international BARCODE OF LIFE

BARCODE BULLETIN

Vol. 1, No, 1 - March 2010

The newsletter of the International Barcode of Life project

Welcome...

...to the first issue of the Barcode Bulletin, the newsletter of the International Barcode of Life project. The news and feature stories in these pages are designed to inform and entertain iBOL collaborators, the global DNA barcoding community and the wider world of biodiversity genomics.

We'd love to hear news about your barcoding project, suggestions about what you'd like to see in future issues as well as feedback about the contents of Issue #1. Send text, photos, artwork, ideas and comments to newsletter@ibolproject.org.

Please help us to spread the word about barcoding by circulating this newsletter among your colleagues and contacts. To receive future issues by email, just send a message to subscribe@ibolproject.org (for a printed copy, include your postal address and put "Print Edition" in the subject line).

We hope that you enjoy the Barcode Bulletin.

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iBOL makes big impact at Mexico City conference

iBOL activities were high on the agenda when 350 researchers from 54 countries gathered in Mexico City for the Third International Barcode of Life Conference November 7-13.

"We are in the early stages of moving iBOL from science plan to science fact... and you are the people who will do this," iBOL Scientific Director Paul Hebert told delegates during a presentation to the opening plenary session.

Noting that the global barcoding community had already assembled a DNA barcode repository of more than 750,000 specimens representing more than 65,000 species, Dr. Hebert said that satisfaction over these figures is tempered by the fact that 60 of the world's 195 nations have fewer than 100 barcode records and 142 countries have not yet passed the 1,000 mark.

"There are only five nations with more than 10,000 records," he said. "Mexico, the United States and Australia are in the 10,000 to 100,000 range, with only Costa Rica and Canada over 100,000. We have a lot of work to do."

The Mexico City conference – the largest gathering yet for the international barcoding community – also marked the first meeting of the iBOL Scientific Steering Committee (SSC), comprising representatives from 25 iBOL nations and leaders of the 20 iBOL working groups.

The SSC meeting provided an opportunity for iBOL collaborators from all over the world to share experiences and to report on the progress of DNA barcoding projects in their regions.

The iBOL Board of Directors also met in Mexico City during the conference.

(See Meet the Board – p. 12) ✤

Above: iBOL Scientific Director Paul Hebert addresses the opening plenary at the Third Barcode of Life Conference in Mexico City.

Mothing group makes a **BOLD** move

In an initiative that could become a model for citizen scientists worldwide, the non-profit North American Moth Photographers Group (MPG) is urging members to get involved in DNA barcoding by submitting specimens for sequencing and input into the Barcode of Life Data Systems (BOLD) digital library.

Continued on page 2

Making every species count

Section of DNA barcode for *Dyseriocrania griseocapitella*

Barcoding the Big Apple: Strange foods and a stranger cockroach

They don't call it the urban jungle for nothing

When Brenda Tan and Matt Cost, students of the Trinity School in New York City, set out to barcode their Manhattan neighbourhood, they uncovered a DNA menagerie of exotic birds, beasts and fishes – 95 different animal species in all, including what may be a new species of cockroach, the Barcode of Life blog reports.

Is it caviar or is it paddlefish eggs? The barcode exposed the lie.

Brenda and Matt were able to extract DNA from all kinds of human and pet foods including dried soup mix, scrambled eggs, dog food, chicken McNuggets, hamburger, beef jerky, bologna, yogurt, cheese and even butter. They found that a popular Asian snack was made from giant flying squid, an expensive delicacy labelled "sturgeon caviar" actually came from a paddlefish, a dog biscuit contained bison DNA and some "sheep's milk" cheese was actually made from plain old cow's milk.

Non-food items included a feather duster that yielded ostrich DNA, an old hairbrush (human), some dried manure in Central Park (horse) and a squashed bug in a case of Texas grapefruit that was identified as the fly *Chrysomya megacephala*, an invasive species.

Guided by Mark Stoeckle, of Rockefeller University (and co-lead of iBOL Working Group 5.2 – Outreach and Networking), Brenda and Matt collected, photographed and labelled 217 specimens from once-living things found in apartments, stores and in the outdoors and delivered them to the American Museum of Natural History for DNA barcode analysis. Then they matched the sequences to records in the Barcode of Life Data Systems (BOLD) and GenBank.

The biggest surprise among the students' specimens was a "mystery" cockroach. It looks like the American Cockroach (*Periplaneta americana*) but is genetically different from other American cockroaches in the databases.

For more on Brenda and Matt's excellent barcode adventure, read the Barcode of Life blog. ✤

phe.rockefeller.edu/barcode/blog/

Left: Brenda Tan and Matt Cost, New York City high school students who decided to barcode their neighbourhood.

Above: Everything living or once living went into the sequencer – including the contents of Brenda's refrigerator.

Continued from page 1

The MPG website, featuring photographs contributed by members, is designed to help nature photographers and others to identify moths occuring in North America.

But, as webmaster Bob Patterson points out, most photographers quickly learn that identifying the moths in their photographs can be very difficult. In a message to members, Bob says that for a small investment of time, photographers can send specimens to the sequencing lab at the Biodiversity Institute of Ontario (BIO). In return, they will receive positive DNA-based identifications of the moths in their photographs.

One MPG member, Mark Dreiling, of Bartlesville, Oklahoma, already appears on BOLD as the contributor of more than 3,700 specimens. Thanks to the DNA barcode sequences generated at BIO, Mark now knows that they represent more than 730 species.

A face only a moth-er could love: Mark Dreiling's photograph of *Dyseriocrania griseocapitella* appears on specimen page MDOK-2149 (sequence data at LPOKC072-09) on BOLD.

"One of the the grand goals of the International Barcode of Life project is to dramatically accelerate the rate of species identification and discovery – and the growth of the BOLD database – by mobilizing large numbers of citizen scientists to collect specimens in their various countries," said iBOL Scientific Director Paul Hebert. "The enthusiastic members of the Moth Photographers Group are demonstrating how this will work." ✤

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Barcoders now have an online community

The Barcode of Life Community Network, a social network for people, institutions and projects involved in barcoding, was unveiled during the Third International Barcode of Life Conference in Mexico City.

A project of the Consortium for the Barcode of Life (CBOL), the Connect site allows people to create special interest groups, start discussion forums, post photos and videos and initiate a range of networking activities with other barcoders around the world.

Since the conference, more than 30 special interest groups have formed on Connect, many of them related to iBOL. They include FISH-BOL, Mammals, Polar life, HealthBOL, blackflies and mosquitoes, Plants, TreeBOL, Quarantine species (QBOL), Freshwater Biosurveillance and a group for the iBOL Scientific Steering Committee.

The site also features hundreds of photos from the Mexico City conference as well as video recordings of conference presentations.

"We hope that all members of the international barcoding community will use this social network as a resource for enhancing their involvement in iBOL projects," said CBOL Executive Secretary David Schindel.

Users can post comments and questions on the appropriate Group or Forum or send ideas about new Connect features to Kristin Jett at CBOL (jettk@si.edu).

Labs network members connect online

CBOL established the Leading Labs Network (LLN) so that barcoding labs around the world can share technical knowledge and support the establishment and growth of new labs. The network now consists of 15 barcoding labs in 10 countries.

LLN members can now share information, experience, problems and solutions using two groups on the Barcode of Life Community Network, one for Lab Operations and the other for Field Methods. The online groups are a great way to connect with other labs and find partners, specimens or other resources for barcoding projects. ✣

connect.barcodeoflife.net

ECBOL2: European barcoders to meet in Braga

Europe's role as a Central Node of the International Barcode of Life project (iBOL) will come into sharp focus when the European Consortium for the Barcode of Life (ECBOL) holds its second conference June 2-4 in Braga, Portugal. The ECBOL2 conference will be hosted by the Centre for Molecular and Environmental Biology, University of Minho.

Conference organizers say that Europe, with the world's largest repository of biological collections and a significant share of the taxonomic knowledge, is a fundamental partner of the International Barcode of Life.

"An effective and extensive contribution from Europe depends on a continuously improved coordination effort among European partners," said Filipe Costa, Portugal's representative on the iBOL Scientific Steering Committee. "Within two years of the first meeting, ECBOL2 will provide the opportunity for strengthening the implementation of DNA barcoding in Europe and to further explore interactions between European partners and institutions with the barcoding community across the world."

For registration details and more information on the conference, see the ECBOL website www.ecbol.org ✣

India Begins Work on Barcoding Marine Life

DNA barcoding has taken a giant leap forward in India, where the government has approved a major project that will use barcodes to create a comprehensive inventory of the country's marine life.

India's Ministry of Earth Sciences has asked the Centre for Marine Living Resources and Ecology (CMLRE) at Kochi to start work on DNA barcoding marine biodiversity. "We have initiated a scheme for DNA barcoding as part of our efforts under the Census of Marine Life to create inventories of biodiversity," CMLRE Director V.N. Sanjeevan told the Indo-Asian News Service (IANS). "We had some meetings and a framework document has been prepared for initiating the project."

A number of institutes, supported by various government agencies, have been barcoding in India since 2006 but on a limited scale. According to Mohideen Wafar, chair of the Indian Ocean Census of Marine Life, the Earth Sciences Ministry is the first to recognize the value of a national barcoding initiative.

"Fewer than 200 out of the 14,000 species known from Indian seas have been barcoded," said Wafar. "Given the number of potential marine species and the difficulties of barcoding some groups, it is difficult to set a time limit. But I would hope that at least 80 to 90 percent of known marine species get their barcodes in a decade." ✣

Barcoding course in India

Fifteen Indian scientists took part in a seven-day national training program on DNA barcoding December 3-10, 2009. The course was organized and conducted at the National Bureau of Fish Genetic Resources in Lucknow, the main DNA barcoding centre in south Asia and a key iBOL collaborator on the Indian subcontinent.

The training course was designed to provide new skills in barcoding and molecular taxonomy to researchers and university teachers from different parts of the country. The event was officially opened by A.P. Sharma, former Director General of the Indian Council of Medical Research and Prof. T.J. Pandian, of Madurai Kamaraj University. ✣

A Brief History of MexBOL

Mexico is one of the nine "regional nodes" of the iBOL project – a strong and well-organized barcoding community thanks to the creation of the MexBOL national network of barcode researchers and institutions. Patricia Escalante, of the National Autonomous University of Mexico (UNAM), provides a brief history of MexBOL.

There was already a lot of barcoding activity in Mexico before the formal establishment of the MexBOL network in 2009. Martha Valdez and Manuel Elias, of El Colegio de la Frontera Sur (ECOSUR) in Chetumal, had taken sabbaticals at the Canadian Centre for DNA Barcoding in Guelph, and Virginia León, of UNAM, attended the first Barcode of Life conference in London. When I visited Guelph in 2007 to get some birds barcoded with Kevin Kerr at the Biodiversity Institute of Ontario, I learned that Blanca Prado, of ECOSUR, was also barcoding Lepidoptera there. I have since learned that various other Mexican researchers have been using COI for years.

The main government funding agencies for biodiversity research, CONACYT and CONABIO, began to show interest in barcoding following a visit from iBOL Scientific Director Paul Hebert in 2007. CONACYT was launching a new program to support networks and in 2008, a series of meetings between CONACYT officials and research leaders resulted in the creation of a number of research networks on themes that included water, ecosystems and sustainability, science and society, health, food, nanotechnology, energy – and the Barcode of Life project.

The MexBOL network was established with a steering committee comprising representatives of three academic institutions (nodes) – ECOSUR, the Institute of Biology at UNAM and the Northwestern Biological Research Centre (CIBNOR) – and CONABIO. In early 2009, CONACYT gave the committee US$31,000 to organize launch events and $110,000 to make the nodes operational. The MexBOL Committee organized a symposium and three workshops (one in each node) to alert the research community and invite them to participate in the project.

About 150 people attended the symposium, held March 2 at UNAM and followed the next day by the first workshop featuring presentations by invited speakers from the University of Guelph, the American Musuem of Natural History, Rutgers University, the University of Tennesee, the New York Botanical Garden and UNAM researchers.

The second and third workshops were given by Manuel Elias and Ticul Alvarez at CIBNOR in La Paz, March 5-6 and at ECOSUR, Chetumal, March 9-10. As a result of these events, more than 40 researchers have started barcoding projects or linked their research programs with MexBOL.

In April, CONABIO received more than 40 applications and approved 16 projects to receive a total of $600,000 and in September, CONACYT received 60 responses to its call for researchers to become part of the MexBOL network. A total of $770,000 will be allocated to the operation of this network in 2010, with funding for lab operations, training, field work and meeting expenses. And while CONACYT has provided some guidelines for how they want the network to operate, it has given the MexBOL committee and its members a free hand in organizing the network.

MexBOL members are confident that the success of the Third International Barcode of Life Conference in Mexico City will get many more Mexican researchers, agencies and students interested in DNA barcoding and MexBOL. ✣

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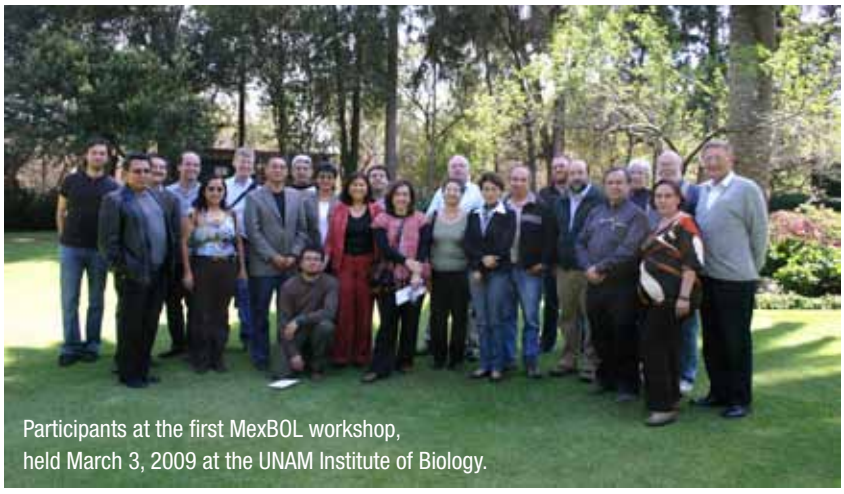

Participants at the first MexBOL workshop, held March 3, 2009 at the UNAM Institute of Biology.

Barcoding Fauna Bavarica:

Taking Bavarian biodiversity research to the next level.

Aerial view of the Bavarian State Collection of Zoology (ZSM). With more than 20 million zoological objects, it is one of the largest natural history collections in the world. (Photo courtesy of ZSM)

After only a year of operation, Barcoding Fauna Bavarica (BFB) has established itself as one of the most ambitious all-species barcoding projects in the world.

An initiative of the Bavarian State Collection of Zoology (ZSM), BFB has received five-year funding (2009-2013) from the Bavarian Ministry for Science, Research and the Arts. The ZSM is the second largest zoological collection in Germany, housing about 20 million traditionally preserved specimens as well as a growing tissue collection in a state-of-the-art DNA storage facility.

Bavaria, Germany's largest state, is a biodiversity hotspot of Central Europe with biomes ranging from lowland to alpine environments at almost 3,000 metres. The state is home to an estimated 35,000 species – about 80 per cent of the German fauna.

Now the BFB project is taking biodiversity research in Bavaria to the next level. It is assembling a tissue bank and generating COI barcodes to compile a comprehensive barcode library which can be queried for various identification purposes, including environmental monitoring, food and seed quality/identity control and identifying the larvae of herbivorous lepidopterans and other pest insects. The DNA bank also has great potential as a character source for global-level phylogenetic research or regional population-level investigations.

During its first year – 2009 – BFB targeted particularly relevant groups: moths and butterflies (Bavaria, 3,209 species), bees (505), ants (90), aquatic insects (excluding Diptera, 1,000) as well as some less diverse taxa such as amphibians and dragonflies.

As of December 2009, some 5,000 barcodes had been generated for more than 2,000 species. All material is sequenced at the Canadian Centre for DNA Barcoding in Guelph as part of the International Barcode of Life project (iBOL).

BFB also submits digital voucher images for barcoded specimens to BOLD,, building a comprehensive photographic online library of all Bavarian animals. The project links morphological information with genetic data, vouchers, DNA samples and taxonomic information on thousands of animal species and makes it available to anyone, anywhere, anytime.

Regular progress reports are posted on the project website and the ZSM Blog. BFB also has a Facebook page and tweets benchmarks on Twitter. ✤

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Norwegian Taxonomy Initiative signs on for barcoding

A new agreement between Norway's Barcode of Life network (NorBOL) and the Norwegian Taxonomy Initiative (NTI) means that all projects funded by NTI will now use DNA-friendly methods to collect and preserve specimens and make them available for DNA barcoding.

One of the major goals of NTI, which is run by the Norwegian Biodiversity Information Centre, is to map the country's biodiversity with particular emphasis on lesser known taxonomic groups. Nine NTI projects totalling NOK 13 million (about US$2.3 million) have been approved for 2010-2011, presenting NorBOL with the challenge of organizing sampling and barcode analysis of the collected material.

NorBOL membership now consists of 15 biodiversity institutions: Natural History Museum, University of Oslo; Bergen Museum, University of Bergen; Museum of Natural History and Archaeology, NTNU; Tromsø University Museum; The University Centre in Svalbard (UNIS); Institute of Marine Research; National Veterinary Institute; Norwegian Forest and Landscape Institute; Norwegian Institute for Nature Research; Norwegian Institute for Water Research; Norwegian Institute of Public Health; Norwegian Polar Institute; Agder Nature Museum; Helgeland Museum; and Midt-Troms Museum. ✤

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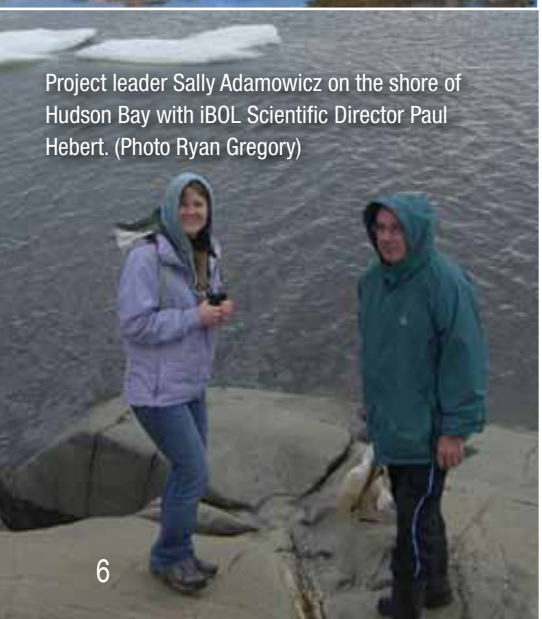
Life in a Cold Climate:

A sting in the tale of Arctic species survey

By Vanessa Perkins

Barcode this! One of Churchill's larger denizens gives BIO photographer Jay Cossey the polar glare.

DNA barcoding gives students the chance to discover new species.



Project leader Sally Adamowicz on the shore of Hudson Bay with iBOL Scientific Director Paul Hebert. (Photo Ryan Gregory)

The Canadian town of Churchill may bill itself as "The Polar Bear Capital of the World", but researchers and collaborators from the Biodiversity Institute of Ontario (BIO) who journey there every summer have only a passing interest in the big white predators. Their mission is to establish a baseline understanding of all Arctic biodiversity, which they believe will also help them understand and better document environmental changes over time.

In a major contribution to the iBOL campaign to construct a DNA barcode reference library for all of the Earth's species, the BIO team has chosen Churchill – situated between the tundra and the boreal forest on Hudson Bay in northern Manitoba – as a test site for an all-taxon barcode inventory to document all living organisms, ecosystems and habitats.

Because of its subarctic climate, Churchill was expected to have only modest biodiversity – and it's true that biodiversity is low compared to more southern locations. But the Guelph researchers say that the actual number of species living in the region is much higher than anyone expected. More than 26,000 specimens and 3,750 species of invertebrates have been barcoded since work began four years ago.

Perhaps the biggest eye-opener so far has been the astonishing level of diversity in the order Hymenoptera (wasps, sawflies, bees and ants). Alex Smith (BIO), José Fernández-Triana (Canadian National Collection) and others have detected more than 1,000 species of parasitoid wasps (Ichneumonidae and Braconidae) after barcoding about 5,000 individuals collected at the Churchill site. In fact, Fernández-Triana has identified over 100 species in one sub-family of Ichneumonidae (Orthocentrinae), more than were previously known in all of Canada. As many as 80 to 90 per cent of the species in these small-bodied wasp groups are new to science.

On one level, these results add to a growing body of evidence suggesting that Hymenoptera – not Coleoptera (beetles) – could be the most diverse order of insects. On a more fundamental level, such findings underline how much there remains to be learned about life on Earth.

"Results from our study are revealing that our overall understanding of biodiversity is very rudimentary," says Churchill project leader Dr. Sarah Adamowicz, who is co-lead of iBOL's WG2.1. "We likely have a better understanding of the number of stars in the universe than we do of how many species there actually are on our own planet."

The researchers are using a variety of techniques to thoroughly document all of Churchill's species – including invertebrates, plants and protists on land, in freshwater and in Hudson Bay. And they will keep coming back to Churchill for several more years to collect specimens because some species have multi-year life cycles. Also, as environmental conditions change, so do Churchill's flora and fauna.

The project's focus on probing the fine details in the ecosystem has also provided many distinctive educational opportunities for students. "The molecular level methods being used are so

While other iBOL working groups concentrate on particular taxonomic groups, the task of Working Group 2.1 (Barcoding Biotas) is to develop protocols for barcoding all life in a particular locale. This work is being carried out at two sites that could hardly be more different – Churchill in the Canadian low Arctic and the tropical Pacific island of Moorea. But they do share several characteristics that make them ideal for WG2.1 – low biodiversity, research stations and ongoing barcode projects. The work of WG2.1 is a vital precursor to the second phase of the iBOL project – creating a barcode library for all eukaryotes.

exciting because they allow students, who may be beginner researchers, to discover new species," says Adamowicz. "This was nearly unimaginable before."

Once the DNA barcode reference library of Churchill's biodiversity is complete, researchers will be able to more thoroughly investigate a variety of topics pertinent to the north. They can use barcodes to identify specimens that they were unable to differentiate before, such as larvae, or species whose ranges have only recently expanded northward – possibly including invasive species, pests and disease vectors. It will also allow analyses of entire communities, and can point out previously unnamed species in need of further description by taxonomists.

"The barcode reference library is unique," says Adamowicz. "We publish DNA sequence data, but we also maintain a solid link to the physical sample by keeping a specimen and providing a photographic record online. This is a huge enabler for future ecosystem research."

Collaborators include more than 100 undergraduate and graduate students, post-doctoral researchers, senior scientists and museum- and university-based researchers from BIO, the Canadian National Collection, the University of Manitoba and the University of New Brunswick in Canada, as well as scientists from the U.S. and Norway.

Funding for the study was provided by the Natural Sciences and Engineering Research Council of Canada through the International Polar Year program, Genome Canada and the Ontario Ministry of Research and Innovation. ✤

Vanessa Perkins is a writer for the Students Promoting Awareness of Research Knowledge (SPARK) program at the University of Guelph.

Top: Dr. Hebert prepares to sample the waters of a Hudson Bay rock pool.

Bottom: A plankton net gives up its haul.

Suggested reading:

Smith, M. Alex, Fernandez-Triana, J, Roughley, R., and Hebert, P. D. N. (2009) DNA barcode accumulation curves for understudied taxa and areas. Molecular Ecology Resources. 9s1:208-216.

Zhou, X., Adamowicz, S., Jacobus, L., DeWalt, R., & Hebert, P. D. N. (2009) Towards a comprehensive barcode library for arctic life-Ephemeroptera, Plecoptera, and Trichoptera of Churchill, Manitoba, Canada. Frontiers in Zoology. 6(1) 30

In the next issue: "Barcoding Moorea"

The Paper Trail

A selection of recent research publications on DNA barcoding.

Barcoding bushmeat: molecular identification of Central African and South American harvested vertebrates

Mitchell J. Eaton, Greta L. Meyers, Sergios-Orestis Kolokotronis, Matthew S. Leslie, Andrew P. Martin, George Amato

Conservation Genetics (2009), doi: 10.1007/s10592-009-9967-0

http://www.springerlink.com/content/b247325p747r7g5j/fulltext.pdf

A globally available database of DNA barcodes has been proposed as a tool for monitoring the legal and illegal trade in wildlife species. The authors of this paper contribute to the Barcode of Life Data System (BOLD) and test whether a COI barcode would reliably distinguish among a suite of commonly hunted African and South American mammal and reptile species.

The Campaign to DNA barcode all fishes, FISHBOL

R. D. Ward, R. Hanner and P. D. N. Hebert

Journal of Fish Biology (2009) 74: 329-356.

http://cbma.bio.uminho.pt/files/ptdcmar1017952008_4.pdf

The benefits of barcoding fishes include facilitating species identification, highlighting cases of range expansion for known species, flagging previously overlooked species and enabling identifications where traditional methods cannot be applied. Current results indicate that past concerns about hybridization, recent radiations, regional differentiation in barcode sequences and nuclear copies of the barcode region are not a problem for most specimens.

A DNA barcode for land plants

CBOL Plant Working Group

Proceedings of the National Academy of Sciences USA (2009) 106, 31: 12794-12797

http://www.pnas.org/content/106/31/12794

The CBOL Plant Working Group was formed to provide a community recommendation on a standard plant barcode. The group recommended the two-locus combination of rbcL+matK as the barcode that will provide a universal framework for identifying specimens and contributing toward the discovery of overlooked species of land plants.

DNA barcoding of commercially important salmon and trout species (*Oncorhynchus* and *Salmo*) from North America

Rosalee S. Rasmussen, Michael T. Morrissey and Paul D. N. Hebert

Journal of Agricultural Food and Chemistry (2009) 57: 8379-8385.

http://pubs.acs.org/doi/abs/10.1021/jf901618z

This study investigates the ability of DNA barcoding to reliably identify the seven commercially important salmon and trout species in North America. More than 1,000 salmonid reference samples were collected from a wide geographic range. DNA barcodes showed that the minimum interspecies divergence was always greater than the maximum intraspecies divergence, indicating that these species can be reliably differentiated using DNA barcodes.

DNA barcodes for 1/1,000 of the animal kingdom

Paul D. N. Hebert, Jeremy R. deWaard, Jean-François Landry

Biology Letters (2009) doi: 10.1098/rsbl.2009.0848

http://rsbl.royalsocietypublishing.org/

This study reports DNA barcodes for more than 1,300 Lepidoptera species from the eastern half of North America, establishing that 99.3 per cent of these species possess diagnostic barcode sequences. The results affirm that a highly effective system for the identification of Lepidoptera in this region can be built with few records per species because of the limited intra-specific variation.

Invasions, DNA barcodes, and rapid biodiversity assessment using ants of Mauritius

M. Alex Smith and Brian L Fisher

Frontiers in Zoology (2009) 6:31, doi: 10.1186/1742-9994-6-31

http://www.frontiersinzoology.com/content/6/1/31

Using an understudied taxon found on a tropical island where native flora and fauna have been threatened by 400 years of habitat modification and introduced species, the authors tested whether estimated incidences of diversity and complementarity were similar when measured by standard morphological alpha-taxonomy or phylogenetic diversity (PD) based on a standardized mitochondrial barcode and corroborating nuclear marker.

On the origin of barcodes

Nick Lane

Nature (2009) 462: 272-274.

http://www.nature.com/news/2009/091118/full/462272a.html

Genetic sequences in a cell's mitochondria can be used to accurately determine species. In this article published in the journal *Nature*, the author of *Life Ascencing: The Ten Great Inventors of Evolution* investigates whether this is because they are responsible for creating what they identify.

Probing marine Gammarus (Amphipoda) taxonomy with DNA barcodes

F. O. Costa, C. M. Henzler, D. H. Lunt, N. M. Whiteley & J. Rock

Systematics and Biodiversity (2009) 7, 4: 365-379.

http://journals.cambridge.org/action/displayJournal?jid=SYS

In the most comprehensive molecular study of marine *Gammarus* to date, the authors used DNA barcode sequences to probe the taxonomy of prominent members of marine and brackish water *Gammarus* of the North Atlantic, Baltic, Mediterranean and Black Seas.

Validation of the ITS2 region as a novel DNA barcode for identifying medicinal plant species

Shilin Chen, Hui Yao, Jianping Han, Chang Liu, Jingyuan Song, Linchun Shi1, Yingjie Zhu1, Xinye Ma, Ting Gao, Xiaohui Pang, Kun Luo, Ying Li, Xiwen Li, Xiaocheng Jia, Yulin Lin, Christine Leon

PLoS ONE (2009) 5: e8613, doi: 10.1371/journal.pone.0008613

Seven candidate DNA barcodes (psbA-trnH, matK, rbcL, rpoC1, ycf5, ITS2, and ITS) from medicinal plant species were ranked according to PCR amplification efficiency, differential intra- and inter-specific divergences, and the DNA barcoding gap. Results suggest that the second internal transcribed spacer (ITS2) of nuclear ribosomal DNA represents the most suitable region for DNA barcoding applications.

Public health response to puffer fish (Tetrodotoxin) poisoning from mislabeled product

Nicole J. Cohen, Jonathan R Deeds, Eugene S. Wong, Robert H. Hanner, Haile Yancy, Kevin D. White, Trevonne M. Thompson, Michael Wahl, Tu D. Pham, Frances M. Guichard, In Huh, Connie Austin, George Dizikes, Susan I. Gerber

Journal of Food Production (2009) 72: 810-817.

In 2007, two people became ill with tetrodotoxin poisoning after eating home-cooked puffer fish purchased in Chicago. Although the Chicago retailer and the California supplier claimed the product was monkfish, DNA barcodes determined that the fish and others retrieved from the supplier belonged to the family Tetraodontidae.

Disentangling vector-borne transmission networks: a universal DNA barcoding method to identify vertebrate hosts from arthropod bloodmeals

Miguel Alcaide1*, Ciro Rico1, Santiago Ruiz2, Ramón Soriguer1, Joaquín Muñoz1, Jordi Figuerola1

PLoS ONE (2009) 4: e7092, doi: 10.1371/journal.pone.0007092

What hosts sustain arthropod disease vectors when they are not biting humans? These researchers from Doñana Research Station, Seville, Spain, collected "wildlife engorged" mosquitoes, sandflies and biting midges and used DNA barcoding to identify vertebrate hosts from the insects' bloodmeals.

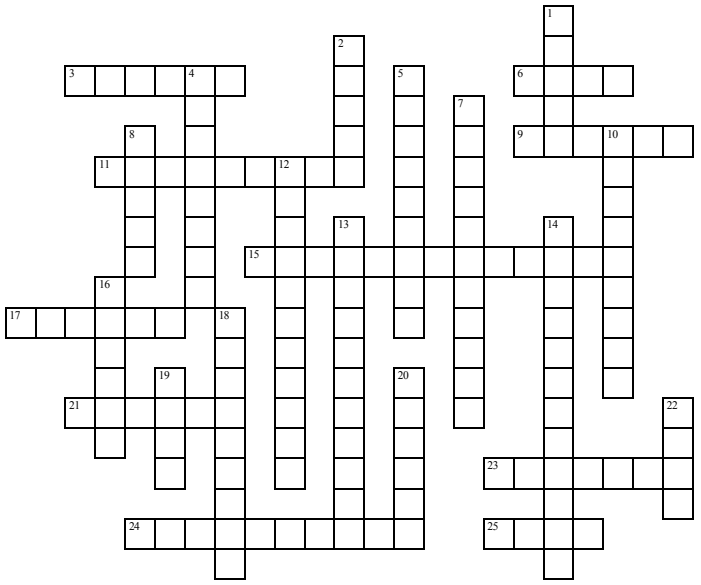
DNA-based identification of forensically important Australian Sarcophagidae (Diptera)

Kelly A. Meiklejohn, James F. Wallman and Mark Dowton

International Journal of Legal Medicine (2009) doi: 10.1007/s00414-009-0395-y

Crime scene investigators often use insect evidence to determine the time of death since the various species that colonize corpses exhibit different stages of development depending on time and temperature. Researchers from the University of Wollongong in Australia tested DNA-barcode identification of forensically important but hard-to-identify Sarcophagidae flies with results that will be instrumental for their implementation in forensic entomology.

iBOL Crossword Puzzle



ACROSS

3 IBOL headquarters (city)
6 Number of specimens that iBOL will barcode (in millions)
9 Northern-most iBOL nation
11 Regional Node where women are known colloquially as "sheilas"
15 Organelle that is important to animal barcoding
17 National Node in Central America, most famous for a canal
21 Scientific Director of iBOL
23 Name of the campaign to barcode all fish on Earth
24 First ten bases of the Folmer primer LCO1490
25 One of the two plant barcode loci

DOWN

1 One of iBOL's Central Nodes
2 Most populous iBOL nation
4 One of the taxonomic kingdoms without an official barcode
5 Endosymbiont of many insects that causes contamination problems
7 IBOL working group 1.6
8 IBOL working group 1.3
10 Southern-most iBOL nation
12 Taxonomic order with the most barcodes
13 Africa's only Regional Node
14 2010 is the international year of _____
16 City that hosted the Second International Barcode of Life Conference
18 National Node in Central America whose name literally means "Rich Coast"
19 Things that are missing from Dan Janzen's collection
20 Largest iBOL nation
22 The DNA barcode database

Answers in the next issue

Third international barcode conference in Mexico City

The Consortium for the Barcode of Life (CBOL) brought the international barcoding community together in Mexico City November 9-13 for the Third International Barcode of Life Conference. The conference, hosted by the Institute of Biology of the National Autonomous University of Mexico (UNAM), attracted 350 participants from 54 countries.

Three days of pre-conference activities on the UNAM campus included: the first meeting of the iBOL Scientific Steering Committee; an all-day workshop on Barcode of Life Data Systems (BOLD); several meetings of plant barcoding projects; an all-day workshop on barcoding protocols organized by CBOL's Leading Labs Network; and a workshop on barcoding and Access and Benefit Sharing sponsored by Canada's International Development Research Centre (IDRC).

The main conference was held at the Mexican Academy of Sciences and featured a videotaped welcome by Ahmed Djoghlaf (left), Executive Secretary of the Convention on Biological Diversity.

"By participating so massively in this conference and in the Barcode of Life movement, you have collectively and individually demonstrated your belief that biodiversity is a global issue that requires global cooperation," Dr. Djoghlaf said. "From the perspective of the Convention on Biological Diversity, your shared conviction makes the Third International Barcode of Life conference a very important event."

Dr. Djoghlaf said that the global Barcode of Life database (BOLD) would not only improve our capacity to document biodiversity on Earth, it would enable countries to exchange information and build a shared understanding of how to live sustainably on a biodiverse planet.

The main business of the conference occurred during the 28 afternoon parallel technical sessions, most of them dealing with the focus areas of the 20 iBOL Working Groups. The lead researchers of several Working Groups took this opportunity to present their group's goals and enlist participants. ✣

A toast to a very successful event from host Patricia Escalante, of the Autonomous National University of Mexico (UNAM), and organizer David Schindel, Executive Secretary of CBOL.

A spectacular close-up of a caterpillar from Costa Rica's Guanacaste Conservation Area introduces a presentation by University of Pennsylvania biology professor Daniel Janzen.

During a presentation to the Mexico City conference, Mehrdad Hajibabaei, co-lead of iBOL's Environmental Barcoding Working Group, makes the point that overloading any system can leave your ass just hanging there. (Photos courtesy of CBOL)

Coffee break at the conference – time to check out the posters or do some networking.

The Art of Barcoding

Photos by Brad Zlotnick

Art is coming face to face with the science of barcoding in galleries across the United States during a ground-breaking exhibition called "The Barcode of Life: Environment–Evolution–Exuberance".

Featuring mixed media sculptures of butterflies and polar bears by Seattle-based artist Joseph Rossano alongside large format photographs of Costa Rican butterflies and caterpillars by famed biologist Daniel Janzen, the exhibit highlights the emerging role of DNA barcoding in cataloguing the Earth's vast, but threatened, biodiversity.

Visitors use mobile devices to scan barcodes on each sculpture, which then links them to a series of web pages. There they find further information on each piece: the organism it portrays and its DNA barcode. They can also read about barcoding in general and about the conservation efforts spearheaded by Janzen, an early adopter of DNA barcoding.

The web content was prepared by the Ontario Genomics Institute (OGI) with barcode information and data provided by the International Barcode of Life (iBOL) project.

"I am thrilled to be collaborating with researchers who are leading biodiversity science to the next level," said Rossano, "and to be exploring their work and its impact through my art. The interface between art and science offers a unique form of engagement: My sculptures direct viewers on a path of introspection and investigation, which in this case is further enhanced by being able to link to the associated online content."

Rossano named his sculpture series BOLD after Barcode of Life Data Systems (www.boldsystems.org/), the web-based repository for barcode records, specimen data and images as well as sequences and trace files.

The Barcode of Life: Environment—Evolution—Exuberance opened at Chicago's Habatat Galleries on November 6, 2009 and then moved to the Bill Lowe Gallery in Atlanta on December 4. More dates and locations will be announced. ✤

Meet the Board of iBOL

iBOL is a not-for-profit corporation governed by a Board of Directors made up of representatives from funding agencies and independent experts. The board monitors compliance with project objectives and ensures good governance.

Christian Burks (Interim Chair)

Christian Burks is President and CEO of the Ontario Genomics Institute, where his role draws on his career in basic and applied research institutions and start-up biotechnology companies: creating, developing, and managing database resources for molecular biology; analysing molecular sequence data; generating and managing genomics and proteomics technology and data to support drug discovery; and involvement at the start of the Human Genome Project. Dr. Burks was part of a team that created, and was later Principal Investigator for GenBank.

Jesse Ausubel

Jesse Ausubel is vice-president of Programs with the Alfred P. Sloan Foundation where his main area of responsibility is support of basic research in science and technology. His programs include the Census of Marine Life, the Encyclopedia of Life and the Consortium for the Barcode of Life. Concurrently, Mr. Ausubel is Director of the Program for the Human Environment and Senior Research Associate at The Rockefeller University in New York City, where he has served on the faculty since 1989.

José Antonio De la Peña

José Antonio De la Peña Mena is deputy director of Mexico's National Council on Science and Technology (CONACYT) and head researcher at the Institute of Mathematics at the National Autonomous University of Mexico, specializing in the theory of algebraic representation. His ground-breaking research has been recognized with the National University Prize for Young Researchers (1991) and the Prize of the Mexican Academy of Sciences in 1994.

Paul Hebert

Paul Hebert is the Scientific Director of iBOL and Director of the Biodiversity Institute of Ontario. Dr. Hebert earned his PhD in genetics at Cambridge, completed postdoctoral fellowships at the University of Sydney and the Natural History Museum in London and in 1990 moved to the University of Guelph where he holds a Canada Research Chair in Molecular Biodiversity. His 2003 research paper proposing a database of DNA barcodes identifying all species is regarded as the beginning of the global barcode enterprise.

Faustino Siñeriz

Faustino Siñeriz is a Professor of Microbiology at the National University of Tucumán, Argentina. He is principal researcher and vice-president of technology with the National Council of Scientific and Technical Research (CONICET) and Director of the Argentinean-Brazilian Centre for Biotechnology (CABBIO). His fields of research are biotechnological processes, microbial physiology, microbial enzymes, process optimization and effluent treatment.

Karl Tibelius

Karl Tibelius joined Genome Canada as Vice President, Genomics Programs, in September, 2009. Previously, he was Director of the Targeted Initiatives Branch at the Canadian Institutes of Health Research (CIHR), where he coordinated program delivery of CIHR initiatives that addressed priority areas such as pandemic preparedness, knowledge translation and commercialization as well as international collaborative research initiatives.

Xian-en Zhang

Xian-en Zhang is Director General of the Basic Research Department in the Chinese Ministry of Science and Technology where he manages major national programmes for the development of scientific research and leads the working group of China's Scientific Data Sharing Programme. Dr. Zhang has published numerous papers on analytical biotechnology and has written three books on biosensors and biochips.

Suzanne Fortier (observer)

Suzanne Fortier has served as President of the Natural Sciences and Engineering Research Council of Canada (NSERC) since January 2006. Previously, she held a number of senior academic and administrative positions at Queen's University in Kingston, Ontario. Dr. Fortier is a crystallographer by training, specializing in the development of mathematical and artificial intelligence methodologies for protein structure determination.

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