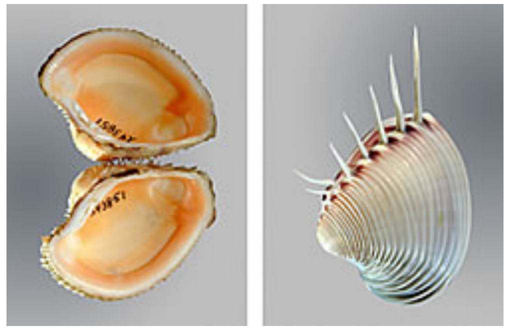
INVERTEBRATE ZOOLOGY

Invertebrate Zoology brings together a broad range of systematic and methodological expertise, including all aspects of research and collection management dealing with nonvertebrate animals at the American Museum of Natural History.



Hardshell clams from the Indo-Pacific (L) and western Mexico (R)

The current systematic strengths of the Division's staff are in the areas of terrestrial arthropod systematics, marine mollusks, and the Annelida, especially leeches. Methodologically the Division has long been strong in the application and refinement of phylogenetic methods. More recently it has become a leader in DNA sequencing and sequence analysis, fostering research that led to the establishing of the Institute for Comparative Genomics.

The Division has a proven record of training doctoral students through cooperative programs with the City University of New York, Columbia University, Cornell University, and Yale University.

BACK TO TOP

THE COLLECTION

South American shore bugs

Collection acquisition within the Division started in 1869, the year the American Museum of Natural History was founded. Growth since that time has been nearly continuous. At the beginning of the 21st century the collections of insects, spiders, and mollusks dominate the Division collection in terms of size and scope.

The insects are the largest group of living organisms, with approximately one million described species. No single collection is reflective of total insect diversity, but several groups are particularly well represented at the Museum. Among these is the termite (Isoptera) collection, built by Alfred Emerson and Kumar Krishna, which contains about 90 percent of all described species with a very high percentage of primary types. The true bug collection (Heteroptera)is not only extremely large, but notable for its family-level diversity and its extensive holdings of primitive bugs and Cimicomorpha. The collections of rove beetles (Coleoptera: Staphylinidae) and inch-worm moths (Lepidoptera: Geometridae) contain extensive holdings, particularly from the New World, of these two very large and diverse groups of insects. The bee collection (Hymenoptera: Apoidea) has tremendous depth from all continental areas except Australia. Other groups such as butterflies and true flies are also represented by world-class holdings.

The Museum also has the most important research holdings of insects fossilized in amber. This collection contains primarily the oldest known ambers, those from the Cretaceous, a pivotal period in the origin and diversification of terrestrial ecosystems.

Among other groups of terrestrial arthropods, the Museum's spider collection is the largest in the world, and is worldwide in scope, with many additions based on field collecting in Chile, Argentina, Australia, and New Caledonia.

The Recent mollusk collection is estimated to be the fifth largest worldwide. It contains approximately 3.5 million specimens, with at least 80 percent of all known species for several important families. The collection is worldwide in scope, but strongest in its representation of western Atlantic and tropical Pacific marine species, including one of the best-preserved specimens of giant squid, Architeuthis kirki Robson, 1887, in existence.

Among all remaining invertebrates, the Division maintains catalogued collections for over 30 major groups. The largest of these are the holdings for Crustacea (which includes lobsters and crabs), Cnidaria (which includes jellyfish, sea anemones, and corals), and Echinodermata (which includes starfish and sea urchins), although substantial collections exist even for rare phyla like the Tardigrada and Hemichordata. There is also significant material for parasitic groups in light of the historically important cestode, trematode, and acanthocephalan collections made by Horace Stunkard and Harold Kirby's unparalleled flagellated protist collection. Current research is focused on increasing the depth of global sampling of leech groups both for standard and frozen tissue collections.

BACK TO TOP

THE FACILITIES

Compact collections storage

The Division maintains state-of-the-art collection facilities in three main areas. First is the pinned-insect collection, a compactor-based facility of about 6,000 square feet that houses more than 10 million specimens. Completed in 1992, this unit allows for a coherent arrangement of about 60 percent of the dry specimens. The insects are housed in a drawer-and-unit system in nearly 900 air-tight cabinets mounted on 60 moveable carriages.

The recently completed C. V. Starr Natural Science Building houses the Invertebrate Zoology alcohol-preserved collections in a 4,000-square-foot compactor facility with an adjoining laboratory area. The more than 700 cases in the unit allow for well-organized and secure storage in an environment of stable temperature and humidity.

A new frozen tissue collection, the Ambrose Monell Collection for Molecular and Microbial Research, opened in early 2001. It has the capacity to store many tens of thousands of frozen samples in liquid-nitrogen-cooled vats. This facility, critical to the work of the Institute for Comparative Genomics, will allow for the long-term preservation of samples for DNA sequencing.

Also integral to the Institute is the Division's state-of-the-art DNA sequencing laboratory. Automated and robot-controlled amplification and sequencing equipment allow for the acquisition of massive amounts of data, on a scale unheard of as little as five years ago.

DNA centrifuges

Virtually unique among Division resources is a massive parallel computing cluster. This facility was built for use in the phylogenetic analysis of DNA sequence data, a computationally most intensive activity. Using special software, this "machine" allows us to solve problems that would otherwise take years of computation or mainframe-style supercomputers of the types used only by the Department of Defense and other U.S. government agencies.

BACK TO TOP

Doing Science: Researchers and Exhibition Staff Talk About Their Work.

Maintaining an Arthropod Collection

Christine Johnson helps maintain the collections in the Department of Entomology at the American Museum of Natural History. She inspects the specimen cases to be sure that none of the delicate parts of the brittle specimens have broken off, that all labels are in place, and that moisture and living insects have not damaged any of the preserved specimens. She also adds newly prepared and identified specimens to existing collections, making sure they are in the right place, according to order, family, genus, and species. It is a big job and one that requires meticulous care and extensive knowledge, but then the Museum's collection includes millions of arthropods, some more than 100 years old.

We asked Chris what advice she had for students setting up and maintaining an arthropod collection on a smaller scale. The first thing she told us is that it is a big job, no matter how small the collection is. "Before going out to take specimens in the field, students should be aware of what's involved in keeping a collection: from killing, preserving, and identifying specimens to pinning and labeling them. And then it all has to be stored properly and checked periodically to ensure that everything stays in good condition. It can be a lot of fun, but it's also a lot of work," she said.

Although entomologists use some dangerous chemicals to kill and preserve specimens, Chris had some good ideas for safe alternatives. "With just a few exceptions, most of what you catch can be put immediately into a jar filled with ordinary ethyl alcohol. This will both kill the specimens and keep them from becoming damaged until you are ready to dry and pin them for exhibit," she advised.

Some specimens--butterflies, moths, and dragonflies--would be damaged by being put in alcohol even briefly. Dragonflies need special treatment to preserve their iridescence (see sidebar "Preserving Color," below). Chris recommends killing butterflies and moths by carefully placing them between two sheets of tissue paper or paper towel, then into a small box or plastic food container. Finally, put them in a freezer for a few hours.

"You can kill any other specimens this way if you don't like the idea of putting them in alcohol," Chris said. But she cautioned that beetles may take longer to die. "You might even want to leave them in the freezer overnight," she said. You should also be careful about putting different kinds of living arthropods in the same container, she warned, since some types will eat other types, "and then you've lost your specimen."

Some specimens are not suited to drying and pinning and should instead remain in alcohol. These include soft-bodied arthropods like spiders, termites, and caterpillars and other larvae. For these specimens, use forceps to carefully transfer each one to its own small vial.

Fill the vial with alcohol and close it tightly. You can tape the label to the outside of the vial or, if it is small enough and written in pencil, put it into the vial along with the specimen. "Don't use ink," Chris warned, "because the alcohol will quickly blur what you have written."

For specimens that will be pinned, the next step is drying, "except for specimens that are frozen, in which case you need to rehydrate them before you pin them." Chris noted that this is the only time dampness is not the collector's enemy. "Otherwise, they are more likely to break when you try to arrange the wings while pinning them."

Chris told us that *Peterson Field Guides: Insects,* edited by Donald J. Borror and Richard E. White, gives detailed instructions for pinning most common types of arthropods.

Chris recommends using forceps rather than your fingers whenever you handle specimens. "Most specimens are very small and quite fragile. Handling them gently with forceps will help prevent damage. If a leg or wing or antenna does break off, don't despair," she said. "Just cut a small piece of card stock, put a drop of white glue on it, pick up the piece with your forceps, and place it on the glue. Then you can put the card right on the pin, just under the specimen. That way, all parts of the specimen can be found in one place and you haven't lost an important piece of your collection." Chris told us that the same thing is done in museum collections.

The next step is labeling. Chris told us there is a standard format for labeling that is used in museum collections worldwide:

- scientific name of specimen
- country, county, town or city; latitude and longitude where it was found
- name of collector
- habitat where it was found: for example, under a leaf, in a log, in the air
- date when it was found

"A properly prepared and maintained arthropod specimen could last for hundreds of years," Chris told us. "I've seen specimens in the Museum's collections dating back to the late 1800s, and there are probably others older than that." It is unlikely your specimens will stay around that long, but it still makes sense to adopt some of the techniques Chris uses to protect the Museum specimens.

Keep the collection dry. "Try to keep it out of a damp environment, such as a basement, but if moisture is a problem where you are, tape a packet of desiccant, available from scientific supply houses, to the inside of each specimen box."

Be on watch for dermestidae. These little beetles--commonly called carpet beetles--can be found just about anywhere. "Even when a specimen box is closed, they get in, lay eggs, and then the larvae literally eat the specimens from the inside out," Chris warned. A telltale sign is a fine dust called frass, which looks almost like sawdust. Chris inspects the collections carefully and regularly--she suggests doing it once every three or four months. At the first sign of frass, she puts the entire specimen box in a freezer for two days. "If I see a dermestid beetle crawling in the specimen box, I'll take it out, but freezing will kill dermestidae larvae and prevent further damage to infested specimens," she explained.

In the past, museum collections were protected from these beetles with mothballs and other fumigants, but Chris said that the American Museum of Natural History no longer uses these harmful chemicals. "We just keep a careful watch on things and freeze anything that looks suspicious," she said.

Basic Equipment

- fine forceps
- hand lens
- vials or small bottles with screw-on tops or rubber stoppers
- alcohol (70-80%)
- Styrofoam (cut to fit into specimen boxes)
- insect pins (available from scientific supply houses) or tailors' straight pins (stainless steel and at least 2 inches long)
- water-based white glue
- card stock (for labels)
- specimen boxes--these can be as fancy as glass-topped Cornell drawers, which come with individual unit trays, or Schmitt boxes, which have to be opened for display (both are available from scientific supply houses), or as humble as cardboard shoe boxes; with a piece of glass or Plexiglas fitted into the top, you will be able to see the specimens without opening the box.

Pinning Specimens

- Specimens in Alcohol
  Pour contents of vial onto a plate. Using forceps, carefully pick out individual specimens and place them on paper towel for 10 to 20 minutes. When they are almost dry but still soft, pin them. For flies and other insects with veined wings, gently arrange wings to show venation.

  Remove specimens and pin them, gently arranging the wings. Leave the specimen box open for about an hour after pinning to allow everything to dry completely.

- Frozen Specimens
  Put about an inch of water in a large plastic food storage container. Place a sheet of paper towel in the bottom of a smaller container and place frozen specimens on the towel. Put the smaller container into the larger one, taking care not to splash water onto the specimens. Leave the smaller container open, but close the larger one tightly and leave in a secure place (where it will not get bumped) for 24 hours.

  Remove specimens and pin them, gently arranging the wings. Leave the specimen box open for about an hour after pinning to allow everything to dry completely.

Preserving Color

Many arthropods have beautiful colors that are worth preserving if possible. The metallic sheen of a beetle, the rich velvety wings of a butterfly, the iridescent lacy wings of a dragonfly are among the fascinations of a well-prepared collection. Some of these colors will fade in bright light, so Chris Johnson advises keeping specimen cases with glass or Plexiglas tops in cabinets except when they are on display. "Being in daylight or incandescent light for several hours at a time won't hurt them, but I'd keep them out of direct sunlight if possible," she said.

The wings of dragonflies tend to lose their iridescence soon after they are killed. Hazardous chemicals such as acetone are sometimes used to "fix" the colors before they fade, but Chris suggested a safe alternative.

"When you're collecting in the field, fold back the wings and put the live dragonfly in an envelope so that you don't destroy the wings. Then tape the envelope shut and put it in a shoe box. You can put more than one dragonfly in the shoe box, as long as there's only one in each envelope. Later, freeze the specimin and rehydrate the dragonfly the next day. When it is soft enough to spread the wings, pin it."

Back to Menu

INTERDEPARTMENTAL LABS: MICROSCOPY & IMAGING FACILITY

Senior Laboratory Technician
Becky A. Rudolph

Laboratory Technician
Emily T. Griffiths

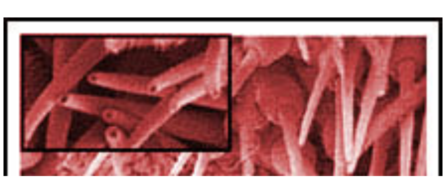
The Interdepartmental Laboratories provide the scientific staff with access to advanced imaging and computing tools that would otherwise be beyond the reach of the individual departments due to both the high acquisition costs and the high levels of expertise necessary to effectively use such tools. A knowledgeable staff maintains the laboratories and provides technology support and training at many levels to all members of the Museum research community. It is the IDL staff's mission to make its expertise base readily available to Museum scientists.

SEM image of a wasp

The advanced imaging instruments include a state-of-the-art high-resolution scanning electron microscope (SEM) with associated X-ray microanalysis capabilities, and a confocal laser scanning microscope (CLSM).

The SEM is used to obtain images of Museum specimens at magnifications above those attainable with light microscopy. It is also an analytical tool used to obtain chemical information from microscopic regions of a specimen. The IDL recently added a cathodoluminescence detector system to the SEM, thus providing an additional analytical capability to the scientific community.

The CLSM is an instrument used to image small, transparent, fluorescent specimens. Its strength lies in its ability to obtain clear optical sections of such specimens without the need for mechanical sectioning. The 2-D optical sections can be reconstructed into a 3-D object for final analysis. In addition, the CLSM is capable of imaging small opaque objects using a reflected light signal. Such imaging can provide researchers with valuable quantitative volume and surface measurements that would otherwise be difficult to obtain.



The Interdepartmental Laboratories computing lab is equipped with a number of multi-user computers including PC, Mac, and SGI workstations. Image processing and 3-D reconstruction software packages are maintained on these computers so

SCIENCE HOME
ANTHROPOLOGY
INVERTEBRATE ZOOLOGY
VERTEBRATE ZOOLOGY
PALEONTOLOGY
PHYSICAL SCIENCES

DEPARTMENT OF LIBRARY SERVICES
MICROSCOPY & IMAGING FACILITY
HAYDEN PLANETARIUM & DIGITAL UNIVERSE
CENTER FOR BIODIVERSITY & CONSERVATION
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SEM image of spider spinnerets

that laboratory staff can assist users with complex image manipulation. A variety of graphics output devices are also maintained in the computer lab and are used extensively by the scientific staff for the purposes of publication and presentation. These devices include a film recorder, a photo-quality digital printer, and a large-format printer used for creating posters for scientific meetings.

The lab also provides the Museum's research community with technology support for scientific information management. The staff offers expertise in Web-based database creation and management for the purposes of disseminating data to the worldwide scientific community.

Continue to Department Site >

Sackler Institute for Comparative Genomics

AMERICAN MUSEUM OF NATURAL HISTORY

Welcome to the Sackler Institute for Comparative Genomics

The work of the American Museum of Natural History lies at the heart of many of science's most promising directions. Founded in 1869, the Museum's mission is to discover, interpret, and disseminate—through scientific research and education—knowledge about human cultures, the natural world, and the universe.

Science and Genomics at the American Museum of Natural History

Throughout its history, the Museum has made many contributions in exploration, discovery, and technical advances in the natural sciences. Central to these efforts has been the accumulation of one of the world's pre–eminent museum collections—more than 32 million specimens and cultural artifacts—an irreplaceable record of life on Earth, which supports the Museum's cutting–edge research. Today, the Museum is in one of the most active periods of collecting in hits history, including building new types of collections such as frozen tissues and vast electronic databases supporting genomics and other research.

In the emerging field of genomic science, the Museum has a unique role—that of exploring genomics as a comparative, rather than single-species, discipline. For more than a decade, the Museum has fostered pacesetting research on the genetic makeup of a great diversity of species. Such research allows scientists to map the evolutionary relationships among organisms and to use that knowledge for applications that include understanding infectious diseases.

News: In 2007, the Institute was named The Sackler Institute for Comparative Genomics in recognition of the major support of the Sackler Foundation. Other support has been provided by the Ambrose Monell Foundation, for which the frozen tissue collection and two postdoctoral research fellowships are named, and from the Starr Foundation, as well as government sources. In 2007, **Dr. George Amato** was named Director of the Sackler Institute for Comparative Genomics.

To effectively organize and build upon these remarkable gains in genomics research, the Museum established, in spring 2001, the Institute for Comparative Genomics (ICG). The Museum and the Institute's approach considers the 3.8–billion–year history of life as a grand biological experiment, one whose observation requires the integration of molecular, anatomical, and paleontological data. That effort has now become the focus for more than 70 research staff using facilities that include modern molecular laboratories, substantial bioinformatics capacity, and a frozen-tissue collection facility. These, together with research partnerships with other prominent scientific institutions, position the Museum to enhance its important contributions to genomics research, particularly in microbial science.

Sitemasters: Sergios-Orestis Kolokotronis & Samuel Crane.
Last updated: 7 November, 2007

CENTER FOR BIODIVERSITY & CONSERVATION

Eleanor J. Sterling

Director

THE CENTER

The Center for Biodiversity and Conservation (CBC) was created in June 1993 by the American Museum of Natural History in order to bring the Museum's extensive scientific and educational resources to bear in conservation decisions and actions. The CBC's programs focus on areas of the world where biodiversity is both rich and of great conservation concern. Currently, the CBC has projects in the Bahamas, Bolivia, Madagascar, Vietnam, and the greater New York metropolitan region.

Bahamas—Supporting Marine Reserve Design. The government of the Bahamas recently initiated one of the world's first marine reserve networks. This provides CBC researchers and colleagues with an unprecedented opportunity to analyze the physical, biological, economic, and cultural processes affecting reef ecosystems, and to integrate all of these aspects into recommendations for conservation strategies.

Gorgonians on a patch reef, Andros Island

Bolivia—Biodiversity Conservation through Integrated Management (COBIMI). Since 1998, the CBC has been partnering with Bolivian scientists and managers to survey critical habitats in protected areas. Their work provides data for management and monitoring, and for developing outreach programs that encourage broad participation in conservation. Project researchers continue to survey animal groups in the Bolivian tropical Andes, an epicenter of global biodiversity that contains a greater diversity of plant and vertebrate species (many of which are found nowhere else) than any other region in the world.

Madagascar—Applying Conservation Genetics to the Study of Humpback Whales. Since 1996, the CBC's partnership with the Wildlife Conservation Society in Madagascar has grown from a simple survey of humpback whales in Antongil Bay to a multinational marine-mammal conservation effort. The CBC's work has led to

SCIENCE HOME
ANTHROPOLOGY
INVERTEBRATE ZOOLOGY
VERTEBRATE ZOOLOGY
PALEONTOLOGY
PHYSICAL SCIENCES

DEPARTMENT OF LIBRARY SERVICES
MICROSCOPY & IMAGING FACILITY
HAYDEN PLANETARIUM & DIGITAL UNIVERSE
CENTER FOR BIODIVERSITY & CONSERVATION
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CENTER FOR CONSERVATION GENETICS
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The CBC's Dan Brumbaugh and Joy Calabrese ground-truth benthic habitats.

the first legislation governing ecotourism and whale watching in Malagasy waters, providing protection for more than 1,000 humpbacks along their annual migration route.

Vietnam—Evaluating Threatened Conservation Areas. In 1998, the CBC began working with the Vietnamese government to map species distribution and document resource use by human populations. These studies helped to determine placement of new protected areas as the country looked to double the size of its forest protected-area system. Based on the CBC's recommendations, the Vietnamese government plans to officially establish a new national biodiversity reserve in 2001.

New York Metropolitan Region—Conserving Natural Areas at Home. In 1999, the CBC's Metropolitan Biodiversity Program joined with key conservation partners to launch The New York State Biodiversity Project—an ambitious collaborative effort to assess for the first time what is known about the biodiversity of New York State. The Metropolitan Biodiversity Program also promotes local initiatives to highlight the importance of invertebrates to conservation.

A breaching humpback whale in Antongil Bay.

International Graduate Student Fellowship Program. The CBC developed this fellowship program in 1994 to provide a multidisciplinary course of study in systematics and conservation biology for international students at the Museum and four participating universities.

Integrated Conservation Biology Curriculum Materials for Tropical Countries Project. Begun in 2000, this project creates innovative materials for educators teaching at the university and graduate levels in developing countries. This project will have a profound impact as it generates well-trained conservation biologists in countries where most of the world's animals and plants reside.

Annual Symposia on Biodiversity. The CBC hosts annual symposia that invite scientists, professionals, educators, decision-makers, and members of the general public to explore an issue related to biodiversity. To date, topics have included biodiversity science and policy, the value of biodiversity to human health, the extinction process, and the role of recent technological advances in conserving genetic diversity.

Conservation Genetics

The AMNH Center for Conservation Genetics (CCG) utilizes cutting-edge techniques in genetics, molecular biology, population biology, molecular ecology, and forensics to identify and ameliorate genetic threats to endangered species and to develop and support conservation strategies for retaining genetic diversity.

Continue to Department Site >

BACK TO TOP

Jessica Ware:

(Extension: 5494, email: jware@amnh.org)
B.Sc., UBC, 2001
PhD, Rutgers, October, 2008

Personal Biography :

I am interested in evolutionary biology, entomology, phylogenetic methodology and organismal biology. My research focuses on the evolution of behavioural and physiological adaptations in insects, with an emphasis on how these occur in dragonflies and Dictyoptera. In particular, I combine molecular tools with morphological, behavioral, biogeographical, and physiological information to develop a holistic understanding of each group. Dragonflies and damselflies are enigmatic, commonly observed insects with a wide range of unique behaviors. I explore two of the main activities in a dragonfly's life: flying and mating. Dictyoptera are a well studied but unresolved group, with behaviors and symbioses that are highly unique. For these taxa, I am interested in popular questions such as the how the evolution of social behavior occurred as well as in family-level phylogenetics.

Professional history:

Jessica completed her Bachelor of Science degree from the University of British Columbia in Vancouver Canada. She obtained a PhD in Entomology from Rutgers University, where her thesis work focused on dragonfly systematics but also included the study of dragonfly flight, dictyopteran systematics and phylogenetic methodology. She is currently an NSF Postdoctoral Fellow working on the systematics of lower termites.

Current projects:

1. Dragonflies: Flight behavior and wing venation
2. Dragonflies: Ovariole evolution (in collaboration with Kamilla Koch)
3. The endemic South African genus, Syncordulia (in collaboration with John Simaika and Michael Samways)
4. Phylogeny of the family Synlestidae (in collaboration with John Simaika and Michael Samways)
5. A new subgenus of Somatochlora or a new genus of dragonflies? (in collaboration with Milen Marinov)
6. Hybridization in Stylogomphus (in collaboration with Carl Cooke and Ellis Laudermilk)
7. Lower termite systematics
8. Evaluating the future of rare Petaltails (Petaluridae) (in collaboration with Chris Beatty and others)

Scientific accomplishments:

Snodgrass Memorial Award, Entomological Foundation, November 2008
Comstock Award, Entomological Society of America, November 2008
Student and Young Professional Participation Award, Entomological Society of America: January 2008
Rutgers Travel Award: December 2007
2007-2008 Bevier Fellowship
Excellence in Science membership, AAAS: September 2007
Outstanding Presentation Award, World Dragonfly Association: April 2007
Compton Markle Award, Rutgers Department of Entomology: April 2007
Rutgers Travel Award: April 2007
Ernst Mayr Finalist, Society for Systematic Biology: June 2006
Runner up, Entomological Society of America, Student Competition for the President's Prize: December 2005
NJWRRI Travel Award: December 2005
Honorable mention, NSF Graduate Research Fellowship: Spring 2005
Honorable mention, NSF Graduate Research fellowship: Spring 2004
Honorable mention, Ford Fellowship: Spring 2004

2004-2003 Cook Excellence Fellowship

Publications:

Ware List of Publications:

(*) *Denotes papers coauthored with undergraduates, which was NSF REU funded.*

Refereed Publications:

1. Baskinger, G., J. Ware, Cornell, D., M. May, K. Kjer. 2008. A phylogenetic exploration of Celithemis (Odonata: Libellulidae): the pennants of North America. Odonatologica 37(2):101-109*

2. Ware, J. L., Litman, J., Klass, K-D, Spearman, L. 2008. Relationships among the major lineages of Dictyoptera: the effect of outgroup selection on dictyopteran tree topology Systematic Entomology, 33:429-450. 3. Ware, J. L., Ho, S., Kjer, K. 2008. Divergence dates of libelluloid dragonflies (Odonata: Anisoptera) estimated from rRNA using paired-site substitution models. Molecular Phylogenetics and Evolution. 47(1):426-32

4. Ware, J. L., M. L. May, K.M. Kjer. 2007. Phylogeny of the higher Libelluloidea (Anisoptera: Odonata): an exploration of the most speciose superfamily of dragonflies. Molecular Phylogenetics and Evolution 45(1): 289-310 .

5. Janmaat, Alida F., Ware, Jessica, Myers, Judy. 2007. Effects of crop type on Bacillus thuringiensis toxicity and residual activity against Trichoplusia ni in greenhouses. Journal of Applied Entomology 131(5): 333-337.

6. Karl M. Kjer, Frank L. Carle, Jesse Litman and Jessica Ware. 2006. A molecular phylogeny of Insecta. Arthropod Systematics and Phylogeny 64(1):35-44.

In press publications:

1. Nielsen, A., Ware, J. L., Mahar, J., Hamilton, G. Entomological Society of America Student Biosecurity Debate, PRO Position. American Entomologist. Accepted June, 2009.

2. Ware, J. L., Simaika, J. P., Samways, M. Biogeography and divergence estimation of the relic Cape dragonfly genus Syncordulia: global significance and implications for conservation. Zootaxa. Accepted May, 2009

3. Ware, J., Lal, S., Grimaldi, D. Mahogany-dwelling termites: a new species of Neotermes (Isoptera: Kalotermitidae) from Fiji. Bishops Museum Occasional Papers: Fijian Arthropod Survey Submitted March, 2009

Reviews:

1. Ware, Jessica L. 2009. Review of “Dragonflies and Damselflies of South Africa” by Michael Samways, The Quarterly Review of Biology, 84(2): 209

Non-peer reviewed publications:

1. Ware, Jessica L., Louton, J. 2009, In the muck: collecting, rearing and imaging dragonfly and damselfly larvae for Encyclopedia of Life Odonata pages. The Bug Dispatch: a newsletter of the NMNH Department of Entomology 1(2):3-4.

2. Ware, J., Louton, J. A larva worth a thousand words: imaging preserved dragonfly nymphs using a digital camera. Argia, July, 2009

Clickable Guide

Calendar

BugGuide Gathering
Pack Forest
Washington State
July 10-12, 2009
Details...

Photos from the 2009 gathering

Photos from the 2008 gathering in Tennessee

Photos from the 2007 gathering in Minnesota

John S. Ascher, Contributing Editor

Full name:
John S. Ascher

City, state, country:
Brooklyn, New York, USA

Biography:

Ph.D. in Entomology from Cornell University, 2004

I manage the American Museum of Natural History Bee Database Project. Specimen records from this project are displayed on maps at www.discoverlife.org together with bee records from other institutions such as the University of Kansas and USGS along with GBIF records. As of June 2009 we have full label data available on maps for more than 83,000 of the ca. 400,000 AMNH bee specimens (these are in the AMNH_BEE [singular] database). More than 86,000 literature records also appear on these maps (these are in the AMNH_BEES [plural] database).

Maps based on literature and/or specimen data are now available for most of the world's 19,000+ valid and nominally valid bee species. These have reviewed as part of recently completed ITIS-led World Bee Checklist. Names of these valid bee species (and selected apoid wasps) are searchable in my "Apoidea species" guide here:

http://www.discoverlife.org/mp/20q?guide=Apoidea_species

A link to Credits can be found on each species page.

Maps should be rather complete at the state and provincial level for the USA, Mexico, and Canada. Maps can be generated by clicking "Global Mapper" to the right of the small world map icon in the Links section of each genus and species page. These can then be modified in various ways using the "Make Map" feature. By clicking on individual dots on the map you can view details for each record.

I maintain a taxonomic and distributional database for world bees, including records from both published and unpublished sources, and these are the basis for the literature records displayed on the maps. State-level records are also incorporated in the bee identification guides developed by Sam Droege and colleagues. Distributional data for the USA were compiled in collaboration with many colleagues, especially Sam Droege (primarily eastern USA) and Terry Griswold (primarily western USA), who each generously shared hundreds of new state records for bee species.

I have more than 25 years experience as a birder and enjoy applying techniques pioneered by field ornithologists to the identification of aculeate Hymenoptera.

My research interests include the taxonomy, biogeography, identification, and phylogeny of all Apoidea, including apoid (=sphecid) wasps in addition to bees.

Tips on using Discover Life maps:

1. Go to the Links section of a genus or species page and click "Global map", found to the right of the small rectangular world map icon, to generate a map.

2. Add an underscore after the generic name to generate a map with each species listed

separately and mapped in a different color and/or symbol (unless the genus has too many species), e.g., for the squash bee genus Peponapis:

http://www.discoverlife.org/mp/20m?kind=Peponapis_

3. Map multiple genera of bees and/or plants by separating generic names with commas and no spaces, e.g., to map the squash bee genera Peponapis and Xenoglossa together with their squash hosts in genus Cucurbita:

http://www.discoverlife.org/mp/20m?kind=Cucurbita,Peponapis,Xenoglossa

Zoom into maps by clicking blank areas next to but not exactly on the dots.

When zooming in, note that more records are present than appear on the global map. Note also that points for the last taxon listed are superimposed upon those for earlier-listed taxa, e.g., on the following map Nomada (cleptoparasitic bee) points obscure the underlying Andrena (host bee) points:

http://www.discoverlife.org/mp/20m?kind=Andrena,Nomada

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