international BARCODE OF LIFE

BARCODE BULLETIN

Vol. 3, No. 2 - Sept 2012

The newsletter of the International Barcode of Life project

Chinese Delegation visits the Biodiversity Institute of Ontario

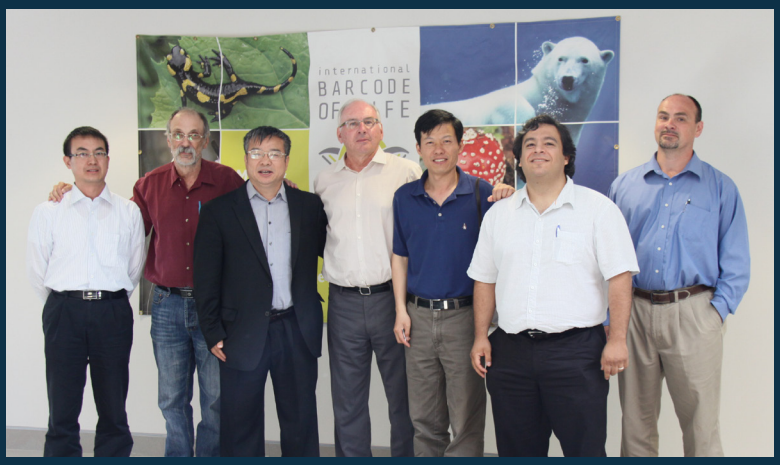
A delegation of executives from the Chinese Academy of Sciences and the Kunming Institute of Botany visited the Biodiversity Institute of Ontario on August 7 to strengthen collaboration within iBOL.

Both groups emphasized the need for scientific exchange programs and training courses for students and stakeholders.

Stay tuned for more exciting news on DNA barcoding efforts in China.

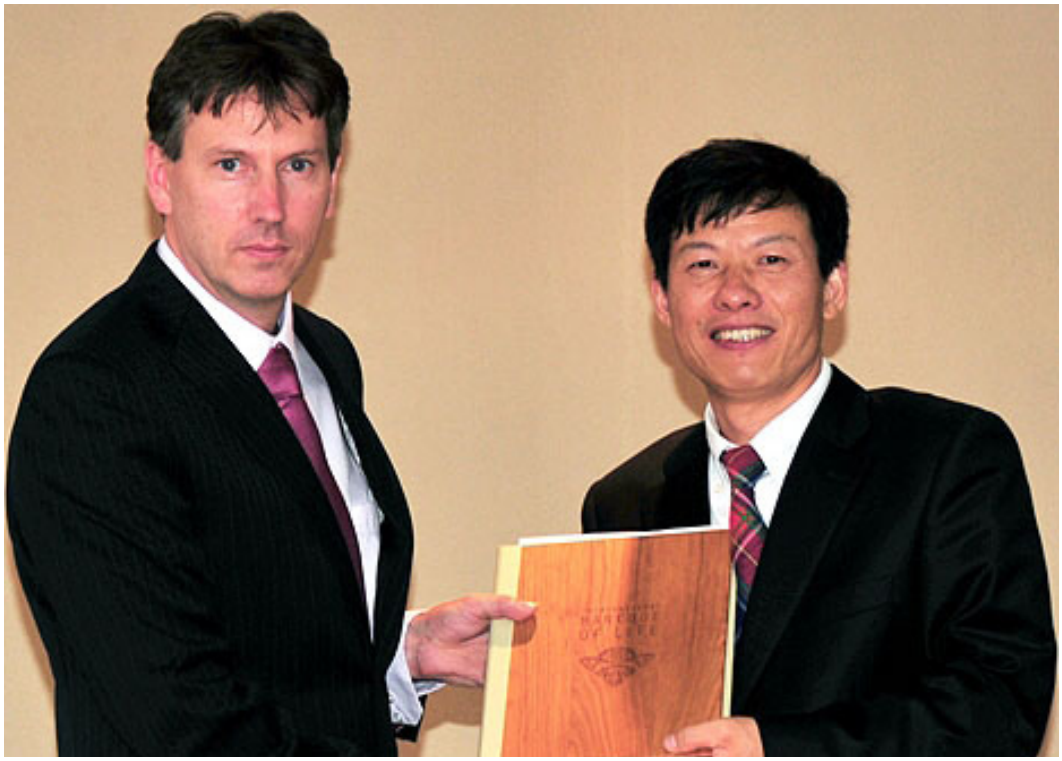
Photo (From left):

Zhiping Lou , Bob Murphy, Jinghua Cao, Paul Hebert, Dezhu Li, Mehrdad Hajibabaei, Bob Hanner.



China Signs iBOL MoU

Eager to play a more prominent role in the global barcoding community



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China Signs Memorandum of Understanding:

Seeks more prominent role in global barcoding community

China is the latest country to sign the Memorandum of Understanding, officially making it a Central Node of the International Barcode of Life project. The Memorandum was signed on May 29th, 2012 at the Kunming Institute of Botany in Yunnan with representatives of the Chinese Academy of Sciences and the Ministry of Science and Technology in attendance.

Prof. Dezhu Li, director of the Kunming Institute of Botany, signed on behalf of the Chinese National iBOL Committee and Dr. Pete Hollingsworth, chair of the iBOL Scientific Steering Committee Executive, represented iBOL.

Prof. Ronghui Su said that the Chinese Academy of Sciences is a driving force behind the country's barcoding efforts.

Among the dignitaries at the signing ceremony were: Prof. Ronghui Su, deputy director, and Dr. Zhiping Lou, division head of the Chinese Academy of Sciences Bureau of Life Sciences and Biotechnology, Prof. Qingli Wang, president of Academy's Kunming Branch, and Dr. Wenjun Chen, head of Department of Basic Research at the Ministry of Science and Technology. The signing ceremony was chaired by Prof. Wang Wen, deputy director of the Kunming Institute of Zoology.

In his address Prof. Ronghui pointed out that, as a new technology for species identification, DNA barcoding has great value for both science and society. The Chinese Academy of Sciences is a main driver of DNA barcoding in China, he said. Guided by the Chinese National iBOL Committee, academic institutions have made strong progress in many fields of barcoding science. They implemented standardized techniques for molecular experiments and developed molecular markers for animals, seed plants, fungi as well as other microorganisms. China has also made great strides in building core facilities including a BOLD mirror system and a data mining platform.

Dr. Wenjun Chen outlined the contributions to barcoding by China's Ministry of Science and Technology.

According to Dr. Wenjun Chen, the Ministry of Science and Technology as the major official funding agency of basic research in China, plays a pivotal role in the development of the country's DNA barcoding effort. The ministry has already funded projects to standardize technology, to construct an informatics system for DNA barcoding of several important organism groups, to support DNA barcoding of natural reserves, and efforts to barcode the fishes of China.

Prof. Wenjun said that the Ministry will continue to work with the Academy of Science and the National Natural Science Foundation of China (NSFC) to further support iBOL activities in China and to ensure that Chinese scientists play a more prominent role in the international barcoding community.

DNA Barcoding of Natural Health Products:

Why sometimes reading the label just isn't enough

Think that it is alright to take Natural Health Product labels at face value? Think again. In fact, Natural Health Products are frequently mislabelled.

Our barcoding study, conducted at the Biodiversity Institute of Ontario, Guelph, and guided by Mehrdad Hajibabaei, revealed that 19% of Natural Health Products are substituted with different ingredients than those listed on the label. The resulting manuscript was published in Food Research International.

Why Barcode Natural Health Products?

The Natural Health Products (NHPs) industry in North America has grown tremendously over the past few decades. Health Canada reports that 71% of Canadians regularly use NHPs, which include herbal medicines, homeopathic preparations, vitamin and mineral supplements and Chinese, Ayurvedic and Native North American medicine, and are generally used in complement with biomedical treatments.

Natural Health Products are often perceived to be safe due to their natural origin, however, adulterated, counterfeit and low quality products, which go undetected through mislabelling, pose serious safety threats to consumers. Although the mislabelling of Natural Health Products can be prevented through adequate regulatory mechanisms, enforcing regulations for product safety can become complicated because the content of the majority of Natural Health Products is difficult to ascertain, as they are sold as capsules, tablets, or dried parts.

In addition, unlike prescription drugs, NHPs are not regulated as closely. For example, in Canada, NHP regulations are stricter than regulations for food products, but less strict than the regulations for drugs in the country. Since 2004, there has been a backlog of product license applications to be processed. During some periods, this has led thousands of products to exist on the market without undergoing full screening for product safety. In the U.S. and the U.K., issues with the regulatory systems for Natural Health Products have also led to problems with their consistency and safety.

Enter DNA Barcoding

Curiosity about the actual content of Natural Health Products led our team of three undergraduate students at the University of Guelph to use DNA barcoding to authenticate 94 widely used plant and animal NHP Products, which included primarily shark fins and ginseng, but also encompassed black cohosh, green tea, Echinacea, and St. John's Wort.

Guided by DNA barcoding researchers Mehrdad Hajibabai and Shadi Shokralla, I headed the study, funded by an Ontario Genomics Institute Summer Fellowship. Working with Stephanie Boilard and Shannon Eagle, who were also completing undergraduate research assistantships at the time, I found uncovering the true identity of products exciting.

Particularly interesting was the fieldwork required to obtain the products. All of the Natural Health Products sampled and sequenced were collected from field trips to pharmacies and informal markets in Toronto and New York. Acting as ordinary consumers, we shopped for natural products to aid in a wide variety of ailments, including the common cold, depression, stomach problems, and symptoms of menopause.

DNA Barcoding of Natural Health Products -

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The most exciting part of the study was when the sequence results came in and we got to explore the health, environmental, economic and legal implications of the numerous substitutions and adulterations that we found. The results we obtained suggest that DNA barcoding is an excellent authentication tool for Natural Health Products and that consumers of Natural Health Products should be wary.

What is in your Natural Health Product?

Fully 81 per cent of Natural Health Products made from animals correctly matched their commercial label. The rest contained everything from cheaper alternatives to protected species.

Interestingly, half of the plant products labeled as Korean ginseng were really American ginseng. Whether these adulterations were completed as a result of taxonomic misidentification or were an attempt to make the consumer pay more for a fraudulent product, they have significant economic and health ramifications for consumers. This is because Korean ginseng is more expensive and is marketed for different medicinal benefits than American ginseng.

An equally interesting find is the sequence of one abalone product. Barcoding this product revealed that our specimen was another marine gastropod. This replacement may have been completed as a result of taxonomic misidentification, but could have also been completed knowingly. As world demand for abalone currently exceeds supply, abalone has become a luxury product, and commercially claiming this product is abalone would allow merchants to charge more for this product.

We found that barcoding could not only assist with the quality assurance for consumers, but with the identification of products that contain vulnerable species.

One of many factors affecting the decline of shark populations is the use of their fins in shark fin soup, a Chinese delicacy thought to have many health benefits. To prevent the decline of shark populations, which is exacerbated by finning, sharks have been protected in the territorial waters of several countries. However, for a non-expert, morphological keys are insufficient for identifying shark fins. As a result, it is difficult to track which species are being killed. Our study shows that DNA barcoding could be a viable part of this tracking process, providing a checkpoint for conservation organisations investigating species exploitation. Several of the shark species identified from the shark fins barcoded are listed on the International Union for the Conservation of Nature's "Red List" as in need of conservation.

The utility of DNA barcoding for food regulation has already caught the interest of regulatory agencies such as the U.S. Food and Drug Administration. Ultimately, our work demonstrates not only that DNA barcoding is a simple and efficient approach to identify the substitution and adulteration of Natural Health Products, but that it can aid in understanding and preventing the economic, legal, health and environmental impacts, of such substitutions.

Written by: Lauren Wallace (graduate student, McMaster University)

Madagascar study finds 40 new reptiles:

DNA barcoding provides a clear advantage for conservation

A DNA barcoding study targeting the entire reptile fauna of the biodiversity hotspot of Madagascar identified over 40 new species of snakes, skinks, chameleons and geckos.

Using a newly developed set of reptile-specific primers for COI, the research team from Brussels, Munich and Brunswick compared gene sequences of around 250 species out of the 393 currently described on the world's fourth largest island.

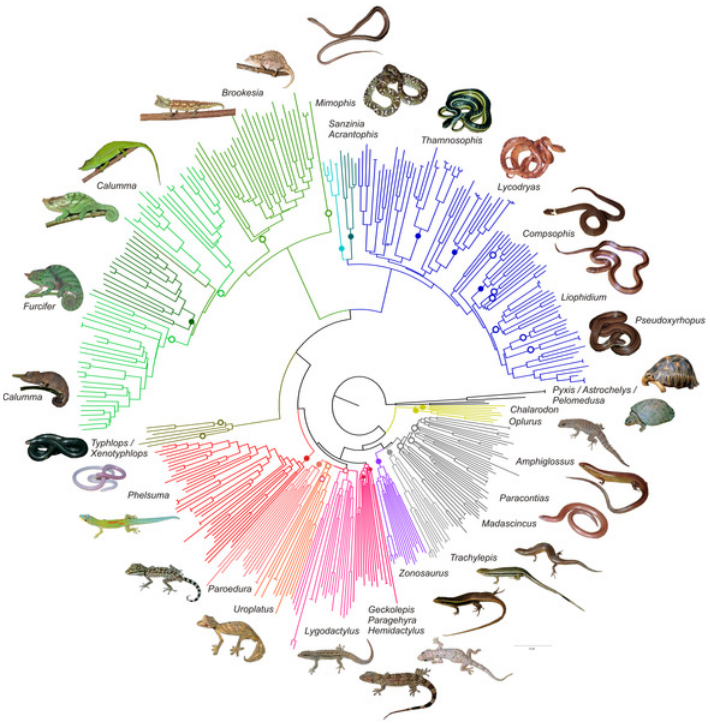
"The large number of newly identified reptile species was striking, because the reptiles of Madagascar have been intensively studied during the last 20 years" comments lead researcher Zoltán T. Nagy, of the Royal Belgian Institute of Natural Sciences in Brussels.

"This surprisingly high number of reptiles new to science represents more than 10 percent of the presently known diversity of reptiles on the island, and highlights Madagascar's importance as being one of the 'hottest hotspots' of biodiversity on Earth."

"In the future, these unknown species will have to be studied morphologically before they can be described and named formally" adds Munich taxonomist Frank Glaw, a co-author of the study.

More importantly, the study generated DNA barcodes for about 110 of the 140 Madagascan reptiles included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), providing a valuable tool for controlling illegal wildlife trade using molecular identification methods.

"DNA barcoding will facilitate rapid and minimally invasive identification of animals—a clear advantage in the context of conservation," commented coauthor Gontran Sonet, also of the Royal Belgian Institute of Natural Sciences.



The Kosher Sardine Conundrum:

Rabbis turn to barcode analysis to worm out the truth

When rabbis from the Orthodox Union started finding worms in cans of sardines and capelin eggs, they turned to scientists at the American Museum of Natural History to answer a culturally significant dietary question: could these foods still be considered kosher?

Researchers at the museum's Sackler Institute for Comparative Genomics used DNA barcode analysis to identify the species and life cycles of the parasitic worms and determine whether the food's preparation violated Jewish dietary laws. The results, which were recently published online in the Journal of Parasitology, show that although the food contains a handful of species of roundworms, it is kosher.

"About 75 percent of all pre-packaged food has a kosher certification," said Mark Siddall, a curator in the Museum's Division of Invertebrate Zoology. "Many people, not just those in the Jewish community, look for this certification as a symbol of quality assurance in food preparation. If you're a food provider and you lose that certification, you're going to take a large hit."

The study began last March, when rabbinical experts from the Orthodox Union, the largest organization that certifies food products for the Jewish community, brought a variety of kosher-certified sardines and capelin eggs to the Museum. Their concern: the presence of the worms might be a sign that intestinal contents were allowed to mix with sardine meat or preserved capelin eggs during food preparation. If that were the case, kosher certification would be compromised.

The key to determining whether the canned food was improperly handled is in the worms' life cycles, Siddall said. "Some species of worms live in the muscles of fish when they're in the larval stage," he said. "Other species live in the fish's intestines when they're adults. We already know the life cycles for these parasites, so all we have to do is figure out what species were present in the canned food."

To do this, researchers turned to DNA barcoding, a technology museum scientists have used previously to identify the presence of endangered whales in Asian markets, document fraud in the labeling of tuna, and determine the species of animals on sale in African bushmeat markets.

In this case, the scientists identified a handful of different nematode species, none of which are known to live in the guts of fish during their lifecycles. Therefore, there's no evidence of intestinal worms co-mingling with the fish meat or eggs. As a result, the Orthodox Union issued a decision that the food remains kosher.

"This paper really exemplifies what science is all about — helping people," said Sebastian Kvist, one of the paper's authors and a student in the Museum's Richard Gilder Graduate School. Other authors include Anna Phillips, from the University of Connecticut, and Alejandro Oceguera-Figuero, from the National Autonomous University of Mexico.

Funding for the Museum's DNA Barcoding Initiative is provided by the Alfred P. Sloan Foundation and the Richard Lounsbery Foundation.

Argentina Lab Network Growing:

Second facility opens in Mar del Plata

Argentina's network of iBOL reference laboratories is taking shape with the opening of a new facility in the Marine Sciences Department at the National University of Mar del Plata.

The lab will focus on aquatic biodiversity – mainly sampling marine fish and invertebrates but also some freshwater species. The work will be overseen by long-time iBOL collaborator Juan Diaz de Astarloa.

This is the second of five iBOL labs being funded by Argentina's National Council of Scientific and Technical Research(CONICET), joining the lab located at the Bernardino Rivadavia Natural Sciences Museum in Buenos Aries.

The other three will open soon at:

» the Northeastern Botanical Institute (IBONE) in Corrientes, processing mostly plant tissues.

» the Patagonian National Centre (CENPAT) in Puerto Madryn, processing the marine and continental Patagonian fauna; and

» the Biodiversity and Environment Research Institute (INIBIOMA) in Bariloche City, mostly processing the freshwater fauna of Andean rivers and lake ecosystems as well as the terrestrial fauna of the Patagonian Andes.

BIObus Returns Home for the Season:

After a summer of visiting Canada's National Parks

The BIObus is a field research vehicle of the Biodiversity Institute of Ontario (BIO). Since 2008, the BIObus has been crisscrossing North America, carrying researchers and students to national parks and other biodiversity hotspots to collect insects and other invertebrates. These sampling missions have already amassed more than 400,000 specimens, representing almost 10,000 species

The BIObus has partnered with Parks Canada to deploy malaise traps in National Parks across Canada. Over a few months a single trap can collect tens of thousands of insects, providing a baseline inventory of species living in the park, and a reference point for the future.

Stay tuned for a feature on the malaise trap program and a student perspective on the BIObus expedition in the next issue of the Barcode Bulletin.

BIObus Statistics:

kms driven (April 27 – August 31, 2012)
31453

# of tire blowouts
4

# of participating National Parks
14

# of malaise traps deployed
88

# of BIObus Blog entries (www.biobus.ca)
30

# of lots collected
1798 (standard collecting)

# of malaise program lots collected
121 (with more to come)

Funding Shortfall Brings Changes at iBOL:

An update from Canada

Canadian funders have played a critical role in both enabling iBOL's activation and its progress.

The Canada Foundation for Innovation, the Ontario Research Foundation, and Genome Canada provided nearly $30M to build the Biodiversity Institute of Ontario (BIO) and to obtain required sequencing and computational hardware.

The Ontario government supports Barcode of Life Database (BOLD), while Genome Canada supports iBOL's governance, and the costs of sequence analysis at BIO.

Recent reductions in funding for science linked to the global economic crisis have made it impossible for Genome Canada to sustain its support at the level originally intended. iBOL's core mission of assembling barcode records for 500K species by December 2015 remains unaltered, but the reduced funding envelope has required the need for two major adjustments. Firstly, to maximize the funding available for research, iBOL's governance has been streamlined. Secondly, the sequencing facility at BIO will need to adopt partial cost recovery.

iBOL Governance

iBOL remains an international research program, coordinated by the project team at the University of Guelph. Although now operating under reduced funding, iBOL will sustain the broadest possible international involvements in DNA barcoding. The iBOL website will remain active and the Barcode Bulletin will continue to provide the community with quarterly updates on progress and achievements.

The governance of iBOL has now been streamlined to a compact Board consisting of senior staff from Genome Canada, a Science Advisory Committee, and an International Scientific Collaboration Committee with members drawn from nations with funded barcoding projects linked to iBOL.

Informatics Support

BOLD provides critical informatics support to iBOL researchers and to the DNA barcoding community at large.

The Ontario Ministry of Economic Development and Innovation has committed $1M a year to support BOLD's ongoing operation and development through 2016. Beyond 2016, BOLD is well positioned to gain long-term support from provincial and federal agencies in Canada that have been charged with developing a national strategy for the preservation and stabilization of access to large-scale data sets. Such action will be reinforced by the rise of BOLD mirror sites in other nations.

Sequencing Support

BIO has generated 450K of the 600K records generated by iBOL researchers since September 2010.

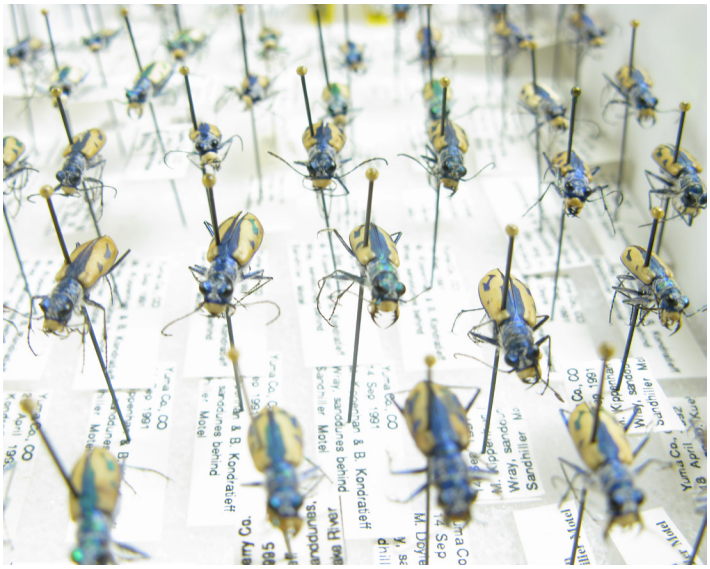
Nearly three quarters of BIO's sequencing effort has been directed toward specimens collected outside Canada, but analytical costs have been heavily subsidized. The reduction in Canadian funding means that BIO must now recover a larger fraction of its costs. Because sequencing infrastructure is in place and because of support for staff salaries and equipment maintenance, BIO can offer subsidized sequencing to iBOL research programs. Details on the cost structure are available on the BIO website.

DNA Barcodes for NEON's Terrestrial Insects:

Short- and long-term development and applications

The National Ecological Observatory Network (NEON) is a National Science Foundation sponsored project designed to gather and make publicly available 30 years of ecological data on the impacts of climate change, land use change and invasive species on natural resources and biodiversity.

NEON includes several science groups that will make terrestrial, aquatic, aerial and tower-based annual observations across 60 sites in the continental US, Alaska, Hawaii and Puerto Rico. The NEON project is also supported by a variety of infrastructural teams (e.g. project management, engineering, and 12 others).



Currently in its construction period, the project is slated to be fully operational by 2017. Visit NEON's website and the science strategy document for more information.

NEON's terrestrial observations are focused on a few focal taxa. Our insect focal taxa are carabids, or ground beetles, and mosquitoes. Over the 30-year operations phase, ground beetle and mosquito specimens will be collected during the growing season and identified to species level by trained technicians (parataxonomists) at 20 NEON support facilities.

Teaching collections and other resources – described below in more detail – will aid technicians' identifications. Subsets of specimens will be checked by expert taxonomists and / or sequenced for the CO1 marker to verify identifications, or possibly, to help unveil new species. All specimens (including unsorted "bycatch"), and any extracted DNA will be archived in existing collections institutions.

To support the parataxonomists' insect species identifications, we are currently using an integrative taxonomic approach to build a digital reference library. We describe the reference library development in arecent PLoS ONE paper. The specimens for this work are either field-collected during prototype campaigns or from museum archives. All the assembled resources for each specimen – sequence data, photos, and other ecological information – can be publicly-accessed online from the Barcode of Life Datasystem (BOLD).

Within BOLD, we have two public projects, NEONT and NEONZ. NEONT includes records that we have the most confidence in; specimens that have been morphologically identified by expert taxonomists and united with bi-directional contiguous reads > 600 bp that do not conflict with any other data. The NEONZ project contains records in progress, which include useful information, but do not meet the criteria of NEONT.

DNA Barcodes for NEON'S Terrestrial Insects -

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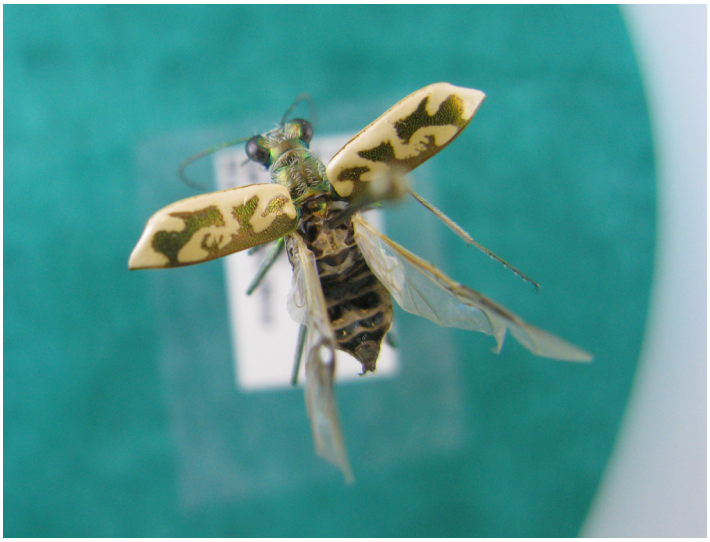
We are also tagging our records for further clarity. Our tag system uses 'parataxonomist' for those specimens looked at only by a parataxonomist, and 'open_to_question' for those records that are not sufficient to be 'reference' records. We welcome input to resolve 'open to question' records into 'reference' records.

Meanwhile, both types of records have proven useful. 'Open to question' records have verified a range expansion in the case of the mosquitoes, and helped us to better understand the genetic relationships among ground beetle species.

The completed reference library, in addition to its critical utility for NEON's parataxonomists, will serve a variety of uses for others. For example, the time-intensive and costly effort of rearing juvenile mosquitoes to adulthood for morphological identification can be avoided by barcoding mosquito larvae. Non-experts can accurately identify ground beetles, which are often used as environmental indicators.

Systematists can view NEON's photos in BOLD to examine the morphological diversity of a particular species. These are a few uses that spring to mind – we look forward to these data supporting as yet unconceived explorations.

Written by: David Hoekman, Cara Gibson, and Kali Blevins



New DNA Barcoding blog: dna-barcoding.blogspot.com

Since mid August Dirk Steinke from the Biodiversity Institute of Ontario runs a new blog on DNA Barcoding. Steinke, a researcher involved in barcoding for seven years, plans to release posts on a more or less daily basis. Topics focus on species discovery, application of DNA Barcoding, and technical advances. "I will try to find a good balance between scientific and non-scientific contributions as I hope that my audience will not consist of DNA Barcoding scientists alone", Steinke says in his first posting.

A New Weapon in the Fight Against Illegal Logging

Illegal logging is on the increase world wide with a focus on rare and protected tree species. Criminal gangs fell the trees to satisfy an international black market for the wood. It is a lucrative business for the loggers, e.g. the wood for a single violin bow is worth several thousand dollars. Just recently the Brazilian police confiscated several violins which are believed to be made from brazilwood (*Caesalpinia echinata*) an endangered tree that gave Brazil its name.

Gibson Guitar Corp, which makes some of the world's most prized guitars, agreed on August 6 to pay a $300,000 penalty after it admitted to possible illegal purchases of ebony from Madagascar.

Unfortunately, mislabelling, lying about origin or substituting one type of wood for another have become common practices in the timber trade. Interpol recently estimated that illegal logging alone causes losses in assets and revenue in excess of 30 Billion Dollar annually.

For a long time the only instruments in the fight against trade in illegal timber were regulations and preventive measures, which have not met with much success. Recently the focus shifted towards using the criminal justice system and law enforcement techniques. Therefore, it was about time to equip law enforcement authorities with a tool that provides conclusive evidence in such cases – DNA Barcoding.

DNA Barcoding is capable to prove that seized wood or wood products are from protected species and there is great interest to develop a barcode reference library of plants that are protected from international trade. Moreover, industry

University of Adelaide Professor Andrew Lowe with a sample of wood, which can be used to trace illegal imports.
Picture: Tait Schmaal Source: The Advertiser

officials say that rapid advances and plunging costs for DNA testing of timber now make it commercially viable for companies trying to meet new regulations in the United States and Europe against such practices. Two examples demonstrate that the technology reached a point where it could be used on a routine base and even successfully transferred into a business model.

A method of extracting DNA taken from a piece of wood was refined at Andrew Lowe's laboratory at the University of Adelaide in South Australia. They were able to extract degraded DNA from decades-old wood and get accurate results. Lowe is also the chief scientific officer at Double Helix Tracking Technologies, a Singapore based company that has commercialised the DNA testing for wood, with most testing done at the lab in Adelaide. The new method and recently implemented laws in the U.S. and Europe led to an increase in business for Double Helix and their ultimate goal is to make DNA testing so cheap that all companies will do it.

A New Weapon in the Fight Against Illegal Logging -

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DNA testing was already having an impact in prosecutions, said Shelley Gardner, illegal logging programme coordinator for the United States Department of Agriculture Forest Service. "Any time we've gone to the point where we got to court, they plea-bargained because the DNA was already such a deterrent. And these are just small cases, so when you start talking about real trade, I think that could have a big impact," she said in an interview with Reuters.

While DNA collected from people and animals has revolutionised police investigations worldwide, obtaining and identifying genetic material from plants to provide hard evidence to help convict criminals seems more complex. This brought Renato Paranaiba, a forensics expert with the Brazilian Federal Police, all the way to Edinburgh, Scotland to learn plant DNA extraction techniques in the lab of Pete Hollingsworth at the Edinburgh Royal Botanic Garden.

He wants to extend his expertise to put an end to illegal logging in the Amazonian rainforest. "I am used to working with bones more than plants, but over the past few years there has been a move to combat environmental crime here, focused on the Amazonian regions," he said in an interview with The Scotsman. "Our government wants to do more to combat this crime and we have permanent environmental crime operations now in Brazil but although human and animal DNA is established in our police work we know little about plant DNA, so this is all new for me. We want to join the vanguard and this lab at the Botanics is the most respected around the world."

The hope is that the collaboration of enforcement institutions, business, and scientists will help create a barcode library for endangered plant species.

Written by: Dirk Steinke

DNA Barcodes go Underground:

GBOL-project 'Subterranean Fauna'

High degrees of endemism, low levels of gene-flow and limited food resources are not only characteristics of oceanic islands but similarly well describe subterranean environments. Cave endemics are frequently reported even from a morphology-only point of view. Considering the likeliness of cave-dwelling taxa adapting in convergent ways to similar (e.g. aphotic) subterranean environments, a considerably high amount of cryptic biodiversity still remains in complete darkness.

Given the fact that caves are frequently misused as dumping grounds or completely destroyed in the process of building activities, a part of the subterranean biodiversity will become extinct before we have a chance to discover it.

A drastic example is the current situation at the 'Vilina spilja – izvor Omble' cave in Croatia. By its extent it is the second longest cave in Dalmatia (3,036 m long, 192 m deep) and it comprises numerous different habitats, both terrestrial and aquatic. It is home for more than 30 cave dwelling, primarily stenoendemic but so-far undescribed species.

Yet, this cave system will be completely flooded during construction activities for the hydro power plant Ombla. The dam, the power plant and the entire facility are planned to be built directly within the cave. Raising public awareness for the existence of caves and their endemic fauna is the only process potentially preventing sometimes irrational governmental decisions.

Members of the Biodiversity Institute of Ontario, the Bio-speleological Register of the Hesse Federation for Cave and Karst Research, the German Federation for Cave and Karst Research, and the Goethe University, Frankfurt am Main have joined forces to build up a DNA Barcode library for all described species that are known to occur in caves of Germany.

DNA Barcodes go Underground -

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This project is part of the German Barcode Initiative (GBOL). The study will first utilize material collected over the past years in German caves and eventually include more freshly collected material.

It is the hope of the participating researchers that this project will serve as a model for other countries and regions to survey the biodiversity of their caves.

Documentation of caves and their subterranean fauna is still in its infancy. The largest and deepest cave of Germany – the Riesending with 16.4 km length and 1,059m depth – was discovered only recently in 1995. Even this year, the Hessenhauhöhle in Baden-Württemberg newly entered the list of the longest caves in Germany (with 3,182 m). Currently, 96 cave systems of length more than 1 km are known, with the majority of them situated in Southern Germany, i.e. Bavaria and Baden-Württemberg.

The Bio-speleological Register of the Hesse Federation for Cave and Karst Research lists 2.116 ecologically classified cave-dwelling morphospecies collected in caves, artificial cavities and springs (April 2008). An amount of 11% of the documented fauna is completely (troglobionts) or temporally restricted (troglophiles) to a life under the earth.

In 1982, the year of the foundation of the Bio-speleological Register, 28 caves were reported for the federal state of Hesse. Thanks to voluntary work the Bio-speleological Register today lists 464 caves and some 4,000 further objects.

Since 2009 and with the aim to raise public awareness for the subterranean fauna of Germany, the German Federation for Cave and Karst Research appoints the 'cave animal of the year'.

This year the large cave spider *Meta menardi* (Latreille, 1804) was chosen and in conjunction with the Arachnological Society (AraGes) also elected as the 'European spider of the year 2012'.

The aim of the GBOL- project 'Subterranean Fauna' is to provide a first snapshot of the genetic diversity present in German cave-dwelling animals and in this course to raise public awareness for the protection and conservation of underground habitats and their enigmatic fauna.

For questions or in case you like to provide material of German cave-dwelling animals please contact the author.

Written by: Alexander M. Weigand (Goethe University Frankfurt)

Top 10 DNA Barcoding Publications 2012

Measured using Publish or Perish (Jan-Sept)

Metrics are largely based on Google Scholar ranking and journal access statistics.

1.
Schoch CL, Seifert KA, Huhndorf S, Robert V, Spouge JL, Levesque CA, Chen W, Consortium FB (2012)
Nuclear ribosomal internal transcribed spacer (ITS) region as a universal DNA barcode marker for Fungi.
Proceedings of the National Academy of Sciences 109: 6241-6246.

2.
Brown SDJ, Collins RA, Boyer S, Lefort M-C, Malumbres-Olarte J, Vink CJ, Chruickshank RH (2012)
Spider: An R package for the analysis of species identity and evolution, with particular reference to DNA barcoding.
Molecular Ecology Resources 12: 562-565.

3.
van Nieukerken EJ, Doorenweerd C, Stokvis FR, Groenenberg DSJ (2012)
DNA barcoding of the leaf-mining moth subgenus Ectoedemia s. str. (Lepidoptera: Nepticulidae) with COI and EF1-alpha: two are better than one in recognising cryptic species.
Contributions to Zoology 81: 1-24.

4.
Che J, Chen HM, Yang J-X, Jin J-Q, Jiang K, Yuan Z-Y, Murphy RW, Zhang Y (2012)
Universal COI primers for DNA barcoding amphibians.
Molecular Ecology Resources 12: 247-258.

5.
Derocles SAP, Le Ralec A, Plantegenest M, Chaubet B, Cruaud C, Cruaud A, Rasplus JY (2012)
Identification of molecular markers for DNA barcoding in the Aphidiinae (Hym. Braconidae).
Molecular Ecology Resources 12: 197-208.

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