A University of California author or department has made this article openly available. Thanks to the Academic Senate’s Open Access Policy, a great many UC-authored scholarly publications will now be freely available on this site. Let us know how this access is important for you. We want to hear your story!
http://escholarship.org/reader_feedback.html

Peer Reviewed

Title:
The founding charter of the Genomic Observatories Network

Journal Issue:
GigaScience, 3(1)

Author:
Davies, N
Field, D
Amaral-Zettler, L
Clark, MS
Deck, J
Drummond, A
Faith, DP
Geller, J
Gilbert, J
Glöckner, FO
Hirsch, PR
Leong, JA
Meyer, C
Obst, M
Planes, S
Scholin, C
Vogler, AP
Gates, RD
Toonen, R
Berteaux-Lecellier, V
Barber, M
Barker, K
Bertilsson, S
Bicak, M
Bietz, MJ
Bobe, J
Bodrossy, L
Borja, A
Coddington, J
Fuhrman, J
Gerds, G
Local Identifier(s):
UCPMS ID: 1039408

Abstract:
© 2014 Davies et al.; licensee BioMed Central Ltd. The co-authors of this paper hereby state their intention to work together to launch the Genomic Observatories Network (GOs Network) for which this document will serve as its Founding Charter. We define a Genomic Observatory as an ecosystem and/or site subject to long-term scientific research, including (but not limited to) the sustained study of genomic biodiversity from single-celled microbes to multicellular organisms. An international group of 64 scientists first published the call for a global network of Genomic Observatories in January 2012. The vision for such a network was expanded in a subsequent paper and developed over a series of meetings in Bremen (Germany), Shenzhen (China), Moorea (French Polynesia), Oxford (UK), Pacific Grove (California, USA), Washington (DC, USA), and London (UK). While this community-building process continues, here we express our mutual intent to establish the GOs Network formally, and to describe our shared vision for its future. The views expressed here are ours alone as individual scientists, and do not necessarily represent those of the institutions with which we are affiliated.

Copyright Information:
All rights reserved unless otherwise indicated. Contact the author or original publisher for any necessary permissions. eScholarship is not the copyright owner for deposited works. Learn more at http://www.escholarship.org/help_copyright.html#reuse
The founding charter of the Genomic Observatories Network

Neil Davies1,2*, Dawn Field2,3,4*, Linda Amaral-Zettler5, Melody S Clark6, John Deck7, Alexei Drummond8,9, Daniel P Faith10, Jonathan Geller11, Jack Gilbert12,13, Frank Oliver Glöckner14,15, Penny R Hirsch16, Jo-Ann Leong17, Chris Meyer18, Matthias Obst19, Serge Planes20, Chris Scholin21, Alfried P Vogler22,23, Ruth D Gates17, Rob Toonen17, Véronique Berteaux-Lecellier20, Michèle Barbier24, Katherine Barker25, Stefan Bertilsson26, Mesude Bicak28, Matthew J Bietz27, Jason Bobe28, Levente Bodrossy29, Angel Borja30, Jonathan Coddington25, Jed Fuhrman31, Gunnar Gerds32, Rosemary Gillespie33, Kelly Goodwin34, Paul C Hanson35, Jean-Marc Hero36, David Hoekman37, Janet Jansson38, Christian Jeantson39, Rebecca Kao40, Anna Klindworth14,15, Rob Knight41,42, Renzo Kottmann14,15, Michelle S Koo13, Georgios Kotoulas44, Andrew J Lowe45, Viggó Thór Marteinsson46, Folker Meyer12, Norman Morrison47, David D Myrrold48, Evangelos Pafilis44, Stephanie Parker37, John Jacob Parnell37, Paraskevi N Polymenakou44, Sujeevan Ratnasingham49, George K Roderick50, Naiara Rodriguez-Ezpeleta51, Karsten Schonrogge3, Nathalie Simon39, Nathalie J Valette-Silver52, Yuri P Springer37, Graham N Stone53, Steve Stones-Havas54, Susanna-Assunta Sansone3, Kate M Thibault37, Patricia Wecker20, Antje Wichels31, John C Wooley55, Tetsukazu Yahara56, Adriana Zingone57 and GOs-COS

Abstract

The co-authors of this paper hereby state their intention to work together to launch the Genomic Observatories Network (GOs Network) for which this document will serve as its Founding Charter. We define a Genomic Observatory as an ecosystem and/or site subject to long-term scientific research, including (but not limited to) the sustained study of genomic biodiversity from single-celled microbes to multicellular organisms.

An international group of 64 scientists first published the call for a global network of Genomic Observatories in January 2012. The vision for such a network was expanded in a subsequent paper and developed over a series of meetings in Bremen (Germany), Shenzhen (China), Moorea (French Polynesia), Oxford (UK), Pacific Grove (California, USA), Washington (DC, USA), and London (UK). While this community-building process continues, here we express our mutual intent to establish the GOs Network formally, and to describe our shared vision for its future. The views expressed here are ours alone as individual scientists, and do not necessarily represent those of the institutions with which we are affiliated.

Keywords: Biodiversity, Genomics, Biocode, Earth observations
Background

Key outcomes of 21st century science include an Earth with its essential life support systems intact, and a planet where human society has achieved sustainable development. Achieving these challenges, however, requires a greatly improved understanding of human interactions with the natural environment. Towards that end, the GOs Network aims to observe DNA sequences – the biocode – across the principal levels of biological organization (cell, organism, ecosystem) up to the planetary genome [1,2]. Our approach is to apply genomic technologies to study the flux of genetic variation within these nested scales of biological function. We will inventory genomic biodiversity and map its distribution over time and space. To address the processes that generate and maintain this diversity, we will link the genomic information to physico-chemical, ecological, and socio-economic data. We will work with the broader scientific community to build models of how genomic biodiversity contributes to ecosystem services, evolutionary potential, and ecological resilience.

Main text

What is a Genomic Observatory?

Some of the terms we use here require definition (See Table 1), since not everyone in the community uses them in the same way. Helping to solidify a shared terminology in such a fast moving field is one contribution of the GOs Network. Our intention here, however, is merely to clarify what we mean in the limited context of this document. Only time will tell whether these terms, or our definitions of them, become broadly accepted. The definitions are deliberately concise and in some cases require fuller explanation, which we plan to provide in a future publication.

Most importantly, we define a ‘Genomic Observatory’ as an ecosystem, and/or a site within an ecosystem, that is the subject of long-term scientific research, including (but not limited to) the sustained study of genomic biodiversity. An observatory is the institutionalized act of observing, and so for a given ecosystem (and/or site) to be recognized as a Genomic Observatory, one or more institutions (e.g., field station, marine laboratory, museum, university, etc.) should express, and preferably have demonstrated, their long-term commitment to the scientific study of that system’s genomic biodiversity. One important feature of this definition is that it allows the establishment of new genomic observatories, while recognizing the value of those that have existing time-series data already.

Mission and vision

The mission of the GOs Network is to work towards Biocoding the Earth; integrating DNA data into Earth observing systems and eventually building a global Genomic Observatory within the Global Earth Observation System of Systems (GEOSS) [3].

The vision of the GOs Network is to:

- Advance the science of biodiversity genomics through a global network of premier research organizations generating well-contextualized genomic biodiversity observations compliant with global data standards.

Table 1 Definitions

| Biocode | The totality of DNA sequences in a given unit of biological organization, such as a cell (e.g., the Yeast Biocode includes both its nuclear and mitochondrial genomes); organism (e.g., the Human Biocode includes both the Human Genome and the Human Microbiome); ecosystem (e.g., the Moorea Biocode includes all the genomes on the island); planet (e.g., the Earth Biocode includes all the genomes on the planet) |
|---|---|
| Biocoding the earth | The aspirational target of sequencing every genome on the planet. While a theoretical goal that is clearly unattainable in practice, strategic genome sequencing (e.g., as proposed by the Global Genome Initiative http://www.mnh.si.edu/ggi/) can cover the major variation found among genomes on Earth |
| Planetary genome | A special case of the biocode: the sum of all genomes that exist on Earth at a given time. (N.B. (nota bene): the existence of a planetary genome neither implies that natural selection acts at this level, nor that the phenotype of the planetary genome is adapted for its preservation and propagation) |
| Genomic biodiversity | The genetic variation found among genomes |
| Biodiversity genomics | The field of scientific study that maps genomic biodiversity over space and time, investigates the functional consequences of this variation, and seeks to explain how it is generated and maintained |
| Ecosystem | A biological community of interacting organisms in their physical and chemical environment |
| Genomic Observatory | An ecosystem and/or site subject to long-term scientific research, including (but not limited to) the sustained study of genomic biodiversity from single-celled microbes to multicellular organisms |
| Genomic Observatories (GOS) Network | A network (i) of ecosystems and sites, which are often already part of existing scientific networks, (ii) of researchers, who are intensively studying one or more GOS, and (iii) of institutions, infrastructures, and initiatives, whose work aligns with the GOS Network’s mission |
| Future ‘omics (futuromics) | The preservation of biological samples for eventual study of their nucleotide and protein sequences through the techniques of genomics, transcriptomics, proteomics, metabolomics, and other ‘omics’ analyses |
• Coordinate a set of long-term DNA-centric research programs (actions) at local, regional, and global scales that help develop and implement common standards and best practices for quantifying genomic biodiversity and mapping biotic interactions over time.

• Partner with natural history museums, repositories, and bio-banks, (e.g., members of the Global Genome Biodiversity Network (GGBN) [4]) to preserve well-contextualized samples (environmental samples and organismal specimens) for future ‘omics analysis, including whole genomes and metagenomes.

• Work with the broader scientific community to develop predictive models of biodiversity, ecosystem services and evolutionary potential [5] - especially with respect to global change.

• Provide training, technical assistance, resources, and best practice guides as a learning platform for individuals and organizations wishing to carry out genomic observations at genomic observatories and beyond.

Governance and membership
The GOs Network is a collaboration of the Genomic Standards Consortium (GSC) and the Group on Earth Observations (GEO) through its Biodiversity Observation Network (GEO BON) [6]. The GSC is incubating the GOs Network, and GEO BON has listed it as a key deliverable. Through this pathway, the GOs Network will also contribute to the new Future Earth program [7] for global sustainability research, thus promoting links to other scientific disciplines and helping forge partnerships with policy makers and other stakeholders.

Working under GEO reflects our mission of integrating genomic data into GEOSS, while working under GSC ensures that these data are fit for that purpose. Initially, a GOs Network Board, including representatives of key stakeholders, will administer the GOs Network and set its strategic objectives (this charter). One of the first tasks of the Board is to define criteria for membership of the GOs Network and to put in place a governance mechanism and operating procedures. All co-authors of this article are considered “founding individual members” of the GOs Network.

Research coordination activities
The GOs Network will focus on coordinating activities, such as (1) Organizing an annual meeting (GOs Network Conference) involving all network members and other interested parties worldwide; (2) Co-organizing regional and thematic meetings (GOs Network Workshops) in collaboration with partner organizations; (3) Maintaining an online registry of Genomic Observatories; (4) Participating in standards development efforts, for example, through the Genomic Biodiversity Working Group (GBWG) - a collaboration of the GSC and the Biodiversity Information Standards organization (TDWG.org); and (5) contributing to GEO and GEOSS, particularly through the cross-cutting Working Group 1 (Genetics) of GEO BON.

Actions
The GOs Network will support actions aiming to build a coordinated and well-contextualized set of genomic biodiversity observations and archived vouchers (specimens and environmental samples). In particular, the GOs Network aims to provide a roadmap for ecosystem-based Genomic Biodiversity Assessment Reports as one of its contributions to GEO BON. These reports might start with a simple checklist of species, building up to a DNA barcode library and eventually to metagenomic inventories. The former will contribute towards the International Barcode of Life (IBOL) initiative and work towards the latter is already underway through the GOs Network’s first action, Ocean Sampling Day (OSD) [8], an initiative of the EU FP7 Project Micro B3 to carry out coordinated sampling of marine microbial communities on June 21, 2014. The GOs Network will help expand the scope of OSD to include new geographies, sampling approaches, taxa and environments, and to maintain this action beyond 2014. OSD represents the GOs Network’s first attempt to aggregate participating sites into a global genomic observatory and to begin functioning as a distributed major research infrastructure. The GOs Network will build on OSD to support development of Marine Biodiversity Observation Networks [9], particularly through the coordinated actions of leading marine Genomic Observatories.

Biocode commons
The GOs Network intends to adopt the Biocode Commons as its informatics stack - a primary forum for sharing tools that support genomic observations from collection through analysis and publication, bringing together developers, scientists and standards (see: http://biocodecommons.org/). Eventually, the Biocode Commons might aim to provide a one-stop shop for genomic biodiversity data and scientific workflows from genomic observatories. We believe that wherever feasible these data should be fully compliant with global data standards, machine-readable, and (while respecting legitimate concerns for privacy and for the protection of endangered species) accessible without restriction to the scientific community [10].

Conclusions
Genomic biodiversity represents the foundational data layer for biological research. The Genomic Observatories (GOs) Network brings together premier research sites to develop ‘systems-based’ approaches that integrate genomics into ecological, evolutionary, and socio-environmental
studies. This paper outlines the network's mission and seeks broad community participation in this collaborative effort.

Abbreviations
GEO: Group on Earth Observations; GEO BON: Group on Earth Observation Biodiversity Observation Network; GEOSS: Global Earth Observation System of Systems; GGI: Global Genome Initiative; GGBN: Global Genome Biodiversity Network; GSC: Genomic Standards Consortium; iBOL: International Barcode of Life; OSD: Ocean Sampling Day.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
ND and DM drafted the original text with detailed input from GOs Steering Committee members (LAZ, MC, JD, ADP, JG, JG, FOG, PH, JL, CM, MO, SP, CS, APV, VBL, RG, and RT) and broad consultation with all the co-authors. All authors read and approved the final manuscript.

Acknowledgements
This paper is contribution #201 of the Gump South Pacific Research Station. This work was supported in part by: The National Science Foundation (RCN4663, CBI-0416099, BCS-1056693); the Gordon and Betty Moore Foundation (Moorea Biocode Project); the U.S. Dept. of Energy under Contract DE-AC02-06CH11357; The Micro B3 project is funded from the European Union’s Seventh Framework Programme (Joint Call OCEAN2011-2: Marine microbial diversity – new insights into marine ecosystems functioning and its biotechnological potential) under the grant agreement no 287589; the Smithsonian Institution (Grand Challenges Consortia).

GOs-COS
Genomic Observatories Community of Scientists. http://genomicobservatories.org/, Oxford, England, UK; info@genomicobservatories.org.

Author details
1 Gump South Pacific Research Station, University of California Berkeley, BP 244 98728 Moorea, French Polynesia. 2Biodiversity Institute, Department of Zoology, University of Oxford, The Tinbergen Building, South Parks Road, Oxford OX1 3PS, UK. 3Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB, UK. 4The Josephine Bay Paul Center for Comparative Molecular Biology and Evolution Marine Biological Laboratory, Woods Hole, Massachusetts, MA 02543, USA. 5British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 0ET, UK. 6Biology Department, Imperial College London, London SW7 2AZ, UK. 7Department of Life Sciences, Imperial College London, London SW7 2BD, UK. 8BB, UK. 9National Oceanic and Atmospheric Administration, AOML stationed in La Jolla, San Diego, CA 92037, USA. 10Institute for Genomic and Systems Biology, University of California, Berkeley, CA 94720-3114, USA. 11Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720, USA. 12Department of Computer Science, University of Auckland, Auckland 1142, New Zealand. 13Allan Wilson Center for Molecular Ecology and Evolution, University of Auckland, Auckland, New Zealand. 14The Australian Museum, 6 College St., Sydney, NSW 2010, Australia. 15Institute for Genomic and Systems Biology, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439, USA. 16Department of Ecology and Evolution, University of Chicago, 5640 South Ellis Avenue, Chicago, IL 60637, USA. 17Microbial Genomics and Bioinformatics Research Group, Max Planck Institute for Marine Microbiology, D-28359 Bremen, Germany. 18Jacobs University Bremen, D-28759 Bremen, Germany. 19Rothamsted Research, Harpenden, Herts AL5 2QJ, UK. 20Hawaii Institute of Marine Biology, School of Ocean & Earth Science & Technology, University of Hawaii at Manoa, PO Box 1346, Kanohe, HI 96744, USA. 21Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, PO Box 37012, MRC-163, Washington, DC 20013, USA. 22Department of Biological and Environmental Sciences, University of Gothenburg, Box 463 SE-405 30 Gothenburg, Sweden. 23Department of Life Sciences, Imperial College London, London SW7 2AZ, UK. 24Independent 316 Scientific Adviser, 2 rue de la Tour de Magnan, 56 000 Nice, France. 25National Museum of Natural History, Smithsonian Institution, PO Box 37012, 318 MRC 106, Washington, DC 20013, USA. 26Department of Ecology and Genetics and Science for Life Laboratory, Uppsala University, Norbyv. 180, SE-75236 Uppsala, Sweden. 27Department of Informatics, University of California, Irvine, Irvine, CA 92697, USA. 28GenomicObservatories.org, Boston, MA 02215, USA. 29BioMarine and Atmospheric Research and Wealth from Oceans National Research Flagship, Hobart, Tasmania, Australia. 30AZTI-Technalia, Marine Research Division, Herrera Kaia, Portaldea s/n, 20110 Pasaia, Spain. 31Department of Biological Sciences, University of Southern California, Los Angeles, CA 90089-0371, USA. 32Alfred Wegener Institute for Polar and Marine Research, Biologische Anstalt Helgoland, 27498 Helgoland, Germany. 33Esz prodac, Marine Research, University of California, Berkeley, CA 94720, USA. 34National Oceanic and Atmospheric Administration, AOML stationed in La Jolla, San Diego, CA 92037, USA. 35Center for Limnology, University of Wisconsin, MadisonWI 53706, USA. 36Environmental Futures Research Institute, Griffith University, Gold Coast, Queensland 4222, Australia. 37National Ecological Observatory Network, Boulder, CO 80301, USA. 38Earth Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA. 39Station Biologique de Roscoff, CNRS - UPMC, Place Georges Teissier, CS 90074, 29688 Roscoff Cedex, France. 40Denver Botanic Gardens, 990 York Street, Denver, CO 80206, USA. 41Howard Hughes Medical Institute, Chevy Chase, Maryland, USA. 42Department of Chemistry & Biochemistry and Computer Science, and BioFrontiers Institute, University of Colorado at Boulder, 4145 Colorado Ave, Boulder, CO 80309, USA. 43Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720-3160, USA. 44Institute of Marine Biology, Biotechnology and Aquaculture (IMBMC), Hellenic Centre for Marine Research (HCMR), Heraklion, Greece. 45Terrestrial Ecosystem Research Network and Environment Institute, University of Adelaide, Adelaide SA5005, Australia. 46Food Safety, Environment & Genetics, Matis Idt. Vinlandslei 12, 113 Reykjavik, Iceland. 47School of Computer Science, The University of Manchester, Oxford Road, Manchester M13 9PL, UK. 48Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331, USA. 49Biodiversity Institute of Ontario, University of Guelph, Guelph, Ontario N1G 2W1, Canada. 50Environmental Science Policy and Management, University of California, Berkeley, CA 94720-3114, USA. 51AZTI-Technalia, Marine Research Division, Trasieramendi ugartea z/g, Sukarreria 48395Bilbao, Spain. 52National Oceanic and Atmospheric Administration, Office of Exploration and Research, Silver Spring, Maryland 20910, USA. 53Institute of Evolutionary Biology, University of Edinburgh, The King's Buildings, Edinburgh EH93JT, UK. 54Biomatters Ltd, Auckland 1010, New Zealand. 55Center for Research on BioSystems, University of California, San Diego, CA 92093-5004, USA. 56Center for Asian Conservation Ecology, Kyushu University, 6-10-1, Fukuoka 812-8581, Japan. 57Ecology and Evolution of Plankton Laboratory, Stazione Zoologica Anton Dohrn, Villa Comunale, 80121 Naples, Italy.

Received: 29 January 2014 Accepted: 24 February 2014

Published: 7 March 2014

References
1. Davies N, Field D. Genomic Observatories Network: Sequencing data: a genomic network to monitor earth. Nature 2012, 481:145. 10.1038/ 481145a http://www.ncbi.nlm.nih.gov/pubmed/22237100.
2. Davies N, Meyer C, Gilbert J, Amaral-Zettler L, Deck J, Bicak M, Rocca-Serra P, Assuntasansa-Sansone S, Willis K, Field D: A call for an international network of genomic observatories (GOs). GigaScience 2012, 1:S. http://dx.doi.org/10.1186/2047-217X-1-5.
3. Global Earth Observation System of Systems ( GEOSS). http://www. geoportal.org/. 4. Global Genome Biodiversity Network. http://ggbn.org/. 5. Faith DP, Magallón S, Hendy AP, Conti E, Yahara T, Donoghue MJ: Ecosystem services: an evolutionary perspective on the links between biodiversity and human well-being. Curr Opin Environ Sustain 2010, 2:65–74. 10.1016/j.cosust.2010.04.002 http://linkinghub.elsevier.com/retrieve/ pii/S1877343510000187.
6. Group on Earth Observations ( GEO) Biodiversity Observation Network (BON). http://www.earthobservations.org/.
7. Future Earth. http://www.iecu.org/future-earth
8. Ocean Sampling Day (OSD). http://www.oceansamplingday.org.
9. Duffy JE, Amaral-Zettler LA, Fautin DG, Paulay G, Rynearson TA, Sosik HM, Stachowicz JJ: Envisioning a Marine Biodiversity Observation Network.
10. Birney E, Hudson TJ, Green ED, Gunter C, Eddy S, Rogers J, Harris JR, Ehrlich SD, Apweiler R, Austin CP, Berglund L, Bobrow M, Bourna A, Brookes AJ, Cambon-Thomsen A, Carter NP, Chisholm RL, Conreras JL, Cooke RM, Crosby WL, Dewar K, Durbin R, Dyke SO, Ecker JR, El Emam K, Feuk L, Gabriel SB, Gallacher J, Gelbart WM, Granell A, et al. Prepublication data sharing. *Nature* 2009, 461:168–170. 10.1038/461168a http://www.ncbi.nlm.nih.gov/pubmed/19741685.