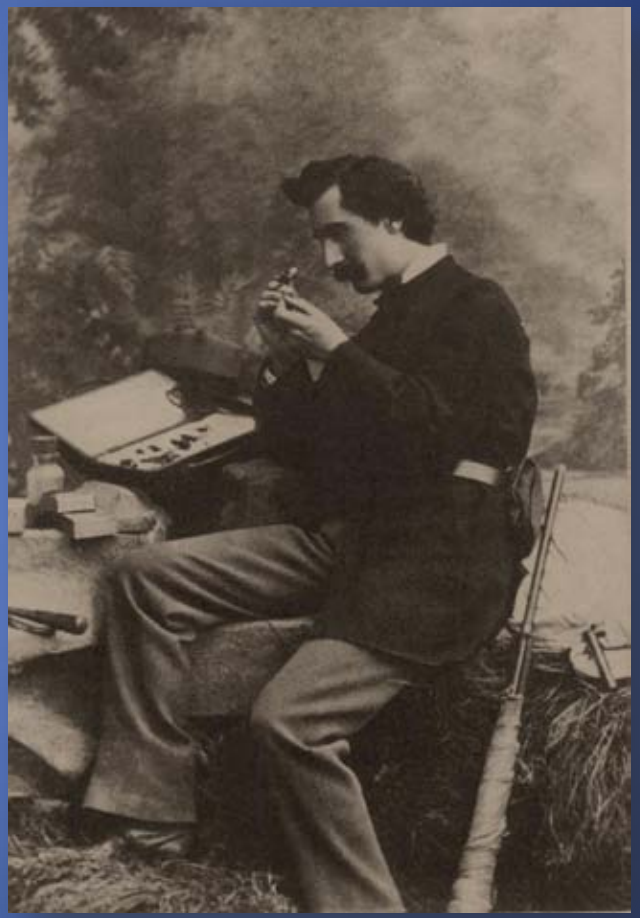
USDA's Systematic Entomology Laboratory (SEL): Global leadership and innovation in insect systematics

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- *It should constitute a study collection to which workers are drawn for unpublished facts and for comparison and determinations.*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

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"It should constitute a study collection to which workers are drawn for unpublished facts and for comparison and determinations."

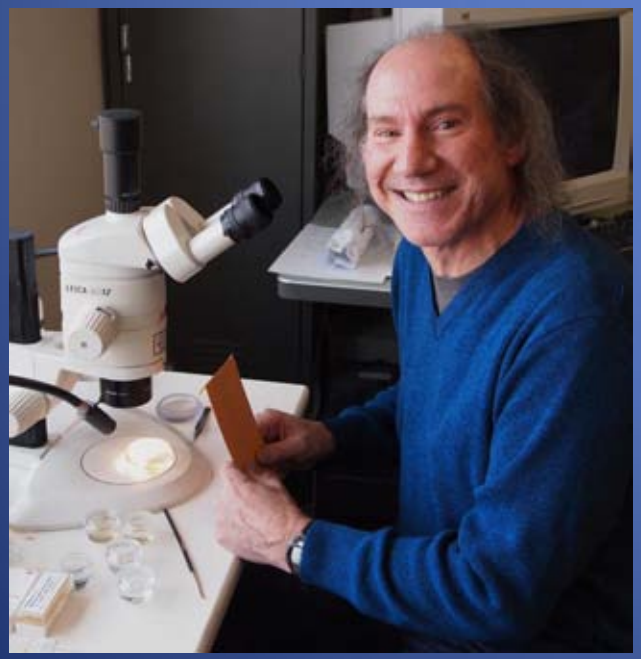
C.V. Riley 1890

SEL FACTOID

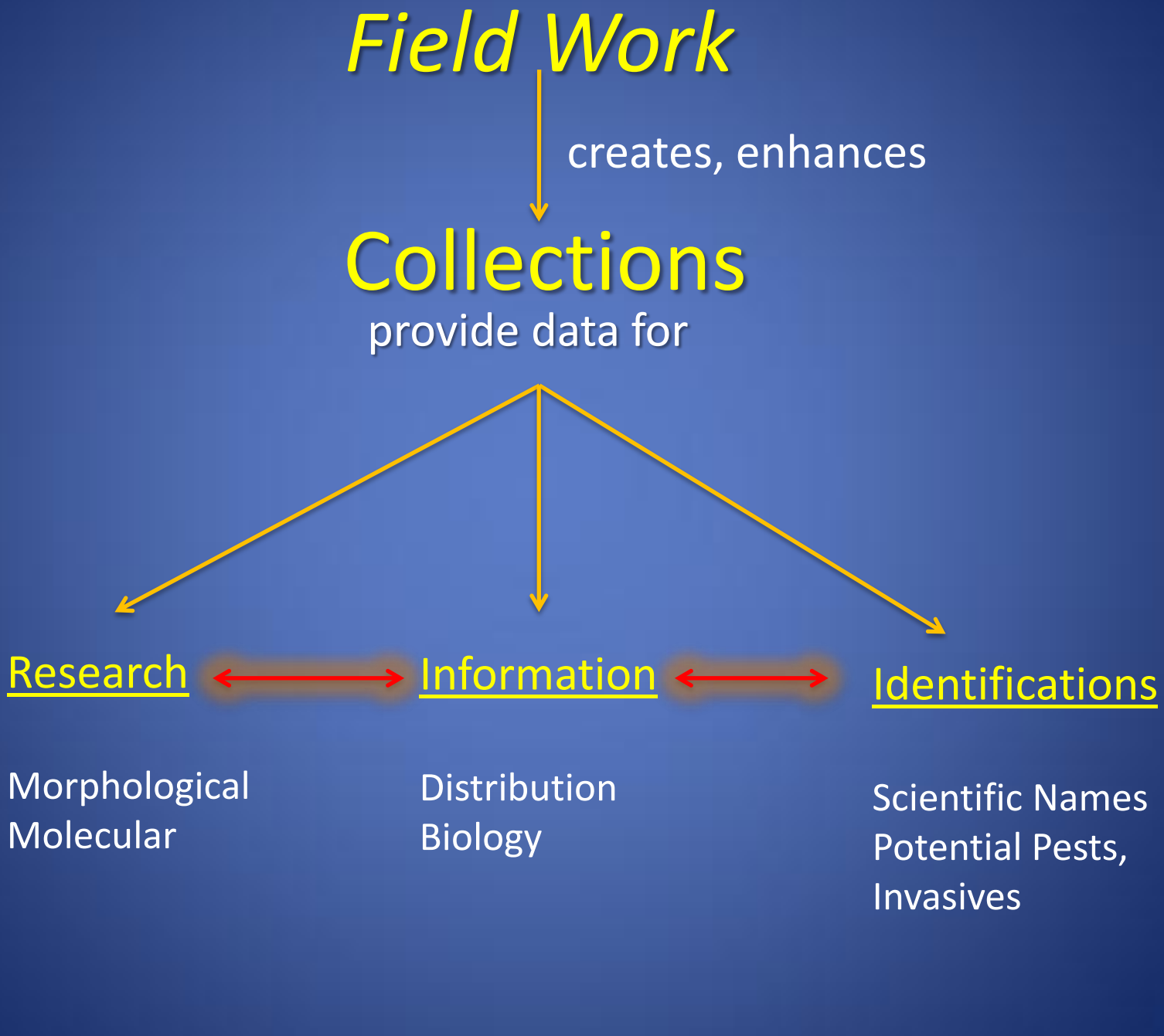
17 scientists
Responsible for
642 families of insects and mites
Over 15 millions specimens

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
Information
Identifications
Morphological
Molecular
Distribution
Biology
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

NSF

project ALAS

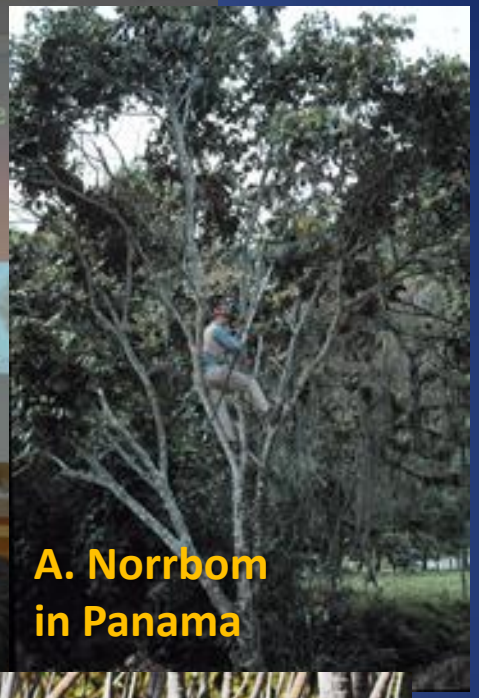
Arthropods of La Selva

G. Miller, Valles Caldera National Preserve, USDA

T. Henry, Planetary Biodiversity Inventory

Training/Workshops

National Plant Diagnostics Network



A. Norrbom
in Panama

R. Ochoa in Trinidad

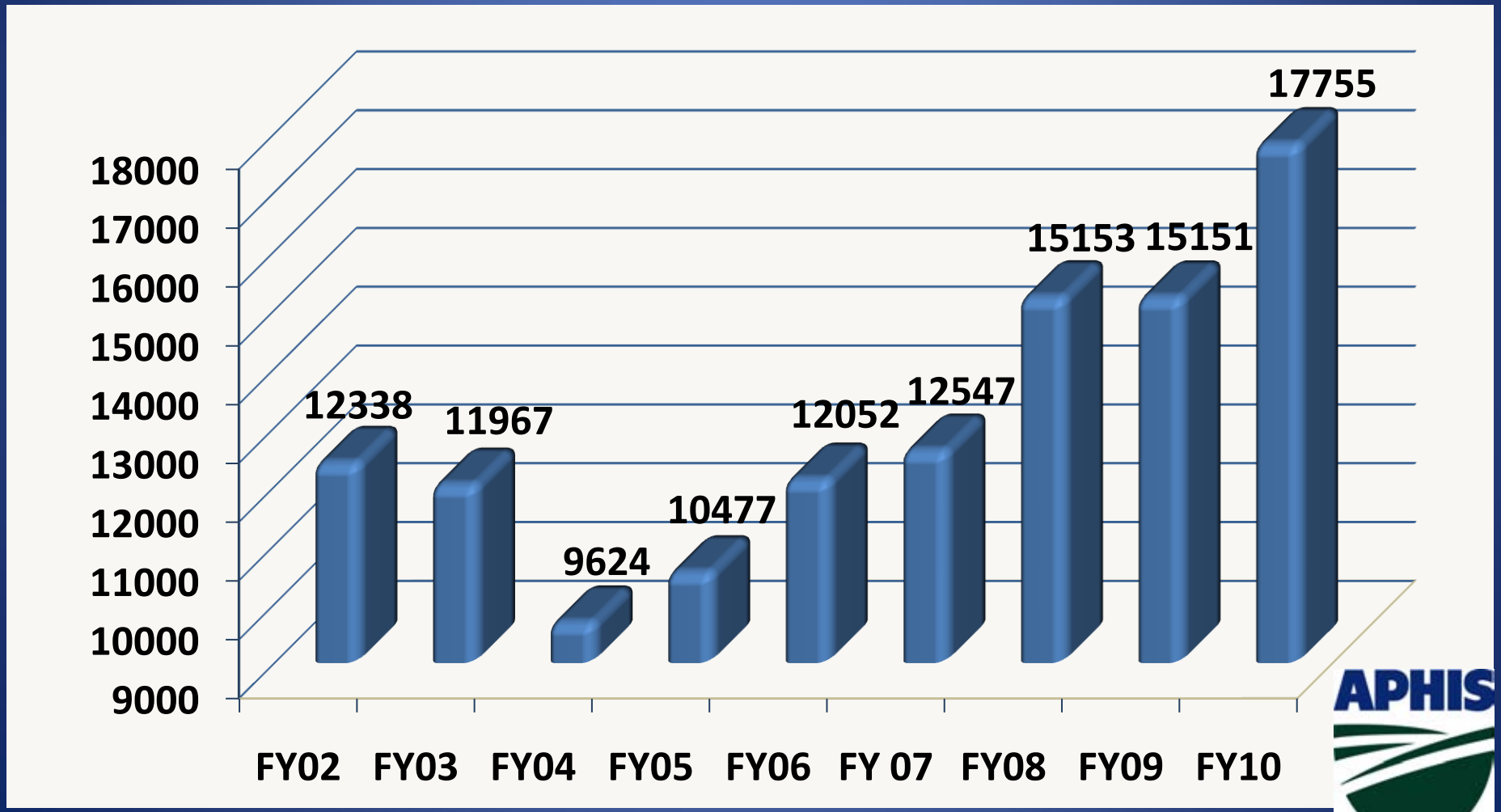
“It should constitute a study collection to which workers are drawn for unpublished facts and for comparison and determinations.”

C.V. Riley 1890

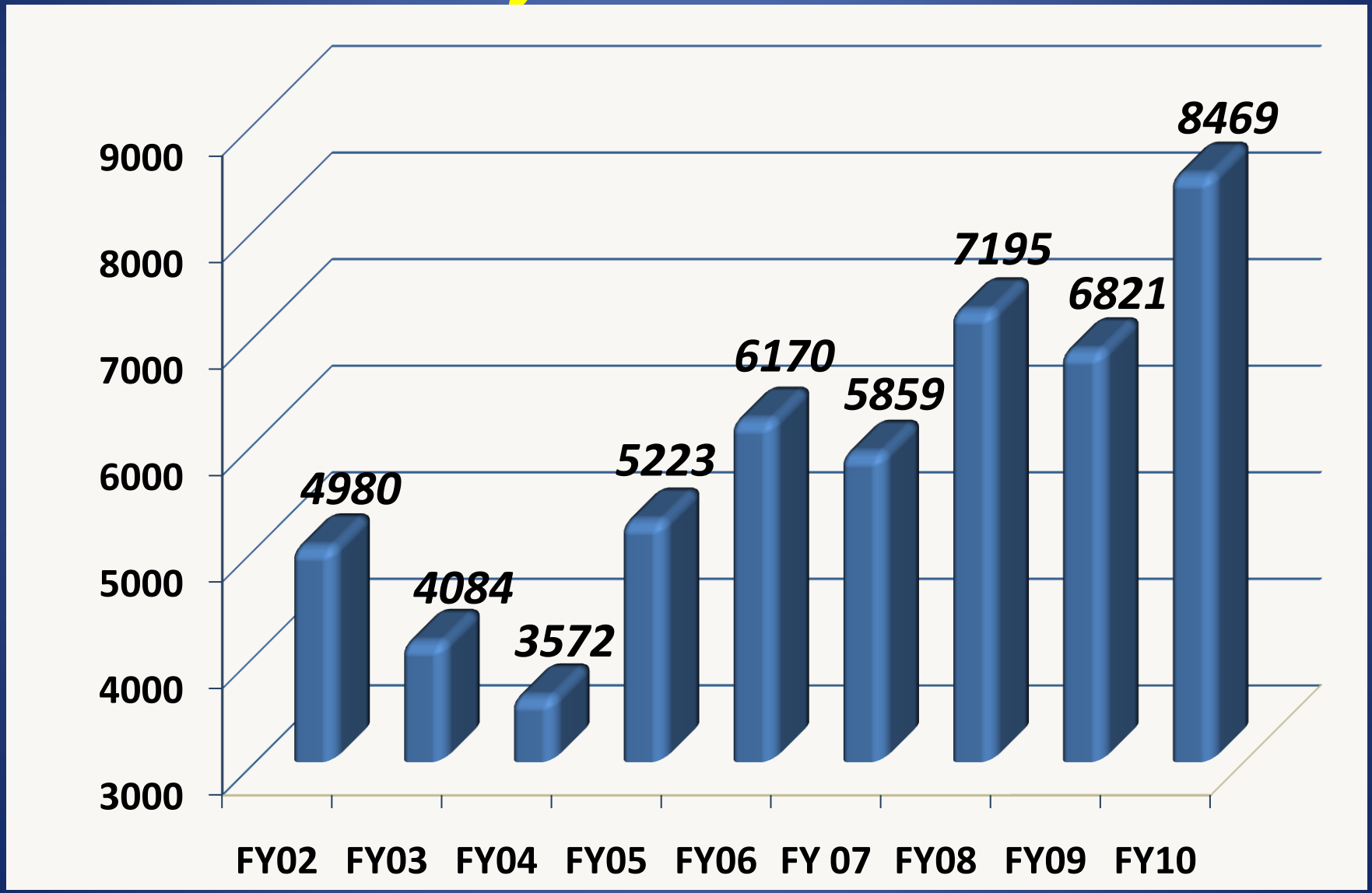
SEL FACTOID

17 scientists
Produce about 30,000 identifications per year

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

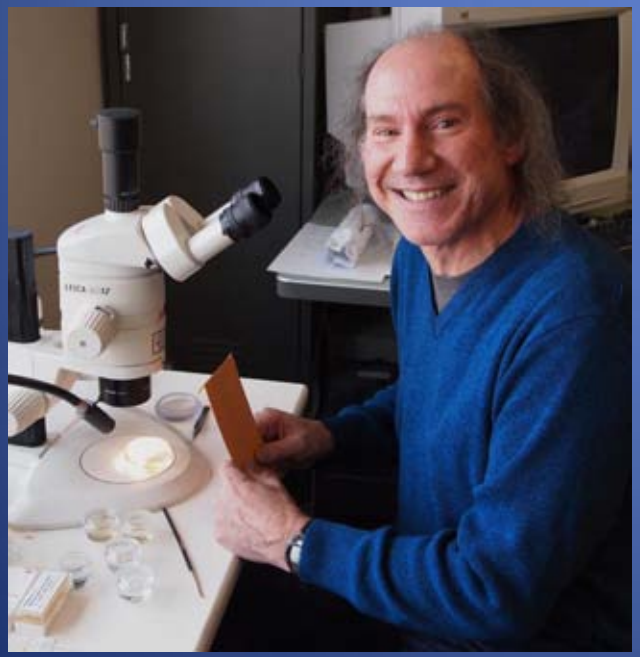


Total URGENT Identifications that are done with a few hours turnaround



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

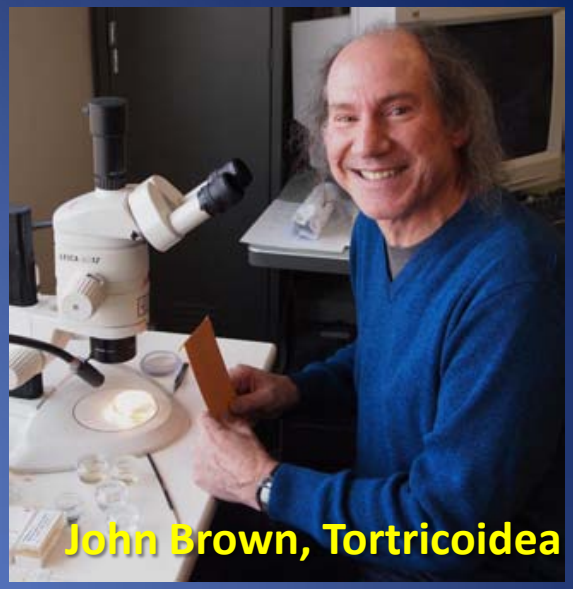
Data mining collections for Systematics Research

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.

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

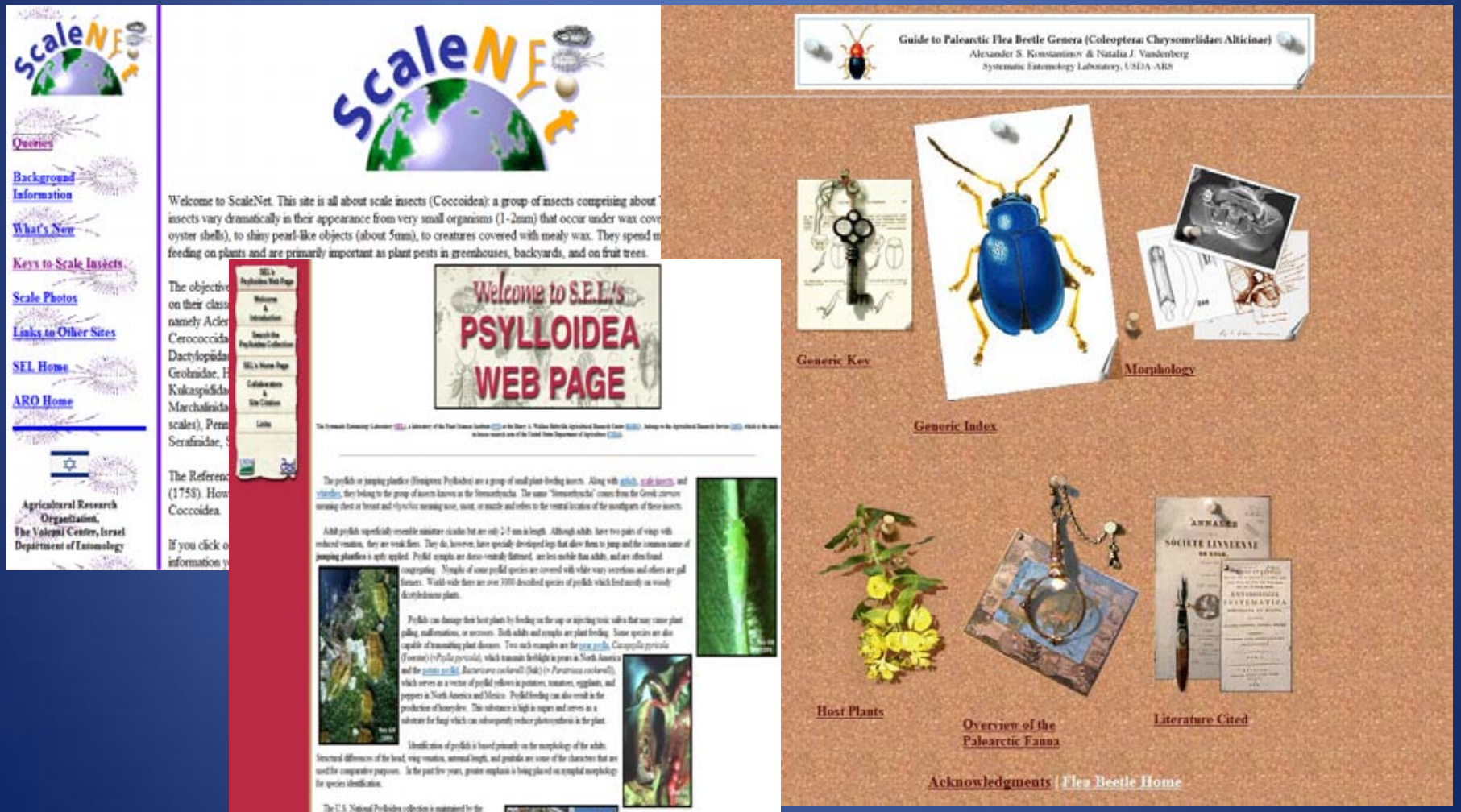
Low Temperature SEM

BARC Imaging Laboratory


1 mm

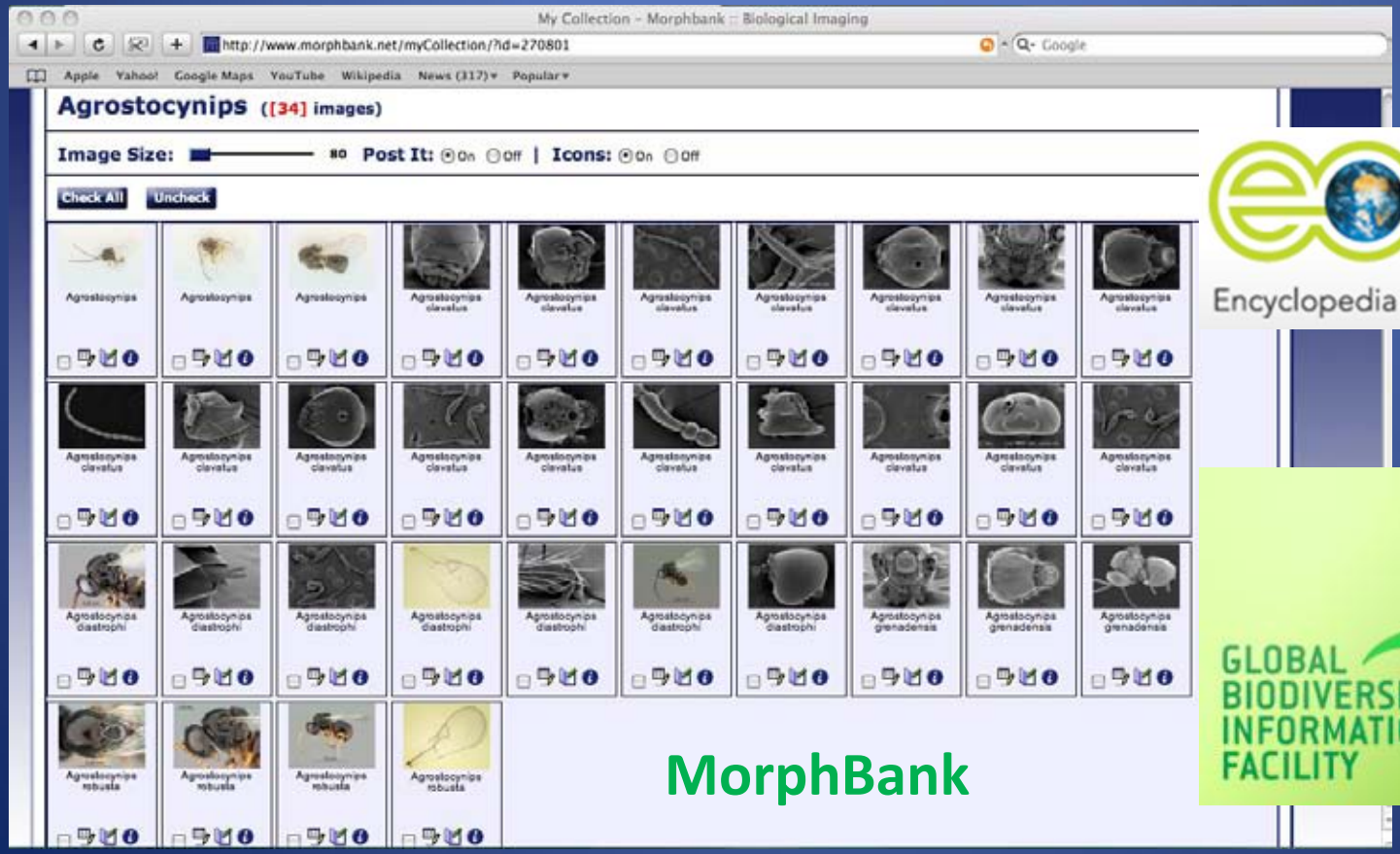
Databasing and Web Page Inititatives

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



Databasing Inititatives

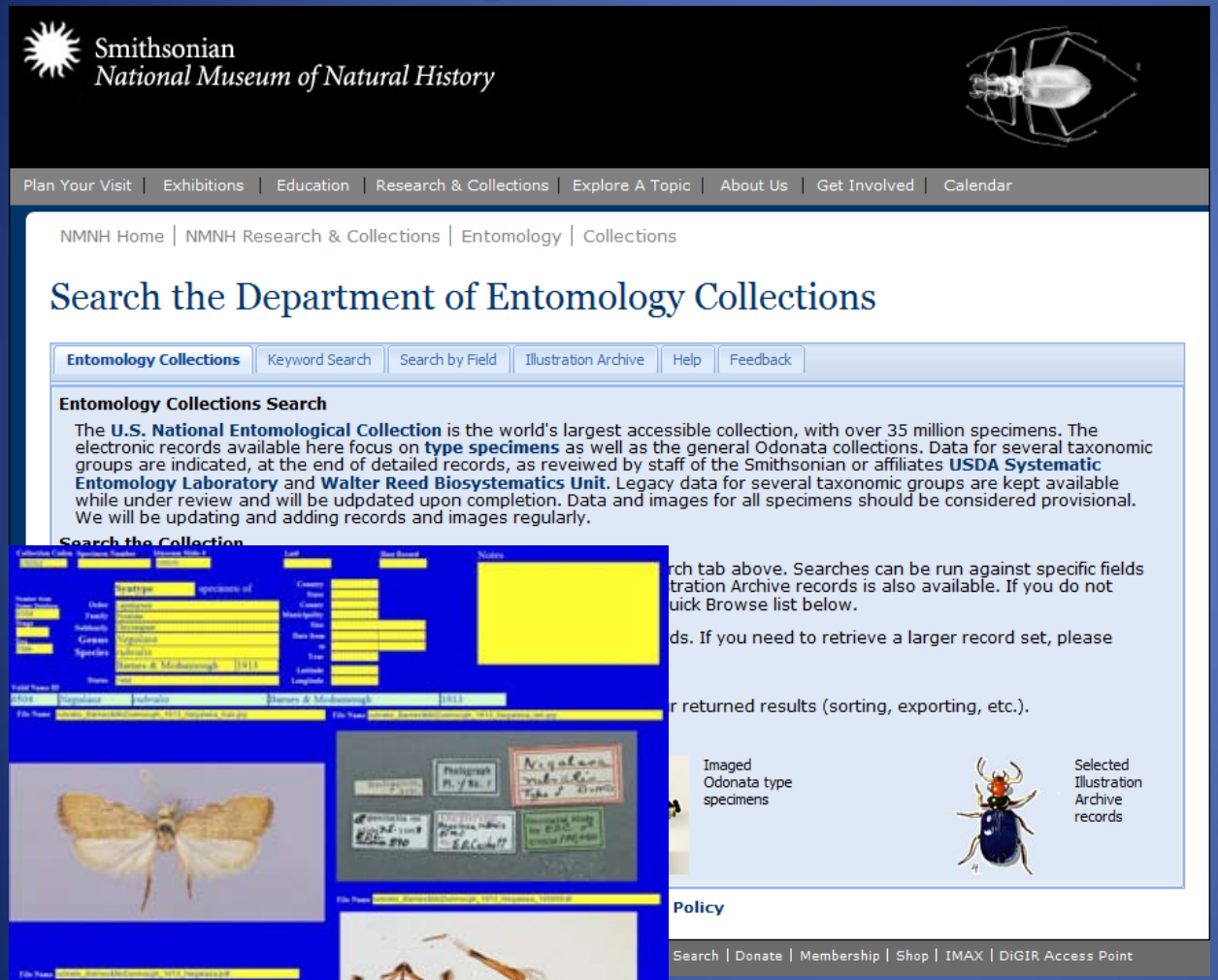
SEL is also involved in larger, external databasing intiatives that thrive on image data, such as MorphBank and GBIF that are linked to Encyclopedia of Life (EOL) and electronic publication outlets such as Zootaxa and ZooKeys.



Encyclopedia of Life

GLOBAL BIODIVERSITY INFORMATION FACILITY

Type Specimen databases for "Creating the virtual museum for the 21st century"



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

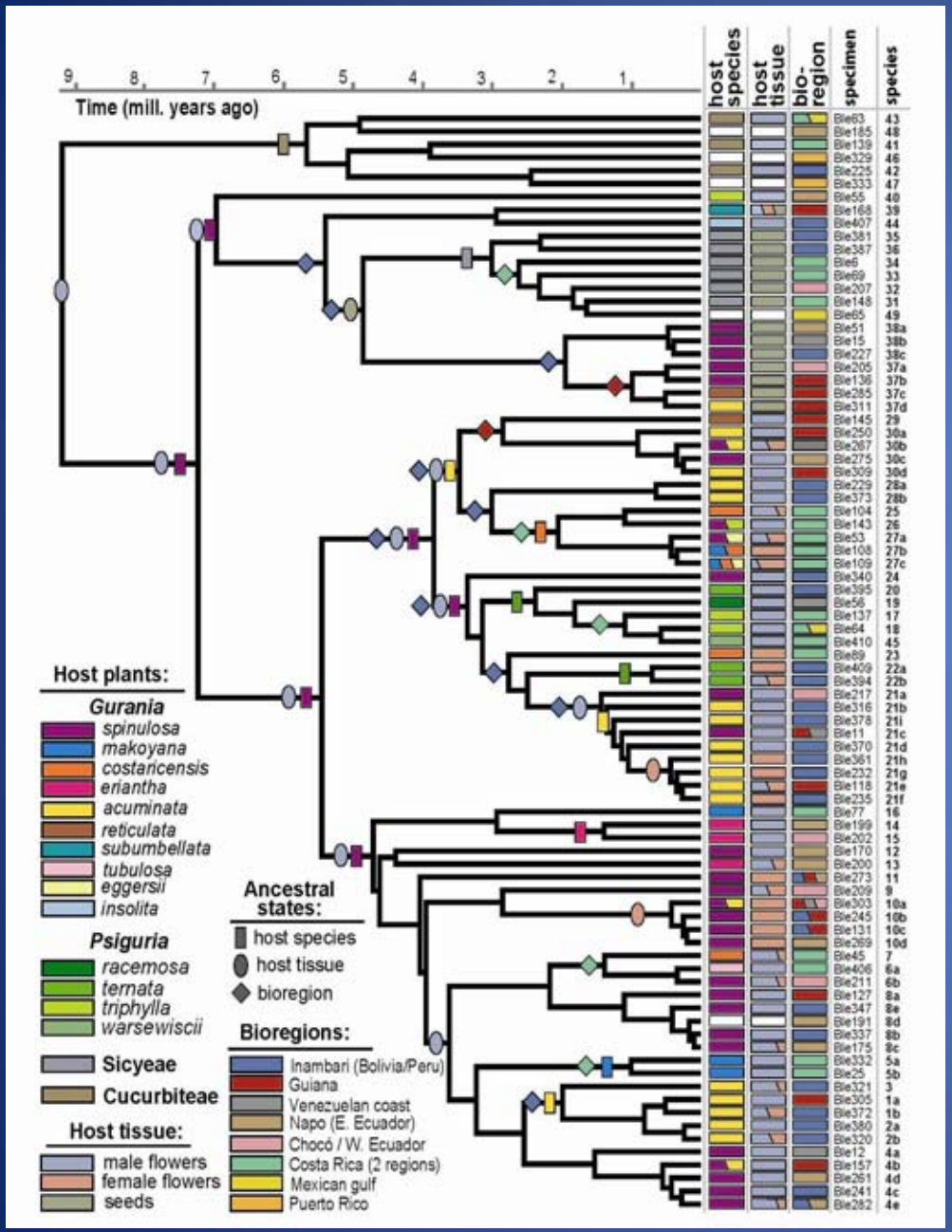
In collaboration with APHIS, SEL has created LUCID keys of quarantine significance with images and associated information.

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

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:

Canadian Barcode of Life Network

NSF Tree-of-Life

Consortium for the Barcode of Life

International Barcode of Life

NCBI

BOLD SYSTEMS

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