TRACKING EVOLUTIONARY DIVERSITY AND PHYLOGENETIC STRUCTURE ACROSS GLOBAL FOREST DYNAMICS PLOTS USING PLANT DNA BARCODES

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Smithsonian Institution
Vital statistics of BCI

- Island in Panama Canal
  - Premier Ecological Plot
- 296 tree species
  - 1035 specimens (~3 accession/species)
- 180 Genera
- 49 Families
- ~50% of genera have one species

50-ha Forest Dynamics Plot on Barro Colorado Island, Panama
Building the DNA Barcode Reference Library: *rbcL*, *matK*, and *trnH-psbA* for Species Identification

**RESULTS**

- *rbcLa* + *trnH-psbA* + *matK*
  - 98% of all samples could be assigned to correct Species
  - All ambiguity was in 4 genera: *Psychotria, Ficus, Inga, Piper*
  - 100% of sequences were assigned to correct Genus
  - Partial sequences were assigned correctly
Constructing a Community Phylogeny with DNA Barcodes: A Supermatrix of \textit{rbcL}, \textit{matK}, and \textit{trnH-psbA}
Follow-up Papers on BCI DNA Barcode Work


Center for Tropical Forest Science and ForestGEO

Purpose:
* Forest Dynamics
* Climate Change
* Conservation

Asian Tropical: Bukit Timah, Asian Temperate: Dinghushan, Changbaishan, Gutianshan, Fushan, Lienhuachih, Nanjenshan

Neotropical: BCI, Luquillo
Neotemperate: SCBI, SERC, Wabikon Lake, Wind River, Yosemite, Wytham Woods

Mongabay,

Million Trees Monitored
10,000 Species
Mega-Phylogeny of All Plots

Vital statistics
- 15 plots
- 1,347 tree species
- 553 Genera
- 125 Families

Phylogeny:
- *rbcL*, *MatK*, *trnH-psbA*

Constraint Tree
SATe Alignment

**GARLI**: ML

Resolution: 78% (81-100%)
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rbcL, MatK, trnH-psbA
Constraint Tree
SATe Alignment
GARLI: ML
Resolution: 78% (81-100%)
Comparative evolutionary diversity and phylogenetic structure across multiple forest dynamics plots: a mega-phylogeny approach

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The Smithsonian Institution
Established in 1846

19 Museums
9 Research Institutes
30 Million Visitors per Year
135 Million Specimens and Objects
350 Research Scientists
Tropical and Temperate Field Stations
National Zoological Park
Smithsonian Conservation Biology Institute
Smithsonian Tropical Research Institute
National Museum of Natural History
Smithsonian Environmental Research Center
BIODIVERSITY INITIATIVES ACROSS THE SMITHSONIAN

BioGenomics

Conservation and Sustainability

Global Earth Observatories

LIVING

IN THE

ANTHROPOCENE
Global Earth Observatories
Smithsonian Forest GEO

*61 Plots in 24 Countries
*6 Million Trees Monitored
*10,000 Species
Smithsonian MarineGEO

Tennenbaum Marine Observatories Network
Smithsonian MarineGEO
Tennenbaum Marine Observatories Network

*7 Sites in 3 Countries*
Genomics is revolutionizing biodiversity sciences
Smithsonian Areas of Scientific Excellence

Evolution

Conservation

Diversity

Ecology

BioGenomics
Institute for Biodiversity Genomics

Institute Leadership
Director
Executive Board
Project Leaders for each Core Area
Outreach/Communication Specialist
Advancement Team
Administrative Support

Advisory Committee
External Review

Collections and BioRepositories
Tissue acquisition, storage, use, and distribution

Virtual Laboratories
Sharing protocols, tools, resources across all units

Computational Genomics Program
Associate Director
Bioinformatics Leader
Computer Engineer leader

Computer and Software Support
Ten Teams Distributed across all Units

Core Areas of Research Emphasis

Conservation Genomics
Evolutionary Genomics
Ecological Genomics
Phylo-Genomics

Existing PIs, New PIs, External/Visiting scientists
Global Genome Initiative

Vision
Preserving the genomic diversity of life on Earth

Mission
Global network
Evolutionary & Ecological Research
Genomic biorepositories
Genomes of key branches of tree of life
Public Awareness and Understanding
Feasibility: Taxonomy

- DOMAINS 3
- PHYLA / DIVISIONS 64
- CLASSES 146
- ORDERS 869
- FAMILIES ~ 9500
- "GENERA" ~ 160,000
- SPECIES >15,000,000
NMNH Biorepository
4-5M 2ml tube capacity

58 Freezers
24 Nitrogen Tanks

BioGenomics
Global Genome Biodiversity Network

Task Force to establish:
- Data Standards and Data Access for Genomic Samples
- Policies and Practices Related to Management and Stewardship of Genomic Samples
- Marketing and Outreach
Institute for Biodiversity Genomics