicable

Scymnus frontalis (F.) COCCINELLIDAE

UNITED STATES

YEAR/PLACE RELEASED 1988 USA, New Jersey and western states (origin not stated) (M. Mayer, pers. comm., New Jersey Dept. of Agriculture)

TARGET PEST *Acyrthosiphon pisum* Harris APHIDIDAE and *Diuraphis noxia* (Kurdjumov) APHIDIDAE

HOST RANGE EVIDENCE **HRI-**
No laboratory prey-range testing done before release. Literature records include (1) *Gueriniella serratulae* (Fabricius) (Monophlebidae) (Della Beffa, 1940); (2) *Saissetia oleae* (Olivier) (Argyriou and Katsoyannos, 1977) (Coccidae); (3) *Parlatoria pergandii* Comstock (Coccidae) (Panis et al., 1977); (4) *Diuraphis noxia* (Kurdjumov) (Aphididae) (Naranjo et al., 1990); and (5–7) in the laboratory, larvae developed well on several aphids, including *Schizaphis graminum* (Rondani), *Macrosiphum* (*Sitobion*) *avenae* (F.), and *Acyrthosiphon pisum* Harris (Gibson et al., 1992).

HOST SPECIFICITY **Three Families**
Aphididae (4 species in 4 genera), **Coccidae** (2 species in 2 genera), and **Monophlebidae** (1 species)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in New Jersey, USA (M. Mayer, pers. comm., New Jersey Dept. of Agriculture) and the western United States (Gibson et al., 1992).
Establishment: Not recovered in New Jersey after release. Not detected in western United States after release there for *D. noxia* (Gordon and Vandenberg, 1991), but able to overwinter in field cages in the Texas High Plains (Michels et al., 1997).
Impact: No impact recorded.

Scymnus ningshanensis Yu and Yao COCCINELLIDAE

No synonyms noted.

UNITED STATES

YEAR/PLACE RELEASED 2007 USA, Connecticut (from western China) (Montgomery et al., 2015a)

TARGET PEST *Adelges tsugae* Annand ADELGIDAE

HOST RANGE EVIDENCE **HRI+**
Laboratory prey-range testing done before release (Butin et al., 2004). This lady beetle was found in China only on hemlock infested with *Adelges tsugae* and did not occur on nearby pine infested with another adelgid. In the laboratory, newly hatched larvae survived only if they could feed on hemlock woolly adelgid eggs (Montgomery et al., 2002). Of 3 non-target adelgids tested (*Adelges laricis* Vallot, *A. cooleyi* [Gillette], *Pineus strobi* [Hartig]), only 2 were fed on (*A. cooleyi*, *P. strobi*) when offered as eggs or adults. Nymphs of 1 non-target aphid, *Prociphilus tessellates* (Fitch) (Aphididae), were fed on by adult beetles at a lower rate than the target pest (Butin et al., 2004).

HOST SPECIFICITY **Two Families**
Adelgidae (3 species in 2 genera) and **Aphididae** (1 species)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Connecticut, USA (Montgomery et al., 2015a).
Establishment: Not established in the USA (Montgomery et al., 2015a).
Impact: Not applicable

Scymnus sinuanodulus Yu and Yao Coccinellidae

No synonyms noted.

UNITED STATES

YEAR/PLACE RELEASED 2005-2011 USA, Connecticut (from western China) (Montgomery et al., 2015b)

TARGET PEST *Adelges tsugae* Annand Adelgidae

HOST RANGE EVIDENCE **HRI+**
Laboratory prey-range testing done before release (M. Montgomery, unpub. data). No other prey species are known from the literature. Oviposition and adult and larval feeding observed on several adelgids. Adult feeding (only) observed on one aphid species (M. Montgomery, unpub. data).

HOST SPECIFICITY **Two Families**
Adelgidae (3 species in 2 genera) and **Aphididae** (1 species)

PROJECT OUTCOMES **R+/E-/I-**
Release: Released in Connecticut, USA (Montgomery et al., 2015b).
Establishment: Not established in the USA (M. Montgomery, pers. comm.).
Impact: Field cage studies showed the ability to reproduce on the target pest (Montgomery et al., 2007). No open-field impacts recorded.

Serangium parcesetosum Sicard Coccinellidae

(formerly *Catana parcesetosa*)

UNITED STATES

YEAR/PLACE RELEASED 1996 USA, Texas (from India) (Legaspi et al., 1996)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRI-**
No laboratory prey-range testing done before release. Literature prey records include various other whiteflies (Aleyrodidae): (1) *Dialeurodes citri* (Ashmead) (Antadze and Timofeeva, 1976); (2) *Aleurolobus barodensis* Maskell (Shah et al., 1986); (3) *Aleurocanthus woglumi* Ashby (Satpute et al., 1986); (4) *Bemisia tabaci* Gennadius (Natarajan, 1990); (5) *Aleurothrixus floccosus* (Maskell) (Abboud and Ahmad, 1998); (6) *Trialeurodes vaporariorum* Westwood (Al-Zyoud and Sengonca, 2004); (7) *Trialeurodes ricini* (Misra) (Al-Zyoud, 2007); and (8) *Aleurocanthus arecae* David (Chandrika et al., 2007). One scale is recorded a suitable prey: *Coccus pseudomagnoliarum* (Kuwana) (Coccidae) (Aboud et al., 2014). Moth eggs were not eaten in laboratory tests (Legaspi et al., 1996).

HOST SPECIFICITY **Two Families**
Aleyrodidae (8 species in 6 genera) and **Coccidae** (1 species)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Texas, USA (Legaspi et al., 1996).
Establishment: Not known if established in Texas.
Impact: None recorded.

PUERTO RICO

YEAR/PLACE RELEASED 1996 USA, Puerto Rico (from India via laboratory colony in Texas USA) (Gould et al., 2008)

TARGET PEST *Bemisia tabaci* (Gennadius) strain B Aleyrodidae
(formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1)

HOST RANGE EVIDENCE **HRI-**
No laboratory prey-range testing done before release. Literature prey records include various other whiteflies (Aleyrodidae): (1) *Dialeurodes citri* (Ashmead) (Antadze and Timofeeva, 1976); (2) *Aleurolobus barodensis* Maskell (Shah et al., 1986); (3) *Aleurocanthus woglumi* Ashby (Satpute et al., 1986); (4) *Bemisia tabaci* Gennadius (Natarajan, 1990); (5) *Aleurothrixus floccosus* (Maskell) (Abboud and Ahmad, 1998); (6) *Trialeurodes vaporariorum* Westwood (Al-Zyoud and Sengonca, 2004); (7) *Trialeurodes ricini* (Misra) (Al-Zyoud, 2007); and (8) *Aleurocanthus arecae* David (Chandrika et al., 2007). One scale is recorded a suitable prey: *Coccus pseudomagnoliarum* (Kuwana) (Coccidae) (Aboud et al., 2014). Moth eggs were not eaten in laboratory tests (Legaspi et al., 1996).

HOST SPECIFICITY **Two Families**
Aleyrodidae (8 species in 6 genera) and **Coccidae** (1 species)

PROJECT OUTCOMES **R+/E?/I-**
Release: Released in Puerto Rico (Gould et al., 2008).
Establishment: Not known if established in Puerto Rico.
Impact: None recorded.

Sphaerophoria scripta (L.) SYRPHIDAE

No synonyms noted.

UNITED STATES

YEAR/PLACE RELEASED	1988 USA, New Jersey (source not determined) (M. Mayer, pers. comm., New Jersey Dept. of Agriculture)
TARGET PEST	*Acyrthosiphon pisum* Harris APHIDIDAE
HOST RANGE EVIDENCE	**HRI-** No laboratory prey-range testing done before release. Literature prey records include various aphids (Aphididae): (1) *Diuraphis noxia* (Kurdjumov) (Grossheim, 1914); (2) *Schizaphis graminum* (Rondani) (Moroshkina, 1930); (3) *Aphis fabae* Scopoli (Szalay-Marzsó, 1958); (4) *Hyperomyzus lactucae* (Kaltenbach) (Wiackowska, 1963); (5) *Brevicoryne brassicae* (L.) (Constantinescu, 1970); (6) *Hyalopterus pruni* (Geoffroy) (Smolarz, 1970); (7) *Sitobion avenae* (Fabricius) (Mitic-Muzina and Srdic, 1977); (8) *Hyadaphis tataricae* (Aizenberg) (Toros, 1986); and (9) *Brachycaudus helichrysi* Kaltenbach (Voicu et al., 1987). Also recorded as a prey was *Euphyllura straminea* Loginova (Psyllidae) (Kaplan et al., 2016).
HOST SPECIFICITY	**Two Families** **Aphididae** (9 species in 9 genera) and **Psyllidae** (1 species)
PROJECT OUTCOMES	**R+/E-/I-** **Release:** Released in New Jersey, USA (M. Mayer, pers. comm., New Jersey Dept. of Agriculture). **Establishment:** No recovery after release in New Jersey. **Impact:** None recorded

Text 1. Synopsis of Table 1, parasitoids introduced into Canada, Mexico, the USA, or the USA Overseas Territories between 1985 and 2018.

Acerophagus papayae Noyes and Schauff Encyrtidae

For species description, see Noyes and Schauff (2003). Noyes (2017) lists no synonyms.

Acerophagus papayae was collected from Mexico, together with other parasitoids of *Paracoccus marginatus* Williams and Granara De Willink (Pseudococcidae), a species native to Mexico and Central America that invaded Puerto Rico, Florida, Guam, India and other locations. No host range estimation was made for this species before its release, but it is certainly at the family level or lower. For purposes of this catalog, outcomes in three locations in the United States (Florida, Puerto Rico, and Guam) are reported. More literature exists relative to its introduction to India that is not discussed here.

United States. *Acerophagus papayae* was released in Florida (parasitoids from Mexico) in 2000, where it and *Anagyrus loecki* Noyes and Menzes established. These parasitoids' impacts in the field were then evaluated against cohorts of mealybugs in a cage-exclusion test. Mealybug densities in the test cohorts were reduced by exposure to field parasitism either by 58% in the open-sleeve cage or 73% in the no-cage treatment (vs. the closed cage). Two parasitoids contributed to control (*A. papayae* and *A. loecki*), but 93% of parasitism was due to *A. papayae* (Amarasekare et al., 2009).

Puerto Rico. *Acerophagus papayae* was released in Puerto Rico (parasitoids from Mexico via Florida) in 2000, where it established and, together with the other parasitoids released against the pest, suppressed mealybug density by 97%, with parasitism of 35–58% (Mani et al., 2012 [original sources unpub.]). The dominant parasitoid recovered was *Acerophagus* sp. (Mani et al., 2012 [original sources unpub.]), later described as *A. papayae* (Noyes and Schauff, 2003).

Guam. *Acerophagus papayae* was released in Guam (parasitoids from Mexico via Florida via Puerto Rico) in 2002, along with other parasitoids of papaya mealybug (Meyerdirk et al., 2004). *Acerophagus papayae* established and within one year, mealybug density declined 99% due to the group of parasitoids released (Meyerdirk et al., 2004).

Adelencyrtus oceanicus Doutt Encyrtidae

Noyes (2017) lists two synonyms: *Adelencyrtus oceanica* (Doutt]) and *Anabrolepis oceanica* Doutt.

Adelencyrtus oceanicus was collected from two of the western Caroline Islands (Ulithi and Koror [Muniappan and Marutani, 1989]) and released in 1988–89 in Guam (Muniappan and Marutani, 1989) for control of red coconut scale, *Furcaspis oceanica* (Lindinger) (Diaspididae). No host range estimate was made for this species before its release, and the breadth of its host range is unknown. No hosts other than the target scale are known from the literature. Surveys were done in 1996 and 2002 for scale abundance and the presence of this parasitoid in Guam, which demonstrated the introduced parasitoid had established (Lali and Muniappan, 1996). The second survey, in 2002, found that the released parasitoid *A. oceanicus* had spread throughout Guam and that the red coconut scale, *F. oceanica*, was at very low levels compared to the 1996 survey (Lali and Muniappan, 1996). Rates of parasitism by *A. oceanicus* observed in 2002 were high compared to those in 1996 (Muniappan et al., 2003).

Ageniaspis citricola Logvinovskaya Encyrtidae

For species description, see Logvinovskaya (1983). The Taiwanese population known as *A. citricola* is likely a distinct species within a cryptic species complex (Hoy et al., 2000). Noyes (2017) lists no synonyms.

Ageniaspis citricola has been introduced into many countries for control of the invasive citrus leafminer, *Phyllocnistis citrella* Stainton (Gracillariidae). Two locations are covered in this catalog: USA (Florida) and Mexico (Colima and Veracruz). For both introductions, the same parasitoid source population was used, being collected in Southeast Asia by Australian scientists, and later moved from Australia to Florida in 1994. From Florida, the parasitoid was moved to Mexico in 1997 (Colima) and 1999 (Veracruz). No original host range estimation was done in North America, but rather the projects relied on work in Australia (Neale et al., 1995) that showed high specificity for the species tested there, which included one species of non-target *Phyllocnistis* leafminer and five other non-target gracillariid leafminers, none of which were parasitized.

United States. *Ageniaspis citricola,* after its introduction in 1994 (Smith and Hoy, 1995), established widely in Florida (Pomerinke and Stansly, 1998). Its impact on the pest population there is supported by data of Hoy and Rogers (2007), being in the range of 33–39% mortality of the pest in the summer flush on citrus in central Florida. Other studies (Xiao et

al., 2007; Xiao and Fadamiro, 2010) suggest that predators play the dominant role in the pest's life tables.

Mexico. *Ageniaspis citricola* established in Colima in northern Mexico after its 1997 introduction (Bautista-Martínez et al., 2008), but its impact was apparently less that in Florida, being 6–12% parasitism (Bautista-Martínez et al., 2008). The parasitoid failed to establish in Veracruz in southern Mexico after its 1999 introduction (Bautista-Martínez et al., 2008), which was speculatively attributed to differences in climate.

Ageniaspis fuscicollis (Dalman) ENCYRTIDAE

Noyes (2017) lists various synonyms, principally (1) *Ageniaspis praysincola* Silvestri, (2) *Encyrtus cyanocephalus* (Bouché), (3) *Encyrtus cyanocephalus* Goureau, (4) *Encyrtus fuscicollis* Dalman, (5) *Holcothorax fuscicollis* (Dalman), (6) *Pteromalus cyanocephalus* Bouché, and other minor variations on the above.

Ageniaspis fuscicollis was introduced against apple ermine moth, *Yponomeuta malinellus* (Zeller) Yponomeutidae from Switzerland in 1987 into Canada (British Columbia) (Cossentine and Kuhlmann, 2002) and then in 1988–1991, from France, South Korea, China, and Russia, into the United States (Washington state) (Unruh et al., 2003). In neither case was any host-range testing done with North American species before introduction. Literature records suggest that the host range of *A. fuscicollis* is centered on the genus *Yponomeuta* (eight known species), but also includes species in a few other genera (two known) of Yponomeutidae as hosts.

Canada. Following its 1987 release in British Columbia, *A. fuscicollis* established, and one study suggests that it reduced the pest's density, based on an inverse correlation of parasitism and pest numbers over time at some sites (Cossentine and Kuhlmann, 2000).

United States. Following the 1988–1991 release of *A. fuscicollis* in Washington state (Unruh et al., 2003), it established (Unruh et al., 2003), and parasitism of the pest at 22 monitored sites increased from <5% in 1989 to nearly 25% by 1993, with <90% of parasitism from the introduced species. This increase in parasitism was accompanied by a decline in catch of male moths in pheromone traps from 10/trap/day to about 1 by 1995, suggesting substantial control of the pest over the 1989–1995 period (Unruh et al., 2003).

Ageniaspis testaceipes (Ratzburg) ENCYRTIDAE

Noyes (2017) lists various synonyms, principally (1) *Ageniaspis nepticulae* (Mayr), (2) *Encyrtus testaceipes* Ratzeburg, (3) *Holcothorax nepticulae* Mayr, (4) *Holcothorax testaceipes* (Ratzeburg), (5) *Holcothorax vellutatus* Askew, and other minor variations on the above.

Ageniaspis testaceipes was released in Connecticut (USA) apple orchards in 1988 (Maier, 1993, 1994) against the invasive gracillariid leafmining moth *Phyllonorycter crataegella* (Clemens). No host range estimate was made for this species before its release. The species is associated with about 25 other species of leafmining moths in deciduous trees, mostly in either *Lithocolletis* or *Phyllonorycter*. It established in Connecticut apple orchards that were not sprayed (abandoned or organic) but not in orchards treated regularly with pesticides. It caused 12–22% mortality to larger larvae but did not reduce pest density (Maier, 1993).

Aleiodes nr *circumscriptus* (Nees) BRACONIDAE

The taxonomic identity of this parasitoid is not certain, but a parasitoid from mango caterpillar on mango in India was later described as *A. circumscriptus* (Rajeshwari and Chacko, 1992). However, the *circumscriptus* species group poses taxonomic problems, and issues may remain.

Aleiodes nr *circumscriptus* was released in 1986–1987 in Guam (Nafus, 1991) for control of the mango caterpillar, *Penicillaria jocosatrix* Guenée (Noctuidae). No laboratory host range estimation was done before release. The species did not establish and so had no impact on the pest. But other species (*Blepharella lateralis* Macquart [Tachinidae] and *Euplectrus* nr *parvulus* Ferrière [Eulophidae]) released in the same project did establish and controlled the pest (Nafus, 1991).

Allotropa nr *mecrida* (Walker) PLATYGASTRIDAE

Species identity is uncertain.

Allotropa nr *mecrida* was introduced to the USA (California) in 2003 (Roltsch et al., 2006) for control of pink mealybug, *Maconellicoccus hirsutus* (Green) (Pseudococcidae) after being found to be the most common parasitoid of this pest in

Egypt (Gonzalez et al., 2003). Host-range testing with four mealybugs did not discover any other new hosts (Roltsch et al., 2007). However, the species identity of the released parasitoid was never exactly determined. If it is the same of *Allotropa mecrida*, then mealybugs in other genera are known to be hosts (Niyazov, 1969; Ibadova, 1985; Yasnosh et al., 2001). The parasitoid did not establish in California (Roltsch et al., 2006).

Amitus bennetti Viggiani & Evans Platygasteridae

Species described from *Bemisia tabaci* (Viggiani and Evans, 1992).

Amitus bennetti was discovered in Puerto Rico parasitizing *Bemisia tabaci* (Gennadius) (Viggiani and Evans, 1992) and was released in Florida (USA) against this invasive whitefly in 1990–1994, after collection from Puerto Rico (Nguyen, and Bennett, 1995), and, later, releases were also made in the western United States (Hoelmer and Goolsby, 2003). No host range estimates were made for the parasitoid before its release, but no other field hosts are known. The parasitoid apparently established in Florida (Nguyen and Bennett, 1995), but its impact there was not evaluated. In the western United States (California), studies in field cages found that *A. bennetti* caused 20–54% mortality to *B. tabaci* on cotton and beans, respectively (Joyce and Bellows, 2000). This parasitoid's impact is nested within that of a large complex of parasitoids introduced into the United States for control of *B. tabaci*.

Anagyrus californicus (Compere) Encyrtidae

Native to Central America and Mexico. Noyes (2017) lists two synonyms: *Apoanagyrus californicus* Compere and *Epidinocarsis californicus* (Compere).

Anagyrus californicus is native to Mexico and Central America and was one of four or five parasitoids introduced into Florida (USA) and Puerto Rico for control of the invasive papaya mealybug, *Paracoccus marginatus* Williams and Granara De Willink (Pseudococcidae) (UF/IFAS factsheet, not dated), in 2000 in both locations. No laboratory host-range testing was done before the parasitoid's release in either location. Field host records include mealybugs in two other genera, including *Maconellicoccus hirsutus* Green (Ceballos Vázquez et al., 2016) and *Phenacoccus solani* Ferris (Poinar, 1964), suggesting family-level specificity.

United States. The release of *A. californicus* in 2000 in Florida is documented (UF/IFAS factsheet, not dated), but no published records of either establishment or impact in Florida, neither of all released parasitoids collectively nor of *A. californicus* separately, were located.

Puerto Rico. The release in 2000 in Puerto Rico was monitored, but results were not published. They are summarized in a factsheet (UF/IFAS), which states that all released parasitoids, including *A. californicus*, established, and collectively, at research sites in Puerto Rico, reduced mealybug density by 97%, with collective parasitism levels of 35% to 58% (UF/IFAS factsheet, not dated). However, most of this impact was due to *Acerophagus papayae* Noyes and Schauff (UF/IFAS factsheet, not dated) and the separate role of *A. californicus*, if any, is unrecorded.

Anagyrus kamali Moursi Encyrtidae

For species description, see Moursi (1948). Noyes (2017) lists five synonyms: (1) *Anagyrus comperei* Subba Rao and Rai; (2) *Anagyrus flavidus* Shafee, Alam and Agarwal; (3) *Anagyrus flavus* Agarwal; (4) *Anagyrus hayati* Sushil and Khan; (5) *Anagyrus mohani* Sushil and Khan; and (6) *Anagyrus nigroradiclatus* Subba Rao and Rai.

Anagyrus kamali is a parasitoid of the pink mealybug, *Maconellicoccus hirsutus* Green (Pseudococcidae). This parasitoid was first detected and described in Egypt (Moursi, 1948). It was later was released into many countries, along with several other parasitoids and some predators, for control of pink mealybug as that pest spread. Among regions covered in this catalog, the pink mealybug invasion and its biological control began in the Caribbean (see Kairo, 1990) and then reached the southern USA and Mexico. Associated with the project in the Caribbean, eight non-target mealybugs were tested (*Planococcus citri* Rissso, *Planococcus halli* Ezzat and McConnell, *Dysmicoccus brevipes* Cockerell, *Pseudococcus elisae* Borchsenius, *Saccharicoccus sacchari* (Cockerell), *Puto barberi* (Cockerell), *Nipaecoccus nipae* (Maskell), and *Plotococcus neotropicus* Williams & Granara de Willink), and the two *Planococcus* species were attacked but failed to support complete parasitoid development (Sagarra et al., 2001). Noyes (2017) lists six additional mealybugs as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Formicococcus robustus* (Ezzat & McConnell), (3) *Naiacoccus serpentinus* Green, (4) *Nipaecoccus vastator* (Maskell), (5) *Nipaecoccus viridis* (Newstead), and (6) *Phenacoccus solenopsis* Tinsley, suggesting all hosts are mealybugs (Pseudococcidae) and that the host range may include nine species in seven genera.

In broad terms, the project was highly successful, with control resulting in virtually all areas, due to a complex of natural enemies, with *A. kamali* being the dominant source of mortality in most cases. For the geographic regions covered here, we have the following details:

Puerto Rico. *Anagyrus kamali* was released in Puerto Rico (using a mixed colony sourced from China, Hawaii, and Egypt) in 1998, where it established and, with contributions from other natural enemies, controlled the pest (Kairo et al., 2000; Michaud and Evans, 2000; W. Roltsch, pers. comm., California Department of Food and Agriculture).

United States. *Anagyrus kamali* (using a mixed colony sourced from China, Hawaii, and Egypt) was released in various southern U.S. states (California, Florida, Louisiana) from 1999 to 2006, with California providing the best documentation of events. Release and establishment in California (Roltsch et al., 2006) was followed by control of the pest mealybug (95% reduction), due to several of the released natural enemies, with *A. kamali* being the dominant summer parasitoid (up to 50% parasitism), while *Gyranusoidea indica* Shafee, Alam & Agarwal was an important winter parasitoid (Roltsch et al., 2006).

U.S. Virgin Islands. *Anagyrus kamali* was released in the Caribbean (using a mixed colony from China and Hawaii) in 1999 (Kairo et al., 2000), where it established in all locations and, with contributions from other natural enemies, controlled the pest (Kairo et al., 2000; W. Roltsch, pers. comm., California Department of Food and Agriculture).

Mexico. *Anagyrus kamali* was released in 1999 in Baja California, Mexico (using material obtained from Puerto Rico), where it is established (Santiago-Islas et al., 2008) and together with the predator *Cryptolaemus montrouzieri* (Mulsant) controlled the pest.

Anagyrus loecki Noyes and Menzes ENCYRTIDAE

Noyes (2017) lists no synonyms

Anagyrus loecki is one of a complex of four or five parasitoid species (from Mexico) introduced into several parts of the world to control the invasive papaya mealybug, *Paracoccus marginatus* Williams and Granara De Willink (Pseudococcidae). Releases were made in Florida, Puerto Rico, and Guam. No host-range testing was done for *A. loecki* before its introduction to these locations, and there are no literature records of other hosts. Noyes (2017) lists two additional mealybugs as hosts: (1) *Dysmicoccus* sp. and (2) *Phenacoccus madeirensis* Green. While papaya mealybug was highly suppressed in all locations after the release of the complex of parasitoids, evaluation of impact was most detailed in Florida.

United States. *Anagyrus loecki* was released in Florida in 2000 (UF/IFAS factsheet, not dated) and its impact was evaluated (Amarasekare et al., 2009). Artificially established cohorts of mealybugs were reduced, due to exposure to parasitism, by 58% in open-sleeve cages and by 73% on uncaged branches, compared to close-cage controls. *Anagyrus loecki* and *A. papayae* both contributed to control, but 93% of parasitism was due to *A. papayae* (Amarasekare et al., 2009).

Puerto Rico. *Anagyrus loecki* was released in Puerto Rico in 2000, where it established (UF/IFAS factsheet, not dated). Following release of five species of parasitoids, mealybug density declined by 97%, with parasitism levels of 35–58% (Mani et al., 2012 [original sources unpub.]). The dominant parasitoid was *Acerophagus* sp. Mani et al., 2012 [original sources unpub.]), later described as *A. papaya* (Noyes and Schauff, 2003). The value of *A. loecki* to control is not reported.

Guam. *Anagyrus loecki* was released in Guam in 2002, as part of a complex of parasitoids that collectively reduced the pest by 99% within one year (Meyerdirk et al., 2004). However, the separate contribution of *A. loecki* to control is not reported.

Anagyrus pseudococci Girault ENCYRTIDAE

This species was described as *Epidinocarsis pseudococci* by Girault (1915) and appears to be identical with the species introduced in about 1999 to California from Argentina (Tryapitzyn and Tryapitzyn, 1999; Triapitsyn et al., 2007). Other forms in the literature under this name are a separate entity (Triapitsyn et al., 2007). "*Anagyrus pseudococci*" was introduced in the 1948–1956 period to California from Brazil against *Planococcus citri* and later recovered (Bartlett and Lloyd, 1958) and this is now believed to be a distinct, unnamed species (Triapitsyn et al., 2007). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms or literature hosts.

Anagyrus pseudococci is native to South America but also adventive in Europe (Triapitsyn et al., 2007). In 1999, *A. pseudococci* was introduced from Argentina into California (USA) (Tryapitzyn and Tryapitzyn, 1999) against *Planococcus ficus* (Signoret) (Pseudococcidae). No host-range testing was done before its introduction to California. Literature hosts include 16 species of mealybugs in eight genera and perhaps one species of Lecanodiaspididae (El-Haidari et al., 1974; Coquis and Salazar, 1975; Gabriel, 1983; Islam and Jahan, 1992; Abd-Rabou, 2000; Lotfalizadeh and Ahmadi, 2000; Leandro et al., 2008; Morsi, 2010; Guerrieri and Pellizzari, 2009; Yigit and Telli, 2013; Ghanbari et al., 2013 Bugila et

al., 2015; Tanga et al., 2016; Attia and Awadallah, 2016), suggesting a family level of specificity. *Anagyrus pseudococci* established in California, but its impact on the target pest has not been determined (Tryapitzyn and Tryapitzyn, 1999).

Anagyrus nr *pseudococci* Girault Encyrtidae

This undescribed species is not the same as *A. pseudococci* and is recognized by place of origin, being either Spain or Israel, in contrast to *A. pseudococci*, which is originally from Argentina, but also is adventive in parts of Italy (Sicily) (S. Triapitsyn, pers. comm.). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms or literature hosts.

In 2001, *A.* nr *pseudococci* was released in Sonora, Mexico against *Planococcus ficus* (Signoret) (Pseudococcidae), having been obtained from a commercial insectary in Spain (Klotz et al., 2002; Fu-Castillo, 2008). No host-range testing was done before introduction to Mexico. The list of hosts from the literature may include16 species of mealybugs in eight genera and perhaps one species of Lecanodiaspididae (El-Haidari et al., 1974; Coquis and Salazar, 1975; Gabriel, 1983; Islam and Jahan, 1992; Abd-Rabou, 2000; Lotfalizadeh and Ahmadi, 2000; Leandro et al., 2008; Morsi, 2010; Guerrieri and Pellizzari, 2009; Yigit and Telli, 2013; Ghanbari et al., 2013 Bugila et al., 2015; Tanga et al., 2016; Attia and Awadallah, 2016); however, these literature records are likely not free of confusion with the true *A. pseudococci*. *Anagyrus nr pseudococci* established in Mexico (Fu-Castillo, 2008), but its impact on the target pest has not been determined.

Anaphes nitens (Girault) Mymaridae

Noyes (2017) lists five synonyms: (1) *Anaphes gonipteri* (Ferrière), (2) *Anaphoidea gonipteri* Ferrière, (3) *Anaphoidea nitens* Girault, (4) *Patasson nitens* (Girault), (5) *Yungaburra nitens* (Girault), and some related minor variations of these names.

Anaphes nitens, originally from Australia, was released in California (USA) in 1994 for control of the eucalyptus pest *Gonipterus scutellatus* Gyllenhal (Curculionidae) (Hanks et al., 2000). No host-range testing was done before release, despite its long history of use around the world. The only other literature host records are *Gonipterus gibberus* Boisduval (Sanches, 2000) and *Gonipterus platensis* (Noyes, 2017). In California, *A. nitens* established and caused high levels of egg parasitism (95%) (Hanks et al., 2000), controlling the pest.

Apanteles murinanae Čapek and Zwölfer Braconidae

Apanteles murinanae was collected in Europe from *Choristoneura murinana* (Hűbner), for release against its pest congener *Choristoneura fumiferana* (Clemens) (Tortricidae) in Canada. No host-range testing was done before release, other than to confirm that the parasitoid could develop in the target pest. One other field host, *Eucosma nigricana* (H.-S.) (Tortricidae), is known from the literature (Čapek, 1961). A single release was made in eastern Canada but failed to result in the parasitoid's establishment (Smith et al., 2002). No further work was done and this new-association approach to biological control was abandoned.

Aphantorhaphopsis samarensis (Villeneuve) Tachinidae

(formerly in *Ceranthia*)

Aphantorhaphopsis samarensis is a European parasitic fly that has been released in both Canada (1991) and the northeastern United States (1992) against the gypsy moth, *Lymantria dispar* (L.) (Erebidae: Lymantriinae). Based on laboratory host-range testing and field collections in Europe, Fuester et al. (2001) described the host range as limited to two genera, *Lymantria* and *Orgyia*. The parasitoid failed to establish in either Canada or the United States (Mills and Nealis, 1992; Nealis and Quednau, 1996; Fuester et al., 2014).

Aphelinoidea anatolica Nowicki Trichogrammatidae

Noyes (2017) lists no synonyms.

Aphelinoidea anatolica is an egg parasitoid of leafhoppers that was collected from Iran and released in California (USA) in 1995 against the beet leafhopper, *Circulifer tenellus* (Baker) (Cicadellidae) (Walker et al., 1997). No laboratory host-range testing was done before its release and no other hosts are recorded in the literature. It established (Bayoun et al., 2008), but the levels of parasitism it caused were too low to affect pest densities (Bayoun et al., 2008).

Aphelinoidea turanica Trjapitzin TRICHOGRAMMATIDAE

For species description, see Trjapitzin (1994). Noyes (2017) lists one synonym: *Aphelinoidea scythica* Fursov.

Aphelinoidea turanica is an egg parasitoid of leafhoppers that was released in California (USA) in 1993 against the beet leafhopper, *Circulifer tenellus* (Baker) (Cicadellidae). It was collected from Turkmenistan (Walker et al., 1997) and was described as a new species by Trjapitzin (1994). No laboratory host-range testing was done before its release and no other hosts are recorded in the literature. It established (Bayoun et al., 2008), but the levels of parasitism it caused were too low to affect pest densities (Bayoun et al., 2008).

Aphelinus asychis Walker APHELINIDAE

Species identity of *A. asychis* relative to other closely related populations was initially unknown but was determined after introduction in further studies (Kazmer et al., 1996; Zhu and Fang, 2009). Because of confusion as to which species within *Aphelinus* were released against Russian wheat aphid (RWA), statements made here on species identities (and as a consequence, literature hosts) were confirmed by Jim Woolley, Texas A&M and Keith Hopper, USDA directly, rather than relying on Noyes (2017). That clarified events as follows: only two species of *Aphelinus* are known to have been released against RWA in the USA: (1) *Aphelinus asychis*, which may have been present in the United States from the 1960s, but regardless, it turned out not to be very important; and (2) *Aphelinus atriplicis*, which established and is the most abundant introduced RWA parasitoid, but which is widely misreported in field studies in the literature as *Aphelinus albipodus* (Hayat & Fatima). Species that were not released, but whose names appear in the USA RWA literature were *Aphelinus albipodus* and *Aphelinus varipes* (Foerster). The former species does not occur geographically in the areas from which RWA parasitoids were collected for use in the USA, and the latter species does not attack RWA (Hopper et al., 2017). Another species, *Aphelinus hordei* (Kurdjumov), is a highly specific parasitoid of RWA (Hopper et al., 2017) that may have been accidentally included in shipments of RWA parasitoids to the USA but misidentified at the time. As such, it may have been released, but there is no clear evidence to prove that or of its current presence in the USA (K. Hopper, pers. comm.).

Aphelinus asychis collected from France, China, and Kazakhstan was released in the western United States in 1990-1992 for control of the Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae). It is a member of the *asychis* species complex and was listed at first as *A.* nr *asychus* (Kazmer et al., 1996). No laboratory host-range testing was done for this specific entity. Literature host records since 1996 include a long list of species of aphids in the family Aphididae. It was released in Colorado (Elliott et al., 1995; Burd et al., 2001) and Texas (Michels and Whitaker-Deerberg, 1993), and it appears to have established in Colorado and surrounding states (Elliott et al., 1995; Burd et al., 2001), Texas (Michels and Whitaker-Deerberg, 1993) and Washington (Pike et al., 1997). However, given that *A. asychis* from Europe was released in Texas and Oklahoma in the 1960s for control of *Schizaphis graminum*, it is not clear that the *A. asychis* released against *D. noxia* established. Regardless of origin, it was not recovered in high numbers from Russian wheat aphid in sampling by K. Hopper or others (K. Hopper, pers. comm.). Setting aside these issues of origin, its impacts on the target pest seem minor. While present in post-release surveys, it was only a minor parasitoid of the pest in the northcentral USA plains in 2001–2002, about 9–10 years after release (Noma et al., 2005).

Aphelinus atriplicis Kurdjumov APHELINIDAE

Because *Aphelinus atriplicis*, after its release and collection in the western USA, was routinely misidentified as *Aphelinus albipodus* (Hayat & Fatima), much of the documentation of *A. atriplicis*' effect on Russian wheat aphid (RWA) populations is reported under the name *A. albipodus*, a species that likely has never been released in the USA (K. Hopper, pers. comm.). Because of confusion as to which species within *Aphelinus* were released against Russian wheat aphid (RWA), statements made here on species identities (and as a consequence, literature hosts) were confirmed by Jim Woolley, Texas A&M and Keith Hopper, USDA directly, rather than relying on Noyes (2017). That clarified events as follows: only two species of *Aphelinus* are known to have been released against RWA in the USA: (1) *Aphelinus asychis*, which may have been present in the United States from the 1960s, but regardless, it turned out not to be very important; and (2) *Aphelinus atriplicis*, which established and is the most abundant introduced RWA parasitoid, but which is widely misreported in field studies in the literature as *Aphelinus albipodus* (Hayat & Fatima). Species that were not released, but whose names appear in the USA RWA literature were *Aphelinus albipodus* and *Aphelinus varipes* (Foerster). The former species does not occur geographically in the areas from which RWA parasitoids were collected for use in the USA, and the latter species does not attack RWA (Hopper et al., 2017). Another species, *Aphelinus hordei* (Kurdjumov), is a highly specific parasitoid of RWA (Hopper et al., 2017) that may have been accidentally included in shipments of RWA parasitoids to the USA but misidentified at the time. As such, it may have been released, but there is no clear evidence to prove that or of its current presence in the USA (K. Hopper, pers. comm.).

Aphelinus atriplicis was introduced into the western United States in 1992 from Central Asia against the Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae) (Hopper et al., 1998; Prokrym, 1998; Heraty et al., 2007). This species

became widely established in the western United States on Russian wheat aphid (K. Hopper, pers. comm. and references cited for release). This is the most important introduced, established parasitoid of this invasive aphid in the western United States.

Aphelinus glycinis Hopper and Woolley Aphelinidae

Aphelinus glycinis was collected in China and released in Minnesota (USA) (Hopper and Diers, 2014) against the soybean aphid, *Aphis glycines* Matsumura (Aphididae) in 2012. Before release, host-range testing determined that its likely host range was restricted to the genus *Aphis* (Hopper, 2010; USDA APHIS, 2012). Post-release sampling did not demonstrate establishment (G. Heimpel, pers. comm.).

Aphelinus spiraecolae Evans & Schauff Aphelinidae

For species description, see Evans et al. (1995). Noyes (2017) lists no other synonyms.

Aphelinus spiraecolae was released against *Aphis spiraecola* Patch (Aphididae) in 1995 in Florida (USA), having been collected from Guangdong Province, China (see Table 2, p. 159 of Frank and McCoy, 2007). No host-range testing was done before release. Two hosts are recorded in the literature other than the target species: *Aphis gossypii* Glover and *Toxoptera aurantii* (Boyer de Fonscolombe) (Yokomi and Tang, 1995). There is no evidence of establishment.

Aphidius colemani Viereck Braconidae

Aphidius colemani is a polyphagous aphid parasitoid of presumed Indian origin that currently has a wide distribution around the world (Starý, 1975). It was introduced before 1985 into California (USA) and so its reintroduction in 1990 as a part of the Russian wheat aphid (*Diuraphis noxia* [Kurdjumov]) project is not included in this catalog. However, the introduction of *A. colemani* to Hawaii (USA) for the first time in 1999 for control of cotton aphid, *Aphis gossypii* Glover (Aphididae), is covered because Hawaii, as an overseas portion of the United States, is being tracked as a distinct unit. No host-range testing was done before the release of *A. colemani* in Hawaii, but it is known to be restricted to aphids, which provides adequate specificity for use in Hawaii, as no native aphids exist on the islands. Literature host records are numerous and are summarized by Benelli et al (2014). Known hosts include 21 aphid species, in 13 genera, especially the genus *Aphis*. This parasitoid is also commonly used for augmentative biocontrol of aphids in greenhouses in over 20 countries (van Lenteren, 2012). *Aphidius colemani* established in Hawaii (Acebes and Messing, 2013a; Messing and Klungness, 2001), but on taro (*Colocasia esculenta* L.) (a key crop for the project), levels of parasitism of *A. gossypii* by *A. colemani* remained low (<3%) six years after release, likely due to high levels of hyperparasitism and high levels of fungal infections in aphids (Rhainds and Messing, 2005).

Aphidius rhopalosiphi de Stefani-Perez Braconidae

Aphidius rhopalosiphi collected from Turkey and Morocco was released in Washington state (USA) from 1988 though 1992 against Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae) (Tanigoshi et al., 1995). No laboratory host range estimation was done before release, but literature records exist for several field hosts, including *Schizaphis graminum* (Rondani) (Gruber et al., 1994) and, in Iran, *Rhopalosiphum padi* (L.), *Sitobion avena* (Fabricius), and *Metopolophium dirhodum* (Walker) (Rakhshani et al., 2008), suggesting a broad host range within the family Aphididae. Cameron, et al. (2013) suggest that the host range consists mainly of species in two aphid tribes, the Aphidini and the Macrosiphini. Höller (1991) states that there may be biotypes of this species that differ in their host ranges. No recoveries were made following release. No other North American literature on *A. rhopalosiphi* was located.

Aphytis sankarani Rosen and DeBach Aphelinidae

For species description, see Rosen and DeBach (1986). Noyes (2017) lists no synonyms.

Aphytis sankarani is listed by Frank and McCoy (2007) as having been released in 2002 in Florida (USA) from Thailand against *Pseudaulacaspis cockerelli* (Cooley) (Diaspididae). No host-range testing for this species was done before release. Noyes (2017) lists two additional species as hosts: *Aonidiella aurantii* Maskell and *Parlatoria pergandii* Comstock. *Aphytis*

sankarani established in southern Florida (H. Glenn, pers. comm. [TREC, Homestead]), but no information was found estimating its impact on the host.

Aphytis yanonensis DeBach & Rosen APHELINIDAE

For species description, see DeBach and Rosen (1982). Noyes (2017) lists no synonyms.

Aphytis yanonensis was released in the northeastern United States (Massachusetts and New Jersey principally) in 1990–1995, from northeastern China (near Beijing) for control of *Unaspis euonymi* (Comstock) (Diaspididae). No host-range testing was done before release. Known field hosts include *Unaspis yanonensis* (Kuwana) (Diaspididae) (DeBach and Rosen, 1982) and the target pest, from which it is was reared in quarantine from *U. euonymi* collected in China (Van Driesche, unpub. data), while *Quadraspidiotus perniciosus* [Comstock] (Diaspididae) is a laboratory host (Matadha et al., 2005). The parasitoid did not establish in either state (Matadha et al., 2005; O'Reilly and Van Driesche, 2009). In the citation by Van Driesche, the species is given only as *Aphytis* sp. In the Matadha publication, it is given as *Aphytis proclia*. The correct name is *Aphytis yanonensis*.

Aprostocetus vaquitarum (Wolcott) EULOPHIDAE

Previously misidentified in the literature as *Tetrastichus gala* (Walker) or *Aprostocetus gala*, a different species attacking leafhopper or cecidomyiid fly eggs. Noyes (2017) lists one synonym: *Tetrastichus vaquitarum* Wolcott.

Aprostocetus vaquitarum was introduced from the Dominican Republic to southern Florida (USA) (Peña et al., 2004; Jacas et al., 2005) for control of the citrus root weevil, *Diaprepes abbreviatus* (L.) (Curculionidae). No host-range testing was done before release. Known hosts include two other weevils with similar egg-laying biology: *Lachnopus coffeae* Marshall (Wolcott, 1924) and *Pachnaeus litus* (Germar) (Jacas et al., 2010). Noyes (2017) also lists the moth *Donacivola saccharella* (Lepidoptera: Elaschisidae) as another host, but this should be confirmed. Following release, *A. vaquitarum* established in southern Florida and caused 70–90% parasitism of eggs of the target pest (Peña et al., 2004; Jacas et al., 2005).

Aroplectrus dimerus Lin EULOPHIDAE

Noyes (2017) lists no synonyms.

Aroplectrus dimerus was introduced to Hawaii (USA) from Taiwan in 2010–2013 for control of the invasive slug caterpillar, *Darna pallivitta* (Moore) (Limacodidae), a pest with urticating hairs posing a potential public health risk. Host-range testing before release in Hawaii with 25 non-target Lepidoptera showed no attack on any species tested. Since there are no native limicodids in Hawaii, tests were run on species in 13 families, including two endemic species and 19 immigrant pests (HDOA, 2007). In other locations, *A. dimerus* has been recorded attacking six limacodid species in the Philippines (Cock et al., 1987) and one in India (Singh, 1988), distributed over four genera in the family. Nothing has yet been published, but the parasitoid is now widely distributed in Hawaii and well established. At HDOA survey sites, *A. dimerus* caused an 80–100% decline in larval densities (J. Yalemar, pers. comm., Hawaii Department of Agriculture).

Banacuniculus utilis (Beardsley) FIGITIDAE: EUCOILINAE

One synonym: *Ganaspidium utilis*, which is the name under which literature appears.

Banacuniculus utilis was released in Guam (from Texas via Hawaii) in 1985 against the invasive leafminer *Liriomyza trifolii* (Burgess) (Agromyzidae) (Johnson and Wilson, 1995). No host-range testing was done before release, but there is only one other host known from the literature— *Liriomyza sativae* Blanchard (Beardsley, Jr. 1988). All species of *Ganaspidium* are parasitoids of flies in the Agromyzidae (Buffington, 2004, 2010). In Guam the parasitoid established in bean plantings and controlled the pest, causing up to 78% parasitism of leafminer larvae, reducing *L. trifolii* density dramatically, and eliminating the need for other controls in unsprayed bean plantings (Johnson and Wilson, 1995).

Binodoxys brevicornis (Haliday) BRACONIDAE: APHIDIINAE

(formerly in *Trioxys*)

Binodoxys brevicornis was introduced in 1989–1990 into California (USA) from the former Czechoslovakia (Starý, 1990) against the asparagus aphid, *Brachycorynella asparagi* (Mordv.) (Aphididae). No laboratory host-range testing was done

before the parasitoid's release, but hosts from the literature include aphids in several genera: *Myzus cerasi* (F.) (Wimshurst, 1925), *Cavariella* sp. (Tremblay, 1975; Mescheloff and Rosen, 1993), and *Hyadaphis coriandri* (Das) (Mescheloff and Rosen, 1993), suggesting it is a polyphagous parasitoid of aphids. Following its release in California, it established in some counties but not others, and in some locations it caused about 10% parasitism in the years immediately after its release (Daane et al., 1992, 1995a).

Binodoxys communis (Gahan) Braconidae: Aphidiinae

For separation from other members of species complex see Desneux et al. (2009a).

Binodoxys communis was introduced into mainland USA (Minnesota, 2006) from China and from there to Hawaii (2010). The target pest in Minnesota was the soybean aphid, *Aphis glycines* Matsumura (Aphididae), while in Hawaii it was the cotton aphid, *Aphis gossypii* Glover (Aphididae).

United States. For the introduction to Minnesota, pre-release laboratory host-range testing was done with 19 species, and six of the eight non-target *Aphis* species were highly suitable for parasitism, while two were either not suitable or only marginally so. For 11 non-target non-*Aphis* species, one was suitable for parasitism, while three were marginally suitable and seven were not (Wyckhuys et al., 2007). Hosts from the literature include (1) *Aphis gossypii* Glover (Shi, 1980); (2) *Aphis citricola* van der Goot (Ng and Starý, 1986); (3) *Toxoptera citricidus* (Kirkaldy) (Calilung, 2008); and (4) *Pentalonia nigronervosa* Coquerel (Lomerio and Calilung, 2008), suggesting genus- or perhaps family-level specificity (depending on validity of the literature records). Releases in Minnesota (Wyckhuys et al., 2009) did not result in the establishment of this species, perhaps due to loss of effective diapause mechanisms because of prolonged laboratory rearing (Gariepy et al., 2015).

Hawaii. In Hawaii, where there are no native aphids (Aphididae), host range tests examined three non-target, non-native *Aphis* species and all three were highly suitable, while three non-target, non-native, non-*Aphis* species were either not suitable (one sp.) or marginally so (two spp.) (Acebes and Messing, 2013b), suggesting a genus-level specificity. However, since this is the same strain as used in Minnesota, the wider testing data set and literature host records should also be considered, which suggest perhaps either a genus- or family-level specificity, depending on the validity of the literature records. The parasitoid established in Hawaii (Acebes, 2011), but rates of parasitism remained low, perhaps because of high levels of hyperparasitism, and there was no observed reduction in the density of the target pest (Acebes, 2011).

Blepharella lateralis Macquart Tachinidae

Blepharella lateralis was one of three parasitoids introduced to Guam against *Penicillaria jocosatrix* Guenée (Noctuidae), a pest of mango (*Mangifera indica* L.) foliage, from India in 1986–1987 (Nafus, 1991). No laboratory host-range testing was done before release. Hosts recorded in the literature include species of Noctuidae, Arctiidae, and Erebidae, including (1) *Euproctis lunata* (Walker) (Erebidae) (Battu and Dhaliwal, 1977); (2) *Spilosoma obliqua* Walker (Erebidae) (Kumar and Yadav, 1987); and (3) *Olepa* (formerly *Pericallia*) *ricini* (Fabricius) (Arctiidae) (Venkatesha et al., 1993). This tachinid, as well as one other parasitoid (*Euplectrus* nr *parvulus* Ferrière) established (Nafus, 1991), and together they parasitized 20 to 99% of the pest, reducing its density by 75%. *Euplectrus* nr *parvulus* was the more abundant, especially in the dry season, while *B. lateralis* was more important in the wet season. Fruit production on monitored trees increased significantly (Nafus, 1991), and positive foodweb effects occurred that benefitted other native mango foliage-feeding Lepidoptera after the decline of the pest species (Schreiner and Nafus, 1992, 1993).

Bracon compressitarsis Wharton Braconidae

Bracon compressitarsis was imported into Texas (USA) in 1988 from Mexico as a parasitoid of the cotton bollworm, *Anthonomus grandis* Boheman (Curculionidae) (P. Krauter, pers. comm., Texas A and M University, Dept Entomology). No host-range testing was done before release. Only other species of *Anthonomus* weevils are known as hosts (Wharton, 1983), but little literature exists on the species. In Texas, *B. compressitarsis* did not establish (P. Krauter, pers. comm., Texas A and M University, Dept Entomology), and so it had no impact.

Callibracon limbatus (Brullé) Braconidae

Callibracon limbatus was introduced into California (USA) in 1995 from Australia (Paine et al., 1995). No host-range

testing was done before release and no other hosts are recorded in the literature, but it is assumed to be limited by its biology to attack on the larvae of wood-boring beetles in species of eucalyptus (Hanks et al., 2001). *Callibracon limbatus* did not establish in California (J. Millar, pers. comm.).

Cephalonomia stephanoderis Betrem BETHYLIDAE

For species description, see Betrem (1961).

Cephalonomia stephanoderis was introduced into Mexico in 1988 from Ivory Coast in West Africa against coffee berry borer, *Hypothenemus* (*Stephanoderes*) *hampei* (Ferrari) (Curculionidae: Scolytinae) (Barrera et al., 1990a, 2008; see also Murphy and Moore, 1990). No host-range testing was done before introduction, and no other field hosts are reported in the literature. However, various weevils were tested to find ones suitable for use as hosts for mass rearing; two species—*Caulophilus oryzae* (Gyllenhal) and *Sitophilus* sp.—supported complete parasitoid development (Pérez-Lachaud and Hardy, 2001). Establishment occurred in southern Mexico (Barrera et al., 1990b), and a field evaluation nearby in Guatemala showed that large releases of *C. stephanoderis* reduced berry infestations from 2.7–5.3% (1993) to 0.9–0.4% (1994), and then to 2.4–1.6% (1995), compared to rates in control plots of 2.8, 2.8, and 3.5%, a difference of 75 and 48% from year to year between treatments (García and Barrios, 1996). However, field evaluations of this species have only been based on augmentative releases and so do not measure effects of self-reproducing *C. stephanoderis* populations.

Ceranisus menes (Walker) EULOPHIDAE

Noyes (2017) lists nine synonyms: (1) *Asecodes aculeo* (Walker), (2) *Ceranisus brui* (Vuillet), (3) *Ceranisus rosilloi* De Santis, (4) *Ceranisus vinctus* (Gahan), (5) *Epomphale menes* (Walker), (6) *Euderomphale menes* (Walker), (7) *Pteroptrix menes Walker*, (8) *Thripoctenus brui Vuillet*, and (9) *Thripoctenus vinctus* Gahan.

Ceranisus menes was introduced to Florida (USA) in 1992 from Thailand and Japan (Loomans and van Lenteren, 1995) against *Thrips palmi* Karny (Thripidae). No host-range testing was done before release. This is a cosmopolitan parasitoid known to attack thrips in at least 12 genera (see pp. 103–104 in Loomans and van Lenteren, 1995). Some recoveries were made after release, but establishment is uncertain and no information was found on its impact on the target thrips.

Ceratogramma etiennei Delvare TRICHOGRAMMATIDAE

For species description, see Delvare (1998). Noyes (2017) lists one synonym: *Szelenyia etiennei* (Delvare).

Ceratogramma etiennei was released in 1998 against the citrus root weevil, *Diaprepes abbreviatus* (L.) (Curculionidae), in Florida (USA), after its collection from Guadeloupe in the Caribbean (Hall et al., 2001; see p. 159 of Frank et al., 2007). In host-range tests, no parasitism occurred in eggs of seven non-target Lepidoptera or in one non-target weevil (Peña et al., 2010). Noyes (2017) lists no other species as hosts. In Florida after release, while some initial recoveries were made, long term establishment did not occur (Frank et al., 2007; Peña et al., 2010; see also Amalin et al., 2004).

Cirrospilus ingenuus Gahan EULOPHIDAE

For species description, see Gahan (1932). Noyes (2017) lists three synonyms: *Cirrospilus quadristriata* (Subba Rao and Ramamani), *Cirrospilus quadristriatus* (Subba Rao and Ramamani), and *Scotolinx quadristriata* Subba Rao and Ramamani.

Cirrospilus ingenuus was released in Florida (USA) from Thailand and Taiwan via Australia in 1994 for control of the citrus leafminer, *Phyllocnistis citrella* Stainton (Gracillariidae) (Smith and Hoy, 1995; LaSalle et al., 1999). Host-range testing for this species was done in Australia before release in North America, and those tests, using Australian species, found that no non-target species were attacked from a test list that included one *Phyllocnistis* leafminer, five gracillariid leafminers in other genera, and 11 other foliovores, leafminers, or gall makers in other families (Neale et al., 1995). One weevil, *Rhynchaenus mangiferae* Marshal (Curculionidae), is listed in the literature as a field host (Peter and Balasubramanian, 1984), but this record may be a misidentification and needs confirmation. In addition to the target pest, Noyes (2017) lists as hosts one unspecified agromyzid fly and the lyonetiid leafmining moth *Leucoptera coffeella* (Guérin-Mèneville). *Cirrospilus ingenuus* established in Florida (LaSalle et al., 1999; Hoy, 2005), but had no apparent effect on the target's density; another parasitoid, *Ageniaspis citricola*, released in the same project, became the dominant introduced-parasitoid attacking citrus leafminer in Florida (Hoy, 2005).

Citrostichus phyllocnistoides (Narayanin) Eulophidae

Noyes (2017) lists four synonyms: *Cirrospiloideus phyllocnistoides* (Narayanan), *Cirrospilus phyllocnistidis* Narayanan, *Cirrospilus phyllocnistoides* Narayanan, and *Tetrastichus phyllocnistoides* (Narayanan).

Citrostichus phyllocnistoides was released in Florida (USA) in 2006 against citrus leafminer, *Phyllocnistis citrella* Stainton (Gracillariidae) (P. Stansly, pers. comm.). *Citrostichus phyllocnistoides* is native to East and Southeast Asia, but it was collected for release in Florida from Spain, where it had been released earlier (P. Stansly, pers. comm.). Host-range testing for this species was done in Australia before release in North America, and those tests, using Australian species, found that no non-target species were attacked from a test list that included one *Phyllocnistis* leafminer, five gracillariid leafminers in other genera, and 11 other foliovores, leafminers, or gall makers in other families (Neale et al., 1995). Field hosts of *C. phyllocnistoides* in the literature include (1) the psyllid *Trioza obsoleta* (Buckton) (Dash and Das, 1997), but this record may be a misidentification and needs confirmation; (2) a *Stigmella* sp. leafminer (Nepticulidae) (Massa et al., 2001), which was detected after the parasitoid's introduction to Italy; (3) *Cosmopterix pulcherimella* Chambers (Cosmopterigidae); and (4) a *Liriomyza* sp. leafmining fly (Agromyzidae) (Rizzo et al., 2006). Noyes (2017) also lists one additional species as a host: *Acalyptris minimella* (Scoble) (Nepticulidae). *Citrostichus phyllocnistoides* established in Florida (P. Stansly, pers. comm.), but it had little impact on citrus leafminer in Florida, as another species, *Ageniaspis citricola,* released in the same project became the dominant parasitoid attacking citrus leafminer there (Hoy, 2005).

Coccobius fulvus (Compere and Annecke) Aphelinidae

Noyes (2017) lists three synonyms: *Coccobius mcdonaldi* Shafee, Siddiqui and Rizvi; *Physcus albipodus* Agarwal; and *Physcus fulvus* Compere and Annecke. For a revision of the genus *Coccobius*, see Wang et al. (2014).

United States. This parasitoid was released in 1997–1998 in Florida (USA) (Howard and Weissling, 1999), having been collected in Thailand, against the cycad scale, *Aulacaspis yasumatsui* Takagi (Diaspididae). No laboratory host-range testing was done before release. *Coccobius fulvus* is known from three diaspidid scales: *Unaspis yanonensis* (Takagi, 1991; Matsumoto et al., 2004), *U. euonymi* (Van Driesche et al., 1998a), and *Aulacaspis yasumatsui* Takagi (Howard and Weissling, 1999). Also, Noyes, J. S. (2017) lists four additional diaspidid hosts: *Aonidiella orientalis* (Newstead), *Aulacaspis crawii* (Cockerell), *Lepidosaphes beckii* (Newman), and *Pinnaspis strachani* (Cooley). A literature record also exists for *Parthenolecanium corni* Bouché (Coccidae) (Basheer et al., 2011), but this species is not listed by Noyes (2017) and so may be an error. The species established in Florida (Howard and Weissling, 1999), but it did not suppress cycad scale, which remains a problem there.

Guam. *Coccobius fulvus* was released in Guam in 2002 with material taken from Florida (originally from Thailand) (G. Reddy, pers. comm.). Establishment of *C. fulvus* in Guam has not been confirmed (T. Marler, pers. comm.). It has had no known impact on the scale in Guam.

Coccobius nr *fulvus* Aphelinidae

Also given as *Physcus* nr *fulvus*. *Coccobius* nr *fulvus* may be the same as *Coccobius fulvus*. This is consistent with a recent revision of Chinese *Coccobius* (Wang et al., 2014). However, direct genetic comparisons have not been made. For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms or literature hosts.

Coccobius nr *fulvus* was released in Massachusetts (USA) in 1990–1995, from China, against *Unaspis euonymi* (Comstock) (Diaspididae) (Van Driesche et al., 1998a). No laboratory host-range testing was done before release. For lack of confirmed species identity, Noyes (2017) could not be consulted for literature hosts, but see the entry for *Coccobius fulvus*. *Coccobius* nr *fulvus* established in Massachusetts (O'Reilly and Van Driesche, 2009) and appears to have become an important parasitoid of the euonymus scale in Massachusetts (USA), causing an average of 21% parasitism 12–14 years after release (O'Reilly and Van Driesche, 2009).

Cosmocomoidea spp.

In the literature, five species of *Gonatocerus* (now all *Cosmocomoidea*) seem to have been released in California against *Homalodisca vitripennis*, the glassy-wing sharpshooter (GWSS). However, subsequent development of molecular information showed that some species were native species or otherwise were already present there. The five species found in the literature in relation to introductions against GWSS in California are (1) *Cosmocomoidea* (*Gonatocerus*) *ashmeadi*, (2) *C.* (*G.*) *fasciata* (*fasciatus* if combined with *Gonatocerus*), (3) *C.* (*G.*) *triguttata* (*triguntatus* if combined with *Gonatocerus*), (4) *C.* (*G.*) *morrilli* Howard, and (5) *C.* (*G.*) *walkerjonesi* S. Triapitsyn. In summary, for these, we can note that:

C.* (*G.*) *ashmeadi was found in California before it was released there. It may be a native species in California, or it may have invaded California as early as 1978 on nursery plants (as parasitized sharpshooter eggs on plants), where it adapted to *Homalodisca liturata* Ball) (Vickerman et al., 2014; Triapitsyn, 2006) before the GWSS invasion. In either case, it is included here as an introduction. It is widespread and important. The southern and southeastern USA strains of *C. ashmeadi* were released in California against *H. vitripennis* (Morgan et al., 2002; Pilkington et al., 2005; Triapitsyn, 2006).

C.* (*G.*) *fasciata was found as a pre-existing species in northern California but not in southern California. It was released in the southern part of the state from the southeastern USA but did not establish (S. Triapitsyn, pers. comm.; D. Morgan, pers. comm., California Department of Food and Agriculture).

C.* (*G.*) *morrilli populations from Texas and Tamaulipas (Mexico) were supposedly introduced into California (Triapitsyn, 2002; Pilkington et al. 2005) although a later report (de León and Morgan 2007) indicated that it was a native species (i.e., *G. walkerjonesi* sp. n. described below) that actually had been released in California due to contamination of the cultures of the insectary-reared *G. morrilli* with this similarly looking species (narrative by S. Triapitsyn).

C.* (*G.*) *triguttata was introduced into California against *H. vitripennis* (initially from Tamaulipas, Mexico and then from Texas) and established in California (Morgan et al., 2000; Morgan et al., 2002; Triapitsyn, 2002; Pilkington et al., 2005; Triapitsyn, 2006).

C.* (*G.*) *walkerjonesi is the dominant parasitoid of GWSS in coastal areas of California (Lytle and Morse, 2012). It was not introduced into California, but in some earlier reports, it was mis-reported as *C.* (*G.*) *morrilli* (S. Triapitsyn, pers. comm.). It is believed to be a species native to the state.

Cosmocomoidea ashmeadi (Girault) MYMARIDAE

The change from *Gonatocerus* to *Cosmocomoidea* follows Huber (2015). Noyes (2017) lists three synonyms: *Gonatocerus ashmeadi* Girault, *Gonatocerus dolichocerus ashmeadi* Girault, and *Lymaenon ashmeadi* (Girault).

Cosmocomoidea ashmeadi was released in 2001 in California (USA) having been collected from Louisiana (USA) and Mexico, by the California Department of Food and Agriculture (D. Morgan, pers. comm., California Department of Food and Agriculture; Boyd and Hoddle, 2007) against the invasive sharpshooter, *Homalodisca vitripennis* (Germar) (Cicadellidae) (formerly *Homalodisca coagulata*). Retrospectively, host-range testing done in California found that *Homalodisca liturata* Ball was a physiologically acceptable host, but *Draeculacephala minerva* Ball and *Graphocephala atropunctata* (Signoret) were not suitable hosts (Boyd and Hoddle, 2007). Field surveys failed to find any parasitism of *G. atropunctata* or *D. minerva* eggs by *C. ashmeadi* in native habitats in southern California (Boyd and Hoddle, 2007). Noyes (2017) lists five additional hosts: (1) *Cuerna costalis* (Fabricius), (2) *Homalodisca lacerta* (Fowler), (3) *Oncometopia clarior* (Walker), (4) *Oncometopia orbona* Hopper, and (5) *Oncometopia undata* (Fabricius), suggesting a host range in the Cicadellidae (three genera). Museum specimens of the parasitoid, however, were eventually found that showed that the parasitoid had been collected in California earlier (1978), indicating that it is either native to California or may have been moved earlier as parasitized sharpshooter eggs on nursery plants and then adopted another sharpshooter, *Homalodisca liturata* Ball, as a host (Vickerman et al., 2014; Triapitsyn, 2006), before the invasion of California by *H. vitripennis*. *Cosmocomoidea ashmeadi* is now a widespread and important parasitoid of *H. vitripennis* eggs in California (Vickerman et al., 2014). But since we cannot separate the population that was introduced from the population that was already present in California, we cannot say if the introduced population established or not.

Cosmocomoidea fasciata (Girault) MYMARIDAE

The change from *Gonatocerus* to *Cosmocomoidea* follows Huber (2015). Noyes (2017) lists two synonyms: *Gonatocerus fasciatus* Girault and *Lymaenon fasciatus* (Girault).

Cosmocomoidea fasciata was released in 2006 in California (USA), having been collected from the southeastern USA, by the California Department of Food and Agriculture (D. Morgan, pers. comm., California Department of

Food and Agriculture) against the invasive sharpshooter, *Homalodisca vitripennis* (Germar), Cicadellidae (formerly *Homalodisca coagulata*). Retrospectively, host-range testing done in California found that *Homalodisca liturata* Ball and *Draeculacephala minerva* Ball were physiologically acceptable hosts, but that *Graphocephala atropunctata* (Signoret) was not (Boyd and Hoddle, 2007). Field surveys failed to detect any parasitism of *G. atropunctata* or *D. minerva* eggs by *C. fasciata* in native habitats in southern California (Boyd and Hoddle, 2007). Literature host records include *Oncometopia orbona* (Fabricius) (Triapitsyn et al., 2003). Noyes (2017) lists two additional species as hosts: (1) *Homalodisca liturata* Ball and (2) *Paraulacizes irrorata* (Fabricius), suggesting a host range of three genera in the Cicadellidae. This species was present as a native species in northern California before being released in southern California, but it was not present at the time of release in southern California (S. Triapitsyn, pers. comm.). It did not establish in release area in southern California (S. Triapitsyn, pers. comm.; D. Morgan, pers. comm., California Department of Food and Agriculture).

Cosmocomoidea triguttata (Girault) Mymaridae

The change from *Gonatocerus* to *Cosmocomoidea* follows Huber (2015). Noyes (2017) lists two synonyms: *Gonatocerus triguttatus* Girault and *Gonatocerus triguttus* Girault.

Cosmocomoidea triguttata was released in 2000 in California (USA) having been collected from the southeastern USA and northeastern Mexico, by the California Department of Food and Agriculture (D. Morgan, pers. comm., California Department of Food and Agriculture; S. Triapitsyn, pers. comm.) against the invasive glassy-winged sharpshooter, *Homalodisca vitripennis* (Germar) (Cicadellidae) (formerly *Homalodisca coagulata*). No host-range testing was done before release, but hosts are likely limited to the genera *Homalodisca*, *Oncometopia,* and *Pseudometopia* (Triapitsyn and Phillips, 2000; Noyes, 2017). Literature hosts include *H. vitripennis* in Tamaulipas, Mexico (Triapitsyn and Phillips, 2000) and *Oncometopia nigricans* Walker in Florida (USA) (Triapitsyn et al., 2002). Noyes (2017) lists five additional species as hosts: (1) *Homalodisca lacerta* (Fowler), (2) *Homalodisca liturat*a Ball, (3) *Oncometopia clarior* (Walker), (4) *Pseudometopia amblardii* (Signoret, and (5) *Pseudometopia phalaesia* (Distant). Field recoveries indicate that this parasitoid established in California (S. Triapitsyn, pers. comm.; D. Morgan, pers. comm., California Department of Food and Agriculture), but there is no information indicating what impact it had on the target pest.

Cotesia flavipes (Cameron) Braconidae

This species was formerly known as *Apanteles flavipes*. It is a member of a four-species complex (Polaszek and Walker, 1991; Muirhead et al., 2012).

Cotesia flavipes was released in the USA (Texas) and Mexico (Tamaulipas) for control of stalk borers.

United States. *Cotesia flavipes* was collected from the Indo-Australian region and released in northern Texas in 1985–1987 against *Diatraea grandiosella* Dyar (Crambidae), but it failed to establish (Overholt and Smith, Jr., 1990). No formal host-range testing was done before release, but this species is known to have many hosts in two families (Noctuidae [one genus, three species] and Crambidae [six genera, 14 species], see Table 1 for species and references).

Mexico. The same parasitoid from the same part of the world was released in 1985 in Tamaulipas in northeastern Mexico against *Diatraea saccharalis* (F.) (Crambidae), where it established (Rodríguez-del-Bosque and Smith, Jr., 1997), but no evaluation is known of its impact.

Cotesia rubecula (Marshall) Braconidae

This species was formerly known as *Apanteles rubecula*. The parasitoid imported from Beijing, China by Van Driesche was identified as *C. rubecula*, but may be a distinct species (given as *C.* nr. *rubecula* by You et al. [2012]), though this needs confirmation.

Cotesia rubecula was introduced in 1988 in Massachusetts (USA) from China (Van Driesche and Nunn, 2002) against *Pieris rapae* L. (Pieridae). While the parasitoid sourced from China was the population that became widely established in the eastern United States, there were two earlier introductions of *C. rubecula* into North America, one natural and one deliberate. The first of these was the arrival of a population of unknown origin in British Columbia, Canada (Wilkinson, 1966), a population that later spread naturally into the northwestern USA in the 1970s (Biever, 1992), where it became the dominant parasitoid of *P. rapae* (Biever et al., 1992). This population was also intentionally redistributed to the eastern United States in the 1960s (Puttler et al., 1970). The second population of this species was deliberately introduced from the former Yugoslavia into the southcentral and eastern United States, also in the 1960s (Puttler et al., 1970). Neither of the releases in the 1960s persisted in the eastern United States (McDonald and Kok, 1992), but may have done so in

eastern Canada (Corrigan, 1982; Godin and Boivan, 1998). In western Europe, laboratory host-range testing with the local native population of *C. rubecula* found that the pest *Pieris brassicae* was a suitable host (Geervliet and Brodeur, 1992). In Massachusetts (USA), host-range testing with the Chinese population of *C. rubecula* found that two native butterflies, *Pieris oleracea* (formerly *P. napi*) Harris and *Pieris virginiensis* Edwards, were also suitable physiological hosts (Van Driesche et al., 2003; Benson et al., 2003). In Massachusetts, these native butterflies, were not attacked in the field (*P. virginiensis* [Benson et al., 2003]; *P. napi* [Benson et al., 2003b; Van Driesche et al., 2003]). In New Zealand, in laboratory host-range tests with nine species, two non-target species received ovipositions, *Plutella xylostella* (L.) (Plutellidae) and *Graphania mutans* (Walker) (Noctuidae), but neither host supported larval development (Cameron and Walker, 1997). Under field conditions, the species appears to be monophagous to *P. rapae*.

Following its release in 1988, *C. rubecula* (from China) established readily in Massachusetts and spread rapidly throughout the northeastern and north central USA (Van Driesche and Nunn, 2002). It proved highly effective and by 1998, achieved an average of 75% parasitism in spring cole crops on organic vegetable farms, and it has displaced its competitor, the introduced *Cotesia glomerata* (L.) (Van Driesche, 2008; Herlihy et al., 2012). Field cohorts of *P. rapae* established to construct lifetable for the pest in Massachusetts showed 62% parasitism from *C. rubecula*, the dominant source of mortality to larvae (Herlihy and Van Driesche, 2013).

Cotesia vestalis (Kurdjumov) Braconidae

This species was formerly known as *Cotesia plutellae*, and an earlier generic placement was in *Apanteles*.

Cotesia vestalis was released in Florida (USA) in 1990–1992 from Malaysia against diamondback moth, *Plutella xylostella* (L.) (Plutellidae), having been released earlier in 1983–84 in Hawaii (USA) (Lai and Funasaki, 1986). Laboratory host-range studies done in New Zealand by Cameron and Walker (1997) found successful reproduction (to the cocoon stage) in eight of 13 species tested, in five families: Plutellidae, Pyralidae, Nymphalidae, Arctiidae, and Noctuidae. A similar host range is apparent from literature records (Wang et al., 1972; Joshi and Sharma, 1974; Chiu and Chou, 1976; Lipa et al., 1993; Kaneko, 1993; Guimarães et al., 1995; Waeyenbergh and Baguette, 1996; Endersby and Cameron, 2004; Karimpour et al., 2005; Yadav et al., 2010). It was released in Florida (see p. 20 of Frank and McCoy, 1993; Mitchell et al., 1999), but establishment was not determined (see p. 20 of Frank and McCoy, 1993). However, Mitchell et al. (1999) report results of augmentative releases that achieved 37% parasitism in field trials and so further investigation to assess establishment, impact, and non-target effects seem needed.

Dacnusa sibirica Telenga Braconidae

No synonyms reported in the literature.

Dacnusa sibirica was released in 1995 in Mexico (having been obtained from commercial insectaries) for control of the invasive leafminer *Liriomyza trifolii* (Burgess) (Agromyzidae) in greenhouse crops (Cortez Mondaca and Valenzuela Escoboza, 2015). No laboratory host-range testing was done before release, but literature records suggest that this parasitoid attacks leafmining agromyzid flies in at least three genera: *Liriomyza*, *Chromatomyia*, and *Phytomyza* (Zucchi and van Lenteren, 1978; van de Veire, 1988; van der Linden, 1992; Garrido et al., 1992; Leuprecht, 1993; Croft and Copland, 1994). The purpose of this species' release was to achieve temporary pest suppression in greenhouse crops at a series of individual locations. As such, establishment of outdoor populations of *D. sibirica* was not intended and, while not reported, neither was it looked for.

Diachasmimorpha kraussii (Fullaway) Braconidae

Diachasmimorpha kraussii was introduced in 2003 into Hawaii (USA) from Australia (Bokonon-Ganta et al., 2013) against the pest fruit fly *Bactrocera latifrons* (Hendel) (Tephritidae). In laboratory testing, successful parasitism occurred in species in three genera: *Eutreta, Ceratitis,* and *Bactrocera* (Messing and Ramadan, 2000; Duan and Messing, 2000; Ero et al., 2010), but the only known field host other than the target pest is the olive fly, *Bactrocera oleae* (Rossi) (Argov et al., 2009). After its release in Hawaii, *D. kraussii* established but had only a small impact on the target pest, with rates of field parasitism of only 1.0–1.4% (Bokonon-Ganta et al., 2013).

Diadegma armillata (Gravenhorst) Ichneumonidae

Formerly given as *Campoplex armillatus*, *Angitia armillata*, *Nythobia armillata*, and *Diadegma armillatum*. Other synonyms include *Diadegma pseudocombinatum* (Szepligeti) and *Diadegma tibiale* (Gravenhorst) (Yu, 2017). See Wagener et al. (2006) for notes on phylogeny of the genus *Diadegma*.

Diadegma armillata was released in 1989–1991 in Washington state (USA) using parasitoids collected in both France and Korea (Unruh et al., 2003) against the apple ermine moth, *Yponomeuta malinellus* (Zeller) (Yponomeutidae) (given formerly as *Hyponomeuta malinellus*). Hosts from the literature include species in four families (Yponomeutidae, Tortricidae, Coleophoridae, and Plutellidae) (Servadei, 1930; Beling, 1933; Grandi, 1937; Franz, 1941; Jahn, 1948; Khristova, 1957; Bartninkaite, 1996; Dijkerman, 1990; Hérard and Prévost, 1997; Agrò et al., 2009; Koehler and Kolk, 1971). Host-range testing with eight species in the genus *Yponomeuta* found that host suitability was varied and was related to the ability of the species to encapsulate the parasitoid's eggs (Dijkerman, 1990; Hérard and Prévost, 1997). The parasitoid did not establish in Washington state and thus had no impact on the target pest (Unruh et al., 2003).

Diadegma semiclausum Hellén Ichneumonidae

Formerly given as *Angitia semiclausa* Hellen. Other synonyms include *Diadegma eucerophagum* Horstmann and *Diadegma xylostellae* Kusigemati (Yu, 2017). See Wagener et al. (2006) for notes on phylogeny of the genus *Diadegma*.

Diadegma semiclausum was released in 1985 in Hawaii (USA) from Pakistan (Funasaki et al., 1985) against the diamondback moth, *Plutella xylostella* (L.) (Xylostellidae). No laboratory host-range testing was done before the parasitoid's release. No other hosts are reported in the literature, and the species shows a strong response to cabbage odor, particularly to cabbage infested by *P. xylostella* (Rossbach et al., 2005). Surveys to confirm establishment and measure impact were, apparently, not done. However, given the frequency with which this parasitoid has established and then controlled this pest in other countries, it is very likely that it also did so in Hawaii. Field work in Hawaii is needed to verify this prediction.

Diadromus pulchellus Wesmael Ichneumonidae

No synonyms have been reported (Yu, 2017).

Diadromus pulchellus was collected from Switzerland and adjacent countries and released in Ontario, Canada in 2010 for control of the leak moth, *Acrolepiopsis assectella* (Zeller) (Acrolepiidae) (Mason et al., 2013). Literature records of other hosts include only *Plutella xylostella* (L.) (Plutellidae) (Thibout, 1988). Host-range testing was done before release (Jenner, 2008) and three of 12 non-target species tested were suitable hosts: *P. xylostella, Plutella porrectella* (L.) (Plutellidae), and *Acrolepiopsis incertella* (Chambers) (Acrolepiidae) (Jenner et al., 2014). *Diadromus pulchellus* was recovered in Ontario the year following its release (Mason et al., 2013), but permanent establishment is not certain. Little impact has been observed in Canada, perhaps due to hyperparasitism by *Conura albifrons* (Walsh) (Chalcididae) (Miall et al., 2014). Native-range impact studies done in Europe before releases in Canada suggest a potential high efficacy (Jenner et al., 2010). More time may be needed to observe the outcome of the release.

Diaeretiella rapae (M'Intosh) Braconidae

Given earlier as *Diaeretus rapae* Curtis and *Aphidius brassicae* Marshall.

Diaeretiella rapae was released in 1986 in California (USA) against the asparagus aphid, *Brachycorynella asparagi* (Mordvilko) (Aphididae), using material from Switzerland (Daane et al., 1995a) (and again later against Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) [Reed et al., 1991]). However, this species is apparently native to the USA, as a species with this name has been reported many times from the United States, including California, before this release (Davis and Satterthwait, 1916; Pimentel, 1961; Oatman and Platner, 1971). This aphid has a broad host-range among aphids in the Aphididae, with at least 15 known host species in 13 genera (Paddook, 1916; Davis and Satterthwait, 1916; Wheeler, 1923; Newton, 1934; Pimentel, 1961; Atwal et al., 1969; Oatman and Platner, 1971; Walker et al., 1973; Nemec and Starý, 1984; Reed et al., 1991; Pike et al., 1999; Nebreda et al., 2005). This parasitoid was subsequently recovered from asparagus aphid in California from counties near the release (but not in same county) (Daane et al., 1995a), but because the released population could not be separated from forms of this parasitoid already present in the United States, it could not be determined if the introduced form established, and separable impacts could not be measured. In Washington state,

a parasitoid with the same name was the dominant parasitoid of asparagus aphid (*B. asparagi*), but it did not regulate the aphid to economically acceptable levels (Wright and Cone, 1988).

Diaparsis jucunda (Holmgren) Ichneumonidae

Diaparsis jucunda was released in 2003 in Rhode Island (USA) from Switzerland, France, and other parts of Europe against the lily leaf beetle, *Lilioceris lilii* (Scopoli) (Chrysomelidae) (Tewksbury, 2014, Tewksbury et al., 2017). Host-range testing was done before release (Gold 2003; Kenis et al., 2003; Casagrande and Kenis, 2004) and tests showed that *D. jucunda* attacked the two European *Lilioceris* species tested. Of eight species of North American, non-*Lilioceris* beetles tested (six same family; two in other families), none were attacked (Kenis et al., 2003; Casagrande and Kenis, 2004). Because there are no native *Lilioceris* in North America, this agent is functionally monophagous in the area of release. Releases were made in various New England states (Casagrande and Kenis, 2004; Tewksbury, 2014, Tewksbury et al., 2017), and the parasitoid established in various New England states and spread (Tewksbury et al., 2017). The population-level impact of this parasitoid on lily leaf beetle has not yet been evaluated but pest population reductions are associated with establishment (Tewksbury, 2014).

Diaphorencyrtus aligarhensis (Shafee, Alam & Agarwal) Encyrtidae

Noyes (2017) lists seven synonyms and some further minor variants: (1) *Aphidencyrtus aligarhensis* Shafee, Alam and Agarwal; (2) *Aphidencyrtus diaphorinae* Myartseva and Trjapitzin; (3) *Aphidencyrtus sacchari* Kaul and Agarwal; (4) *Diaphorencyrtus aligarensis* (Shafee, Alam and Agarwal); (5) *Diaphorencyrtus diaphorinae* (Lin and Tao); (6) *Psyllaephagus diaphorinae* Lin and Tao; and (7) *Syrphophagus aligarhensis* (Shafee, Alam and Agarwal).

Diaphorencyrtus aligarhensis was released first in 2000–2002 in Florida (USA) from Taiwan (Hoy, 2005), second in 2007–2009 in Florida from China (Rohrigh et al., 2012), and third in 2014 in California from Pakistan (USDA APHIS, 2014; Milosavljević et al., 2017), all against the citrus psyllid *Diaphorina citri* Kuwayama (Liviidae, formerly Psyllidae). No host-range testing was done before the releases in Florida, but such tests were conducted before the species' release in California (Bistline-East et al., 2015). Of seven non-target psyllids (in the superfamily sense) tested—(1) *Bactericera cockerelli* (Sulc) (Triozidae), (2) *Heteropsylla* sp. (Psyllidae: Ciriacreminae), (3) *Arytainilla spartiophylla* (Forester) (Psyllidae: Psyllinae), (4) *Euphyllura olivina* (Costa) (Liviidae: Euphyllurinae), (5) *Heteropsylla texana* Crawford (Psyllidae: Ciriacreminae), (6) *Diclidophlebia fremontiae* (Klyver) (Liviidae: Liviinae), and (7) *Boreioglycaspis melaleucae* Moore (Aphalaridae)—only one species was parasitized: the non-native pest, potato psyllid (*B. cockerelli*), at a 14% rate (Bistline-East et al., 2015). The releases in Florida failed to result in establishment (Rohrigh et al., 2012). In California, *D. aligarhensis* has been recovered (as of 2017) in 13 of 15 release locations, with parasitism ranging from 0.2–34.5% (Milosavljević et al., 2017). More time is needed to evaluate the impact of the parasitoid on pest populations in California.

Diglyphus isaea (Walker) Braconidae

This species may be a complex of many cryptic species, four having been suggested from China alone (Sha et al., 2007). Synonyms include *Solenotus isaea*.

Diglyphus isaea was introduced into Mexico in 1995 (sourced from Koppert or other commercial insectaries) against *Liriomyza trifolii* (Burgess) (Agromyzidae) (Cortez Mondaca and Valenzuela Escoboza, 2015). No laboratory host-range testing was done before release. Literature records, together with records of Noyes (2017), suggest a host list that includes many agromyzid leafminers (17 species in seven genera, of which eight species are in *Liriomza*), together with one leafminer species in Nepticulidae and one in Gracillariidae (Ciampolini, 1949; Burges, 1974; Sant et al., 1975; Takada and Kamijo, 1979; Hendrickson and Barth, 1979; Navone and Vidano, 1983; Villevieille, 1987; Weigand, 1990; Leuprecht, 1992; Boot et al., 1992; van der Linden, 1992; Beitia et al., 1994; González Tirado et al., 1996; Massa and Rizzo, 2000; Georgiev and Boyadzhiev, 2002; El-Serwy, 2003; Niranjana et al., 2005; Bjorksten et al., 2005; Tokumaru, 2006). This parasitoid was introduced into Mexico for use in greenhouses and its establishment outdoors was not intended. Whether it established outdoors or had any impacts there is unknown.

Digonogastra kimballi Kirkland Braconidae
(formerly known as *Iphiaulax kimballi*)

Digonogastra kimballi was introduced in 1985–1987 into northern Texas (USA) from Mexico against *Diatraea grandiosella* Dyar (Crambidae) (Overholt and Smith, Jr., 1990). No laboratory host-range testing was done before release. Hosts known from literature records are *Eoreuma loftini* (Dyar) and six species of *Diatraea* (all Crambidae) (Wharton et al., 1989; Rodríguez-del-Bosque and Smith, 1990). Establishment was not demonstrated, but some ability to overwinter was observed (Overholt and Smith, Jr., 1990). Further work would be needed to determine if *D. kimballi* has established and whether it has had any impact on the target pest.

Doryctobracon trinidadensis (Gahan) Braconidae
(formerly in *Opius*)

Doryctobracon trinidadensis was released in 1985 in Florida (USA), having been collected from Trinidad, for control of *Anastrepha suspensa* (Loew) (Tephritidae) (Baranowski et al., 1993). No laboratory host-range testing was done before release, and the only literature host records are *Anastrepha serpentina* (Wiedemann) and *Anastrepha striata* Schiner (Gahan, 1919). Some initial recoveries were made but establishment could not be confirmed (Baranowski et al., 1993).

Encarsia aurantii (Howard) Aphelinidae
Noyes (2017) lists three synonyms: (1) *Coccophagus aurantii* Howard, (2) *Prospalta aurantii* (Howard), and (3) *Prospaltella aurantii* (Howard).

Encarsia aurantii was released in Sacramento, California (USA) in 1988 for control of the obscure scale, *Melanaspis obscura* (Comstock) (Diaspididae), a pest of oak trees. *Encarsia aurantii* is an Asian species that invaded the eastern United States along with one of its hosts and eventually reached Texas, from where it was collected for introduction to California, a new ecoregion (Ehler, 1995, 1997, 2005). No host-range testing was done before movement to California. Literature host records include 11 species of diaspidid scales in eight genera (including the target pest) (Nakayama, 1921; Anon., 1929; Wasser, 1938; Reyne, 1948; Mesnil, 1949; Matta and Hichins, 1979; Terán et al., 1985; Khalaf and Sokhansanj, 1993; Abd-Rabou, 2001; Chkhaidze and Yasnosh, 2001). Noyes (2017) lists an extensive set of hosts, including one in Aleyrodidae, three in Coccidae, 52 in Diaspididae, and one in Kermesidae. Since 93% of the existing host records are in the Diaspididae, it appears this is most likely a polyphagous parasitoid of diaspidid scales. The scale established at the release site (Ehler, 1995, 1997, 2005). By 2002, obscure scale was under complete biological control and chemical pesticides were no longer needed to protect oak trees at the release site (Capitol Park, Sacramento) (Ehler, 1995, 2005).

Encarsia bimaculata Heraty and Polaszek Aphelinidae
For species description see (Heraty and Polaszek, 2000). Noyes (2017) lists no synonyms.

Encarsia bimaculata was released in the United States twice: (1) first from India in 1994–1997 into Texas and other western U.S. states (Hoelmer and Goolsby, 2003) and (2) later from Guatemala, India, and Sudan into Florida (Lahey 2014; Lahey et al., 2016), in both cases against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No host-range testing was done before release in either case, and no other species are listed as hosts in the literature. Noyes (2017) lists one additional host: *Trialeurodes vaporariorum* Westwood. The parasitoid did not establish in the western United States but did successfully establish in Florida (Lahey, 2014; Lahey et al., 2016). Its impact on the pest in Florida, however, has not been determined.

Encarsia diaspidicola (Silvestri) Aphelinidae
Noyes (2017) lists one synonym: *Prospaltella diaspidicola* Silvestri.

Encarsia diaspidicola was introduced in 2013 in Hawaii (USA) from a pooled introduction (USA, France, and Tonga) via Samoa against white peach scale, *Pseudaulacaspis pentagona* (Targioni) (Diaspididae) (Follett et al., 2015). Of seven non-target insects tested before this introduction, none were parasitized or killed. These non-target species included three diaspidids (*Pseudaulacaspis cockerelli* [Cooley], *Aspidiotus destructor* Signoret, *Aulacaspis yasumatsui* Takagi) and

the Hawaiian endemic palm scale, *Colobopyga pritchardiae* (Stickney) (Halimococcidae), which was also unaffected (Neumann et al., 2010). Literature host records include the two diaspidids *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Sands et al., 1990) and *Quadraspidiotus perniciosus* (Comstock) (Matadha et al., 2005). In addition, Noyes (2017) lists three other hosts: (1) *Aspidiotus hederae* (Vallot), (2) *Chrysomphalus dictyospermi* (Morgan), and (3) *Lepidosaphes beckii* (Newman), collectively suggesting a family level host range (five known host species in five genera). If this species is the same as *Encarsia* nr *diaspidicola* discussed above, then *Unaspis euonymi* (Comstock) (Diaspididae) would be another host (Van Driesche et al., 1998a). *Encarsia diaspidicola* established in Hawaii, parasitizing 5–12% of the target pest (Follett et al., 2015), but the population-level impact of this parasitism on the pest still needs to be evaluated.

Encarsia nr *diaspidicola* (Silvestri) APHELINIDAE

Taxonomic identity of this entity is unclear. For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms. This species may be the same or different from *E. diaspidicola* discussed above.

Encarsia nr *diaspidicola* was introduced into Massachusetts (USA) from China in 1990–1995. The taxonomic identity of this entity is unclear, and the list of hosts mentioned here are for *Encarsia diaspidicola* (see previous entry). This introduction was against *Unaspis euonymi* (Comstock) (Diaspididae). No laboratory host-range testing was done before release. If this entity is the same as *E. diaspidicola*, then literature host records include *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Sands et al., 1990) and *Quadraspidiotus perniciosus* (Comstock) (Matadha et al., 2005), both diaspidids. Species of diaspidids that were not parasitized in laboratory host-range testing (Neumann et al., 2010) were *Pseudaulacaspis cockerelli* (Cooley), *Aspidiotus destructor* Signoret, and *Aulacaspis yasumatsui* Takagi. For lack of confirmed species identity, Noyes (2017) could not be consulted for host records. This parasitoid was released in several states in the northeastern United States (Van Driesche et al., 1998a; Matadha et al., 2003). Recoveries were made in Massachusetts shortly after releases, but long-term establishment was not shown (Van Driesche et al., 1998a). No evidence for establishment was obtained following releases in New Jersey (Matadha et al., 2003).

Encarsia formosa Gahan APHELINIDAE

Noyes (2017) lists one synonym: *Trichaporus formosus* (Gahan).

Encarsia formosa was introduced into the western United States in 1992–1995 and to Guam in 2011 (G. Reddy, pers. comm.), in both cases against *Bemisia tabaci* (Gennadius) strain B (= Middle East-Asia Minor 1) (Aleyrodidae), and in Mexico in 1992–1993 (Arredondo-Bernal, 1999) against *Trialeurodes vaporariorum* Westwood. Details by location follow.

United States. In the USA, the *E. formosa* released in California and Arizona was collected from Greece, Egypt, and Thailand (Goolsby et al., 1998). No laboratory host-range testing was done before release (the species already being in the United States). Literature host records include four whiteflies in addition to the target pest: (1) *Trialeurodes vaporariorum* Westwood (Speyer, 1927); (2) *Dialeurodes chittendeni* Laing (Wilson, 1935); (3) *Aleyrodes spiraeoides* Quaintance and *Bemisia tabaci* (Gennadius) (Gerling, 1966a); and (4) *Trialeurodes ricini* (Misra) (Shishehbor and Brennan, 1995), while Noyes (2017) lists 12 additional species as hosts: (1) *Aleuroglandulus subtilis* Bondar, (2) *Aleurothrixus floccosus* Maskell, (3) *Aleurotrachelus trachoides* Back, (4) *Aleyrodes lonicerae* Walker, (5) *Aleyrodes proletella* L., (6) *Aleyrodes singularis* Danzig, (7) *Dialeurodes citri* (Ashmead), (8) *Lipaleyrodes atriplex* (Froggatt), (9) *Lipaleyrodes euphorbiae* David & Subramaniam, (10) *Tetraleurodes mori* Quaintance, (11) *Trialeurodes abutiloneus* Haldeman, and (12) *Trialeurodes variabilis* (Quaintance), suggesting a host range in the Aleyrodidae (16 species in nine genera). *Encarsia formosa* strains from Greece, Egypt, and Thailand did not establish in the western United States on *B. tabaci* (Goolsby et al., 1998; Kirk et al., 2000).

Mexico. *Encarsia formosa* was introduced into Mexico, in Baja California in 1992–1993 (Arredondo-Bernal, 1999), from Egypt via Texas USA for control of *Trialeurodes vaporariorum* Westwood (Aleyrodidae). In Mexico, the parasitoid established (Myartseva et al., 2012; E. Ruiz Cancino, pers. comm.), but its specific impact on *B. tabaci* has not been determined.

Guam. *Encarsia formosa* was introduced into Guam in 2011 (G. Reddy, pers. comm.) (purchased from a commercial insectary) for control of *Bemisa tabaci* (Gennadius) strain B (= Middle East-Asia Minor 1) (Aleyrodidae). In Guam, the parasitoid is believed to have become established but further survey work is needed to confirm this. No information exists on the impact of the parasitoid on *B. tabaci* levels on Guam.

Encarsia nr *hispida* De Santis Aphelinidae

Taxonomic identity unclear, but it is assumed here to be *E. hispida*. Note, *E. hispida* is no longer considered a synonym of *E. meritoria* (Polaszek et al., 1992). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms.

Encarsia nr *hispida* was released in the USA in Texas, Arizona, and California in 1995–1996 (release years are for California and Arizona from W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al. 2008), after being collected in Brazil for use against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory host-range testing was done before release, but literature host records (for *E.* nr *hispida* + *E. hispida*) include seven whitefly species, in six genera (Maignet and Onillon, 1997; Viscarret et al., 2000; Trujillo et al., 2004; Telli and Yigit, 2012), suggesting family-level (Aleyrodidae) specificity. *Encarsia* nr *hispida* did not establish in the United States (Hoelmer and Goolsby, 2003; Goolsby et al. 2005).

Encarsia inaron (Walker) Aphelinidae

Noyes (2017) lists 14 synonyms: (1) *Aphelinus idaeus* Walker, (2) *Aphelinus inaron* Walker, (3) *Coccophagus inaron* (Walker), (4) *Encarsia aleurodis* (Mercet), (5) *Encarsia aleyrodis* (Mercet), (6) *Encarsia borealis* Hulden, (7) *Encarsia brassicae* Shafee and Bela, (8) *Encarsia indifferentis* Mercet, (9) *Encarsia partenopea* Masi, (10) *Myina idaeus* (Walker), (11) *Trichaporus aleyrodis* Mercet, (12) *Trichaporus partenopeus* (Masi), (13) *Trichaporus parthenopeus* (Masi), and (14) *Trychaporus aleyrodis* Mercet.

Encarsia inaron was introduced in 1989-1990 to California (USA) from Europe, for control of the ash whitefly, *Siphoninus phillyreae* (Haliday) (Gould et al., 1992a). No formal host-range testing was done before release. Literature host records, together with hosts mentioned in Noyes (2017), include 23 whitefly species from 12 genera, showing this to be a polyphagous parasitoid of whiteflies (Hodson and Beaumont, 1929; Priesner and Hosny, 1932; Butler, 1936; Viggiani, 1981; Mohyuddin et al., 1989; Bene et al., 1991; Abd-Rabou, 2000b; Malekmohammadi et al., 2012). *Encarsia inaron* established readily in California and other U.S. states (Bellows et al., 2006) and quickly and dramatically gave complete control of the pest. Lifetables of cohorts at release sites showed that nymphal mortality (2–4th instars) increased from 51–58% at control sites to 96–98% at release sites (Gould et al., 1992ab). Densities on ash in California were reduced from 99.9 to 99.999% (Dreistadt and Flint, 1995) and economic benefits in the state were $220–299 million dollars (Pickett et al., 1996).

Encarsia lutea (Masi) Aphelinidae

Noyes (2017) lists three synonyms: (1) *Coccophagus sanctus* Girault, (2) *Encarsia sancta* (Girault), and (3) *Prospaltella lutea* Masi.

Encarsia lutea was introduced into Florida (USA) in 1991 from Israel (Nguyen and Bennett, 1995) against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae) and also into the western United States (Texas, Arizona, and California) in 1993–1999 (using parasitoids from Florida, originally from Israel) (Hoelmer and Goolsby, 2003). No laboratory host-range estimation was done before introduction, but literature records of field hosts include 48 whitefly species in 19 genera (Rosen, 1966; Viggiani, 1981; Kajita, 1981; Longo et al., 1990; Abd-Rabou, 1997; Abd-Rabou and Abou-Setta, 1998; Noyes, 2017), and one non-whitefly host, the coccid *Parthenolecanium corni* (Bouché). These records, apart from the one scale record, suggest family-level (Aleyrodidae) specificity for females of *E. lutea*. Males, in contrast, are parasitoids of eggs of Lepidoptera (Stoner and Butler, 1965). This parasitoid did not establish in Florida (Nguyen and Bennett, 1995) or the western United States (Goolsby et al., 2005) and so had no impact on the target host.

Encarsia noyesi Hayat Aphelinidae

Noyes (2017) lists three synonyms: (1) *Encarsiella noyesi* Hayat, (2) *Dirphys noyesi* (Hayat), and (3) *Dyrphis noyesi* (Hayat).

Encarsia noyesi was released in 1997 in California (USA) having been collected from Mexico (Bellows and Meisenbacher, 2000) against the whitefly *Aleurodicus dugesii* Cockerell (Aleyrodidae). No laboratory host-range testing was done before its release. Five of the six non-target literature hosts are whiteflies in *Aleurodicus*, but there is one whitefly record in *Aleurothrixus* and two records for mealybugs as hosts (Noyes, 2017). *Encarsia noyesi* established in a variety of locations in southern California (Bellows and Meisenbacher, 2000). Dense populations of the pest were observed to decline to unimportant levels (complete biological control), due to the action of this parasitoid and another parasitoid, *Idioporus affinis* LaSalle, released against *A. dugesii* in the same biocontrol project (Bellows and Meisenbacher, 2000).

Encarsia sophia (Girault & Dodd) APHELINIDAE

Noyes (2017) lists nine synonyms: (1) *Coccophagus sophia* Girault and Dodd, (2) *Encarsia bemisiae* (Ishii), (3) *Encarsia shafeei* Hayat, (4) *Encarsia sublutea* (Silvestri), (5) *Encarsia transvena* (Timberlake), (6) *Prospaltella bemisiae* Ishii, (7) *Prospaltella flava* Shafee, (8) *Prospaltella sublutea* Silvestri, and (9) *Prospaltella transvena* Timberlake.

Encarsia sophia from Pakistan was introduced into the United States in both the western United States and Puerto Rico against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory host-range testing was done before introduction to either location. Literature records, together with Noyes (2017), list 28 species of whiteflies in 20 genera as hosts. In addition, Noyes (2017) lists other host records that are unlikely and need confirmation: Aphididae (one species), Diaspididae (one species), and Liviidae (one species).

United States. *Encarsia sophia* was introduced in 1995 to Texas, Arizona, and California (Hoelmer and Goolsby, 2003; Goolsby et al., 2005). The parasitoid established in California (in the Imperial Valley) (Goolsby et al., 2005; Gould et al., 2008) and Texas (Goolsby et al., 2009). Field cage evaluation for this species was done by Goolsby et al. (1998), but its impact on field populations of the target pest has not been determined.

Puerto Rico. *Encarsia sophia* was introduced in 1996 to Puerto Rico (Goolsby et al., 1998). In Puerto Rico, *E. sophia* established and became the dominant parasitoid of *B. tabaci* (Pantoja et al., 2005).

Encarsia strenua (Silvestri) APHELINIDAE

Noyes (2017) lists one synonym: *Prospaltella strenua* Silvestri.

Encarsia strenua was introduced into California (USA) in 1987–1995 (exact date not stated) from Puerto Rico for control of *Dialeurodes citrifolii* (Morgan) (Aleyrodidae) (Bellows and Arakawa, 1995). No laboratory host-range testing was done before introduction. Literature host records and Noyes (2017) suggest family level (Aleyrodidae) specificity, with 13 whitefly species in eight genera recorded as hosts. Establishment was not confirmed. No information is available on its impact on the target pest.

Encarsia tabacivora Viggiani APHELINIDAE

Introduced as *Encarsia* nr *pergandiella* Howard. Relationships in the *E. pergandiella* species complex have been reviewed by Gebiola et al. (2017), who state that the form introduced to the USA from Brazil was *E. tabacivora*, not the *E. pergandiella* that is native to parts of the USA. Noyes (2017) lists one synonym: *Encarsia bemisiae* De Santis.

Encarsia tabacivora was collected from Brazil and introduced into the United States (Texas, Arizona, and California) in 1995–1996 against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae) (Hoelmer and Goolsby, 2003). No host-range testing was done for the released population from Brazil before its release. In addition to the target pest, Noyes (2017) lists four additional species as hosts: (1) *Aleurodicus dispersus* Russell, (2) *Aleurotrachelus trachoides* Back, (3) *Trialeurodes abutiloneus* (Haldane), and (4) *Trialeurodes vaporariorum* Westwood. The literature suggests that, in at least some members of the *pergandiella* complex, males are hyperparasitoids of whitefly parasitoids (Zhang et al., 2015) and the same may be the case for *E. tabacivora*. *Encarsia tabacivora* failed to establish in the United States (Goolsby et al., 1998).

Enoggera reticulata Naumann PTEROMALIDAE

For species description, see Naumann (1991). Noyes (2017) lists no synonyms.

Enoggera reticulata was released in 2000 in California (USA) against *Trachymela sloanei* Blackburn (Chrysomelidae) (Millar et al., 1999–2000; Paine and Millar, 2002). It is native to Australia but was obtained from South Africa, where it had been introduced earlier for biocontrol of another species of *Trachymela* (Tribe and Cillié, 2000). No laboratory host-range testing was done before release. Literature host records include only the chrysomelids *Paropsisterna* sp. and *Trachymela tincticollis* (Blackburn) (Naumann, 1991; Tribe and Cillié, 2000). Noyes (2017) lists no other hosts. *Enoggera reticulata* did not establish in California (J. Millar, pers. comm.; Paine et al., 2015), and no further work was done against this target pest.

Entedononecremnus krauteri Zolnerowich and Rose Eulophidae

For species description, see Zolnerowich and Rose (1996). Noyes (2017) lists no synonyms.

Entedononecremnus krauteri was introduced (from Texas USA via California USA) against the giant whitefly, *Aleurodicus dugesii* Cockerell (Aleyrodidae), in 1997, into Florida (see Table 4, p. 164 of Frank and McCoy, 2007), after the parasitoid's accidental discovery in Texas (Zolnerowich and Rose, 1996), which is another part of the pest's U.S. invaded-range. No host-range testing was done before release in Florida, and there are no other records from the literature. *Entedononecremnus krauteri* established in Florida (see Table 4, p. 164 of Frank and McCoy, 2007), but there is no information on its impact on the target pest.

Ephedrus plagiator (Nees) Braconidae: Aphidiinae

Yu (2017) lists three synonyms: (1) *Ephedrus homostigma* Fahringer, (2) *Ephedrus japonicus* Ashmead, and (3) *Ephedrus parcicornis* (Nees).

Ephedrus plagiator was introduced in 1988–1992 into several states in the western United States, in particular Washington state (Tanigoshi et al., 1995) and Colorado (Elliott et al., 1995) against the Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae), after having been collected from Morocco and the Middle East. No laboratory host-range testing was done before release, but literature host records show this is a polyphagous parasitoid of aphids parasitizing at least eight species in seven genera (Cierniewska, 1973; Chang et al., 1994; Devi et al., 1999; Rakhshani et al., 2008; Takada and Nakamura, 2010; Ji et al., 2014). The parasitoid is not listed among those believed to have established in Colorado (Burd et al., 2001).

Eretmocerus emiratus Zolnerowich & Rose Aphelinidae

For species description, see Zolnerowich and Rose (1998). Noyes (2017) lists no synonyms.

United States. *Eretmocerus emiratus* from United Arab Emirates was released in the USA in California, Arizona, and Texas (Hoelmer and Goolsby, 2003; Goolsby et al., 2005) in 1994 against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory host-range testing was done before release and no other hosts are recorded in the literature. This parasitoid established in California and Arizona, but not Texas (Goolsby et al., 2005; Gould et al., 2008). However, in post-release monitoring, *E. emiratus* was recovered only in small numbers and did not dominate the parasitoid complex at any of the sites studied by Goolsby et al. (2005).

Mexico. *Eretmocerus emiratus* from the United Arab Emirates, via the USA, was released in Baja California, Mexico (Cota-Gómez, et al., 1998) about 1995 or shortly thereafter against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory host-range testing was done before release and no other hosts are recorded in the literature. Whether or not this parasitoid established in Mexico is unknown.

Eretmocerus nr *emiratus* Zolnerowich & Rose Aphelinidae

Taxonomic identity of this species is unclear. For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms.

Eretmocerus nr *emiratus* from Ethiopia was released in the USA in California, Arizona, and Texas (Hoelmer and Goolsby, 2003; Goolsby et al., 2005) in 1993–1999 against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). The taxonomic identity of this entity is unclear and is best tracked either by the accession number assigned in quarantine in Mission Texas, or by its collection location (Ethiopia). No laboratory host-range testing was done before release and the only other host recorded in the literature as attacked by *Eretmocerus* nr *emiratus* is *Aleyrodes lonicerae* Walker in China (Yu, 2015). This parasitoid established in California and Arizona (Goolsby et al., 2005; Gould et al., 2008), and, in post-release monitoring, it was the most commonly collected of the *Eretmocerus* species released against *B. tabaci* in the Imperial Valley in California and the Yuma, Arizona area (Goolsby et al., 2005).

Eretmocerus eremicus Rose & Zolnerowich APHELINIDAE

This species is native to the southwestern USA (Goolsby et al., 2005) and may also be native to Mexico. Noyes (2017) lists no synonyms.

Eretmocerus eremicus was released about 1995 in Baja California, Mexico against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae) (Cota-Gómez, et al., 1998). It was sourced from commercial insectaries and used in augmentative biological control. This species is native to the southwestern USA (Goolsby et al., 2005) and may also be native in Mexico. No laboratory host-range testing was done before release. Noyes (2017) lists other hosts as *Trialeurodes abutiloneus* Haldeman, *Trialeurodes vaporariorum* Westwood, and *Trialeurodes variabilis* (Quaintance). The status of this species in Mexico is unknown.

Eretmocerus furuhashii Rose and Zolnerowich APHELINIDAE

For species description, see Rose and Zolnerowich (1994). Noyes (2017) lists no synonyms.

Eretmocerus furuhashii was released in 1993–1999, in the USA in Texas, Arizona, and California, having been collected from Taiwan, for control of *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae) (Hoelmer and Goolsby, 2003). No laboratory host-range testing was done before release. Literature hosts, apart from *B. tabaci*, include only *Parabemisia myricae* (Kuwana) (Rose and Zolnerowich, 1994), and Noyes (2017) lists no other hosts. *Eretmocerus furuhashii* did not establish in the United States. For results of field-cage trials with *E. furuhashii* (unnamed and coded as *Eretmocerus* sp. M95026 Taiwan), see Goolsby et al. (1998).

Eretmocerus hayati Zolnerowich & Rose APHELINIDAE

For species description, see Zolnerowich and Rose (1998). Noyes (2017) lists no synonyms.

Eretmocerus hayati from Pakistan was released in the southwestern United States (in 1994 in Texas, Arizona, and California), in Mexico (1997), and in Puerto Rico (1997) for control of *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae) (Hoelmer and Goolsby, 2003). No laboratory host-range testing was done before release. No other hosts are listed in Noyes (2017) or in other literature.

United States. *Eretmocerus hayati* established in the Rio Grande River Valley in Texas, but not in Arizona or California (Hoelmer and Goolsby, 2003; Goolsby et al., 2005). In Texas, *E. hayati* was the dominant exotic *B. tabaci* parasitoid recovered in surveys (Goolsby et al., 2005).

Mexico. *Eretmocerus hayati* was released in 1997 in Mexico (Gould et al., 2008), but no further information was located.

Puerto Rico. *Eretmocerus hayati* established in Puerto Rico (Pantoja et al., 2005). In subsequent surveys of *B. tabaci*, only 10% of the parasitoids recovered were species of *Eretmocerus,* the complex being dominated by *Encarsia sophia* (Girault & Dodd), indicating that *E. hayati* did not become a dominant parasitoid of *B. tabaci* in Puerto Rico (Pantoja et al., 2005).

Eretmocerus melanoscutus Zolnerowich & Rose APHELINIDAE

For species description, see Zolnerowich and Rose (1998). Noyes (2017) lists no synonyms.

Eretmocerus melanoscutus was released during 1994–1996 in the USA in Texas, Arizona, and California against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae), having been collected from Thailand and Taiwan (Hoelmer and Goolsby, 2003). No laboratory host-range testing was done before release, and no other hosts are listed in Noyes (2017) or in other literature. *Eretmocerus melanoscutus* did not establish in Texas, Arizona, or California (Goolsby et al., 2005).

Eretmocerus mundus Mercet APHELINIDAE

Noyes (2017) lists the following synonyms: *Eretmocerus aligarhensis* Khan and Shafee and *Eretmocerus longipilus* Khan and Shafee.

Eretmocerus mundus from Spain and Israel was released in the southwestern United States (in 1994 in Texas, Arizona, and California) (Hoelmer and Goolsby, 2003), Mexico (about 1995 or later) (Cervantes and Cota, 1992; Cota-Gómez,

et al., 1998; E. Ruiz Cancino, pers. comm.), and Puerto Rico (1996) (Pantoja et al., 2005) for control of *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory host-range testing was done before any of these releases. In the laboratory, *Eretmocerus mundus* attacks two species of *Trialeurodes*: *T. abutilonea* (Haldeman) and *T. vaporariorum* (Westwood) (Greenberg et al., 2009). Noyes (2017) lists 12 additional hosts (Tiwari et al., 1978; Viggiani and Battaglia, 1983; Kapadia and Puri, 1993; Abd-Rabou and Abou-Setta, 1998; Onillon et al., 2004), suggested family-level (Aleyrodidae), for a total of 15 known hosts in ten genera. However, post-release field surveys in California recovered *E. mundus* only from *B. tabaci*, not from several non-target whiteflies collected (Pickett et al., 2013).

United States. *Eretmocerus mundus* established in Texas (Hoelmer and Goolsby, 2003; Goolsby et al., 2005) and California (Roltsch, 2000; Hoelmer and Goolsby, 2003; Goolsby et al., 2005), but not Arizona (Goolsby et al., 2005). For results of field cage evaluations see Goolsby et al. (1998). In post-release monitoring, *E. mundus* was the dominant parasitoid recovered in the San Joaquin Valley, but not in the Imperial Valley of California. Also, it was only a minor parasitoid among the parasitoids recovered in the Rio Grande Valley of Texas (Goolsby et al., 2005). Of all parasitoids of *B. tabaci*, only 10% were in *Eretmocerus,* indicating that *E. mundus* did not become a dominant parasitoid of *B. tabaci* on the island (Pantoja et al., 2005).

Mexico. Whether or not *E. mundus* established in Baja California, Mexico is unknown; nor is there any information on its impact on the target pest in Mexico.

Puerto Rico. *Eretmocerus mundus* established in Puerto Rico (Pantoja et al., 2005). Of all parasitoids of recovered in post-release surveys of *B. tabaci* in Puerto Rico, only 10% were in the genus *Eretmocerus,* indicating that *E. mundus* did not become a dominant parasitoid of *B. tabaci* on the island (Pantoja et al., 2005), which was dominated by another released parasitoid, *Encarsia sophia* (Girault & Dodd).

Eretmocerus rui Zolnerowich and Rose Aphelinidae

For species description, see Zolnerowich and Rose (2004). Noyes (2017) lists no synonyms.

Eretmocerus rui was released in Florida, USA (Zolnerowich and Rose, 2004), about 1994–1995, after having been collected from Hong Kong (currently, China) (Nguyen and Bennett, 1995), against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory host-range testing was done before release, and Noyes (2017) lists only two additional whitefly hosts: *Bemisia emiliae* (Chen & Ko) and *Crenidorsum turpiniae* (Takahashi). While some post-release recoveries were made, it is uncertain if *E. rui* established in Florida after its release (Zolnerowich and Rose, 2004).

Eretmocerus staufferi Rose and Zolnerowich Aphelinidae

For species description, see Rose and Zolnerowich (1997). Noyes (2017) lists no synonyms.

Eretmocerus staufferi was released in 1994 in California and Arizona, USA (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al. 2008) after being collected from Texas, where it is either native or adventitiously introduced (Hoelmer and Goolsby, 2003) against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory host-range testing was done before release. Literature host records include only *Trialeurodes abutiloneus* Haldeman (Rose and Zolnerowich, 1997). Noyes (2017) lists no other hosts besides *B. tabaci* and T. *abutiloneus*. *Eretmocerus staufferi* did not establish in California or Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008).

Eretmocerus tejanus Rose & Zolnerowich Aphelinidae

Noyes (2017) lists no synonyms.

Eretmocerus tejanus was released in 1994 in the USA in California and Arizona (W. Roltsch, pers. comm., California Department of Food and Agriculture, based on Gould et al., 2008) against *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1 (Aleyrodidae), having been collected from Texas (USA), where it is assumed to be a native species (Hoelmer and Goolsby, 2003). No laboratory host-range testing was done before release and Noyes (2017) lists no other hosts apart from *B. tabaci*.

Euplectrus maternus Bhatnagar EULOPHIDAE

Noyes (2017) lists no synonyms.

Euplectrus maternus was released in 1999–2001 in Guam (USA) after being collected in India against the fruit-piercing moth *Eudocima* (*Othreis*) *fullonia* (Clerck) (Noctuidae) (Muniappan et al., 2004). No host-range testing was done before release. Noyes (2017) lists two additional underwing moths as hosts of *E. maternus*: *Eudocima materna* L. and *Eudocima homaena* (Hübner) (Bhumannavar and Viraktamath, 2000). No evidence of establishment was obtained despite weekly monitoring for two years (Muniappan et al., 2004).

Euplectrus nr *parvulus* Ferrière EULOPHIDAE

Taxonomic identity unclear, but if this is *E. parvulus*, then *Euplectrus plecopterae* Mani is a synonym (Noyes, 2017). For lack of confirmed species identity, Noyes (2017) could not be consulted for synonyms.

Euplectrus nr *parvulus* was released in Guam (USA) in 1986–1987 from India, possibly Kerala (Rajeshwari and Chacko, 1992) for control of the mango defoliating moth *Penicillaria jocosatrix* Guenée (Noctuidae) (Nafus, 1991). No laboratory host-range testing was done before release. If this is the true *E. parvulus,* then the known host range includes, in addition to the target pest, four species in three families (Lophopidae, Geometridae, and Noctuidae), in two orders (Hemiptera, Lepidoptera) (Noyes, 2017), but the Hemiptera record should be confirmed. *Euplectrus* nr *parvulus* established on Guam (Nafus, 1991) and as part of a complex of released agents substantially controlled the pest: "The wasps *Aleiodes* sp. [given here as *Aleiodes* nr *circumscriptus*] and *Euplectrus* sp. [given here as *Euplectrus* nr *parvulus*] and the fly *Blepharella lateralis* were released. *Aleiodes* sp. did not establish, but *Euplectrus* sp. and *B. lateralis* did. [Due to the two established species,] populations of the pest fell to 25% of their pre-release levels. Parasitism rates ranged from 20 to 99%. *Euplectrus* sp. was the most abundant parasitoid [and] was more abundant in the dry season, whereas *B. lateralis* was more common in the wet season. Fruit production on monitored trees increased significantly" (Nafus, 1991). Positive foodweb effects also occurred that benefitted other mango-feeding species of Lepidoptera after decline of the pest species (Schreiner and Nafus, 1992, 1993).

Eurithia consobrina (Meigen) TACHINIDAE

(formerly in *Ernestia*)

Eurithia consobrina was released in Manitoba, Canada in 1986–1987, having been collected from Germany, against *Mamestra configurata* Walker (Noctuidae) (Turnock and Carl, 1995; Mason et al., 2002). Host-range testing was done before release, and, of five non-target noctuids tested by placing a fly maggot on the test larva, four (*Agrotis ipsilon* [Hufnagel], *Lacanobia radix* [Walker], *Pseudaletia unipuntata* [Haworth], and *Eruois occulta* [L.]) supported development to pupation (Turnock and Carl, 1995). Literature host records include (1) *Lacanobia oleracea* (L.) (Noctuidae) (Zorin and Zorina, 1928); (2) *Mamestra brassicae* (L.) (Noctuidae) (Yastrebov, 1978); and (3–5) *Laconobia splendens* (Hübner), *Laconobia suasa* (D. & S.), *Melanchra persicariae* (L.) (all Noctuidae) (Turnock and Carl, 1995). Collectively, these findings suggest a host range in two subfamilies of the Noctuidae: Noctuinae and Hadeninae. *Eurithia consobrina* did not established in Canada (Mason et al., 2002; Erlandson, 2013).

Eurysthaea scutellaris (Robineau–Desvoidy) TACHINIDAE

Synonym is *Erythrocera scutellaris*. *Eurystheae* is a misspelling of the generic name in Unruh et al. (2003).

Eurysthaea scutellaris was released in 1989–91 in Washington state (USA) having been collected in France, against the apple ermine moth, *Yponomeuta malinellus* (Zeller) (Yponomeutidae) (Unruh et al., 2003; Table 1; misspelled as *Eurystheae scutellaris*). No laboratory-based host-range testing was done before release. Hosts recorded in the literature include species in three families: (1) the pyralid *Acrobasis consociella* (Hübner) (Lerer and Plugar, 1962); (2) the yponomeutid *Yponomeuta padellus* (L.) (Heusinger, 1981); and (3) the geometrid *Abraxas pantaria* (L.) (Pernek et al., 2015). *Eurystheae scutellaris* was not recovered in Washington (Unruh et al., 2003), but other species released against apple ermine moth did establish and achieved significant control of the target pest.

Eurytoma erythrinae Gates and Delvare Eurytomidae

Noyes (2017) lists no synonyms.

Eurytoma erythrinae was released in 2008 in Hawaii (USA) having been collected in East Africa, for control of the erythrina gall wasp, *Quadrastichus erythrinae* Kim (Eulophidae) (Kaufman and Yalemar, 2017). Host-range testing was done before release, and none of seven non-target gall-makers tested (one native, four biocontrol agents, two adventive species) (*Josephiella microcarpae* Beardsley & Rasplus, *Tectococcus ovatus* Hempel, *Ophelimus* sp., *Trioza* sp., *Eutreta xanthochaeta* Aldrich, *Procecidochares alani* Steyskal, *Procecidochares utilis* Stone), none were attacked (HDOA, 2008). Noyes (2017) lists no other hosts for *E. erythrinae*, nor are any other hosts recorded in the literature. *Eurytoma erythrinae* became widely established in Hawaii (Kaufman and Yalemar, 2017) and greatly reduced the level of leaf galling in most sites (Kaufman and Yalemar, 2017), but not at all locations (Bell et al., 2013).

Euxestonotus error (Fitch) Platygastridae

Also given as *Platygaster error.*

Euxestonotus error was released in Saskatchewan, Canada (having been collected from Europe) in 1995 for control of the wheat midge *Sitodiplosis mosellana* (Géhin) (Cecidomyiidae) (Doane et al. 2002). No host-range testing was done before release. No other hosts are known from the literature, suggesting this species may have species-level of specificity.

Canada. Establishment of *E. error* in Saskatchewan was not confirmed by Doane et al. (2013), who only recovered three individuals in the year following release. However, establishment in Canada can be inferred by the subsequent recovery of *E. error* in Montana, in areas not receiving releases, which was attributed to natural spread from Canada (Echegaray et al., 2016). The impact of this species on the target pest in Saskatchewan has not been evaluated.

United States. *Euxestonotus error* was collected in Saskatchewan, Canada and released in 2015 in Montana (G. Reddy, pers. comm.). It was not recovered at the release sites but was found in another part of Montana (Echegaray et al., 2016), where its occurrence appears to be due to natural spread from Saskatchewan. The impact of this species on the target pest in Montana has not been evaluated.

Fidiobia asina (Loiacono) Platygastridae

For species description, see Loiacono (1982). Also given as *Platystasius asinus* Loiacono in Frank and McCoy (1993 [see page 30]).

Fidiobia asina was released in Florida (USA) in 1991, having been collected from Chile, for control of citrus weevil, *Diaprepes abbreviatus* L. (Curculionidae) (see p. 30 of Frank and McCoy, 1993). No laboratory-based host-range testing was done before release. Literature host records include *Naupactus xanthographus* Germar (Loiacono, 1982). Establishment is undetermined (see p. 30 of Frank and McCoy, 1993).

Fidiobia dominica Evans and Peña Platygastridae

For species description, see Evans and Peña (2005).

Fidiobia dominica was released in Florida (USA) in 2006, having been collected from *Diaprepes doublierii* Guérin (Curculionidae) on the island of Dominica in the Caribbean. It was released against a novel host, the invasive citrus weevil, *Diaprepes abbreviatus* (L.) (Evans and Peña, 2005). No host-range testing was done before release, but *F. dominica* was reared for more than 50 generations on *D. abbreviatus* in the laboratory before release (Jacas et al., 2007). This species is likely a parasitoid of various weevils whose eggs are concealed in plant tissues. It is unknown if this parasitoid established in Florida.

Fopius ceratitivorus Wharton Braconidae

For species description, see Wharton (1999).

Fopius ceratitivorus was released in Hawaii (USA) in 2017 (R. Messing, pers. comm.) from Kenya via Guatemala (Lopez et al., 2003), against Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Tephritidae). Laboratory host-range testing was done before release. In host-range tests, the non-target native Hawaiian tephritid *Trupanea dubautiae* (Bryan), infesting flowerheads of the endemic Asteraceae shrub *Dubautia raillardioides* Hillebrand, was not attacked (Wang et al.,

2004). Similarly, three other tephritids (*Bactrocera cucurbitae* [Coquillett], *Bactrocera dorsalis* [Hendel], and *Bactrocera latifrons* [Hendel]) were not attacked (Bokonon-Ganta et al., 2005). The target pest is the only known host, but no other *Ceratitis* species were tested as none are found in Hawaii. The outcome of the release in 2017 has not yet been determined.

Goetheana shakespearei Girault EULOPHIDAE

Noyes (2017) lists four synonyms: (1) *Dasyscapus parvipennis* Gahan; (2) *Dasyscapus thripsivorous* Narayanan, Subba Rao and Ramachandra; (3) *Goetheana parvipennis* (Gahan); and (4) *Goetheana thripsivora* (Narayanan, Subba Rao and Ramachand).

Goetheana shakespearei, originally collected from the Gold Coast in West Africa, was released in Florida (USA) in 1986 (following a long history of releases in the Caribbean based on sharing of colonies) against *Selenothrips rubocinctus* (Girard) (Thripidae) (Frank and McCoy, 1993). No host-range testing was done before release. Noyes (2017) lists eight other hosts: (1) *Caliothrips insularis* (Hood), (2) *Ceratothripoides claratris* (Shumsher), (3) *Dinurothrips hookeri* Hood, (4) *Frankliniella occidentalis* (Pergande), (5) *Heliothrips haemorrhoidalis* (Bouché), (6) *Hercinothrips femoralis* (Reuter), (7) *Pseudodendrothrips mori* Niwa, and (8) *Thrips tabaci* Lindeman, all in Thripidae, suggesting a wide host range within this one family. Detection of *G. shakespearei* in Florida in 1992 (see p. 26 of Frank and McCoy, 1993) shows this species established, but it has been suggested by Frank and McCoy (1993) that the population detected may either have been from the known release or may have spread on its own from other locations in the Caribbean.

Goniozus pakmanus Gordh BETHYLIDAE

For species description see Gordh (1984).

Goniozus pakmanus was released in 1984 (Arizona) and 1985 (California) in the USA, after being collected from Pakistan, for the control of pink bollworm, *Pectinophora gossypiella* (Saunders) (Gelechiidae) (Gordh and Medved, 1986). No host-range testing was done before release. No other hosts of *G. pakmanus* are listed in the literature. However, too little information exists to assess the host range of this species. Whether it established or not has not been determined (Gordh and Medved, 1986).

Gyranusoidea indica Shafee, Alam & Agarwal ENCYRTIDAE

Noyes (2017) lists no synonyms.

Gyranusoidea indica was released in the Caribbean (U.S. Virgin Islands and Puerto Rico), Mexico, and mainland USA (California, Louisiana, and Florida) (see details below) against pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (Pseudococcidae). No laboratory host-range testing was done before release. Noyes (2017) lists four other mealybugs species as hosts: (1) *Ferrisia virgata* Cockerell, (2) *Nipaecoccus viridis* (Newstead), (3) *Phenacoccus solenopsis* Tinsley, and (4) *Pseudococcus longispinus* (Targioni Tozzetti), suggesting these species might be attacked. However, post-hoc sampling of some of these non-target mealybugs in California after the release and establishment of *G. indica*, found no parasitism of *P. solenopsis* or *Ferrisia* species (Roltsch et al., 2006).

U.S. Virgin Islands. *Gyranusoidea indica* was released on St. Thomas, U.S. Virgin Islands in 1998, having been collected from Pakistan and Egypt (W. Roltsch, pers. comm., California Department of Food and Agriculture), where it established (W. Roltsch, pers. comm., California Department of Food and Agriculture) and contributed to the control of the target pest (Kairo et al., 2000).

Puerto Rico. *Gyranusoidea indica* was collected from Pakistan and Egypt (W. Roltsch, pers. comm., California Department of Food and Agriculture) and released in Puerto Rico in 1999 (Michaud and Evans, 2000), where is it established (Michaud and Evans, 2000). In less than two years, *G. indica* was recovered at 29% of all locations sampled and represented 17% of all the natural enemy individuals recovered (Michaud and Evans, 2000).

Mexico. *Gyranusoidea indica* was released in Baja California, Mexico in 1999, having been recollected from Puerto Rico (see above) (Santiago-Islas et al., 2008). *Gyranusoidea indica* established in Mexico (Santiago-Islas et al., 2008) and contributed to control of the pest (Kairo et al., 2000).

United States. *Gyranusoidea indica* was released in several parts of the continental United States between 2000 and 2006: (1) in 2000, California (from Australia); (2) in 2002, Florida (from Pakistan, Egypt, Australia—mixed colony); and (3) in 2006, Louisiana (from Pakistan, Egypt, Australia—mixed colony) (W. Roltsch, pers. comm., California Department of Food and Agriculture). Documentation is most extensive for California, where the release resulted in establishment (Roltsch et al., 2006) and complete pest control was achieved, due to release of *G. indica* and *Anagyrus kamali*, which

together reduced pink mealybug density by >95%. *Anagyrus kamali* was the dominant summer parasitoid with up to 50% parasitism, while *G. indica* was an important winter parasitoid (Roltsch et al., 2006)

Haeckeliania sperata Pinto Trichogrammatidae

For species description, see Pinto (2005). Noyes (2017) lists no synonyms.

Haeckeliania sperata was released in Florida (USA) in 2005 (Jacas et al., 2008), after having been collected from eggs of an unidentified citrus weevil on the island of Dominica (Caribbean) (Pinto, 2005). Host-range testing was done before release. No attack occurred on eggs of two species of Lepidoptera or eggs of two species of beetles (one Coccinellidae and one non-*Diaprepes* Curculionidae) (Peña et al., 2010). *Pachnaeus litus* Schoenherr (Curculionidae) is a suitable host in the laboratory (Jacas et al., 2010). No other hosts are listed in Noyes (2017). *Haeckeliania sperata* established in Florida (Peña et al., 2010), but no information is available on its impact on the target weevil.

Herpestomus brunnicornis (Gravenhorst) Ichneumonidae

Herpestomus brunnicornis was released in 1989–1991 in Washington state, USA (Unruh et al., 2003; Lee and Pemberton, 2005) and 1990 in British Columbia, Canada (Cossentine and Kuhlmann, 2002), having been collected both in Europe and East Asia, for control apple ermine moth, *Yponomeuta malinellus* (Zeller) (Yponomeutidae). Laboratory host-range testing was done before release and three non-target hosts in the same genus in the native range were suitable hosts (Fischer, 1987). Literature hosts include the following yponomeutids: (1) *Yponomeuta malinellus* (Zeller) (formerly *Hyponomeuta malinellus)* (Mokrzecki, 1913); (2) *Yponomeuta rorellus* (Hübner) (formerly *Hyponomeuta rorella*) (Tudor and Marcu, 1974); (3) *Yponomeuta euonymellus* L. (Miczulski and Anasiewicz, 1976); (4–5)*Yponomeuta padella* (L.) (formerly *Hyponomeuta padellus*) and *Yponomeuta cagnagellus* (Hübner) (Fischer, 1987), suggesting a host range limited to various species in one genus (*Yponomeuta*) of the moth family Yponomeutidae.

United States. Some recoveries of *H. brunnicornis* were made in Washington state, but establishment was not confirmed (Unruh et al., 2003), and there are no reports of any impact by it on *Y. mallinellus* in the USA after release.

Canada. There is no evidence of the parasitoid's establishment inBritish Columbia, nor any report of any impact by it on *Y. mallinellus* in Canada after release.

Horismenus elineatus Schauff Eulophidae

For species description, see Schauff (1989). Noyes (2017) lists no synonyms.

Horismenus elineatus was released in Florida (USA) in 1990 (having been collected in Texas or Hawaii [USA], but originally from Bolivia), against the lesser cornstalk borer, *Elasmopalpus lignosellus* (Zeller) (Pyralidae) (see p. 26 of Frank and McCoy, 1993). No laboratory host-range testing was done before release. There are no literature host records and Noyes (2017) gives no other host records. Establishment of *H. elineatus* in Florida has not been determined, nor has any impact on the target pest been reported.

Idioporus affinis La Salle et Polaszek Pteromalidae

For species description, see LaSalle et al. (1997). Noyes (2017) lists no synonyms.

Idioporus affinis was released in California (USA) in 1998–2000, after being collected in Central America, against *Aleurodicus dugesii* Cockerell (Aleyrodidae) (Bellows and Meisenbacher, 2000). No laboratory host-range testing was done before release, and no other hosts are reported in the literature. Noyes (2017) gives no other host records. *Idioporus affinis* established in California. Dense whitefly populations declined to unimportant levels (complete biological control), due to the action of this parasitoid and that of another introduced parasitoid, *Encarsia noyesi* Hayat, released in the same biocontrol project (Bellows and Meisenbacher, 2000).

Jarra maculipennis Marsh and Austin Braconidae

For species description, see Austin et al. (1994).

Jarra maculipennis Marsh and Austin (Braconidae) was introduced about 1993 to California (USA) after being collected

in Australia, for control of *Phoracantha semipunctata* (F.) (Cerambycidae) (J. Millar, pers. comm.). No laboratory host-range testing was done before release. No other hosts are listed in the literature, but parasitism by *J. phoracantha* is likely restricted to borers in eucalyptus trees due to the parasitoid's attraction to eucalyptus odors. There is no record of its establishment in California.

Jarra phoracantha Marsh and Austin Braconidae

For species description, see Austin et al. (1994).

Jarra phoracantha was introduced in 1993 to California (USA) after being collected in Australia, for control of *Phoracantha semipunctata* (F.) (Cerambycidae) (Paine and Millar, 2003). No laboratory host-range testing was done before release. No other hosts are listed in the literature, but parasitism by *J. phoracantha* is likely restricted to borers in eucalyptus trees due to the parasitoid's attraction to eucalyptus odors. There is no record of its establishment in California.

Larra bicolor Fabricius Crabronidae

Synonyms include *Larra gastrica*, *L. guiana*, and *L. scapteriscica* (Menke, 1992).

Larra bicolor was introduced into northern Florida (USA) in 1989, having been collected in Bolivia (Frank and Bennett, 1995; Frank and Walker, 2006). Previously in the 1980s, a population of *L. bicolor* was established in southern Florida taken from Puerto Rico, where it had been introduced earlier from Brazil (Frank and Bennett, 1995). The target pests were three invasive mole crickets (Gryllotalpidae) (formerly in *Scapteriscus*): *Neoscapteriscus abbreviatus* (Scudder); *Neoscapteriscus vicinus* (Scudder), and *Neoscapteriscus borellii* (Giglio-Tos) (all targets formerly in *Scapteriscus*). Laboratory host-range testing was done before the release in northern Florida in 1989 (Castner, 1984), and in addition to *N. vicinus*, *L. bicolor* was found to parasitize the non-native mole crickets *Scapteriscus abbreviatus* Scudder, S. *didactylus* (Latreille), *S. imitatus* Nickle & Castner, and *Scapteriscus borellii* Giglio-Tos (previously known as *S. acletus*). Attack on the only U.S native non-target mole cricket, *Neocurtilla hexadactyla* (Perty), was unsuccessful in >90% of cases (Castner, 1984; Frank et al., 1995), making *L. bicolor* functionally specific in the USA, with a host range of five species in one genus (*Scapteriscus*) of Gryllotalpidae. *Larra bicolor* established in northern Florida (Meagher and Frank, 1998; Frank and Walker, 2006) and provided control of pest. In northern Florida an IPM program using *Steinernema scapterisci* (Nguyen and Smart) and *L. bicolor* suppressed two invasive mole crickets, *N. vicinus* and *S. didactylus*, by 95% (Leppa et al., 2007). *Larra bicolor*, as either the population from Bolivia or the one from Brazil, now occurs throughout Florida (Frank et al., 2009). The mole cricket biocontrol program produced a benefit-to-cost return of 52:1 (Mhina et al., 2016).

Larra godmani Cameron Crabronidae

This species was an accidental contaminant in a shipment of *L. bicolor* (Frank et al., 1995). Synonyms include *Larra braunsii* Kohl and *L. transandina* Williams (Menke, 1992).

Larra godmani was accidentally released (being a contaminant in a shipment of *L. bicolor*) (Frank et al., 1995) in Florida (USA) in 1988 (having been collected in Bolivia) (see p. 32 of Frank and McCoy, 1993), against *Neoscapteriscus vicinus* (Scudder) (formerly *Scapteriscus*) and other invasive *Neoscapteriscus* species (Gryllotalpidae). No laboratory host–range testing was done before its unintended release, and there are no other recorded literature hosts. *Larra godmani* did not establish in Florida (see p. 32 of Frank and McCoy, 1993).

Lathrolestes ensator (Brauns) Ichneumonidae

Synonyms include *Tryphonopsis ensator* Brauns, *Lathrolestes dilatatus* (Nordenstrom), and *Lathrolestes ensatrix* (Schulz) (Yu, 2017).

Lathrolestes ensator was released in 1995–1999 in Quebec, Canada (from Switzerland and surrounding countries) (Vincent et al., 2001a) and, from Canada, into New Hampshire (USA) in 2002 (Vincent et al., 2016) against the apple sawfly, *Hoplocampa testudinea* (Klug) (Tenthredinidae). In neither country was laboratory host-range testing done before release, but from literature records there is only one known host of *L. ensator*, the target, *H. testudinea*.

Canada. *Lathrolestes ensator* established in Quebec, Canada (Vincent et al., 2001b; 2016), but its impact on the target pest has not yet been determined.

United States. *Lathrolestes ensator* did not establish in New Hampshire, USA (A. Eaton, pers. comm.).

Lathrolestes thomsoni Reshchikov Ichneumonidae

For species description, see Reshchikov et al. (2010). The species attacking *Profenusa thomsoni* in Canada that was later introduced into Alaska was initially misidentified as *Lathrolestes luteolator* Gravenhorst, which it is not. No synonyms noted by Yu (2017).

Lathrolestes thomsoni was introduced into Alaska (USA) in 2006, having been collected from western Canada (Soper and Van Driesche, 2014; Soper et al., 2015), against the invasive *Betula* leafminer *Profenusa thomsoni* (Konow) (Tenthredinidae). No laboratory host-range testing was done before release. No other hosts are recorded in the literature apart from the target pest. *Lathrolestes thomsoni* established in Alaska (Soper, 2011; Soper and Van Driesche, 2014; Soper et al., 2015). The release of *L. thomsoni* was associated with a large decline in leafminer density, providing complete control due to this species and two naturally occurring parasitoids (*Lathrolestes soperi* Reshchikov and *Aptesis signis* Provancher) (Soper et al., 2015).

Lemophagus errabundus (Gravenhorst) Ichneumonidae

Lemophagus errabundus was released in 2003 in the USA, in several New England states, having been collected from Switzerland, France, or other parts of Europe (Tewksbury, 2014, Tewksbury et al., 2017), against the lily leaf beetle, *Lilioceris lilii* (Scopoli) (Chrysomelidae). Host-range testing was done before release (Gold, 2003; Kenis et al., 2003; Casagrande and Kenis, 2004; USDA APHIS, 2017). Of two non-target species of European *Lilioceris* that were tested, both were attacked. Of eight species of North American non-*Lilioceris* species (six in the same family; two in other families), none were attacked (Casagrande and Kenis, 2004). Because there are no native *Lilioceris* species in North America, *L. errabundus* is functionally monophagous in North America, although *Lilioceris cheni* Gressit and Kimoto has recently been released in Florida for biocontrol of the weed air potato (*Dioscorea bulbifera* L.) (Featured Creatures, 2017a). *Lemophagus errabundus* has established at release sites in several New England states and is spreading (Tewksbury, 2014, Tewksbury et al., 2017). While the impact of this parasitoid on the target pest has yet to be determined, the earlier release of another parasitoid (*Tetrastichus setifer*) has reduced the pest's larval density by 50–88% at release sites (Tewksbury et al., 2017).

Liotryphon caudatus (Ratzburg) Ichneumonidae

Former generic placements include *Apistephialtes*, *Calliephialtes*, and *Ephialtes*. Yu (2017) lists 3 synonyms: *Liotryphon brevivalvis* (Hensch), *Liotryphon foveolatus* (Constantineanu & Pisica), and *Liotryphon incertus* (Hensch).).

Liotryphon caudatus was collected in Kazakhstan and released in the USA in California and Washington state in 1993 for control of *Cydia pomonella* (L.) (Tortricidae: Olethreutinae) (Mills, 2005b). No laboratory host-range testing was done before release. No other hosts of *L. caudatus* are recorded in the literature, but it is believed to attack only fruit-boring/cocoon-forming tortricids such as *Grapholita molesta* (Busck) and *Grapholita funebrana* (Treitschke) (N. Mills, pers. comm.). *Liotryphon caudatus* apparently established in California (Mills, 2005b), but there is no information available on its impact on the target pest.

Lipolexis oregmae Gahan Braconidae: Aphidiinae

Synonym is *Lipolexis scutellaris* Mackauer, the name under which it was introduced into the USA (Persad and Hoy, 2003).

Lipolexis oregmae was introduced into Florida (USA) in 2000 from Guam against *Toxoptera citricida* Kirkaldy (Aphididae) (= *Toxoptera citricidus*) (Persad et al., 2007). No laboratory host-range testing was done before release. Literature host records include seven species of aphids (Aphididae) in two genera (*Toxoptera* and *Aphis*) (Chang and Youn, 1983; Starý and van Harten, 1983; Starý and Zeleny, 1983; Muraleedharan et al., 1988; Hoy et al., 2007b; Singh et al., 2009). Post-release field studies in Florida found parasitism of *Toxoptera aurantii* (Boyer de Fonscolombe), *Aphis craccivora* Koch, *Aphis spiraecola* Patch), and *Aphis gossypii* Glover (Persad et al., 2007). *Lipolexis oregmae* established in Florida (Persad et al., 2007), but no information is available on its effect on the target pest.

Lixadmontia franki Wood and Cave Tachinidae

For species description, see Wood and Cave (2006).

Lixadmontia franki was released in Florida (USA) in 2007, having been collected from Honduras (Cooper et al., 2011).

Some laboratory host-range testing was done before release: one non-target native Floridian weevil, *Metamasius mosieri* Barber, was tested and found to be attacked at significant rates in both choice and no-choice tests (H. Frank, pers. comm.). Literature host records are limited to *Metamasius quadrilineatus* Champion (Suazo et al., 2006). This information suggests that the host range of *L. franki* is likely limited to the genus *Metamasius* in the Curculionidae. *Lixadmontia franki* was not recovered in trap hosts deployed to detect establishment in Florida, but there were technical problems with loss of the trap-host plants (Cooper et al., 2011). Further work in the future is needed to determine if the parasitoid has established.

Lysiphlebia japonica (Ashmead) Braconidae

Synonyms are (1) *Lysiphlebia mirzai* Shujauddin and (2) *Lysiphlebia sacchari* Chen (Yu, 2017). Earlier generic placements include *Lysiphlebus*, *Coelonotus*, and *Aphidius*.

Lysiphlebia japonica was introduced into Florida (USA) in 1996 (having been collected from Taiwan) against *Toxoptera citricida* (Kirkaldy) (Aphididae) (syn. = *Toxoptera citricidus*) (see p. 532 of Michaud, 2002a). No laboratory host-range testing was done before release. Literature hosts include at least 21 species of aphids in 12 genera (Watanabe, 1939; Watanabe and Takada, 1967; Takada, 1976; Tian et al., 1981; Gao, 1985; Takanashi, 1990; Starý et al., 2002; Kikuchi, 2005). *Lysiphlebia japonica* did not establish in Florida (see p. 532 of Michaud, 2002a).

Lytopylus rufipes (Nees von Esenbeck) Braconidae

Earlier generic placements include *Agathis*, *Microdus*, and *Bassus*.

Lytopylus rufipes was released in California and Washington state (USA) in 1993–2000 (having been collected from Kazakhstan) against *Cydia pomonella* (L.) (Tortricidae) (formerly *Laspeyresia pomonella* L.) (Biocat, 2017). No laboratory host-range testing was done before release. Literature hosts include only *Archips rosanus* (L.) (Zlatanova, 1970), but several tortricids and pyralids are believed to be used as hosts (N. Mills, pers. comm.). *Lytopylus rufipes* did not establish in the USA (Biocat, 2017).

Macrocentrus prolificus Wharton Braconidae

For species description, see Wharton (1984). Yu (2017) lists no synonyms.

Macrocentrus prolificus was released in northern Texas (USA) (having been collected in Mexico) in 1985–1987 against the stalk borer *Diatraea grandiosella* Dyar (Crambidae) (Overholt and Smith, Jr., 1990). No laboratory host-range testing done before release. Literature hosts include *Diatraea considerata* Heinrich (Vejar-Cota et al., 2005), as well as *D. grandiosella* Dyar and *D. saccharalis* (F.) (W. Overholt, pers. comm.), suggesting a host range limited to one genus (*Diatraea*) in one family (Crambidae).While *M. prolificus* exists in southern Texas and Mexico, it did not establish in northern Texas.

Macroglenes penetrans (Kirby) Pteromalidae

Noyes (2017) lists nine synonyms: (1) *Decatoma penetrans* (Kirby), (2) *Ichneumon penetrans* Kirby, (3) *Macroglenes brevicornis* Thomson, (4) *Macroglenes decipiens* (Graham), (5) *Macroglenes oculatus* Westwood, (6) *Macroglennes decipiens* (Graham), (7) *Macroglennes penetrans* (Kirby), (8) *Pirene decipiens* Graham, and (9) *Pirene penetrans* (Kirby).

Macroglenes penetrans was released in the USA in central Montana ("golden triangle area") in 2014 (having been collected from Saskatchewan, Canada) against *Sitodiplosis mosellana* (Géhin) (Cecidomyiidae) (Thompson and Reddy, 2016; G. Reddy, pers. comm.). No laboratory host-range testing was done before release. Noyes (2017) lists one additional cecidomyiid, *Contarinia tritici* (Kirby), as a host. *Macroglenes penetrans* established in central Montana ("golden triangle area") (Thompson and Reddy, 2016). While its impact on the pest *S. mosellana* in central Montana has not yet been evaluated, in extreme northeastern Montana, a population of *M. penetrans* that spread into Montana from Saskatchewan on its own causes 52% parasitism of *S. mosellana* (Shanower, 2005).

Mallochia pyralidis Wharton Ichneumonidaee

For species description, see Wharton (1985). No synonyms listed by Yu (2017).

Mallochia pyralidis was introduced into Texas (USA) from Mexico in 1985 for control of the stem borer *Eoreuma loftini*

(Dyar) (Crambidae) (Wharton, 1985). No laboratory host-range testing was done before release, and there are no hosts listed in the literature or by Yu (2017). It is unknown if it established or not.

Mastrus ridens Horstmann Ichneumonidae

Mastrus ridibundus is a synonym.

Mastrus ridens was released in California (USA) in 1995 (having been collected from Kazakhstan) (Mills, 2005ab) against the codling moth, *Cydia pomonella* L. (Tortricidae) (formerly *Laspeyresia pomonella* L.). No laboratory host-range testing was done before release. In New Zealand, some post-facto host-range testing showed that of five species tested, one non-target *Cydia* species (*Cydia succedana* [Haworth]) and four non-*Cydia,* non-target tortricids (*Argyroploce chlorosaris* Meyrick, *Grapholita molesta* (Busck), *Planotortrix octo* Dugdale, and *Ctenopseustis obliquana* [Walker]) were all parasitized, but offspring were small and mostly male (Charles et al., 2013). *Mastrus ridens* is known in its native range only from the target pest, *C. pomonella*; but little sampling has been done of species other than the target (Charles et al., 2013). Non-target tortricids may be killed by this parasitoid but such species seem unlikely to support *M. ridens* populations due to rapid host death from the paralyzing venom of the parasitoid. *Mastrus ridens* is established in California (Mills, 2005a), but its impact on the target pest has not been determined.

Metaphycus flavus (Howard) Encyrtidae

Noyes (2017) lists five synonyms: (1) *Aphycus flavidulus caridei* Brèthes, (2) *Aphycus flavus* Howard, (3) *Aphycus hesperidum* Mercet, (4) *Euaphycus flavus* (Howard), and (5) *Metaphycus mauritanicus* Compere.

Metaphycus flavus was released twice in California (USA), first in 1987 (using a population collected from Italy) (Kennett et al., 1995) and secondly in 1996 (using a population collected from Turkey) (Bernal et al., 1999), in both cases against citricola scale, *Coccus pseudomagnoliarum* (Kuwana) (Coccidae). The second release was in the context of a large-scale augmentative trial against *C. pseudomagnoliarum* in citrus groves in California (Schweizer et al., 2002). No laboratory host-range testing was done before either release. Noyes (2017) lists 39 host species, other than the target pest, in five families: (1) Cerococcidae (one species), (2) Coccidae (30 species in 14 genera), (3) Diaspididae (five species in two genera), (4) Eriococcidae (one species), and (5) Kerriidae (two species in two genera), indicating that this parasitoid has a wide host range among scales, concentrated in the soft scales (Coccidae). The first release (from Italy) did not establish in California (Kennett et al., 1995). The second release (from Turkey) achieved significant same-season parasitism of the pest in citrus groves, but samples taken a year after release found no evidence of establishment (Schweizer et al., 2002).

Metaphycus hageni Daane and Caltagirone Encyrtidae

Introduced as *Metaphycus* sp. A (see p. 145 of Daane et al., 1995b). For species description, see Daane and Caltagirone (1999). Noyes (2017) lists no synonyms.

Metaphycus hageni was introduced into California (USA) in 1986 from Spain for control of *Saissetia oleae* (Olivier) (Coccidae). No laboratory host-range testing was done before release. There are no other hosts given in the literature or by Noyes (2017). *Metaphycus hageni* established in California (see p. 145 of Daane et al., 1995b), but its impact on the target host has not been reported.

Metaphycus orientalis (Compere) Encyrtidae

For species description, see Compere (1924). Noyes (2017) lists one synonym: *Aphycus orientalis* Compere.

Metaphycus orientalis was released in California (USA) in 1985 (having been collected in Japan) against citricola scale, *Coccus pseudomagnoliarum* (Kuwana) (Coccidae) (Kennett et al., 1988, 1995). No laboratory host-range testing was done before release. Literature records of other species as hosts include only *Coccus hesperidum* L. (Compere, 1924). Noyes (2017) lists one additional species as a host: *Saissetia coffeae* (Walker) (Coccidae). *Metaphycus orientalis* did not establishe in California (Kennett et al., 1988, 1995).

Microctonus hyperodae Loan BRACONIDAE

For species description, see Loan and Lloyd (1974). Yu (2017) gives this species as *Perilitus hyperodae* (Loan) but no literature is found under this name

Microctonus hyperodae was introduced into Quebec, Canada (from Argentina via New Zealand) as a new-association form of biological control in 2002 for control of carrot weevil, *Listronotus oregonensis* (LeConte) (Curculionidae), a native pest in Quebec (Boivin, 2013). Host-range testing was done before release in Quebec. Of 24 North American weevils tested, *Microctonus hyperodae* parasitized five species: (1) *Listronotus sparsus* Say; (2) *Listronotus maculcollis* Kirby; (3) *Nedyus flavicaudus* Boheman; (4) *Ceutorhynchus erysimi* Fabricius; and (5) *Gymnetron tetrum* Fabricius (Boivin unpub. data, in Boivin, 2013). Other literature hosts include (1) *Hyperodes bonariensis* Kuschel (Loan and Lloyd, 1974); (2) *Irenimus aequalis* (Broun) (now synonym of *Chalepistes tenebricus*) (Goldson et al., 1992); and (3–6) *Nicaeana cervina* Broun, *Irenimus* (now *Chalepistes*) *egens* (Boun), *Irenimus* (now *Chalepistes*) *aequalis* Broun, and *Irenimus* (now *Chalepistes*) *stolidus* (Barratt et al.,1997); generic placements revised based on Brown (2017). These host records suggest family-level specificity, with at least 11 host species in seven genera. *Microctonus hyperodae* did not establish in Quebec, Canada (Boivin, 2013).

Microplitis mediator (Haliday) BRACONIDAE

Other generic placements include *Microgaster.* Yu (2017 lists synonyms: (1) *Microplitis halidayi* Fahringer, (2) *Microplitis medianus* (Ruthe), and (3) *Microplitis pseudomedianus* Fahringer. *rientalis* Compere.

Microplitis mediator was released in Saskatchewan and Alberta, Canada, in 1991–1999 (having been collected from Switzerland) against *Mamestra configurata* Walker (Noctuidae) (Mason et al., 2002). No laboratory host-range testing was done before release. Literature host records include various noctuids (six species [including the target pest] in five genera) (Slovák, 1985; Arthur and Mason, 1986; Tanaka, 1987; Sengonca and Peters, 1991; Foerster et al., 2001; Ren et al., 2004). *Microplitis mediator* did not establish in Canada (Mason et al., 2002).

Microterys okitsuensis (Compere) ENCYRTIDAE

Noyes (2017) lists no synonyms.

Microterys okitsuensis was released in California (USA) (having been collected from Japan) in 1985 against *Coccus pseudomagnoliarum* (Kuwana) (Kennett et al., 1988, 1995). No laboratory host-range testing was done before release. Literature host records include *Pulvinaria aurantii* Cockerell (Ishii, 1932) and the target pest, *Coccus pseudomagnoliarum* (Kuwana) (Kennett et al., 1988). Noyes (2017) lists four additional coccids as hosts: (1) *Ceroplastes rubens* Maskell, (2) *Coccus hesperidum* L., (3) *Pulvinaria psidii* Maskell, and (4) *Saissetia oleae* (Olivier), suggesting family-level specificity. *Microterys okitsuensis* did not establish in California (Kennett et al., 1988, 1995).

Muscidifurax raptorellus Kogan and Legner PTEROMALIDAE

Noyes (2017) lists no synonyms.

Muscidifurax raptorellus was released in various types of animal-rearing facilities in California (USA) in 1985–1987 (Legner et al., 1989; Meyer et al., 1990) and Alberta, Canada in 1996 (Floate et al., 2000) for augmentative control of *Musca domestica* L. (Muscidae) in manure, the parasitoid having been obtained initially from South America (Chile and Peru) but later from various commercial insectaries that began to rear the species. No host-range testing was done before release in either country. Post-release host-range testing by Geden and Moon (2009) found that all five species of manure-breeding flies tested were successfully parasitized in the laboratory: (1) *Musca domestica* L. (Muscidae), (2) *Haematobia irritans* (L.) (Muscidae), (3) *Hydrotaea aenescens* (Wiedemann) (Muscidae), (4) *Stomoxys calcitrans* (L.) (Muscidae), and (5) *Sarcophaga bullata* (Parker) (Sarcophagidae). Literature field host records include (1) *Musca sorbens* Wiedemann (Muscidae) (Legner et al., 1974) and (2–3) *Musca domestica* L. (Muscidae) and *Stomoxys calcitrans* (L.) (Muscidae) (Lysyk, 2004). Noyes (2017) lists one additional species as a host: *Calliphora vomitoria* (Calliphoridae). Collectively, this suggests a host range of three families: Muscidae (five species in four genera), Sarcophagidae (one species), and Calliphoridae (one species).

United States. Establishment of *M. raptorellus* was not the objective of its release in California (USA), and sampling after releases in some locations found no permanent increase in parasitism of target flies, suggesting the parasitoid indeed

did not establish (e.g., Petersen and Currey, 1996). Temporary increases in rates of parasitism at animal rearing facilities followed parasitoid releases for several weeks, but within the season rates returned to background levels (Petersen and Currey, 1996). Releases in poultry houses in Florida caused partial suppression of *M. domestica* flies (Geden and Hogsette, 2006), as also occurred in dairy calf facilities in New York (Kaufman et al., 2012).

Canada. There is no clear evidence for establishment of *M. raptorellus* in Alberta, Canada; however, overwintering survival in cattle facilities in southern Alberta was 1–10% (Floate and Skovgård, 2004), suggesting some potential for establishment. Augmentative releases in cattle feed yards in southern Alberta increased parasitism of *M. domestica* to about 34% (versus 1–3% in control feed lots) for a short period (Floate et al., 2000).

Myxexoristop hertingi Mesnil Tachinidae

Myxexoristop hertingi (no known synonyms) was released in Ontario, Canada (from Italy) in 2002–2004 against the sawfly *Acantholyda erythrocephala* (L.) (Pamphiliidae) (Lyon, 2014). No host-range testing was done before release. Literature host records include only the target pest, *Acantholyda erythrocephala* (L.) (Pamphiliidae) (Herting, 1957). *Myxexoristop hertingi* did not establish in Canada (Lyon, 2014).

Nothoserphus afissae (Watanabe) Proctotrupidae

Synonyms include *Disogmus afissae* Watanabe and *Watanabeia afissae* Watanabe.

Nothoserphus afissae was introduced to Maryland (USA) in 1988 (source not recorded but, but most likely from Korea or Japan) against the Mexican bean beetle, *Epilachna varivestis* Mulsant (Coccinellidae: Epilachninae) (see p. 206 of Barbosa et al., 1994). No laboratory host-range testing was done before release. Literature host records include (1) *Epilachna niponica* (Lewis) (Ohgushi and Sawada, 1998) (formerly *Henosepilachna pustulosa* (Kono) (Nakamura and Ohgushi, 1981); (2) *Henosepilachna vigintioctomaculata* (Motschulsky) (= *Epilachna vigintioctomaculata*) (Lee et al., 1988); and (3) *Epilachna varivestis* Mulsant (Nakamura and Shiratori, 2010), suggesting a host range limited to the genus *Epilachna*. *Nothoserphus afissae* did not establish in Maryland (see p. 206 of Barbosa et al., 1994).

Oobius agrili Zhang and Huang Encyrtidae

Noyes (2017) lists no synonyms.

Oobius agrili was released in 2007 in the USA in Michigan (having been collected from northeastern China) against the emerald ash borer, *Agrilus planipennis* Fairmaire (Buprestidae) (Duan et al., 2010). Host-range testing was done before release. In the laboratory, of six non-target species of *Agrilus* tested, three were attacked (*A. anxius* Gory, *A. bilineatus* (Weber), and *A. ruficollis* [F.]) and three were not (*A. cyanescens* [Ratzeburg], *A. egenus* Curtis, and *A. subcinctus* Gory) (Gould, 2007). Of six non-target, non-*Agrilus*, none were attacked (Gould, 2007). Noyes (2017) lists no other species as hosts. Collectively, this information suggests genus-level specificity. *Oobius agrili* established in the United States (Duan et al., 2010; Abell et al., 2014), and post-release surveys in Michigan found 10–20% of the pest's eggs were parasitized by *O. argili* (Abell et al., 2014).

Oobius longoi (Siscaro) Host race #1 Encyrtidae

For species description, see Siscaro (1992). Noyes (2017) lists one synonym: *Avetianella longoi* Siscaro, which is the name in the biocontrol literature.

This form of *O. longoi* was released in 1993 in California (USA) having been collected from Victoria, Australia for control of a eucalyptus borer, *Phoracantha semipunctata* (F.) (Cerambycidae) (Paine et al., 1993; Hanks et al., 1996). No laboratory host-range testing was done before release. This race of *O. longoi* attacked both *P. semipunctata* and *Phoracantha recurva* Newman, but preferred the former (Luhring et al., 2000) and did better in it as a host (Luhring et al., 2004) due to lower host encapsulation defenses of *P. semipunctata* (McDonald et al., 2015). In addition, Noyes (2017) lists two other cerambycids as hosts of *O. longoi*: *Coptocerus aberrans* (Newman) and *Epithora dorsalis* MacLeay. This parasitoid is likely restricted to hosts on eucalypts due to attraction to host plant odors. Host race #1 of *O. longoi* established in California (Hanks et al., 1996), and parasitism in the field exceeded 90% (Hanks et al., 1996), which controlled *P. semipunctata* (see also, Paine and Millar [2003] and McDonald et al. [2015]).

Oobius longoi (Siscaro) Host race #2 ENCYRTIDAE

For species description, see Siscaro (1992). Noyes (2017) lists one synonym: *Avetianella longoi* Siscaro, which is the name in the biocontrol literature.

This form of *O. longoi* was released in 2007 in California (USA) for control of a second invasive borer, *Phoracantha recurva* Newman (Cerambycidae) (J. Millar and T. Paine, pers. comm.). No laboratory host-range estimation done before release. Unlike host race #1, this second race can successfully develop in *P. recurva* (Umeda and Paine, 2015; McDonald et al., 2015). Establishment of host race #2 of *O. longoi* was not determined. Eggs of *P. recurva* were deployed as trap hosts to detect parasitism by this host race, but project funding ended before establishment could be confirmed (J. Millar and T. Paine, pers. comm.). Impact of this borer remains to be determined.

Ormia depleta (Wiedemann) TACHINIDAE

(formerly in *Euphasiopteryx*)

Ormia depleta was released in Florida (USA) in 1988 (having been collected from Brazil) against two species of invasive mole crickets: *Neoscapteriscus vicinus* (Scudder) and *Neoscapteriscus borellii* (Giglio-Tos) (Gryllotalpidae) (formerly in *Scapteriscus*) (Frank et al., 1996). Host-range testing was done before release (Fowler, 1987). *Ormia depleta* was attracted to three of five *Scapteriscus* (now *Neoscapteriscus*) species tested, two of which were program targets and one a non-target invasive species (Fowler, 1987). Based on attraction to host song (the test deemed most reliable, as such attraction must occur for a species to be a field host), Walker (H. Frank, pers. comm.), indicated that the world host range of *Ormia depleta* includes *N. vicinus*, *N. borellii* (Fowler and Kochalka, 1985), *N. imitatus* Nickle & Castner (Fowler, 1987), and *N. abbreviatus* (H. Frank, pers. comm.), but it does not include either *Neocurtilla hexadactyla* (Perty) (Gryllotalpidae) (contrary to Fowler and Garcia [1987]) nor a Brazilian *Anurogryllus* sp. (Gryllidae) (contrary to Fowler and Mesa, 1987; Fowler, 1988). *Ormia depleta* established successfully in Florida (Frank et al., 1996). Percentage reductions in trap catch of the two target mole crickets due to biocontrol introductions in Florida ranged from 25 to 81% of former numbers, depending on place, year, and mole cricket species (Parkman et al., 1996). The target pests became fully controlled (Frank and Walker, 2006), but this change was due to several parasitoid species (*O. depleta* and *L. bicolor*) and an introduced entomoparasitic nematode (*Steinernema scapterisci* Nguyen & Smart (Parkman et al., 1996). The mole cricket biocontrol program produced a benefit to cost return of 52:1 (Mhina et al., 2016).

Parallorhogas pyralophagus (Marsh) BRACONIDAE

(formerly *Allorhogas pyralophagus*, the name under which nearly all literature is found). For species description, see Marsh (1984). Yu (2017) lists no other synonyms.

Parallorhogas pyralophagus was released in northern Texas (USA) in 1985–1987 (having been collected from Mexico) against the stem borer *Diatraea grandiosella* Dyar (Crambidae) (Overholt and Smith, 1990). No laboratory host-range testing was done before release. Literature host records (either in field or as laboratory-rearing hosts) include at least 16 species of stemborers of grasses from four moth families (Crambidae, Tortricidae, Pyralidae, and Noctuidae) in 11 genera (Rajabalee and Banymadhub, 1986; Melton and Browning, 1986; Varma et al., 1987; Anon., 1987; Ballal and Kumar, 1989; Castilho et al., 1989; Quashie-Williams, 1991; and Easwaramoorthy et al., 1992). *Parallorhogas pyralophagus* did not establish in northern Texas (Overholt and Smith, 1990), but is established in southern Texas from other work on *Eoreuma loftini* (Meagher et al., 1998). No evaluation of impact was possible in in northern Texas, but in southern Texas on *E. loftini*, see Meagher et al. (1998) for notes on degree of parasitism.

Pediobius foveolatus (Crawford) Eulophidae

Noyes (2017) lists 11 synonyms: (1) *Mestocharis lividus* Girault, (2) *Mestocharomyia lividus* (Girault), (3) *Pediobius epilachnae* (Rohwer), (4) *Pediobius faveolatus* (Crawford), (5) *Pediobius mediopunctata* (Waterston), (6) *Pediobius mediopunctatus* (Waterston), (7) *Pediobius simiolus* (Takahashi), (8) *Pleurotropis epilachnae* Rohwer, (9) *Pleurotropis foveolatus* Crawford, (10) *Pleurotropis mediopunctata* Waterston, and (11) *Pleurotropis simiolus* Takahashi.

Pediobius foveolatus was released in the Northern Mariana Islands (USA) in 1985 from a USDA laboratory colony held in Newark, Delaware, USA (original source, India [Clausen et al., 1978]) against *Epilachna philippinensis* Dieke (Coccinellidae: Epilachninae) (Chiu and Moore, 1993). No laboratory host-range testing was done before release. Host

literature records and Noyes (2017) suggest a host range the includes many *Epilachna* (10 species) and other Epilachninae (five species) (Coccinellidae), as well as two species of predacious ladybirds (Coccinellinae); in addition Noyes (2017) lists other records that seem to call for confirmation (eight species in five families of Lepidoptera) and one record as a hyperparasitoid of a species of *Cotesia* (Braconidae) (Peterson, 1955; Angelet et al., 1968; Tachikawa, 1976; Nakamura and Ohgushi, 1981; Dhingra et al., 1986; Romero-Nápoles et al., 1987; Nakamura et al., 1988; Paulraj and Ignacimuthu, 2007; Beyene et al., 2007; Nakamura and Shiratori, 2010; Noyes, 2017). *Pediobius foveolatus* established in the Northern Mariana Islands (Chiu and Moore, 1993) and provided substantial control of the target pest (Chiu and Moore, 1993).

Pediobius furvus (Gahan) Eulophidae

Noyes (2017) lists two synonyms: *Pediobius furvum* (Gahan) and *Pleurotropis furvum* Gahan.

Pediobius furvus was released in northern Texas (USA) in 1985–1987 (having been collected from Mexico) against *Diatraea grandiosella* Dyar (Crambidae) (Overholt and Smith, Jr., 1990). No laboratory host-range testing was done before release. Field hosts are lepidopteran stem borers in grasses. Literature hosts (both field and laboratory), together with additional species listed by Noyes (2017) suggest a host range spanning four families (23 species in 13 genera), dominated by the Crambidae (12 species in five genera) and Noctuidae (seven species in four genera), but with some hosts in the Pyralidae (three species in three genera) and Geometridae (one species) (Gahan, 1928; La Croix, 1967; Williams, 1970; Scheibelreiter, 1980; Overholt and Smith, Jr., 1989; Rodríguez-del-Bosque and Smith, 1990; Vignes, 1991; Oloo, 1992; Pfannenstiel et al., 1992; Yitaferu and Gebre-Amlak, 1994; Kuniata and Sweet, 1994; Noyes, 2017). *Pediobius furvus* did not establish in northern Texas (Overholt and Smith, Jr., 1990).

Peristenus conradi Marsh Braconidae

Synonym and perhaps current name is *Leiophron conradi* (Marsh) (Yu, 2017), but the biocontrol literature is under *Peristenus*.

Peristenus conradi was released in Delaware (USA) in 1986–1990 (having been collected in Europe) against the invasive alfalfa plantbug, *Adelphocoris lineolatus* (Goeze) (Miridae) (Day et al., 1992). No laboratory host-range testing was done before release. There are no other hosts recorded in the literature. *Peristenus conradi* established in Delaware (Day et al., 1992). In post-release surveys in two U.S. states, no parasitism was found in any of seven phytophagous mirids sampled other than the target pest (Day, 1999, 2005). At the original release site, *P. conradi* caused 40% parasitism of the target pest (Day et al., 1992). In a wider, later survey (Day, 1999), it parasitized 22% of *A. lineolatus*, but apparently caused only minor reduction in the target pest's density ("slight") (Day 2005).

Peristenus digoneutis Loan Braconidae

Leiophron digoneutis (Loan) is a synonym or may be the current name (Loan) (Yu, 2017), but the biocontrol literature is under *Peristenus*. For species description, see Loan and Bilewicz-Pawinska (1973).

Peristenus digoneutis was introduced to the USA from Europe before 1985 (Day et al., 1990) against a native insect, the tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois) (Miridae). Again before 1985, the parasitoid spread naturally to Quebec, Canada and was then redistributed from Quebec to Ontario (Broadbent et al., 2013). *Peristenus digoneuti*s was also released in Saskatchewan in 1981 and 1990–1992 (Broadbent et al., 2002), but apparently without establishment. In 2005, the Ontario/Quebec population was redistributed into Saskatchewan (Broadbent et al., 2013), but did not establish (Broadbent et al., 2013). No laboratory pre-release host-range testing was done in either the USA or Canada. Post-release field host records in the northeastern United States showed that *P. digoneutis* parasitized only the target pest *L. lineolaris* of seven phytophagous mirids found in alfalfa fields (Day, 1999; Day, 2005). Host literature records from Europe include (1) *Lygus rugulipennis* Poppius, its principal European host (Bilewicz-Pawinska, 1976) and (2–3) *Adelphocoris lineolatus* (Goeze), and *Leptopterna dolobrata* (L.) (Haye et al., 2005). Based on European host records and post-release laboratory host-range testing in Canada, Mason et al. (2011) suggested that the host range of *P. digoneutis* in North America will be limited to the genus *Lygus*.

The impact of this species has not yet been determined in Quebec or Ontario, Canada, but in the United States, this species increased parasitism of the target pest in alfalfa in the northeastern United States from about 15% (by native species) to 40–50% (*P. digoneutis* plus native species) and the density of the pest mirid in alfalfa, the main population reservoir, decreased by 75% (Day, 1996; see also Day, 2005).

Peristenus relictus (Ruthe) BRACONIDAE

Leiophron relicta is either a synonym or may be the current correct name; other synonyms include *Peristenus stygicus* and *Microctonus relictus* (Yu, 2017). The biocontrol literature on the species is under both *P. relictus* and *P. stygicus*. For species description, see Loan and Bilewicz-Pawinska (1973).

Peristenus relictus was released in the USA and later in Mexico against the western North American species *Lygus hesperus* Knight (Miridae). No laboratory host-range testing was done before release in any of the three locations. Host literature records (field or laboratory) from Europe include the following mirid bugs: (1) *Lygus rugulipennis* Poppius (Loan and Bilewicz-Pawinska, 1973); (2) *Polymerus unifasciatus* (F.) (Drea et al., 1973); (3) *Lygus hesperus* Knight (Butler and Wardecker, 1974); (4–7) *Lygus lineolaris* (Palisot de Beauvois), *Polymerus basalis* (Reuter), *Labopidicola geminatus* (Johnston), and *Psallus seriatus* (Reuter) (Condit and Cate, 1982); and (8) in northern Germany, the field host range of *P. relictus* includes at least 16 species, in the Mirinae, Phylinae, and Bryocorinae (Haye et al., 2006). These records suggest that the host range of *P. relictus* includes species in several subfamilies of Miridae.

United States. *Peristenus relictus* was released in California (USA) in 1998 using parasitoids from Europe (Pickett et al., 2007). The same parasitoid had been released earlier in 1973 in California, in 1973, where it reproduced but the population later died out (Van Steenwyk and Stern, 1977). Following the 1998 release, the parasitoid established in California (Pickett et al., 2013b). At the two locations where *P. relictus* is known to have established in central California, reductions in densities of *L. hesperus* in alfalfa have been observed (Pickett et al., 2013b). In addition, spread of the parasitoid to new sites in central California has occurred (Picket et al., 2013b).

Mexico. *Peristenus relictus* was released in Baja California in 2014, from an unstated source (likely California, USA) (H. C. Arredondo-Bernal, pers. comm.). Establishment of this parasitoid in Mexico has not been determined and so its impact there is unknown.

Phygadeuon wiesmanni Sachtleben ICHNEUMONIDAE

Yu (2017) lists no synonyms for this species.

Phygadeuon wiesmanni was released in Ontario, Canada in 1985–1991 for control of *Rhagoletis pomonella* (Walsh) (Tephritidae) (Hoffmeister, 2002). No laboratory host-range testing was done before release. Literature records include other species of *Rhagoletis*: *R. cerasi L.* (Weismann, 1933) and *R. alternata* Fallén (Rygg, 1979). *Phygadeuon wiesmanni* did not establish after release in Ontario (Hoffmeister, 2001).

Phymastichus coffea (LaSalle) EULOPHIDAE

Noyes (2017) lists no synonyms. For species description, see LaSalle (1990).

Phymastichus coffea was introduced into Chiapas, Mexico in 1992 (from West Africa via Colombia and Guatemala) against coffee berry borer, *Hypothenemus hampei* (Ferrari) (Curculionidae, Scolytinae) (Barrera et al., 2008). No laboratory host-range testing done before release. Post-release, host-range testing showed that of the three curculionids tested all were all suitable for parasitism: *Araptus* sp., *Hypothenemus obscurus* (Fabricius), *Hypothenemus seriatus* (Eichhoff) (López-Vaamonde and Moore, 1998). Also, Castillo et al. (2004) found that of three non-target *Hypothenemus* species tested, two species (*H. crudiae* [Panzer] and *H. eruditus* Westwood) were successfully parasitized. at levels of 14 and 6%; *Hypothenemus plumeriae* (Nordlinger) was not parasitized, nor were two species in other weevil genera (*Scolytodes borealis* Jordal and *Arpatus fossifrons* Wood). Noyes (2017) lists no other hosts. *Phymastichus coffea* did not establish in Mexico (Barrera et al., 2008), but it did establish in Honduras (Rafael Trejo et al., 2000) and so may spread naturally into Mexico. The measurement of the impact of self-reproducing field populations of this parasitoid has not yet been possible in Mexico. However, augmentative sleeve-cage trials under field conditions suggest the potential for substantial control (Infante et al., 2013).

Platygaster tuberosula Kieffer PLATYGASTERIDAE

Platygaster tuberosula was released in 1993 in Saskatchewan, Canada (having been collected from Switzerland and surrounding parts of central Europe) against *Sitodiplosis mosellana* (Géhin) (Cecidomyiidae), a wheat midge (Olfert et al., 2003). No laboratory host-range testing was done before release. Literature records include only the target pest, *S.*

mosellana (Chavalle et al., 2015), but the literature on this parasitoid is extremely limited.

Canada. *Platygaster tuberosula* established in Saskatchewan, Canada (Olfert et al., 2003), and in one study location, parasitism by *P. tuberosula* of the target pest in 2011 was measured as 11% (Doane et al., 2013), suggesting the potential for some modest impact on the pest's density.

United States. *Platygaster tuberosula* was released in Montana (USA) in 2015 (using parasitoids collected from Saskatchewan, Canada, see above) (G. Reddy, pers. comm.). The parasitoid established in Montana, USA (G. Reddy, pers. comm.), but its impact there has not been assessed.

Prorops nasuta Waterson Bethylidae

Prorops nasuta was released in Chiapas, Mexico, in 1988 (having been collected from Kenya and Togo, or secondarily taken from Brazil, where it was introduced earlier) against coffee berry borer, *Hypothenemus hampei* (Ferrari) (Curculionidae: Scolytinae) (Barrera et al., 1990a, 2008). No host-range testing done before release. Of five species tested after release by Pérez-Lachau and Hardy (2001), *P. nasuta* parasitized two: *Caulophilus oryzae* (Gyllenhal) and *Sitophilus* sp. (both Curculionidae). Literature hosts also include *Xylosandrus compactus* (Eichhoff) (Curculionidae: Scolytinae) (Balakrishnan et al., 2011). *Prorops nasuta* did not establish in Mexico (Infante et al., 2001; Barrera et al., 2008).

Pseudacteon cultellatus Borgmeier Phoridae

Pseudacteon cultellatus was released against *Solenopsis invicta* Buren (Formicidae) in Florida (USA) in 2010, having been collected from northern Argentina and nearby areas in Brazil or adjacent countries (Porter et al., 2013). Host-range testing was done before release. One non-target species, *Solenopsis geminata* (F.), was tested and was attacked at ~5% the rate of attack on the target host in the same test (Estrada et al., 2006). This species is more host specific than *P. curvatus* but less so than other *Pseudacteon* species released. *Pseudacteon cultellatus* established in Florida (Porter et al., 2013), but its impact on the target pest has not yet been determined.

Pseudacteon curvatus Borgmeier Phoridae

Pseudacteon curvatus was released as two different biotypes against *Solenopsis invicta* Buren (Formicidae). Host-range testing was done before release. Of 19 non-*Solenopsis,* non-target ants tested, none were attacked (Porter, 2000). Two species of non-target *Solenopsis* ants were attacked (*S. geminata* [F.] and *S. xyloni* McCook), but at lower rates than the target species (Porter, 2000; Vazquez et al., 2004). Host specificity was confirmed in post-release field studies (Vazquez and Porter, 2005).

Biotype #1. This form was introduced in 2000 to both Tennessee and Florida (USA) having been collected from Argentina and environs (Vazquez et al., 2006). Biotype #1 established in Tennessee, but it did not establish in Florida, where the local invasive fire ant was the red imported fire ant (*S. invicta*), rather than the black imported fire ant (*Solenopsis richteri* Buren, to which biotype #1 was adapted. The impact of biotye #1 on the black imported fire ant in Tennessee has not been reported.

Biotype #2. The second biotype of *P. curvatus,* better adapted to the red imported fire ant, *S invicta,* was introduced in 2003 into Florida (S. Porter, pers. comm.), where it established (Vazquez et al., 2006). The impact of biotype #2 on red imported fire ant, *S. invicta*, has not yet beenreported.

The outcome of these releases of *P. curvatus* was characterized in 2005 as "no impact" on the target pest (Morrison et al., 2005). However, further evaluation continues.

Pseudacteon litoralis Borgmeier Phoridae

Pseudacteon litoralis was released in 1995–2005, in several U.S. states: Texas (1995), Florida and Louisiana (2003–2006), and Alabama (2005), having been collected from northern Argentina and surrounding areas, against two invasive fire ants (*Solenopsis invicta* Buren and *S. richteri* Forel) and their hybrid (S. Porter pers. comm.; Porter et al., 2011). Host-range testing was done before release, and there was no attack on 27 non-target non-*Solenopsis* ants (Porter et al., 1995; Porter and Alonso, 1999). One non-target species of *Solenopis* (*S. geminata*) was attacked (at 9% of rate on the target pest) but there was no successful development (Gilbert and Morrison, 1997). In Brazil in a field test, there was no attack on *S.*

geminata (Porter, 1998). Establishment failed in Texas, Florida, and Louisiana, but succeeded in Alabama (Porter et al., 2011). While this species had no effect where it failed to establish, its impact in Alabama has not yet been determined.

Pseudacteon nocens Borgmeier PHORIDAE

Pseudacteon nocens was released in 2006–2010 in Texas (USA) having been collected from Argentina and environs (Plowes et al., 2012), being targeted against *Solenopsis invicta* Buren, *S. richteri* Forel, and their hybrids (Formicidae). Host-range testing was done before release and a low level of parasitism occurred on one non-target, native *Solenopsis* species, *S. geminata* (F.), which was attacked at about 1/5 the rate of that on the target pest (Estrada et al., 2006). *Pseudacteon nocens* established in Texas and spread (Plowes et al., 2012). The impact of *P. nocens* in Texas has not yet been determined.

Pseudacteon obtusus Borgmeier PHORIDAE

Pseudacteon obtusus was released in the USA in Texas (2006) and Florida (2007), after being collected from Argentina and environs, against *Solenopsis invicta* Buren, *S. richteri* Forel, and their hybrid (Formicidae) (Porter and Calcaterra, 2013). Host-range testing was done before release, and one non-target *Solenopsis* species (*S. geminata* [F.]) was tested. *Solenopsis geminata* was not attacked in one assessment (Morrison and Gilbert, 1999), but was attacked in another at about 10% the rate on the target pest (Estrada et al. 2006). *Pseudacteon obtusus* established in Florida (Porter and Calcaterra, 2013), but its impact has not yet been determined. Its establishment in Texashas not been reported.

Pseudacteon tricuspis Borgmeier PHORIDAE

Pseudacteon tricuspis was released in the USA in Texas (1995) and Florida (1997), after being collected from Argentina and environs, against *Solenopsis invicta* Buren, *S. richteri* Forel, and their hybrid (Formicidae) (Porter et al., 1999). Host-range testing was done before release. In quarantine, of six non-target, non-*Solenopsis* ant species in five genera, none were attacked (Porter and Alonso, 1999). *Solenopsis geminata* (F.) was either attacked at a very low rate (4% of rate on target: Gilbert and Morrison, 1997; Porter and Alonso, 1999) or not at all (Morrison and Porter, 2006), or without production of fly progeny (Porter, 1998). After establishment in Florida, host specificity was confirmed by disturbing fire ant mounds, exposing non-target ants to potential attack. Of 14 species in 12 genera that were exposed in this manner, none were attacked (Morrison and Porter, 2006). Releases in Texas failed, but the parasitoid established in Florida (Porter et al., 1999) and spread (Callcott et al., 2011). The impact of *P. tricuspis* in Florida is not yet determined.

Pseudleptomastix mexicana Noyes and Schauff ENCYRTIDAE

For species description, see (Noyes and Schauff, 2003). Noyes (2017) lists no synonyms.

Pseudleptomastix mexicana was introduced into Guam (USA) in 2002 (likely native to Mexico but collected in Puerto Rico; its release in Puerto Rico is not recorded) for control of papaya mealybug, *Paracoccus marginatus* Williams and Granara De Willink (Pseudococcidae) (Meyerdirk et al., 2004). No laboratory host-range testing was done before release. No other hosts are recorded in the literature for *P. mexicana*, and Noyes (2017) lists no hosts other than the target pest. Establishment of *P. mexicana* in Guam is undetermined; however, the target mealybug was reduced >99% within one year of the introduction of this parasitoid and *Acerophagus papaya*, another species used in the program. No separate accounting of the impact of *P. mexicana* was found for Guam. In Puerto Rico, where *P. mexicana* occurs, most impact on *P. marginatus* was due to *A. papaya*, not *P. mexicana* (UF/IFAS factsheet, not dated).

Psyllaephagus bliteus Riek ENCYRTIDAE

Noyes (2017) lists one synonym: *Psyllaephagus quadricyclus* Riek. Note: two parasitoids of two other invasive eucalypt psyllids were self-introduced in the USA: (1) *Psyllaephagus parvus* Riek (Hymenoptera: Encyrtidae) on lemon gum psyllid, *Cryptoneossa triangula* Taylor and (2) *Psyllaephagus perplexans* Cockerell on the lerp-forming spotted gum psyllid, *Eucalyptolyma maideni* Froggatt (Jones et al., 2011). These are not included in this work because they were not deliberately introduced but are referenced here to prevent confusion.

Psyllaephagus bliteus was released in 2000 in Calfornia, USA (being collected from Australia) (Dahlsten et al., 2003)

against the red gum lerp psyllid, *Glycaspis brimblecombei* Moore (Psyllidae) and later redistributed from California to Mexico (2001) (Villa Castillo, 2005). Host-range testing was done before release. None of three non-target eucalyptus-feeding psyllids tested before release (*Trioza eugeniae* Froggatt, *Ctenarytaina eucalypti* [Maskell], *Boreioglycaspis melaleucae* Moore) were attacked (Dahlsten et al., 2003). Literature hosts other than the target pest include only *Spondyliaspis* cf. *plicatuloides* (Froggatt) (Psyllidae) (Bush et al., 2017). Noyes (2017) lists four species as hosts; however, two were ones tested by Dahlsten et al. (2003) and found not to be parasitized (*B. melaleucae* and *C. eucalypti*). Disregarding those two, the other host psyllids listed by Noyes (2017) are *Creiis costatus* (Froggatt) and *Glycaspis granulata* (Froggatt).

United States. *Psyllaephagus bliteus* established in California (Dahlsten et al., 2003). Initial control in some parts of California (USA) was substantial, with a 50% reduction in female psyllids being observed within a year or so of release at several sites (Dahlsten et al., 2003). Pest suppression by *P. bliteus* is, however, mostly limited to coastal California, and less control has occurred in the inland, hotter areas (Sime et al., 2004; Daane et al., 2012).

Mexico. *Psyllaephagus bliteus* established in northern Mexico (Villa Castillo, 2005). The impact on the target pest has not been reported.

Psyllaephagus pilosus Noyes Encyrtidae

Noyes (2017) lists no synonyms.

Psyllaephagus pilosus was collected from Australia and released in 1993 into California (USA) for control of the blue gum psyllid, *Ctenarytaina eucalypti* (Maskell) (Psyllidae) (Dahlsten et al., 1998a,b). No laboratory host-range testing was done before release. This parasitoid is likely a specialist on eucalyptus-feeding psyllids, conferring high host specificity where eucalypts are not native. No other hosts are known from the literature. Noyes (2017) lists no other species as hosts. *Psyllaephagus pilosus* established in California (Dahlsten et al., 1998a,b), and complete control of the pest occurred within one year (Dahlsten et al., 1998a). Economic benefits to blue gum foliage growers were between 9 and 24 to 1 (Dahlsten et al., 1998b).

Psyllaephagus yaseeni Noyes Encyrtidae

Recorded as *P. rotundifolius* or *P.* nr *rotundiformis* before Noyes (1990) described it as a new species (Beardsley and Uchida, 1990). Noyes (2017) lists no synonyms.

Psyllaephagus yaseeni was released in Hawaii (USA) in 1987 (from Tobago) (Nakahara and Funasaki, 1987) for control of the leucaena psyllid *Heteropsylla cubana* Crawford (Psyllidae). Host-range testing was done before release and *Heteropsylla huasachae* Caldwell and *H. fusca* Crawford were accepted as hosts (Nakahara and Funasaki, 1987). Noyes (2017) lists one additional species as a host: *Heteropsylla incisa* (Šulc). These records suggest a host range that is focused on one psyllid genus, *Heteropsylla*. *Psyllaephagus yaseeni* established in Hawaii (Beardsley and Uchida, 1990; Nagamine et al., 1990), but control of the pest has not been recorded.

Psyttalia carinata (Thompson) Braconidae

Synonyms include *Psyttalia rhagoleticola* (Sachtleben) and a former generic placement as an *Opius* species (Yu, 2017).

Psyttalia carinata was collected from Austria, Switzerland, and Germany and released in Ontario, Canada, in 1985–1991 against *Rhagoletis pomonella* (Walsh) and *Rhagoletis cerasi* (L.) (Tephritidae) (Hoffmeister, 2002). No laboratory host-range testing was done before release. Host literature records include *Rhagoletis cingulata* (Loew) in Europe, where this North American species is invasive (Schuler et al., 2016). *Psyttalia carinata* did not establish in Canada (Hoffmeister, 2002).

Psyttalia humilis (Silvestri) Braconidae

Formerly in *Opius*; no other synonyms (Yu, 2017). The *Psyttalia concolor* (Szépligeti) species complex has been described, with the species *P. humilis* as a member that is sub-Saharan in distribution (Rugman-Jones et al., 2009).

Psyttalia humilis was released in California (USA) in 2006–2013 (having been collected in Namibia) against the olive fruit fly, *Bactrocera oleae* Gmelin (Tephritidae) (Yokoyama et al., 2011; Daane et al., 2011, 2017). Host-range testing was done before release. No attack occurred on two of the five non-target tephritids tested: *Chaetorellia succinea* (Costa) and *Euphranta canadensis* (Loew). Of the other three test species, one was successfully parasitized (*Parafreutreta regalis* [Munro]) and two were probed, but without successful parasitism: *Rhagoletis fausta* (Osten Sacken) and *Rhagoletis*

pomonella (Walsh), (Daane et al., 2011). Host literature records include *Ceratitis capitata* (Wiedemann) (Ehrhorn, 1915) and *Rhagoletis completa* Cresson (Boyce, 1934), although it is unclear if the parasitoid recorded from *R. completa* is the same *P. humilis* or another member of the *P. concolor* species complex. While field reproduction of *P. humilis* did occur in California following its release, the parasitoid apparently failed to overwinter, even at mild coastal sites (Daane et al., 2017).

Psyttalia lounsburyi (Silvestri) Braconidae

Formerly in *Opius*; no other synonyms (Yu, 2017).

Psyttalia lounsburyi was released from 2006–2013 in California, USA (as two colonies, one from Kenya and the other from South Africa) against the olive fruit fly, *Bactrocera oleae* Gmelin (Tephritidae) (Daane et al., 2011, 2017). Host-range testing was done before release. No attack occurred on the five non-target tephritids tested: *Rhagoletis fausta* (Osten Sacken), *Rhagoletis pomonella* (Walsh), *Euphranta canadensis* (Loew), *Parafreutreta regalis* (Munro), and *Chaetorellia succinea* (Costa) (Daane et al., 2008, 2011). In field collections in the native range (Africa), *P. lounsburyi* has been reared only from *B. oleae* (see references in Daane et al., 2008 [Narayanan and Chawla, 1962; Neuenschwander, 1982; Wharton and Gilstrap, 1983; Wharton et al., 2000]). Literature host records include *Ceratitis capitata* (Wiedemann) as a laboratory-rearing host (Billah et al., 2005). These records suggest a narrow field host-range, perhaps limited to the target or to its genus. Recoveries of *P. lounsburyi* were made in California that were determined to be of South African origin (Bon et al. 2017), and establishment has been confirmed (Daane et al., 2017). Field cage trials were done in California before release from 2006 to 2009 that showed substantial parasitism (Wang et al., 2011). Post-establishment impact in the field has not yet been measured.

Pteroptrix wanhsiensis (Compere) Aphelinidae

Noyes (2017) lists one synonym: *Casca wanhsiensis* Compere.

Pteroptrix wanhsiensis was released in Maryland (USA) in 1986 (having been collected in Korea) against *Unaspis euonymi* (Comstock) (Diaspididae) (see p. 230 of Barbosa et al., 1994). No laboratory host-range testing was done before release. Literature host records include *Aonidiella aurantii* Maskell (Diaspididae) (Flanders, 1956) and *Quadraspidiotus perniciosus* (Constock) (Diaspididae) (Chumakova, 1964). Noyes (2017) lists no other species as hosts. *Pteroptrix wanhsiensis* did not establish in Maryland, USA (see p. 230 of Barbosa et al., 1994).

Quadrastichus haitiensis (Gahan) Eulophidae

For species description, see Gahan (1929). Noyes (2017) lists former generic placements in *Aprostocetus* and *Tetrastichus*, but no other synonyms.

Quadrastichus haitiensis was released in Florida (USA) in 1998 (having been collected in the Caribbean islands) against citrus weevil, *Diaprepes abbreviatus* (L.) (Curculionidae) (Peña et al., 2004). *Quadrastichus haitiensis* was also released earlier (1969) in Florida (Sutton et al., 1972), but apparently did not establishment on *Diaprepes abbreviatus* (L.) (Beavers and Selhime, 1975; Hall et al., 2001), but the parasitoid was recovered in the field in Florida, following release, from *Pachnaeus opalus* (Olivier) (Beavers et al., 1980). No laboratory host-range testing was done before release. Literature host records include the following curculionids: (1) *Exophthalmus quadrivittatus* (Olivier) (Gahan, 1929); (2) *Diaprepes abbreviatus* (L.) (Wolcott, 1934); (3–4) *Diaprepes* (*Prepodes*) *vittatus* (L.) and *Exophthalmus similis* Drury (Edwards, 1938); (5) *Pachnaeus litus* (Germar) (Sutton et al., 1972); and (6) *Pachnaeus opalus* (Olivier) (Beavers et al., 1980). Noyes (2017) lists one additional weevil as a host: *Diaprepes famelicus* (Olivier). *Quadrastichus haitiensis* established in Florida following its 1998 release (Peña et al., 2004), but its impact on the target pest was not been determined.

Schoenlandella diaphaniae (Marsh) Braconidae

For species description, see (Marsh, 1986). Former generic placement in *Cardiochiles*; no other synonyms (Yu, 2017).

Schoenlandella diaphaniae was released in Florida (USA) in 1986 (having been collected from South America) against two pickleworms, *Diaphania nitidalis* (Stoll) and *Diaphania hyalinata* (L.) (Crambidae) (Marsh, 1986). No laboratory host-range testing was done before release. Literature hosts include only the two target hosts (Smith et al., 1994). *Schoenlandella diaphaniae* established in Florida (F. Gallardo pers. comm. to J. Peña), but its impacts on the target pests have not been determined.

Spathius agrili Yang Braconidae

For species description, see Yang et al. (2005). No synonyms given in Yu (2017).

Spathius agrili was released in Michigan (USA) in 2007 and later in many other eastern U.S. states (collected from northeast China) for control of *Agrilus planipennis* Fairmaire (Buprestidae) (Duan et al., 2010b; Van Driesche et al., 2016b). Host-range testing was done before release. Of 17 woodborers collected from the field in northeastern China, none other than the target pest produced *S. agrili* (Yang et al., 2008). Of nine non-target *Agrilus* species offered to *S. agrili* in the laboratory in China or the USA, five species were attacked, but only one (*Agrilus mali* Matsumura) yielded adult females (Yang et al., 2008) (see Gould [2007] for summary of host specificity information). No other hosts are recorded in the literature. Next-year recoveries of *S. agrili* were made in Michigan following release, but populations apparently died out later (J. Duan and J. Gould, pers. comm.). Potential establishment in Maryland has been reported (Jennings et al., 2016). There has been no apparent impact on the target pest.

Spathius galinae Belokobylskij and Strazanac Braconidae

For species description, see Belokobylskij et al. (2012). No synonyms in literature.

Spathius galinae was collected in the Russian Far East and released in the northeastern United States (Massachusetts, Connecticut, and New York) in 2015 for control of *Agrilus planipennis* Fairmaire (Buprestidae) (J. Duan and R. Van Driesche, pers. comm.). Host-range testing was done before release. Of 15 wood-boring insects tested, including five species of non-target *Agrilus*, only one species (*Agrilus auroguttatus* Schaeffer) was parasitized (Duan et al., 2015). High levels of parasitism were observed at 3 of 6 sites in the northeastern USA in 2018, one year after last release, with low or medium levels at the other 3 sites. (J. Duan and R. Van Driesche, pers. comm.).

Syngaster lepidus Brullé Braconidae

Synonyms include only *Iphiaulax morleyi* (Austin et al., 1994).

Syngaster lepidus was released in California (USA) in 1993 (having been collected from Australia) against two eucalyptus borers, *Phoracantha semipunctata* (F.) and *Phoracantha recurva* Newman (Cerambycidae) (Paine et al., 1995; Paine and Millar, 2003). No laboratory host-range testing was done before release. Literature host records include only the two target pests (Moore, 1963; Millar et al., 2002). *Syngaster lepidus* established in California, USA (Paine et al., 1995), but its impact on the target pests was not determined.

Tamarixia dahlsteni Zuparko Eulophidae

(introduced as *Tamarixia* sp.) For species description , see Zuparko et al. (2011). Noyes (2017) lists no synonyms.

Tamarixia dahlsteni was collected in Australia and released in 1992 in California (USA) against the eugenia psyllid, *Trioza eugeniae* Froggatt (Triozidae) (Dahlsten et al. 1995). No laboratory host-range testing was done before release. Noyes (2017) and the literature lists no other species as hosts. *Tamarixia dahlsteni* established in California (Dahlsten et al. 2000). Dahlsten et al. (2000) report that "effectiveness controlling the eugenia psyllid has varied from near complete control in most warmer areas [in California] to ineffective control, particularly in cooler areas such as the city of San Francisco."

Tamarixia radiata (Waterson) Eulophidae

Noyes (2017) lists three synonyms: (1) *Tamarixia radiatus* (Waterston), (2) *Tetrastichus indicus* Khan and Shafee, and (3) *Tetrastichus radiatus* Waterston.

Tamarixia radiata has been introduced separately in the USA to both Florida (in 1999 from Taiwan [Michaud, 2002b]) and California (in 2011 from Pakistan [Hoddle, 2012]) against the citrus psyllid, *Diaphorina citri* Kuwayama (Liviidae, formerly Psyllidae). Host-range testing was done before release in California, but not Florida. For work in California, of seven non-target psyllids tested, there was no parasitism of the five native species or one adventive species. The second adventive species, *Bactericera cockerelli* Sulc, a common pest species, was attacked at a low rate (5%) (Hoddle and Pandey, 2014). Literature hosts include only the target pest, *D. citri,* (Husain and Lal, 1920) and *Pallipsylla hyalina* (Mathur)

(Psyllidae) (Noyes, 2017). In Florida, *T. radiata* established (Michaud, 2002b). In one study, *T. radiata*'s impact in Florida was limited by local predators (Michaud, 2004), but in another study, significant levels of parasitism (20–56%) were reported (Qureshi et al., 2009). In California, *T. radiata* established (Hoddle, 2012), and, acting with local generalist predators, it reduced the net reproductive rate of the pest by 55–95% (Kistner et al., 2016).

Telenomus remus Nixon PLATYGASTRIDAE

For species description, see Nixon (1937). No synonyms found in literature.

Telenomus remus was released in southern Florida (USA) in 1988–1989 (from Asia [likely Malaysia] via Puerto Rico and the Cayman Islands) against fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Noctuidae) (Bennett, 1994). Host-range testing was done before release. Of 39 non-target species whose eggs were tested, of those not in the Noctuidae, there were seven in Arctiidae, one in Ctenuchidae, five in Geometridae, one in Mimallonidae, two in Notodontidae, and two in Pyralidae. Of these non-noctuids, only one pyralid was parasitized. Of the 21 noctuids tested, 11 species in 11 genera were parasitized (Wojcik et al., 1976). Together with other literature records, the known hosts of *T. remus* include species in three families: Noctuidae (20 species in 11 genera, concentrated in *Spodoptera*, with eight species), Pyralidae (one species), and Erebidae (two species in two genera). In addition, several other species were used successfully as rearing hosts under laboratory conditions. The recovery of several specimens of *Telenomus* parasitoids from eggs masses of *S. frugiperda* exposed as sentinel eggs masses in 2009–2013 in southern Florida that matched (via barcoding) colonies of *T. remus* in Ecuador and Honduras suggest this parasitoid established in Florida (Hay-Roe et al., 2015). No information on its impact on the host is available.

Tetrastichus brontispae Ferrière EULOPHIDAE

Noyes (2017) lists one synonym: *Tetrastichodes brontispae* Ferrière.

Tetrastichus brontispae was introduced into Hawaii (USA) in both 1986 (from Guam) and 1991 (from Java) against a coconut leafminer, *Brontispa chalybeipennis* (Zacher) (Chrysomelidae) (Funasaki et al., 1988). No laboratory host-range testing was done before release. Literature host records include the following chrysomelids: (1) *Brontispa longissimi* (Gestro) (= *Brontispa froggatti*) (Awibowo, 1934; Lever, 1936); (2) *Brontispa mariana* Spaeth (Lange, Jr., 1950); (3) *Gestronella centrolineata* (Fairmaire) (Appert, 1974); and (4) *Octodonta nipae* (Maulik) (Tang et al., 2014). Noyes (2017) lists one additional host: *Brontispa palauensis* (Esaki and Chujo) (Chrysomelidae). *Tetrastichus brontispae* established in Hawaii (Culliney and Nagamine, 2000), and it controlled the pest: "By 1988, visible damage to coconuts in the areas of infestation in Honolulu had been reduced" (Culliney and Nagamine, 2000).

Tetrastichus planipennisi Yang EULOPHIDAE

For species description, see (Yang et al., 2006). Noyes (2017) lists no synonyms.

Tetrastichus planipennisi was released in Michigan (USA) in 2007 (from northeastern China) against the emerald ash borer, *Agrilus planipennis* Fairmaire (Buprestidae) (Duan et al., 2010b, 2013). Host-range testing was done before release, and, of six non-target *Agrilus* species collected in the field in China, none were attacked. Of five non-target *Agrilus* and six other buprestids examined in laboratory tests, none were attacked (Gould, 2007). Literature host records include only the target pest, *Agrilus planipennis* Fairmaire (Liu et al., 2007) and Noyes (2017) lists no other species as hosts. *Tetrastichus planipennisi* established in Michigan, USA (Duan et al., 2010b, 2013) and later in many other states. Rates of *T. planipennisi* parasitism in study plots in Michigan reached 20% in mid-sized ash trees, suggesting partial control of the pest (Duan et al., 2013, 2014, 2015b). Parasitism is substantially higher (40-80%) in sapling-sized ash (Duan et al., 2017).

Tetrastichus setifer Thomson EULOPHIDAE

Noyes (2017) lists one synonym: *Aprostocetus setifer* (Thomson).

Tetrastichus setifer was introduced into several New England states (USA) and then redistributed to Ontario, Canada (having been originally collected from Switzerland, France, and other parts of Europe) against the lily beetle, *Lilioceris lilii* Scopoli (Chrysomelidae). Host-range testing was done before release (Gold, 2003; Kenis et al., 2003; Casagrande and Kenis, 2004; USDA APHIS, 2017). Of two non-target European *Lilioceris* species (*L. merdigera* [L.] and *L. tibialis* [Villa]), both were attacked. Of eight species of North American non-*Lilioceris* species (six in the same family; two in other

families), none were attacked (Casagrande and Kenis, 2004). No other literature host records were found. Noyes (2017) lists no other species as hosts

United States. *Tetrastichus setifer* was released in New England (USA) in 1999 (Tewksbury, 2014, Tewksbury et al., 2017). The parasitoid established in several states and is spreading (Tewksbury et al., 2005; Tewksbury, 2014, Tewksbury et al., 2017). At two monitored release sites, pest density declined 50–88% in association with increasing parasitism over an 8–9-year period (Tewksbury et al., 2017).

Canada. *Tetrastichus setifer* was released in Ontario in 2010 and established (Cappaccino et al., 2013), but its impact has not yet been determined.

Thripobius javae (Girault) Eulophidae

For species description, see Boucek (1976). One synonym: *Thripobius semiluteus* Boucek, the name under which most literature appears. Noyes (2017) does not list this species.

Thripobius javae was introduced into California (USA) in 1986–1989 (from Australia) against *Heliothrips haemorrhoidalis* (Bouché) (Thripidae) (McMurtry, 1988). No laboratory host-range testing was done before release. Froud et al. (1996) estimated *T. javae*'s host range to be within the Panchaetothripinae in the Thripidae. Evaluation of its potential for non-target effects in New Zealand (Froud and Stevens, 2003) concluded it was safe for introduction. There are no other literature host records. Noyes (2017) does not list this parasitoid species in his catalog. *Thripobius javae* established in California (McMurtry et al.,1991), but no published information exists on its impact on the pest.

Trichogramma atopovirilia Oatman and Platner Trichogrammatidae

Noyes (2017) lists two synonyms: (1) *Trichogramma atopovirilla* Oatman and Platner and (2) *Trichogramma caiaposi* Brun, Gomez de Moraes and Soares.

Trichogramma atopovirilia was released in northern Texas (USA) in 1985–1987 (having been collected in Mexico) against the stalk borer *Diatraea grandiosella* Dyar (Crambidae) (Overholt and Smith, Jr., 1990). Host-range testing was done before release to determine if certain pest borers of grasses (especially corn and sugarcane) were susceptible to parasitism, and *Diatraea considerata* Heinrich, *D. saccharalis* (F.), *D. grandiosella* Dyar, and *Eoreuma loftini* (Dyar) were susceptible (Browning and Melton, 1987). Literature host records and hosts cited by Noyes (2017) include 23 host species in 20 genera (Tejada et al., 1988; Rodríguez-del-Bosque et al., 1989; Resende and Ciociola, 1996; Foerster and Avanci, 1999; Beserra et al., 2002; Nicoli et al., 2004; Morales et al., 2004; Vejar-Cota et al., 2005; Molina et al., 2005; Melo et al., 2007; Nava et al., 2007; Pratissoli et al., 2008; Bueno et al., 2009; Milanez et al., 2009; Andrade et al., 2011; Isas et al., 2016), in nine families of Lepidoptera: Crambidae, Noctuidae, Pyralidae, Tortricidae, Gelechiidae, Nymphalidae, Depressariidae, Sphingidae, and Plutellidae. The families with the greatest number of hosts are the Crambidae (five species) and Noctuidae (nine species). These recorded hosts come largely from laboratory tests and thus correspond to the physiological host range, which is expected to be wide given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species. The proportion of these species that are also parasitized in the field is unknown. *Trichogramma atopovirilia* did not establish in northern Texas (Overholt and Smith, Jr., 1990).

Trichogramma ostriniae Pang et Chen Trichogrammatidae

For species description, see Pang and Chen (1974). Noyes (2017) lists one synonym: *Trichogramma ostrinia* Pang et Chen.

Trichogramma ostriniae was released (for augmentative biocontrol) in New York (USA) in 1991 (having been imported from China) against European corn borer, *Ostrinia nubilalis* (Hübner) (Crambidae) (M. Hoffmann pers, comm.; Gardner et al., 2013). No host-range testing was done before release. Post-release host-range testing showed that 13 of the species tested were parasitized, especially species of Noctuidae, Pyralidae*, and Plutellidae (Hoffmann et al., 1995). (*Parts of the Pyralidae were subsequently considered their own family, the Crambidae). Adults of *T. ostriniae* showed an innate response to odors of *O. nubilalis*, but not to *Spodoptera frugiperda* J. E. Smith (Yong et al., 2007). Host literature records, together with Noyes (2017), record 22 host species, in 19 genera, in eight families, principally Crambidae, Pyralidae, Tortricidae, and Noctuidae, but with one host each in the Notodontidae, Plutellidae, Limacodidae, and Gelechiidae. Many of these host records are based on laboratory tests and thus correspond to the physiological host range, which is expected to be wide given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species.

The proportion of these species that are also parasitized in the field is unknown. It is possible that this species has established in New York, given that "positive identification of *T. ostriniae* from naturally occurring *O. nubilalis* eggs collected from field sites where augmentative releases had been made in previous years [has occurred in New York]" (Gardner et al., 2013). Augmentative releases of *T. ostriniae* in New York state reduced damage by *O. nubilalis* in test plots by 50% compared to untreated controls (Wright et al., 2002).

Trichogramma platneri Nagarkatti TRICHOGRAMMATIDAE

For species description, see Nagarkatti et al. (1975). Noyes (2017) lists no synonyms.

Trichogramma platneri was introduced into Guam (USA) in 1986 (from California, USA where it is native) for control of *Penicillaria jocosatrix* Guenée (Noctuidae) (Nafus, 1991). No laboratory host-range testing was done before release. Host records include 24 species in 20 genera, in 10 families: Tortricidae, Plutellidae, Erebidae, Lycaenidae, Nymphalidae, Geometridae, Noctuidae, Pyralidae, Sphingidae, and Crambidae, dominated by Pyralidae (six species) and Tortricidae (six species) (Nagarkatti et al., 1975; Oatman et al., 1983; Wysocki and Renneh, 1985; Manweiler, 1986; Wysoki et al., 1988; Hohmann et al., 1988; Zhang and Cossentine, 1995; Lawson et al., 1997; Mansfield and Mills, 2004; García Nevárez and Tarango Rivero, 2013). Many of these host records are based on laboratory tests and thus correspond to the physiological host range, which is expected to be wide given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species. The proportion of these species that are also parasitized in the field is unknown. *Trichogramma platneri* did not establish in Guam.

Trichogrammatoidea bactrae Nagaraja TRICHOGRAMMATIDAE

For species description, see Nagaraja (1978). Noyes (2017) lists one synonym: *Trichogramma bactrae*.

Trichogrammatoidea bactrae was released in California (USA) in 1986 (having been collected from Australia) against pink bollworm, *Pectinophora gossypiella* (Saunders) (Gelechiidae) (Naranjo et al., 1995). No laboratory host-range testing was done before release. Literature host records include 40 species, one in the Diptera and 39 in the Lepidoptera. For Lepidoptera, 39 host species are known in 13 families in 33 genera. Families are Tortricidae, Plutellidae, Noctuidae, Pyralidae, Sphingidae, Crambidae, Gelechiidae, Oecophoridae, Hesperiidae, Gracillariidae, Nolidae, Blastobasidae, and Pieridae, dominated by Crambidae (ten species), Noctuidae (eight species), Tortricidae (six species), and Gelechiidae (four species) (Nagaraja, 1978; Supharngkasen. 1979; Rao et al., 1980; Nagarkatti, 1980; Lim, 1983, 1986; Klemm and Schmutterer, 1992; Röhl and Woods, 1994; Naranjo et al., 1995; Visalakshy and Jayanth, 1995; El-Hafez, 1995; Stevens, 1995; Sushil et al., 1999; Shalaby et al., 2000; Jalali et al., 2002; Marwoto and Nasir Saleh, 2003; Mesbah et al., 2003; Perera et al., 2015; Goda et al., 2015). Many of these host records are based on laboratory tests and thus correspond to the physiological host range, which is expected to be wide, given that insect eggs have no immune defenses. More such host records likely could be obtained by testing more species. The proportion of these species that are also parasitized in the field is unknown. *Trichogrammatoidea bactrae* did not establish in California (Naranjo et al., 1992; S. Naranjo, pers. comm.).

Trichomma cnaphalocrocis Uchida ICHNEUMONIDAE

No synonyms given in Yu (2017).

Trichomma cnaphalocrocis was released in Guam, USA (from Taiwan) in 1986 against the Asian corn borer, *Ostrinia furnacalis* (Guenée) (Crambidae) (D. Nafus, unpub. data). No laboratory host-range was testing done before release. Literature hosts include *Ostrinia nubilalis* (Hübner) (Clark, 1934) and *Cnaphalocrocis medinalis* (Guenée) (both Crambidae) (Barrion et al., 1979). No published information is available concerning establishment or impact.

Trissolcus basalis (Wollaston) SCELIONIDAE

Synonyms are *Microphanurus basalis*, *Asolcus basalis*, *Telenomus megacephalus*, and *Microphanurus megacephalus*.

Trissolcus basalis was released in California (USA) in 1987–89 (from France, Italy, and Spain) against the green stink bug, *Nezara viridula* L. (Pentatomidae) (Aswan et al., 1989; Hoffmann et al., 1991). This parasitoid is native to the eastern United States (Miller, 1928) but not to California. No laboratory host-range testing was done before release. Hosts records

in the literature include at least 25 species other than *N. viridula*, all pentatomids (Miller, 1928; Johns, 1941; Shapiro et al., 1975; Gallego et al., 1979; Buschman and Whitcomb, 1980; Panizzi and Slansky, 1985; Corrêa-Ferreira, 1986; Awan, 1989; Clarke and Walter, 1994; Weber et al., 1996; Coombs and Khan, 1998; Ehler, 2002; Haddad and Louw, 2006; Forouzan et al., 2013; Zachrisson et al., 2014). *Trissolcus basalis* established in California (Hoffmann et al., 1991; Ehler, 2002). Hoffmann et al., (1991) deployed sentinel egg masses of *N. viridula* to measure field parasitism rates by *T. basalis* and found, for different months, years, and locations, a range from 1–83% parasitism for all eggs deployed. Also, Ehler, 2002) found *T. basalis* to be the most common parasitoid recovered from *N. viridula* egg masses deployed as sentinel hosts in northern California (Ehler, 2002).

Uga menoni Kerrich Chalcididae

Noyes (2017) lists one synonym: *Neotainania brevicorpus* Husain and Agarwal.

Uga menoni was released in the USA in two states, Maryland (in 1987) and Florida (in 1990) (from Korea [Lee et al., 1988]) against the Mexican bean beetle, *Epilachna varivestis* Mulsant (Coccinellidae) (Maryland: see p. 206 of Barbosa et al., 1994; Florida: see p. 19 of Frank and McCoy, 1993). No laboratory host-range testing was done before release. Literature host records include two coccinellids: *Henosepilachna vigintioctomaculata* (F.) (Azam et al., 1974) and *Epilachna ocellata* Redtenbacher (Dhingra et al., 1986). Noyes (2017) lists no other species as hosts. *Uga menoni* did not establish in either Maryland (see p. 206 of Barbosa et al., 1994) or Florida (see p. 19 of Frank and McCoy, 1993).

TEXT 2. SYNOPSIS OF TABLE 2, PREDACIOUS INSECTS INTRODUCED INTO CANADA, MEXICO, THE USA, OR THE USA OVERSEAS TERRITORIES BETWEEN 1985 AND 2018.

Chilocorus circumdatus (Schoenherr) COCCINELLIDAE

No synonyms noted.

Chilocorus circumdatus was released in Florida (USA) in 1996 (from SE Asia, but via Australia where it invaded naturally) against snow scale, *Unaspis citri* (Comstock) (Diaspididae) (see Table 1, p. 154 of Frank and McCoy, 2007). No laboratory prey-range testing was done before release. Literature prey records include eight species of diaspidid scales, in eight genera (Rutherford, 1914ab; Dupont, 1931; Das, 1979; Houston, 1991; Smith et al., 1995; Chen, 1998; Elder and Bell, 1998) and one species of coccid scale (Illingworth, 1929). *Chilocorus circumdatus* established in Florida (H. Browning, pers. comm., in Table 1, p. 154 in Frank and McCoy, [2007]), but its impact on the target pest has not been determined.

Chilocorus kuwanae (Silvestri) COCCINELLIDAE

No synonyms noted.

Chilocorus kuwanae was introduced into Maryland and Delaware (USA) in 1984 (from Korea) (Drea and Carlson, 1987) and into Massachusetts in 1990–1995 (from China) (Van Driesche et al., 1998a), both times against euonymus scale, *Unaspis euonymi* (Comstock) Diaspididae. No laboratory prey-range testing was done before release. Field prey include various diaspidid scales, e.g., *Unaspis yanonenis* (Kuwana) (Nohara et al., 1962), *Quadraspidiotus perniciosus* (Comstock) (Chumakova, 1967), and *Quadraspidiotus macroporanus* Takagi (Tachikawa, 1974). Xia et al. (1986) record 28 prey species in five families, including the mealybug *Pseudococcus citriculus* Green (Itioka and Inoue, 1996), the coccid *Protopulvinaria mangiferae* (Green) (Kim and Morimoto, 1998), and the eriococcid *Eriococcus lagerstroemiae* Kuwanae (Luo et al., 2000), suggesting a wide prey range within the Coccoidea. *Chilocorus kuwanae* established widely in the northeastern USA (Drea and Carlson, 1987; Van Driesche et al., 1998b), and scale infestations were significantly reduced (Van Driesche et al., 1998b; Van Driesche and Nunn, 2003).

Chrysoperla carnea (Stephens) CHRYSOPIDAE

This name is loosely applied to a species complex of European green lacewings, recognition of whose member species requires both morphological and genetic information and studies of courtship songs (Henry et al., 2002; Lourenço et al., 2006; Bozsik et al., 2014). Since separation of these species have only recently been achieved, names in the non-taxonomic literature are difficult to relate to entities below the complex level.

Chrysoperla carnea sensu lato (sl) was introduced to Guam (USA) in 2011 (G. Reddy, pers. comm.). The origin of the population introduced was not recorded, but *C. carnea* sl populations from Europe have long been mass-reared commercially for augmentative biocontrol of aphids and other Hemiptera in greenhouses and that is a plausible source. *Chrysoperla carnea* was released in Guam (G. Reddy, pers. comm.) as a generalist predator of many Hemiptera, including aphids and whiteflies. No laboratory prey-range testing was done before release. The species is highly polyphagous on Hemiptera and on eggs of insects of various other orders (Bozsik et al., 2014). Whether the species is established in Guam has not been reported. Whether native *Chrysoperla* species occur in Guam and if the introduced species established there should be determined.

Clitostethus arcuatus (Rossi) COCCINELLIDAE

One synonym: *Nephus arcuatus*.

Clitostethus arcuatus was released in California (USA) in 1989–1990 (Bellows et al., 1990), having been collected from Israel (Bellows et al., 1992a) for control of the ash whitefly, *Siphoninus phillyreae* (Haliday) (Aleyrodidae). No laboratory prey-range testing was done before release. Literature host records include nine species of whiteflies (Aleyrodidae) in seven genera (Golfari, 1937; Priore, 1969; Anon., 1977; Agekyan, 1977; Russell and Etienne, 1985; Bathon and Pietrzik, 1986; Katsoyannos et al., 1997; Hassan, 2001; Yazdani and Zarabi, 2009). *Clitostethus arcuatus* established in some areas in California but not others (Bellows et al., 1992b). The target pest was controlled by another introduced agent, *Encarsia inaron*, and any potential value that *C. arcuatus* might have had became irrelevant.

Cryptolaemus montrouzieri (Mulsant) Coccinellidae

Cryptolaemus montrouzieri was released in the U.S. Virgin Islands in 1997 (Kairo et al., 2000) (having been collected from India [Gautam, 2003]) and in Nayarit and Jalisco, Mexico, in 2004 (from India via the USA and Canada) (Gautam, 2003; Santiago-Islas, 2008) against pink mealybug, *Maconellicoccus hirsutus* (Green) (Pseudococcidae). No laboratory prey-range testing was done before release. Literature records of prey include species in over eight families of Hemiptera (Kairo et al., 2013).

U.S. Virgin Islands. *Cryptolaemus montrouzieri* established throughout the Caribbean (Kairo et al., 2000, 2013). While control of pink mealybug occurred throughout region, this was attributed to the combination of *Anagyrus kamali* Moursi and *C. montrouzieri* (Kairo et al., 2000).

Mexico. *Cryptolaemus montrouzieri* established in Nayarit and Jalisco, Mexico (Santiago-Islas, 2008). Control was attributed to several natural enemies, with a significant contribution by *C. montrouzieri*, mainly against high density patches (Santiago-Islas, 2008).

Curinus coeruleus Mulsant Coccinellidae

Curinus coeruleus was introduced into the USA overseas territories of Guam and the Northern Mariana Islands (having been collected from Hawaii USA) against the leucaena psyllid, *Heteropsylla cubana* Crawford (Psyllidae) (see p. 82 of Nafus and Schreiner, 1989). No laboratory prey-range testing was done before release. Known prey include species in at least five families of Hemiptera: (1) aphids (Aphididae), e.g., *Rhopalosiphum maidis* (Fitch) (Nawanich et al., 2013); (2) whiteflies (Aleyrodidae), e.g., *Aleurodicus dispersus* Russell (Villacarlos and Robin, 1992); (3) mealybugs (Pseudococcidae) (see p. 82 of Nafus and Schreiner, 1989); *Nipaecoccus nipae* (Maskell) (Osborn, 1938); and (4–5) two families of psyllids (Liviidae and Psyllidae), e.g., *Diaphorina citri* Kuwayama (Michaud, 2002b) (Liviidae) and *Heteropsylla cubana* Crawford (Psyllidae). *Curinus coeruleus* established on Guam and Saipan (Northern Mariana Islands), but its impact there on the target pest has not been determined (see p. 82 of Nafus and Schreiner, 1989).

Cybocephalus nr *nipponicus* Enrody-Younga Nitidulidae

Species is likely *C. nipponicus* (Smith, 2006).

Cybocephalus nr *nipponicus* was released in the USA in 1984 in Maryland and Delaware (Drea and Carlson, 1987) and in 1990–1995 in Massachusetts (Van Driesche et al., 1998a) against the euonymus scale, *Unaspis euonymi* (Comstock) (Diaspididae). No laboratory prey-range testing was done before release. Known field prey that support larval development include various diaspidid scales, e.g., *Quadraspidiotus macroporanus* Takagi (Tachikawa, 1974) and *Unaspis yanonensis* Kuwana (Huang et al., 1981). Oviposition and development occur only in diaspidids, occurring in six of nine species tested (Song et al., 2012). *Cybocephalus* nr *nipponicus* established in Massachusetts, USA (Van Driesche et al., 1998a). While the target pest was controlled by the biocontrol project, control was due to a group of introduced natural enemies (Silvestri) (Van Driesche et al., 1998b; Van Driesche and Nunn, 2003), and no separate evaluation was made of the impact of *C.* nr *nipponicus* alone.

Delphastus catalinae (Horn) Coccinellidae

One synonym: *Delphastus pusillus* (LeConte).

Delphastus catalinae was introduced into Guam (USA) in 2011 (G. Reddy, pers. comm.) (source not stated; likely, the USA mainland) against the tobacco whitefly (strain B), *Bemisia tabaci* (Gennadius) (Aleyrodidae) (G. Reddy, pers. comm.). *Delphastus catalinae* is native to California (Anon., 1915), but was imported early to Florida (Watson, 1919). No prey-range testing was done before release in Guam. Literature prey records are mostly whiteflies (Aleyrodidae), including ten species in seven genera (Watson, 1923; Smith, 1945; Watve and Clower, 1976; Meyerdirk et al., 1985; Nguyen and Hamon, 1985; Gold et al., 1990; Nelson and Parrella, 1992; Jing et al., 2003; García González et al., 2005). Eggs of one spider mite (Tetranychidae) are also used as prey (Jing et al., 2003). No information was located about either the establishment of *D. catalinae* or its impact on the target pest in Guam.

Eriopis connexa (Germar) COCCINELLIDAE

No synonyms noted.

Eriopis connexa was released in New Jersey (USA) (source not recorded; but it appears to be native to Chile and Agentina) in 1988 (M. Mayer, pers. comm., New Jersey Dept. of Agriculture) against pea aphid, *Acyrthosiphon pisum* Harris (Aphididae). No laboratory prey-range testing was done before release. Literature prey records include mostly aphids (15 species in 14 genera), but also whiteflies (one species), psyllids (one species), lepidopteran eggs (three species, in three genera, in two families), mite eggs (two species in two families), and stink bug eggs (one species) (Lopez Cristobal, 1937; Anon., 1972; Gartel, 1972; Carrillo and Mellado, 1975; Link and Costa, 1980; Botto and de Crouzel, 1981; Aguilera and Pacheco, 1995; Araya et al., 1997; Sáiz et al., 2003; Oliveira et al., 2004; Fuentes-Contreras et al., 2004; Duarte Gómez and Zenner de Polanía, 2006; Resende et al., 2006; Reviriego et al., 2006; Sarmento et al., 2007; Ribeiro and Castiglioni; Tavares et al., 2010). No information was found as to whether the species established in New Jersey or had any impact on the target pest.

Harmonia axyridis (Pallas) COCCINELLIDAE

Synonyms include *Ptychanatis axyridis*, *Leis axyridis*, and *Coccinella axyridis*.

Harmonia axyridis was introduced (native to China, but proximal source of this introduction not stated, likely the USA) in 1999 into Quintana Roo, in southern Mexico, against the citrus pest *Toxoptera citricola* Kirkaldy (Aphididae) (Munguía, 2002; López-Arroyo et al., 2008). This deliberate release in southern Mexico was preceded by the invasion of northern Mexico by *H. axyridis*, which dispersed on its own from the southern United States (H. C. Arredondo-Bernal, pers. comm.). No laboratory prey-range testing was done before release. *Harmonia axyridis* is a highly polyphagous predator with prey species in one family of mites and four orders of insects, dominated by species of aphids. Literature records cited here (an incomplete list) include 63 prey species, of which three are eggs of spider mite species (Tetranychidae) and the rest are insects. Insect prey include aphids (30 species), one mealybug (Pseudococcidae), three whiteflies (Aleyrodidae), two monophlebid scales, four armored scales (Diaspididae), two soft scales (Coccidae), five psyllids (Psyllidae), one psyllid in Liviidae, two ladybird beetles (an undercount) (Coccinellidae), five leaf beetles (Chrysomelidae), one erebid moth, one adelgid, and one species in each of Cecidomyiidae, Miridae, and Phylloxeridae (Hukusima and Kondô, 1962; Vasil'Ev, 1963; Savoiskaya, 1970; Okamoto and Sato, 1973; Togoshi, 1976; Fye, 1981; Wang, 1982; Choi and Kim, 1985; Park and Kim, 1990; Li, 1992; Trouvé, 1995; Choi et al., 1995a,b; Ferran et al., 1996; Shi et al., 1997; Lucas et al., 1997; Lieten, 1998; Michaud, 1999; El-Arnaouty et al., 2000; Wu and Yu, 2000; Gai et al., 2001; Michaud, 2002b; Moriya et al., 2002; Zhao et al., 2003; Villanueva et al., 2004; Xie et al., 2004; Matos and Obrycki, 2006; Lin et al., 2006; Mignault et al., 2006; Berthiaume et al., 2007; Brown and Mathews, 2007; Corlay et al., 2007; Li et al., 2008; Zhang et al., 2008; Alhmedi et al., 2008; Omata, 2008; Chen et al., 2009; Nimmo, and Tipping, 2009; Finlayson et al., 2010; Li et al., 2010; Dang et al., 2010; Harizanova et al., 2012; Thomas et al., 2013; Guo et al., 2013; Glavendekic´ et al., 2013; Kögel et al., 2013; Wu et al., 2017; Li et al., 2017). Whether *H. axyridis* established in southern Mexico was not reported, but is likely. Also, its impact on the target pest was not reported, but is likely to have occurred, based on its impacts on this pest in Florida.

Hippodamia undecimnotata (Schneider) COCCINELLIDAE

Synonyms include *Adalia undecimnotata* (Scheider), *Ceratomegilla undecimnotata* (Schneider), *Coccinella undecimnotata* Schneider, and *Semiadalia undecimnotata* Schneider (see https://www.biolib.cz/en/taxon/id10834/)

Hippodamia undecimnotata from the former USSR was released in the western United States for control of the Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae) (Gordon and Vandenberg, 1991). No laboratory prey-range testing was done before release. Literature prey records include various aphids (Aphididae), covering at least five species in five genera: *Schizaphis graminum* Rondani (Moroshkina, 1930); *Aphis fabae* Scopoli (Iperti, 1965); *Myzus persicae* (Sulzer) (Ferran and Larroque, 1977); *Acyrthosiphon pisum* (Harris) (Ruzicka et al., 1981); and *Toxoptera aurantii* (Boyer de Fonscolombe) (Sikharulidze, 1986). No information on establishment or impact of the predator on the target pest was found.

Laricobius nigrinus Fender Derodontidae

No synonyms.

Laricobius nigrinus was released in the eastern United States in 2003, first in Virginia and later north to Massachusetts (having been collected from British Columbia, Canada, and reared in the laboratory) against hemlock woolly adelgid, *Adelges tsugae* Annand (Adelgidae) (Lamb et al., 2006). An inland population from Montana was also released in Massachusetts (Mausel et al., 2011; R. Van Driesche, pers. observ.). Laboratory prey-range testing was done before release (Zilahi-Balogh et al., 2002). In laboratory prey-range trials, all three non-target adelgids tested (*Adelges piceae* [Ratzeburg], *A. abietis* [L.], *Pineus strobi* [Hartig]) elicited predator oviposition, but none supported full larval/pupal development of *L. nigrinus*; conifer-feeding aphids and scales tested did not elicit oviposition in paired choice tests. Eggs of all three non-target adelgids tested were consumed to some degree by adults of *L. nigrinus.* No other field prey are known for *L. nigrinus*. *Laricobius nigrinus* established in many sites in the Appalachian Mountains, from New Jersey southward, in the eastern United States (Mausel et al., 2010). An inland population from Montana (Mausel et al., 2011) that was released in Massachusetts likely did not establish (R. Van Driesche, pers. observ). Clear population-level effects on *A. tsugae* by *L. nigricus* have not been demonstrated (Mausel et al., 2010); effects in cage-enclosure studies (beetles in cages) show prey suppression inside cages (Story et al., 2012). Further work, using cage-exclosure methods (with natural beetle populations as the treatment and caged adelgids as the controls) are underway in both eastern and western United States (J. Elkinton, pers. comm.).

Laricobius osakensis Montgomery and Shiyake Derodontidae

No synonyms. For species description, see Montgomery et al. (2011).

Laricobius osakensis from Japan was released in 2012 in Virginia and West Virginia (USA) against hemlock woolly adelgid, *Adelges tsugae* Annand (Adelgidae) (Mooneyham et al., 2016). Laboratory prey-range testing was done before release. No, or minimal, oviposition and no complete development occurred on six non-target species tested: *Adelges piceae* (Ratzeburg), *A. abietis* (L.), *Pineus strobi* (Hartig) (all Adelgidae); *Prociphilus tessellates* (Fitch) (Aphididae), *Chionaspis pinifoliae* (Fitch) (Diaspididae), and *Fiorinia externa* Ferris (Diaspididae). Some adult feeding occurred on the three adelgids and the single aphid species, but not on the two armored scales (Vieira et al., 2011). Establishment of *L. osakensis* has not yet been determined. No information is available on the field impact of *L. osakensis* on *A. tsugae*, but see Story et al. (2012) for results of a field branch-cage evaluation study.

Leucopis atritaris Tanasijtshuk Chamaemyiidae

No synonyms noted in literature search.

Leucopis atritaris was released in Saskatchewan, Canada, in 1991 (having been collected from Kazakhstan) for control of Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae) (Olfert et al., 2001). No laboratory prey-range testing was done before release. No literature records of other prey were found. *Leucopis atritaris* did not establish in Canada (Olfert et al., 2001) and thus had no impact on the target pest.

Leucopis ninae Tanasijtshuk Chamaemyiidae

No synonyms noted.

Leucopis ninae was released in Saskatchewan, Canada, in 1991 (having been collected from the former Yugoslavia) for control of Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae) (Olfert et al., 2001). No laboratory prey-range testing was done before release. Literature records of prey include three additional aphids (Aphididae), i.e., *Aphis nerii* Boyer de Fonscolombe (Abdul-Satar, 1988); *Rhopalosiphum padi* (L.) (Dabiré et al., 1997); and *Hyalopterus pruni* (Geoffroy) (Duzgunes et al., 1982). *Leucopis ninae* did not establish in Canada (Olfert et al., 2001) and thus had no impact on the target pest.

Neoseiulus californicus (McGregor) PHYTOSEIIDAE

"*Neoseiulus californicus* has a very complex taxonomic history. It was first described by McGregor in 1954 from lemon in California as *Typhlodromus californicus*. After 1954, it was moved to the genus *Amblyseius* and later to the genus *Neoseiulus* or Cydnodromus" (Featured Creatures, 2107b).

Neoseiulus californicus was released in Guam, USA in 2010 for augmentative biocontrol of *Tetranychus marianae* McGregor (Acari: Tetranychidae) (Reddy and Bautista, 2012; G. Reddy, pers. comm.), having been obtained from the mainland USA. No laboratory prey-range testing was done before release. Mites (mainly in the Tetranychidae), are the dominant prey of *N. californicus*, with 16 prey mite species listed in six families (Tetranychidae, Tarsonemidae, Eriophyidae, Glycyphagidae, Acaridae, and Tenuipalpidae) in ten genera (Gilstrap et al., 1977; Oatman et al., 1977; de Moraes and McMurtry, 1985; Ramírez et al., 1988; Costa-Comelles et al., 1990; Castagnoli and Falchini, 1993; Smith et al., 1996; Croft et al., 1998ab; El-Laithy and El-Sawi, 1998; Hoddle et al., 1999; Castagnoli et al., 2003; Simoni et al., 2006; Roberto Trincado, 2007; Reddy and Bautista, 2012). Recorded insect prey are limited to thrips (Thripidae), including three species in three genera (Rodríguez-Reina et al., 1992; Mizobe et al., 2005). It is not reported if *N. californicus* established in Guam or not, as it was used in a program of augmentative biocontrol and field assessments would likely not have been made.

Oenopia conglobata (L.) COCCINELLIDAE

One synonym: *Synharmonia conglobata*.

Oenopia conglobata was introduced into the western United States in 1990 (source not determined) against the Russian wheat aphid, *Diuraphis noxia* (Kurdjumov) (Aphididae) (Gordon and Vandenberg, 1991). This coccinellid was released earlier, in Washington state (USA) in 1977–1981, but failed to establish (Fye, 1981). No laboratory prey-range testing was done before release. Literature host records include 20 species in 16 genera in nine families in three orders, dominated by aphids (Bodenheimer and Neumark, 1955; Plugaru, 1971; Kesten, 1975; Talhouk, 1977; Chen, 1982; Baki and Ahemed, 1985; Toros, 1986; Ülgentürk and Toros, 1999; Mehrnejad, 2002; Özsemerci and Aksit, 2003; Sadeghi et al., 2004; Yasar and Özger, 2005; Antonucci, 2005; Bayram, 2009; Wu et al., 2011; Yigit and Telli, 2013; Elekcioglu, 2013; Rounagh and Samih, 2014; Öztürk et al., 2015). This agent does not appear to have established in the United States (Gordon and Vandenberg, 1991).

Rhizophagus grandis Gyllenhal RHIZOPHAGIDAE

Rhizophagus grandis was released in Louisiana (USA) in 1988 (from Europe) against *Dendroctonus terebrans* (Olivier) (Curculionidae: Scolytinae) (Coulson et al., 2000). No laboratory prey-range testing was done before release. Literature prey records include only two bark beetles (Curculionidae) in one genus: (1) *Dendroctonus micans* (Kugelann) (Palm, 1948; Gregoire, 1976); (2) *Dendroctonus valens* LeConte (Wei et al., 2010). *Rhizophagus grandis* established in the United States (Coulson et al., 2000), but its impact on the target host was not reported.

Rhyzobius lophanthae Blaisdell COCCINELLIDAE

One synonym: *Lindorus lophanthae.*

Rhyzobius lophanthae was introduced into Guam (USA) in 2005 (from Australia via Hawaii USA) against cycad scale, *Aulacaspis yasumatsui* Takagi (Diaspididae) (T. Marler, pers. comm.). No laboratory prey-range testing was done before release. Literature prey records include at least 22 species in three families of scales (Hemiptera): Diaspididae (19 species in 11 genera), Coccidae (two species in two genera), and Phoenicococcidae (one species). *Rhyzobius lophanthae* established in Guam (T. Marler, pers. comm.), and the predator suppressed *A. yasumatsui* scales on mature cycads, but not on juvenile plants (T. Marler, pers. comm.).

Rodolia blackburni Ukrainsky Coccinellidae

One synonym: *Rodolia limbata*; sometimes with the alternative generic placement of Novius. See Ukrainsky (2009) for nomenclatural changes.

Rodolia blackburni was released in 1997 in Palau (from Australia) against *Icerya aegyptiaca* (Douglas) (Monophlebidae) (ACIAR, 1995; D. Sands, pers. comm., CSIRO [retired]). Palau became independent of the United States in 1994. However, this project against the breadfruit 'mealybug' (*I. aegyptiaca*) was initiated before this date (1992) and so this release is included here. No laboratory prey-range testing was done before release. Literature prey records include only monophlebid scales: (1) *Drosicha contrahens* Walker (Chu, 1933); (2) *Drosicha corpulenta* (Kuwana) (Lü et al., 2002); (3) *Icerya* sp. (Lethane, 1998); and (4) *Icerya purchasi* Maskell (Chen, 1936). *Rodolia blackburni* established in Palau (ACIAR, 1995) and provided substantial control of the target pest (ACIAR, 1995).

Sasajiscymnus tsugae (Sasaji and McClure) Coccinellidae

One synonym: *Pseudoscymnus tsugae*. For species description, see Sasaji and McClure (1997).

Sasajiscymnus tsugae was released in Connecticut (USA) in 1994 (having been collected from Japan) against hemlock woolly adelgid, *Adelges tsugae* Annand (Adelgidae) (McClure and Cheah, 1998). No laboratory prey-range testing was done before release. Post-release prey-range studies showed that eggs of three non-target adelgids (*Adelges laricis* Vallot, *A. cooleyi* [Gillette, *Pineus strobi* [Hartig]) and one non-target aphid (*Prociphilus tessellates* [Fitch]) were fed on by adult beetles but at lower rates than occurred on eggs of the target pest. Larvae of *S. tsugae* could not develop when fed only *P. tessellates* (Butin et al., 2004). Literature prey records include *Adelges tsugae* Annand (Cheah and McClure, 1998) and *Adelges piceae* Ratzeburg (Jetton et al., 2011). *Sasajiscymnus tsugae* established in Connecticut (Cheah and McClure, 2000) and the southern Appalachian Mountains (Hakeem et al., 2010), but there is no evidence of any population-level impact on the target pest.

Scymnus coniferarum (Crotch) Coccinellidae

Scymnus coniferarum was released in North Carolina (USA) in 2013 (from Washington state, USA) against the hemlock woolly adelgid, *Adelges tsugae* Annand (Adelgidae). Laboratory prey-range testing was done before release (Montgomery and McDonald, 2010). *Scymnus coniferarum* did not feed on any prey offered in the laboratory other than adelgids. Adelgids that were suitable as prey were *Adelges piceae* [Ratzeburg], *Pineus strobi* (Hartig), and *Pineus pini* (Macquart) (Montgomery and McDonald, 2010). Non-target prey that were not attacked were woolly alder aphid (*Paraprociphilus tessellates*) (Pemphigidae), linden aphid (*Eucallipterus tiliae*) (Aphididae), Taxus mealybug (*Dysmicoccus wistariae*) (Pseudococcidae), and elongate hemlock scale (*Fiorina externa*) (Diaspididae) (Montgomery and McDonald, 2010). Literature prey records were *Pseudococcus pini* (Kuwana) (Pseudococcidae) (Anon., 1915b) and *Adelges tsugae* (Adelgidae) (Darr et al., 2016). There is no evidence of establishment of *S. coniferarum* in the eastern USA (N. Havill, pers. comm.; R. McDonald, pers. comm.).

Scymnus frontalis (F.) Coccinellidae

Scymnus frontalis was released in New Jersey (USA) in 1988 (origin not stated) against *Acyrthosiphon pisum* Harris (Aphididae) (M. Mayer, pers. comm., New Jersey Dept. of Agriculture) and in the western United States against *Diuraphis noxia* (Kurdjumov) (Aphididae) (Gibson et al., 1992). No laboratory prey-range testing was done before release. Literature records include scales and aphids: (1) *Gueriniella serratulae* (Fabricius) (Monophlebidae) (Della Beffa, 1940); (2) *Saissetia oleae* (Olivier) (Coccidae) (Argyriou and Katsoyannos, 1977); (3) *Parlatoria pergandii* Comstock (Coccidae) (Panis et al., 1977); (4) *Diuraphis noxia* (Kurdjumov) (Aphididae) (Naranjo et al., 1990); (5–7) In the laboratory, larvae developed well on several aphids, including *Schizaphis graminum* (Rondani), *Macrosiphum* (*Sitobion*) *avenae* (F.) and *Acyrthosiphon pisum* Harris (Gibson et al., 1992). *Scymnus frontalis* was not recovered in New Jersey after release. Similarly, it was not detected in western United States after release there for *D. noxia* (Gordon and Vandenberg, 1991), but it was able to overwinter in field cages in the Texas High Plains (Michels et al., 1997).

Scymnus ningshanensis Yu and Yao COCCINELLIDAE

No synonyms noted.

Scymnus ningshanensis was released in Connecticut (USA) in 2007 (collected from western China) against *Adelges tsugae* Annand (Adelgidae) (Montgomery et al., 2015a). Laboratory prey-range testing was done before release (Butin et al., 2004). This lady beetle was found in China only on hemlock infested with *Adelges tsugae* and did not occur on nearby pine infested with another adelgid. In the laboratory, newly hatched larvae survived only if they could feed on hemlock woolly adelgid eggs (Montgomery et al., 2002). Of three non-target adelgids tested by Butin et al. (2004) (*Adelges laricis* Vallot, *A. cooleyi* [Gillette], *Pineus strobi* [Hartig]), only two were fed on (*A. cooleyi, P. strobi*) when offered as eggs or adults. Nymphs of one non-target aphid, *Prociphilus tessellates* (Fitch) (Aphididae), were fed on by adult beetles, but at a lower rate than the target pest. *Scymnus ningshanensis* did not establish in Connecticut (Montgomery, 2015).

Scymnus sinuanodulus Yu and Yao COCCINELLIDAE

No synonyms noted.

Scymnus sinuanodulus was released in Connecticut (USA) in 2005 (collected from western China) against *Adelges tsugae* Annand (Adelgidae) (Montgomery et al., 2015b). Laboratory prey-range testing was done before release (M. Montgomery, unpub. data). No other prey are known from the literature. *Scymnus sinuanodulus* did not establish in Connecticut (M. Montgomery, pers. comm.).

Serangium parcesetosum Sicard COCCINELLIDAE

(formerly *Catana parcesetosa*)

Serangium parcesetosum was introduced into Texas (Legaspi et al., 1996) and Puerto Rico (USA) (Gould et al., 2008), both in 1996, (having been collected from India) against sweet potato whitefly, *Bemisia tabaci* (Gennadius) strain B (formerly called *Bemisia argentifolii*) (= Middle East-Asia Minor 1) (Aleyrodidae). No laboratory prey-range testing was done before release. Literature prey records include various other whiteflies: (1) *Dialeurodes citri* (Ashmead) (Antadze and Timofeeva, 1976); (2) *Aleurolobus barodensis* Maskell (Shah et al., 1986); (3) *Aleurocanthus woglumi* Ashby (Satpute et al., 1986); (4) *Bemisia tabaci* Gennadius (Natarajan, 1990); (5–6) *Aleurothrixus floccosus* (Maskell) (Abboud and Ahmad, 1998); *Trialeurodes vaporariorum* Westwood (Al-Zyoud and Sengonca, 2004); (7) *Trialeurodes ricini* (Misra) (Al-Zyoud, 2007); and (8) *Aleurocanthus arecae* David (Chandrika et al., 2007). One scale is recorded a suitable prey: *Coccus pseudomagnoliarum* (Kuwana) (Coccidae) (Aboud et al., 2014). Moth eggs were not eaten in laboratory tests (Legaspi et al., 1996). *Serangium parcesetosum* is not known to have established in either location.

Sphaerophoria scripta (L.) SYRPHIDAE

No synonyms noted.

Sphaerophoria scripta was released in New Jersey (USA) in 1988 (origin not determined) against *Acyrthosiphon pisum* Harris (Aphididae) (M. Mayer, pers. comm., New Jersey Dept. of Agriculture). No laboratory prey-range testing was done before release. Literature host records include mostly various aphids (Aphididae) (nine species in nine genera) (Grossheim, 1914; Moroshkina, 1930; Szalay-Marzsó, 1958; Wiackowska, 1963; Constantinescu, 1970; Smolarz, 1970; Mitic-Muzina and Srdic, 1977; Toros, 1986; Voicu et al., 1987), but also one species of psyllid, *Euphyllura straminea* Loginova (Kaplan et al., 2016). *Sphaerophoria scripta* did not establish after its release in New Jersey (M. Mayer, pers. comm., New Jersey Dept. of Agriculture).

References

Abbassi, M. 1975. Bio-ecological notes on *Parlatoria pergandei* Comstock (Homopt. Coccidae) in Morocco. *Bulletin SROP* 5: 179–184.

Abboud, R. and M. Ahmad. 1998. Effect of temperature and prey-species on development of the immature stages of the coccinellid, *Serangium parcesetosum* Sicard. *Arab Journal of Plant Protection* 16(2): 90–93.

Abd-Rabou, S. 1997. Parasitoids attacking genus *Aleurolobus* (Homoptera: Aleyrodidae) in Egypt. *Acta Phytopathologica et Entomologica Hungarica* 32: 363–367.

Abd-Rabou, S. 2000a. Parasitoids attacking *Saccharicoccus sacchari* (Cockerell) (Hemiptera: Pseudococcidae) on sugarcane in Egypt, pp. 72–75. In: *Sugarcane Pest Management in the New Millennium. 4th Sugarcane Entomology Workshop International Society of Sugar Cane Technologists, Khon Kaen, Thailand, 7–10 February 2000*. International Society of Sugar Cane Technologists, c/o Bureau of Sugar Experiment Stations, Indooroopilly, Queensland, Australia.

Abd-Rabou, S. 2000b. Role of *Encarsia inaron* (Walker) (Hymenoptera: Aphelinidae) in biological control of some whitefly species (Homoptera: Aleyrodidae) in Egypt. *Shashpa* 7(2): 187–188.

Abd-Rabou, S. 2001. The effect of augmentative releases of indigenous parasitoids on populations of *Parlatoria oleae* (Colvée) (Hemiptera: Coccoidea) in olive groves in Egypt. *Bollettino di Zoologia Agraria e di Bachicoltura* 33(3): 473–481.

Abd-Rabou, S. and M. M. Abou-Setta. 1998. Parasitism of *Siphoninus phillyreae* (Homoptera: Aleyrodidae) by aphelinid parasitoids at different locations in Egypt. *Journal of Hymenoptera Research* 7: 57–61.

Abdul-Satar, S., N. A. Al-Saadi, A. Ouda, S. Haidar, Al-Haidari, and A. Al-Azzawi. 1988. Insect predators of *Aphis nerii* in Baghdad area and their predatory efficiency and feeding preference. *Journal of Biological Science Research* 19: 31–40.

Abell, K. J., L. S. Bauer, J. J. Duan, and R. G. Van Driesche. 2014. Long-term monitoring of the introduced emerald ash borer (Coleoptera: Buprestidae) egg parasitoid, *Oobius agrili* (Hymenoptera: Encyrtidae), in Michigan, USA and evaluation of a newly developed monitoring technique. *Biological Control* 79: 36–42.

Aboud, R., M. Mofleh, H. Habaq, F. Al-Kaum, and M. Ahmed. 2014. Studies on the soft citrus scale insect, *Coccus pseudomagnoliarum* (Kuwana) on citrus trees along the Syrian coast and efficacy of its associated predators. *Arab Journal of Plant Protection* 32(2): 182–191.

Acebes, A. L. 2011. Introduction and preliminary evaluation of a new aphid parasitoid, *Binodoxys communis* (Hymenoptera: Aphidiinae) in Hawai'i. Masters of Science, Department of Entomology, University of Hawaii, Honolulu. https://scholarspace.manoa.hawaii.edu/handle/10125/101412

Acebes, A. L. and R. H. Messing. 2013a. Comparative susceptibility to hyperparasitism of *Binodoxys communis* and *Aphidius colemani*, primary aphid parasitoids introduced to Hawaii. *Biological Control* 65: 286–292.

Acebes, A. L. and R. H. Messing. 2013b. Host range of a newly introduced parasitoid, *Binodoxys communis*, among common aphid species in Hawaii. *BioControl* 58: 635–644.

ACIAR. 1995. Confidential ACIAR project review report. Biological control of breadfruit mealybug (*Icerya aegyptiaca*) in the Pacific. Canberra, Australia; ACIAR, 20 pp.

Adamson, A. M. 1936. Progress report on the introduction of a parasite of the cacao thrips from the Gold Coast to Trinidad, B.W.I. *Tropical Agriculture* 13(3): 62–63.

Agekyan, N. G. 1977. *Clitostethus arcuatus* Rossi (Coleoptera, Coccinellidae)—a predator of citrus whitefly in Adzharia. *Entomologicheskoe Obozrenie* 56(1): 31–33.

Agrò, A., A. Cusumano, and M. lo Pinto. 2009. Study on the parasitoid complex of *Prays oleae* (Bernard) and parasitism levels in an organic olive orchard in western Sicily (Italy). *Protezione delle Colture* 1: 33–39.

Aguilera, P., A. and V., C. Pacheco. 1995. Determination of predators of the hazelnut aphid, *Myzocallis coryli* (Goeze) (Homoptera: Aphididae) in the IX region of Chile. *Revista Chilena de Entomología* 22: 17–19.

Alhmedi, A., E. Haubruge, and F. Francis. 2008. Role of prey-host plant associations on *Harmonia axyridis* and *Episyrphus balteatus* reproduction and predatory efficiency. *Entomologia Experimentalis et Applicata* 128: 49–56.

Al-Zyoud, F. A. 2007. Prey species preference of the predator *Serangium parcesetosum* Sicard (Col., Coccinellidae) and its interaction with another natural enemy. *Pakistan Journal of Biological Sciences* 10(13): 2159–2165.

Al-Zyoud, F. and C. Sengonca. 2004. Prey consumption preferences of *Serangium parcesetosum* Sicard (Col., Coccinellidae) for different prey stages, species and parasitized prey. *Journal of Pest Science* 77(4): 197–204.

Amalin, D. M., P. Stansly, and J. E. Peña. 2004. Effect of Micromite® on the egg parasitoids *Ceratogramma etiennei* (Hymenoptera: Trichogrammatidae) and *Quadrastichus haitiensis* (Hymenoptera: Eulophidae). *Florida Entomologist* 87: 222–224.

Amarasekare, K. G., C. M. Mannion, and N. D. Epsky. 2009. Efficiency and establishment of three introduced parasitoids of the mealybug *Paracoccus marginatus* (Hemiptera: Pseudococcidae). *Biological Control* 51: 91–95.

Andrade, G. S., D. Pratissoli, L. P. Dalvi, N. Desneux, and H. J. G. dos Santos, Jr. 2011. Performance of four *Trichogramma* species (Hymenoptera: Trichogrammatidae) as biocontrol agents of *Heliothis virescens* (Lepidoptera: Noctuidae) under various temperature regimes. *Journal of Pest Science* 84: 313–320.

Angelet, G. W., L. W. Coles, and J. A. Stewart. 1968. Two potential parasites of the Mexican bean beetle from India. *Journal of Economic Entomology* 61: 1073–1075.

Annecke, D. P. and C. J. Cilliers. 1963. The citrus psylla, *Trioza erytreae* (Del Guercio), and its parasites in South Africa. *South African Journal of Agricultural Science* 6(2): 187–191.

Anon. 1915a. Insect notes. *Monthly Bulletin of the California Commission of Horticulture* 4(11): 528 pp.

Anon. 1915b. *Insect Notes. Monthly Bulletin. California Commission of Horticulture* 4(10). 484 pp.

Anon. 1929. 41st Annual report Texas Agricultural Experimental Station 1928. College Station, Texas, see pp. 42–49.

Anon., 1972. Outbreaks and new records. *Plant Protection Bulletin, FAO* 20(5): 115–118.

Anon., 1977. Two new predators of the white fly in Iraq. *PANS* 23(2): 210

Anon. 1987. South Africa Sugar Experiment Station Annual Report 1986–87. Mount Edgecombe: South African Sugar Association Experiment Station,1987. pp. 55–57.

Antadze, A. I. and T. V. Timofeeva. 1976. A predator of the citrus whitefly. *Zashchita Rastenii* 10: 46.

Antonucci, C. 2005. *Acizzia jamatonica*—an insect harmful to *Albizia julibrissin*. *Sherwood - Foreste ed Alberi Oggi* 116: 45–46.

Appert, J. 1974. On two Hispine beetles of the genus *Gestronella* injurious to coconut palm in Madagascar. *Oleagineux* 29(12): 559–564.
Araya, J. E., O. Arretz, L. Lamborot, and M. A. Guerrero. 1997. Natural control by predators of *Rachiplusia nu* (Guenée) (Lepidoptera: Noctuidae) on *Phaseolus* beans in central Chile. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* 104: 147–152.
Argov, Y., A. Tabic, K. Hoelmer, W. Kuslitzky, and E. A. Zchori-Fein. 2009. A survey of natural and introduced parasitoids of the olive fruit fly, *Bactrocera oleae* (Diptera: Tephritidae) in Israel, p. 636. *In*: Mason, P. G., D. R. Gillespie, and C. Vincent (eds.). *Proceedings of the 3rd International Symposium on Biological Control of Arthropods, Christchurch, New Zealand, 8–13 February, 2009.* USDA Forest Service, Forest Health Technology Enterprise Team, Morgantown, West Virginia, USA.
Argyriou, L. C. and P. Katsoyannos. 1977. Coccinellid species found in the olive-groves of Greece. *Annales de l'Institut Phytopathologique Benaki* 11(4): 331–345.
Arredondo-Bernal, H. C. 1999. *Encarsia formosa* Gahan. (Hymenoptera: Aphelinidae). Centro de Sanidad Vegetal. Ficha Técnica CB-21. DGSV, México. 4 pp.
Arthur, A. P. and P. G. Mason. 1986. Life history and immature stages of the parasitoid *Microplitis mediator* (Hymenoptera: Braconidae), reared on the bertha armyworm *Mamestra configurata* (Lepidoptera: Noctuidae). *The Canadian Entomologist* 118: 487–491.
Attia, A. R. and K. T. Awadallah. 2016. Parasitoids and predators of the citrus mealybug, *Planococcus citri* (Risso) (Hemiptera: Pseudococcidae) infesting the herb, *Withania somnifera*, a new host plant in Egypt. *Egyptian Journal of Biological Pest Control* 26: 245–248.
Atwal, A. S., J. P. Chaudhary, and M. Ramzan. 1969. Some preliminary studies in India on the bionomics and rate of [parasitizatism] of *Diaeretiella rapae* Curtis (Braconidae: Hymenoptera) a parasite of aphids. *Journal of Research - Punjab Agricultural University* 6: 177–182.
Austin, A. D., D. L. J. Quicke, and P. M. Marsh. 1994. The hymenopterous parasitoids of eucalypt longicorn beetles, *Phoracantha* spp. (Coleoptera: Cerambycidae) in Australia. *Bulletin of Entomological Research* 84: 145–174.
Awan, M. S. 1989. Parasitism of two endemic predacious stink bugs by the introduced egg parasitoid *Trissolcus basalis* (Wollaston) (Hymenoptera: Scelionidae). *Annales de la Société Entomologique de France* 25: 119–120.
Awibowo, R. 1934. The coconut leaf beetle, *B. froggatti* var. *selebensis* and its biological control in Celebes. (Preliminary Communication.). / De klapperbladkever Brontispa froggatti var. selebensis en zijn biologische bestrijding op Celebes. (Voorloopige mededeeling.). *Landbouw* 10(2): 76–92.
Azam, K. M., S. A. Aziz, and M. H. Ali. 1974. A new record of *Uga menoni* Kerrich as parasite of *Epilachna vigintioctopunctata* (F.) in India. *Current Research* 3(8): 88.
Baki, M. H. A. A. and M. S. Ahemed. 1985. Ecological studies on olive psyllid *Euphyllura straminea* Log. at Mosul Region with special reference to its natural enemies. *Iraqi Journal of Agricultural Sciences "Zanco"* 3(1): 1–14.
Balakrishnan, M. M., K. S. Ramya, G. V. M. Reddy, and P. K. Kumar, P. K. V. 2011. An update on the natural enemies of the black twig borer *Xylosandrus compactus* (Coleoptera: Curculionidae). *Journal of Coffee Research* 39: 86–89.
Ballal, C. R. and P. Kumar. 1989. Performance specifications of an introduced parasitoid, *Allorhogas pyralophagus* (Marsh) on different laboratory hosts. *Entomon* 14(12): 63–66.
Baranowski, R., H. Glenn, and J. Sivinski. 1993. Biological control of the Caribbean fruit fly (Diptera: Tephritidae). *Florida Entomologist* 76: 245–251.
Barbosa, P., S. M. Braxton, and A. E. Segarra-Carmona. 1994. A history of biological control in Maryland. *Biological Control* 4: 185–243.
Barratt, B. I. P., A. A. Evans, C. M. Ferguson, G. M. Barker, M. R. McNeill, and C. B. Phillips. 1997. Laboratory nontarget host range of the introduced parasitoids *Microtonus aethiopoides* and *M. hyperodae* (Hymenoptera: Braconidae) compared with field parasitism in New Zealand. *Environmental Entomology* 26: 694–702.
Barrera, J. F., P. S. Baker, J. E. Valenzuela, and A. Schwarz. 1990a. Introduction of two African parasitoid species to Mexico for biological control of the coffee borer *Hypothenemus hampei* (Ferrari) (Coleoptera: Scolytidae). *Folia Entomológica Mexicana* 79: 245–247.
Barrera, J. F., D. Moore, Y. J. Abraham, S. T. Murphy, and C. Prior. 1990b. Biological control of the coffee berry borer, *Hypothenemus hampei*, in Mexico and possibilities for further action, pp. 391–396. *Brighton Crop Protection Conference, Pests and Diseases–1990. Vol. 1.* British Crop Protection Council, Thornton Heath, UK.
Barrera, J. F., J. Gómez, A. Castillo, E. López, J. Herrera, and G. González. 2008. Broca del café, (Coleoptera: Curculionidae), pp. 101–120. *In*: Arredondo Bernal, H. C. and L. A. Rodríguez el Bosque (eds.). *Casos de Control Biológico en México*. Grupo Mundi-Prensa, Madrid, Spain.
Barrion, A. T., J. P. Bandong, M. D. Lumaban, P. C. Pantua, R. A. Apostol, and J. A. Litsinger. 1979. Natural enemies of the rice leaf folder *Cnaphalocrosis medinalis* in the Philippines. *International Rice Research Newsletter* 4(2): 18.
Bartlett, K. A. 1938. The introduction and colonization in Puerto Rico of *Dasyscapus parvipennis* Gahan, a parasite of thrips. *Agricultural Notes Puerto Rico Experiment Station* No. 87, 6 pp.
Bartlett, B. E. and D. C. Lloyd. 1958. Mealybugs attacking citrus in California – a survey of their natural enemies and the release of new parasites and predators. *Journal of Economic Entomology* 51: 90–93.
Bartninkaite, I. 1996. Influence of the physiological state of the ermine moth *Yponomeuta evonymella* L. to its relations with parasites and microorganisms. *Lietuvos entomologu darbai* 30: 150–157.
Basheer, A., M. Z. Mahmalji, and A. Berawe. 2011. Survey of the parasitoids of the fruit scale insect, *Parthenolecanium corni* Bouché (Homoptera: Coccidae) on almond trees at Kalamon, Damascus countryside, Syria. *Egyptian Journal of Biological Pest Control* 21(1): 27–31.
Bathon, H. and J. Pietrzik. 1986. Food uptake by the ladybird *Clitostethus arcuatus* (Rossi) (Col., Coccinellidae), a predator of the cabbage whitefly, *Aleurodes proletella* Linné (Hom., Aleurodidae). *Journal of Applied Entomology* 102: 321–326.
Battu, G. S. and G. S. Dhaliwal. 1977. A note on the occurrence of *Blepharella lateralis* Macquart as a parasite of *Euproctis lunata* (Walker). *Science and Culture* 43(6): 271.
Bautista-Martínez, N., J. A. Villanueva-Jiménez, and H. C. Arrendondo-Bernal. 2008. Minador de la hoja de los citricos, *Phyllocnistis citrella* (Lepidoptera: Gracillariidae), pp. 347–358. *In*: Arredondo Bernal, H. C. and L. A. Rodríguez el Bosque (eds.). *Casos de Control Biológico en México*. Grupo Mundi-Prensa, Madrid, Spain.
Bayoun, I. M., G. P. Walker, and S. V. Triapitsyn. 2008. Parasitization of beet leafhopper eggs, *Circulifer tenellus*, in California. *Journal of Applied Entomology* 132: 412–424.
Bayram, S. 2009. Predator species of Coccinellidae (Coleoptera) of *Dysaphis devecta* Walk. (Homoptera, Aphididae) rosy leaf-curling aphid on apple in Ankara. *Tarim Bilimleri Dergisi* 15(1): 53–57.
Beardsley, J. W., Jr. 1988. Eucoilid parasites of agromyzid leafminers in Hawaii (Hymenoptera: Cynipoidea). *Proceedings of the Hawaiian Entomological Society* 28: 33–47.

Beardsley, J. W. and G. K. Uchida. 1990. Parasites associated with leucaena psyllid, *Heteropsylla cubana* Crawford, in Hawaii. *Proceedings of the Hawaiian Entomological Society* 30: 155–156.
Beavers, J. B. and A. G. Selhime. 1975. Further attempts to establish the weevil egg parasite, *Tetrastichus haitiensis* in Florida. *Florida Entomologist* 58: 29–31.
Beavers, J. B., S. A. Lovestrand, and A. G. Selhime. 1980. Establishment of the exotic parasite *Tetrastichus haitiensis* (Hym.: Eulophidae) and recovery of a new Trichogramma (Hym.: Trichogrammatidae) from root weevil egg masses in Florida. Entomophaga 25: 91–94.
Bedford, E. C. G. 1949. Report of the Plant Pathologist for 1948. *Report of the Department of Agriculture, Bermuda* 1949: 13–24.
Beitia, F., J. Tormos, and A. Garrido. 1994. Some aspects on the superparasitism of *Diglyphus isaea* (Walker, 1838). *Boletín de Sanidad Vegetal, Plagas* 20(3): 793–796.
Bell, R. C., A. Belmaker, C. S. Couch, K. M. Marchetto, J. L. Simonis, R. Q. Thomas, J. P. Sparks, J. M. Brown, K. S. Francisco, and M. E. Manuel. 2013. Effectiveness of *Erythrina* gall wasp biocontrol and implications for the recovery of threatened wiliwili trees (Fabaceae: *Erythrina sandwicensis*). *Journal of the Torrey Botanical Society* 140(2): 215–224.
Bellows, T. S. and K. Y. Arakawa. 1995. Cloudy-wing whitefly, pp. 109–110. *In* Nechols, J. R., L. A. Andres, J. W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). *Biological Control in the Western United States, Accomplishments and Benefits of Regional Project W-84, 1964–1989*. Publication 3361 of the University of California, Division of Agriculture and Natural Resources, Oakland, California, USA.
Bellows, T. S. and C. Meisenbacher. 2000. Biological control of giant whitefly, *Aleurodicus dugesii*, in California, pp. 113–116. *In*: Hoddle, M.S. (ed.). *Proceedings of the 2nd California Conference on Biological Control, Riverside, California, USA, 11–12 July, 2000*. Center for Biological Control of the University of California, Berkeley, California, USA.
Bellows, T. S., T. D. Paine, K. Y. Arakawa, C. Meisenbacher, P. Leddy, and J. Kabashima. 1990. Biological control sought for ash whitefly. *California Agriculture* 44: 4–6.
Bellows, T. S., Jr., T. D. Paine, and D. Gerling. 1992a. Development, survival, longevity, and fecundity of *Clitostethus arcuatus* (Coleoptera: Coccinellidae) on *Siphoninus phillyreae* (Homoptera: Aleyrodidae) in the laboratory. *Environmental Entomology* 21: 659–663.
Bellows, T. S., T. D. Paine, J. R. Gould, L. G. Bezark, and J. C. Ball. 1992b. Biological control of ash whitefly: a success in progress. *California Agriculture* 46(1): 24, 27–28.
Bellows, T. S., Jr., T. D. Paine, L. G. Bezark, and J. Ball. 2006. Optimizing natural enemy release rates, and associated pest population decline rates, for *Encarsia inaron* Walker (Hymenoptera: Aphelinidae) and *Siphoninus phillyreae* (Haliday) (Homoptera: Aleyrodidae). *Biological Control* 37: 25–31.
Belokobylskij, S. A., G. I. Yurchenko, J. S. Strazanac, A. Zaldívar-Riverón, and V. Mastro. 2012. A new emerald ash borer (Coleoptera: Buprestidae) parasitoid species of *Spathius* Nees (Hymenoptera: Braconidae: Doryctinae) from the Russian Far East and South Korea. *Annals of the Entomological Society of America* 105: 165–178.
Bene, G. del, E. Gargani, and S. Landi. 1991. Notes on *Pealius azaleae* (Baker and Moles) (Hom. Aleyrodidae), a species new to Italy. *Redia* 74: 163–175.
Bénédet, F., Y. Bigot, S. Renault, J. Pouzat, and E. Thibout. 1999. Identification and perception of stimulus used by the endoparasitoid *Diadromus pulchellus* (Hymenoptera: Ichneumonidae) during host acceptance. *Annales de la Société Entomologique de France* 35: 364–370.
Benelli, G., R. H. Messing, M. G. Wright, G. Giunti, N. G. Kavallieratos, and A. Canale. 2014. Cues triggering mating and host–seeking behavior in the aphid parasitoid *Aphidius colemani* (Hymenoptera: Braconidae: Aphidiinae): implications for biological control. *Journal of Economic Entomology* 107: 2005–2022.
Bennett, F. D. 1994. Fall armyworm, pp. 33. *In*: Rosen, D., F. D. Bennett, and J. L. Capinera (eds.). *Pest Management in the Subtropics: Biological Control – a Florida Perspective*. Intercept, Andover, U.K.
Benson, J., A. Pasquale, R.G. Van Driesche, and J. Elkinton. 2003a. Assessment of risk posed by introduced braconid wasps to *Pieris virginiensis*, a native woodland butterfly in New England. *Biological Control* 26: 83–93.
Benson, J., R. G. Van Driesche, A. Pasquale, and J. Elkinton. 2003b. Introduced braconid parasitoids and range reduction of a native butterfly in New England. *Biological Control* 28: 197–213.
Bernal, J. S., R. F. Luck, and J. G. Morse. 1999. Augmentative release trials with *Metaphycus* spp. (Hymenoptera: Encyrtidae) against citricola scale (Homoptera: Coccidae) in California's San Joaquin Valley. *Journal of Economic Entomology* 92: 1099–1107.
Berthiaume, R., C. Hébert, and C. Cloutier. 2007. Comparative use of *Mindarus abietinus* (Homoptera: Aphididae) by two coccinellids (Coleoptera: Coccinellidae), the native *Anatis mali* and the exotic *Harmonia axyridis*, in a Christmas tree plantation. *Environmental Entomology* 36: 319–328.
Beserra, E. B., C. T. dos S. Dias, and J. R. P. Parra. 2002. Distribution and natural parasitism of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) eggs at different phenological stages of corn. *Florida Entomologist* 85: 588–593.
Betbeder-Matibet, M. 1971. Biological control of *Chilo sacchariphagus* the spotted borer of sugar-cane in Madagascar. *Agronomie Tropicale* 26: 332–336.
Betrem, J. G. 1961. *Cephalonomia stephanoderis* nov. spec. (Hym., Bethylidae). *Entomologische Berichten* 21(10): 183–184.
Beyene, Y., T. Hofsvang, and Ferdu Azerefegne. 2007. Population dynamics of tef epilachna (*Chnootriba similis* Thunberg) (Coleoptera, Coccinellidae) in Ethiopia. *Crop Protection* 26: 1634–1643.
Bhattacharya, A., S. Kumar, A. K. Jaiswal, and K. K. Kumar. 2006. Efficacy of the egg parasitoids, *Trichogramma* spp. for the management of *Eublemma amabilis* Moore (Lepidoptera: Noctuidae)—a predator of Indian lac insect. *Entomon* 31: 121–124.
Bhumannavar, B.S. and C.A. Viraktamath. 2000. Biology and behaviour of *Euplectrus maternus* Bhatnagar (Hymenoptera: Eulophidae), an ectoparasitoid of *Othreis* spp. (Lepidoptera: Noctuidae) from southern India. *Pest Management in Horticultural Ecosystems* 6: 1–14.
Biever, K. D. 1992. Distribution and occurrence of *Cotesia rubecula* (Hymenoptera: Braconidae), a parasite of *Artogeia rapae* in Washington and Oregon. *Journal of Economic Entomology* 85: 739–742.
Biever, K. D., R. L. Chauvin, G. L. Reed, and R. C. Wilson. 1992. Seasonal occurrence and abundance of lepidopterous pests and associated parasitoids on collards in the northwestern United States. *Journal of Entomological Science* 27: 5–18.
Bilewicz-Pawinska, T. 1976. Natural enemies of some plant bugs (Miridae) in Poland. *Roczniki Nauk Rolniczych* E 6(1): 125–135.
Billah, M. K., S. Kimani-Njogu, W. A. Overholt, R. A. Wharton, D. D. Wilson, and M. A. Cobblah. 2005. The effect of host larvae on three *Psyttalia* species (Hymenoptera: Braconidae), parasitoids of fruit-infesting flies (Diptera: Tephritidae). *International Journal of Tropical Insect Science* 25: 168–175.
Bistline-East, A., R. Pandey, M. Kececi, and M.S. Hoddle. 2015. Host-range testing of *Diaphorencyrtus aligarhensis* (Hymenoptera: Encyrtidae) for use in classical biological control of *Diaphorina citri* (Hemiptera: Liviidae) in California. *Journal of Economic Entomology* 108: 940–950.
Bjorksten, T. A., M. Robinson, M. and J. LaSalle. 2005. Species composition and population dynamics of leafmining flies and their parasitoids in Victoria. *Australian Journal of Entomology* 44: 186–191.
Blanco-Metzler, H. and S. Laprade. 1998. Natural enemies of the spiralling whitefly, *Aleurodicus dispersus* Russell (Homoptera: Aleyrodidae): Parasitoids

and predators. *Agronomia Mesoamericana* 9(2): 41–44.
Bodenheimer, F. S. and S. Neumark. 1955. The Israel pine *Matsucoccus* (*Matsucoccus josephi* nov. spec.). Kiryath Sepher Ltd., Jerusalem.
Boivin, G. 2013. *Listronotus oregonensis* (LeConte), carrot weevil (Coleoptera: Curculionidae), pp. 214–220. *In*: Mason, P.G. and D.R. Gillespie. *Biological Control Programmes in Canada, 2001–2012.* CABI, Wallingford, UK.
Bokonon-Ganta, A. H., M. M. Ramadan, X. G. Wang, and R. H. Messing. 2005. Biological performance and potential of *Fopius ceratitivorus* (Hymenoptera: Braconidae), an egg-larval parasitoid of tephritid fruit flies newly imported to Hawaii. *Biological Control* 33: 238–247.
Bokonon-Ganta, A. H., G. T. McQuate, R. H. Messing, and E. B. Jang. 2013. Release and establishment of the parasitoid *Diachasmimorpha kraussii* against the tephritid fruit fly *Bactrocera latifrons* in Hawaii. *Journal of Insect Science* 13: paper no. 7.
Bon, M. C., L. Smith, K. M. Daane, C. Pickett, X. Wang, A. Blanchet, F. Chardonnet, F. Guermache, and K. A. Hoelmer. 2017. Benefits of pre-release population genetics: a case study using *Psyttalia lounsburyi*, a biocontrol agent of the olive fruit fly in California, pp. 38–41. *In*: Mason, P. G., D. R. Gillespie, and C. Vincent. *Proceedings of the 5th International Symposium on Biological Control of Arthropods, Langkawi, Malaysia, September 11–15, 2017*. CABI, Wallingford, UK. http://www.isbca-2017.org/download/ISBCA-Proceedings.web.pdf
Boot, W. J., O. P. J. M. Minkenberg, R. Rabbinge, and G. H. de Moed. 1992. Biological control of the leafminer *Liriomyza bryoniae* by seasonal inoculative releases of *Diglyphus isaea*: simulation of a parasitoid-host system. *Netherlands Journal of Plant Pathology* 98(3): 203–212.
Borah, B. K. and K. K. Sarma. 1995. Seasonal incidence of plassey borer, *Chilo tumidicostalis* Hmpsn. in ratoon sugarcane. *Plant Health* 1: 29–33.
Botto, E. N. and I. S. de Crouzel. 1981. Contribution to knowledge of the reasons for mortality among the lucerne larva *Colias lesbia* (F.) in Castelar, Buenos Aires. *Revista de la Sociedad Entomologica Argentina* 40(1/4): 201–210.
Boucek, Z. 1976. Taxonomic studies on some Eulophidae (Hym.) of economic interest, mainly from Africa. *Entomophaga* 21: 401–414.
Boughton, A. J., M. A. Mendez, A. W. Francis, T. R. Smith, L. S. Osborne, and C. M. Mannion. 2015. Host stage suitability and impact of *Encarsia noyesi* (Hymenoptera: Aphelinidae) on the invasive rugose spiraling whitefly, *Aleurodicus rugioperculatus* (Hemiptera: Aleyrodidae), in Florida. *Biological Control* 88: 61–67.
Boyce, A. M. 1934. Bionomics of the walnut husk fly, *Rhagoletis completa*. *Hilgardia* 8(11): 363–579.
Boyd, E. A. and M. S. Hoddle. 2007. Host specificity testing of *Gonatocerus* spp. egg parasitoids used in a classical biological control program against *Homalodisca vitripenis*: a retrospective analysis of non-target impacts in southern California. *Biological Control* 43: 56–70.
Bozsik, A., M. Canard, and D. Thierry. 2014. "*Chryso*(*pa*)*perla carnaffinis*"? (Neuroptera: Chrysopidae): incomplete history of a natural enemy. *Növényvédelem* 50(7): 309–318.
Brewer, M. J., T. Noma, and N. C. Elliott. 2005. Hymenopteran parasitoids and dipteran predators of the invasive aphid *Diuraphis noxia* after enemy introductions: temporal variation and implication for future aphid invasions. *Biological Control* 33: 315–323.
Broadbent, A. B., H. Goulet, J. W. Whistlecraft, S. Lachance, and P. G. Mason. 1999. First Canadian record of three parasitoid species (Hymenoptera: Braconidae: Euphorinae) of the tarnished plant bug, *Lygus lineolaris* (Hemiptera: Miridae). *Proceedings of the Entomological Society of Ontario* 130: 109–111.
Broadbent, A. B., R. G. Mason, S. Lachance, J. W. Whistlecraft, J. J. Soroka, and U. Kuhlmann. 2002. *Lygus* spp., plant bugs (Hemiptera: Miridae), pp. 153–159. *In*: Mason, P. G. and J. T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, UK.
Broadbent, A. B., T. Haye, T. Garietpy, W. Olfert, and U. Kuhlmann. 2013. *Lygus lineolaris* (Palsiot), tarnished plant bug (Hemiptera: Miridae), pp. 221–227. *In*: Mason, P. G. and D. R. Gillespie (eds.). *Biological Control Programmes in Canada 2001–2012*. CABI, Wallingford, U.K.
Brown, S. D. J. 2017. A revision of the New Zealand weevil genus *Irenimus* Pascoe, 1876 (Coleoptera: Curculionidae: Entiminae). *Zootaxa* 4263(1): 1–42. doi: 10.11646/zootaxa.4263.1.1.
Brown, M. W. and C. R. Mathews. 2007. Conservation biological control of rosy apple aphid, *Dysaphis plantaginea* (Passerini), in eastern North America. *Environmental Entomology* 36: 1131–1139.
Browning, H. W. and C. W. Melton. 1987. Indigenous and exotic trichogrammatids (Hymenoptera: Trichogrammatidae) evaluated for biological control of *Eoreuma loftini* and *Diatraea saccharalis* (Lepidoptera: Pyralidae) borers on sugarcane. *Environmental Entomology* 16: 360–364.
Bueno, R. C. O. F., J. R. P. Parra, A. de F. Bueno, and M. L. Haddad. 2009. Performance of trichogrammatids as biocontrol agents of *Pseudoplusia includens* Walker (Lepidoptera: Noctuidae). *Neotropical Entomology* 38: 389–394
Bueno, R. C. O. de F., A. de F. Bueno, M. F. da C. Xavier, and M. M. Carvalho. 2014. *Telenomus remus* (Hymenoptera: Platygastridae) parasitism on eggs of *Anticarsia gemmatalis* (Lepidoptera: Erebidae) compared with its natural host *Spodoptera frugiperda* (Lepidoptera: Noctuidae). *Annals of the Entomological Society of America* 107: 799–808.
Buffington, M. L. 2004. Taxonomic notes on *Nordlandiella* Diaz and *Ganaspidium* Weld (Hymenoptera: Figitidae: Eucoilinae). *Proceedings of the Entomological Society of Washington* 106: 192–198.
Buffington, M. L. 2010. A revision of *Ganaspidium* Weld, 1952 (Hymenoptera, Figitidae, Eucoilinae): new species, bionomics, and distribution. 2010. *Zookeys* 37: 81–101.
Bughio, A. R., Talib Hussain, and Z. A. Qureshi. 1994. Host range and rate of parasitism by an egg parasite, *Telenomus remus* Nixon (Hymenoptera: Scelionidae). *Proceedings of Pakistan Congress of Zoology* 14: 103–106.
Bugila, A. A., J. C. Franco, E. B. da Silva, and M. Branco. 2015. Suitability of five mealybug species (Hemiptera, Pseudococcidae) as hosts for the solitary parasitoid *Anagyrus* sp. nr. *pseudococci* (Girault) (Hymenoptera: Encyrtidae). *Biocontrol Science and Technology* 25: 108–120.
Bull, B.C., M.J. Raupp, M.R. Hardin, and C.S. Sadof. 1993. Suitability of five horticulturally important armored scale insects as hosts for an exotic predaceous lady beetle. *Journal of Environmental Horticulture* 11: 28–30.
Burd, J. D. and G. J. Puterka. 2012. Occurrence of hymenopterous parasitoids of *Diuraphis* spp. in the Western Rocky Mountain region. *Southwestern Entomologist* 37: 231–234.
Burd, J. D., K. A. Shufran, N. C. Elliott, B. W. French, and D. A. Prokrym. 2001. Recovery of imported hymenopterous parasitoids released to control Russian wheat aphids in Colorado. *Southwestern Entomologist* 26: 23–31.
Burges, H. D. 1974. Modern pest control in glasshouses. *International Pest Control* 16(3): 18–21.
Buschman, L. L. and W. H. Whitcomb. 1980. Parasites of *Nezara viridula* (Hemiptera: Pentatomidae) and other Hemiptera in Florida. *Florida Entomologist* 63:154–162.
Bush, S. J., B. Slippers, and B. P. Hurley. 2017. Host specificity testing of *Psyllaephagus bliteus*, an accepted biocontrol agent of *Glycaspis brimblecombei*, reveals a new host, p. 266. *In*: Mason, P. G., D. R. Gillespie, and C. Vincent (eds.). *Proceedings of the 5th International Symposium on Biological Control of Arthropods, Langkawi, Malaysia, September 11–15, 2017*. CABI, Wallingford, UK. http://www.isbca-2017.org/download/ISBCA-Proceedings.web.pdf

Butin, E. E., N. P. Havill, J. S. Elkinton, and M. E. Montgomery. 2004. Feeding preferences of three lady beetle predators of the hemlock woolly adelgid (Homoptera: Adelgidae). *Journal of Economic Entomology* 97: 1635–1641.

Butler, C. G. 1936. The occurrence of the chalcids *Encarsia partenopea* Masi and *E. tricolor* Förster in England (Hymenoptera). *Proceedings of the Royal Entomological Society of London* 11(3–5): 79–80.

Butler, G. D., Jr. and A. L. Wardecker. 1974. Development of *Peristenus stygicus*, a parasite of *Lygus hesperus*, in relation to temperature. *Journal of Economic Entomology* 67: 132–133.

Calilung, V. J. 2008. Natural enemies of *Pentalonia nigronervosa* Coq. (Hemiptera: Aphidoidea), the vector of abaca and banana bunchy-top virus. *Philippine Entomologist* 22(1): 53–70.

Callcott, A.-M. A., S. D. Porter, R. D. Weeks, Jr., L.C. Graham, S. J. Johnson, and L. E. Gilbert. 2011. Fire ant decapitating fly cooperative release programs (1994–2008): Two *Pseudacteon* species, *P. tricuspis* and *P. curvatus*, rapidly expand across imported fire ant populations in the southeastern United States. *Journal of Insect Science* 11(19): 1–25.

Cameron, P. J. and G. P. Walker. 1997. Host specificity of *Cotesia rubecula* and *Cotesia plutellae,* parasitoids of white butterfly and diamondback moth, pp. 236–241. *In*: O'Callaghan, M. (ed.). *Proceedings of the Fiftieth New Zealand Plant Protection Conference, Lincoln University, Canterbury, New Zealand, 18–21 August, 1997.* New Zealand Plant Protection Society, Rotorua, New Zealand.

Cameron, P. J., R. L. Hill, D. A. J. Teulon, M. A. W. Stufkens, P. G. Connolly, and G. P. Walker. 2013. A retrospective evaluation of the host range of four *Aphidius* species introduced to New Zealand for the biological control of pest aphids. *Biological Control* 67: 275–283.

Cao, K. C. and S. F. Guo. 1987. Preliminary observations on the bionomics of *Recurvaria syrictis* Meyrick. *Insect Knowledge* 24(5): 279–281.

Čapek, M. 1961. On knowledge of larval parasites of *Eucosma nigricana*. *Journal of Applied Entomology* 4–8: 75–93.

Cappaccino, N., T. Haye, L. Tewksbury, and R. Casagrande. 2013. *Lilioceris lilii* (Scopoli), lily leaf beetle (Coleoptera: Chrysomelidae), pp. 208–213. *In*: Mason, P.G. and D.R. Gillespie (eds.). *Biological Control Programmes in Canada, 2001–2012*. CABI, Wallingford, UK.

Carrillo L., R. and Z., M. Mellado. 1975. Effect of the sowing date and the aphid *Metopolophium dirhodum* (Walker) on the yield of cultivars of spring wheat (*Triticum aestivum* L.). *Agricultura Tecnica* 35(4): 190–204.

Casagrande, R. A. and M. Kenis. 2004. Evaluation of lily leaf beetle parasitoids for North American introduction, pp. 121–137. *In*: Van Driesche, R.G. and R. Reardon (eds.). *Assessing Host Ranges of Parasitoids and Predators Used for Classical Biological Control: A Guide to Best Practice.* FHTET-04-03. USDA Forest Service, Morgantown, West Virginia, USA.

Cassanello, A. M. L., A. Z. Maramag, N-Z. Yao, Y. Yoshiyasu, K. Hirai, and M. Takeda. 2000. Search for alternative host species for mass production system of *Trichogramma ostriniae. Science Reports of Faculty of Agriculture, Kobe University* 24(1): 53–58.

Castagnoli, M. and L. Falchini. 1993. Suitability of *Polyphagotarsonemus latus* (Banks) (Acari, Tarsonemidae) as prey for *Amblyseius californicus* (McGregor) (Acari, Phytoseiidae). *Redia* 76: 273–279.

Castagnoli, M., S. Simoni, S., and M. Liguori. 2003. Evaluation of *Neoseiulus californicus* (McGregor) (Acari Phytoseiidae) as a candidate for the control of *Aculops lycopersici* (Tryon) (Acari Eriophyoidea): a preliminary study. *Redia* 86: 97–100.

Castilho, H. J., P. S. M. Botelho, N. Macedo, and J. R. de Araújo. 1989. Evaluation of *Allorhogas pyralophagus* (March, 1984) (Hymenoptera: Braconidae) as an ectoparasitoid of the sugarcane borer *Diatraea saccharalis* (Fabricius, 1794) (Lepidoptera: Pyralidae). *Anais da Sociedade Entomológica do Brasil* 18: 75–89.

Castillo, A., F. Infante, G. López, J. Trujillo, J. R. Kirkendall, and F. E. Vega. 2004. Laboratory parasitism by *Phymastichus coffea* (Hymenoptera: Eulophidae) upon non-target bark beetles associated with coffee plantations. *Florida Entomologist* 87: 274–277.

Castner, J. L. 1984. Suitability of *Scapteriscus* spp. mole crickets (Ort.: Gryllotalpidae) as hosts of *Larra bicolor* (Hym.: Sphecidae). *Entomophaga* 29: 323–329.

Ceballos Vázquez, M., H. Lellani Baños, R. Chico, M. de L. A. Martínez. 2016. Presence in Cuba of natural enemies of the pink hibiscus mealybug (*Maconellicoccus hirsutus* Green). *Revista de Protección Vegetal* 31(1): 77–80.

Cervantes, M. and C. Cota. 1992. Evaluación de parasitoides específicos del género *Eretmocerus mundus* (España) y *Encarsia formosa* (E.E.U.U. y Egipto). Mexicali, B.C., Informe del Centro Nacional de Referencia de Control Biológico, p. 4.

Chandrika, M., P. Rajan, and C. P. R. Nair. 2007. Incidence of the white fly (*Aleurocanthus arecae* David) on coconut foliage. *Journal of Plantation Crops* 35(2): 119–121.

Chang, Y. D. and Y. N. Youn. 1983. A study on the biology of primary parasites of the cowpea aphid, *Aphis craccivora* Koch (Aphididae, Homo.) and its hyperparasites. *Korean Journal of Plant Protection* 22: 237–243.

Chang, Y. D., J. Y. Lee, and Y. N. Youn. 1994. Primary parasitoids and hyperparasitoids of the soyabean aphid, *Aphis glycines* (Homoptera: Aphididae). *Korean Journal of Applied Entomology* 33: 51–55.

Charles, J. G., W. R. M. Sandanayaka, A. Chhagan, and N. E. M. Page-Weir. 2013. Survival of the gregarious ectoparasitoid *Mastrus ridens* on codling moth, *Cydia pomonella*, and non-target species. *BioControl* 58: 505–513.

Chatterjee, P. N. 1945. On the biology and morphology of *Euplectrus parvulus* Ferr. (Hymenop: Enlophidae). *Indian Journal of Entomology* 6(1–2): 95–101.

Chavalle, S., P. N. Buhl, F. Censier, F.; and M. de Proft. 2015. Comparative emergence phenology of the orange wheat blossom midge, *Sitodiplosis mosellana* (Géhin) (Diptera: Cecidomyiidae) and its parasitoids (Hymenoptera: Pteromalidae and Platygastridae) under controlled conditions. *Crop Protection* 76: 114–120.

Cheah, C. A. S. J. and M. S. McClure. 1998. Life history and development of *Pseudoscymnus tsugae* (Coleoptera: Coccinellidae), a new predator of the hemlock woolly adelgid (Homoptera: Adelgidae). *Environmental Entomology* 27: 1531–1536.

Cheah, C. A. S. J. and M. S. McClure. 2000. Seasonal synchrony of life cycles between the exotic predator, *Pseudoscymnus tsugae* (Coleoptera: Coccinellidae) and its prey, the hemlock woolly adelgid *Adelges tsugae* (Homoptera: Adelgidae). *Agricultural and Forest Entomology* 2: 241–251.

Chen, D-L. 1998. Study on bionomics of four ladybird beetles preying on *Aulacaspis roarum*. *Wuyi Science Journal* 14: 106–111.

Chen, F-G. 1936. Notes on the scale insects of citrus in several districts of East Chekiang, with description of one new species. *Entomology and Phytopathology* 4(11): 208–228.

Chen, H. Q. 1982. A preliminary observation on *Altica* sp. *Kunchong Zhishi* 19(6): 21–23.

Chen, G-H., Y-J. Shi, M. Tao. 2009. Natural enemies of *Aonidiella citrina* and population dynamic of main parasitic wasp in Kunming. *Chinese Journal of Biological Control* 25(1): 1–4.

Cheng, W. Y., S. M. Chen, and Z. T. Wang. 1998. Occurrence of *Trichogramma chilonis* and *T. ostriniae* in spring-planted cane field. *Report of the Taiwan Sugar Research Institute* 160: 1–18.

Cheng, W. Y., S. M. Chen, and Z. T. Wang. 1999. Survey of larval and pupal parasitoids of cane borers in spring cane. *Report of the Taiwan Sugar Research Institute* No. 164, pp. 1–14.
Chiu, S. C. and L. Y. Chou. 1976. Hymenopterous parasitoids of *Spodoptera litura* Fab. *Journal of Agricultural Research of China* 25(3): 227–241.
Chiu, C.H. and A. Moore. 1993. Biological control of the Philippine lady beetle, *Epilachna philippinensis* (Coleoptera: Coccinellidae), on solanaceous plants by the parasitoid, *Pediobius foveolatus* (Hymenoptera: Eulophidae), on Saipan. *Micronesica* 4 (suppl): 79–80.
Chkhaidze, L. and V. Yasnosh. 2001.The *Dictyospermum* scale *Chrysomphalus dictyospermi* (Morgan) (Coccinea: Diaspididae), pest of fruit and ornamental plants in the Black Sea coast of Georgia: a review. *Bollettino di Zoologia Agraria e di Bachicoltura* 33(3): 495–499.
Choi, S. Y. and G. H. Kim. 1985. Aphidivorous activity of a coccinellid beetle, *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae). *Korean Journal of Plant Protection* 24(1): 11–14.
Choi, K-S., S-G. Lee, J-K. Kim, and J-D. Park. 1995a. Role of the coccinellid beetle, *Harmonia axyridis* in the biological control of the black pine bast scale insect, *Matsucoccus thunbergianae*. *FRI Journal of Forest Science* (*Seoul*) (51): 115–118.
Choi, K-S., S-G. Lee, J-K. Kim, and S-M. Lee Sang. 1995b. Host plants of *Comstockaspis macroporanus* and its predators. *FRI Journal of Forest Science* (*Seoul*) (51): 143–146.
Chu, J-T. 1933. On the mulberry coccid, *Drosicha contrahens* Walker. *Entomology and Phytopathology* 1(19–20): 410–414.
Chumakova, B. M. 1964. The San José scale *Diaspidiotus perniciosus* Comst. (Coccoidea, Diaspididae) and its parasites in the conditions of the Far East. *Entomologicheskoe Obozrenie* 43(3): 535–552.
Chumakova, B. M. 1967. The San José scale and the natural supply of entomophagous insects attacking it in Sakhalin. *Byulleten' Vsesoyuznogo Nauchno-issledovatel'skogo Instituta Zashchity Rastenii, Leningrad* 1(9): 9–13.
Ciampolini, M. 1949. Observations on the bionomics of *Pseudonapomyza dianthicola* Venturi / Osservazioni sull'etologia della *Pseudonapomyza dianthicola* Venturi (Diptera Agromyzidae). *Redia* 34: 289–301.
Cierniewska, B. 1973. Parasites of aphids occurring in the orchards near Poznan (Hymenoptera, Aphidiidae). *Polskie Pismo Entomologiczne* 43(3): 837–839.
Clark, C. A. 1934. The European corn borer and its controlling factors in the Orient. *USDA Technical Bulletin* No. 455, 37 pp.
Clarke, A. R. and G. H. Walter. 1994. Biological control and the species status of two host-associated populations of *Trissolcus basalis* (Wollaston) (Hymenoptera: Scelionidae). *Australian Journal of Ecology* 19: 35–39.
Clausen, C. P. (ed.). 1978. *Introduced Parasites and Predators of Arthropod Pests and Weeds: A World Review.* Agricultural Handbook #480. U.S. Department of Agriculture. Washington, D.C.
Cleary, D. F. R. and W. van Ginkel. 2004. Effects of host species and size on brood size and larval mortality of the parasitoid, *Ageniaspis fuscicollis* (Dalman) (Hymenoptera, Encyrtidae). *Environmental Entomology* 33: 528–534.
Cock, M. J. W., H. C. J. Godfray, and J. D. Holloway (eds.). 1987. *Slug and Nettle Caterpillars: The Biology, Taxonomy and Control of the Limacodidae of Economic Importance on Palms in South-East Asia.* C.A.B. International, Wallingford, UK. 270 pp.
Compere, H. 1924. A preliminary report on the parasitic enemies of the citricola scale [*Coccus pseudomagnoliarum* (Kuwana)] with descriptions of two new chalcidoid parasites. *Bulletin of the Southern California Academy of Science* 23(4): 111–123.
Condit, B. P. and J. R. Cate. 1982. Determination of host range in relation to systematics for *Peristenus stygicus* (Hym.: Braconidae), a parasitoid of Miridae. *Entomophaga* 27: 203–210.
Constantinescu, V. 1970. Factors limiting the multiplication of the grey cabbage aphid (*Brevicoryne brassicae* L.). *Analele Institutului de Cercetari pentru Protectia Plantelor* 8: 103–110.
Coombs, M. and S. A. Khan. 1998. Population levels and natural enemies of *Plautia affinis* Dallas (Hemiptera: Pentatomidae) on raspberry, *Rubus idaeus* L., in south-eastern Queensland. *Australian Journal of Entomology* 37: 125–129.
Cooper, T. M., J. H. Frank, R. D. Cave, M. S Burton, J. S. Dawson, and B. W. Smith. 2011. Release and monitoring of a potential biological control agent, *Lixadmontia franki*, to control an invasive bromeliad-eating weevil, *Metamasius callizona*, in Florida. *Biological Control* 59: 319–325.
Coquis, F. D. and T. Salazar. 1975. Biology and morphology of *Phenacoccus gossypii* Townsend & Cockerell, 1898 (Homopt., Pseudococcidae). *Revista Peruana de Entomologia* 18(1): 34–45.
Corlay, F., G. Boivin, and G. Bélair. 2007. Efficiency of natural enemies against the swede midge *Contarinia nasturtii* (Diptera: Cecidomyiidae), a new invasive species in North America. *Biological Control* 43: 195–201.
Corrêa-Ferreira, B.S. 1986. Natural occurrence of the egg parasitoid complex of stink bugs on soyabean in Parana, Brazil. *Anais da Sociedade Entomológica do Brasil* 15: 189–199.
Corrigan, J. E. 1982. *Cotesia* (*Apanteles*) *rubecula* (Hymenoptera: Braconidae) recovered in Ottawa, Ontario ten years after its release. *Proceedings of the Entomological Society of Ontario* 113: 71.
Cortez Mondaca, E. and F. A. Valenzuela Escoboza. 2015. Minador de la hoja, *Liriomyza trifolii* (Diptera: Agromyzidae), pp. 251–267. In: Arredondo Bernal, H. C. and L. A. Rodríguez el Bosque (eds.). *Casos de Control Biológico en México, Vol. 2.* Printing Arts Mexico, Guadalajara, Mexico. see p. 262.
Cossentine, J. and U. Kuhlmann. 2000. Status of *Ageniaspis fuscicollis* (Hymenoptera: Encyrtidae), an introduced parasitoid of the apple ermine moth (Lepidoptera: Yponomeutidae). *The Canadian Entomologist* 132: 685–689.
Cossentine, J. and U. Kuhlmann. 2002. *Yponomeuta malinellus* Zeller, apple ermine moth (Lepidoptera: Yponomeutidae), pp. 275–278. In: Mason, P. G. and J. T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000.* CABI Publishing, Wallingford, UK.
Cossentine, J. E. and U. Kuhlmann. 2007. Introductions of parasitoids to control the apple ermine moth in British Columbia, pp. 13–19. *In*: Vincent, C., M. S. Goettel, and G. Lazarovits (eds.). *Biological Control: A Global Perspective*. CABI, Wallingford, UK.
Costa-Comelles, J., A. Santamaria, F. García-Marí, R. Laborda, R., and A. Soto. 1990. Use of integrated control against *Panonychus ulmi* (Koch) in commercial apple crops. *Boletín de Sanidad Vegetal, Plagas* 16(1): 317–331.
Cota-Gómez, C., W. Roltsch, and G. Simmons. 1998. Introducción de parasitoides exóticos de la especie *Eretmocerus emiratus* (Hymenoptera: Aphelinidae) contra la mosquita blanca *Bemisia argentifolii* Bellows y Perring (Homoptera: Aleyrodidae) en cultivo de algodonero y refugios en el Valle de Mexicali, B.C. *Memoria XXI Congreso Nacional de Control Biológico*. México, pp. 182–185.
Coulson, J. R., P. V. Vail, M. E. Dix, D. A. Nordlund, and W. C. Kauffman (eds.). 2000. *110 Years of Biological Control Research and Development in the United States Department of Agriculture, 1883–1993*. USDA, Agricultural Research Service, Washington, DC. 645 pp. see p. 396.
Croft, P. and M. J. W. Copland. 1994. The influence of humidity on emergence in *Dacnusa sibirica* Telenga (Hymenoptera: Braconidae). *Biocontrol Science and Technology* 4: 347–351.

Croft, B. A., L. N. Monetti, and P. D. Pratt. 1998a. Comparative life histories and predation types: are *Neoseiulus californicus* and *N. fallacis* (Acari: Phytoseiidae) similar type II selective predators of spider mites? *Environmental Entomology* 27: 531–538.

Croft, B. A., P. D. Pratt, G. Koskela, and D. Kaufman. 1998b. Predation, reproduction, and impact of phytoseiid mites (Acari: Phytoseiidae) on cyclamen mite (Acari: Tarsonemidae) on strawberry. *Journal of Economic Entomology* 91: 1307–1314.

Culliney, T. W. and W. T. Nagamine. 2000. Introductions for biological control in *Hawaii, 1987–1996*. *Proceedings of the Hawaiian Entomological Society* 34: 101–113.

Daane, K. M. and L. E. Caltagirone. 1999. A new species of *Metaphycus* (Hymenoptera: Encyrtidae) parasitic on *Saissetia oleae* (Olivier) (Homoptera: Coccidae). *Pan-Pacific Entomologist* 75: 13–17.

Daane, K. M., G. Y. Yokota, R. F. Gill, L. E. Caltagirone, K. S. Hagen, D. González, P. Starý, and W. E. Chaney. 1992. Imported parasite may help control European asparagus aphid. *California Agriculture* 46(6): 12–14.

Daane, K. M., K. S. Hagen, D. González, and L. E Caltagirone. 1995a. European asparagus aphid, pp. 120–122. *In* Nechols, J. R., L. A. Andres, J. W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). *Biological Control in the Western United States, Accomplishments and Benefits of Regional Project W-84, 1964–1989*. Publication 3361 of the University of California, Division of Agriculture and Natural Resources, Oakland, California, USA.

Daane, K. M., C. E. Kennett, L. E. Caltagirone, and M. S. Barzman. 1995b. Black scale, pp. 144–147. *In:* Nechols, J. R., L. A. Andres, J. W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). *Biological Control in the Western United States, Accomplishments and Benefits of Regional Project W-84, 1964–1989*. Publication 3361 of the University of California, Division of Agriculture and Natural Resources, Oakland, California, US.

Daane, K. M., K. R. Sime, X. G. Wang, H. Nadel, M. W. Johnson, V. M. Walton, A. Kirk, and C. H. Pickett. 2008. *Psyttalia lounsburyi* (Hymenoptera: Braconidae), potential biological control agent for the olive fruit fly in California. *Biological Control* 44: 79–89.

Daane, K. M., M. W. Johnson, C. H. Pickett, K. R. Sime, X. G. Wang, H. Nadel, J. W. , Jr. Andrews, and K. A. Hoelmer. 2011. Biological controls investigated to aid management of olive fruit fly in California. *California Agriculture* 65(1): 21–28.

Daane, K. M., K. R. Sime, and T. D. Paine, T. D. 2012. Climate and the effectiveness of *Psyllaephagus bliteus* as a parasitoid of the red gum lerp psyllid. *Biocontrol Science and Technology* 22: 1305–1320.

Daane, K. M., X. G. Wang, C. P. Pickett, A. Blanchet, D. Nieto, K. A. Hoelmer, M. C. Bon, and L. Smith. 2017. Biological control of olive fruit fly in California—release, establishment and impact of *Psyttalia lounsburyi* and *Psyttalia humilis*, pp. 156–158. *In*: Mason, P. G., D. R. Gillespie, and C. Vincent (eds.). *Proceedings of the 5th International Symposium on Biological Control of Arthropods, Langkawi, Malaysia, September 11–15, 2017*. CABI, Wallingford, UK. http://www.isbca-2017.org/download/ISBCA-Proceedings.web.pdf

Dabiré, R., K. R. Hopper, and F. Leclant. 1997. Food preference of *Leucopis ninae* Tanasijtshuk larva vis-á-vis of *Diuraphis noxia* (Mordvilko), pp. 879–886. *In*: *Proceedings of International Conference on Pests in Agriculture, 6–8 January 1997, at le Corum, Montpellier, France*, *Vol. 3*. Association Nationale pour la Protection des Plantes (ANPP), Paris.

Dahlsten, D. L., D. M. Kent, D. L. Rowney, W. A. Copper, T. E. Young, and R. L. Tassan. 1995. Parasitoid shows potential for biocontrol of eugenia psyllid. *California Agriculture* 49 (4): 36–40.

Dahlsten, D. L., D. L. Rowney, W. A. Copper, R. L. Fassan, W. E. Chaney, K. L. Robb, S. Tjosvold, M. Bianchi, and P. Lane. 1998a. Parasitoid wasp controls blue gum psyllid. *California Agriculture* 52: 31–34.

Dahlsten, D. L., E. P. Hansen, R. L. Zuparko, and R. B. Norgaard. 1998b. Biological control of blue gum psyllid proves economically beneficial. *California Agriculture* 52: 35–40.

Dahlsten, D. L., D. L. Rowney, and W. A. Copper, W. A. 2000. Landscapes: integrating biological control of the eugenia psyllid into the day-to-day management of the landscape in Disneyland, pp. 59–64. *In*: Hoddle, M. S. (ed.). *California Conference on Biological Control II, The Historic Mission Inn Riverside, California, USA, 11–12 July, 2000*. Center for Biological Control, College of Natural Resources, University of California, Berkeley, California, USA.

Dahlsten, D. L., D. L. Rowney, K. L. Robb, J. A. Downer, D. A. Shaw, and J. N. Kabashima. 2003. Biological control of introduced psyllids on eucalyptus, pp. 356–361. *In*: Van Driesche, R.G. (ed.). *Proceedings of the 1st International Symposium on Biological Control of Arthropods, Honolulu, Hawaii, 14–18 January 2002*. FHTET 03-05. USDA Forest Service, Morgantown, West Virginia, USA. http://www.fs.fed.us/foresthealth/technology/webpubs/FHTET-2003-05/index.html

Dang, F-H., M-L. Gong, S-D. Bi, Y-D. Zou, and Z-E. Xu. 2010. Comparison of the relationship among three major pests and multiple natural enemies in tea garden. *Journal of Zhejiang University (Agriculture and Life Sciences)* 36(5): 513–520.

Darr, M. N., T. J. McAvoy, C. C. Brewster, and S. M. Salom. 2016. Field-cage evaluation of survival, reproduction, and feeding behavior of adult *Scymnus coniferarum* (Coleoptera: Coccinellidae), a predator of *Adelges tsugae* (Hemiptera: Adelgidae). *Environmental Entomology* 45: 1527–1535.

Das, S. C. 1979. Parasites and predators of tea pests. *Two and a Bud* 26(2): 72–73.

Dash, P. C. and A. K. Das. 1997. Arthropod fauna associated with kendu, *Diospyres melanoxylon* (Roxb.) (Ebenaceae) in Orissa. *Insect Environment* 3(3): 71–72.

Davis, J. J. and A. F. Satterthwait. 1916. The false cabbage aphis. (*Aphis pseudobrassicae*, Davis). *Bulletin of the Indiana Agricultural Experiment Station* 18(185): 915–939.

Day, W. H. 1996. Evaluation of biological control of the tarnished plant bug (Hemiptera: Miridae) in alfalfa by the introduced parasite *Peristenus digoneutis* (Hymenoptera: Braconidae). *Environmental Entomology* 25: 512–518.

Day, W. H. 1999. Host preference of introduced and native parasites (Hymenoptera: Braconidae) of phytophagous plant bugs (Hemiptera: Miridae) in alfalfa-grass fields in the north-eastern USA. *BioControl* 44: 249–261.

Day, W. H. 2005. Changes in abundance of native and introduced parasites (Hymenoptera: Braconidae), and of the target and non-target plant bug species (Hemiptera: Miridae), during two classical biological control programs in alfalfa. *Biological Control* 33: 368–374.

Day, W. H., R. C. Hedlund, L. B. Saunders, and D. Coutinot. 1990. Establishment of *Peristenus digoneutis* (Hymenoptera: Braconidae), a parasite of the tarnished plant bug (Hemiptera: Miridae), in the United States. *Environmental Entomology* 19 4: 1528–1533.

Day, W. H., P. M. Marsh, R. W. Fuester, H. Hoyer, and R. J. Dysart. 1992. Biology, initial effect, and description of a new species of *Peristenus* (Hymenoptera: Braconidae), a parasite of the alfalfa plant bug (Hemiptera: Miridae), recently established in the United States. *Annals of the Entomological Society of America* 85: 482–488.

DeBach, P. and D. Rosen. 1982. *Aphytis yanonensis* n. sp. (Hymenoptera, Aphelinidae), a parasite of *Unaspis yanonensis* (Kuwana) (Homoptera, Diaspididae). *Kontyu* 50: 626–634.

Della Beffa, G. 1940. The bean coccid, *G. serratulae*, in Piedmont. / La Cocciniglia delle Fave in Piemonte *Gueriniella serratulae* Fabr. *Boll. Lab. sper. Oss. Fitopatol*. 16(1–4): 33–53.

Delvare, G. 1998. *Ceratogramma etiennei* n. sp., a parasite, in Guadeloupe, of *Diaprepes abbreviatus* L. (Hymenoptera, Trichogrammatidae; Coleoptera, Curculionidae). *Revue Française d'Entomologie* 10: 1–4.

D'Emmerez de Charmoy, D. 1937.Réveil d'un parasite de la canne à sucre à la Réunion. *Revue Agricole de l'Ile de Reunion* 42: 311–314.

de Moraes, G. J. and J. A. McMurtry. 1985. Comparison of *Tetranychus evansi* and *T. urticae* (Acari: Tetranychidae) as prey for eight species of phytoseiid mites. *Entomophaga* 30: 393–397.

Desneux, N., P. Starý, C. J. Delebecque, T. D. Gariepy, R. J. Barta, K. A. Hoelmer, and G. E. Heimpel. 2009a. Cryptic species of parasitoids attacking the soybean aphid (Hemiptera: Aphididae) in Asia: *Binodoxys communis* and *Binodoxys koreanus* (Hymenoptera: Braconidae: Aphidiinae). *Annals of the Entomological Society of America* 102: 925–936.

Desneux, N., R. J. Barta, K. A. Hoelmer, K. R. Hopper, and G. E. Heimpel. 2009b. Multifaceted determinants of host specificity in an aphid parasitoid. *Oecologia* 160 : 387–398.

Desneux, N., R. Blahnik, C.J. Delebecque, and G.E. Heimpel. 2012. Host phylogeny and specialisation in parasitoids. *Ecology Letters* 15: 453–460.

Devi, P. B., T. K. Singh, and H. J. Singh, H. J. 1999. Studies on the natural enemy complex of the green peach aphid, *Myzus persicae* (Sulzer) on knol-khol, *Brassica oleracea gongylodes*. *Annals of Plant Protection Sciences* 7: 37–40.

Dhingra, M. R., S. V. Dhamdhere, and R. R. Rawat. 1986. Natural enemies of *Epilachna ocellata* Redenbacher at Jabalpur (Madhya Pradesh). *Bulletin of Entomology* 27: 184–185.

Dijkerman, H. J. 1990. Suitability of eight *Yponomeuta* species as hosts of *Diadegma armillata*. *Entomologia Experimentalis et Applicata* 54: 173–180.

Doane, J. F, M. P. Braun, O. O. Olfert, F. Affolter, and K. Carl. 2002. *Sitodiplosis mosellana* (Géhin), orange blossom midge (Diptera: Cecidomyiidae), pp. 246–249. In: Mason, P. G. and J. T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000.* CABI Publishing, Wallingford, UK.

Doane, J. F., O. O. Olfert, R. H. Elliott, S. Hartley, and S. Meers. 2013. *Sitodiplosis mosellana* (Géhin), orange wheat blossom midge (Diptera: Cecidomyiidae), pp. 272–276. *In*: Mason, P. G. and D. R. Gillespie (eds.). *Biological Control Programmes in Canada 2001–2012*. CABI, Wallingford, U.K.

Douglas, L. A. 1965. Some aspects of coconut agronomy in Papua and New Guinea. *Papua New Guinea Agricultural Journal* 17(2): 87–91.

Doutt, R. L. 1951. The parasite complex of *Furcaspis oceánica* Lindinger. *Annals of the Entomological Society of America* 43: 501–507.

Drea, J. J. and R. W. Carlson. 1987. The establishment of *Chilocorus kuwanae* (Coleoptera: Coccinellidae) in eastern United States. *Proceedings of Entomological Society of Washington* 89: 821–824.

Drea, J. J., Jr., L. Dureseau, E. Rivet. 1973. Biology of *Peristenus stygicus* from Turkey, a potential natural enemy of lygus bugs in North America. *Environmental Entomology* 2: 278–280.

Dreistadt, S. H. and M. L. Flint. 1995. Ash whitefly (Homoptera: Aleyrodidae) overwintering and biological control by *Encarsia inaron* (Hymenoptera: Aphelinidae) in northern California. *Environmental Entomology* 24: 459–464.

Duan, J. J. and R. H. Messing. 2000. Host specificity tests of *Diachasmimorpha kraussii* (Hymenoptera: Braconidae), a newly introduced opiine fruit fly parasitoid with four nontarget tephritids in Hawaii. *Biological Control* 19: 28–34.

Duan, J. J., L. Bauer, M. Ulyshen, J. Gould, R. Van Driesche. 2010a. Development of methods for the field evaluation of *Oobius agrili* (Hymenoptera: Encyrtidae) in North America, a newly introduced egg parasitoid of the emerald ash borer (Coleoptera: Buprestidae). *Biological Control* 56: 170–174.

Duan, J. J., M. D. Ulyshen, L. S. Bauer, J. Gould, R. Van Driesche. 2010b. Measuring the impact of biotic factors on populations of immature emerald ash borers (Coleoptera: Buprestidae). *Environmental Entomology* 39: 1513–1522.

Duan, J. J., L. S. Bauer, K. J. Abell, J. P. Lelito, and R. Van Driesche. 2013. Establishment and abundance of *Tetrastichus planipennisi* (Hymenoptera: Eulophidae) in Michigan: Potential for success in classical biocontrol of the invasive emerald ash borer (Coleoptera: Buprestidae). *Journal of Economic Entomology* 106: 1145–1154.

Duan, J. J., K. J. Abell, L. S. Bauer, J. Gould, and R. Van Driesche. 2014. Natural enemies implicated in the regulation of an invasive pest: a life table analysis of the population dynamics of the emerald ash borer. *Agricultural and Forest Entomology* 16: 406–416.

Duan, J. J., J. R. Gould, and R. W. Fuester. 2015a. Evaluation of the host specificity of *Spathius galinae* (Hymenoptera: Braconidae), a larval parasitoid of the emerald ash borer (Coleoptera: Buprestidae) in northeast Asia. *Biological Control* 89: 91–97.

Duan, J. J., L.S. Bauer, K. J. Abell, M. D. Ulyshen, and R. G. Van Driesche. 2015b. Population dynamics of an invasive forest insect and associated natural enemies in the aftermath of invasion: implications for biological control. *Journal of Applied Ecology* 52: 1246–1254.

Duan, J. J., L. S. Bauer, and R. G. Van Driesche. 2017. Emerald ash borer biocontrol in ash saplings: the potential for early stage recovery of North American ash trees. *Forest Ecology and Management* 394: 64–72.

Duarte Gómez, H. W. and I. Zenner de Polanía. 2006. Feeding preference of *Eriopis connexa connexa* (Germar) (Coleoptera: Coccinellidae). *Revista U.D.C.A. Actualidad & Divulgacion Centrifica* 9(1): 163–171.

Duncan, R. E., B. J. Ulmer, and J. E. Peña, and S. L. Lapointe. 2007. Reproductive biology of *Fidiobia dominica* (Hymenoptera: Platygastridae), an egg parasitoid of *Diaprepes abbreviatus* (Coleoptera: Curculionidae). *Environmental Entomology* 36: 376–382.

Dupont, P. R. 1931. Entomological and Mycological Notes. *Annual Report of the Department of Agriculture* [*of the*] *Seychelles* [*for*] *1930*.Victoria, Seychelles, 1931, pp. 11–13.

Duzgunes, Z., S. Toros, N. Kiliincer, and B. Kovanci. 1982. *Leucopis* species (Dip: Chamaemyiidae) found as aphid predators in Ankara Province. *Turkiye Bitki Koruma Dergisi* 6(2): 91–96.

Easwaramoorthy, S., H. David, M. Shanmugasundaram, G. Santhalakshmi, and R. Kumar. 1992. Laboratory and field evaluation of *Allorhogas pyralophagus* for the control of lepidopterous borers infesting sugarcane in tropical India. *Entomophaga* 37: 613–619.

Echegaray, E. R., R. N. Stougaard, and B. Bohannon. 2016. First record of *Euxestonotus error* (Hymenoptera: Platygastridae) in the Pacific Northwest, United States of America. *The Canadian Entomologist* 148: 616–618.

Edwards, W. H. 1938. Report of the entomologist for the year 1937. Report of the Department of Agriculture, Jamaica for 1937. 1938: 55–58.

Ehrhorn, E. M. 1915. Division of Entomology [report]. *Hawaiian Forester and Agriculturist* 12(1): 13–16.

Elder, R. J. and K. L. Bell. 1998. Establishment of *Chilocorus* spp. (Coleoptera: Coccinellidae) in a *Carica papaya* L. orchard infested by *Aonidiella orientalis* (Newstead) (Hemiptera: Diaspididae). *Australian Journal of Entomology* 37: 362–365.

El-Arnaouty, S. A., V. Beyssat-Arnaouty, A. Ferran, and H. Galal. 2000. Introduction and release of the coccinellid *Harmonia axyridis* Pallas for controlling *Aphis craccivora* Koch on faba beans in Egypt. *Egyptian Journal of Biological Pest Control* 10(1/2): 129–136.

El-Hafez, A. Abd. 1995. A comparison of thermal requirements and some biological aspects of *Trichogramma evanescens* Westwood and *Trichogrammatoidea bactrae* Nagaraja reared from eggs of the pink and spiny bollworms. *Annals of Agricultural Science (Cairo)* 40(2): 901–912.

El-Haidari, H. S.; Aziz, F. I.; Wahab, W. A. 1974. Activity of predators and parasites of the mealybug, *Nipaecoccus vastator* (Maskell) in Iraq. *Yearbook of Plant Protection Research, Iraq Ministry of Agriculture and Agrarian Reform* 1, Ar pp. pp. 41–46.
El-Laithy, A. Y. M. and S. A. El-Sawi. 1998. Biology and life table parameters of the predatory mite *Neoseiulus californicus* fed on different diet. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* 105(5): 532–537.
El-Serwy, S. A. 2003. The changes in the seasonal abundance of the wheat leafminer, *Agromyza nigrella* (Rondani) (Diptera: Agromyzidae), and related parasites in two different agro-ecosystems. *Egyptian Journal of Agricultural Research* 81(3): 1055–1071.
Ehler, L. E. 1995. Biological control of obscure scale (Homoptera: Diaspididae) in California: an experimental approach. *Environmental Entomology* 24: 779–795.
Ehler, L. E. 2002. An evaluation of some natural enemies of *Nezara viridula* in northern California. *BioControl* 47: 309–325.
Ehler, L. E. 2005. Biological control of *Melanaspis obscura* on oaks in northern California. *BioControl* 50: 739–749.
Elekcioglu, N. Z. 2013. Parasitoids and predators of citrus leafminer, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) in east Mediterranean region of Turkey. *IOBC/WPRS Bulletin* 95: 161–168.
Elliott, N. C., J. D. Burd, J. S. Armstrong, C. B. Walker, D. K. Reed, and F. B. Peairs. 1995. Release and recovery of imported parasitoids of the Russian wheat aphid in eastern Colorado. *Southwestern Entomologist* 20: 125–129.
Elliott, N. C., J. H. Lee, and S. D. Kindler. 1999. Parasitism of several aphid species by *Aphelinus asychis* (Walker) and *Aphelinus albipodus* Hayat and Fatima. *Southwestern Entomologist* 24: 5–12.
Endersby, N. and P. Cameron, P. 2004. Parasitism of *Nyctemera amica* (White) (Lepidoptera: Arctiidae) and *Plutella xylostella* (L.) (Lepidoptera: Plutellidae) by *Cotesia plutellae* (Kurdjumov) (Hymenoptera: Braconidae), pp. 265–268. Endersby, N. M. and P. M. Ridland (eds.). *In*: *The Management of Diamondback Moth and other Crucifer Pests. Proceedings of the Fourth International Workshop, Melbourne, Victoria, Australia, 26–29 November 2001.* The Regional Institute Ltd., Gosford, Australia.
Erlandson, M. A. 2013. *Mamestra configurata* Walker, bertha armyworm (Lepidoptera: Noctuidae), pp. 228–232. *In*: Mason, P.G. and D.R. Gillespie. *Biological Control Programmes in Canada, 2001–2012*. CABI, Wallingford, UK.
Ero, M. M., E. L. Hamacek, T. Peek, and A. R. Clarke. 2010. Preference among four *Bactrocera* species (Diptera: Tephritidae) by *Diachasmimorpha kraussii* (Fullaway) (Hymenoptera: Braconidae). *Australian Journal of Entomology* 49: 324–331.
Estrada, C., R. J. W. Patrock, P. J. Folgarait, and L. E. Gilbert. 2006. Host specificity of four *Pseudacteon* spp. (Diptera: Phoridae), parasitoids of fire ants in Argentina (Hymenoptera: Formicidae). *Florida Entomologist* 89: 462–468.
Evans, G. A. and J. E. Peña. 2005. A new *Fidiobia* species (Hymenoptera: Platygastridae) reared from eggs of *Diaprepes doublierii* (Coleoptera: Curculionidae) from Dominica. *Florida Entomologis*t 88: 61–66.
Evans, G. A., M. E. Schauff, M. L. Kok-Yokomi, and R. K. Yokomi. 1995. A new species of *Aphelinus* (Hymenoptera: Aphelinidae) that parasitizes the spirea aphid, *Aphis spiraecola* Patch (Homoptera: Aphididae). *Proceedings of the Entomological Society of Washington* 97: 17–21.
Featured Creatures, 2017a. University of Florida, IFAS factsheet http://entnemdept.ufl.edu/creatures/BENEFICIAL/BEETLES/air_potato_leaf_beetle.htm
Featured Creatures, 2017b. University of Florida, IFAS factsheet. http://entnemdept.ufl.edu/creatures/beneficial/Neoseiulus_californicus.htm
Feng, J. G. 1988. Studies on the biological control of insect pests in fruit tree and oak tree with *Trichogramma dendrolimi* Matsumura. *Colloques de l'INRA* 43: 460–467.
Feng, G. K., Y. L. Chou, K. S. Chang, and S. H. Nieh. 1977. Studies on the control of European corn borers by using trichogrammatid egg parasites. *Acta Entomologica Sinica* 20: 253–258.
Ferran, A. and M.M. Larroque. 1977. Study of host-predator relations: the consumption and utilisation of an aphid, *Myzus persicae* Sulz. by different larval stages of the coccinellid *Semiadalia undecimnotata* Sch. (Col. Coccinellidae). *Annales Zoologie, Ecologie Animale* 9: 665–691.
Ferran, A., H. Niknam, F. Kabiri, J. L. Picart, C. de Herce, J. Brun, G. Iperti, and L. Lapchin. 1996. The use of *Harmonia axyridis* larvae (Coleoptera: Coccinellidae) against *Macrosiphum rosae* (Hemiptera: Sternorrhyncha: Aphididae) on rose bushes. *European Journal of Entomology* 93(1): 59–67.
Ferro, S. 1963. The bionomics of *Pseudaulacaspis pentagona* and its control in the context of the commonest diseases of peach in Campania. / Biologia della *Diaspis pentagona* e sua lotta nel quadro delle più freqaenti malattie del pesco in Campania. *Notiziario sulle Malattie delle Piante* 65: 41–61.
Finlayson, C., A. Alyokhin, S. Gross, and E. Porter. 2010. Differential consumption of four aphid species by four lady beetle species. *Journal of Insect Science* 10: 31.
Fischer, R. 1987. Ecological studies on the pupal parasites (Hym., Ichneumonidae) of four native species of *Yponomeuta* (Lepid., Yponomeutidae). *Journal of Applied Entomology* 103: 515–523.
Flanders, S. E. 1930. Notes on the life-history of *Lindorus lophanthae*. *Annals of the Entomological Society of America* 23: 594–596.
Flanders, S. E. 1956. Hymenopterous parasites of three species of oriental scale insects. *Bollettino del Laboratorio di Zoologia Portici* 33: 10–28.
Floate, K. D. and H. Skovgård. 2004. Winter survival of nuisance fly parasitoids (Hymenoptera: Pteromalidae) in Canada and Denmark. *Bulletin of Entomological Research* 94: 331–340.
Floate, K. D., P. Coghlin, and G. A. P. Gibson. 2000. Dispersal of the filth fly parasitoid *Muscidifurax raptorellus* (Hymenoptera: Pteromalidae) following mass releases in cattle confinements. *Biological Control* 18: 172–178.
Flores, D. and J. Carlson. 2009. Fortuitous establishment of *Rhyzobius lophanthae* (Coleoptera: Coccinellidae) and *Aphytis lingnanesis* (Hymenoptera: Encyrtidae) in South Texas on the cycad aulacaspis scale, *Aulacaspis yasumatsui* (Hemiptera: Diaspididae). *Southwestern Entomologist* 34(4): 489–492.
Foerster, L. A. and M. R. F. Avanci. 1999. Egg parasitoids of *Anticarsia gemmatalis* Hübner (Lepidoptera: Noctuidae) in soybeans. *Anais da Sociedade Entomológica do Brasil* 28: 545–548.
Foerster, L. A., A. K. Doetzer, and M. R. F.Avanci. 2001. Larval parasitoids of *Mythimna* (*Pseudaletia*) *sequax* Franclemont and the parasitism capacity of *Glyptapanteles muesebecki* (Blanchard) in time of exposition, temperature and host density. *Acta Biológica Paranaense* 30(1/4): 139–149.
Follett, P., G. Neumann, R. Hollingsworth, A. Swedman, and R. Sibucao. 2015. Release and establishment of *Encarsia diaspidicola* (Hymenoptera: Aphelididae) against white peach scale (Hemiptera: Diaspididae) in Papaya. *Proceedings of the Hawaiian Entomological Society* 47: 51–54.
Forouzan, M., M. H. Safaralizadeh, J. Shirazi, S. A. Safavi, and M. Rezaei. 2013. Biology and demography of *Trissolcus basalis* (Hym.: Scelionidae) on eggs of two different hosts. *Journal of Entomological Society of Iran* 33(1): Pe69–Pe85.
Fowler, H. G. 1987. Field behavior of *Euphasiopteryx depleta* (Diptera: Tachinidae): Phonotactically orienting parasitoids of mole crickets (Orthoptera: Gryllotalpidae: *Scapteriscus*). *Journal of the New York Entomological Society* 95: 474–480.
Fowler, H. G. 1988. Suitability of *Scapteriscus* moles crickets (Ort.: Gryllotalpidae) as hosts of *Euphasiopteryx depleta* (Dipt.: Tachinidae). *Entomophaga* 33: 397–401.

Fowler, H. G. and C. R. Garcia. 1987. Attraction to synthesized songs and experimental and natural parasitism of *Scapteriscus* mole crickets (Orthoptera: Gryllotalpidae) by *Euphasiopteryx depleta* (Diptera: Tachinidae). *Revista Brasileira de Biologia* 47: 371–374.
Fowler, H. G. and J. N. Kochalka. 1985. New record of *Euphasiopteryx depleta* (Diptera: Tachinidae) from Paraguay: attraction to broadcast calls of *Scapteriscus acletus* (Orthoptera: Gryllotalpidae). *Florida Entomologist* 68: 225–226.
Fowler, H. G. and A. Mesa. 1987. Alternate orthopteran hosts (*Anurogryllus* sp.) of *Euphasiopteryx depleta* (Diptera: Tachinidae). *Florida Entomologist* 70: 408–409.
Frank, J. H. and F. D. Bennett. 1995. *Larra bicolor* (Hymenoptera: Sphecidae), a biological control agent of *Scapteriscus* mole crickets (Orthoptera: Gryllotalpidae), established in northern Florida. *Florida Entomologist* 78: 619–623.
Frank, J. H. and E. D. McCoy. 1993. The introduction of insects into Florida. *Florida Entomologist* 76: 1–53.
Frank, J. H. and E. D. McCoy. 2007. The risk of classical biological control in Florida. *Biological Control* 41: 151–174.
Frank, J. H. and T. J. Walker. 2006. Permanent control of pest mole crickets (Orthoptera: Gryllotalpidae) in Florida. *American Entomologist* 52(3): 138–144.
Frank, J. H., J. P. Parkman, and F. D. Bennett. 1995. *Larra bicolor* (Sphecidae), a biological control agent of *Scapteriscus* mole crickets (Orthoptera: Gryllotalpidae). *Florida Entomologist* 78: 619–623.
Frank, J. H., T. J. Walker, and J. P. Parkman. 1996. The introduction, establishment, and spread of *Ormia depleta* in Florida. *Biological Control* 6: 368–377.
Frank, J. H., N. C. Leppla, R. K. Sprenkel, A. C. Blount, and R. F. Mizell, III. 2009. *Larra bicolor* Fabricius (Hymenoptera: Crabronidae): its distribution throughout Florida. *Insecta Mundi* (0063) Gainesville: Center for Systematic Entomology, Inc.: 1–5.
Franz, J. 1941. Contributions to the bionomics and ecology of the silver-fir shoot tortricid, *Tortrix murinana*. Part II. / Der Tannentriebwickler *Cacoecia murinana* Hb. *Zeitschrift fur Angewandte Entomologie* 27(4): 585–620.
Froud, K. J. and P. S. Stevens. 2003. Importation biological control of *Heliothrips haemorrhoidalis* by *Thripobius semiluteus* in New Zealand – a case study of non-target host and environmental risk assessment, pp. 366–369. *In*: Van Driesche, R.G. (ed.). *Proceedings of the First International Symposium on Biological Control of Arthropods, Honolulu, Hawaii, 14–18 January 2002,USDA*. FHTET-03-05. USDA Forest Service, Morgantown, West Virginia, USA.
Froud, K. J., P. S. Stevens, and D. R. Cowley. 1996. A potential biological control agent for greenhouse thrips, pp. 17–20. *In*: O'Callaghan, M. (ed.). *Proceedings of the Forty Ninth New Zealand Plant Protection Conference, Quality Hotel Rutherford, Nelson, New Zealand, 13–15 August, 1996*. New Zealand Plant Protection Society, Rotorua, New Zealand.
Fu-Castillo, A. A. 2008. Piojo harinoso de la vid, *Planococcus ficus* (Hemiptera: Pseudococcidae), pp. 253–265. *In*: Arredondo Bernal, H. C. and L. A. Rodríguez el Bosque (eds.). *Casos de Control Biológico en México*. Grupo Mundi-Prensa, Madrid, Spain.
Fuchs, T. W., F. R. Huffman, and J. W. Smith, Jr. 1979. Introduction and establishment of *Apanteles flavipes* [Hym.: Braconidae] on *Diatraea saccharalis* [Lep.: Pyralidae] in Texas. *Entomophaga* 24: 109–114.
Fuentes-Contreras, E., E. Basoalto, C. Muñoz, C. Gaete-Eastman, G. Peralta, G. And C. Carrasco. 2004. Population dynamics and natural enemies of the tobacco aphid (*Myzus nicotianae* Blackman) in Central Chile., pp. 293–297. *In*: Simon, J. C., C. A. Dedryver, C. Rispe, and M. Hullé. *Aphids in a New Millennium. Proceedings of the Sixth International Symposium on Aphids, September, 2001, Rennes, France*. Institut National de la Recherche Agronomique, Paris, France.
Fuester, R. W., M. Kenis, K. S. Swan, P. C. Kingsley, C. López-Vaamonde, and Franck Hérard. 2001. Host range of *Aphantorhaphopsis samarensis* (Diptera: Tachinidae), a larval parasitoid of the gypsy moth (Lepidoptera: Lymantriidae). *Environmental Entomology* 30: 605–611.
Fuester, R.W., A.E. Hajek, J.S. Elkinton, and P.W. Schaefer. 2014. Gypsy moth (*Lymantria dispar* L.) (Lepidoptera: Erebidae: Lymantriinae), pp. 49–82. *In*: Van Driesche, R.G. and R. Reardon (eds.). *The Use of Classical Biological Control to Preserve Forests in North America*. FHTET-2013-02. USDA Forest Service, Morgantown, West Virginia, USA. http://www.fs.fed.us/foresthealth/technology/pub_titles.shtml
Funasaki, G. Y., L. M. Nakahara, and B. R. Kumashiro. 1988. Introductions for biological control in Hawaii: 1985 and 1986. *Proceedings of the Hawaiian Entomological Society* 28: 101–104.
Fye, R. E. 1981. Rearing and release of coccinellids for potential control of pear psylla. *Advances in Agricultural Technology, Agricultural Research Service, United States Department of Agriculture* (*AAT-W-20*). No. 9.
Gabriel, D. 1983. Survey of the occurrence of the scale insect *Antonina graminis* (Maskell, 1897) (Homoptera: Pseudococcidae) and of its parasites in areas of pasture in São Paulo State. III. - Municipalities of Martinópolis, Caiabú, Regente Feijó, Indiana, Onda Verde, Bady Bassit and Nova Granada. *Biológico* 49(8): 207–218.
Gahan, A. B. 1919. Descriptions of seven new species of *Opius* (Hymenoptera: Braconidae). *Proceedings of the Entomological Society* of Washington, D.C. 21(7): 161–170.
Gahan, A. B. 1928. Some reared parasitic Hymenoptera from the Sudan. *Bulletin of Entomological Research* 19: 255–257.
Gahan, A. B. 1929. Description of an egg-parasite of *Exophthalmus quadrivittatus* (Olivier). *Proceedings of the Entomological Society of Washington* 31: 17–18.
Gahan, A. B. 1932. Miscellaneous descriptions and notes on parasitic Hymenoptera. *Annals of the Entomological Society of America* 25: 736–757.
Gai, Y-P., X-L. Ji, Y-S. Liu, and X-G. Sun. 2001. Control effects of *Harmonia axyridis* Pallas on *Psylla chinensis* Yang et Li nymphs. *Acta Phytophylacica Sinica* 28(3): 285–286.
Galichet, P. F. 1971. Introduction and rearing of *Apanteles flavipes* Cameron (Hym. Braconidae) in the French West Indies, pp. 373–375. In: *Anales del Primer Congreso Latinoamericano de Entomologia Cusco, Peru, 12–18 de Abril 1971*.
Gallego, C., J. Sanchez-Boccherini, E. Polo, A. Notario, and L. Castresana. 1979. Contribution to the study of the parasites of *Aelia rostrata* Boheman. *Anales del Instituto Nacional de Investigaciones Agrarias, Serie: Proteccion Vegetal* 11: 67–72.
Gao, J. F. 1985. Study on the utilization of *Lysiphleba japonica* (Hymen.: Braconidae). *Natural Enemies of Insects* 7: 152–154.
Gaprindashvili, N. K. 1975. Biological control of the main pests on tea plantations in the Georgian SSR. *VIII International Plant Protection Congress, Moscow, 1975*. Vol. III: 29–33.
García, A. and L. Barrios, L. 1996. Effectivity of the parasitoid *Cephalonomia stephanoderis* for the control of the coffee borer. *Boletín de Promecafé* 69–70: 15–16.
García González, J., S., E. R. Benítez, and A. López-Ávila. 2005. Life table of *Delphastus pusillus* (Coleoptera: Coccinellidae) on the whitefly *Trialeurodes vaporariorum* (Hemiptera: Aleyrodidae). *Revista Colombiana de Entomología* 31(2): 155–160.
García Nevárez, G. and S. H. Tarango Rivero. 2013. Efficacy of *Trichogramma platneri* (Hymenoptera: Trichogrammatidae) for the biological control of *Acrobasis nuxvorella* (Lepidoptera: Pyralidae) and *Cydia caryana* (Lepidoptera: Tortricidae). *Southwestern Entomologist* 38: 523–530.

Gardner, J., T. H. Yong, S. A. Pitcher, and M. P. Hoffmann. 2013. Overwintering of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) within target and non-target host eggs. *Biocontrol Science and Technology* 23: 367–380.
Gariepy, V., G. Boivin, and J. Brodeur. 2015. Why two species of parasitoids showed promise in the laboratory but failed to control the soybean aphid under field conditions. *Biological Control* 80: 1–7.
Garrido, A., J. Tormos, and F. Beitia. 1992. Explanatory notes on agromyzids (Dipt.) injurious to chickpea and their parasitoids (Hym.: Braconidae, Eulophidae). *Annales de la Societe Entomologique de France* 28: 111–112.
Gartel, W. 1972. The vine gall mite *Eriophyes vitis* Pgst., the causal agent of pox disease (erinosis), as a bud pest and as the cause of severe leaf-roll. *Weinbau und Keller* 19: 589–614.
Gautam, R. D. 1986. Influence of different noctuid hosts on the parasitisation by *Telenomus remus* Nixon (Scelionidae: Hymenoptera). *Journal of Entomological Research* 10: 70–73.
Gautam, R. D. 2003. Classical biological control of pink hibiscus mealy bug, *Maconellicoccus hirsutus* (Green), in the Caribbean. *Plant Protection Bulletin (Faridabad)* 55(1/2): 1–8.
Gauthier, N., N. Mandon, S. Renault, and F. Bénédet. 2004. The *Acrolepiopsis assectella* silk cocoon: kairomonal function and chemical characterisation. *Journal of Insect Physiology* 50: 1065–1074.
Gebiola, M., M. M. Monti, R. C. Johnson, J. B. Woolley, M. S. Hunter, M. Giorgini, and P. A. Pedata. 2017. A revision of the *Encarsia pergandiella* species complex (Hymenoptera: Aphelinidae) shows cryptic diversity in parasitoids of whitefly pests. *Systematic Entomology* 42: 31–59.
Geden, C. J. and J. A. Hogsette. 2006. Suppression of house flies (Diptera: Muscidae) in Florida poultry houses by sustained releases of *Muscidifurax raptorellus* and *Spalangia cameroni* (Hymenoptera: Pteromalidae). *Environmental Entomology* 35: 75–82.
Geden, C. J. and R. D. Moon. 2009. Host ranges of gregarious muscoid fly parasitoids: *Muscidifurax raptorellus* (Hymenoptera: Pteromalidae), *Tachinaephagus zealandicus* (Hymenoptera: Encyrtidae), and *Trichopria nigra* (Hymenoptera: Diapriidae). *Environmental Entomology* 38: 700–707.
Geervliet, J. B. F. and J. Brodeur. 1992. Host species affecting the performance of the larval parasitoids *Cotesia glomerata* and *C. rubecula* (Hymenoptera: Braconidae) II. Comparative suitability of three *Pieris* species (Lepidoptera: Pieridae). *Mededelingen van de Faculteit Landbouwwetenschappen, Rijksuniversiteit Gent* 57(2b): 547–550.
Georgiev, G. T. and P. Boyadzhiev. 2002. New parasitoids of *Paraphytomyza populi* (Kltb.) (Diptera, Agromyzidae) in Bulgaria. *Anzeiger für Schädlingskunde* 75(3): 69–71.
Gerling, D. 1966. A new record of a whitefly, *Aleurodes spiraeoides* Quaintance, infesting cotton, with a note on its parasites. *Journal of Economic Entomology* 59: 482–483.
Gerling, D. and A. Schwartz. 1974. Host selection by *Telenomus remus*, a parasite of *Spodoptera littoralis* eggs. *Entomologia Experimentalis et Applicata* 17: 391–396.
Ghanbari, A. H., H. Ghajarieh, M. Alichi, and K. Kheradmand. 2013. The determination of sex ratio of dominant natural enemies and parasitism rate of *Nipaecoccus viridis* Newstead on sour orange and oleander trees in Shiraz, Iran. *International Journal of Agriculture and Crop Sciences (IJACS)* 5(11): 1214–1220.
Gibson, R. L., N. C. Elliott, and P. Schaefer. 1992. Life history and development of *Scymnus frontalis* (Fabricius) (Coleoptera: Coccinellidae) on four species of aphid. *Journal of the Kansas Entomological Society* 65: 410–415.
Gilbert, L. E. and L. W. Morrison. 1997. Patterns of host specificity in *Pseudacteon* parasitoid flies (Diptera: Phoridae) that attack *Solenopsis* fire ants (Hymenoptera: Formicidae). *Environmental Entomology* 26: 1149–1154.
Gilstrap, F. E., D. D. Friese, K. R. Summy, and A. A. Armstrong. 1977. Persistence of *Amblyseius californicus*, *Phytoseiulus persimilis* and *Typhlodromus occidentalis* released in field populations of banks grass mite on corn. *Southwestern Entomologist* 2: 159–163.
Girault, A. A. 1915. Four new encyrtids from Sicily and the Philippines. Entomologist 627: 184–186.
Glavendekic´, M., J. Lazin, and Z. Nedeljkovic´. 2013. Outbreak of *Cinara cupressobium tujafilina* (Del Guercio) (Homoptera: Aphididae) on Thuja cultivars in Belgrade. *Biljni Lekar (Plant Doctor)* 41(6):720–725.
Goda, N. F., A. H. El-Heneidy, K. Djelouah, and N. Hassan. 2015. Integrated pest management of the tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in tomato fields in Egypt. *Egyptian Journal of Biological Pest Control* 25: 655–661.
Godin, C. and G. Boivin. 1998. Occurrence of *Cotesia rubecula* (Hymenoptera: Braconidae) in Quebec, 30 years after its introduction in North America. *The Canadian Entomologist* 130: 733–734.
Gold, M. S. 2003. Biological control of the lily leaf beetle, *Lilioceris lilii,* in North America. PhD in Environmental Sciences, University of Rhode Island, North Kingston, Rhode Island, USA.
Gold, C. S., M. A. Altieri, and A. C. Bellotti. 1989. The effects of intercropping and mixed varieties of predators and parasitoids of cassava whiteflies (Hemiptera: Aleyrodidae) in Colombia. *Bulletin of Entomological Research* 79: 115–121.
Goldson, S. L., M. R. McNeill, C. B. Phillips, and J. R. Proffitt. 1992. Host specificity testing and suitability of the parasitoid *Microctonus hyperodae* (Hym.: Braconidae, Euphorinae) as a biological control agent of *Listronotus bonariensis* (Col.: Curculionidae) in New Zealand. *Entomophaga* 37: 483–498.
Golfari, L. 1937. Contributions to the knowledge of the insect fauna of the pear. / Contributi alia eonoseenza dell'entomofauna del pero (*Pirus communis* L.). I. *Bollettino dell'Istituto di Entomologia, Bologna* 9: 206–249.
Gonzalez, D., A. H. El-Heneidy, S. M. Mousa, S. V. Triapitsyn, D. Adly, V. A. Trjapitzin, and D. E. Meyerdirk. 2003. A survey for pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) and its parasitoids in Egypt, Spain and Morocco. *Egyptian Journal of Biological Pest Control* 13(1/2): 1–5.
González Tirado, G., P. Bernabé Ruiz, and M. Castaño López. 1996. Natural enemies of *Phyllocnistis citrella* Stainton (Lepidoptera. Gracillariidae, Phyllocnistinae) in Huelva province. Geographic distribution, seasonal development and stages parasitized. *Boletín de Sanidad Vegetal, Plagas* 22(4): 741–760.
Goolsby, J. A., M. A. Ciomperlik, B. C. Legaspi, Jr., J. C. Legaspi, and L. E. Wendel. 1998. Laboratory and field evaluation of exotic parasitoids of *Bemisia tabaci* (Gennadius) (Biotype 'B') (Homoptera: Aleyrodidae) in the Lower Rio Grande Valley of Texas. *Biological Control* 12: 127–135.
Goolsby, J. A., P. J. DeBarro, A. A. Kirk, R. W. Sutherst, L. Canas, M. A. Ciomperlik, P. C. Ellsworth, J. R. Gould, D. M. Hartley, K. A. Hoelmer, S. E. Naranjo, M. Rose, W. J. Roltsch, R. A. Ruiz, C. H. Pickett, and D. Vacek. 2005. Post-release evaluation of biological control of *Bemisia tabaci* biotype "B" in the USA and the development of predictive tools to guide introductions for other countries. *Biological Control* 32: 70–77.
Goolsby, J. A., R. S. Pfannenstiel, and G. A. Evans. 2009. New state record for the silverleaf whitefly parasitoid *Encarsia sophia* in Texas. *Southwestern Entomologist* 34: 327–328.

Gordh, G. 1984. *Goniozus pakmanus* (Hymenoptera, Bethylidae), A new species imported into California for the biological control of pink bollworm, *Pectinophora gossypiella* (Lepidoptera, Gelechiidae). *Entomological News* 95: 207–211.
Gordh, G. and R. E. Medved. 1986. Biological notes on *Goniozus pakmanus* Gordh. (Hymenoptera: Bethylidae), a parasite of pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae). *Journal of the Kansas Entomological Society* 59: 723–734.
Gordon, R.D. and N. Vandenberg. 1991. Field guide to recently introduced species of Coccinellidae (Coleoptera) in North America, with a revised key to North American genera of Coccinellini. *Proceedings of the Entomological Society of Washington* 93: 845–864.
Gou, X. Q. 1985. Cold storage test of rice moth eggs parasitized by *Trichogramma ostriniae*. *Chinese Journal of Biological Control* 1(4): 20–21.
Gou, X. Q. 1988. Bionomics of *Trichogramma ostriniae* Pang et Chen. *Colloques de l'INRA* 43: 191–195.
Goulart, M. M. P., A. de F. Bueno, R. C. O de F. Bueno, and A. F. Diniz. 2011. Host preference of the egg parasitoids *Telenomus remus* and *Trichogramma pretiosum* in laboratory. *Revista Brasileira de Entomologia* 55: 129–133.
Gould, J. 2007. Proposed release of three parasitoids for the biological control of the emerald ash borer (*Agrilus planipennis*) in the continental United States. *Marketing and Regulatory Programs Animal and Plant Health Inspection Service. Environmental Assessment, July 2007.* https://www.aphis.usda.gov/plant_health/ea/downloads/eab-ea07-07.pdf
Gould, J. R., T. S. Bellows, and T. D. Paine. 1992a. Evaluation of biological control of *Siphoninus phillyreae* (Haliday) by the parasitoid *Encarsia partenopea* (Walker), using life-table analysis. *Biological Control* 2: 257–265.
Gould, J. R.; Bellows, S., Jr.; Paine, T. D. 1992b. Population dynamics of *Siphoninus phillyreae* in California in the presence and absence of a parasitoid, *Encarsia partenopea*. *Ecological Entomology* 17: 127–134.
Gould, J. R., K. A. Hoelmer, and J. A. Goolsby. 2008. Classical biological control of *Bemisia tabaci* in the United States: A review of interagency research and implementation. *Progress in Biological Control* 4. Springer, Dordrecht, The Netherlands. 343 pp.
Govoni, I. 1982. The cherry bud moth. *Informatore Fitopatologico* 32(2): 15–17.
Grandi, G. 1937. Parasites of *C. molesta* found in Emilia. / Parassiti della *Cydia molesta* Busek riscontrati nell'Emilia. *Bollettino dell'Istituto di Entomologia, Bologna* 9: 250–252.
Greenberg, S. M., W. A. Jones, and T. X. Liu. 2009. Tritrophic interactions among host plants, whiteflies, and parasitoids. *Southwestern Entomologist* 34: 431–445.
Gregoire, J. C. 1976. Note on two natural enemies of *Dendroctonus micans* Kugelmann in Belgium (Coleoptera: Scolytidae). *Bulletin et Annales de la Societe Royale Belge d'Entomologie* 112(7/9): 208–212.
Grossheim, N. A. 1914. *Brachycolus noxius*, Mordw. Memoirs of the *Natural-History Museum of the Zemstvo of the govt. of Taurida, Simferopol* 3: 35–78.
Gruber, P. F., T. J. Poprawski, and D. Coutinot. 1994. Hymenopterous parasites and hyperparasites of *Schizaphis graminum* (Rondani) (Hom., Aphididae) on sorghum, in the Drôme, France. *Journal of Applied Entomology* 117: 477–490.
Guerrieri, E. and G. Pellizzari. 2009. Parasitoids of *Pseudococcus comstocki* in Italy. *Clausenia purpurea* and *Chrysoplatycerus splendens*: first records from Europe. *Bulletin of Insectology* 62: 179–182.
Guimarães, F. R., E. Vargas-Osuna, P. B. Maracajá, and C. Santiago-Alvarez. 1995. Presence of *Spodoptera exigua* Hb. (Lep.; Noctuidae) and its associated biotic agents in Cordoba province. *Boletín de Sanidad Vegetal, Plagas* 21(4): 641–646.
Guo, H., X-Z. Zhou, S-D. Bi, Y-D. Zou, L. Yang, S-B. Ke, X-L. Lin, K. L. Yuan, and X-Y. Chen. 2013. Relationships between *Aleurocanthus spiniferus* Quaintance and Demotina fasciculata Baly and their predatory natural enemies in tea garden. *Journal of South China Agricultural University* 34: 345–351.
Haddad, C. R. and S. v. d. M. Louw. 2006. Phenology and potential biological control of the stink-bug *Atelocera raptoria* Germar (Hemiptera: Pentatomidae) in pistachio orchards. *African Plant Protection* 12: 23–27.
Hailemichael, Y., F. Schulthess, J. W. Smith, and W. A. Overholt. 1997. Suitability of West African gramineous stemborers for the development of *Cotesia* species. *Insect Science and its Application* 17(1): 89–95.
Hakeem, A., J. F. Grant, P. L. Lambdin, D. Buckley, F. A. Hale, J. R. Rhea, G. J. Wiggins, and G. Taylor. 2010. Recovery of *Sasajiscymnus tsugae*, released against hemlock woolly adelgid, *Adelges tsugae*, in the southern Appalachians. *Biocontrol Science and Technology* 20: 1069–1074.
Hall, D. G., J. Peña, R. Franqui, R. Nguyen, P. Stansly, C. McCoy, S. L. Lapointe, R. C. Adair, and B. Bullock. 2001. Status of biological control by egg parasitoids of *Diaprepes abbreviatus* (Coleoptera: Curculionidae) in citrus in Florida and Puerto Rico. *BioControl* 46: 61–70.
Hamiti [no initials], Y-X. Yao, W-X. Zhao, and W-X. Huai. 2011. Hymenoptera parasitoids of *Yponomeuta padella* attacking wild orchards in Dorbiljin, Xinjiang. *Chinese Journal of Biological Control* 27(1): 128–131.
Hanks, L. M., T. D. Paine, and J. G. Millar. 1996. Tiny wasp helps protect eucalypts from eucalyptus longhorned borer. *California Agriculture* 50: 14–16.
Hanks, L.M., J.G. Millar, T.D. Paine, and C.D. Campbell. 2000. Classical biological control of the Australian weevil *Gonipterus scutellatus* (Coleoptera: Curculionidae) in California. *Environmental Entomology* 29: 369–375.
Hanks, L. M., J. G. Millar, T. D. Paine, Q. Wang, and E. O. Paine. 2001. Patterns of host utilization by two parasitoids (Hymenoptera: Braconidae) of the eucalyptus longhorned borer (Coleoptera : Cerambycidae). *Biological Control* 21: 152–159.
Harizanova, V., A. Stoeva, and M. Mohamedova, M. 2012. Preliminary study on the invasive *Acizzia jamatonica* (Hemiptera: Psyllidae) and its predators in Bulgaria. *Agricultural Science and Technology* 4(1): 56–61.
Hassan, M. A. 2001. Biology and efficiency of *Clitostethus arcuatus* (Rossi) (Coleoptera: Coccinellidae) as a predator of *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae). *Egyptian Journal of Biological Pest Control* 11(1/2): 95–100.
Hay-Roe, M. M., R. N. Nagoshi, R. L. Meagher, M. Arias de Lopez, and R. Trabanino. 2015. Isolation and DNA barcode characterization of a permanent *Telenomus* (Hymenoptera: Platygastridae) population in Florida that targets fall armyworm (Lepidoptera: Noctuidae). *Annals of the Entomological Society of America* 108: 729–735.
Haye, T., H. Goulet, P. G. Mason, and U. Kuhlmann. 2005. Does fundamental host range match ecological host range? A retrospective case study of a *Lygus* plant bug parasitoid. *Biological Control* 35: 55–67.
Haye, T., U. Kuhlmann, H. Goulet, and P. G. Mason. 2006. Controlling *Lygus* plant bugs (Heteroptera: Miridae) with European *Peristenus relictus* (Hymenoptera: Braconidae) in Canada—risky or not? *Bulletin of Entomological Research* 96: 187–196.
Haynes, C. R., A. Rajkumar, D. Kumar, and L. Dasrat, L. 2001. Experiences with *Cotesia flavipes* (Cameron) (Hymenoptera: Braconidae) as a biological control agent for *Diatraea centrella* (Moschler) (Lepidoptera: Pyralidae) in sugarcane. *Proceedings of the XXVII West Indies Sugar Technologists Conference, held at the Hilton Conference Center, Port of Spain, Trinidad and Tobago, 23rd–27th April, 2001.* Sugar Association of the Caribbean, Bridgetown, Barbados.
HDOA, 2007. Field release of *Aroplectrus dimerus* Lin. (Hymenoptera: Eulophidae) for biological control of the nettle caterpillar, *Darna pallivitta*

(Moore) (Lepidoptera: Limacodidae), in Hawaii. Draft Environmental Assessment November 2007. http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2008-04-23-ST-DEA-Nettle-Caterpillar-Biocontrol-and-Agent-Host-Specificity-Report.pdf

HDOA, 2008. Field release of *Eurytoma* sp. (Hymenoptera: Eurytomidae), for biological control of the erythrina gall wasp, *Quadrastichus erythrinae* Kim (Hymenoptera: Eulophidae), in Hawaii. Final Environmental Assessment April 7, 2008. http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Statewide/2000s/2008-04-23-ST-FEA-Field-Release-of-Eurytoma-Erythrina-Gall-Wasp-BioControl.pdf

Hendrickson, R. M., Jr. and S. E. Barth. 1979. Introduced parasites of *Agromyza frontella* (Rondani) in the USA. *Journal of the New York Entomological Society* 87: 167–174.

Henry, C. S., S. J. Brooks, P. Duelli, and J. B. Johnson. 2002. Discovering the true *Chrysoperla carnea* (Insecta: Neuroptera: Chrysopidae) using song analysis, morphology, and ecology. *Annals of the Entomological Society of America* 95: 172–191.

Hérard, F. and G. Prévost. 1997. Suitability of *Yponomeuta mallinellus* and *Y. cagnagellus* (Lepidoptera: Yponomeutidae) as hosts of *Diadegma armillata* (Hymenoptera: Ichneumonidae). *Environmental Entomology* 26: 933–938.

Heraty, J. M. and A. Polaszek. 2000. Morphometric analysis and descriptions of selected species in the *Encarsia strenua* group (Hymenoptera: Aphelinidae). *Journal of Hymenoptera Research* 9: 142–169.

Heraty, J. M., J. B. Woolley, K. R. Hopper, D. L. Hawks, J. W. Kim, and M. Buffington. 2007. Molecular phylogenetics and reproductive incompatibility in a complex of cryptic species of aphid parasitoids. *Molecular Phylogenetics and Evolution* 45: 480–493.

Herlihy, M. V. and R. G. Van Driesche. 2013. Effect of *Cotesia rubecula* (Hymenoptera: Braconidae) on survival of larval cohorts of *Pieris rapae* (Lepidoptera: Pieridae) on collards: evaluation of an introduced biological control agent. *Florida Entomologist* 96: 360–369.

Herlihy, M. V., R. G. Van Driesche, and D. L. Wagner. 2014. Persistence in Massachusetts of the veined white butterfly due to use of the invasive form of cuckoo flower. *Biological Invasions* 16: 2713–2724.

Herlihy, M. V., R. G. Van Driesche, M. R. Abney, J. Brodeur, A. B. Bryant, R. A. Casagrande, D. A. Delaney, T. E. Elkner, S. J. Fleischer, R. L. Groves, D. S. Gruner, J. P. Harmon, G. E. Heimpel, K. Hemady, T. P. Kuhar, C. M. Maund, A. M. Shelton, A. J. Seaman, M. Skinner, R. Weinzierl, K. V. Yeargan, and Z. Szendrei. 2012. Distribution of *Cotesia rubecula* (Hymenoptera: Braconidae) and its displacement of *Cotesia glomerata* in eastern North America. *Florida Entomologist* 95: 461–467.

Herting, B. 1957. *M. hertingi*, the tachinid parasite of *A. erythrocephala*. / *Myxexoristops hertingi* Mesn., die Taohine der Kiefern-schonungsgespinstblattwespe (*Acantholyda erythrocephala* L.). *Zeitschrift für Angewandte Entomologie* 40(4): 576–578.

Heusinger, G. 1981. Comparative study of mortality factors of the small ermine moth, *Yponomeuta padellus* L. (Yponomeutidae), on *Prunus spinosa* L. at different sites. *Mitteilungen der Deutschen Gesellschaft für Allgemeine und Angewandte Entomologie* 3: 21–25.

Hirashima, Y., K. Miura, T. Miura, and K. Shiro, K. 1990. Studies on the biological control of the diamondback moth, *Plutella xylostella* (Linnaeus). 2. Effect of temperature on the development of the egg parasitoids *Trichogramma chilonis* and *Trichogramma ostriniae*. *Science Bulletin of the Faculty of Agriculture, Kyushu University* 44: 71–75.

Hoddle, M. S. 2012. Foreign exploration for natural enemies of Asian citrus psyllid, *Diaphorina citri* (Hemiptera: Psyllidae), in the Punjab of Pakistan for use in a classical biological control program in California USA. *Pakistan Entomologist* 34(1): 1–5.

Hoddle, M. S. and R. Pandey. 2014. Host-range testing of *Tamarixia radiata* (Hymenoptera: Eulophidae) sourced from the Punjab of Pakistan for classical biological control of *Diaphorina citri* (Hemiptera: Liviidae: Euphyllurinae: Diaphorinini) in California. *Journal of Economic Entomology* 107: 125–136.

Hoddle, M. S., O. Aponte, O., V. Kerguelen, V.; and J. Heraty. 1999. Biological control of *Oligonychus perseae* (Acari: Tetranychidae) on avocado: I. Evaluating release timings, recovery and efficacy of six commercially available phytoseiids. *International Journal of Acarology* 25: 211–219.

Hodson, W. E. H. and A. Beaumont. 1929. *A Fifth Annual Report of the Department of Plant Pathology for the Year ending September 30, 1928*. Vol. 30 Seale-Hayne Agricultural College, Newton Abbot, Devon, UK.

Hoelmer, K. A. 2007. Field cage evaluation of introduced *Eretmocerus* species (Hymenoptera: Aphelinidae) against *Bemisia tabaci* strain B (Homoptera: Aleyrodidae) on cantaloupe. *Biological Control* 43: 156–162.

Hoelmer, K. and J. Goolsby. 2003. Release, establishment and monitoring of *Bemisia tabaci* natural enemies in the United States, pp. 58–65. *In*: Van Driesche, R.G. (ed.). *Proceedings of the First International Symposium on Biological Control of Arthropods, January 14–18, 2002. Honolulu, Hawaii, USA*. FHTET-03-05. USDA Forest Service, Morgantown, West Virginia, USA. http://www.fs.fed.us/foresthealth/technology/webpubs/FHTET-2003-05/day1/hoelmer.pdf

Hoffmann, M. P., N. A. Davidson, L. T. Wilson, L. E. Ehler, W. A. Jones, and F. G. Zalom. 1991. Imported wasp helps control southern green stink bug. *California Agriculture* 45(3): 20–22.

Hoffmann, M. P., D. L. Walker, and A. M. Shelton. 1995. Biology of *Trichogramma ostriniae* (Hym.: Trichogrammatidae) reared on *Ostrinia nubilalis* (Lep.: Pyralidae) and survey for additional hosts. *Entomophaga* 40: 387–402.

Hoffmann, M. P., P. R. Ode, D. L. Walker, J. Gardner, S. van Nouhuys, and A. M. Shelton. 2001. Performance of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) reared on factitious hosts, including the target host, *Ostrinia nubilalis* (Lepidoptera: Crambidae). *Biological Control* 21: 1–10.

Hoffmeister, T. S. 2002. *Rhagoletis pomonella* (Walsh), apple maggot (Diptera: Tephritidae), pp. 238–241. *In*: Mason, P.G. and J.T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, U.K.

Hohmann, C. L., R. F. Luck, E. R. Oatman, and G. R. Platner. 1989. Effects of different biological factors on longevity and fecundity of *Trichogramma platneri* Nagarkatti (Hymenoptera: Trichogrammatidae). *Anais da Sociedade Entomológica do Brasil* 18: 61–70.

Höller, C. 1991. Evidence for the existence of a species closely related to the cereal aphid parasitoid *Aphidius rhopalosiphi* De Stefani-Perez based on host ranges, morphological characters, isoelectric focusing banding patterns, cross-breeding experiments and sex pheromone specificities (Hymenoptera, Braconidae, Aphidiinae). *Systematic Entomology* 16: 15–28.

Hopper, K. R. 2010. Petition for the release of *Aphelinus glycinis* (Hymenoptera: Aphelinidae) for the biological control of the soybean aphid, *Aphis glycines* (Hemiptera: Aphididae). USDA APHIS. 32 pp.

Hopper, K. R. and B. W. Diers. 2014. Parasitism of soybean aphid by *Aphelinus* species on soybean susceptible versus resistant to the aphid. *Biological Control* 76: 101–106.

Hopper, K. R., D. Coutinot, K. Chen, G. Mercadier, S. E. Halbert, D. J. Kazmer, R. H. Miller, K. S. Pike, and L. K. Tanigoshi. 1998. Exploration for natural enemies to control *Diuraphis noxia* in the United States, pp. 166–182. *In*: Quissenbery, S. S. and F. B. Peairs (eds.). *A Response Model for an Introduced Pest—The Russian Wheat Aphid*. Thomas Say Publications in Entomology: Proceedings. Entomological Society of America, Lanham, Maryland, USA.

Hopper, K. R., A. M. I. de Farias, J. B. Woolley, J. M. Heraty, and S. C. Britch. 2005. Genetics: relation of local populations to the whole "species"—

implications for host range tests, pp. 665–671. *In*: Hoddle, M.S. (ed.). *Second International Symposium on Biological Control of Arthropods, Davos, Switzerland, 12–16 September, 2005.* FHTET-2005-08. USDA Forest Service, Morgantown, West Virginia, USA.

Hopper, K. R., K. Lanier, J. H. Rhoades, D. Coutinot, G. Mercadier, N. Ramualde, M. Roche, J. B. Woolley, and J. M Heraty. 2017. Host specificity of *Aphelinus* species considered for introduction to control *Diuraphis noxia*. *Biological Control* 107: 21–32.

Houston, K. J. 1991. *Chilocorus circumdatus* Glyllenhal newly established in Australia and additional records for *Coccinella undecimpuntata* L. (Coleoptera: Coccinellidae). *Journal of Australian Entomological Society* 30: 341–342.

Howard, F. W. and T. J. Weissling. 1999. Questions and answers about the cycad *Aulacaspis* scale insect. *Proceedings of the Florida State Horticultural Society* 112: 243–245.

Hoy, M. A. 2005. Classical biological control of citrus pests in Florida and the Caribbean: interconnections and sustainability, pp. 237–253. *In*: Hoddle, M. S. (ed.). *Second International Symposium on Biological Control of Arthropods, Davos, Switzerland, 12–16 September, 2005.* FHTET-2005-08. USDA, Forest Service, Morgantown, West Virginia, USA.

Hoy, M. A. and R. Nguyen. 1997. Classical biological control of the citrus leafminer *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae): theory, practice, art and science. *Tropical Lepidoptera* (Suppl. 1): 19 pp.

Hoy, M. A., A. Jeyaprakash, R. Morakote, P. K. C. Lo, and Ru Nguyen. 2000. Genomic analyses of two populations of *Ageniaspis citricola* (Hymenoptera: Encyrtidae) suggest that a cryptic species may exist. *Biological Control* 17: 1–10.

Hoy, M. A., R. Singh, and M. E. Rogers. 2007a. Citrus leafminer, *Phyllocnistis citrella* (Lepidoptera: Gracillariidae), and natural enemy dynamics in Central Florida during 2005. *Florida Entomologist* 90: 358–369.

Hoy, M. A., A. Jeyaprakash, D. Clarke-Harris, and L. Rhodes. 2007b. Molecular and field analyses of the fortuitous establishment of *Lipolexis oregmae* (Hymenoptera: Aphidiidae) in Jamaica as a natural enemy of the brown citrus aphid. *Biocontrol Science and Technology* 17: 473–482.

Huang, L. L., D. W. Wang, Q. Zhang, W. Zhu, and K. Matsumoto. 1981. A study on the biology and control of the arrowhead scale (*Unaspis yanonensis* Kuwana). *Proceedings of the International Society of Citriculture* 2: 640–643.

Huber, J. T. 2015. World reclassification of the *Gonatocerus* group of genera (Hymenoptera: Mymaridae). *Zootaxa* 3967: 1–184.

Huffaker, C. B., J. K. Holloway, R. L. Doutt, and G. L. Finney. 1954. Introduction of egg parasites of the beet leafhopper. *Journal of Economic Entomology* 47: 785–789.

Hukusima, S. and K. Kondô. 1962. Further evaluation in the feeding potential of the predaceous insects and spiders in association with aphids harmful to apple and pear growing, and the effect of pesticides on predators. *Japanese Journal of Applied Entomology and Zoology* 6: 274–280.

Husain, M. A. and M. M. Lal. 1920. Annual Report of the Entomologist, 1918–19. Report of the Department of Agriculture, Punjab Part II, 1918–19 Lahore, 1920. pp. 153–157.

Ibadova, S. I. 1985. The apple mealybug *Phenacoccus mespili* Sign. and its natural enemies in the Apsheronskiy Peninsula. *Izvestiya Akademii Nauk Azerbaidzhanskoi SSR, Biologicheskikh Nauk* 1: 32–36.

Illingworth, J. F. 1929. Preliminary notes of pests of agricultural crops of Kona, March 15, 1928. *Proceedings of the Hawaiian Entomological Society* 12(2) 248–254.

Infante, F., J. Mumford, and I. Mendez. 2001. Non-recovery of *Prorops nasuta* (Hymenoptera: Bethylidae), an imported parasitoid of the coffee berry borer (Coleoptera: Scolytidae) in Mexico. *Southwestern Entomologist* 26: 159–163.

Infante, F., A. Castillo, J. Pérez, and F. E. Vega. 2013. Field-cage evaluation of the parasitoid *Phymastichus coffea* as a natural enemy of the coffee berry borer, *Hypothenemus hampei*. *Biological Control* 67: 446–450.

Iperti, G. 1965. Contribution to the study of host-specificity among the main Coccinellids attacking aphids in the Alpes-Mari-times and the Basses-Alpes. *Entomophaga* 10: 159–178. (in French)

Isas, M., E. L. P. Albarracin, M. L. del Pérez, and A. Salvatore. 2016. *Trichogramma* (Hymenoptera: Trichogrammatidae) species, egg parasitoids of *Diatraea saccharalis* (Lepidoptera: Crambidae) on sugarcane (Poales: Poaceae) in Argentina. *Florida Entomologist* 99: 133–134.

Ishii, T. 1932. The Encyrtinae of Japan. II. Studies on morphology and biology. *Bulletin of the Imperial Agricultural Experiment Station of Japan* 3(3): 161–202.

Islam, K. S. and M. Jahan. 1992. Influence of different types of food on the reproductive performance of *Anagyrus pseudococci* (Hymenoptera: Encyrtidae). *Bangladesh Journal of Entomology* 2: 17–22.

Itioka, T. and T. Inoue. 1996. The role of predators and attendant ants in the regulation and persistence of a population of the citrus mealybug *Pseudococcus citriculus* in a satsuma orange orchard. *Applied Entomology and Zoology* 31: 195–202.

Jacas, J. A., J. E. Peña, and R. E. Duncan. 2005. Successful oviposition and reproductive biology of *Aprostocetus vaquitarum* (Hymenoptera: Eulophidae): a predator of *Diaprepes abbreviatus* (Coleoptera: Curculionidae). *Biological Control* 33: 352–359.

Jacas, J. A., J. E. Peña, and R. E. Duncan. 2007. Morphology and development of immature stages of *Fidiobia dominica* (Hymenoptera: Platygastridae: Sceliotrachelinae). *Annals of the Entomological Society of America* 100: 413–417.

Jacas, J. A., J. E. Peña, R. E. Duncan, and B. J. Ulmer. 2008. Thermal requirements of *Fidiobia dominica* (Hymenoptera: Platygastridae) and *Haeckeliania sperata* (Hymenoptera: Trichogrammatidae), two exotic egg parasitoids of *Diaprepes abbreviatus* (Coleoptera: Curculionidae). *BioControl* 53: 451–460.

Jacas, J. A., B. J. Ulmer, R. E. Duncan, and J. E. Peña. 2010. The role of *Brachyufens osborni* (Hymenoptera: Trichogrammatidae) in the classical biological control program against *Diaprepes abbreviatus* (Coleoptera: Curculionidae) in Florida. *Biological Control* 54: 213–220.

Jahn, E. 1948. Observations on the occurrence of parasites in connection with the outbreak of the grey larch tortricid, *Enarmonia diniana*, in Tyrol in the year 1947. *Pflanzenschutzberichte* 2(11–12): 176–182. (in German)

Jalali, S. K., S. P. Singh, and T. Venkatesan. 2002. Selection of promising species of trichogrammatid egg parasitoid for field evaluation against coconut leaf eating caterpillar, *Opisina arenosella* Walker. *Journal of Plantation Crops* 30(2): 30–32.

Jenner, W. H. 2008. Evaluation of a candidate classical biological control agent and critical assessment of suggested host specificity testing guidelines. PhD thesis, Carleton University, Ottawa, Ontario, Canada. https://curve.carleton.ca/d86d86c7-517b-4610-afb8-857a1c19dffd

Jenner, W. H., P. G. Mason, N. Cappuccino, and U. Kuhlmann, U. 2010. Native range assessment of classical biological control agents: impact of inundative releases as pre-introduction evaluation. *Bulletin of Entomological Research* 100: 387–394.

Jenner, W. H., U. Kuhlmann, J. H. Miall, N. Cappuccino, and P. G. Mason. 2014. Does parasitoid state affect host range expression? *Biological Control* 78: 15–22.

Jennings, D. E., J. J. Duan, D. Bean, J. R. Gould, K. A. Rice, and P. M. Shrewsbury. 2016. Monitoring the establishment and abundance of introduced parasitoids of emerald ash borer larvae in Maryland, U.S.A. *Biological Control* 101: 138–144.

Jetton, R. M., J. F. Monahan, and F. P. Hain. 2011. Laboratory studies of feeding and oviposition preference, developmental performance, and survival of the predatory beetle, *Sasajiscymnus tsugae*, on diets of the woolly adelgids, *Adelges tsugae* and *Adelges piceae*. *Journal of Insect Science*, Article No. 68.

Ji, C-W., E-J. Kang, Y-W. Byeon, J-H. Kim, and B-R. Choi. 2014. Comparative analysis of the biological characteristics of *Ephedrus plagiator* (Nees) and *Aphidius ervi* Haliday according to different aphid hosts. *Korean Journal of Applied Entomology* 53: 427–433.

Jing, Y., J. Huang, and J-C. Han. 2003. Effects of alternative prey *Tetranychus fijiensis* on the experimental population of *Delphastus catalinae* (Horn) (Coleoptera: Coccinellidae). *Acta Arachnologica Sinica* 12(2): 100–105.

Johns, R. 1941. *Annual report of the Department of Agriculture* (*British Solomon Islands Protectorate*)*, 1st April 1940–31st March 1941*. Tulagi, 1941, 6 pp.

Johnson, M. W. and L. T. Wilson. 1995. Integrated pest management: Contributions of biological control to its implementation, pp. 7–24. *In:* Nechols, J. R., L. A. Andres, J. W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). *Biological Control in the Western United States, Accomplishments and Benefits of Regional Project W-84, 1964–1989*. Publication 3361 of the University of California, Division of Agriculture and Natural Resources, Oakland, California, USA. (see page 8)

Jones, M. E., K. M. Daane, and T. D. Paine. 2011. Establishment of *Psyllaephagus parvus* and *P. perplexans* as serendipitous biological control agents of Eucalyptus psyllids in southern California. *BioControl* 56: 735–744.

Joshi, F. L. and J. C. Sharma. 1974. New record of a braconid, *Apanteles plutellae* Kurdj. parasitising the larvae of *Plutella xylostella* L. and *Trichoplusia ni* Hb. in Rajasthan. *Indian Journal of Entomology* 36(2): 160.

Joshi, B. G., S. Sitaramaiah, and G. Ramaprasad. 1989. Note on tobacco looper, *Plusia signata* F. as a new host of *Telenomus remus* Nixon (Hymenoptera, Scelionidae). *Bulletin of Entomology* (*New Delhi*) 30(2): 236–238.

Joyce, A. L. and T. S. Bellows. 2000. Field evaluation of *Amitus bennetti* (Hymenoptera: Platygasteridae), a parasitoid of *Bemisia argentifolii* (Hemiptera: Aleyrodidae), in cotton and bean. *Biological Control* 17: 258–266.

Kadubowski, W. 1981. The parasite complex of the leaf-miner *Lithocolletis blancardella* (F.) (Lepidoptera, Gracillariidae) in western Poland. *Polskie Pismo Entomologiczne* 51: 493–499.

Kairo, M. T. K., G. V. Pollard, D. D. Peterkin, and V. F. Lopez. 2000. Biological control of the hibiscus mealybug, *Maconellicoccus hirsutus* Green (Hemiptera: Pseudococcidae) in the Caribbean. *Integrated Pest Management Reviews* 5: 241–254.

Kairo, M. T. K., O. Paraiso, R. D. Gautam, and D. D. Peterkin. 2013. *Cryptolaemus montrouzieri* (Mulsant) (Coccinellidae: Scymninae): a review of biology, ecology, and use in biological control with particular reference to potential impact on non-target organisms. *CAB Reviews* 8(005): 1–20.

Kaiser, M. E., T. Noma, M. J. Brewer, K. S. Pike, J. R. Vockeroth, and S. D. Gaimari. 2007. Hymenopteran parasitoids and dipteran predators found using soybean aphid after its midwestern United States invasion. *Annals of the Entomological Society of America* 100: 196–205.

Kajita, H. 1981. Native parasites of the greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood), in Japan and results of first use as biological control agents. *Zeitschrift für Angewandte Entomologie* 92: 457–464.

Kaneko, J. 1993. Parasitic wasps of the silver Y moth, *Autographa gamma* (L.) (Noctuidae: Plusiinae) and the Asiatic common looper, *A. nigrisigna* (Walker) in Hokkaido, Japan. *Japanese Journal of Applied Entomology and Zoology* 37: 22–24.

Kapadia, M. N. and S. N. Puri. 1993. New records of natural enemies of castor whitefly. *Journal of Maharashtra Agricultural Universities* 18(2): 339.

Kaplan, M., I. Özgen, and T. Ayaz. 2016. Natural enemies of the olive psyllid [*Euphyllura straminea* Loginova (Hemiptera: Psyllidae)] and population trends of the most important species in olive orchards in Mardin province (Turkey). *Harran Tarm ve Gda Bilimleri Dergisi / Harran Journal of Agricultural and Food Science* 20(3): 175–182.

Karimpour, Y., Y. Fathipour, A. A. Talebi, S. Moharramipour, K. Horstmann, and J. Papp. 2005. New records of two parasitoid wasps of *Simyra dentinosa* Freyer (Lep., Noctuidae) larvae from Iran. *Applied Entomology and Phytopathology* 73(1): Pe133, en37.

Katsoyannos, P., K. Ifantis, and D. C. Kontodimas. 1997. Phenology, population trend and natural enemies of *Aleurothrixus floccosus* (Hom.: Aleyrodidae) at a newly invaded area in Athens, Greece. *Entomophaga* 42: 619–628.

Kaufman, L. V. and J. Yalemar. 2017. Protection of wiliwili trees, the foundation of Hawaiian dry forests, through suppression of an invasive gall wasp, pp. 36–47. In: Van Driesche, R. G. and R. C. Reardon (eds.). *Suppressing Over-abundant Invasive Plants and Insects in Natural Areas by Use of their Specialized Natural Enemies*. FHTET-2017-02, USDA Forest Service, Morgantown, West Virginia, USA.

Kaufman, P. E., C. Strong, J. K. Waldron, and D. A. Rutz. 2012. Individual and combined releases of *Muscidifurax raptor* and *M. raptorellus* (Hymenoptera: Pteromalidae) as a biological control tactic targeting house flies in dairy calf facilities. *Journal of Medical Entomology* 49: 1059–1066.

Kazmer, D. J., K. Maiden, N. Ramualde, D. Coutinot, and K. R. Hopper. 1996. Reproductive compatibility, mating behavior, and random amplified polymorphic DNA variability in some *Aphelinus asychis* derived from the Old World. *Annals of the Entomological Society of America* 89: 212–220.

Kenis, M., T. Haye, R.A. Casagrande, M.S. Gold, and L.A. Tewksbury. 2003. Selection and importation of European parasitoids for the biological control of the lily leaf beetle in North America, and prospects for control in Europe, pp. 416–419. In: *Van Driesche (ed.). Proceedings of the First International Symposium of Biological Control of Arthropods, January 14–18, 2002, Honolulu, Hawaii*. FHTET-2003-05. USDA, Forest Service. Morgantown, West Virginia, USA.

Kennett, C. E. 1988. Results of exploration for parasitoids of citricola scale, *Coccus pseudomagnoliarum* (Homoptera, Coccidae), in Japan and their introduction in California. *Kontyû* 56(2): 445–457.

Kennett, C. E., K. S. Hagen, and K. M. Daane. 1995. Citricola scale, pp. 148–149. *In* Nechols, J. R., L. A. Andres, J. W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). *Biological Control in the Western United States, Accomplishments and Benefits of Regional Project W-84, 1964–1989*. Publication 3361 of the University of California, Division of Agriculture and Natural Resources, Oakland, California, US.

Kesten, L. A. 1975. Insect enemies of the lucerne aphid. *Zashchita Rastenii* 11: 28.

Khalaf, J. and M. Sokhansanj. 1993. Bioecological studies on orientalis yellow scale (*Aonidiella orientalis* New.) and its control by integrated methods in Fars province. *Applied Entomology and Phytopathology* 60(1–2): 53–59, 11–12.

Kharchenko, G.L. and T.A. Ryabchinskaya. 1995. A method for counting the natural enemy *Holcothorax* – a parasitoid of the apple leaf miner. *Sel'skokhozyaistvennaya Biologiya* (5): 103–105.

Khristova, E. 1957. *Plutella maculipennis* Curt, and its control. Nauchni Trud. Minist. Zemedel. 1: 239–255.

Kikuchi, O. 2005. Seasonal occurrence of *Lysiphlebus japonicus* (Hymenoptera: Aphidiidae) parasitizing *Aphis hederae* (Homoptera: Aphididae), as possible specified pest control agent. *Annual Report of the Society of Plant Protection of North Japan* 56: 141–144.

Kim, J-K. and K. Morimoto. 1998. Studies on the natural enemies of *Protopulvinaria mangiferae* (Green) (Homoptera: Coccidae). *Journal of Forest Science* 14: 128–137.

Kim, C. W., Y. T. Noh, and J. I. Kim. 1968. Study on the natural enemies proper in Korea attacking fall webworm, *Hyphantria cunea* Drury. *Entomological Research Bulletin* 4: 17–36.

Kirk, A. A., L. A. Lacey, J. K. Brown, M. A. Ciomperlik, J. A. Goolsby, D. C. Vacek, L. E. Wendel, and B. Napompeth. 2000. Variation in the *Bemisia tabaci* s.l. species complex (Hemiptera: Aleyrodidae) and its natural enemies leading to successful biological control of *Bemisia* biotype B in the USA. *Bulletin of Entomological Research* 90: 317–327.

Kistner, E. J., N. Melhem, E. Carpenter, M. Castillo, and M. S. Hoddle. 2016. Abiotic and biotic mortality factors affecting Asian citrus psyllid (Hemiptera: Liviidae) demographics in southern California. *Annals of the Entomological Society of America* 109: 860–871.

Klemm, U. and H. Schmutterer. 1992. Selection of effective egg-parasitoids of the genera *Trichogramma* and *Trichogrammatoidea* (Hymenoptera: Trichogrammatidae) and diamondback moth control in Taiwan. *Mitteilungen der Deutschen Gesellschaft für Allgemeine und Angewandte Entomologie* 8(1–3): 82–86.

Klotz, J., D. González, S. Triapitsyn, K. Tollerup and R. M. Ibarra. 2002. Resumen de investigación sobre el piojo harinoso (vine mealybug, Planococcus ficus) en el valle de Coachella, California de 1994 á 2002, pp. 6–21. *In*: González Hernández, H., A. Fú Castillo & R. Báez Sañudo (eds.). *Simposio Internacional sobre Piojos Harinosos, XXV Congreso Nacional de Control Biológico, 15 de noviembre del 2002, Hermosillo, Sonora, México*. 36 pp.

Koehler, W. and A. Kolk. 1971. The large-scale occurrence of two species of the genus *Hyponomeuta* (Lep., Hyponomeutidae) in afforestations and forests. *Polskie Pismo Entomologiczne* 41(1): 193–196.

Kögel, S., M. Schieler, and C. Hoffmann. 2013.The ladybird beetle *Harmonia axyridis* (Coleoptera: Coccinellidae) as a possible predator of grape phylloxera *Daktulosphaira vitifoliae* (Hemiptera: Phylloxeridae). *European Journal of Entomology* 110(1): 123–128.

Kos, K. and S. Trdan. 2011. New findings about parasitoids of pest insects in Slovenia, pp. 253–257. *In*: Maček, J. and S. Trdan (eds.). *Zbornik Predavanj in Referatov, 10. Slovenskega Posvetovanja o Varstvu Rastlin, Podčetrtek, Slovenia, 1.-2. Marec 2011 Ljubljana*. Published by the Plant Protection Society of Slovenia.

Kruidhof, H. M., L. Catalá-Senent, R. Vijverberg, and A. Leman. 2017. Foraging and egg-laying behaviour of the coccinellid predator *Rhyzobius lophanthae*. *IOBC/WPRS Bulletin* 124: 74–80.

Kumar, R. and P. R. Gupta. 2006. Natural enemies associated with the greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood), on vegetable crops in the mid-hill region of Himachal Pradesh. *Pest Management and Economic Zoology* 14: 73–78.

Kumar, N. and R. P. Yadav. 1987. Records of *Blepharella lateralis* Macquart and *Carcelia* sp. – two indigenous parasitoids of *Spilosoma* (= *Diacrisia*) *obliqua* Walker from Bihar (India). *Current Science, India* 56(22): 1192–1193.

Kuniata, L. S. and C. P. M. Sweet. 1994. Management of *Sesamia grisescens* Walker (Lep.: Noctuidae), a sugar-cane borer in Papua New Guinea. *Crop Protection* 13(7): 488–493.

La Croix, E. A. S. 1967. Maize stalk borers in the Coast Province of Kenya. *East African Agricultural and Forestry Journal* 33(1): 49–54.

Lahey, Z. 2014. Parasitoids of an invasive *Bemisia* tabaci species (Hemiptera: Aleyrodidae) in southwest Florida: faunal composition, host-plant associations, and interspecific competition. M. Sc. Thesis, University of Florida, Gainesville, Florida.

Lahey, Z. J., H. J. McAuslane, and P. A. Stansly. 2016. Interspecific competition between two exotic parasitoids (Hymenoptera: Aphelinidae) of an invasive *Bemisia tabaci* species (Hemiptera: Aleyrodidae). *Florida Entomologist* 99: 535–540.

Lai, P. Y. and G. Y. Funasaki. 1986. Introduction for biological control in Hawaii: 1983 and 1984. *Proceedings of the Hawaiian Entomological Society* 26: 89–91.

Lali, T. S. and R. Muniappan. 1996. Distribution of the red coconut scale, *Furcaspis oceanica* Lindinger (Homoptera: Diaspididae) and its introduced parasitoid, *Adelencyrtus oceanicus* Doutt (Hymenoptera: Encyrtidae) in Guam. *Journal of Biological Control* 10(1/2): 15–20.

Lamb, A. B., S. M. Salom, L. T. Kok, and D. L. Mausel. 2006. Confined field release of *Laricobius nigrinus* (Coleoptera: Derodontidae), a predator of the hemlock woolly adelgid, *Adelges tsugae* (Hemiptera: Adelgidae), in Virginia. *Canadian Journal of Forest Research* 36: 369–375.

Lange, W. H., Jr. 1950. The biology of the Mariana coconut beetle, *Brontispa mariana* Spaeth, on Saipan, and the introduction of parasites from Malaya and Java for its control. *Proceedings of the Hawaiian Entomological Society* 14: 143–162.

LaPorte, M. L. 1949. Parasites of *Chrysomphalus ficus* Ashm. (Hom. Coccoidea) in Algeria. / Les parasites de *Chrysomphalus ficus* Ashm. (Hom. Coecoidea) en Algérie. *Revue de Pathologie Vegetale* 28(3): 150–158.

LaSalle, J. 1990. A new genus and species of Tetrastichinae (Hymenoptera: Eulophidae) parasitic on the coffee berry borer, *Hypothenemus hampei* (Ferrari) (Coleoptera: Scolytidae). *Bulletin of Entomological Research* 80: 7–10.

LaSalle, J., R. E. Duncan, and J. E. Peña. 1999. The recovery and apparent establishment of *Cirrospilus ingenuus* (Hymenoptera: Eulophidae) in Florida. *Florida Entomologist* 82: 371–373.

Lawson, D. S., J. P. Nyrop, and W. H. Reissig. 1997. Assays with commercially produced *Trichogramma* (Hymenoptera: Trichogrammatidae) to determine suitability for obliquebanded leafroller (Lepidoptera: Tortricidae) control. *Environmental Entomology* 26: 684–693.

Leandro, M. J., M. Oliveira, A. M. Passarinho, E. Figueiredo, J. C. Franco, J Neves-Martins, and A. Mexia. 2008. Assessment of parasitism by *Anagyrus pseudococci* and *Leptomastix dactylopii* on mealybugs from Proteaceae. *Acta Horticulturae* 805: 121–126.

Lee, J-H. and R. W. Pemberton. 2005. Larval parasitoids of the apple ermine moth, *Yponomeuta malinellus* in Korea, Japan, and China. BioControl 50: 247–258.

Lee, J-H. and R. W. Pemberton. 2007. Seasonal phenology and stage-specific parasitism of the apple ermine moth, *Yponomeuta malinellus* Zeller, in Korea. *Entomological Research* 37(1): 54–59.

Lee, J-H. and R. W. Pemberton. 2009. Parasitoid complex of the bird cherry ermine moth *Yponomeuta evonymellus* in Korea. *Entomological Research* 39(3): 201–206.

Lee, J. H., D. K. Reed, H. P. Lee, and R. W. Carlson. 1988. Parasitoids of *Henosepilachna vigintioctomaculata* (Moschulsky) (Coleoptera: Coccinellidae) in Kyonggido area, Korea. *Korean Journal of Applied Entomology* 27: 28–34.

Legaspi, J. C., B. C. Legaspi, Jr., R. L. Meagher, Jr., and M. A. Ciomperlik. 1996. Evaluation of *Serangium parcesetosum* (Coleoptera: Coccinellidae) as a biological control agent of the silverleaf whitefly (Homoptera: Aleyrodidae). *Environmental Entomology* 25: 1421–1427.

Legner, E. F., B. B. Sugerman, H. S. Yu, and H. Lum. 1974. Biological and integrated control of the bush fly, *Musca sorbens* Wiedemann and other filth breeding Diptera in Kwajalein Atoll, Marshall Islands. *Bulletin of the Society of Vector Ecologists* 1: 1–14.

Legner, E. F., W. D. McKeen, and R. W. Warkentin. 1989. Inoculation and spread of parasitic wasps to control filth flies in poultry houses. *Proceedings and Papers of the Annual Conference of the California Mosquito and Vector Control Association* 57: 146–150.

León, J. H. de and D. J. W. Morgan. 2007. Evaluation of molecular markers for discriminating *Gonatocerus morrilli* (Hymenoptera: Mymaridae): a biological control agent for *Homalodisca vitripennis*. *Annals of the Entomological Society of America* 100: 749–757.

Leppla, N. C., J. H. Frank, M. B. Adjei, and N. E. Vicente, N. E. 2007. Management of pest mole crickets in Florida and Puerto Rico with a nematode and parasitic wasp. *Florida Entomologist* 90: 229–233.
Lerer, A. Z. and S. G. Plugar. 1962. The tachinid parasites (Diptera, Larvaevoridae) of pests of oak in Moldavia. *Entomologicheskoe Obozrenie* 41(2): 359–365.
Lethane, R. 1998. Breadfruit pest succumbs to a ladybird beetle. *Partners in Research for Development* 11: 25–31.
Leuprecht, B. 1992. *Liriomyza huidobrensis*, a new, dangerous leaf- miner. *Gesunde Pflanzen* 44(2): 51–58.
Leuprecht, B. 1993. Studies on the chemical and biological control of a dangerous leafminer in greenhouse vegetables. *Gesunde Pflanzen* 45(3): 89–93.
Lever, R. J. A. W. 1936. Control of *Brontispa* in Celebes by the parasite *Tetrastichodes* of Java. *British Solomon Islands Agricultural Gazette* 3 (4, Suppl) Tulagi, 6 pp.
Lever, R. J. A. W. 1943. The cutworm *Prodenia litura* Fabr. *Agricultural Journal of Fiji* 14(1): 11–13.
Li, J. P. 1992. Morphology and bionomics of *Chromaphis juglandicola* Kaltenback and its control. *Entomological Knowledge* 29(6): 345-347.
Li, X-Y., X-Q. Zhao, S-X. Gong, F-S. Chen, T.Tan, and A-D. AiDong. 2008. The population dynamics and its role in controlling *Eriosoma lanigerum* by *Harmonia axyridis* (Pallas). *Southwest China Journal of Agricultural Sciences* 21: 1165–1168.
Li, G-T., Y-L. Tian, Y-D. Zou, S. Lu, F-H. Dang, S-B. Ke, Y-J. Zhao, and K. Yu. 2010. Relationship between *Oides decempunctata* and its natural enemies under different fertilization treatments in grapery in Jianghuai hilly region and ancient course of the Yellow River. *Zhongguo Shengtai Nongye Xuebao / Chinese Journal of Eco-Agriculture* 18(5): 1046–1053.
Li, J-H., F. Yang, Q. Wang, H-S. Pan, H-B. Yuan, and Y-H. Lu. 2017. Predation by generalist arthropod predators on *Apolygus lucorum* (Hemiptera: Miridae): molecular gut-content analysis and field-cage assessment. *Pest Management Science* 73(3): 628–635.
Lieten, F. 1998. Strawberries. Integrated strawberry production: experiences with ladybirds to control aphids. *Proeftuinnieuws* 8(19): 45–46.
Lim, G. T. 1983. *Trichogrammatoidea bactrae fumata* Nagaraja (Hymenoptera: Trichogrammatidae) a new egg parasitoid of *Acrocercops cramerella* Snellen. *MAPPS Newsletter* 7: 5–6.
Lim, G. T. 1986. Biological studies on *Trichogrammatoidea bactrae fumata* Nagajara in the laboratory. *Journal of Applied Entomology* 101: 48–54.
Lin, K-J., K-M. Wu, S-B. Liu, Y-J. Zhang, Y-Y. Guo. 2006. Functional responses of *Chrysopa sinica*, *Propylea japonica* and *Leis axyridis* to *Bemisia tabaci*. *Chinese Bulletin of Entomology* 43(3): 339–343.
Link, D. and E. C. Costa. 1980. Occurrence of natural enemies of the whitefly, *Bemisia tabaci* (Gennadius, 1889), on soyabean crops. *Revista do Centro de Ciencias Rurais* 10(2): 111–113.
Lipa, J. J., C. Santiago-Álvarez, E. Vargas-Osuna, H. K. Aldebis, P. Caballero, and P. Hernández-Crespo. 1993. Microorganisms, nematodes and parasitoids of *Ocnogyna baetica* (Rambur) (Lep.: Arctiidae) in southern Spain with potential for use in biological control. *Biocontrol Science and Technology* 3: 347–353.
Liu, H. P., L. S. Bauer, D. L. Miller, T-H. Zhao, R-T. Gao Rui, L-W. Song, Q-S. Luan, R-Z. Jin, and C-Q.Gao. 2007. Seasonal abundance of *Agrilus planipennis* (Coleoptera: Buprestidae) and its natural enemies *Oobius agrili* (Hymenoptera: Encyrtidae) and *Tetrastichus planipennisi* (Hymenoptera: Eulophidae) in China. *Biological Control* 42: 61–71.
Loan, C. C. and T. Bilewicz-Pawinska. 1973. Systematics and biology of four Polish species of *Peristenus* Foerster (Hymenoptera: Braconidae, Euphorinae). *Environmental Entomology* 2: 271–278.
Loan, C. C. and D. C. Lloyd. 1974. Description and field biology of *Microctonus hyperodae* n. sp. (Hymenoptera: Braconidae, Eulophidae) a parasite of *Hyperodes bonariensis* in South America (Coleoptera: Curculionidae). *Entomophaga* 19: 7–12.
Logvinovskaya, T. V. 1983. A new species of encyrtid of the genus *Ageniaspis* Dahlbom, 1857 (Hymenoptera, Encyrtidae) from Vietnam. *Entomologicheskoe Obozrenie* 62(3): 610–611.
Loiacono, M. S. 1982. A new platygastrid (Hymenoptera: Platygastridae) reared from eggs of *Naupactus xanthographus* Germ. (Coleoptera-Curculionidae). *Revista de la Sociedad Entomológica Argentina* 41(1/4): 85–88.
Lomerio, E. O. and V. J. Calilung. 2008. Suitability of *Aphidius absinthii* Marshall and *Trioxys* (*Binodoxys*) *communis* Gahan (Hymenoptera: Aphidiidae) for the biological control of *Pentalonia nigronervosa* Coq. (Hemiptera: Aphididae). *Philippine Entomologist* 22(2): 163–172.
Longo, S. 1985. Morphological and bio-ethological observations on *Ceroplastes japonicus* Green (Homoptera: Coccidae) in Italy. Atti XIV Congresso Nazionale Italiano di Entomologia sotto gli auspici dell'Accademia Nazionale Italiana di Entomologia, della Società Entomologica Italiana e della International Union of Biological Sciences. Palermo - Erice - Bagheria, 28 maggio–1 giugno 1985.
Longo, S., C. Rapisarda, A. Russo, and G. Siscaro. 1990. Preliminary studies on the bioethology of *Parabemisia myricae* (Kuwana) and its natural enemies in Sicily and Calabria. *Bollettino di Zoologia Agraria e di Bachicoltura* 22: 161–171.
Loomans, A. J. M. and J. C. van Lenteren, J. C. 1995. Biological control of thrips pests: a review on thrips parasitoids, pp. 89–201. Wageningen Agricultural University Papers (95–1). Wageningen Agricultural University, Wageningen, The Netherlands. (see page 102 for list of hosts, and page 115 for release in Florida)
Lopez Cristobal, U. 1937. The green aphids of cereals and their parasites. / Los "pulgones verdes" de los cereales y sus parasites. *Boletén del Laboratorio de Zoología Agrícola de la Facultad de Agronomía, La Plata* 3: 1–5.
Lopez, M., J. Sivinski, P. Rendon, T. Holler, K. Bloem, R. Copeland, M. Trostle, and M. Aluja. 2003. Colonization of *Fopius ceratitivorus*, a newly discovered African egg-pupal parasitoid (Hymenoptera: Braconidae) of *Ceratitis capitata* (Diptera: Tephritidae). *Florida Entomologist* 86: 53–60.
López-Arroyo, J. I., J. Loera-Gallardo, M. A. Rocha-Peña, R. Canales, I. Hernández, M. A. Reyes, A. Berlanga, and M. A. Miranda. 2008. Pulgón café de los citricos, *Toxoptera citricida* (Hemiptera: Aphididae), pp. 279–292. *In*: Arredondo Bernal, H. C. and L. A. Rodríguez el Bosque (eds.). *Casos de Control Biológico en México*. Grupo Mundi-Prensa, Madrid, Spain.
López-Vaamonde, C. and D. Moore. 1998. Developing methods for testing host specificity of *Phymastichus coffea* LaSalle (Hym.: Tetrastichinae), a potential biological control agent of *Hypothenemus hampei* (Ferrari) (Col.: Scolytidae) in Colombia. *Biocontrol Science and Technology* 8: 397–411.
Lotfalizadeh, H. and A. A. Ahmadi. 2000. Natural enemies of cypress tree mealybug, *Planococcus vovae* (Nasonov), and their parasitoids in Shiraz, Iran. *Iran Agricultural Research* 19(2): 145–154.
Lourenço, P., C. Brito, T. Backeljau, D. Thierry, and M. A. Ventura. 2006. Molecular systematics of the *Chrysoperla carnea* group (Neuroptera: Chrysopidae) in Europe. *Journal of Zoological Systematics and Evolutionary Research* 44(2): 180–184.
Lü, S-J., X-J. Wang, J-L. Zhang JunLing, S-A. Xie. 2002. The forecast techniques of *Drosicha corpulenta*. *Journal of Northeast Forestry University* 30(5): 63–64.
Lucas, É., D. Coderre, and C. Vincent. 1997. Voracity and feeding preferences of two aphidophagous coccinellids on *Aphis citricola* and *Tetranychus urticae*. *Entomologia Experimentalis et Applicata* 85: 151–159.

Luhring, K. A., T. D. Paine, J. G. Millar, and L. M. Hanks. 2000. Suitability of the eggs of two species of eucalyptus longhorned borers (*Phoracantha recurva* and *P. semipunctata*) as hosts for the encyrtid parasitoid *Avetianella longoi*. *Biological Control* 19: 95–104.

Luhring, K. A., J. G. Millar, T. D. Paine, D. Reed, and H. Christiansen. 2004. Ovipositional preferences and progeny development of the egg parasitoid *Avetianella longoi*: factors mediating replacement of one species by a congener in a shared habitat. *Biological Control* 30: 382–391.

Luo, Q-H., X-L. Xie, L. Zhou, S. W. Wang, and Z-Y. Xu. 2000. A study on the dynamics and biological characteristics of *Eriococcus lagerstroemiae* Kuwanae population in Guiyang. *Acta Entomologica Sinica* 43: 35–42.

Lyons, D. B. 2013. *Acantholyda erythrocephala* L., sic [L.], pine false webworm (Hymenoptera: Pamphiliidae), pp. 54–65. *In*: Mason, P. G. and D. R. Gillespie (eds.). *Biological Control Programmes in Canada 2001–2012*. CABI, Wallingford, U.K.

Lyons, D. B. 2014. Pine false webworm (*Acantholyda erythrocephala* [L.]) (Hymenoptera: Pamphiliidae), pp. 245–254. In: Van Driesche, R. and R. Reardon (eds.). *The Use of Classical Biological Control to Preserve Forests in North America*. Morgantown, West Virginia. FHTET-2013-2. USDA Forest Service, Morgantown, West Virginia, USA.

Lysyk, T. J. 2004. Host mortality and progeny production by solitary and gregarious parasitoids (Hymenoptera: Pteromalidae) attacking *Musca domestica* and *Stomoxys calcitrans* (Diptera: Muscidae) at varying host densities. *Environmental Entomology* 33: 328–339.

Lytle, J. and J. G. Morse. 2012. Distribution of several species of parasitoids of the glassy-winged sharpshooter (Hemiptera: Cicadellidae) in southern California. *Pan-Pacific Entomologist* 88: 1–7.

Maier, C. T. 1993. Inoculative release and establishment of *Holcothorax testaceipes* (Hymenoptera: Encyrtidae), a Palaearctic agent for the biological control of *Phyllonorycter* spp. (Lepidoptera: Gracillariidae) in Connecticut apple orchards. *Journal of Economic Entomology* 86: 1069–1077.

Maier, C. T. 1994. Biology and impact of parasitoids of *Phyllonorycter blancardella* and *P. crataegella* (Lepidoptera: Gracillariidae) in northeastern North American apple orchards, pp. 6–24. In: Maier, C. T. (ed.). *Integrated Management of Tentiform Leafminers,* Phyllonorycter *spp. (Lepidoptera: Gracillariidae) in North American Apple Orchards.* Thomas Say publication in Entomology, Entomological Society of America, Lanham, Maryland, USA.

Maignet, P. and J. C. Onillon. 1997. Initial data on the biotic potential of *Encarsia hispida* De Santis (Hymenopt.: Aphelinidae), endoparasitoid of biotype 'B' of *Bemisia tabaci* (Gennadius) and of *Trialeurodes vaporariorum* West. (Homoptera: Aleyrodidae). *Bulletin OILB/SROP* 20(4): 121–125.

Malekmohammadi, A., P. Shishehbor, and F. Kocheili. 2012. Influence of constant temperatures on development, reproduction and life table parameters of *Encarsia inaron* (Hymenoptera: Aphelinidae) parasitizing *Neomaskellia andropogonis* (Hemiptera: Aleyrodidae). *Crop Protection* 34: 1–5.

Mamedov, Z. M. and D. D. Makhmudova-Kurbanova, D. D. 1982. The morphology, biology and natural enemies of ermine moths in the Azerbaijan SSR. *Izvestiya Akademii Nauk Azerbadzhansko SSR, Biologicheskikh Nauk* 3: 83–88.

Mani, M., C. Shivaraju, and A. N. Shylesha. 2012. *Paracoccus marginatus*, an invasive mealybug of papaya and its biological control – an overview. *Journal of Biological Control* 26(3): 301–216 (see references to pub. sources, p. 208).

Mani, M., M. Kalyanashundaram, and C. Shivaraju. 2016. Fruit crops: papaya, pp. 395–410. In: Mani, M. and C. Shivaraju (eds.). *Mealybugs and their Management in Agricultural and Horticultural Crops*. Springer, New Delhi, New York, London; see p. 403.

Mansfield, S. and N. J. Mills. 2004. A comparison of methodologies for the assessment of host preference of the gregarious egg parasitoid *Trichogramma platneri*. *Biological Control* 29: 332–340.

Manweiler, S. A. 1986. Developmental and ecological comparisons of *Trichogramma minutum* and *Trichogramma platneri* (Hymenoptera: Trichogrammatidae). *Pan-Pacific Entomologist* 62: 128–139.

Mapondera, T.S., T. Burgess, M. Matsuki, and R.G. Oberprieler. 2012. Identification and molecular phylogenetics of the cryptic species of the *Gonipterus scutellatus* complex (Coleoptera: Curculionidae: Gonipterini). *Australian Journal of Entomology* 51: 175–188.

Marsh, P.M. 1984. A new species of Braconidae (Hymenoptera) from Mexico introduced into Texas to control a sugar cane borer, *Eoreuma loftini* (Lepidoptera: Pyralidae*). Proceedings of the Entomological Society of Washington* 86: 861–863.

Marsh, P. M. 1986. A new species of *Cardiochiles* (Hymenoptera: Braconidae) introduced into Florida to control *Diaphania* spp. (Lepidoptera: Pyralidae). *Proceedings of the Entomological Society of Washington* 88: 131–133.

Martelli, G. 1915. [Two insect enemies of *Chrysomphalus dictyospermi* var. *pinnulifera* Mask.: *Rhizobius lophantae* and *Aphelinus chrysomphali*]. *Giornale di agricoltura meridionale* 8(6): 81–88.

Martínez Carillo, J. L., U. Nava Camberos, H. C. Arredondo Bernal, and S. Aguilar Medel. 2015. Mosca blanca, *Bemisia tabaci* (Hemiptera: Aleyrodidae), pp. 269–294. *In*: Arredondo Bernal, H. C. and L. A. Rodríguez el Bosque (eds.). *Casos de Control Biológico en México*, *Vol. 2*. Printing Arts Mexico, Guadalajara, Mexico. see p. 282.

Marwoto and Nasir Saleh. 2003. Increasing the role of egg parasitoid *Trichogrammatoidea bactrae-bactrae* in controlling soybean pod borer *Etiella* spp. *Jurnal Penelitian dan Pengembangan Pertanian* 22(4): 141–149.

Mason, P. G. and D. R. Gillespie (eds.). 2013. *Biological Control Programmes in Canada 2001–2012.* CABI, Wallingford, U.K.

Mason, P. G. and J. T. Huber (eds.). 2002. *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, UK.

Mason, P. G., W. J. Turnock, M. A. Erlandson, U. Kuhlmann, and L. Braun. 2002. *Mamestra configurata* Walker, Bertha armyworm (Lepidoptera: Noctuidae), pp. 169–176. *In*: Mason, P. G. and J. T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, UK. (see pages 172–173)

Mason, P. G., A. B. Broadbent, J. W. Whistlecraft, and D. R. Gillespie. 2011. Interpreting the host ranges of *Peristenus digoneutis* and *Peristenus relictus* (Hymenoptera: Braconidae), biological control agents of *Lygus* spp. (Hemiptera: Miridae) in North America. *Biological Control* 57: 94–102.

Mason, P. G., A. M. Brauner, J. H. Miall, and A. M. R. Bennett. 2013. *Diadromus pulchellus* in North America: field release against leek moth and new characters to distinguish it from *Diadromus subtilicornis*, a native diamondback moth parasitoid. *Biocontrol Science and Technology* 23: 260–276.

Massa, B. and M. C. Rizzo. 2000. *Agromyza hiemalis* Becker (Diptera, Agromyzidae) leaf-miner of nettle (*Urtica* spp.): phenology and parasitoids in Italy. *Phytophaga* (*Palermo*) 10: 53–67.

Massa, B., M. C. Rizzo, and V. Caleca. 2001. Natural alternative hosts of Eulophidae (Hymenoptera: Chalcidoidea) parasitoids of the citrus leafminer *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) in the Mediterranean Basin. *Journal of Hymenoptera Research* 10: 91–100.

Matadha, D., G. C. Hamilton, M. G. Hughes, and J. H. Lashomb. 2003. Distribution of natural enemies of euonymus scale, *Unaspis euonymi* (Comstock) (Homoptera: Diaspididae), in New Jersey. *Environmental Entomology* 32: 602–607.

Matadha, D., G. C. Hamilton, J. H. Lashomb, and J. X. Zhang. 2005. Ovipositional preferences and functional response of parasitoids of euonymus scale, *Unaspis euonymi* (Comstock) and San Jose scale, *Quadraspidiotus perniciosus* (Comstock) (Homoptera: Diaspididae). *Biological Control* 32: 337–347.

Matos, B. and J. J. Obrycki. 2006. Prey suitability of *Galerucella calmariensis* L. (Coleoptera: Chrysomelidae) and *Myzus lythri* (Schrank) (Homoptera: Aphididae) for development of three predatory species. *Environmental Entomology* 35: 345–350.

Matsumoto, T., T. Itioka, and T. Nishida. 2004. Why can arrowhead scales, *Unaspis yanonensis* Kuwana (Homoptera: Diaspididae), which burrow and settle below conspecifics, successfully avoid attack by its parasitoid, *Coccobius fulvus* Compere et Annecke (Hymenoptera: Aphelinidae)? *Applied Entomology and Zoology* 39: 147–154.
Matta, V., A. 1979. Natural enemies of the white scales attacking olive in the Azapa valley, Arica-Chile. *Idesia* 5: 231–242.
Matta V., A. and O., N. Hichins. 1979. New identifications of insect parasites (Hym. Chalcidoidea) from northern Chile. *Idesia* 5: 287–288.
Mausel, D. L., S. M. Salom, L. T. Kok, and J. G. Fidgen. 2008. Propagation, synchrony, and impact of introduced and native *Laricobius* spp. (Coleoptera: Derodontidae) on hemlock woolly adelgid in Virginia. *Environmental Entomology* 37: 1498–1507.
Mausel, D. L., S. M. Salom, L. T. Kok, and G. A. Davis. 2010. Establishment of the hemlock woolly adelgid predator, *Laricobius nigrinus* (Coleoptera: Derodontidae), in the eastern United States. *Environmental Entomology* 39: 440–448.
Mausel, D. L., R. G. Van Driesche, J. S. Elkinton. 2011. Comparative cold tolerance and climate matching of coastal and inland *Laricobius nigrinus* (Coleoptera: Derodontidae), a biological control agent of hemlock woolly adelgid. *Biological Control* 58: 96–102.
McClure, M. S. and C. A. S. J. Cheah. 1998. Released Japanese ladybugs are multiplying and killing hemlock woolly adelgids. *Frontiers of Plant Science* 50(2): 6–8.
McDonald, R. C. and L. T. Kok. 1992. Colonization and hyperparasitism of *Cotesia rubecula* (Hymen.: Braconidae), a newly introduced parasite of *Pieris rapae*, in Virginia. *Entomophaga* 37: 223–228.
McDonald, H., D. A. Reed, S. Ahmadian, and T. D. Paine. 2015. Parasitoid discrimination between suitable and unsuitable congener hosts. *Journal of Insect Behavior* 28: 417–425.
McKenzie, H. L. 1935. Biology and control of avocado insects and mites. *Bulletin of the California Agricultural Experiment Station* No. 592, Berkeley, California, 48 pp.
McMurtry, J. A. 1988. Biological control on greenhouse thrips. *Citrograph* 73(4): 81–82.
McMurtry, J. A., H. G. Johnson, and S. J. Newberger. 1991. Imported parasite of greenhouse thrips established on California avocado. *California Agriculture* 45(6): 31–32.
McNamara, J. E. C. 1991. First Canadian record of *Rhyzobius lophanthae* (Blaisdell) (Coleoptera: Coccinellidae). *Coleopterists Bulletin* 45(2): 196–197.
Meagher, R. L., Jr. and J. H. Frank. 1998. *Larra bicolor* (Hymenoptera: Sphecidae: Larrinae) collected in pheromone- and phenylacetaldehyde-baited traps. *Florida Entomologist* 81: 555–556.
Meagher, R. L., Jr., J. W. Smith, Jr., H. W. Browning, and R. R. Saldana. 1998. Sugarcane stemborers and their parasites in southern Texas. *Environmental Entomology* 27: 759–766.
Mehrnejad, M. R. 2002. Bionomics of the common pistachio psylla, *Agonoscena pistaciae*, in Iran. *Acta Horticulturae* 591: 535–539.
Melo, R. L., D. Pratissoli, R. A. Polanczyk, D. F. Melo, R. Barros, and A. M. Milanez. 2007. Biology and thermal requirements of *Trichogramma atopovirilia* Oatman & Platner (Hymenoptera: Trichogrammatidae) parasitizing eggs of *Diaphania hyalinata* L. (Lepidoptera: Pyralidae). *Neotropical Entomology* 36: 431–435.
Melton, C. W. and H. W. Browning, H. W. 1986. Life history and reproductive biology of *Allorhogas pyralophagus* (Hymenoptera: Braconidae), a parasite imported for release against *Eoreuma loftini* (Lepidoptera: Pyralidae). *Annals of the Entomological Society of America* 79: 402–406.
Menke, A. S. 1992. Mole cricket hunters of the genus *Larra* in the New World (Hymenoptera: Sphecidae, Larrinae). *Journal of Hymenoptera Research* 1: 175–234.
Mesbah, A. H., M. A. Shoeb, and A. H. El-Heneidy. 2003. Preliminary approach towards the use of the egg parasitoid, *Trichogrammatoidea bactrae* Nagaraja against cotton bollworms in Egyptian cotton fields. *Egyptian Journal of Agricultural Research* 81(3): 981–995.
Mescheloff, E. and D. Rosen. 1993. Biosystematic studies on the Aphidiidae of Israel (Hymenoptera: Ichneumonoidea). 5. The genera *Trioxys* and *Binodoxys*. *Israel Journal of Entomology* 27: 31–47.
Mesnil, L. P. 1949. Remarques sur quelques Diaspines du pin sylvestre ou du génévrier et leurs parasites. *Revue de Pathologie Vegetale* 28 (2): 73–97.
Messing, R. 2014. Field release of the parasitoid *Fopius ceratitivorus* for biological control of Mediterranean fruit fly (*Ceratitis capitata*) in Hawaii. Final Environmental Assessment, August 2014. https://www.aphis.usda.gov/plant_health/ea/downloads/2016/fopius-cerativivorus-hi-ea-fonsi.pdf
Messing, R. H. and L. M. Klungness. 2001. A two-year survey of the melon aphid, *Aphis gossypii* Glover, on crop plants in Hawaii. *Proceedings of the Hawaiian Entomological Society* 35: 91–101.
Messing, R. H. and M. M. Ramadan. 2000. Host range and reproductive output of *Diachasmimorpha kraussii* (Hymenoptera: Braconidae), a parasitoid of tephritid fruit flies newly imported to Hawaii, pp. 713–718. *In*: Tan, K-H. (ed.). *Area-wide Control of Fruit Flies and other Insect Pests. Joint Proceedings of the International Conference on Area-wide Control of Insect Pests, 28 May–2 June, 1998 and the Fifth International Symposium on Fruit Flies of Economic Importance, Penang, Malaysia, 1–5 June, 1998.* Penerbit Universiti Sains, Pulau Pinang, Malaysia.
Meyer, J. A., B. A. Mullens, T. L. Cyr, and C. Stokes. 1990. Commercial and naturally occurring fly parasitoids (Hymenoptera: Pteromalidae) as biological control agents of stable flies and house flies (Diptera: Muscidae) on California dairies. *Journal of Economic Entomology* 83: 799–806.
Meyerdirk, D. E., J. B. Kreasky, and W. G. Hart. 1980. Whiteflies (Aleyrodidae) attacking citrus in southern Texas with notes on natural enemies. *The Canadian Entomologist* 112: 1253–1258.
Meyerdirk, D.E., R. Muniappan, R. Warkentin, J. Bamba, and G.V.P. Reddy. 2004. Biological control of the papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae) in Guam. *Plant Protection Quarterly* 19(3): 110–114.
Mhina, G. J., N. C. Leppla, M. H. Thomas, and D. Solís. 2016. Cost effectiveness of biological control of invasive mole crickets in Florida pastures. *Biological Control* 100: 108–115.
Miall, J. H., P. K. Abram, N. Cappuccino, and P. G. Mason. 2014. Potential impact of the native hyperparasitoid *Conura albifrons* (Hymenoptera: Chalcididae) on the exotic biological control agent *Diadromus pulchellus* (Hymenoptera: Ichneumonidae). *Biocontrol Science and Technology* 24: 611–624.
Michaud, J. P. 1999. Sources of mortality in colonies of brown citrus aphid, *Toxoptera citricida*. *BioControl* 44: 347–367.
Michaud, J.P. 2002a. Classical biological control: a critical review of recent programs against citrus pests in Florida. *Annals of the Entomological Society of America* 95: 531–540.
Michaud, J.P. 2002b. Biological control of Asian citrus psyllid, *Diaphorina citri* (Hemiptera: Psyllidae) in Florida: a preliminary report. *Entomological News* 113(3): 216–222.
Michaud, J. P. 2004. Natural mortality of Asian citrus psyllid (Homoptera: Psyllidae) in central Florida. *Biological Control* 29: 260–269.
Michaud, J. P. and G. A. Evans. 2000. Current status of pink hibiscus mealybug in Puerto Rico including a key to parasitoid species. *Florida Entomologist* 83: 97–101.

Michels, G. J. and R. L. Whitaker-Deerberg. 1993. Recovery of *Aphelinus asychis*, an imported parasitoid of Russian wheat aphid, in the Texas panhandle. *Southwestern Entomologist* 18: 11–17

Michels, G. J., R. V. Flanders, and J. B. Bible. 1997. Overwintering survival of seven imported coccinellids in the Texas high plains. *Southwestern Entomologist* 22: 157–166.

Miczulski, B. and A. Anasiewicz. 1976. Parasitic insects reared from larvae and pupae of *Yponomeuta euonymellus* L. (Lep., Yponomeutidae) collected in the city area of Lublin. *Polski Pismo Entomologiczne* 46: 823–827.

Mignault, M. P., M. Roy, and J. Brodeur. 2006. Soybean aphid predators in Québec and the suitability of *Aphis glycines* as prey for three Coccinellidae. *BioControl* 51: 89–106.

Milanez, A. M., D. Pratissoli, R. A. Polanczyk, A. de F. Bueno, and C. B. A. Tufik. 2009. Evaluation of *Trichogramma* spp. for the control of *Trichoplusia ni*. *Pesquisa Agropecuária Brasileira* 44(10): 1219–1224.

Milevoj, L. 1996. A study on *Aphelinus asychis* Walk. in Slovenia. *Zbornik Biotehniške Fakultete Univerze v Ljubljani, Kmetijstvo* 67: 115–120.

Millar, J. G., T. D. Paine, and M. Hoddle. 1999–2000. Biological control of a newly introduced pest, the eucalyptus tortoise beetle, *Trachymela sloanei*. Slosson Report 1999–2000 pp. 1–7 https://www.researchgate.net/publication/265445958_Biological_Control_of_a_Newly_Introduced_Pest_the_Eucalyptus_Tortoise_Beetle_Trachymela_sloanei

Millar, J. G., T. D. Paine, C. D. Campbell, and L. M. Hanks. 2002. Methods for rearing *Syngaster lepidus* and *Jarra phoracantha* (Hymenoptera: Braconidae), larval parasitoids of the phloem-colonizing longhorned beetles *Phoracantha semipunctata* and *P. recurva* (Coleoptera: Cerambycidae). *Bulletin of Entomological Research* 92: 141–146.

Miller, R.L. 1928. *Telenomus megacephalus*, Ashm., an egg parasite of the green pumpkin bug, *Nezara viridula* Linn., in Florida. *Florida Entomologist* 12: 17–20.

Mills, N. 2005a. Selecting effective parasitoids for biological control introductions: codling moth as a case study. *Biological Control* 34: 274–282.

Mills, N. 2005b. Classical biological control of codling moth: the California experience, pp. 126–131. *In*: Hoddle, M.S. (ed.). *Second International Symposium on Biological Control of Arthropods, Davos, Switzerland, 12–16 September, 2005*. FHTET-2005-08. USDA Forest Service, Morgantown, West Virginia, USA. https://www.bugwood.org/arthropod2005/vol1/3b.pdf#view=FitH

Mills, N. J. and V. G. Nealis. 1992. European field collections and Canadian releases of *Ceranthia samarensis* (Dipt.: Tachinidae), a parasitoid of the gypsy moth. *Entomophaga* 37: 181–191.

Mitchell, E. R., G. Y. Hu, J. S. Okine, and J. E. Carpenter. 1999. Parasitism of diamondback moth (Lepidoptera: Plutellidae) larvae by *Cotesia plutellae* (Hymenoptera: Braconidae) and *Diadegma insulare* (Hymenoptera: Ichneumonidae) in cabbage fields after inundative releases of *C. plutellae*. *Journal of Entomological Science* 34: 101–112.

Milosavljević, I., D. J.W. Morgan, and M. S. Hoddle. 2017. Building a coalition: Biocontrol of ACP by *Tamarixia* and *Diaphorencyrtus* in California. *Citrograph* 8(4): 58–63.

Mishra, M. P., R. Samujh, R. S. Tripathi, and A. D. Pawar. 1981. Effect of natural host on mass-rearing of *Lindorus lophanthae* Blaisd. in the biocontrol of crop pests. *Indian Journal of Entomology* 43(4): 439–441.

Mitic-Muzina, N. and Z. Srdic. 1977. Distribution and natural enemies of *Macrosiphum* (*Sitobium*) *avenae* Fabr. (Homoptera, Aphidoidea) in Yugoslavia. *Zastita Bilja* 28(3): 255–267.

Mizobe, M., T. Kashio, S. Morita, and M. Takagi, M. 2005. Predation rate of *Neoseiulus californicus* (McGregor) on three species of greenhouse thrips. *Kyushu Plant Protection Research* 51: 73–77.

Mohyuddin, A. I., A. G. Khan, and A. A. Goraya. 1989. Population dynamics of cotton whitefly *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) and its natural enemies in Pakistan. *Pakistan Journal of Zoology* 21: 273–288.

Mokrzecki, S. A. 1913. *Hyponomeuta malinellus*, Zell.; its bionomics and methods of fighting it. Simferopol.

Molina, R. M. S., V. Fronza, and J. R. P. Parra. 2005. Biology and thermal requirements for *Trichogramma* spp. selection for *Ecdytolopha aurantiana* control. *Revista Brasileira de Entomologia* 49: 152–158.

Montgomery, M. E. and R. D. McDonald. 2010. Host preferences of *Scymnus* (*Pullus*) *coniferarum*: an adelgid predator, pp. 173–176. *In*: Onken, B. and R. Reardon (eds.). *Fifth Symposium on Hemlock Woolly Adelgid in the Eastern United States, Asheville, NC USDA Forest Service.* FHTET-2008-01. USDA Forest Service, Morgantown, West Virginia, USA.

Montgomery, M. E., H. Wang, D. Yao, W. Lu, N. Havill, and G. Li. 2002. Biology of *Scymnus ningshanensis* (Coleoptera: Coccinellidae): a predator of *Adelges tsugae* (Homoptera: Adelgidae), pp. 181–188. *In*: Onken, B., R. Reardon, and J. Lashomb, J. (eds.). *Proceedings: Hemlock Woolly Adelgid in the Eastern United States Symposium.* Rutgers University, New Jersey, USA.

Montgomery, M., C. S-J. Cheah, and C. Asaro. 2007. Field cage evaluations of the lady beetle *Scymnus sinuanodulus* for biological control of the hemlock woolly adelgid, p. 77. *In*: Gottschalk, K. W. (ed.). *Proceedings, 17th U.S. Department of Agriculture Interagency Research Forum on Gypsy Moth and other Invasive Species, 2006*. U.S. Department of Agriculture, Forest Service, Northern Research Station. General Technical Report NRS-P-10. Newtown Square, Pennsylvania, USA.

Montgomery, M. E., S. Shiyake, N. P. Havill, and R. A. B. Leschen. 2011. A new species of *Laricobius* (Coleoptera: Derodontidae) from Japan with phylogeny and a key for native and introduced congeners in North America. *Annals of the Entomological Society of America* 104: 389–401.

Montgomery, M. E., M. Keena, E. Butin, and J. Elkinton. 2015a. Release and evaluation of *Scymnus ningshanensis*. USDA Forest Service Northern Research Station. https://www.nrs.fs.fed.us/disturbance/invasive_species/hwa/control_management/release_scymnus_ningshanensis/

Montgomery, M. E., M. Keena, W. Berisford, R. McDonald, and C. Cheah. 2015b. Release and evaluation of *Scymnus sinuanodulus*. USDA Forest Service Northern Research Station. https://www.nrs.fs.fed.us/disturbance/invasive_species/hwa/control_management/release_scymnus_sinuanodulus/

Mooneyham, K. L., S. M. Salom, and L. T. Kok. 2016. Release and colonization of *Laricobius osakensis* (Coleoptera: Derodontidae), a predator of the hemlock woolly adelgid, *Adelges tsugae*. *Northeastern Naturalist* 23(1): 141–150.

Moore, K. M. 1963. Observations on some Australian forest insects. 15. Some mortality factors of *Phoracantha semipunctata* (F.) (Coleoptera: Cerambycidae). *Proceedings of the Linnean Society of New South Wales* 88(2): 221–229.

Morales, S. J., C. Vásquez, J. S. Gallardo, F. Gutiérrez, Y. Ríos, and N. L. Pérez. 2004. Biological potential of *Trichogramma atopovirilia* (Hymenoptera: Trichogrammatidae) as parasitoid of the angoumois grain moth. *Bioagro* 16(3): 197–204.

Morgan, D. J. W., S. V. Triapitsyn, R. A. Redak, L. G. Bezark, and M. S. Hoddle. 2000. Biological control of the glassy-winged sharpshooter: current status and future potential, pp.167–171. *In*: Hoddle, M. (ed.). *Proceedings of the California Conference on Biological Control II*. July 11–12, 2000 at the historic Mission Inn, Riverside, California. 205 pp.

Morgan, D. J. W., Simmons, G. S., Higgins, L. M. & K. Shea. 2002. Glassy-winged sharpshooter biological control in California: building framework for

active adaptive management, pp.140–143. *In*: Hoddle, M. (ed.). Proceedings of the 3rd California Conference on Biological Control, held August 15–16, 2002 at the University of California at Davis 162 pp.
Moriya, S., K. Tanaka, K. Yamamura, T. Shimizu, and S. Shiyake, S. 2002. Expansion of the distribution range of the ragweed beetle, *Ophraella communa* LeSage (Coleoptera: Chrysomelidae) and its natural enemies in Japan. *Annual Report of the Kanto-Tosan Plant Protection Society* (49): 131–133.
Morrison, L. W. and L. E. Gilbert. 1999. Host specificity in two additional *Pseudacteon* spp. (Diptera: Phoridae), parasitoids of *Solenopsis* fire ants (Hymenoptera: Formicidae).Florida Entomologist 82: 404–409.
Morrison, L. W. and S. D. Porter. 2006. Post-release host-specificity testing of *Pseudacteon tricuspis*, a phorid parasitoid of *Solenopsis invicta* fire ants. *BioControl* 51: 195–205.
Moroshkina, O. S. 1930. *Toxoptera graminum* B[R.]ond. (Biology, ecology, experiments in control measures.). *Izvestiya po opytnomu delu Dona i severnogo Kavkaza* 3(20): 19–78.
Morsi, G. A. 2010. Population abundance of the African scale insect, *Lecanodiaspis africana* Newst. and its parasitoid, *Scutellista cyanea* Motch. in Upper Egypt. *Egyptian Journal of Biological Pest Control* 20: 131–134.
Moursi, A. A. 1948. Contributions to the knowledge of the natural enemies of mealybugs. 1. Description of two new species of *Anagyrus* (Hymenoptera: Encyrtidae). *Bull. Soc. Fouad I. Ent*. 32:1–7.
Muirhead, K. A., N. P. Murphy, N. Sallam, S. C. Donnellan, and A. D. Austin. 2012. Phylogenetics and genetic diversity of the *Cotesia flavipes* complex of parasitoid wasps (Hymenoptera: Braconidae), biological control agents of lepidopteran stemborers. *Molecular Phylogenetics and Evolution* 63: 904–914.
Munguía, R. A. 2002. Programa de manejo del pulgón café en el sureste de México. In: *Memorias del Curso de Acreditacíon en Virus Tristeza de los Cítricos. SAGARPA, Comité Estatal de Sanidad Vegetal de Yucatán. Agosto de 2002, Mérida, Yucatán, México*.
Muniappan, R. and M. Marutani. 1989. Biology and biological control of the red coconut scale, *Furcaspis oceanica* (Lindinger), pp. 17–18. *In*: Anon. *Tropical and Subtropical Agricultural Research under PL 89–106, Special Research Grants. Progress and Achievements, the Pacific Basin Group, 1989*. University of Hawaii at Manoa, Honolulu, Hawaii.
Muniappan, R., J. Bamba, J. Cruz, and G.V.P. Reddy. 2003. Current status of the red coconut scale, *Furcaspis oceanica* Lindinger (Homoptera: Diaspididae) and its parasitoid, *Adelencyrtus oceanicus* Doutt (Hymenoptera: Encyrtidae), in Guam. *Plant Protection Quarterly* 18(2): 52–54.
Muniappan, R., J. Bamba, J. Cruz, and G.V.P. Reddy. 2004. Biology, rearing and field release on Guam of *Euplectrus maternus*, a parasitoid of the fruit-piercing moth, *Eudocima fullonia*. *BioControl* 49: 537–551.
Muñoz Irles, C., S. Gómez Vives, and M. Ferry. 2008. Field study of the effectiveness of *Rhyzobius lophanthae* Blaisdell in the biological control of the red date scale, *Phoenicoccocus marlatti* by means of inoculative releases. *Boletín de Sanidad Vegetal, Plagas* 34(1): 117–127.
Muraleedharan, N., R. Selvasundaram, and B. Radhakrishnan. 1988. Natural enemies of certain tea pests occurring in southern India. *Insect Science and its Application* 9: 647–654.
Murray, D. A. H. 1982. Pineapple scale (*Diaspis bromeliae* (Kerner)) distribution and seasonal history. *Queensland Journal of Agricultural and Animal Sciences* 39(2): 125–130.
Myartseva, S. N., E. Ruíz-Cancino, J. M. Coronado-Blanco, and A. M. Corona-López. 2012. Aphelinidae (Hymenoptera: Chalcidoidea) en el control biológico de insectos plaga en México. *Recursos Naturales. UAT, Tamaulipas, Cd. Victoria, México,* pp. 253–264.
Nafus, D. 1991. Biological control of *Penicillaria jocosatrix* (Lepidoptera: Noctuidae) on mango on Guam with notes on the biology of its parasitoids. *Environmental Entomology* 20: 1725–1731.
Nafus, D. and I. Schreiner. 1989. Biological control activities in the Mariana Islands from 1911 to 1988. *Micronesica* 22(1): 65–106.
Nagaraja, H. 1978. Studies on *Trichogrammatoidea* (Hymenoptera: Trichogrammatidae). *Oriental Insects* 12(4): 489–529.
Nagarkatti, S. 1980. Trichogrammatid parasites of sugarcane borers in India—distribution and identification, pp. 13–19. Sithanantham, S. and A. R. Solayappan (eds.). *Biological Control of Sugarcane Pests in India*. Tamil Nadu State Federation of Cooperative Sugar Factories Ltd., Madras, India.
Nagarkatti, S., E. R. Oatman, and G. R. Platner. 1975 Two new species of *Trichogramma* (Hym.: Trichogrammatidae) from the USA. *Entomophaga* 20: 245–248.
Nakamura, H. and S. Shiratori. 2010. The progress of invasion of insect pest, the Mexican been beetle, *Epilachna varivestis* in Nagano Prefecture. *Journal of the Faculty of Agriculture, Shinshu University* 46(1/2): 105–111.
Nakamura, K. and T. Ohgushi. 1981. Studies on the population dynamics of a thistle-feeding lady beetle, *Henosepilachna pustulosa* (Kono) in a cool temperate climax forest. II. Life tables, key-factor analysis, and detection of regulatory mechanisms. *Researches on Population Ecology* 23: 210–231.
Nakamura, K., I. Abbas, and A. Hasyim. 1988. Population dynamics of the phytophagous lady beetle, *Epilachna vigintioctopunctata* in an eggplant field in Sumatra. *Researches on Population Ecology* 30: 25–41.
Nakahara, L. M. and G.Y. Funasaki. 1987. Release of *Psyllaephagus* sp. nr. *rotundiformis* (Howard) (Hymenoptera: Encyrtidae) for the biological control *Heteropsylla cubana* Crawford (Homoptera: Psyllidae) and other *Heteropsylla* species in Hawaii. *Leucaena Research Reports* 8: 11–13.
Nakayama, S. 1921. An enumeration of the Japanese Aphelininae, with descriptions of two new species. *Philippine Journal of Science* 18: 97–101.
Naranjo, S. E., R. L. Gibson, and D. D. Walgenbach. 1990. Development, survival, and reproduction of *Scymnus frontalis* (Coleoptera: Coccinellidae), an imported predator of Russian wheat aphid, at four fluctuating temperatures. *Annals of the Entomological Society of America* 83: 527–532.
Naranjo, S. E., G. Gordh and M. Moratorio. 1992. Inundative release of *Trichogrammatoidea bactrae* for biological control of pink bollworm. In Cotton, a College of Agriculture Report, Univ. Arizona, Tucson, Series P-91.
Naranjo, S. E., T. J. Henneberry, and C. G. Jacoson. 1995. Pink bollworm, pp. 199–202. *In* Nechols, J. R., L. A. Andres, J. W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). *Biological Control in the Western United States, Accomplishments and Benefits of Regional Project W-84, 1964–1989*. Publication 3361 of the University of California, Division of Agriculture and Natural Resources, Oakland, California, US.
Natarajan, K. 1990. Natural enemies of *Bemisia tabaci* Gennadius and effect of insecticides on their activity. *Journal of Biological Control* 4(2): 86–88.
Nath, D. K. and I. S. Hikim. 1978. Braconid parasites of rice yellow borer *Tryporyza incertulas* in West Bengal, India. *International Rice Research Newsletter* 3(5).
Naumann, I. D. 1991. Revision of the Australian genus *Enoggera* Girault (Hymenoptera: Pteromalidae: Asaphinae). *Journal of the Australian Entomological Society* 30: 1–17.
Nava, D. E., K. M. Takahashi, and J. R. P. Parra. 2007. *Trichogramma* and *Trichogrammatoidea* strains to control *Stenoma catenifer. Pesquisa Agropecuária Brasileira* 42: 9–16.
Navone, P. and C. Vidano. 1983. Studies on hymenopterous parasites of *Stigmella malella* (Stainton) in Piedmont, pp. 213–220. *In*: *Atti XIII Congresso Nazionale Italiano di Entomologia. Turin: Istituto di Entomologia Agraria e Apicoltura, Università di Torino*.

Nawanich, S., S. Fudsiri, and W. Chongrattanameteekul. 2013. Predatory efficiency study of *Curinus coeruleus* Mulsant on *Rhopalosiphum maidis* (Fitch) and *Phenacoccus manihoti* Matile-Ferrero. *Proceedings of the 51st Kasetsart University Annual Conference, Bangkok, Thailand, 5–7 February 2013.* P125. Kasetsart University, Bangkok, Thailand.

Neale, C., D. Smith, G.A.C. Beattie, and M. Miles. 1995. Importation, host specificity testing, rearing and release of three parasitoids of *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) in eastern Australia. *Journal of the Australian Entomological Society* 34: 343–348.

Nealis, V.G. and F.W. Quednau. 1996. Canadian field releases and overwinter survival of *Ceranthia samarensis* (Villeneuve) (Diptera: Tachinidae) for biological control of the gypsy moth, *Lymantria dispar* (L.) (Lepidoptera: Lymantriidae). *Proceedings of the Entomological Society of Ontario* 127: 11–20.

Nealis, V. G., N. Carter, M. Kenis, F. W. Quednau, and K. van Frankenhuyzen. 2002. *Lymantria dispar* (L.), gypsy moth (Lepidoptera: Lymantriidae), pp. 159–168. *In*: Mason, P. G. and J. T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, UK.

Nebreda, M., J. M. Michelena, J., and A. Fereres. 2005. Seasonal abundance of aphid species on lettuce crops in Central Spain and identification of their main parasitoids. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* 112: 405–415.

Nechols, J. R., L. A. Andres, J. W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). 1995. *Biological Control in the Western United States, Accomplishments and Benefits of Regional Project W-84, 1964–1989*. Publication 3361 of the University of California, Division of Agriculture and Natural Resources, Oakland, California, USA.

Nelson, J. and M. J. Parrella. 1992. Potential interference among natural enemies of *Bemisia tabaci. Bulletin OILB/SROP* 16(2): 121–124.

Nemec, V. and P. Starý. 1984. Population diversity of *Diaeretiella rapae* (M'Int.) (Hym., Aphidiidae), an aphid parasitoid in agroecosystems. *Zeitschrift für Angewandte Entomologie* 97: 223–233.

Nenon, J. P. 1976. Variations in the rate of polyembryony of the parasitoid *Ageniaspis fuscicollis* Dalm. (Hymenoptera, Encyrtidae) according to the temperature at which its hosts develop. *Annales de Zoologie, Ecologie Animale* 8: 161–175.

Neumann, G., P. A. Follett, R. G. Hollingsworth, and J. H. de León. 2010. High host specificity in *Encarsia diaspidicola* (Hymenoptera: Aphelinidae), a biological control candidate against the white peach scale in Hawaii. *Biological Control* 54: 107–113.

Newton, H. C. F. 1934. Insect pests at Rothamsted and Woburn, 1932–3, pp. 51–53. *Report of the Rothamsted Experiment Station, 1933*. Harpenden, United Kingdom.

Ng, S. M. and P. Starý. 1986. Records on aphid parasitoids from Malaysia (Hymenoptera, Aphidiidae). *Acta Entomologica Bohemoslovaca* 83 (2): 101–104.

Nguyen, R. and F. D. Bennett. 1995. Importation and field release of parasites against silverleaf whitefly, *Bemisia argentifolii* (Bellows and Perring) in Florida from 1990–1994. *Proceedings of the Florida State Horticultural Society* 108: 43–47.

Nguyen, R. and A. Hamon. 1985. Cloudy-winged whitefly, *Dialeurodes citrifolii* (Morgan) (Homoptera: Aleyrodidae: Aleyrodinae). *Entomology Circular, Division of Plant Industry, Florida Department of Agriculture and Consumer Services* No. 275, 2 pp.

Nicoli, E. M., D. Pratissoli, E. F. dos Reis, and H. S. Santos. 2004. Viability and sex ratio of *Trichogramma atopovirilia* Oatman & Platner, 1983 (Hymenoptera, Trichogrammatidae) under influence of the host *Anagasta kuehniella* (Zeller, 1879) (Lepidoptera, Pyralidae) on laboratory. *Entomología y Vectores* 11(3): 521–533.

Nimmo, K. R. and P. W. Tipping. 2009. An introduced insect biological control agent preys on an introduced weed biological control agent. *Florida Entomologist* 92: 179–180.

Niranjana, R. F., H. N. P. Wijeyagunesekara, and S. Raveendranath. 2005. Parasitoids of *Liriomyza sativae* in farmer fields in the Batticaloa District. *Tropical Agricultural Research* 17: 214–22.

Nixon, G. E. J. 1937. Some Asiatic Telenominae (Hym., Proetotrupoidea). *Annual Magazine of Natural History* 20: 444–475.

Niyazov, O. D. 1969. The parasites and predators of grape mealybug. *Zashchita Rastenii* 14(11): 38–40.

Nohara, K. 1962. Studies on the biology of *Unaspis yanonenis* (Kuwana) (Homoptera: Diaspidae). *Science Bulletin of the Faculty of Agriculture, Kyushu University* 20: 13–27.

Noma, T., M. J. Brewer, K. S. Pike, and S. D. Gaimari. 2005. Hymenopteran parasitoids and dipteran predators of *Diuraphis noxia* in the west-central Great Plains of North America: species records and geographic range. *BioControl* 50: 97–111.

Noyes, J. S. 1990. A new encyrtid (Hymenoptera) parasitoid of the leucaena psyllid (Homoptera: Psyllidae) from Mexico, Central America and the Caribbean. *Bulletin of Entomological Research* 80: 37–41.

Noyes J. S. 2017. Universal Chalcidoidea Database. World Wide Web electronic publication. Available from: http://www.nhm.ac.uk/chalcidoids

Noyes, J. S. and M. E. Schauff. 2003. New Encyrtidae (Hymenoptera) from papaya mealybug (*Paracoccus marginatus* Williams and Granara De Willink) (Hemiptera: Sternorrhyncha: Pseudococcidae). *Proceedings of the Entomological Society of Washington* 105: 180–185.

Oatman, E. R. and G. R. Platner. 1971. Parasitization of natural enemies attacking the cabbage aphid on cabbage in southern California. *Environmental Entomology* 2: 365–367.

Oatman, E. R., J. A. McMurtry, F. E. Gilstrap, and V. Voth, V. 1977. Effect of releases of *Amblyseius californicus*, *Phytoseiulus persimilis*, and *Typhlodromus occidentalis* on the twospotted spider mite on strawberry in southern California. *Journal of Economic Entomology* 70: 45–47.

Oatman, E. R., J. A. McMurtry, M. Waggonner, G. A. Platner, and H. G. Johnson. 1983. Parasitization of *Amorbia cuneana* (Lepidoptera: Tortricidae) and *Sabulodes aegrotata* (Lepidoptera: Geometridae) on avocado in southern California. *Journal of Economic Entomology* 76: 52–53.

Ohgushi, T. and H. Sawada. 1998. What changed the demography of an introduced population of an herbivorous lady beetle? *Journal of Animal Ecology* 67: 679–688.

Okamoto, H. and M. Sato. 1973. The influence of different aphids as food upon the ecological and morphological characters of the lady beetles *Harmonia axyridis* Pallas and *Coccinella septempunctata bruckii* Mulsant (Coleoptera: Coccinellidae). (Laboratory studies on food ecology of aphidophagous Coccinellids 1). *Kontyu* 41(3): 342–358.

Olfert, O. O., J. F. Doane, K. Carl, M. A. Erlandson, and M. S. Goettel. 2001. *Diuraphis noxia* (Kurdjumov), Russian wheat aphid (Homoptera: Aphididae), pp. 110–114. *In*: Mason, P.G., and J.T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, UK.

Olfert, O., J. F. Doane, and M. P. Braun. 2003. Establishment of *Platygaster tuberosula*, an introduced parasitoid of the wheat midge, *Sitodiplosis mosellana*. *The Canadian Entomologist* 135: 303–308.

Oliveira, N. C. de, C. F. Wilcken, and C. A. O. de Matos. 2004. Biological cycle and predation of three coccinellid species (Coleoptera, Coccinellidae) on giant conifer aphid *Cinara atlantica* (Wilson) (Hemiptera, Aphididae). *Revista Brasileira de Entomologia* 48: 529–533.

Oloo, G. W. 1992. Life tables and intrinsic rate of natural increase of *Pediobius furvus* (Hym.: Eulophidae) on *Chilo partellus* (Lep.: Pyralidae). *Entomophaga* 37: 29–35.

Omata, R. 2008. Spider mite predation and occurrence of Asian lady beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), in a tea field. *Annual Report of the Kanto-Tosan Plant Protection Society* 55: 145–150.

Onillon, J. C., A. Panis, and M. El-Ouartassi. 2004. On three parasitoids of whiteflies in North Morocco (Hem., Aleyrodidae). *Bulletin de la Société Entomologique de France* 109: 378.

Ooi, A. C., P. 1974. A padi stem-borer survey in the Muda scheme, Kedah. *Malaysian Agricultural Journal* 49(4): 5.

O'Reilly, A. and R.G. Van Driesche. 2009. Status of *Coccobius* nr. *fulvus* (Hymenoptera: Aphelinidae), a parasitoid of Euonymus scale (Hemiptera: Diaspididae), 12–16 years after its release in Massachusetts. *Florida Entomologist* 92: 645–647.

Osborn, H. T. 1938. Introduction into the Hawaiian Islands of Mexican enemies of the avocado mealybug. *Hawaiian Planters' Record* 42(2): 153–158.

Overholt, W. A. and J. W. Smith, Jr. 1989. *Pediobius furvus* parasitization of overwintering generation southwestern corn borer pupae. *Southwestern Entomologist* 14: 35–40.

Overholt, W. A. and J. W. Smith, Jr. 1990. Colonization of six exotic parasites (Hymenoptera) against *Diatraea grandiosella* (Lepidoptera: Pyralidae) in corn. *Environmental Entomology* 19: 1889–1902.

Overholt, W. A., A. J. Ngi-Song, S. K. Kimani, J. Mbapila, P. Lammers, and E. Kioko. 1994. Ecological considerations of the introduction of *Cotesia flavipes* Cameron (Hymenoptera: Braconidae) for biological control of *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) in Africa. *Biocontrol News and Information* 15(2): 19N–24N.

Özsemerci, F. and T. Aksit. 2003. Investigations on some biological characteristics and population fluctuation of *Ceroplastes rusci* L. (Homoptera: Coccidae) harmful to fig trees in Aydn province. *Türkiye Entomoloji Dergisi* 27(1): 13–25.

Öztürk, N., G. Kacar, and M. R. Ulusoy. 2015. A new pest of walnut orchards of Turkey, walnut leaf miner [*Caloptilia roscipennella* (Hübner) (Lepidoptera: Gracillariidae)]. *Bitki Koruma Bülteni* 55(1): 41–52.

Paddook, F. B. 1916. Observations on the turnip louse. *Journal of Economic Entomology* 9: 67–71.

Paine, T. D. and J. G. Millar. 2002. Insect pests of eucalypts in California: implications for managing invasive species. *Bulletin of Entomological Research* 92: 147–151.

Paine, T.D. and J.G. Millar. 2003. Biological control of introduced pests of eucalyptus in California, pp. 66–71. *In*: Van Driesche, R.G. (ed.). *Proceedings of the First International Symposium on Biological Control of Arthropods, January 14–18, 2002. Honolulu, Hawaii, USA*. FHTET-03-05. USDA Forest Service, Morgantown, West Virginia, USA. http://www.fs.fed.us/foresthealth/technology/webpubs/FHTET-2003-05/day1/paine.pdf

Paine, T. D., J. G. Millar, T. S. Bellows, L. M. Hanks, and J. R. Gould. 1993. Integrating classical biological control with plant health in the urban forest. *Journal of Arboriculture* 19: 125–130.

Paine, T. D., J. G. Millar, and L.M. Hanks. 1995. Integrated program protects trees from eucalyptus longhorned borer. *California Agriculture* 49(1): 34–37.

Paine, T. D., J. G. Millar, L. M. Hanks, J. Gould, Q. Wang, K. Daane, D. L. Dahlsten, and E. G. McPherson. 2015. Cost–benefit analysis for biological control programs that targeted insect pests of eucalypts in urban landscapes of California. *Journal of Economic Entomology* 108: 2497–2504. DOI: 10.1093/jee/tov224

Palm, T. 1948. An attack by *Dendroctonus micans* on pine. / Ett angrepp av *Dendroctonus micans* Kugel pà tall (Col. Scolytldae). *Entomologisk Tidskrift* 69(4): 212–214.

Pang, X. F. and T. L. Chen. 1974. *Trichogramma* of China (Hymenoptera: Trichogrammatidae). *Acta Entomologica Sinica* 17: 441–454.

Panis, A., J. M. Carrero, and F. Limon. 1977. Biological note on the entomofauna of citrus trees in Spain. *Anales del Instituto Nacional de Investigaciones Agrarias. Serie: Proteccion Vegetal* 7: 139–143.

Panizzi, A. R. and F. Slansky, Jr. 1985. Review of phytophagous pentatomids (Hemiptera: Pentatomidae) associated with soybean in the Americas. *Florida Entomologist* 68: 184–214.

Pantoja, A., M. A. Ciomperlik, L. Wiscovitch, N. Gabriel, P. Vázquez, and W. Robles. 2005. Establishment and distribution of exotic biological control agents for silverleaf whitefly in Puerto Rico. *Journal of Agriculture of the University of Puerto Rico* 89(1/2): 67–73.

Park, J. D. and K. C. Kim. 1990.Host range, life cycle and natural enemies of mulberry scale (*Pseudaulacaspis pentagona*) on *Prunus mume* in southern Korea. *Korean Journal of Applied Entomology* 29(2): 104–112.

Parkman, J. P., J. H. Frank, T. J. Walker, and D. J. Schuster. 1996. Classical biological control of *Scapteriscus* spp. (Orthoptera: Gryllotalpidae) in Florida. *Environmental Entomology* 25: 1415–1420.

Paulraj, M. G. and S. Ignacimuthu. 2007. Occurrence of hyperparasitism on *Cotesia* sp. (Hymenoptera: Braconidae), an effective parasitoid of *Pericallia ricini* (Lepidoptera: Arctiidae). *Entomon* 32: 231–234.

Peña J. E., D. G. Hall, R. Nguyen, C. W. McCoy, D. Amalin, P. Stansly, R. Adair, S. Lapointe, R. Duncan, and A. Hoyte. 2004. Recovery of parasitoids (Hymenoptera: Eulophidae and Trichogrammatidae) released for biological control of *Diaprepes abbreviatus* (Coleoptera: Curculionidae) in Florida. *Proceedings of the International Citrus Congress* 3: 879–884.

Peña, J. E., J. A. Jacas, B. Ulmer, S. Trypazin and R. E. Duncan. 2010. Biological control with egg parasitoids other than *Trichogramma*—the citrus and grape cases, pp. 341–371. *In*: Consoli, L.F., J.R.P. Parra, and R.A. Zucchi (eds.). *Egg Parasitoids in Agroecosystems with Emphasis on Trichogramma.* Springer, London.

Perera, M. C. D., K. S. Hemachandra, and U. G. A. I. Sirisena. 2015. *Trichogrammatoidea bactrae* Nagaraja (Hymenoptera: Trichogrammatidae): a potential biocontrol agent of rice leaf folder. *Tropical Agricultural Research* 26(3): 537–546.

Pérez-Lachaud, G. and I. C. W. Hardy. 2001. Alternative hosts for bethylid parasitoids of the coffee berry borer, *Hypothenemus hampei* (Coleoptera: Scolytidae). *Biological Control* 22: 265–277.

Pernek, M., I. Lukic´, N. Lackovic´, E. Cota, and H.P. Tschorsnig. 2015. Tachinid (Diptera: Tachinidae) parasitoids of spotted ash looper (*Abraxas pantaria*) in Krka National Park in Croatia. *Periodicum Biologorum* 117(4): 533–535.

Persad, A. B. and M. A. Hoy. 2003. Intra- and interspecific interactions between *Lysiphlebus testaceipes* and *Lipolexis scutellaris* (Hymenoptera: Aphidiidae) reared on *Toxoptera citricidus* (Homoptera: Aphididae). *Journal of Economic Entomology* 96: 564–569.

Persad, A. B., M. A. Hoy, and R. Nguyen. 2007. Establishment of *Lipolexis oregmae* (Hymenoptera: Aphidiidae) in a classical biological control program directed against the brown citrus aphid (Homoptera: Aphididae) in Florida. 2007. *Florida Entomologist* 90: 204–213.

Peter, C. and R. Balasubramanian. 1984. New report of parasites on mango fleaweevil, *Rhynchaenus mangiferae* (Coleoptera: Curculionidae). *Entomon* 9(1): 73.

Petersen, J. J. and D. M. Currey. 1996. Timing of releases of gregarious *Muscidifurax raptorellus* (Hymenoptera: Pteromalidae) to control flies associated with confined beef cattle. *Journal of Agricultural Entomology* 13(1): 55–63.

Peterson, G. D., Jr. 1955. Biological control of *Epilachna philippinensis* Dieke in Guam. *Journal of Economic Entomology* 48: 758–759.
Pfannenstiel, R. S., H. W. Browning, and J. W. Smith, Jr. 1992. Searching behavior of *Pediobius furvus* (Hymenoptera: Eulophidae) for *Eoreuma loftini* (Lepidoptera: Pyralidae) in sugarcane. *Journal of Economic Entomology* 85: 384–388.
Pickett, C. H., J. C. Ball, K. C. Casanave, K. M. Klonsky, K. M. Jetter, L. G. Bezark, and S. E. Schoenig. 1996. Establishment of the ash whitefly parasitoid *Encarsia inaron* (Walker) and its economic benefit to ornamental street trees in California. *Biological Control* 6: 260–272.
Pickett, C.H., R. Rodriguez, J. Brown, D. Coutinot, K.A. Hoelmer, U. Kuhlmann, H. Goulet, M.D. Schwartz, and P.B. Goodell. 2007. Establishment of *Peristenus digoneutis* and *P. relictus* (Hymenoptera: Braconidae) in California for the control of *Lygus* spp. (Heteroptera: Miridae). *Biocontrol Science and Technology* 17: 261–272.
Pickett, C. H., D. Keaveny, and M. Rose. 2013a. Spread and non-target effects of *Eretmocerus mundus* imported into California for control of *Bemisia tabaci*: 2002–2011. *Biological Control* 65: 6–13.
Pickett, C. H., D. J. Nieto, J. A. Bryer, S. L. Swezey, M. Stadtherr, D. Wisheropp, M. Erlandson, and M. Pitcairn. 2013b. Post–release dispersal of the introduced lygus bug parasitoid *Peristenus relictus* in California. *Biocontrol Science and Technology* 23: 861–871.
Pike, K. S., P. Starý, T. Miller, D. Allison, L. Boydston, G. Graf, and R. Gillespie. 1997. Small-grain aphid parasitoids (Hymenoptera: Aphelinidae and Aphidiidae) of Washington: distribution, relative abundance, seasonal occurrence, and key to known North American species. *Environmental Entomology* 26: 1299–1311.
Pike, K. S., P. Starý, T. Miller, D. Allison, G. Graf, L. Boydston, R. Miller, and R. Gillespie. 1999. Host range and habitats of the aphid parasitoid *Diaeretiella rapae* (Hymenoptera: Aphidiidae) in Washington State. *Environmental Entomology* 28: 61–71.
Pilkington, L. J., N. A. Irvin, E. A. Boyd, M. S. Hoddle, S. V. Triapitsyn, B. G. Carey, W. A. Jones & D. J. W. Morgan. 2005. Introduced parasitic wasps could control glassy-winged sharpshooter. *California Agriculture* 59(4): 223–228.
Pimentel, D. 1961. Natural control of aphid populations on cole crops. *Journal of Economic Entomology* 51: 885–888.
Pinto, J. D. 2005. Descriptions of additional new world Trichogrammatidae (Hymenoptera): the genus *Nicolavespa* and a new species of *Haeckeliania*. *Proceedings of the Entomological Society of Washington* 107(3): 627–664.
Plowes, R. M., P. J. Folgarait, and L. E. Gilbert. 2012. The introduction of the fire ant parasitoid *Pseudacteon nocens* in North America: challenges when establishing small populations. *BioControl* 57: 503–514.
Plugaru, S. G. 1971. On the biology of the oak flea-beetle in Moldavia. *Vrednaya i Poleznaya Fauna Bespozvonochnykh Moldavii* [no volume]: 56–64, 224. (abstract in *Review of Applied Entomology* for 1971 59A 11, No. 3563).
Polaszek, A. and A. K. Walker. 1991. The *Cotesia flavipes* species-complex: parasitoids of cereal stem borers in the tropics. *Redia* 74: 335–341.
Polaszek, A., G. A. Evans, and F. D. Bennett. 1992. *Encarsia* parasitoids of *Bemisia tabaci* (Hymenoptera: Aphelinidae, Homoptera: Aleyrodidae): a preliminary guide to identification. *Bulletin of Entomological Research* 82: 375–392.
Pomerinke, M. A. and P. A. Stansly. 1998. Establishment of *Ageniaspis citricola* (Hymenoptera: Encyrtidae) for biological control of *Phyllocnistis citrella* (Lepidoptera: Gracillariidae) in Florida. *Florida Entomologist* 81: 361–372.
Poinar, Jr., G. O. 1964. Studies on nutgrass insects in southern California and their effectiveness as biological control agents. *Journal of Economic Entomology* 57: 379–383.
Pomari, A. F., A. F. Bueno, R. C. O. F. Bueno, and A. O. Menezes Júnior. 2013. *Telenomus remus* Nixon egg parasitization of three species of *Spodoptera* under different temperatures. *Neotropical Entomology* 42: 399–406.
Porter, S.D. 1998. Host-specific attraction of *Pseudacteon* flies (Diptera: Phoridae) to fire ant colonies in Brazil. *Florida Entomologist* 81: 423–429.
Porter, S. D. 2000. Host specificity and risk assessment of releasing the decapitating fly *Pseudacteon curvatus* as a classical biocontrol agent for imported fire ants. *Biological Control* 19: 35–47.
Porter, S. D. 2010. Distribution of the Formosa strain of the fire ant decapitating fly *Pseudacteon curvatus* (Diptera: Phoridae) three and a half years after releases in North Florida. *Florida Entomologist* 93: 107–112.
Porter, S. D. and L. A. Calcaterra. 2013. Dispersal and competitive impacts of a third fire ant decapitating fly (*Pseudacteon obtusus*) established in North Central Florida. *Biological Control* 64: 66–74.
Porter, S. D. and L. E. Alonso. 1999. Host specificity of fire ant decapitating flies (Diptera: Phoridae) in laboratory oviposition tests. *Journal of Economic Entomology* 92: 110–114.
Porter, S. D., H. G. Fowler, S. Campiolo, and M. A. Pesquero. 1995. Host specificity of several *Pseudacteon* (Diptera: Phoridae) parasites of fire ants (Hymenoptera: Formicidae) in South America. *Florida Entomologist* 78: 70–75.
Porter, S. D., L. A. Nogueira de Sá, K. Flanders, and L. Thompson. 1999. Field releases of the decapitating fly *Pseudacteon tricuspis*. 1999 Imported Fire Ant Conference, Charleston, South Carolina, p. 10–12.
Porter, S. D., L. C. Graham, S. J. Johnson, L. G. Thead, and J. A. Briano. 2011. The large decapitating fly *Pseudacteon litoralis* (Diptera: Phoridae): Successfully established on fire ant populations in Alabama. *Florida Entomologist* 94: 208–213.
Porter, S. D., V. Kumar, L. A. Calcaterra, J. A. Briano, and D. R. Seal. 2013. Release and establishment of the little decapitating fly *Pseudacteon cultellatus* on imported fire ants in Florida. *Florida Entomologist* 96: 1567–1573.
Pralavorio, R., Y. Arambourg, and D. Codou. 1977. Conditions of production and storage of *Ageniaspis fuscicollis* var. *praysincola*, for use in biological control. *Entomophaga* 22: 151–161.
Pratissoli, D., R. A. Polanczyk, A. M. Holtz, L. P. Dalvi, A. F. Silva, and L. N. Silva. 2008. Selection of *Trichogramma* species for controlling the diamondback moth. *Horticultura Brasileira* 26(2): 194–196.
Priesner, H. and M. Hosny. 1932. Contributions to a knowledge of the white Flies (Aleurodidae) of Egypt (I). *Bulletin of the Ministry of Agriculture, Egypt* 121: 1–8.
Prinsloo, G. L. 1980. Annotated records of economically important Chalcidoidea (Hymenoptera) from South Africa. I. *Phytophylactica* 12: 159–163.
Priore, R. 1969. *Dialeurodes citri* (Ashmead) (Homoptera Aleyrodidae) in Campania. (Notes on morphology and biology). *Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' Portici* 27: 287–316.
Prokrym, D. A. 1998. Biological control of *Diuraphis noxia* (Homoptera: Aphididae): implementation and evaluation of natural enemies, pp. 183–208. In: Quissenbery, S. S. and F. B. Peairs (eds.). *A Response Model for an Introduced Pest—The Russian Wheat Aphid. Thomas Say Publications in Entomology: Proceedings. Entomological Society of America*, Lanham, Maryland, USA.
Puttler, B., F. D. Parker, R. E. Pinnell, and S. E. Thewke. 1970. Introduction of *Apanteles rubecula* into the United States as a parasite of the imported cabbage worm. *Journal of Economic Entomology* 63: 304–305.
Quashie-Williams, C. A. 1991. Introduction of *Allorhogas pyralophagus* Marsh (Hym.: Brac.) for the biological control of the yellow headed borer,

Diatraea centrella (Lep.: Pyral.) in Guyana. Proceedings of the 24th West Indies Sugar Technologists' Conference, Kingston, 8–12 April 1991. Bridgetown: Sugar Association of the Caribbean,1991, pp. 80–87.

Qureshi, J. A., M. E. Rogers, D. G. Hall, and P. A. Stansly. 2009. Incidence of invasive *Diaphorina citri* (Hemiptera: Psyllidae) and its introduced parasitoid *Tamarixia radiata* (Hymenoptera: Eulophidae) in Florida citrus. *Journal of Economic Entomology* 102: 247–256.

Rafael Trejo, A., H. Paz, H., and R.Muñoz. 2000. Advances in the biological control of the coffee berry borer *Hypothemus hampei* Ferr. using the parasitoid *Phymastichus coffea*, pp. 321–329. In: Anon. XIX *Simposio Latinoamericano de caficultura. Memoria, San José, Costa Rica, 2–6 Octubre 2000.* Instituto del Café de Costa Rica, ICAFE, San José, Costa Rica.

Rahman, M. 1970. Effect of parasitism on food consumption of *Pieris rapae* larvae. *Journal of Economic Entomology* 63: 820–821.

Rajabalee, A. and N. Banymadhub. 1986. Rearing and attempt at introduction of *Allorhogas pyralophagus* Marsh, a braconid ectoparasite of *Chilo sacchariphagus* Boj., the spotted borer of sugarcane in Mauritius, with some notes on its biology. *Revue Agricole et Sucrière de l'Île Maurice* 65(2–3): 67–72.

Rajapakse, R. H. S. and V. L. Kulasekare. 1982. Larval parasites of rice leaffolder in southern Sri Lanka. *International Rice Research Newsletter* 7(1): 11.

Rajeshwari, S. K. and M. J. Chacko. 1992. Parasitoids of the mango shoot caterpillar *Penicillaria jacosatrix* Guenée (Lepidoptera: Noctuidae) in southern India. *Entomon* 17(1,2): 41–47.

Rakhshani, E., Z. Tomanovic´, P. Starý, A. A. Talebi, N. G. Kavallieratos, A. A. Zamani, and S. Stamenkovic´. 2008. Distribution and diversity of wheat aphid parasitoids (Hymenoptera: Braconidae: Aphidiinae) in Iran. *European Journal of Entomology* 105: 863–870.

Ramírez, L. A., M. Ramos, M. R. Chico, and H. Rodriguez. 1988. *Amblyseius californicus* (Acari: Phytoseiidae): new report for Cuba. *Revista de Protección Vegetal* 3(1): 53–57.

Rao, K. J., T. S. Thontadarya, and K. Rangadhamaiah. 1980. New record of *Trichogrammatoidea bactrae* Nagaraja (Hym.: Trichogrammatidae) as an egg parasite of the castor semilooper *Achaea janata* (Lep.: Noctuidae). *Current Science* 49(20): 800.

Rao, A., S. B. Vinson, F. E. Gilstrap, and G. J. Michels, Jr. 1999. Response of an aphid parasitoid, *Aphelinus asychis* to its host, plant, host-plant complex, and to malathion. *Entomologia Experimentalis et Applicata* 91: 449–456.

Reddy, G. V. P. and J. R. Bautista. 2012. Integration of the predatory mite *Neoseiulus californicus* with petroleum spray oil treatments for control of *Tetranychus marianae* on eggplant. *Biocontrol Science and Technology* 22: 1211–1220.

Reed, D. K., J. A. Webster, B. G. Jones, and J. D. Burd. 1991. Tritrophic relationships of Russian wheat aphid (Homoptera: Aphididae), a hymenopterous parasitoid (*Diaeretiella rapae* McIntosh), and resistant and susceptible small grains. *Biological Control* 1: 35–41.

Ren, L., Y-Z. Yang, X. Li, L. Miao, Y-S. Yu, and Q-L. Qin. Impact of transgenic Cry1A plus CpTI cotton on *Helicoverpa armigera* (Lepidoptera: Noctuidae) and its two endoparasitoid wasps *Microplitis mediator* (Hymenoptera: Braconidae) and *Campoletis chlorideae* (Hymenoptera: Ichneumonidae). *Acta Entomologica Sinica* 47: 1–7.

Resende, D. L. M. C. and A. I. Ciociola. 1996. Parasitoid capacity of *Trichogramma atopovirilia* Oatman & Platner, 1983 (Hymenoptera: Trichogrammatidae) reared on *Helicoverpa zea* eggs (Boddie, 1850) (Lepidoptera: Noctuidae) under different temperatures. *Ciência e Agrotecnologia* 20(4): 421–424.

Resende, A. L. S., E. E. Silva, V. B. Silva, R. L. D. Ribeiro, J. G. M. Guerra, and E. L. Aguiar-Menezes. 2006. First record of *Lipaphis pseudobrassicae* Davis (Hemiptera: Aphididae) and its association with predator insects, parasitoids and ants in kale (Cruciferae) in Brazil. *Neotropical Entomology* 35: 551–555.

Reshchikov, A. V., A. Soper, and R. G Van Driesche. 2010. Review and key to Nearctic *Lathrolestes* Foerster (Hymenoptera: Ichneumonidae), with special reference to species attacking leaf mining tenthredinid sawflies in *Betula* Linnaeus (Betulaceae). *Zootaxa* 2614: 1–17.

Reviriego, M. E., L. R. Descamps, and A. A. Ferrero. 2006. Population fluctuation of *Diuraphis noxia* and its natural enemies in wheat crops at in the area of Bahía Blanca, Argentina. *Agricultura Técnica* 66(4): 425–434.

Reyne, A. 1948. Studies on a serious outbreak of *Aspidiotus destructor rigidus* in the Coconut-palms of Sangi (North Celebes). *Tijdschrift voor Entomologie* 89: 83–123.

Rhainds, M. and R. H. Messing. 2005. Spatial and temporal density dependence in a population of melon aphid, *Aphis gossypii* Glover (Homoptera: Aphididae), on established and sentinel taro plants. *Applied Entomology and Zoology* 40: 273–282.

Ribeiro, A. and E. Castiglioni. 2008. Characterization of populations of natural enemies of *Piezodorus guildinii* (Westwood) (Hemiptera: Pentatomidae). *Agrociencia* (*Montevideo*) 12(2): 48–56.

Rizzo, M. C., V. lo Verde, and V. Caleca. 2006. Role of spontaneous plants as a reservoir of alternative hosts for *Semielacher petiolatus* (Girault) and *Citrostichus phyllocnistoides* (Narayanan) (Hymenoptera, Eulophidae) in citrus groves. *Bulletin OILB/SROP* 29(6): 109–112.

Roberto Trincado, C. 2007. Biological control of mites of agricultural importance, using spring release of predators *Neoseiulus californicus* (McGregor) (Anactinotrichida: Phytoseiidae). *Revista Frutícola* 28(1): 5–14.

Rodríguez-del-Bosque, L. A. and J. W. Smith, Jr. 1990. Parasitization of *Diatraea lineolata* pupae and diapausing larvae by several exotic parasites. *Florida Entomologist* 73: 703–705.

Rodríguez-del-Bosque, L.A. and J.W. Smith, Jr. 1997. Biological control of maize and sugarcane stemborers in Mexico: A review. *Insect Science and Application* 17: 305–314.

Rodríguez-del-Bosque, L. A., J. W. Smith, Jr., and R. S. Pfannenstiel. 1989. Parasitization of *Diatraea grandiosella* eggs by trichogrammatids on corn in Jalisco, Mexico. *Southwestern Entomologist* 14: 179–180.

Rodríguez-Reina, J. M., F. García-Marí, and F. Ferragut. 1992. Predatory activity of phytoseiid mites on different developmental stages of the western flower thrips, *Frankliniella occidentalis*. *Boletín de Sanidad Vegetal, Plagas* 18(1): 253–263.

Röhl, L. J. and W. Woods. 1994. Biological and insecticidal control of *Arotrophora arcuatalis* (Walker) (Lepidoptera: Tortricidae): an important pest of banksias in Western Australia. *Plant Protection Quarterly* 9(1): 20–23.

Rohrig, E. A., D. G. Hall, J. A. Qureshi, and P. A. Stansly. 2012. Field release in Florida of *Diaphorencyrtus aligarhensis* (Hymenoptera: Encyrtidae), an endoparasitoid of *Diaphorina citri* (Homoptera: Psyllidae), from Mainland China. *Florida Entomologist* 95: 479–481.

Roltsch, W. J. 2000. Establishment of silverleaf whitefly parasitoids in Imperial Valley, 176–179. *In*: Hoddle, M.S. (ed.). *California Conference on Biological Control II, Riverside, California, USA, 11–12 July, 2000*. Center for Biological Control, College of Natural Resources, University of California, Riverside, California, USA.

Roltsch, W.J., D.E. Meyerdirk, R. Warkentin, E.R. Andress, and K. Carrera. 2006. Classical biological control of the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green), in southern California. *Biological Control* 37: 155–166.

Roltsch, W.J., L.R. Ertle, and D.E. Meyerdirk. 2007. No-choice host range tests for *Allotropa* sp. near *mecrida*, a parasitoid of the pink hibiscus mealybug,

Maconellicoccus hirsutus (Hemiptera: Pseudococcidae). *Biocontrol Science and Technology* 17: 977–981.
Romero-Nápoles, J., H. Bravo-Mojica, and T. H. Atkinson. 1987. Biology of the Epilachninae (Coleoptera: Coccinellidae) from Morelos and their susceptibility to parasitism by *Pediobius foveolatus* (Hymenoptera: Eulophidae). *Folia Entomológica Mexicana* 71: 37–46.
Rose, M. and G. Zolnerowich. 1994. *Eretmocerus furuhashii* sp. n. (Hymenoptera, Aphelinidae), a parasite of *Parabemisia myricae* (Kuwana) (Homoptera, Aleyrodidae) in Japan. *Japanese Journal of Entomology* 62: 285–292.
Rose, M. and G. Zolnerowich. 1997. *Eretmocerus* Haldeman (Hymenoptera: Aphelinidae) in the United States, with descriptions of new species attacking *Bemisia* (*tabaci* complex) (Homoptera: Aleyrodidae). *Proceedings of the Entomological Society of Washington* 99: 1–27.
Rosen, D. 1966. Notes on the parasites of *Acaudaleyrodes citri* (Priesner & Hosrni) (Hem. Aleyrodidae) in Israel. *Entomologische Berichten* 26: 55–59.
Rosen, D. and P. DeBach. 1986. Three new species of *Aphytis* (Hymenoptera: Aphelinidae), parasites of *Pseudaulacaspis* spp. (Homoptera: Diaspididae) in India and Australia. *Entomophaga* 31: 139–151.
Rossbach, A., B. Löhr, and S. Vidal. 2005. Generalism versus specialism: responses of *Diadegma mollipla* (Holmgren) and *Diadegma semiclausum* (Hellen), to the host shift of the diamondback moth (*Plutella xylostella* L.) to peas. *Journal of Insect Behavior* 18: 491–503.
Rounagh, H. and M. A. Samih. 2014. The two-sex life table and predation rate of *Oenopia conglobata contaminata* (Col.: Coccinellidae) feeding on pomegranate green aphid, *Aphis punicae* (Hem.: Aphididae), under laboratory conditions. *Journal of Entomological Society of Iran* 34(1): 59–72.
Rothschild, G. H. L. 1970. Parasites of rice stemborers in Sarawak (Malaysian Borneo). *Entomophaga* 15: 21–51.
Rugman-Jones, P. F., R. Wharton, T. van Noort, and R. Stouthamer, R. 2009. Molecular differentiation of the *Psyttalia concolor* (Szépligeti) species complex (Hymenoptera: Braconidae) associated with olive fly, *Bactrocera oleae* (Rossi) (Diptera: Tephritidae), in Africa. *Biological Control* 49: 17–26.
Russell, L. M. and J. Etienne. 1985. A list of the Aleyrodidae of the Island of Réunion. *Proceedings of the Entomological Society of Washington* 87: 202–206.
Rutherford, A. 1914a. Insects pests of some leguminous plants. *Tropical Agriculture* 43(4): 319–323.
Rutherford, A. 1914b. Some Ceylon Coccidae. *Bulletin of Entomological Research* 5(3): 259–268.
Rutledge, C. E. and R. N. Wiedenmann. 1999. Habitat preferences of three congeneric braconid parasitoids: implications for host-range testing in biological control. *Biological Control* 16: 144–154.
Ruzicka, Z., G. Iperti, and I. Hodek. 1981. Reproductive rate and longevity in *Semiadalia undecimnotata* and *Coccinella septempunctata* (Coccinellidae, Col.). *Vestnik Ceskoslovenske Spolecnosti Zoologicke* 45(2): 115–128.
Rygg, T. 1979. Investigations on the rose hip fly, *Rhagoletis alternata* Fall. (Diptera: Trypetidae). *Forskning og Forsoek i Landbruket* 30: 269–277.
Sadeghi, S. E., Z. Mojib, J. Jalali, and J. Haji. 2004. Investigation on the biology of lady beetle *Oenopia conglobata* (L.) on poplar aphid *Chaitophorus leucomelas* (Koch) in laboratory conditions. *Resources* 62: 20–24.
Sagarra, L. A., C. Vincent, and R. K. Stewart. 2001. Suitability of nine species (Homoptera: Pseudococcidae) as hosts for the parasitoids *Anagyrus kamali* (Hymenoptera: Encyrtidae). *Florida Entomologist* 84: 112–116.
Sáiz, F., A. Giambruno, and P. Jelves. 2003. Ecology of *Ctenarytaina eucalypti* (Maskell, 1890) (Hemiptera, Psyllidae), pest of *Eucalyptus globulus* Labill. in central Chile. *Revista Chilena de Entomología* 29: 19–28.
Sanches, M.A. 2000. Parasitism of eggs of *Gonipterus scutellatus* Gyllenhal, 1833 and *Gonipterus gibberus* Boisduval, 1835 (Coleoptera, Curculionidae) by the mymarid *Anaphes nitens* (Girault, 1928) (Hymenoptera, Mymaridae) in Colombo, PR, Brazil. *Arquivos do Instituto Biológico (São Paulo)* 67: 77–82.
Sanchez, J. A., M. la Spina, J. M. Michelena, A. Lacasa, and A. Hermoso de Mendoza. 2011. Ecology of the aphid pests of protected pepper crops and their parasitoids. *Biocontrol Science and Technology* 21: 171–188.
Sands, D. P. A., R. Broe, and W. J. M. M. Liebregts. 1990. Identity of *Encarsia* spp. (Hymenoptera: Aphelinidae) introduced into Western Samoa for biological control of *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Hemiptera: Diaspididae). *Proceedings of the Entomological Society of Washington* 92: 135–138.
Sant, L. E. van't, J. G. C. Bethe, H. E. Vijzelman, and J. C. Freriks. 1975. Observations on mining flies (*Napomyza* spp., Diptera, Agromyzidae) on Witloof chicory, carrots and camomile. *Verslagen van Landbouwkundige Onderzoekingen* No. 840, 44 pp.
Santiago-Islas, T., A. Zamora-Cruz, E. A. Fuentes-Temblador, L. Valencia-Luna, and H. C. Arredondo-Bernal. 2008. Cochinilla rosada del hibiscus, *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae), pp. 177–191. *In*: Arredondo Bernal, H. C. and L. A. Rodríguez el Bosque (eds.). *Casos de Control Biológico en México*. Grupo Mundi-Prensa, Madrid, Spain.
Sarmento, R. A., A. Pallini, M. Venzon, O. F. F. de Souza, A. J. Molina-Rugama, and C. L. de Oliveira. 2007. Functional response of the predator *Eriopis connexa* (Coleoptera: Coccinellidae) to different prey types. *Brazilian Archives of Biology and Technology* 50(1): 121–126.
Sasaji, H. and M. S. McClure. 1997. Description and distribution of *Pseudoscymnus tsugae* sp. nov. (Coleoptera: Coccinellidae), an important predator of hemlock woolly adelgid in Japan. *Annals of the Entomological Society of America* 90: 563–568.
Satpute, P. P., Y. M. Taley, S. A. Nimbalkar, and N. R. Kadu. 1986. Natural enemies of citrus black fly, *Aleurocanthus woglumi* Ashby, in Nagpur region. *Bulletin of Entomology* (*New Delhi*) 27(2): 128–131.
Savoiskaya, G. I. 1970. The Far-Eastern ladybird against the apple aphid. *Zashchita Rastenii* 15(6): 12–13.
Scalenet. 2017. http://scalenet.info/catalogue/
Schauff, M. E. 1989. A new species of *Horismenus* (Hymenoptera: Eulophidae) parasitic on the lesser cornstalk borer, *Elasmopalpus lignosellus* (Lepidoptera: Pyralidae). *Proceedings of the Entomological Society of Washington* 91: 534–537.
Scheibelreiter, G. K. 1980. Sugarcane stem borers (Lep.: Noctuidae and Pyralidae) in Ghana. *Zeitschrift für Angewandte Entomologie* 89: 87–99.
Schirmer, S., P. Blaeser, and C. Sengonca. 2006. Comparative studies on the suitability of two aphelinids, *Aphelinus asychis* Walker and *Aphelinus varipes* Förster (Hym., Aphelinidae), for the biological control of *Aphis gossypii* Glover (Hom., Aphididae). *Mitteilungen der Deutschen Gesellschaft für allgemeine und angewandte Entomologie* 15: 289–293.
Schreiner, I. H. and D. M. Nafus. 1992. Changes in a moth community mediated by biological control of the dominant species. *Environmental Entomology* 21: 664–668.
Schreiner, I. H. and D. M. Nafus. 1993. Population increases of native moths following biological control of an introduced pest moth. *Micronesica* 4 (suppl): 49–56.
Schuler, H., P. Kern, W. Arthofer, H. Vogt, M. Fischer, C. Stauffer, and M. Riegler. 2016. *Wolbachia* in parasitoids attacking native European and introduced eastern cherry fruit flies in Europe. *Environmental Entomology* 45: 1424–1431.
Schweizer, H., J. G. Morse, R.F. Luck, and L. D. Forster. 2002. Augmentative releases of a parasitoid (*Metaphycus* sp. nr. *flavus*) against citricola scale (*Coccus pseudomagnoliarum*) on oranges in the San Joaquin Valley of California. *Biological Control* 24: 153–166.

Sengonca, Ç. and G. Peters, G. 1991. Occurrence of indigenous parasitoids of the important cabbage pests in the Cologne-Bonn production region. *Zeitschrift für Angewandte Zoologie* 78: 91–99.
Servadei, A. 1930. Contributo alla conoscenza delle *Hyponomeuta padellus* L., *cognatellus* Hbn. e *vigintipunctatus* Retz. *Bollettino dell'Laboratorio di Entomologia, Bologna* 3: 254–301.
Sha, Z. L., C. D. Zhu, R. W. Murphy, and D. W. Huang. 2007. *Diglyphus isaea* (Hymenoptera: Eulophidae): a probable complex of cryptic species that forms an important biological control agent of agromyzid leaf miners. *Journal of Zoological Systematics and Evolutionary Research* 45: 128–135.
Shah, A. H., M. B. Patel, and G. M. Patel. 1986. Record of a coccinellid predator (*Serangium parcesetosum* Sci.) of sugarcane whitefly in South Gujarat. *Gujarat Agricultural University Research Journal* 12(1): 63–64.
Shalaby, F. F., A. A. El-Hafez, E. F. El-Khayat, and M. A. A. El-Sharkawy. 2000. Effect of shifting the rearing host on fecundity, emergence and sex-ratio of *Trichogramma evanescens* Westwood and *Trichogrammatoidea bactrae* Nagaraja. *Egyptian Journal of Biological Pest Control* 10: 1–14.
Shanower, T. G. 2005. Occurrence of *Sitodiplosis mosellana* (Diptera: Cecidomyiidae) and its parasitoid, *Macroglenes penetrans* (Hymenoptera: Platygasteridae), in northeastern Montana. *The Canadian Entomologist* 137: 753–757.
Shapiro, V. A., G. V. Gusev, and O. V. Kapustina. 1975. Comparative evaluation of the biological properties of egg parasites of the family Scelionidae, both introduced and indigenous species. *Trudy Vsesoyuznogo Nauchno-issledovatel'skogo Instituta Zashchity Rastenii* 44: 57–69.
Shi, D. S. 1980. Studies on the hymenopterous parasite complex and its fluctuation on the cotton aphid (*Aphis gossypii* Glover) in Shanghai. *Contributions of the Shanghai Institute of Entomology* 1: 215–219.
Shi, G-L., X-Q. Liu, J. Li, L-C. Li, and F-D. Yang. 1997. Study on the bionomics of *Quadraspidiotus perniciosus* and its infestation pattern. *Scientia Silvae Sinicae* 33(2): 161–167.
Shishehbor, P. and P. A. Brennan. 1995. Parasitism of *Trialeurodes ricini* by *Encarsia formosa*: level of parasitism, development time and mortality on different host plants. *Entomophaga* 40: 299–305.
Sikharulidze, A. M. 1986. Tea aphid, a pest of feijoa, and results obtained with Ambush for its control. *Subtropicheskie Kul'tury* 1: 139–141.
Sime, K. R., K. M. Daane, D. L. Dahlsten, J. W. Andrews, Jr., and D. Rowney. 2004. Constraints on the effectiveness of *Psyllaephagus bliteus* (Hymenoptera: Encyrtidae), a biological control agent for the red-gum lerp psyllid (Hemiptera: Psylloidea) in California, pp. 141–144. In: Hoddle, M. S. (ed.). *California Conference on Biological Control IV, Berkeley, California, USA, 13–15 July, 2004*. Center for Biological Control, College of Natural Resources, University of California, Berkeley, California, USA.
Simmonds, F. J. 1958. The effect of lizards on the biological control of scale insects in Bermuda. *Bulletin of Control Research* 49(3): 601–612.
Simoni, S., R. Nannelli, D. Goggioli, S. Guidi, and M. Castagnoli. 2006. Biological and demographic parameters of *Neoseiulus californicus* (McGregor) (Acari Phytoseiidae) reared on two astigmatid mites. *Redia* 89: 59–63.
Singh, B. P., R. P. Singh, and V. D. Verma. 1988. New record of *Aroplectrus dimerus* Linn. [sic] and *Platyplectrus* sp. as a larval parasite of slug caterpillar (*Parasa bicolor* Walk) [sic] from U.P. *Farm Science Journal* 3(2): 199–200. http://trophort.com/002/169/002169592.html
Singh, D., S. Prasad, and R. Singh. 2009. Life-table of aphid parasitoid, *Lipolexis oregmae* (Gahan) a parasitoid of *Aphis gossypii* Glover reared on pigeonpea. *Indian Journal of Entomology* 71(2): 110–112.
Sinha, A. K. 1982. Integrated pest control programme in intermediate savannahs of Guyana. *Caribbean Plant Protection Newsletter* 1(2), unpaginated.
Siscaro, G. 1992. *Avetianella longoi* sp. n. (Hymenoptera, Encyrtidae) egg parasitoid of *Phoracantha semipunctata* F. (Coleoptera, Cerambycidae). *Bolletino di Zoologia Agraria e di Bachicoltura* 24(2): 205–212.
Slavgorodskaya-Kurpieva, L.E. 1986. *Ageniaspis*: a parasitoid of yponomeutid moths. *Zashchita Rastenii* (*Moskva*) 6: 29–30.
Slovák, M. 1985. Biological observations on *Microplitis med*iator Hal. (Hym., Braconidae). *Biológia, Czechoslovakia, B (Zoológia)* 40(10): 987–996.
Smith, R. H. 1943. Bionomics and control of the nigra scale, *Saissetia nigra*. *Hilgardia* 16(5): 225–288.
Smith, H. D. 1945. The citrus blackfly on the west coast of Mexico and the importation and distribution of *E. serius* for its control. / La " mosca prieta " de los citricos en la Costa Occidental de México y la importacion y colonizacion de *Eretmocerus serius* Silv. para su control. *Fitofilo* 4(2): 67–103.
Smith, T. R. 2006. Life history and pesticide susceptibility of *Cybocephalus nipponicus* Endrödy-Younga (Coleoptera: Cybocephalidae) and a taxonomic revision of the Cybocephalidae of North America and the West Indies. PhD dissertation University of Florida, Gainesville, Florida, USA. http://ufdc.ufl.edu/UFE0016901/00001/pdf
Smith, J. M. and M. A. Hoy. 1995. Rearing methods for *Ageniaspis citricola* (Hymenoptera: Encyrtidae) and *Cirrospilus quadristriatus* (Hymenoptera: Eulophidae) released in a classical biological control program for the citrus leafminer *Phyllocnistis citrella* (Lepidoptera: Gracillariidae). *Florida Entomologist* 78: 600–608.
Smith, H. A., J. L. Capinera, J. E. Peña, and B. Linbo-Terhaar. 1994. Parasitism of pickleworm and melonworm (Lepidoptera: Pyralidae) by *Cardiochiles diaphaniae* (Hymenoptera: Braconidae). *Environmental Entomology* 23:1283–1293.
Smith, D., D. Papacek, and N. Smith. 1995. Biological control of citrus snow scale, *Unaspis citri* (Comstock) (Homoptera: Diaspididae) in south-east Queensland, Australia. *Israel Journal of Entomology* 29: 253–260.
Smith, L., M. E. Cuellar, and E. L. Melo. 1996. Evaluating prey preference by several phytoseiid predators for *Mononychellus tanajoa* (Bondar) and *M. caribbeanae* McGregor (Acari: Tetranychidae) in cassava. *Biological Control* 7: 179–184.
Smith, S. M., K. van Frankenhuyzen, G. G. Nealis, and R. S. Bourchier. 2002. *Choristoneura fumiferana* (Clemens), eastern spruce budworm (Tortricidae), pp. 58–68. *In*: Mason, P.G. and J.T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, UK.
Smolarz, S. 1970. The biology of the mealy plum aphid—*Hyalopterus pruni* (Geoff.) (Homoptera, Aphidodea). / Biologia mszycy sliwowo-trzcinowej—*Hyalopterus pruni* (Geoff.) (Homoptera, Aphidodea). *Polskie Pismo Entomologiczne* 40(2): 287–328.
Snyder, W. E., S. N. Ballard, S. A. Yang, G. M. Clevenger, T. D. Miller, J. J. Ahn, T. D. Hatten, and A. A. Berryman. 2004. Complementary biocontrol of aphids by the ladybird beetle *Harmonia axyridis* and the parasitoid *Aphelinus asychis* on greenhouse roses. *Biological Control* 30: 229–235.
Song, M. Q., X. D. Liu, and S. Z. Cheng. 1982. The dominant parasite, *Trichogramma confusum* Viggiani, parasitising *Leguminivora glycinivorella* Matsumura (Lep.: Olethreutidae). *Natural Enemies of Insects* 4(4): 16–18.
Song, S-Y., C-W. Tan, and S-Y. Hwang. 2012. Host range of *Cybocephalus flavocapitis* and *Cybocephalus nipponicus*, two potential biological control agents for the cycad aulacaspis scale, *Aulacaspis yasumatsui*. *Journal of Asia-Pacific Entomology* 15: 595–599.
Soper, A. and R. Van Driesche. 2014. Ambermarked birch leafminer, pp. 231–235. *In:* Van Driesche, R. and R. Reardon (eds.). *The Use of Classical Biological Control to Preserve Forests in North America*. FHTET 2013–2. USDA Forest Service, Morgantown, West Virginia, USA.
Soper, A. L., C. J. K. MacQuarrie, and R. Van Driesche. 2015. Introduction, establishment, and impact of *Lathrolestes thomsoni* (Hymenoptera: Ichneumonidae) for biological control of the ambermarked birch leafminer, *Profenusa thomsoni* (Hymenoptera: Tenthredinidae), in Alaska. *Biological Control* 83: 13–19.

Soto, A., F. Ohlenschläger, and F. García-Marí. 2001. Population dynamics and biological control of the whiteflies *Aleurothrixus floccosus*, *Dialeurodes citri* and *Parabemisia myricae* (Homoptera: Aleyrodidae) in citrus orchards of Valencia (Spain). *Boletín de Sanidad Vegetal, Plagas* 27(1): 3–20.

Speyer, E. R. 1927. An important parasite of the greenhouse white-fly (*Trialeurodes vaporariorum*, Westwood). *Bulletin of Entomological Research* 17: 301–308.

Starý, P. 1975. *Aphidius colemani* Viereck: its taxonomy, distribution and host range (Hymenoptera, Aphidiidae). *Acta Entomologica Bohemoslovaca* 72(3): 156–163.

Starý, P. 1990. The asparagus aphid, *Brachycorynella asparagi* (Mordv.) (Hom., Aphididae) and its natural enemy spectrum in Czechoslovakia. *Journal of Applied Entomology* 110: 253–260.

Starý, P. and A. van Harten. 1983. Aphid parasitoids from Bangladesh (Hymenoptera: Aphidiidae). *Entomologische Berichten* 43(2): 29–32.

Stary, P. and J. Zeleny. 1983. Aphid parasitoids from Vietnam (Hymenoptera, Aphidiidae). *Acta Entomologica Bohemoslovaca* 80(3): 190–195.

Starý, P., J. Havelka, and J-Y. Choi. 2002. *Lysiphlebia japonica* (Ashm.), a keystone aphid parasitoid in the Korean peninsula (Hymenoptera, Braconidae, Aphidiinae). *Journal of Asia-Pacific Entomology* 5(1) 135–137.

Stathas, G. J., P. J. Skouras, and D. C. Kontodimas. 2015. Data on ecology of the purple scale *Lepidosaphes beckii* (Newman) on citrus in Greece. *Bulletin OEPP/EPPO Bulletin* 45(1): 128–132.

Stevens, P. S. 1995. Host preferences of *Trichogrammatoidea bactrae fumata* (Hym.: Trichogrammatidae) an egg parasitoid of leafrollers (Lep.: Tortricidae). *Entomophaga* 40: 379–385.

Stoner, A. and G.D. Butler, Jr. 1965. *Encarsia lútea* as an egg parasite of bollworm and cabbage looper in Arizona cotton. *Journal of Economic Entomology*. 58: 1148–1150.

Story, H. M., L. C. Vieira, S. M. Salom, and L. T. Kok. 2012. Assessing performance and competition among three *Laricobius* (Coleoptera: Derodontidae) species, predators of hemlock woolly adelgid, *Adelges tsugae* (Hemiptera: Adelgidae). *Environmental Entomology* 41: 896–904.

St-Onge, M., D. Cormier, S. Todorova, and É. Lucas. 2016. Conservation of *Ephestia kuehniella* eggs as hosts for *Trichogramma ostriniae*. *Journal of Applied Entomology* 140: 218–222.

Suazo, A., D. P. Pacheco, R. D. Cave, and J. H. Frank. 2006. Longevity and fecundity of *Metamasius quadrilineatus* Champion (Coleoptera: Dryophthoridae) on a natural bromeliad host in the laboratory. *Coleopterists Bulletin* 60(3): 264–270.

Sun, Y. Z., G. F. Ma, and X. F. Zhao. 1987. A preliminary study of parasitic wasps of *Lithocolletis ringoniella* Matsumura. *Natural Enemies of Insects* 9(3): 156–159, 134.

Supharngkasen, P. 1979. Studies on hymenopterous parasites of *Helicoverpa armigera* Hubner eggs in Thailand. *Thai Journal of Agricultural Science* 12(1): 35–42.

Sushil, S. N., Y. D. Mishra, A. Bhattacharya, and P. Kumar. 1999. Screening of some egg parasitoids against *Pseudohypatopa pulverea* (Meyr.) (Lepidoptera: Blastobasidae)—a serious predator of lac insect, *Kerria lacca* (Kerr). *Journal of Entomological Research* 23: 365–368.

Sutton, R. A., A. G. Selhime, and W. McCloud. 1972. Colonization and release of *Tetrastichus haitiensis* as a biological control agent for citrus root weevils. *Journal of Economic Entomology* 65: 184–185.

Szalay-Marzsó, L. 1958. Investigations on the population dynamics of stocks of the beet aphid (*A. fabae*) in Hungary in the years 1955 and 1956. / Populationsdynamische Untersuchungen an Beständen der Rübenblattlaus (*Aphis* (*Doralis*) *fabae* Scop.) in Ungarn, in den Jahren 1955 und 56. *Acta Agronomica* 8(3–4): 187–211.

Tachikawa, T. 1974. Natural enemies of *Quadraspidiotus macroporanus* Takagi (Homoptera: Diaspididae). *Transactions of the Shikoku Entomological Society* 12(1/2): 31–32.

Tachikawa, T. 1976. Occurrence of *Pediobius foveolatus* (Crawford) (Hymenoptera: Eulophidae) parasitic on *Henosepilachna* (Coleoptera: Coccinellidae) in Japan. *Transactions of the Shikoku Entomological Society* 13(1/2): 61–63.

Takada, H. 1976. Studies of aphids and their parasites on cruciferous crops and potatoes. I. Parasite complex of aphids. *Kontyu* 44(2): 234–253.

Takada, H. and K. Kamijo. 1979. Parasite complex of the garden pea leaf-miner, *Phytomyza horticola* Gourea, in Japan. *Kontyu* 47: 18–37.

Takada, H. and T. Nakamura. 2010. Native primary parasitoids and hyperparasitoids attacking an invasive aphid *Uroleucon nigrotuberculatum* in Japan. *Entomological Science* 13: 269–272.

Takagi, M. 1991. Host stage selection in *Aphytis yanonensis* DeBach et Rosen and *Coccobius fulvus* (Compere et Annecke) (Hymenoptera: Aph9elinidae), introduced parasitoids of *Unaspis yanonensis* (Kuwana) (Homoptera: Diaspididae). *Applied Entomology and Zoology* 26: 505–513.

Takanashi, M. 1990. Development and reproductive ability of *Lysiphlebus japonicus* Ashmead (Hymenoptera: Aphidiidae) parasitizing the citrus brown aphid, *Toxoptera citricidus* (Kirkaldy) (Homoptera: Aphididae). *Japanese Journal of Applied Entomology and Zoology* 34: 237–243.

Talebi, A. A., E. Rakhshani, and S. I. Sadeghi. 2002. Parasitoids and hyperparasitoids of walnut aphid, in Karaj. *Agricultural Science* (*Tabriz*) 12(1): 41–57.

Talhouk, A. S. 1977. Contribution to the knowledge of almond pests in East Mediterranean countries. VI. The sap-sucking pests. *Zeitschrift für Angewandte Entomologie* 83: 248–257.

Tanaka, T. 1987. Morphological changes in haemocytes of the host, *Pseudaletia separata*, parasitized by *Microplitis mediator* or *Apanteles kariyai*. *Developmental and Comparative Immunology* 11: 57–67.

Tanaka, M. and K. Inoue. 1980. Biology of *Cybocephalus nipponicus* Endroy Yonga (Cybocephalidae) and its role as a predator of citrus red mites, *Panonychus citri* (McGregor). *Bulletin of the Fruit Tree Research Station, Japan, D* (*Kuchinotsu*) 2: 91–110.

Tang, B-Z., L. Xu, and Y-M. Hou. 2014. Effects of rearing conditions on the parasitism of *Tetrastichus brontispae* on its pupal host *Octodonta nipae*. *BioControl* 59: 647–657.

Tanga, C. M., S. Ekesi, P. Govender, and S. A. Mohamed. 2016. Host-plant relationships and natural enemies of the invasive mealybug, *Rastrococcus iceryoides* Green in Kenya and Tanzania. *Journal of Applied Entomology* 140: 655–668.

Tanigoshi, L.K., K.S. Pike, R.H. Miller, T.D. Miller, and D. Allison. 1995. Search for, and release of, parasitoids for the biological control of Russian wheat aphid in Washington State (USA). *Agriculture, Ecosystems, and Environment* 52(1): 25–30.

Tavares, W. S., M. A. Costa, I. Cruz, R. D. Silveira, J. E. Serrão, and J. C. Zanuncio. 2010. Selective effects of natural and synthetic insecticides on mortality of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) and its predator *Eriopis connexa* (Coleoptera: Coccinellidae). *Journal of Environmental Science and Health. Part B, Pesticides, Food Contaminants, and Agricultural Wastes* 45(6): 557–561.

Tejada, M. L. O. and P. R. Pablo. 1988. Species of the family Trichogrammatidae collected in the states of Nuevo Leon and Sinaloa and the centre for reproduction of beneficial insects. December 1984–October 1985. *Informe de Investigación - División de Ciencias Agropecuarias y Maritimas, Instituto Technologico y de Estudios Superiores de Monterrey, Mexico* 20: 42–43.

Telli, Ö. and A. Yigit. 2012. Natural enemies of citrus woolly whitefly, *Aleurothrixus floccosus* (Maskell) and nesting whitefly, *Paraleyrodes minei* Iaccarino (Hemiptera: Aleyrodidae) in Hatay Province, Turkey. *Türkiye Entomoloji Dergisi* 36: 147–154.

Terán, A. L., M. L. Collado de Manes, M., S. Glenross, H. Lázaro, and R. Alvarez. 1985. Primary and secondary parasites of the California red scale *Aonidiella aurantii* (Mask.) (Homoptera: Coccoidea: Diaspididae) in citrus orchards of Tucuman, Argentina. *Revista de Investigación, Centro de Investigaciones para la Regulación de Poblaciones de Organismos, Nocivos, Argentina* 3(3–4): 7–14.

Tewksbury, E. A. 2014. Introduction and establishment of three parasitoids of the lily leaf beetle, *Lilioceris lilii*, (Coleoptera: Chrysomelidae) in North America. PhD Dissertation. Environmental Science, University of Rhode Island, North Kingston, Rhode Island, USA.

Tewksbury, L., M. S. Gold, R. A. Casagrande, and M. Kenis. 2005. Establishment in North America of *Tetrastichus setifer* Thomson (Hymenoptera: Eulophidae), a parasitoid of *Lilioceris lilii* (Coleoptera: Chrysomelidae), pp. 142–143. *In:* Hoddle, M. (ed.). *Second International Symposium on Biological Control of Arthropods, Davos, Switzerland, 12–16 September, 2005*. FHTET-2005-08. USDA Forest Service, Morgantown, West Virginia, USA.

Tewksbury, L., R. A. Casagrande, N. Cappuccino, and M. Kenis. 2017. Establishment of parasitoids of the lily leaf beetle (Coleoptera: Chrysomelidae) in North America. *Environmental Entomology* 46: 226–236.

Thibout, E. 1988. The specificity of *Diadromus pulchellus* (Hymenoptera: Ichneumonidae) towards its host *Acrolepiopsis assectella*, the leek moth. *Entomophaga* 33: 439–452.

Thomas, A. P., J. Trotman, A. Wheatley, A. Aebi, R. Zindel, and P. M. J. Brown. 2013. Predation of native coccinellids by the invasive alien *Harmonia axyridis* (Coleoptera: Coccinellidae): detection in Britain by PCR-based gut analysis. *Insect Conservation and Diversity* 6: 20–27.

Thompson, B. and G. V. P. Reddy. 2016. Status of *Sitodiplosis mosellana* (Diptera: Cecidomyiidae) and its parasitoid, *Macroglenes penetrans* (Hymenoptera: Pteromalidae), in Montana. *Crop Protection* 84: 125–131.

Tian, L. X., L. F. Yang, and S. G. Gao. 1981. A preliminary study on aphid parasites in cotton fields (Hymenoptera: Aphidiidae). *Insect Knowledge* (*Kunchong Zhishi*) 18(4): 158–160.

Tian, J-C., Z-C. Wang, G-R. Wang, L-Q. Zhong, X-S. Zheng, H-Z. Xu, L-S. Zang, and Z-X Lu. 2017. The effects of temperature and host age on the fecundity of four *Trichogramma* species, egg parasitoids of the *Cnaphalocrocis medinalis* (Lepidoptera: Pyralidae). *Journal of Economic Entomology* 110: 949–953.

Tippins, H. H. 1968. Observations on *Phenacaspis cockerelli* (Cooley) (Homoptera : Diaspididae), a pest of ornamental plants in Georgia. *Journal of the Georgia Entomological Society* 3(1): 13–15.

Tiwari, N. K., P. N. Avasthy, H. Nigam, and J. Chandra. 1978. Parasite complex in sugarcane white fly, *Aleurolobus barodensis* Mask. *Indian Journal of Entomology* 40(4): 446.

Togoshi, I. 1976. Insect community associated with a large chestnut aphid (Hemiptera, Aphididae). (Insect fauna of chestnut orchards in Ishikawa Prefecture II). *Mushi* 49(9): 87–93.

Tokumaru, S. 2006. Hymenopterous parasitoids of *Liriomyza chinensis* Kato (Diptera: Agromyzidae) in Kyoto Prefecture. *Japanese Journal of Applied Entomology and Zoology* 50: 63–65.

Toros, S. 1986. *Hyadaphis tataricae* (Aizenberg) (Hom.: Aphididae); a species new to the fauna of Turkey. *Türkiye Bitki Koruma Dergisi* 10(3): 141–148.

Tremblay, E. 1975. The species of the genus *Trioxys* Hal. (Hymenoptera Ichneumonoidea) parasites of aphids of the genus *Cavariella* Del. Guer. (Homoptera Aphidoidea). *Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri', Portici* 32: 37–46.

Trjapitzin, S.V. 1994. A new species of *Aphelinoidea* (Hymenoptera: Trichogrammatidae), with a key to species of the Holarctic Region. *Journal of the Kansas Entomological Society* 67: 301–310.

Triapitsyn, S. and P. A. Phillips. 2000. First record of *Gonatocerus triguttatus* (Hymenoptera: Mymaridae) from eggs of *Homalodisca coagulata* (Homoptera: Cicadellidae) with notes on the distribution of the host. *Florida Entomologist* 83: 200–203.

Tryapitzyn, S. V. and V. A. Tryapitzyn. 1999. Parasitoids of mealybugs (Homoptera, Pseudococcidae) on cultivated grapes in Argentina, with description of a new species of the genus *Aenasius* Walker (Hymenoptera, Encyrtidae). *Entomologicheskoe Obozrenie* 78(1): 174–180.

Triapitsyn, S. V. 2002. Taxonomy and host associations of *Gonatocerus* spp. (Mymaridae)—egg parasitoids of proconiine leafhoppers. *Egg Parasitoid News*: 14: 10.

Triapitsyn, S. V. 2006. A key to the Mymaridae (Hymenoptera) egg parasitoids of proconiine sharpshooters (Hemiptera: Cicadellidae) in the Nearctic region, with description of two new species of *Gonatocerus*. *Zootaxa* 1203: 1–38.

Triapitsyn, S. V., M. S. Hoddle, and D. J. W. Morgan. 2002. A new distribution and host record for *Gonatocerus triguttatus* in Florida, with notes on *Acmopolynema sema* (Hymenoptera: Mymaridae). *Florida Entomologist* 85: 654–655.

Triapitsyn, S. V., D. J. W. Morgan, M. S. Hoddle, and V. V. Berezovskiy. 2003. Observations on the biology of *Gonatocerus fasciatus* Girault (Hymenoptera: Mymaridae), egg parasitoid of *Homalodisca coagulata* (Say) and *Oncometopia orbona* (Fabricius) (Hemiptera: Clypeorrhyncha: Cicadellidae). *Pan-Pacific Entomologist* 79: 75–76.

Triapitsyn, S. V., D. González, D. B. Vickerman, J. S. Noyes, and E. B. White. 2007. Morphological, biological, and molecular comparisons among the different geographical populations of *Anagyrus pseudococci* (Hymenoptera: Encyrtidae), parasitoids of *Planococcus* spp. (Hemiptera: Pseudococcidae), with notes on *Anagyrus dactylopii*. *Biological Control* 41: 14–24.

Tribe, G. D. and J. J. Cillié. 2000. Biological control of the Eucalyptus-defoliating Australian tortoise beetle *Trachymela tincticollis* (Blackburn) (Chrysomelidae: Chrysomelini: Paropsina) in South Africa by the egg parasitoid *Enoggera reticulata* Naumann (Hymenoptera: Pteromalidae: Asaphinae). *African Entomology* 8: 15–22.

Trouvé, C. 1995. Biological control trials against the hop aphid *Phorodon humuli* (Schrank) (Homoptera: Aphididae) in northern France. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen, Universiteit Gent* 60(3a): 781–792.

Trujillo, H. E., B. Arias, J. M. Guerrero, P. Hernandez, A. Bellotti, and J. E. Peña. 2004. Survey of parasitoids of whiteflies (Homoptera: Aleyrodidae) in cassava growing regions of Columbia and Ecuador. *Florida Entomologist* 87: 268–273.

Tudor, I. and O. Marcu. 1974. *Hyponomeuta rorella* and its natural enemies. *Buletinul Universitatii din Brasov* B 16: 91–96.

Turnock, W. J. and K. P. Carl. 1995. Evaluation of the Palaearctic *Eurithia consobrina* (Diptera: Tachinidae) as a potential biocontrol agent for *Mamestra configurata* (Lepidoptera: Noctuidae) in Canada. *Biocontrol Science and Technology* 5: 55–67.

UF/IFAS Anon. No year. fact sheet on papaya mealybug http://entnemdept.ufl.edu/creatures/fruit/mealybugs/papaya_mealybug.htm

Ukrainsky, A. S. 2009. Species names homonymy in the ladybirds (Coleoptera: Coccinellidae). IV. *Russian Entomological Journal* 18(4): 285–286.

Ülgentürk, S. and S. Toros. 1999. Natural enemies of the oak scale insect, *Eulecanium ciliatum* (Douglas) (Hemiptera: Coccidae) in Turkey. *Entomologica* 33: 219–224.

Umeda, C. and T. D. Paine. 2015. Evidence of a genetic basis for differences in parasitization success between strains of *Avetianella longoi* (Siscaro). *PLoS ONE* 10(6): e0129558.

Unruh, T., R. Short, F. Herard, K. Chen, K. Hopper, R. Pemberton, J-H. Lee, L. Ertle, K. Swan, R. Fuester, and E. LaGasa. 2003. Introduction and establishment of parasitoids for the biological control of the apple ermine moth, *Yponomeuta malinellus* (Lepidoptera: Yponomeutidae), in the Pacific Northwest. *Biological Control* 28: 332–345.

USDA APHIS. 2012. Field release of *Aphelinus glycinis* (Hymenoptera: Aphelinidae) for biological control of the soybean aphid, *Aphis glycines* (Hemiptera: Aphididae), in the Continental United States. Environmental Assessment, September 2012. https://www.aphis.usda.gov/plant_health/ea/downloads/soybeanaphid-EA-FONSI.pdf

USDA APHIS. 2014. Field release of the parasitoid *Diaphorencyrtus aligarhensis* for the biological control of the Asian citrus psyllid in the contiguous United States. Environmental Assessment, October 2014 https://www.aphis.usda.gov/plant_health/ea/downloads/diaphorencyrtus-aligarhensis-acp-biocontrol.pdf

USDA APHIS, 2017. Field release of *Diaparsis jucunda* (Hymenoptera: Ichneumonidae), *Lemophagus errabundus* (Hymenoptera: Ichneumonidae), and *Tetrastichus setifer* (Hymenoptera: Eulophidae) for biological control of the lily leaf beetle, *Lilioceris lilii* (Coleoptera: Chrysomelidae) in the contiguous United States. Environmental Assessment, August 2017. https://www.aphis.usda.gov/plant_health/ea/downloads/2017/lily-leaf-beetle-ea-signed-fonsi.pdf

Valério, E., A. Cecílio, F. A. Ilharco, and A. Mexia. 2006. The problematic of aphid *Nasonovia ribisnigri* (Mosley) (Homoptera: Aphidoidea) population control in protected lettuce (*Lactuca sativa* Linné) crop, in West Continental Portugal. *Boletín de Sanidad Vegetal, Plagas* 32(1): 3–11.

van de Veire, M. 1988. Towards integrated control of leaf-mining flies of tomatoes under glass. *Revue de l'Agriculture* 41(1): 45–51.

van der Linden, A. 1992. *Phytomyza caulinaris* Hering, an alternative host for the development of an open rearing system for parasitoids of *Liriomyza* species. *Proceedings of the Section Experimental and Applied Entomology of the Netherlands Entomological Society* 3: 31–39.

Van Driesche, R. G. 2008. Biological control of *Pieris rapae* in New England: host suppression and displacement of *Cotesia glomerata* by *Cotesia rubecula* (Hymenoptera: Braconidae). *Florida Entomologist* 91: 22–25.

Van Driesche, R. and M. Hoddle. 2016. Non-target effects of insect biocontrol agents and trends in host specificity since 1985. *CAB Reviews* 11, No. 044 doi: 10.1079/PAVSNNR201611044.

Van Driesche, R. G. and C. Nunn. 2002. Establishment of a Chinese strain of *Cotesia rubecula* (Hymenoptera: Braconidae) in the northeastern United States. *Florida Entomologist* 85: 386–388.

Van Driesche, R. G. and C. Nunn. 2003. Status of euonymus scale in Massachusetts fourteen years after release of *Chilocorus kuwanae* (Coleoptera: Coccinellidae). *Florida Entomologist* 86: 384–385.

Van Driesche, R.G., K. Idoine, M. Rose, and M. Bryan. 1998a. Release, establishment and spread of Asian natural enemies of euonymus scale (Homoptera: Diaspididae) in New England. *Florida Entomologist* 81: 1–9.

Van Driesche, R. G., K. Idoine, M. Rose, and M. Bryan. 1998b. Evaluation of the effectiveness of *Chilocorus kuwanae* (Coleoptera: Coccinellidae) in suppressing euonymus scale (Homoptera: Diaspididae). *Biological Control* 12: 56–65.

Van Driesche, R. G., C. Nunn, N. Kreke, B. Goldstein, and J. Benson. 2003. Laboratory and field host preferences of introduced *Cotesia* spp. parasitoids (Hymenoptera: Braconidae) between native and invasive *Pieris* butterflies. *Biological Control* 28: 214–221.

Van Driesche, R. G., D. Simberloff, B. Blossey, C. Causton, M. S. Hoddle, C. Marks, K. Heinz, D. Wagner, and K. Warner (eds.). 2016. *Integrating Biological Control into Conservation Practice.* Wiley/Blackwell, Oxford, UK.

van Lenteren, J.C. 2012. The state of commercial augmentative biological control: plenty of natural enemies, but a frustrating lack of uptake. *BioControl* 57: 1–20.

Van Steenwyk, R. A. and V. M. Stern. 1977. Propagation, release, and evaluation of *Peristenus stygicus*, a newly imported parasite of *Lygus* bugs. *Journal of Economic Entomology* 70: 66–69.

Varma, G. C. and O. S. Bindra. 1974. Laboratory studies on host-parasite relationships of two *Apanteles* species when reared on *Chilo partellus* (Swinhoe). *Indian Journal of Entomology* 36(2): 110–112.

Varma, G. C., S. N. Mohanty, and Maninder. 1981. Natural enemies of *Acigona steniella* (Hmps.) (Crambidae: Lepidoptera) in the Punjab. *Journal of Research, Punjab Agricultural University* 18(2): 163–169.

Varma, A., H. Nigam, and K. Singh. 1987. Laboratory and field evaluations of an exotic parasite, *Allorhogas pyralophagus* Marsh (Hymenoptera: Braconidae) against sugarcane stalk borer, *Chilo auricilius* Ddgn. (Lepidoptera: Pyralidae). *Entomon* 12: 367–372.

Vasil'Ev, R. A. 1963. On the bionomics of *Gastrolina thoracica* Baly (Coleóptera, Chrysomelidae). *Entomologicheskoe Obozrenie* 42(2): 264–272.

Vásquez-Ordóñez, A.A., N.A. Hazzi, D. Escobar-Prieto, D. Paz-Jojoa, and S.A. Parsa. 2015. A geographic distribution database of the Neotropical cassava whitefly complex (Hemiptera, Aleyrodidae) and their associated parasitoids and hyperparasitoids (Hymenoptera). *ZooKeys* 545: 75–87.

Vazquez, R. J. and S. D. Porter. 2005. Re-confirming host specificity of the fire ant decapitating fly *Pseudacteon curvatus* (Diptera: Phoridae) after field release in Florida. *Florida Entomologist* 88: 107–110.

Vazquez, R. J., S. D. Porter, and J. A. Briano. 2004. Host specificity of a biotype of the fire ant decapitating fly *Pseudacteon curvatus* (Diptera: Phoridae) from Northern Argentina. *Environmental Entomology* 33: 1436–1441.

Vazquez, R. J., S. D. Porter and J. A. Briano. 2006. Field release and establishment of the decapitating fly *Pseudacteon curvatus* on red imported fires ants in Florida. *BioControl* 51: 207–216.

Vejar-Cota, G., A. Caro, L. A. Rodríguez-del-Bosque, and D. Sahagún. 2005. Inundative releases of hymenopterous parasitoids against *Diatraea considerata* (Lepidoptera: Crambidae) on sugarcane in Northwestern Mexico. *Journal of Entomological Science* 40: 231–233.

Venkatesha, M. G., P. K. Bhat, and D. K. S. Gowda. 1993. Record of some lepidopteran pests' outbreak on *Coffea arabica* L. *Journal of Coffee Research* 23(1): 59–61.

Vickerman, D. B., M. S. Hoddle, S. Triapitsyn, and R. Stouthammer. 2014. Species identity of geographically distinct populations of the glassy-wing sharpshooter parasitoid *Gonatocerus ashmeadi*: morphology, DNA sequences, and reproductive compatibility. *Biological Control* 31: 338–345.

Vieira, L. C., T. J. McAvoy, J. Chantos, A. B. Lamb, S. M. Salom, and L. T. Kok. 2011. Host range of *Laricobius osakensis* (Coleoptera: Derodontidae), a new biological control agent of hemlock woolly adelgid (Hemiptera: Adelgidae). *Environmental Entomology* 40: 324–332.

Viggiani, G. 1981. Aphelinid parasites of *Asterobemisia avellanae* (Signoret) (Homoptera Aleyrodidae), with a description of a new species. *Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri'* 38: 67–72.

Viggiani, G. and D. Battaglia. 1983. The Italian species of the genus *Eretmocerus* Hald. (Hymenoptera: Aphelinidae). *Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri'* 40: 97–101.

Viggiani, G. and G. A. Evans. 1992. Descriptions of three new species of *Amitus* Haldeman (Hymenoptera, Platygasteridae), parasitoids of known whiteflies from the New World. *Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri'* 49: 189–194.
Vignes, W. G. des. 1991. The use and availability of *Trachylepidia fructicassiella* Ragworth (Lepidoptera: Pyralidae) as a laboratory host for rearing parasitoids for the biological control of *Diatraea* spp. (Lepidoptera: Pyralidae) on sugar cane in Trinidad, pp. 74–79. *In*: *Proceedings of the 24th West Indies Sugar Technologists' Conference, Kingston, 8–12 April 1991.* Bridgetown: Sugar Association of the Caribbean.
Viljoen, H. 1986. Natural enemies of mango scale. *Information Bulletin, Citrus and Subtropical Fruit Research Institute, South Africa* 164: 8–9.
Villa Castillo, J. 2005. The use of biological control to control forest pests in Mexico. *Forestal XXI* 8(1): 11–12.
Villacarlos, L. T. and N. M. Robin. 1992. Biology and potential of *Curinus coeruleus* Mulsant, an introduced predator of *Heteropsylla cubana* Crawford. *Philippine Entomologist* 8(6): 1247–1258.
Villanueva, R. T., J. P. Michaud, and C. C. Childers. 2004. Ladybeetles as predators of pest and predacious mites in citrus. *Journal of Entomological Science* 39: 23–29.
Villevieille, M. 1987. The phytosanitary protection of tomato seed-beds. *Phytoma* 384: 49.
Vincent, C., D. Babendreier, and U. Kuhlmann. 2001a. *Hoplocampa testudinea* (Klug), European apple sawfly (Hymenoptera: Tenthredinidae), pp. 135–139. *In*: Mason, P.G. and J.T. Huber (eds.). *Biological Control Programmes in Canada, 1981–2000*. CABI Publishing, Wallingford, UK.
Vincent, C., B. Rancourt, M. Sarazin, and U. Kuhlmann. 2001b. Releases and first recovery of *Lathrolestes ensator* (Hymenoptera: Ichneumonidae) in North America, a parasitoid of *Hoplocampa testudinea* (Hymenoptera: Tenthredinidae). *The Canadian Entomologist* 133: 147–149.
Vincent, C., D. Babendreier, U. Kuhlmann, and J. Lasnier. 2013. *Hoplocampa testudinea* (Klug), European apple sawfly (Hymenoptera: Tenthredinidae), pp. 198–202. *In*: Mason, P.G. and D.R. Gillespie. *Biological Control Programmes in Canada, 2001–2012.* CABI, Wallingford, UK.
Vincent, C., M. Appleby, A. Eaton, and J. Lasnier. 2016. Dissemination of *Lathrolestes ensator* (Ichneumonidae), a larval parasite of the European apple sawfly, *Hoplocampa testudinea* (Tenthredinidae), in eastern North America. *Biological Control* 100: 1–6.
Visalakshy, P. N. G. and K. P. Jayanth.1995. Suppression of *Bactra venosana*, a potential natural enemy of *Cyperus rotundus*, by *Trichogrammatoidea bactrae* in Bangalore, India. *Phytoparasitica* 23(4): 355–356.
Viscarret, M. M., E. N. Botto, and A. Polaszek. 2000.Whiteflies (Hemiptera: Aleyrodidae) of economic importance and their natural enemies (Hymenoptera: Aphelinidae, Signiphoridae) in Argentina. *Revista Chilena de Entomología* 26: 5–11.
Voicu, M., T. Sapunaru, C. Nagler, and S. Buzdea. 1987. The role of predatory insects in the reduction of populations of aphid pests on sunflower. *Cercetari Agronomice în Moldova* 20(2): 135–139.
Waddill, V. H. and W. H. Whitcomb. 1982. Release of *Telenomus remus* (Hym. Scelionidae) against *Spodoptera frugiperda* (Lep.: Noctuidae) in Florida, U.S.A. *Entomophaga* 27: 159–162.
Waeyenbergh, M. and M. Baguette. 1996. First Belgian record of *Cotesia vestalis* (Haliday, 1834) (Hymenoptera, Braconidae), parasite of *Proclossiana eunomia* (Esper, 1799) (Lepidoptera, Nymphalidae), new host species. *Belgian Journal of Zoology* 126(1): 79–81.
Wagener, B., A. Reineke, B. Löhr, and C. P. W. Zebitz. 2006. Phylogenetic study of *Diadegma* species (Hymenoptera: Ichneumonidae) inferred from analysis of mitochondrial and nuclear DNA sequences. *Biological Control* 37: 131–140.
Walker, A. L., D. G. Bottrell, and J. R. Cate, Jr. 1973. Hymenopterous parasites of biotype C greenbug in the high plains of Texas. *Annals of the Entomological Society of America* 66: 173–176.
Walker, G. P., N. Zareh, I. M. Bayoun, and S. V. Triapitsyn. 1997. Introduction of western Asian egg parasitoids into California for biological control of beet leafhopper, *Circulifer tenellus*. *Pan-Pacific Entomologist* 73: 236–242.
Walker, G. P., S. N. Lal, B. Tairea, M. Poeschko, J. Wemin, F. Ecke, and P. Wesis. 2004. Developments in IPM programmes for vegetable brassicas in Fiji, Cook Islands and Papua New Guinea, p. 413. *In*: Endersby, N. M. and P. M. Ridland, P. M. Endersby, N. M. and P. M. Ridland (eds.). *In*: *The Management of Diamondback Moth and other Crucifer pests. Proceedings of the Fourth International Workshop, Melbourne, Victoria, Australia, 26–29 November 2001.* The Regional Institute Ltd., Gosford, Australia.
Wang, L. Y. 1982. Control of *Matsucoccus massonianae* Young et Hu (Hom.: Margarodidae) by *Leis axyridis* (Pallas). *Natural Enemies of Insects* 4(4): 37–39.
Wang, C. L., H. Chio, and K. K. Ho. 1972. The comparative study of parasitic potential of the Braconid wasp (*Apanteles plutellae* Kurdj.) to the diamond-back moth (*Plutella xylostella* L.) and rice moth (*Corcyra cephalonica* Staint). *Plant Protection Bulletin, Taiwan* 14 (3): 125–128.
Wang, G. R., Z. C. Liu, Z. Y. Wang, S. R. Sun, Q. R. Jiang, Y. F. Liang, Q. Zhen, and J. C. Zheng. 1985. Studies on the dominant species of *Trichogramma* in sugarcane fields in Guangdong Province and the effect of releasing exotic species. *Natural Enemies of Insects* (*Kunchong Tiandi*) 7(1): 13–18.
Wang, X. G., A. H. Bokonon-Ganta, M. M. Ramadan and R. H. Messing. 2004. Egg-larval opiine parasitoids (Hym., Braconidae) of tephritid fruit fly pests do not attack the flowerhead-feeder *Trupanea dubautiae* (Dipt., Tephritidae). *Journal of Applied Entomology* 128: 716–722.
Wang, Q., J. G. Millar, D. A. Reed, J. L. Mottern, J. M. Heraty, S. V. Triapitzyn, T. D. Paine, and X. Z. He. 2008. Development of a strategy for selective collection of a parasitoid attacking one member of a large parasitoid guild. *Journal of Economic Entomology* 101: 1771–1778.
Wang, X. G., M. W. Johnson, V. Y. Yokoyama, C. H. Pickett, and K. M. Daane. 2011. Comparative evaluation of two olive fruit fly parasitoids under varying abiotic conditions. *BioControl* 56: 283–293.
Wang, Z-H., J. Huang, and D-M. Pan. 2014. Taxonomic review of *Coccobius* species (Hymenoptera: Aphelinidae) from China, with notes on their use in biological control of scale insect pests (Hemiptera: Diaspididae), and description of a new species. *Journal of Natural History* 48(5/6): 359–373.
Wasser, R. E. 1938. Biology and ecology of the coccids on the Black Sea Coast. *Zashchita rastenii ot vreditelei* 16: 41–49.
Watanabe, C. 1939. A new species of genus *Aphidius* Nees and redescription of *Aphidius japonicus* Ashmead (taxonomic notes on Aphidiidae of Japan, I). *Insecta Matsumurana* 13(2–3): 81–84.
Watanabe, C. and H. Takada. 1967. Aphidiid parasites of the green peach aphid, *Myzus persicae* (Sulzer), in Japan (Hymenoptera, Aphidiidae). *Journal of the Fukuoka Entomological Society* 40(7): 83–87.
Watson, J. R. 1919. The California *Delphastus*. *Florida Buggist* 2(2): 88 [one page].
Watson, J. R. 1923. Report of the entomologist. *Report. Florida Agricultural Experiment Station Gainesville, Florida, for 1923*, pp. 29–33.
Watve, C. M. and D. F. Clower. 1976. Natural enemies of the bandedwing whitefly in Louisiana. *Environmental Entomology* 5: 1075–1078.
Weber, C. A., J. M. Smilanick, L. E. Ehler, and F. G. Zalom. 1996. Ovipositional behavior and host discrimination in three scelionid egg parasitoids of stink bugs. *Biological Control* 6: 245–252.
Wei, J-R., B-F. Ding, Y-L. Tang, J-X. Zhao, and Z-Q. Yang. 2010. Study on the relationship between growth and environmental temperature of *Rhizophagus grandis* (Coleoptera: Rhizophagidae), an important predator of *Dendroctonus valens* (Coleoptera: Scolytidae). *Forest Research* 23(3): 478–481.

Weigand, S. 1990. Insect pests of chickpea in the Mediterranean area and possibilities for resistance. *Options Méditerranéennes. Série A, Séminaires Méditerranéens* 9: 73–76.
Weismann, R. 1933. A parasite of the cherry fruit-fly (*Rhagoletis cerasi* L.). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 15: 553–557. (in German)
Wharton, R. A. 1983. New species of *Illidops* and *Bracon* (Hymenoptera: Braconidae) of potential use in biological control. *The Canadian Entomologist* 115: 667–672.
Wharton, R. A. 1984. The status of certain Braconidae (Hymenoptera) cultured for biological control programmes, and description of a new species of *Macrocentrus*. *Proceedings of the Entomological Society of Washington* 86: 902–912.
Wharton, R. A. 1985. A new species of *Mallochia* (Hymenoptera: Ichneumonidae) introduced to Texas to control *Eoreuma loftini* (Dyar) (Lepidoptera: Pyralidae) in sugarcane. *Pan-Pacific Entomologist* 61: 160–162.
Wharton, R. A. 1999. A review of the Old World genus *Fopius* Wharton (Hymenoptera: Braconidae: Opiinae), with description of two new species reared from fruit-infesting Tephritidae (Diptera). *Journal of Hymenoptera Research* 8: 48–64.
Wharton, R. A., J. W. Smith, Jr., D. L. J. Quicke, and H. W. Browning. 1989. Two new species of *Digonogastra* Viereck (Hymenoptera: Braconidae) parasitic on neotropical pyralid borers (Lepidoptera) in maize, sorghum and sugarcane. *Bulletin of Entomological Research* 79: 401–410.
Wheeler, E. W. 1923. Some braconids parasitic on aphids and their life-history (Hym.). *Annals of the Entomological Society of America* 16: 1–29.
Wiackowska, I. 1963. Preliminary studies on predacious flies (Syrphidae) in the orchards of Skierniewice. / Wstepne badania nad drapnieznymi muchówkami (Díptera, Syrphidae) w sadach Skierniewic. *Prace Instytutu Sadownictwa w Skierniewicach* 7: 227–231.
Wilkinson, A. T. S. 1966. *Apanteles rubecula* Marsh. and other parasites of *Pieris rapae* in British Columbia. *Journal of Economic Entomology* 59: 1012–1013.
Williams, J. R. 1970. Cane pests. *Report of the Mauritius Sugar Industry Research Insititute* 1970: 77–80.
Willink, E. 1982. Species of *Diatraea* in sugar-cane fields in north-western Argentina. *Boletin, Estacion Experimental Agro-industrial 'Obispo Colombres'* No. 140, 38 pp.
Wilson, G. F. 1935. The rhododendron white fly. *Journal of the Royal Horticultural Society* 60(6): 264–271.
Wimshurst, F. M. 1925. The cherry black fly (*Myzus cerasi*). *Bulletin of Entomological Research* 16: 85–94.
Wojcik, B., W. R. Whitcomb, and D. H. Habeck. 1976. Host-range testing of *Telenomus remus* (Hymenoptera: Scelionidae). *Florida Entomologist* 59: 195–198.
Wolcott, G. N. 1924. Insectae Portoricensis [sic]. A preliminary annotated check–list of the insects of Porto Rico with descriptions of some new species. *Journal of the Department of Agriculture*, *Porto Rico* 7(1): 1–313.
Wolcott, G. N. 1934. The diapause portion of the larval period of *Diaprepes abbreviatus* L. *Journal of Agriculture of the University of Puerto Rico* 18(3): 417–428.
Wood, D. M. and R. D. Cave. 2006. Description of a new genus and species of weevil parasitoid from Honduras (Diptera: Tachinidae). *Florida Entomologist* 89: 239–244.
Wright, L. C. and W. W. Cone. 1988. Population dynamics of *Brachycorynella asparagi* (Homoptera: Aphididae) on undisturbed asparagus in Washington State. *Environmental Entomology* 17: 878–886.
Wright, M. G., T. P. Kuhar, M. P. Hoffmann, and S. A. Chenus. 2002. Effect of inoculative releases of *Trichogramma ostriniae* on populations of *Ostrinia nubilalis* and damage to sweet corn and field corn. *Biological Control* 23: 149–155.
Wu, S-A. and W-C. Yu. 2000. A study on *Physokermes shanxiensis* Tang (Homoptera: Coccoidea: Coccidae). *Scientia Silvae Sinicae* 36(2): 98–102.
Wu, G., D. Y. Wang Deng, and X-D. Wang. 2011. Investigation on species of predators of *Bemisia tabasi* [sic: *tabaci*] Gennadius in the cotton field by SCAR PCR. *Xinjiang Agricultural Sciences* 48(2): 223–228.
Wu, P-X., B-X. Ma, J. Xu, J. He, R. Zhang, and R-Z. Zhang. 2017. Predation of *Paratrioza sinica* Yang & Li by *Harmonia axyridis* adults. *Journal of Plant Protection* 44: 582–588.
Wyckhuys, K. A. G., R. L. Koch, and G. E. Heimpel. 2007. Physical and ant-mediated refuges from parasitism: implications for non-target effects in biological control. *Biological Control* 40: 306–313.
Wyckhuys, K. A. G., R. L. Koch, R. R. Kula, and G. E. Heimpel. 2009. Potential exposure of a classical biological control agent of the soybean aphid, *Aphis glycines*, on non-target aphids in North America. *Biological Invasions* 11: 857–871.
Wysoki, M. and S. Renneh. 1985. Introduction into Israel of *Trichogramma platneri* Nagarkatti, an egg parasite of Lepidoptera. *Phytoparasitica* 13: 139–140.
Wysoki, M., M. de Jong, and S. Rene. 1988. *Trichogramma platneri* Nagarkatti (Hymenoptera: Trichogrammatidae), its biology and ability to search for eggs of two lepidopterous avocado pests, *Boarmia* (*Ascotis*) *selenaria* (Schiffermüller) (Geometridae) and *Cryptoblabes gnideilla* (Milliere) (Phycitidae) in Israel. *Colloques de l'INRA* 43: 295–301.
Xia, B. C., Y. Zhang, and B. Y. Shen. 1986. Biology of *Chilocorus kuwanae* and its control of coccids in the field. *Chinese Journal of Biological Control* 2: 70–74
Xiao, Y. F. and H. Y. Fadamiro. 2010. Exclusion experiments reveal relative contributions of natural enemies to mortality of citrus leafminer, *Phyllocnistis citrella* (Lepidoptera: Gracillariidae) in Alabama satsuma orchards. *Biological Control* 54: 189–196.
Xiao, Y. F., J. A. Qureshi, and P. A. Stansly. 2007. Contribution of predation and parasitism to mortality of citrus leafminer *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) populations in Florida. *Biological Control* 40: 396–404.
Xie, Y-P., J-L. Xue, X-Y. Tang, and S-L. Zhao. 2004. The bunge prickly-ash tree damaged by a mealybug, *Phenacoccus azaleae* attracting the ladybug, *Harmonia axyridis*. *Scientia Silvae Sinicae* 40: 116–122.
Yadav, R., N. Yadav; R. Yadav, and R. R. Katiyar. 2010. Parasitization by *Cotesia plutellae* on major insect pests of crops under laboratory conditions. *International Journal of Plant Protection* 3(2): 293–294.
Yang, Z-Q., J. S. Strazanac, P. M. Marsh, C. van Achterberg, and W-Y. Choi. 2005. First recorded parasitoid from China of *Agrilus planipennis*: a new species of *Spathius* (Hymenoptera: Braconidae: Doryctinae). *Annals of the Entomological Society of America* 98: 636–642.
Yang, Z-Q., J. S. Strazanac, Y-X. Yao, and X-Y. Wang. 2006. A new species of emerald ash borer parasitoid from China belonging to the genus *Tetrastichus* Haliday (Hymenoptera: Eulophidae). *Proceedings of the Entomological Society of Washington* 108: 550–558.
Yang, Z-Q., X-Y. Wang, J. R. Gould, and H. Wu. 2008. Host specificity of *Spathius agrili* Yang (Hymenoptera: Braconidae), an important parasitoid of the emerald ash borer. *Biological Control* 47: 216–221.
Yasar, B. and S. Özger. 2005. Functional response of *Oenopia conglobata* (L.) (Coleoptera: Coccinellidae) on *Hyalopterus pruni* (Geoffroy) (Homoptera: Aphididae) in three different size arenas. *Türkiye Entomoloji Dergisi* 29(2): 91–99.

Yasnosh, V., M. Rtskhiladze, and E. Tabatadze. 2001. Coccids (Hemiptera, Coccinea) and their natural enemies in the vineyards of Georgia: present situation. *Bollettino di Zoologia Agraria e di Bachicoltura* 33(3): 351–355.

Yastrebov, I. O. 1978. The role of certain ecological factors in the control of cabbage pests. *Vestnik Zoologii* 1: 84–87.

Yazdani, M. and M. Zarabi. 2009. Studies on developmental stages of *Clitostethus arcuatus* (Coleoptera: Coccinellidae) on ash whitefly with note on a new host, *Aleyrodes singularis*. *Hexapoda* 16(1): 14–17.

Yitaferu, K. and A. Gebre-Amlak. 1994. Phenology and survival of the maize stalk borer, *Busseola fusca* in eastern Ethiopia. *Insect Science and its Application* 15: 177–184.

Yigit, A. and S. Telli. 2013. Distribution, host plants and natural enemies of *Pseudococcus cryptus* Hempel (Hemiptera: Pseudococcidae), injurious to citrus plantations in Hatay. *Türkiye Entomoloji Dergisi* 37: 359–373.

Yokomi, R. K. and Y. Q. Tang. 1995. Host preference and suitability of two aphelinid parasitoids (Hymenoptera: Aphelinidae) for aphids (Homoptera: Aphididae) on citrus. 2011. *Journal of Economic Entomology* 88: 840–845.

Yokoyama, V. Y., P. A. Rendón, X. G. Wang, S. B. Opp, M. W. Johnson, and K. M. Daane. 2011. Response of *Psyttalia humilis* (Hymenoptera: Braconidae) to olive fruit fly (Diptera: Tephritidae) and conditions in California olive orchards. *Environmental Entomology* 40: 315–323.

Yong, T. H., S. Pitcher, J. Gardner, and M. P. Hoffmann. 2007. Odor specificity testing in the assessment of efficacy and non-target risk for *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae). *Biocontrol Science and Technology* 17: 135–153.

You, L-S., A-P. Zeng, and L-Z. 2012. Identification of a *Cotesia* species parasitizing on *Pieris rapae* from Beijing. *Journal of Hunan Agricultural University* 38: 61–63.

Yu, G-Y. 2015. First discovery of the honeysuckle whitefly, *Aleyrodes lonicerae* Walker (Hemiptera: Aleyrodidae) in China. *Acta Entomologica Sinica* 58: 1368–1372.

Yu, D. S. K. 2017. Home of Ichneumonoidea. http://www.taxapad.com/index.php

Yuan, X-H., L-W. Song, J-J. Zhang, L-S. Zang, L. Zhu, C-C. Ruan Chang, and G-Z. Sun. 2012. Performance of four Chinese *Trichogramma* species as biocontrol agents of the rice striped stem borer, *Chilo suppressalis*, under various temperature and humidity regimes. *Journal of Pest Science* 85: 497–504.

Zachrisson, B., V. Costa, and J. Bernal. 2014. Natural incidence of eggs parasitoids of *Oebalus insularis* Stal (Heteroptera: Pentatomidae) in Panama. *IDESIA* 32(2) 119–121.

Zlatanova, A. A. 1970. The biology of *Microdus rufipes* Nees (Hymenoptera, Braconidae)—a parasitoid of the codling moth in Kazakhstan. *Entomologicheskoe Obozrenie* 49(4): 749–755.

Zhang, Y. and J. E. Cossentine. 1995. *Trichogramma platneri* (Hym.: Trichogrammatidae): host choices between viable and nonviable codling moth, *Cydia pomonella*, and three-lined leafroller, *Pandemis limitata* (Lep.: Tortricidae) eggs. *Entomophaga* 40: 457-466.

Zhang, Y., Q-J. Qin, J. Chen, S. Liu, and Y-Z. He. 2008. Effects of five species aphids on development and fecundity of *Harmonias axyridis* (Pallas). 2008. *Acta Phytophylacica Sinica* 35: 394–398.

Zhang, Y-Z., S-L. Si, J-T. Zheng, H-L. Li, Y. Fang, C-D. Zhu, and A.P. Vogler. 2011. DNA barcoding of endoparasitoid wasps in the genus *Anicetus* reveals high levels of host specificity (Hymenoptera: Encyrtidae). *Biological Control* 58: 182–191.

Zhang, Y-B., C. Castañé, R. Gabarra, R. Albajes, and F-H. Wan. 2015. Host selection by the autoparasitoid *Encarsia pergandiella* on primary (*Bemisia tabaci*) and secondary (*Eretmocerus mundus*) hosts. *Insect Science* 22: 793–802.

Zhao, J-J., Z-L. Wang, S-D. Ye, S. Y. Wang, Y. Chen, and X-M. Chen. 2003. Investigation on species of natural enemies from natural population of *Ericerus pela* (Chavannes) and their damage in Kunming. *Forest Research, Beijing* 16(1): 32–38.

Zhu, Y. C. and Q. Q. Fang. 2009. The phylogenetic relationships of introduced *Aphelinus* (Hymenoptera: Aphelinidae), biological control agents of the Russian wheat aphid (Homoptera: Aphididae). *Insect Science* 16: 277–285.

Zilahi-Balogh, G.M.G., L.T. Kok, and S.M. Salom. 2002. Host specificity of *Laricobius nigrinus* Fender (Coleoptera: Derodontidae), a potential biological control agent of the hemlock woolly adelgid, *Adelges tsugae* Annand (Homoptera: Adelgidae). *Biological Control* 24: 192–198.

Zolnerowich, G. and M. Rose. 1996. A new species of *Entedononecremnus* (Hymenoptera: Chalcidoidea: Eulophidae) parasitic on the giant whitefly, *Aleurodicus dugesii* Cockerell (Homoptera: Aleyrodidae). *Proceedings of the Entomological Society of Washington* 98(2): 369–373.

Zolnerowich, G. and M. Rose. 1998. *Eretmocerus* Haldeman (Hymenoptera: Aphelinidae) imported and released in the United States for control of *Bemisia* (*tabaci* complex) (Homoptera: Aleyrodidae). *Proceedings of the Entomological Society of Washington* 100: 310–323.

Zolnerowich, G. and M. Rose. 2004. *Eretmocerus rui* n. sp. (Hymenoptera: Chalcidoidea: Aphelinidae), an exotic natural enemy of *Bemisia* (*tabaci* group) (Homoptera: Aleyrodidae) released in Florida. *Florida Entomologist* 87: 283–287.

Zorin, P. V. and L. M. Zorina. 1928. Contributions à la biologie de la *Polia olerácea* L. *Zashchita rastenii ot vreditelei* 5(5–6): 475–486.

Zucchi, R. and J. C. van Lenteren. 1978. Biological characteristics of *Opius pallipes* Wesmael [sic *Dacnusa sibirica*] (Hymenoptera: Braconidae), parasite of the tomato leafminer *Liriomyza bryoniae* Kalt. *Mededelingen van de Faculteit Landbouwwetenschappen Rijksuniversiteit Gent* 43: 455–462.

Zuparko, R. L., D. L. de Queiroz, and J. LaSalle. 2011. Two new species of *Tamarixia* (Hymenoptera: Eulophidae) from Chile and Australia, established as biological control agents of invasive psyllids (Hemiptera: Calophyidae, Triozidae) in California. *Zootaxa* 2921: 13–27.

Index

E

F

G

H

I

J

L

M