Wissenschaftliche Konferenz
„Vom Mineral zur Noosphäre“
aus Anlass des 150. Geburtstages von Vladimir Ivanovič Vernadskij (1863-1945)

Berlin, 15. März 2013

Foto: P. Knoll, 15.03.2013

Living with Biodiversity

MLS Johannes Vogel
Generaldirektor des Museums für Naturkunde, Berlin

Die nachfolgenden Darstellungen stellen die nicht abschließend lektorierten Präsentationen des Vortragenden zur Konferenz am 15.03.2013 dar.

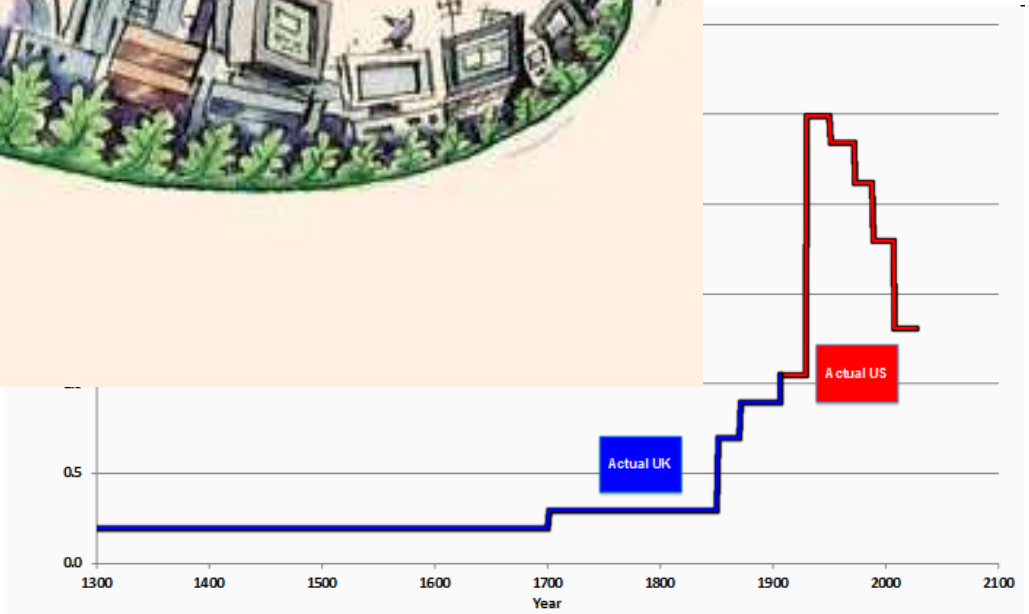
Sie dienen ausschließlich als Basis für fachliche Diskussionen; sie sind nur für den privaten Gebrauch bestimmt und nicht für die Weiterverwendung freigegeben.

Living with Biodiversity

Professor Johannes Vogel, PhD.
Museum für Naturkunde, Berlin

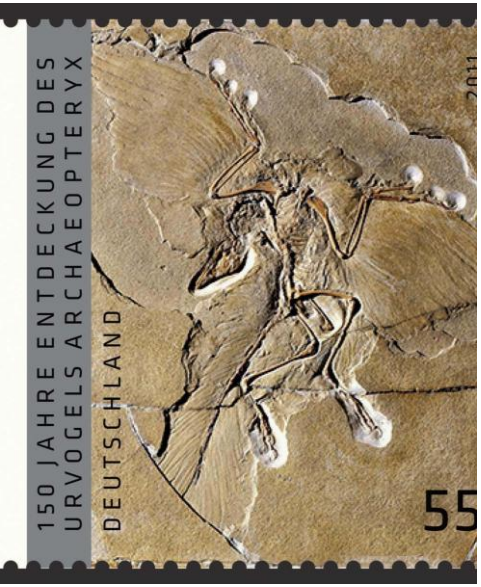
Living within means

Growth in real GDP per capita, 1300-2100



Global challenges: Climate, resources, biodiversity, water, food, social justice

- **The *Knowledge Society* is governed by science and technology**
- ***No innovation without participation***
- **Democracy needs scientifically literate citizen**
- **New ways of communication**
- **Citizens want to engage**



Museum für Naturkunde

- 198 years at Humboldt University
- Leibniz Association since 2009
- 30M collection – global top ten
- Top ten visitor attraction in Berlin (6/150)
- 252 staff (>400)
- € 14,5M grant-in-aid per year

Science outputs

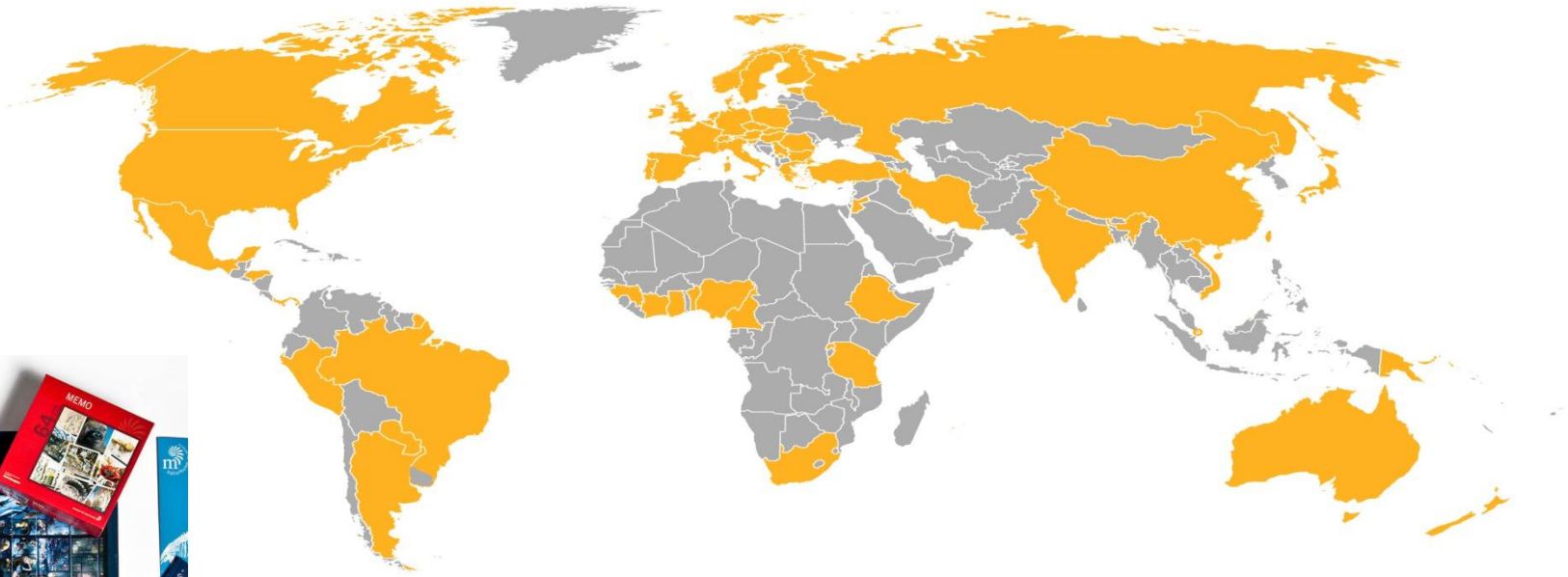
- **41% of ISI publications in top quartile journals**
- **3 peer-reviewed publications per year per scientist, 5 in all categories**
- **1/3 of all GBIF-D records supplied since 2010**
- **1% of global new species (500) described**

External net funding

2012 = € 4.3 M
2009 = € 1.9 M

c.20 % EU funding

Partner and leader



- **co-authorship with partners in 58 countries**
- **1,870 visitors from > 70 countries**
- **41 (inter-)national scientific conferences**

Museum für Naturkunde 2020

1. **How diverse is life on earth and how did it evolve?**

2. **How did the earth and the solar system evolve?**

3. **How do people best access their natural and cultural heritage, and how can (scientific) knowledge lead to action and care for our planet?**

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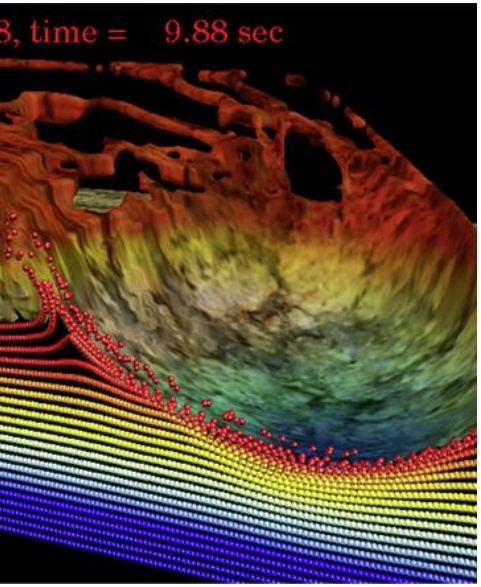
4. How is the interdependence between the earth system and human society?



5. How can our collections and museum infrastructure be best developed to serve current and future scientific and societal needs?

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Knowledge and motivation

- UK (NHM-MORI poll 2010)
  - 50-60% have difficulties identifying common wildlife
  - 60% say they want to learn more
- Germany (Jugendreport Natur 2010)
  - 50-60% have difficulties answering simple questions about nature
  - 70% say they want to learn more

Consistent picture: A strong majority wants to know more - but does not know how to.

Not just the
Museum für Naturkunde

Science = Trust

Objects = Validation

Participation = Skills

Participatory Science

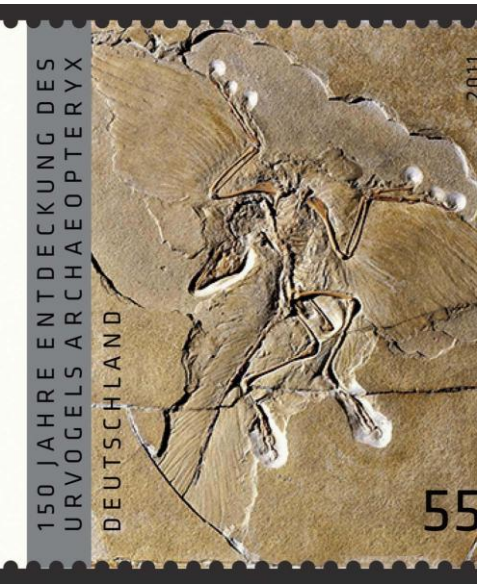
Tell me - and I will forget

Show me - and I will remember

Involve me - and I will understand

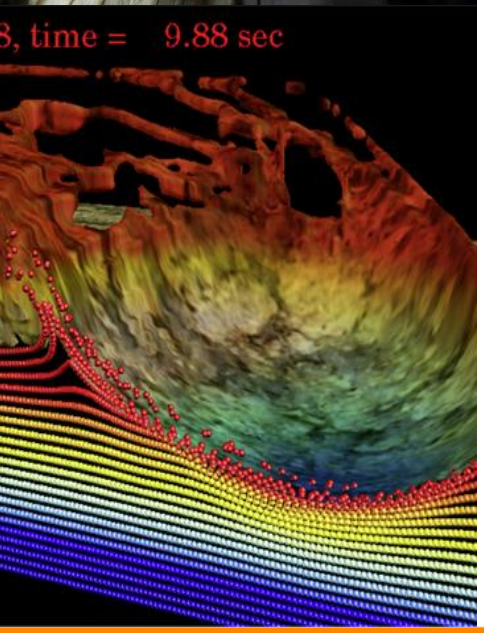
and, in addition to involvement

Give me a platform - and I will contribute



Public Engagement with Science

- ***Public understanding*** **versus** ***up stream engagement*** **and co-production**
- **Valuing diversity - of people and their knowledge**



Public Engagement with Science

1. **Passive observers, communication of ideas = many**

2. **Active participants (surveys)**

3. **Public and Scientists working together**

4. **Public informs or directs science = very few**

Opportunities for progression needed

The Power of Place

- **First Biodiversity Survey**
- **1855-1856**

The Power of Place: Great Puckland Meadow

- **Flowering plant species:**
  - **Darwin & Thorley (1855): 142 species**
  - **NHM Botany (2005-7): 141 species**

The Power of Place: Great Puckland Meadow

PNAS

A DNA barcode for land plants

CBOL Plant Working Group[1]

Communicated by Daniel H. Janzen, University of Pennsylvania, Philadelphia, PA, May 27, 2009 (received for review March 18, 2009)

DNA barcoding involves sequencing a standard region of DNA as a tool for species identification. However, there has been no agreement on which region(s) should be used for barcoding land plants. To provide a community recommendation on a standard plant barcode, we have compared the performance of 7 leading candidate plastid DNA regions (*atpF–atpH* spacer, *matK* gene, *rbcL* gene, *rpoB* gene, *rpoC1* gene, *psbK–psbI* spacer, and *trnH–psbA* spacer). Based on assessments of recoverability, sequence quality, and levels of species discrimination, we recommend the 2-locus combination of *rbcL*+*matK* as the plant barcode. This core 2-locus barcode will provide a universal framework for the routine use of DNA sequence data to identify specimens and contribute toward the discovery of overlooked species of land plants.

matK | *rbcL* | species identification

Large-scale standardized sequencing of the mitochondrial gene *CO1* has made DNA barcoding an efficient species identification tool in many animal groups (1). In plants, however, low substitution rates of mitochondrial DNA have led to the search for alternative barcoding regions. From initial investigations of plastid regions (2–4), 7 leading candidates have emerged (5, 6). Four are portions of coding genes (*matK*, *rbcL*, *rpoB*, and *rpoC1*), and 3 are noncoding spacers (*atpF–atpH*, *trnH–psbA*, and *psbK–psbI*). Different research groups have proposed various combinations of these loci as their preferred plant barcodes, but no consensus has emerged (5–12). This lack of an agreed standard has impeded progress in plant barcoding.

Our aim here is to identify a standard DNA barcode for land plants. To achieve this goal, we have pooled data across laboratories including sequence data from 907 samples, representing 445 angiosperm, 38 gymnosperm, and 67 cryptogam species. Using various subsets of these data, we evaluated the 7 candidate loci using criteria in the Consortium for the Barcode of Life's (CBOL) data standards and guidelines for locus selection (http://www.barcoding.si.edu/protocols.html). *Universality*: Which loci can be routinely sequenced across the land plants? *Sequence quality and coverage*: Which loci are most amenable to the production of bidirectional sequences with few or no ambiguous base calls? *Discrimination*: Which loci enable most species to be distinguished?

Results

Universality. Direct universality assessments using a single primer pair for each locus in angiosperms resulted in 90%–98% PCR and sequencing success for 6/7 regions. Success for the seventh region, *psbK–psbI*, was 77% (Fig. 1*A*). Greater problems were encountered in other land plant groups, with *rpoB*, *matK*,

intergenic spacers *trnH–psbA* and *psbK–psbI*, in part attributable to a high frequency of mononucleotide repeats disrupting individual sequencing reads.

Species Discrimination. Among 397 samples successfully sequenced for all 7 loci, species discrimination for single-locus barcodes ranged from 43% (*rpoC1*) to 68%–69% (*psbK–psbI* and *trnH–psbA*), with *rbcL* and *matK* providing 61% and 66% discrimination respectively (rank order: *rpoC1*<*rpoB*<*atpF–*

Author contributions: P.M.H., L.L.F., J.L.S., M.H., S.R., M.v.d.B., M.W.C., R.S.C., D.L.E., A.J.F., S.W.G., K.E.J., K.-J.K., W.J.K., H.S., S.C.H.B., C.v.d.B., M.C., T.A.J.H., B.C.H., G.P., J.E.R., G.A.S., V.S., O.S., M.J.W., and D.P.L. designed research; D.L.E., A.J.F., K.E.J., J.v.A.S., D.B., K.S.B., K.M.C., J.C., A.C., J.J.C., F.C., D.S.D., C.S.F., M.L.H., L.J.K., P.R.K., J.S.K., Y.D.K., R.L., H.-L.L., D.G.L., S.M., O.M., I.M., S.G.N., C.-W.P., D.M.P., and D.-K.Y. performed research; L.L.F., J.L.S., M.H., S.R., and D.P.L. analyzed data; and P.M.H., S.W.G., S.C.H.B., and D.P.L. wrote the paper.

Conflict of interest statement: Following the publication of Lahaye et al. (PNAS 105:2923, 2008), the process of filing a patent on DNA barcoding of land plants using *matK* was initiated by V.S., M.v.d.B., R.L., and D.B., but because of the lack of commercial interest the patent application was subsequently dropped.

Freely available online through the PNAS open access option.

Data deposition: The sequence reported in this paper has been deposited in the GenBank database. For a list of accession numbers, see SI Table 1. FASTA files of sequences are available on request.

See Commentary on page 12569.

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Vision: Reconnecting people with Nature.

- **Big Lottery funded, 2007-2012,**
- **£14M budget**
- **15 academic partners**

- **Research programme**
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OPAL Open Air Laboratories

EXPLORE NATURE

- National surveys:
- Air, soil, water, biodiversity.
- Regional engagement
- Natural History Societies
- Educational resources
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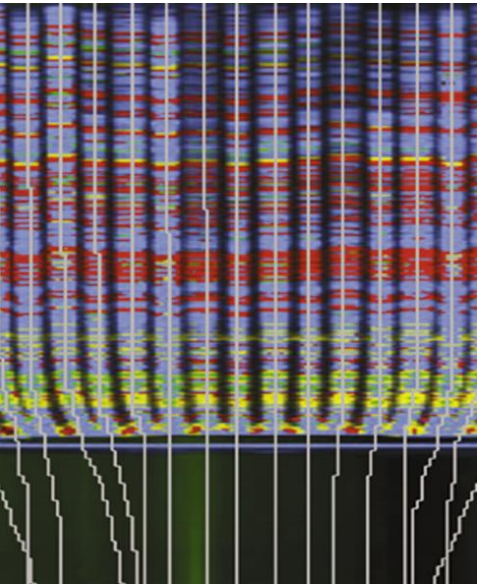
OPAL Alexander Palace Bioblitz

- **BBC – NHM - OPAL**
- **Direct contact: 100 scientist/amateur naturalists and 8,000 local people in THEIR environment**
- **Inter-generational sharing of knowledge**
- **1 new species!**

- **In Berlin??**

OPAL Impact

- 600,000 people directly involved
- 20% in hard to reach communities
- Data from over 25,000 sites submitted
- Spending time outdoors
- Exploring and recording local nature
- 1000 community organisations
- 2000 schools
- Huge press coverage



Museum für Naturkunde 2020

- **Excellent and relevant**
- **Accessible**
- **Interdisciplinary collaborations, networks, partnerships**
- **Participatory and open**
- **Listening and learning**

DEAD or ALIVE?