

USDA's Systematic Entomology
Laboratory (SEL): Global
leadership and innovation in
insect systematics

M. Alma Solis
Research Leader

The U.S. Entomology Collection- 1885

The brainchild of Charles V. Riley,
Chief USDA entomologist

- *He donated his collection to
Smithsonian Institution
- *It included 30,000 species (3,000
species of economic importance),
150,000 specimens, housed in
800 boxes
- *and the USDA collection consisted
of 623 insect boxes



C.V. Riley wrote in 1890:

- *“The ideal cabinet collection of a National Museum should represent, as completely as possible, the insect fauna of a country, properly classified and determined.*
- *It should constitute a study collection to which workers are drawn for unpublished facts and for comparison and determinations.*
- *It will be many years ere such an ideal collection can be gotten together, and none now may witness it, but the material now on hand forms a good foundation for it.”*

The partnership between
The U.S. National Collection
(Smithsonian Institution)

and

The
Systematic Entomology Laboratory,
(U.S. Department of Agriculture)



Smithsonian
National Museum of Natural History

Washington, DC



Entomology Collection

**National Museum
of Natural History**

Washington, DC

Beltsville Agricultural Research Center Beltsville, MD





USA: New Mexico
Valle Caldera Nat'l Preserve
road VC0301
21 August 2007
ex: *Cirsium scolorum*
A. Jensen coll.

SEL VCNP#1



Aphis
helianthi Monell

USNM ENT



00743000

**Beltsville Agricultural
Research Center**

Beltsville, MD

“It should constitute a study collection to which workers are drawn for unpublished facts and for comparison and determinations.”

C.V. Riley 1890

SEL FACTOID

17 scientists

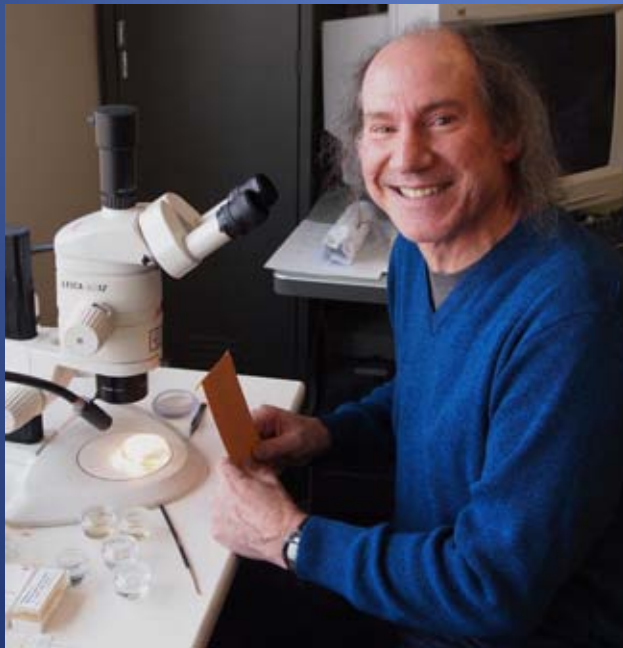
Responsible for

642 families of insects and mites

Over 15 millions specimens

Each scientist conducts research in a few or even one family of insects, but is responsible for many families as Curator of the National Collection.

For example, John Brown conducts research on Tortricoidea or leaf rolling moths, but is responsible for many other families of micromoths:



Alucitidae
Amphisbatidae
Autostichidae
Batrachedridae
Brachodidae
Chimabachidae
Choreutidae
Coleophoridae
Cosmopterigidae
Deoclonidae
Elachistidae
Epermeniidae
Gelechiidae
Glyphidoceridae
Immidae
Lecithoceridae
Oecophoridae
Peleopodidae
Schistonoeidae
Sesiidae
Sphingidae
Tortricidae
Urodidae
Xyloryctidae

Field Work

creates, enhances

Collections

provide data for

Research

Morphological
Molecular

Information

Distribution
Biology

Identifications

Scientific Names
Potential Pests,
Invasives



The scientists in the Systematic Entomology Laboratory conduct targeted fieldwork via various avenues:

Individual expeditions



M. Buffington in Florida



R. Kula in Kansas



**A. Konstantinov & M. Gates
in Florida**



**S. Scheffer
in Australia**



N. Vandenberg

Biodiversity Inventories



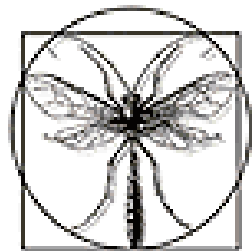
Discover Life in America
Great Smoky Mountains National Park All Taxa Biodiversity Inventory



Instituto Nacional de Biodiversidad,
Area de Conservacion Guanacaste
Costa Rica



G. Miller, Valles Caldera National
Preserve, USDA



project

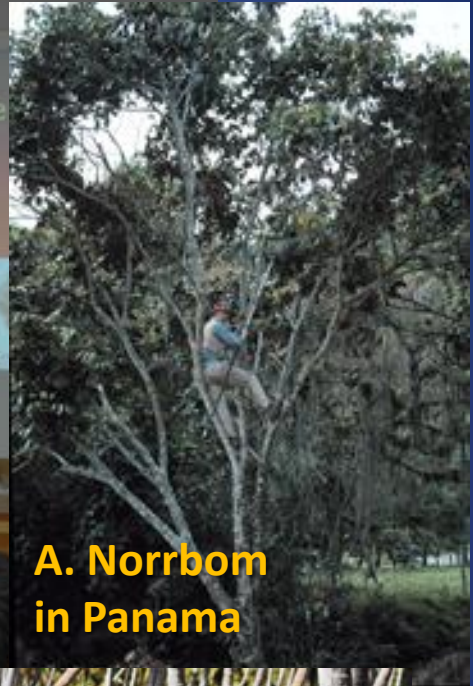
ALAS

Arthropods of La Selva



T. Henry,
Planetary Biodiversity Inventory

Training/Workshops



**A. Norrbom
in Panama**



R. Ochoa in Trinidad

*“It should constitute a study collection to which **workers are drawn** for unpublished facts and **for comparison and determinations.**”*

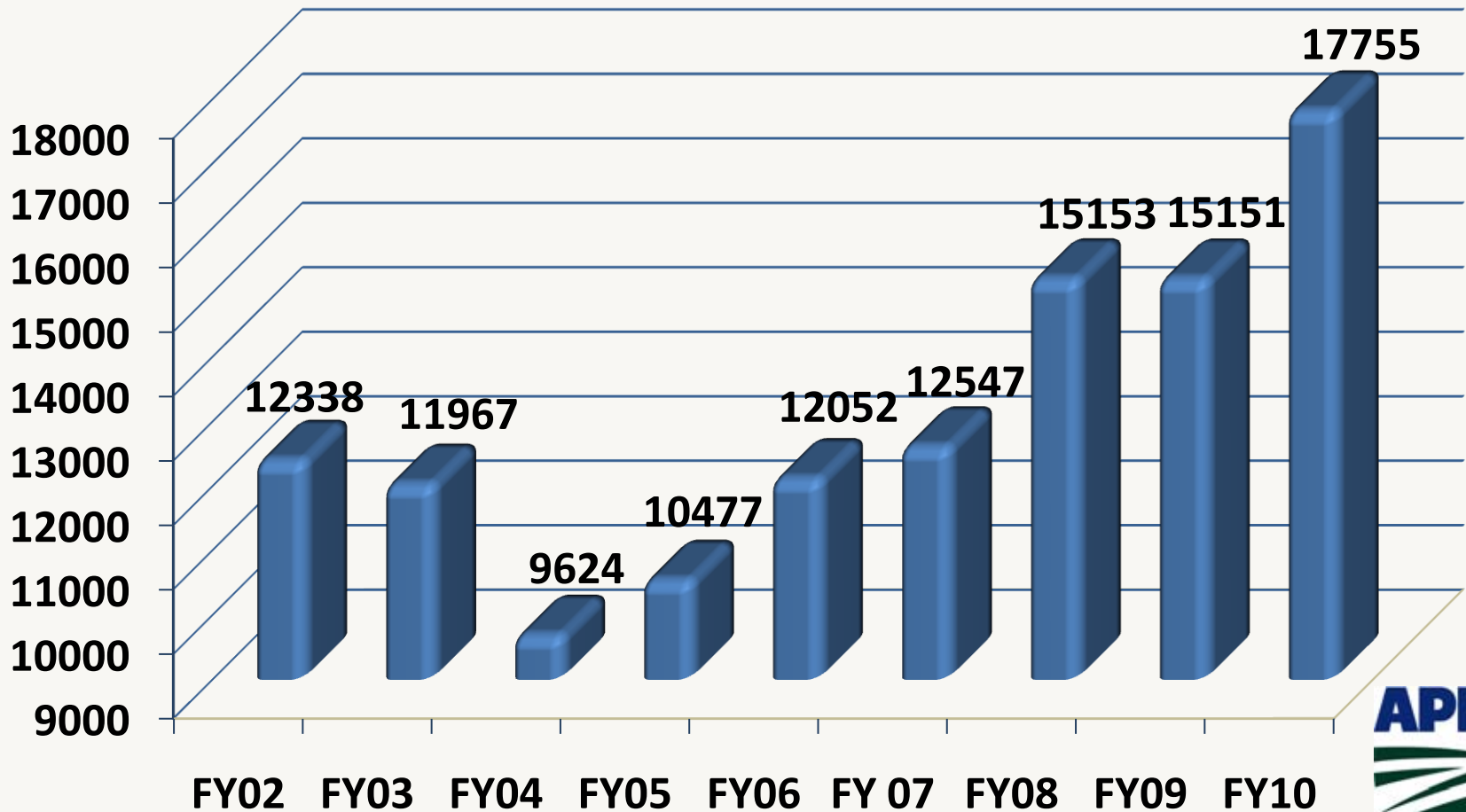
C.V. Riley 1890

SEL FACTOID

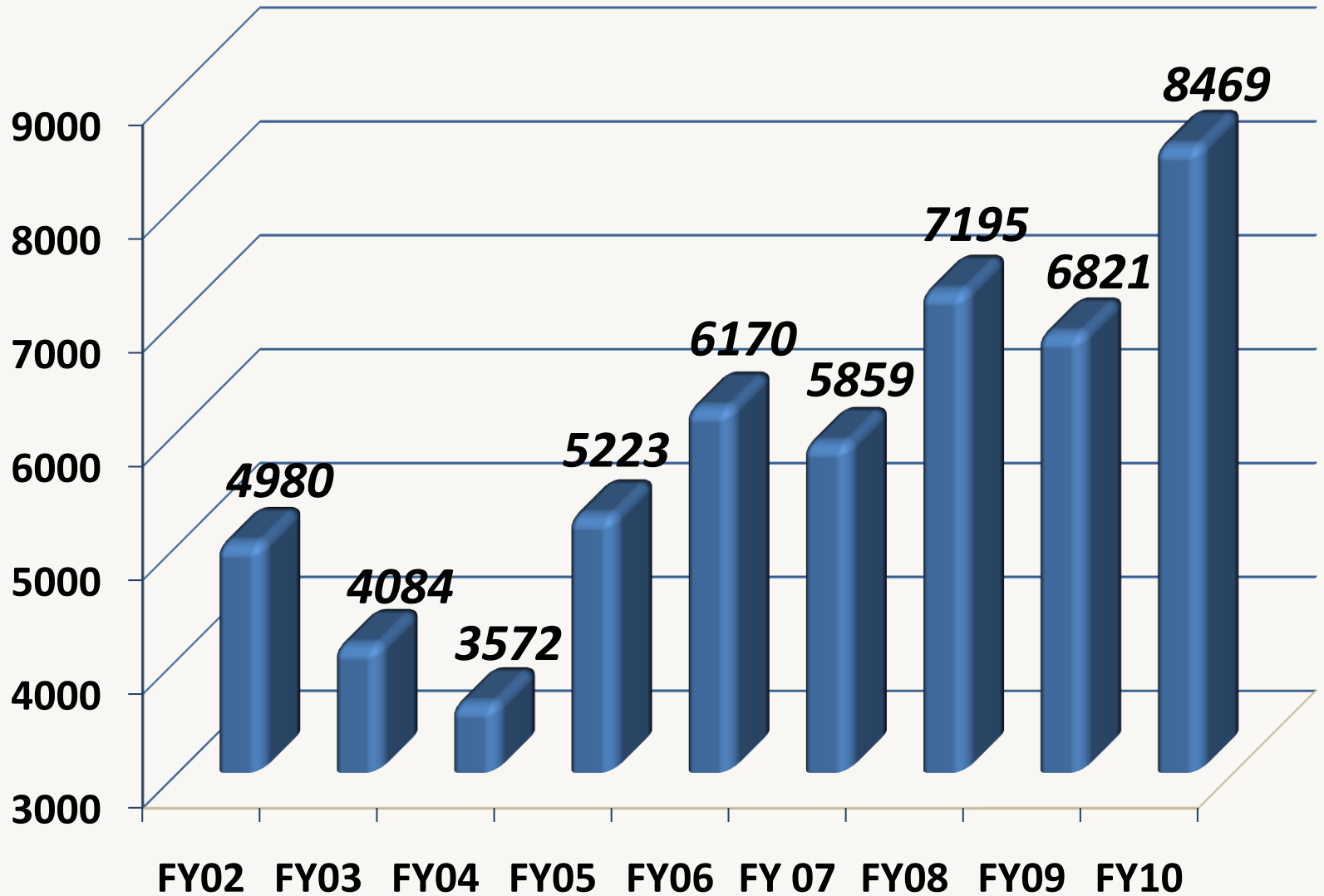
17 scientists

*Produce about 30,000
identifications per year*

SEL scientists provide identifications for insects intercepted at U.S. Ports

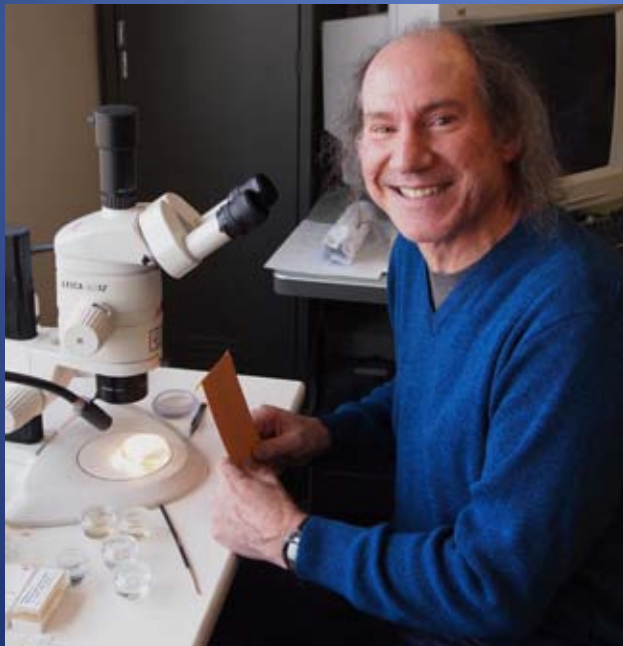


Total URGENT Identifications that are done with a few hours turnaround



Each scientist conducts research in a few or even one family of insects, but provides identifications for many families.

For example, John Brown conducts research on Tortricoidea or leaf rolling moths, but is provides identifications for many other families of moths:



Alucitidae	Limacodidae
Batrachedridae	Lyonetiidae
Blastobasidae	Lyonetiidae
Bucculatricidae	Megalopygidae
Carposinidae	Mimallonidae
Castniidae	Momphidae
Choreutidae	Nepticulidae
Coleophoridae	Oecophoridae
Cosmopterigidae	Plutellidae
Cossidae	Prodoxidae
Dalceridae	Psychidae
Elachistidae	Roeslerstammiidae
Epermeniidae	Scythrididae
Gelechiidae	Sesiidae
Glyphipterigidae	Tineidae
Gracillariidae	Tischeriidae
Heliozelidae	Tortricidae
Hepialidae	Xyloryctidae
Lacturidae	Yponomeutidae
Limacodidae	Ypsolophidae
	Zygaenidae

*“It should constitute a study collection to which
workers are drawn for unpublished facts and
for comparison and determinations.”*

C.V. Riley 1890

*Data mining
collections
for
Systematics
Research*

SEL FACTOID

17 scientists

*Produce more than 50 research
papers, books, and electronic
publications each year*

Each SEL scientist conducts systematic research to produce phylogenies or trees of relationships, complete revisions of groups of insects, and species descriptions,

but they also produce papers of impact for a wide variety of purposes. For example, John Brown has produced the following research papers in addition to the systematic papers.

Hostplant information

Brown, J. W. & S. Passoa. 1998. Larval foodplants of Euliini (Lepidoptera: Tortricidae): from *Abies* to *Vitis*. Pan-Pacific Entomologist

New pest species on commodities

Brown, J. W. 2000. A new genus of tortricid moths injurious to grapes and stone fruits in Chile (Lepidoptera: Tortricidae). Journal of the Lepidopterists' Society

Type specimen information

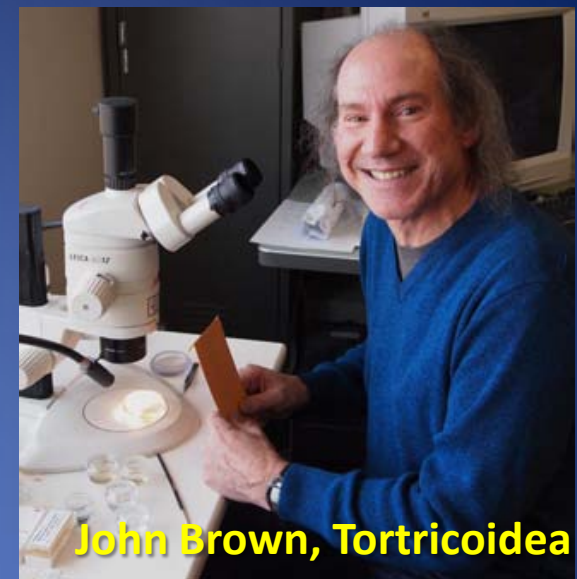
Brown, J. W. & J. A. Lewis. 2000. Catalogue of the type specimens of Tortricidae (Lepidoptera) in the collection of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Proceedings of the Entomological Society of Washington

New species for biological control

Brown, J. W. & C. Zachariades. 2007. A new species of *Dichrorampha* (Lepidoptera: Tortricidae) from Jamaica: a potential biocontrol agent against *Chromolaena odorata* (Asteraceae). Proceedings of the Entomological Society of Washington

Higher-level molecular phylogenies

Regier, J., Zwick, A., Cummings, M., Kawahara, A., Cho, S., Weller, Roe, A., S. Baixeras, J., Brown, J., Parr, C, Davis, D., Epstein, M., Hallwachs, W., Hausmann, A., Janzen, D., Kitching, I., Solis, A., Yen, S.-H., Bazinet, A., and Mitter, C. 2009. Toward reconstructing the evolution of advanced moths and butterflies (Lepidoptera: Ditrysia): initial molecular study. BMC Evolutionary Biology 9: 21 pp.



John Brown, Tortricodea

Distribution in space and time

Brown, J. W. 2001. Species turnover in the leafrollers (Lepidoptera: Tortricidae) of Plummers Island, Maryland: assessing a century of inventory data. Proceedings of the Entomological Society of Washington

Faunal surveys

Brown, J. W. & K. Bash. 2000. Lepidoptera of Marine Corps Air Station Miramar: Calculating faunal similarity among sampling sites and estimating overall species richness. Journal of Research on the Lepidoptera

Keys for identification

Brown, J. W. & F. Komai. 2008. Key to the larvae of *Castanea*-feeding Olethreutinae frequently intercepted at U.S. ports-of-entry. Tropical Lepidoptera Research

Nomenclature

Brown, J. W. 2006. Scientific names of pest species in Tortricidae (Lepidoptera) frequently cited erroneously in the entomological literature. American Entomologist

Revisionary systematics

Brown, J. W. & J. A. Powell. 2000. Systematics of *Anopina* Obraztsov (Lepidoptera: Tortricidae: Euliini). University of California Publications in Entomology

Character evolution

Rota, J., A. Yang, and J. W. Brown. 2009. Variation in the female frenulum in Tortricidae (Lepidoptera). Part 2. Olethreutinae. Proceedings of the Entomological Society of Washington

Catalogs

Brown, J. W. 2005. World Catalogue of Insects. Volume 5. Tortricidae (Lepidoptera). Apollo Books. 741 pp.

Imaging techniques

- Seizing upon modern technology, SEL has focused much of its energy and resources towards improving methods and techniques that effectively illustrate species.
- The result has been a profound improvement in how other scientists conduct and publish research on the vast biodiversity of arthropods.

Morphological Characters

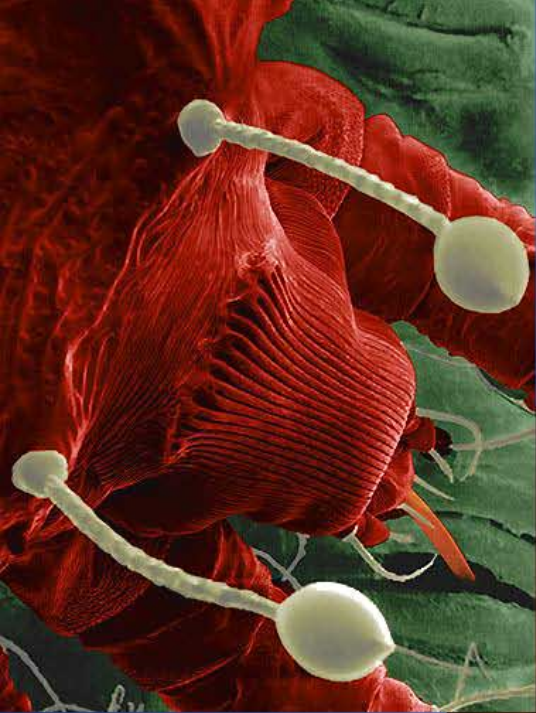




Low Temperature SEM



BARC Imaging Laboratory



Databasing and Web Page Initiatives

SEL is involved in worldwide internal databasing and web page initiatives that thrive on data associated with specimens.



ScaleNet

- Queries
- Background Information
- What's New
- Keys to Scale Insects
- Scale Photos
- Links to Other Sites
- SEL Home
- ARO Home

Agricultural Research Organization, The Volcani Center, Israel Department of Entomology



Welcome to ScaleNet. This site is all about scale insects (Coccoidea): a group of insects comprising about 100,000 species. Insects vary dramatically in their appearance from very small organisms (1-2mm) that occur under wax cover on oyster shells, to shiny pearl-like objects (about 5mm), to creatures covered with mealy wax. They spend most of their lives feeding on plants and are primarily important as plant pests in greenhouses, backyards, and on fruit trees.

The objective of our class is to study the life cycle of scale insects, namely Aculeata, Cercozoa, Dactylopiidae, Grolidae, Hemiptera, Kukulsiidae, Marchalidae (scales), Pentameridae, and Sericidae.

The Reference Collection (1755) Homoptera Coccoidea.

If you click on the information you will find...

SEL's Psyllidae Web Page

- Welcome & Introduction
- Search the Psyllidae Collection
- SEL's Home Page
- Collaborators & Site Content
- Links



The Entomology Laboratory is a member of the Plant Science Center at the Hebrew University of Jerusalem, which is part of the Agricultural Research Organization. It is located in the Department of Entomology.

The psyllids or jumping plantlice (Homoptera: Psyllidae) are a group of small plant-feeding insects. Along with aphids, whiteflies, and mealybugs, they belong to the group of sucking insects or the Phloem-feeders. The name "psyllid" comes from the Greek word *psyllon*, meaning short or broad and *psyllon* meaning insect, insect, or muscle and refers to the small location of the mouthparts of these insects.

Adult psyllids specifically resemble miniature cicadas but are only 1-2 mm in length. Although adults have two pairs of wings with reduced venation, they are weak fliers. They do, however, have specially developed legs that allow them to jump and the common name of jumping plantlice is aptly applied. Psyllid nymphs are three-toothed, flattened, are less mobile than adults, and are often found congregating. Nymphs of some psyllid species are covered with white waxy secretions and others are gall-formers. World-wide there are over 3000 described species of psyllids which feed mainly on woody dicotyledonous plants.



Psyllids can damage their host plants by feeding on the sap or injecting toxic saliva that may cause plant galling, malformation, or necrosis. Both adults and nymphs are plant feeding. Some species are also capable of transmitting plant diseases. Two such examples are the *citrus psyllid*, *Carpodacus citricola* (Javanese) (= *Psylla citricola*), which transmits *Little Leaf* in citrus in North America and the *citrus psyllid*, *Aspidiotus citricola* (Sulc) (= *Psylla citricola*), which serves as a vector of psyllid yellow in potatoes, tomatoes, eggplants, and peppers in North America and Mexico. Psyllid feeding can also result in the production of honeydew. This substance is high in sugars and serves as a substrate for fungi which can subsequently reduce photosynthesis in the plant.

Identification of psyllids is based primarily on the morphology of the adults. Structural differences of the head, wing venation, antennal length, and genitalia are some of the characters that are used for comparative purposes. In the past five years, greater emphasis is being placed on genital morphology for species identification.

The U.S. National Psyllidae collection is maintained by the USDA's Systematic Entomology Laboratory but is part of the Smithsonian's National Museum of Natural History. This collection is located in Building 505 at the USDA's Henry A. Wallace Institute.



Guide to Palearctic Flea Beetle Genera (Coleoptera: Chrysomelidae: Alticinae)
Alexander S. Konstantinov & Natalia J. Vandenbergh
Systematic Entomology Laboratory, USDA-ARS



Generic Key

Morphology

Generic Index



Host Plants

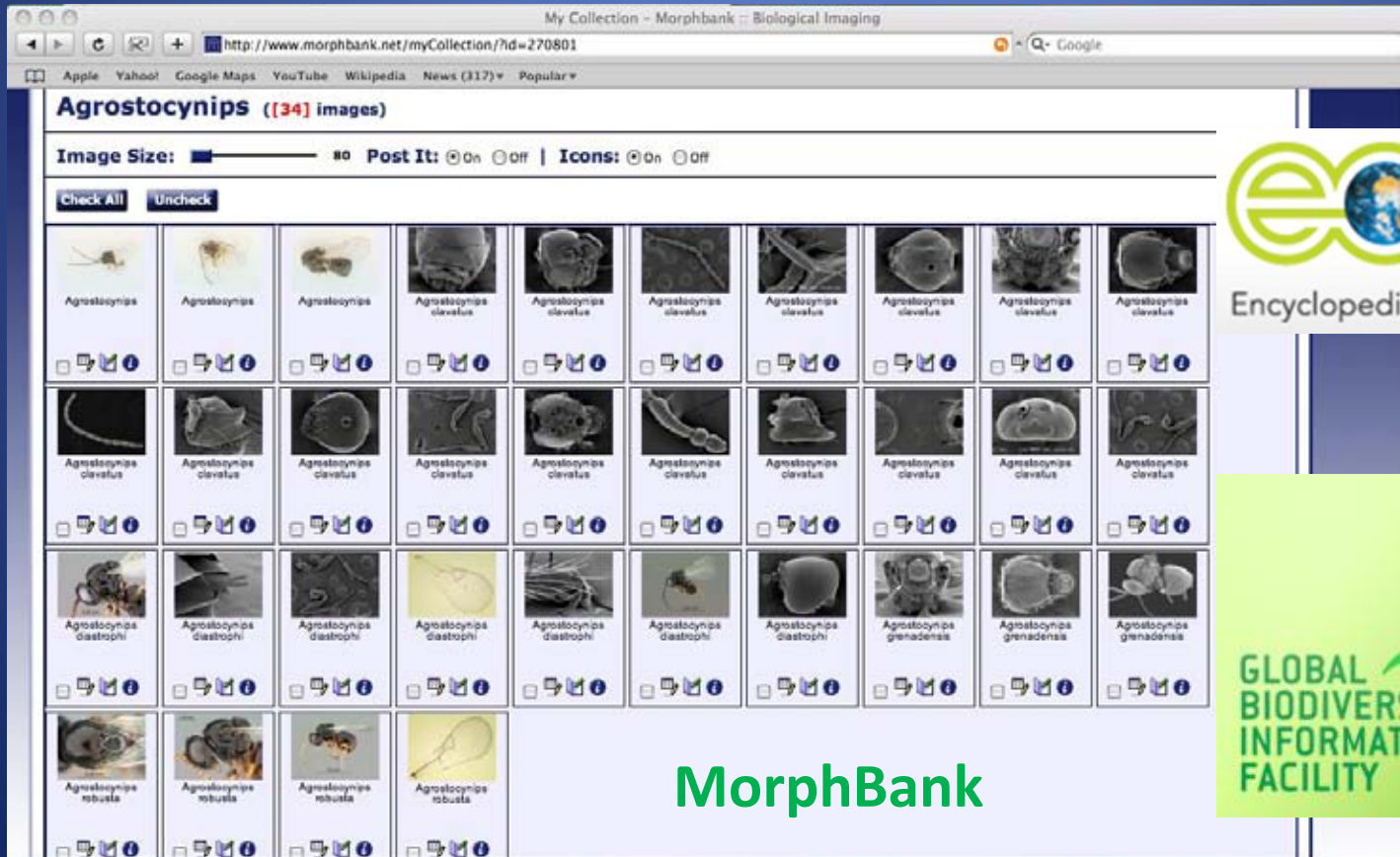
Overview of the Palearctic Fauna

Literature Cited

Acknowledgments | Flea Beetle Home

Databasing Initiatives

SEL is also involved in larger, external databasing initiatives that thrive on image data, such as MorphBank and GBIF that are linked to Encyclopedia of Life (EOL) and electronic publication outlets such as Zootaxa and ZooKeys.



The screenshot shows a web browser window with the URL <http://www.morphbank.net/myCollection/?id=270801>. The page title is "My Collection - Morphbank :: Biological Imaging". The main heading is "Agrostocynips ([34] images)". Below the heading are controls for "Image Size", "Post It" (On/Off), and "Icons" (On/Off). There are "Check All" and "Uncheck" buttons. The main content is a grid of 34 image thumbnails, each with a small icon set below it. The thumbnails are labeled with species names: Agrostocynips, Agrostocynips clavatus, Agrostocynips diastrophii, Agrostocynips genadensis, and Agrostocynips robusta.



MorphBank

Type Specimen databases for

“Creating the virtual museum for the 21st century”



Smithsonian
National Museum of Natural History



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NMNH Home | NMNH Research & Collections | Entomology | Collections

Search the Department of Entomology Collections

Entomology Collections | Keyword Search | Search by Field | Illustration Archive | Help | Feedback

Entomology Collections Search

The **U.S. National Entomological Collection** is the world's largest accessible collection, with over 35 million specimens. The electronic records available here focus on **type specimens** as well as the general Odonata collections. Data for several taxonomic groups are indicated, at the end of detailed records, as reviewed by staff of the Smithsonian or affiliates **USDA Systematic Entomology Laboratory** and **Walter Reed Biosystematics Unit**. Legacy data for several taxonomic groups are kept available while under review and will be updated upon completion. Data and images for all specimens should be considered provisional. We will be updating and adding records and images regularly.

Search the Collection

The screenshot shows the search interface with a search form on the left and a list of results on the right. The search form includes fields for 'Number Specimens', 'Order', 'Family', 'Subfamily', 'Genus', 'Species', 'Author & Date', 'Country', 'Sex', 'Age', 'Length', and 'Weight'. The results list shows columns for 'Number Specimens', 'Order', 'Family', 'Subfamily', 'Genus', 'Species', 'Author & Date', 'Country', 'Sex', 'Age', 'Length', and 'Weight'. The first result is for 'Nymphalid' specimens of 'Gnathocentrus' from 'Cuba'.

Search tab above. Searches can be run against specific fields. Illustration Archive records is also available. If you do not click Browse list below.

records. If you need to retrieve a larger record set, please

for returned results (sorting, exporting, etc.).

Imaged
Odonata type
specimens



Selected
Illustration
Archive
records

Policy

Search | Donate | Membership | Shop | IMAX | DiGIR Access Point

Types or name-bearing specimens represent an irreplaceable resource to taxonomists.

In collaboration with the Smithsonian Institution, SEL has placed large numbers of e-types (images and associated information) on the web thereby making them available from anywhere on the planet.

LUCID keys for identification

In collaboration with APHIS, SEL has created LUCID keys of quarantine significance with images and associated information.

These are on the web making them available to anyone on the planet.

Home
Getting Started
Check for Java
About Lucid

Scale Tools

- Scale Families
- Mealybugs
- Soft Scales
- Other Scales


Systematic Entomology
Laboratory, ARS, USDA


Center for Plant Health
Science and Technology,
APHIS, USDA
National Identification
Service, APHIS, USDA

SCALE INSECTS

Identification Tools for
Species of Quarantine Significance

Site last updated • August 27, 2007 Interactive key: Lucid v. 3.3

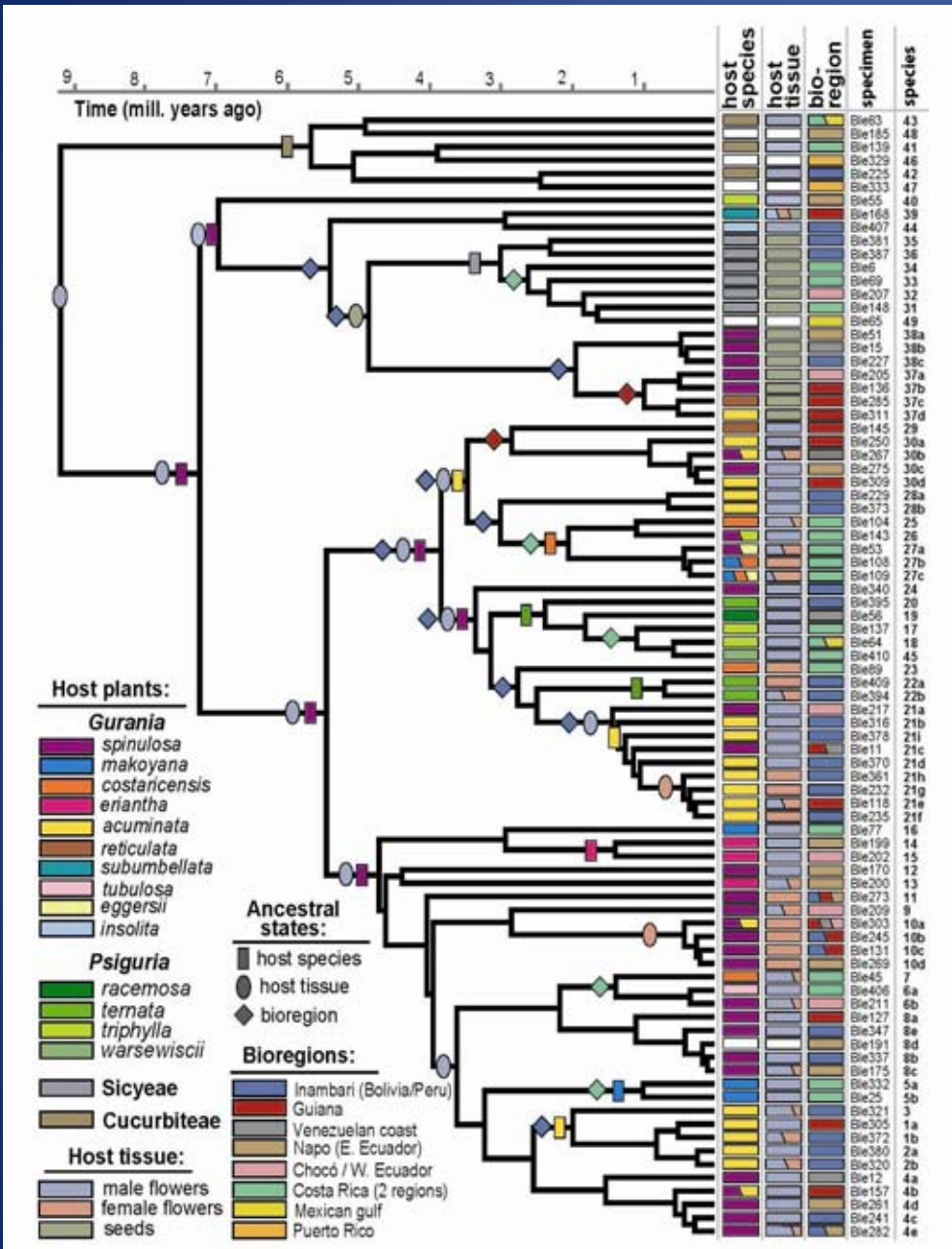
Molecular characters or “DNA helps light the way”

SEL's molecular lab uses a multigene sequence approach to phylogenetic analysis of many taxa at various taxonomic levels, from reconstructing higher-level relationships to deciphering species limits using COI to better understand complexes involving cryptic species.



SEL Molecular Laboratory





Collaborations:



Tree-of-Life



**Current SEL Initiative:
Non-destructive DNA
extraction from specimens in
collections**



Systematic Entomology Laboratory

Current research initiatives

- Systematic research on insects on wheat and their parasitoids in collaboration with an ARS conservation biological control project
- LUCID projects in mites, aphids, and *Diabrotica* in collaboration with APHIS
- Faunal survey of insects and mites with on-going reforestation at Valles Caldera National Preserve
- Systematic research on the Emerald Ash Borer and relatives in collaboration with the Forest Service
- Barcoding of tephritid fruit flies in collaboration with APHIS and fruit fly workers worldwide

