



Dimensions of Biodiversity

International Workshop on Long-term Studies on Biodiversity Sao Paulo, Brazil

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National Science Foundation
23 November 2010

Dimensions of Biodiversity

A 10-year campaign to characterize the dimensions of biodiversity on Earth

Integrative approaches

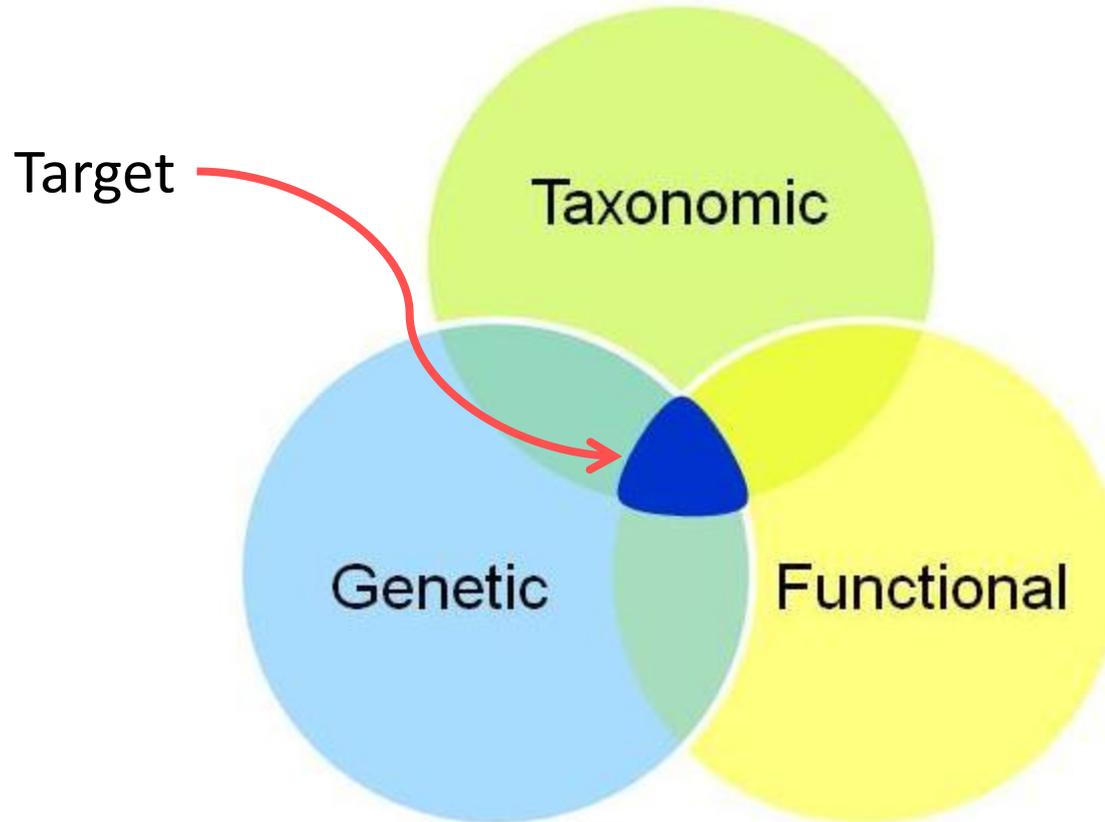
Innovative concepts

Rapid advances



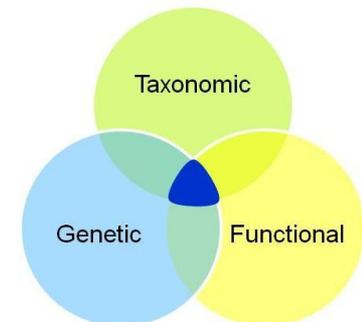
“an inexact first pass”

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Why biodiversity? And why now?

1. CURIOSITY - centuries of discovery but most biodiversity remains unknown
2. CONCERN - rapid and permanent loss
3. TIMELINESS - genomics, computation, informatics, systematics and other fields make it finally possible



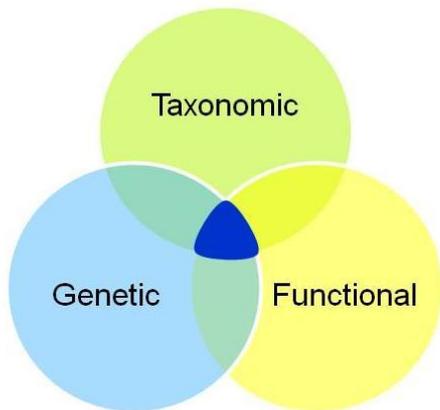
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FY2010 Competition:

195 proposals reviewed in two panels
held July 2010

Criteria:

1. Intellectual Merit
2. Broader Impacts
3. Integration of the three dimensions of biodiversity



Panelist quote:

“[Dimensions] will accomplish in 10 years what would have taken 50 years with traditional approaches”

<http://www.nsf.gov>

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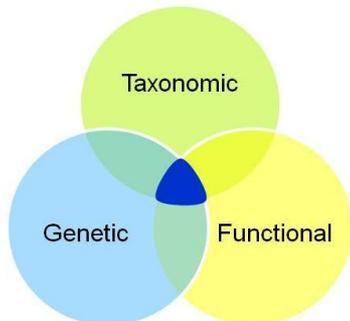
FY 2010 Awards:

14 Research Awards

1 Joint U.S.-China Research Coordination Network

1 Distributed Graduate Seminar

~\$24 M from NSF BIO, GEO and OPP



<http://www.nsf.gov>



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Coordinated elements of 10-year campaign:

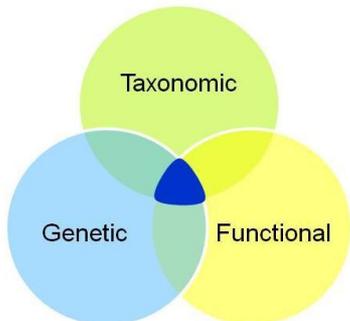
Research – initiated 2010

Cyberinfrastructure - planning

Workforce - planning

Collections Digitization – initiated 2010

Synthesis - planning



Partnerships



How will we assess and tune the program?

Baselining – Distributed Graduate Seminar

- Network of 10 U.S. universities and 5 international universities with a faculty lead and graduate students at each institution
- Charge is to “baseline” the activity and determine what is presently known about taxonomic, genetic, and functional dimensions of biodiversity

Wiki - Crowd-sourced and frozen annually

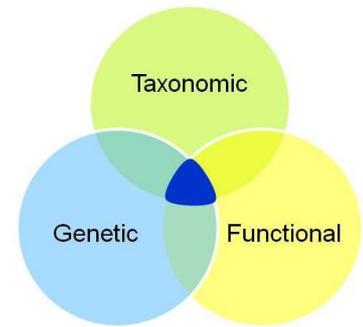
PI meetings

Listening



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Planning Activities



- Sept. 17-19: Design Charette at NESCent, Durham, NC
 - Organized by Toby Kellogg, Kent Holsinger, and Mendy Smith
 - ~20 participants gathered to discuss a research agenda for Dimensions of Biodiversity
 - Report to be issued fall 2010
- Oct. 13-15: Cyberinfrastructure workshop at Univ. of Wisconsin
 - Organized by Corinna Gries
 - Will address appropriate biodiversity information management (e.g. data capture, interoperability, access, query, and archiving capabilities)
 - Workshop will incorporate real-time, online reporting to a Wiki page
- Nov. 23: Workshop in São Paulo, Brazil
 - NSF representatives attend workshop entitled “Long-term Studies on Biodiversity”
 - Opportunities to listen to ongoing and planned activities and seek synergies

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Planning Activities, cont.

- Spring 2011: Partnership meeting with NSFChina
 - Meeting with funded IRCN PIs and NSFC counterparts
 - Discussions on how to move forward with NSF-NSFC partnership
- Ongoing: Dimensions Workforce Activities
 - Working group focusing on training the next generation of biodiversity scientists
 - Group exploring NSF models - e.g. supporting undergraduate training through supplements to new and existing grants
 - Workshop in planning to inform workforce needs for upcoming solicitations
- Ongoing: Interagency partnerships
 - Partnership with NASA for 2012-2014 being finalized (research)
 - Active discussions with NOAA focused on 2012 and beyond (workforce, research)
 - Initial discussions with USGS/BRD (cyberinfrastructure)

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Planning Activities, cont.

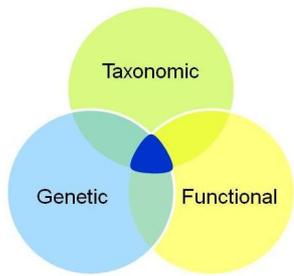
- Ongoing: International partnerships

- Active discussions with Brazil and South Africa funding agencies
- Internal strategic planning to prioritize efforts
- Potential collaboration: US AID

- Ongoing: NGO partnerships

- Active discussions with Moore Foundation
- October discussions with NatureServe: follow on to Fall 2009 workshop on role of NGOs in biodiversity infrastructure.





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CONCEPTUAL TIMELINE

Research
Workforce
Collections Digitization
Cyberinfrastructure
Synthesis

2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

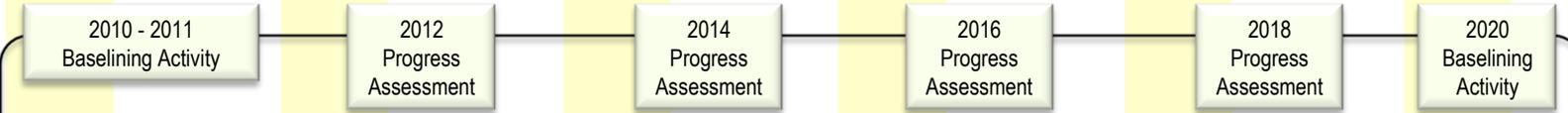
PLANNING ACTIVITIES

PI MEETINGS AND CONFERENCES

Funding Solicitations

CI & Data Mgmt Guidelines Issued

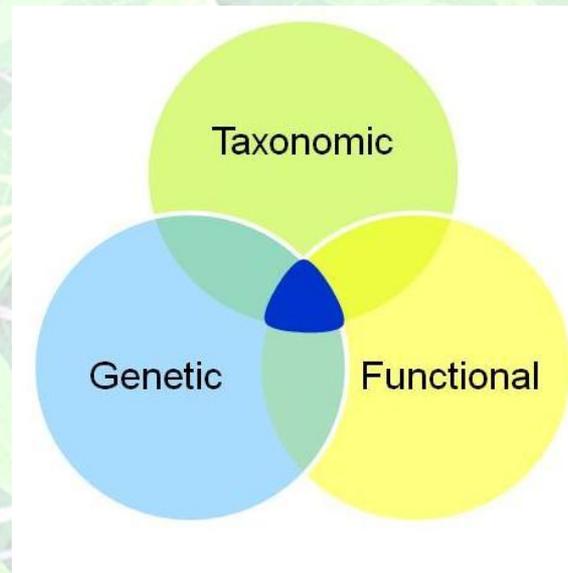
Coordination and Partnerships: NSF, Interagency, International, NGO, Private Sector



Baselining and Progress Assessment: Crowd-sourcing approaches

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The science...



Dimensions IRCN: Diversity and forest change: Characterizing functional, phylogenetic and genetic contributions to diversity gradients and dynamics in tree communities

Stuart Davies, Harvard University; Richard Condit and Helene Muller-Landau, Smithsonian Tropical Research Institute; W. John Kress, Smithsonian Institution; Nathan Swenson, Michigan State University

Overview:

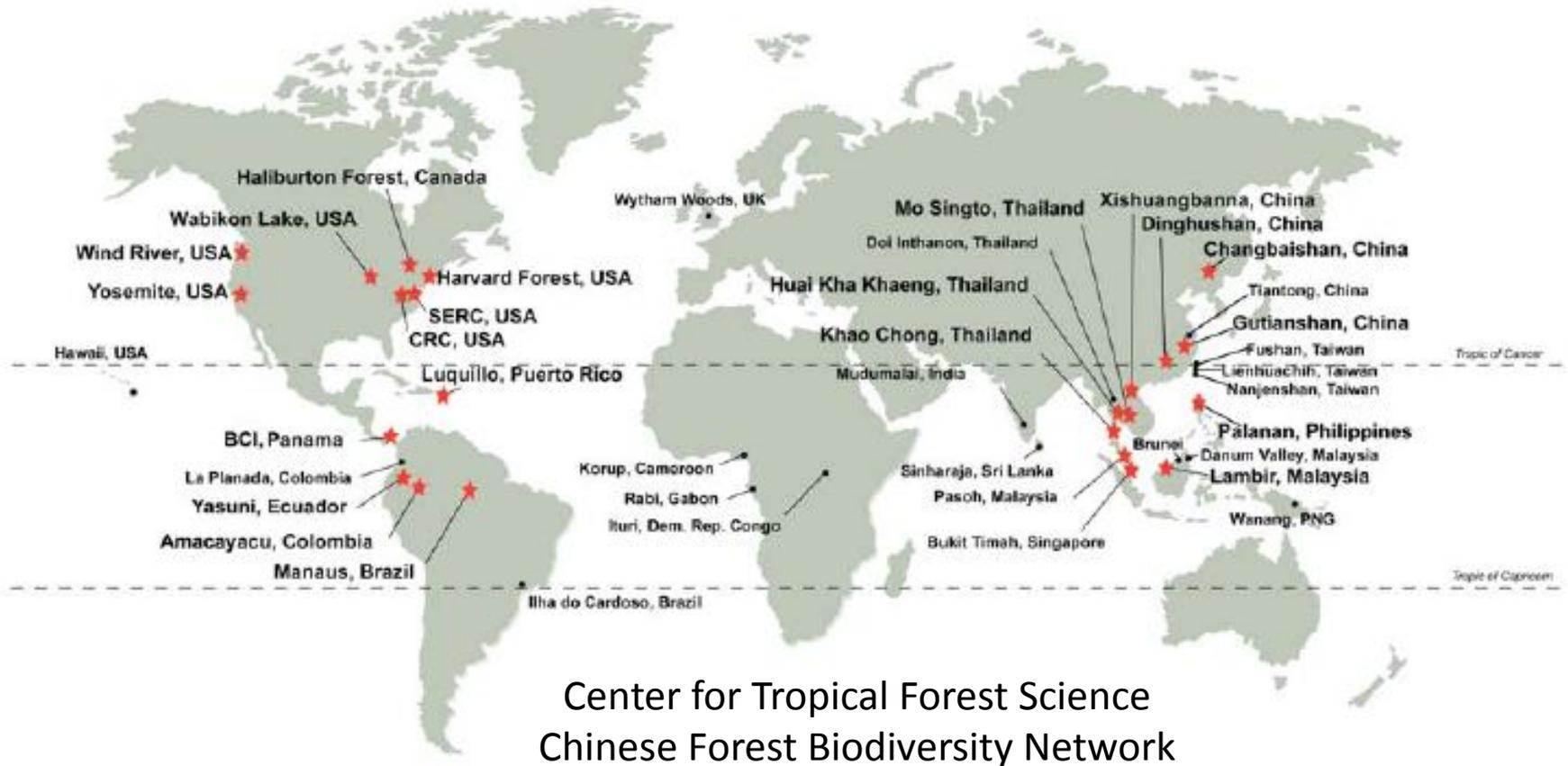
First project funded by NSF-NSFC partnership designed to strengthen collaborations between U.S and China



NSF/DEB: 1046113

Photo P. Firth, NSF

Brings together two forest research networks to understand what makes forests resilient to global change



Plots span > 40 degrees latitude and an order of magnitude in diversity

Available data from forest plots:

- repeated measurement and identification of trees
- carbon flux measures (e.g., litterfall, soil carbon)
- spatial distribution of soil nutrients
- plant functional traits (e.g., SLA, wood density)
- seed traps and seedling plots
- DNA barcode data

NSF/DEB: 1046113



Series of workshops and symposia over 5 years:

Workshop 1: Predicting tree species demography based on functional traits and phylogenetic relatedness

Workshop 2: Relationships between species, phylogenetic and functional diversity with ecosystem function

Workshop 3: Intraspecific variation in performance within/ among forests (predicting responses to climate change)

Workshop 4: Genetic diversity and dispersal in temperate and tropical tree species

Workshop 5: Synthesis and integration

[NSF/DEB: 1046113](#)

Dimensions: Genomics, functional roles, and diversity of the symbiotic gut microbiota of honey bees and bumble bees

Nancy Moran, Yale University; Jay Evans, USDA

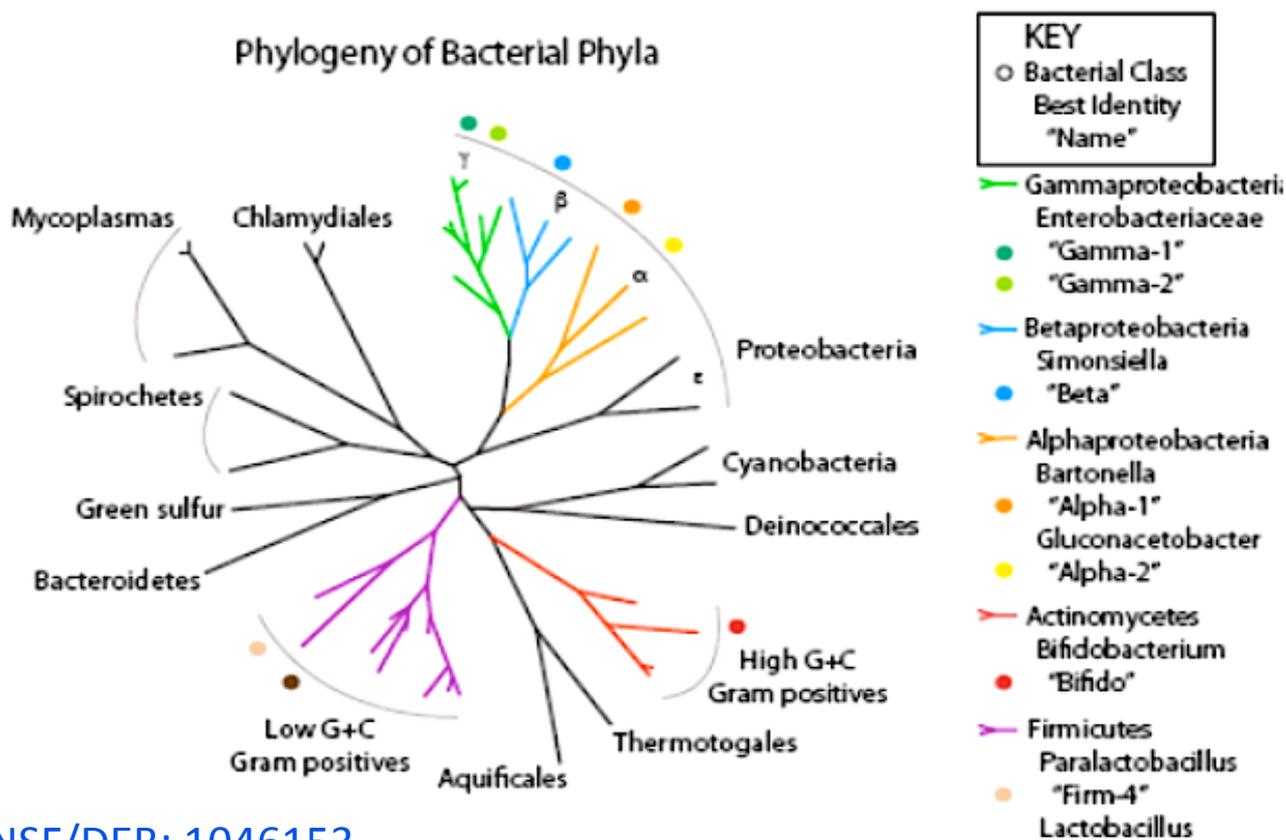
Microbial gut flora is essential to life for most animals, but little is known about genetics, taxonomy, and function.

Even less is known about how symbionts respond to disturbance



Honey bees have at least 8 different types of bacteria in their guts. Many also in bumble bees...

Fig. 1. Schematic of bacterial diversity showing phylogenetic positions of the 8 bacterial phylotypes (or species) characteristic of the honey bee gut microbiota.



NSF/DEB: 1046153

What's really cool about this?

Diversity of microbes in the bees can be manipulated...

Various chemical and environmental stresses on the bees can be imposed...

Geographic scale of project and collaboration with Chinese bee biologists...

[NSF/DEB: 1046153](#)



And...

Illustrates importance of microbiota of bees for pollinator services



www.carolinabees.com/shop/services/pollination/



NSF/DEB: 1046153

<http://www.washingtonpost.com/wp-dyn/content/gallery/2009/03/26/GA2009032601794.html>

Dimensions: Collaborative Research: An integrative traits-based approach to predicting variation in vulnerability of tropical and temperate stream biodiversity to climate change

Leroy Poff, W. Chris Funk, Cameron Ghalambor, Boris Kondratieff, Colorado State University; Steven Thomas, University of Nebraska Lincoln; Alexander Flecker, Joseph Bernardo, Kelly Zamudio, Cornell University

Mountain streams harbor high levels of insect and amphibian diversity, but are susceptible to climate change

Parallel studies and field experiments in streams in Ecuador and Colorado

[NSF/DEB: 1046408](#)



Tropical vs. temperate streams greater than 1800m elevation

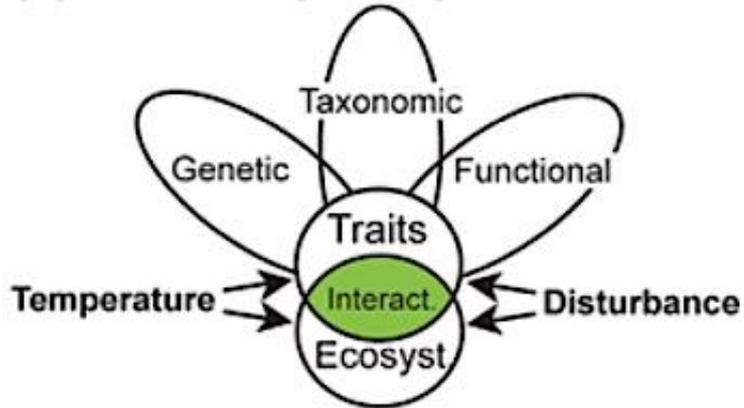


Mindo Biol. Station, Ecuador

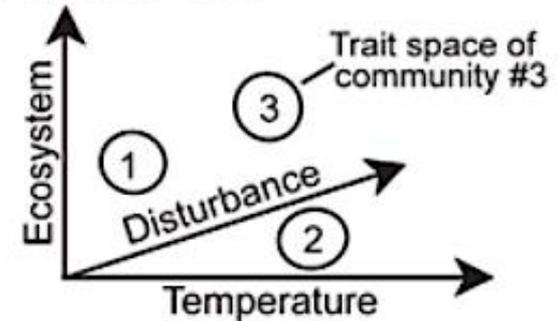


Rocky Mountain Natl. Park, CO

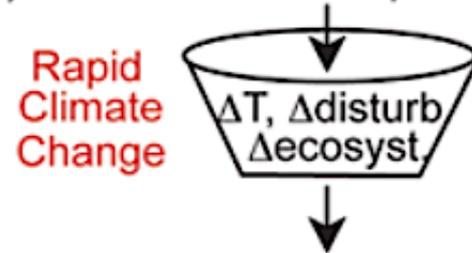
(A) Evolutionary history



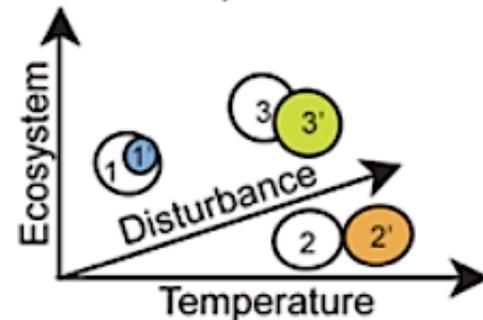
(B) Ecological time: Spatial distribution of species traits



(C) Future: Time and space

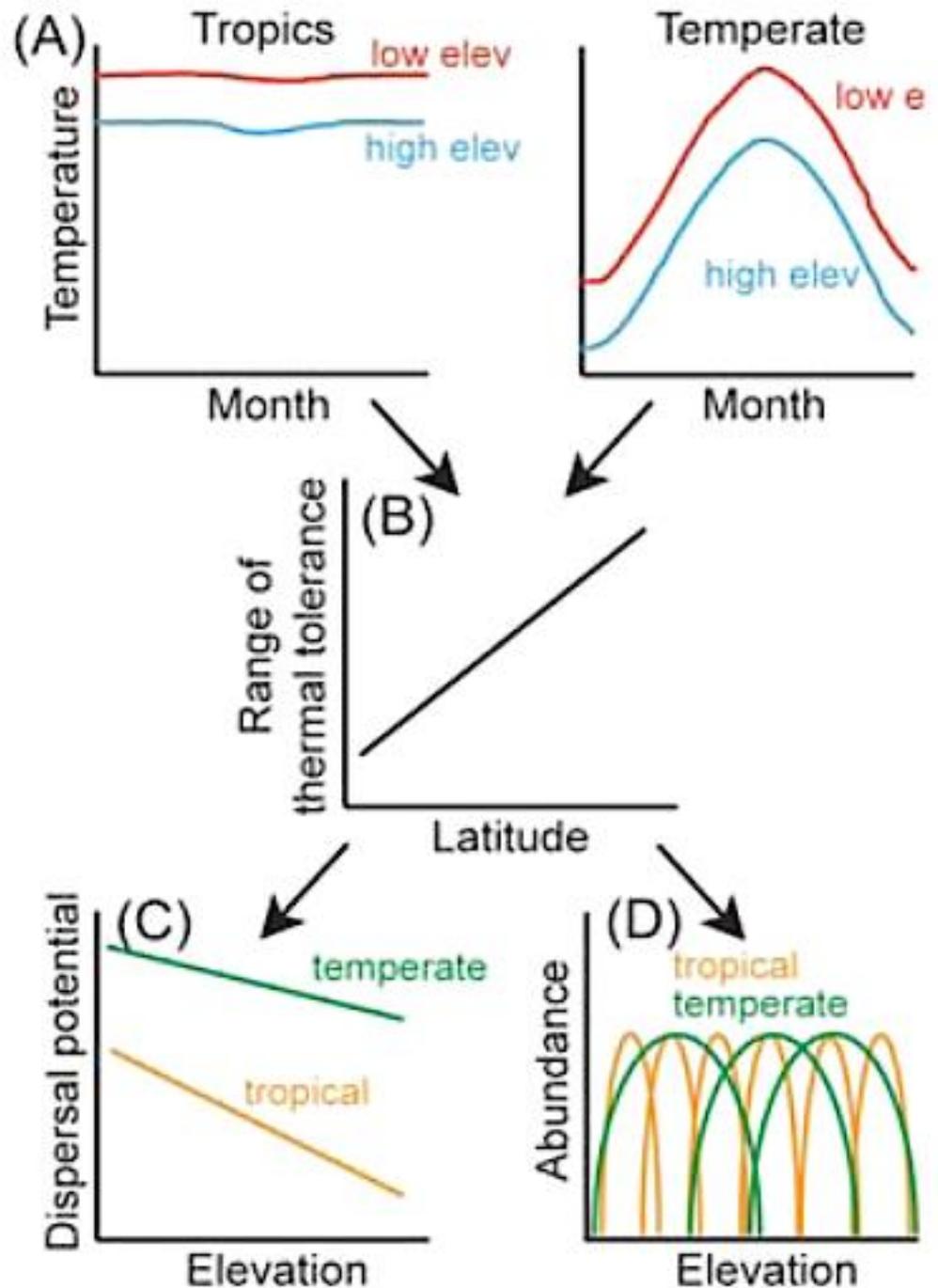


(D) Shift in trait space



Hypothesis: Species sensitivities to climate change are explained by physiological and dispersal traits that have evolved in response to *past* selection in different environments

The *climate variability hypothesis* predicts that climate change may have larger effect in tropics than in temperate zone...



What's really cool about this?

Experimental manipulations of stream temperature and flow regimes in the field and monitoring responses of insects and amphibians (understand mechanisms of vulnerability and effects on ecosystem processes)



Nymphargus wileyi

First experimental test of the climate variability hypothesis

Discovery of new species of stream insects

Relevance to management and conservation of streams

