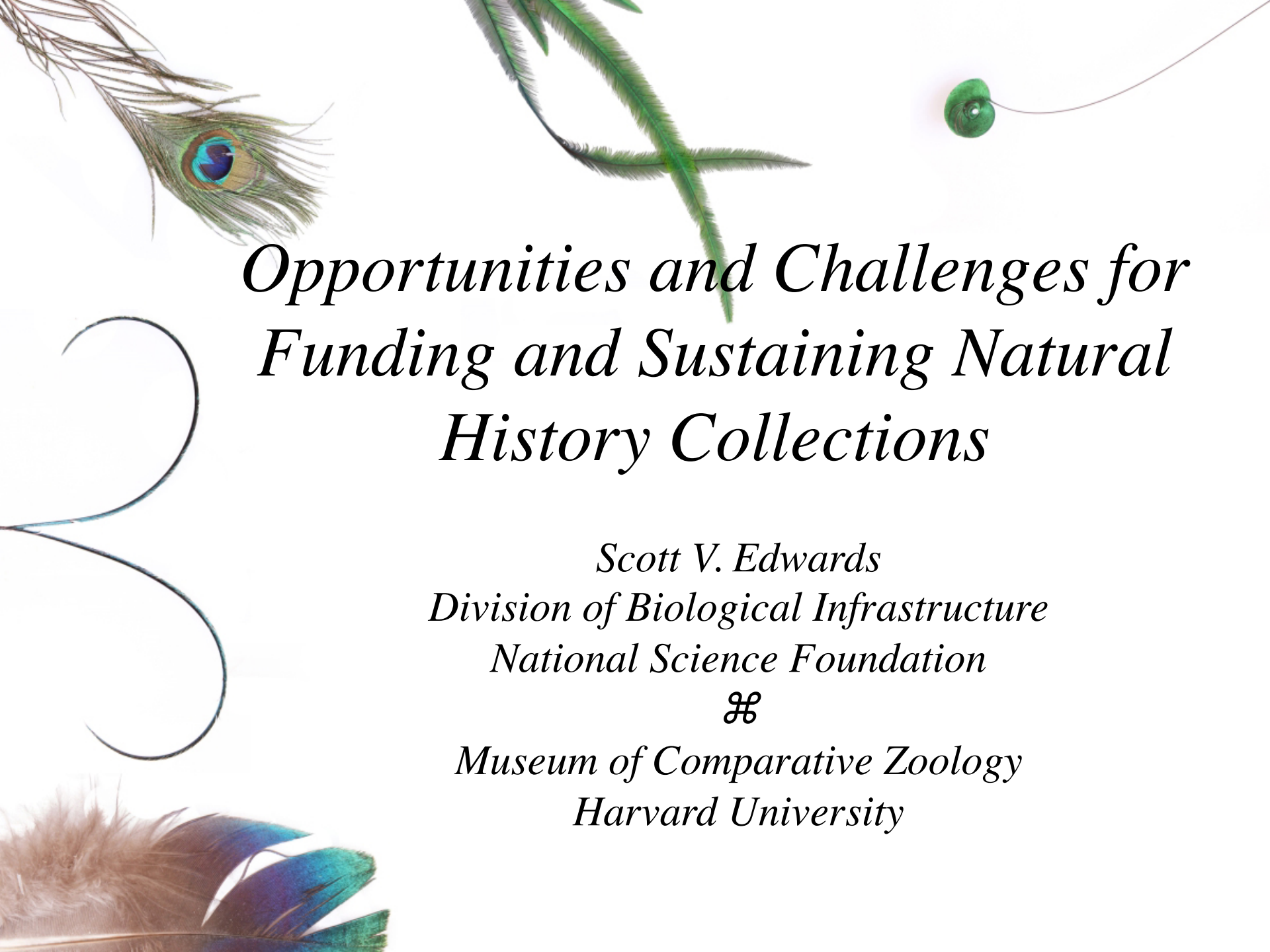


Opportunities and Challenges for Funding and Sustaining Natural History Collections

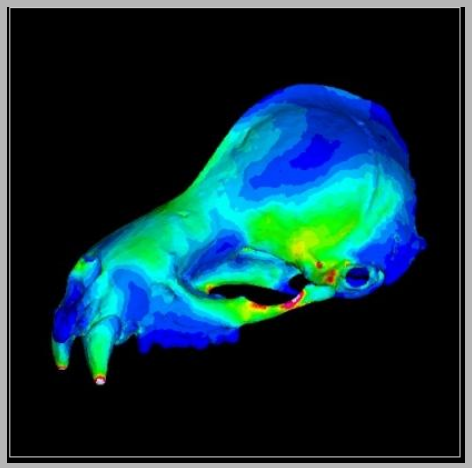
Scott V. Edwards
Division of Biological Infrastructure
National Science Foundation
⌘
Museum of Comparative Zoology
Harvard University

Overview

- Museums: linking Darwin to the 21st century

- Funding collections & digitization: NSF, DBI & beyond

- Recommendations for community involvement and maintaining collections momentum at NSF



Past, present and future of the Museum of Comparative Zoology

A recurring argument …

"…The Museum is no mere storehouse of dead and dusty trash, but is a living and vital center.... The Museum's place in present-day biology grows more, not less, important as its collections grow…."

Thomas Barbour
MCZ Director
Annual Report, 1930-31

The MCZ Bird Department today

- 5th largest bird collection in the world (360,000 specimens)
- global representation
- computerized and searchable data base
- fieldwork in North America, Costa Rica, Australia, Alaska, Russia, Mongolia
- Teaching and research in ornithology, conservation, and evolutionary biology

Aligning museum activities with the educational mission

MCZ Grant Recipients
Academic Year 2010–2011

Grants-In-Aid of Undergraduate Research (GUR)

These grants support research by Harvard undergraduates under faculty supervision. Priority is given to projects that utilize MCZ and Harvard University Herbaria (HUH) research collections, laboratories and facilities. Support for these grants comes from the MCZ's Myvanwy M. and George M. Dick Scholarship for Students and from HUH.

Recipient	Faculty Sponsor	Project Title	Amount
Annabel C. Beichman	James J. McCarthy & Peter R. Girguis	The North Atlantic Right Whale Microbiome Project	$2,300
Joseph Brancale IV	Arkhat Abzhanov	Morphological analyses of beak diversity in the family Thraupidae	$1,800
Andrew H. Chen	N. Michele Holbrook	Ecology, taxonomy and adaptation of the invasive species *Myoporum* aff. *laetum* in California	$1,500
Natalie L. Jacowicz	Jonathan B. Losos	Proposal to study feeding and mating behavior in *Anolis* lizards with diverse head shapes: a field study on Cayman Brac	$1,795
Alexander M. Kim	Gonzalo Giribet	A phylogenetic survey of trans-Isthmian freshwater prawns: vicariance and invasion at the crossroads of the two Americas	$530
Bianca M. Lee	Scott V. Edwards	Laying the foundation for study of MHC and mate choice in Leach's storm petrel	$2,424
Kathy S. Lin	Naomi E. Pierce	The pattern of caterpillar aggregation in a butterfly/ant mutualism	$1,215
Kevin H. Lin	Hopi E. Hoekstra	Evolution of tail length variation in *Peromyscus*	$1,400
Julian Moll-Rocek	N. Michele Holbrook	Logging and Brazil nut conservation in Amazonian Peru	$1,000
Linda Y. Pan	Hopi E. Hoekstra	Ontogeny of burrowing behavior in deer mice (*Peromyscus*)	$2,060
Riva Riley	Saul Nava	Effects of environment on learning in fish: a study at Los Amigos field station	$1,238
Hanny E. Rivera	Robert M. Woollacott	Effects of micro-grazers on the larval recruitment and survival of the brooding coral *Porites astreoides*	$2,500
Elizabeth K. Schold	Scott V. Edwards	Phylogeographical analysis of North American Warbling Vireo (*Vireo gilvus*) populations	$2,000
Guo Xuan Teo	Jacques Dumais	Elucidating the "trap mechanism" of *Porroglossum* orchids	$1,500
Grace X. Xiong	George V. Lauder	Senior thesis research on the kinematics and fluid mechanics of anal fin propulsion in the clown fish, *Notopterus chitala*	$2,500
Serena Y. Zhao	Anne Pringle & Naomi E. Pierce	Biodiversity of Laboulbeniales	$815
		Total Awards	**$26,577**

anama Canal`

Rufous motmot

Museums: a place to study extinct and endangered species

Courtesy Leon Claessens, Aves 3D http://aves3d.org/

idae)

Baselines for a changing world: digitizing MCZ field notes

Connecting Content: Field Notes, Specimens, & Published Literature

The Condor 112(4):754–762

EFFECTS OF CLIMATE CHANGE ON SPRING ARRIVAL TIMES OF BIRDS IN THOREAU'S CONCORD FROM 1851 TO 2007

ELIZABETH R. ELLWOOD[1], RICHARD B. PRIMACK, AND MICHELE L. TALMADGE

Department of Biology, Boston University, Boston, MA 02215

William Brewster
1851-1919

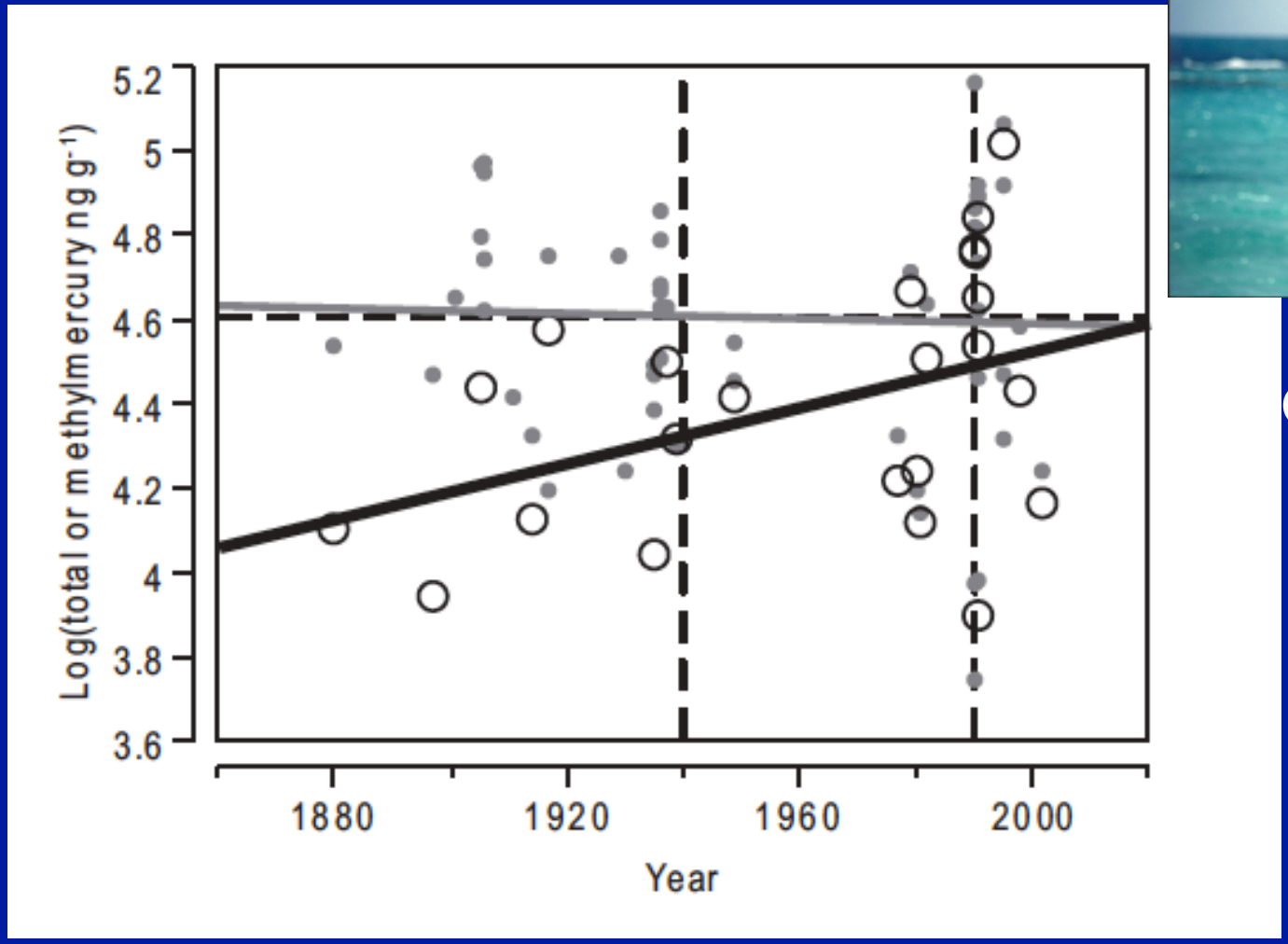
PNAS

Phylogenetic patterns of species loss in Thoreau's woods are driven by climate change

Charles G. Willis[a], Brad Ruhfel[a], Richard B. Primack[b], Abraham J. Miller-Rushing[b], and Charles C. Davis[a,1]

[a]Department of Organismic and Evolutionary Biology, Harvard University Herbaria, 22 Divinity Avenue, Cambridge, MA 02138; and [b]Department of Biology, Boston University, 5 Cummington Street, Boston, MA 02215

Old museum specimens reveal the changing chemical environment



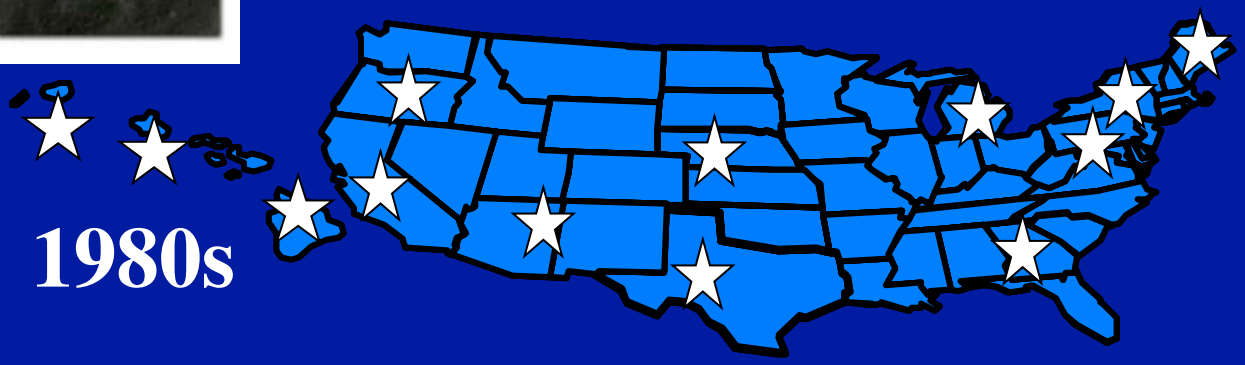
Organic mercury

Total mercury
(organic + inorganic)

Vo et al. 2011. *PNAS* 108: 7466-7471.

Tracking diseases through time: House Finches and *Mycoplasma gallisepticum*

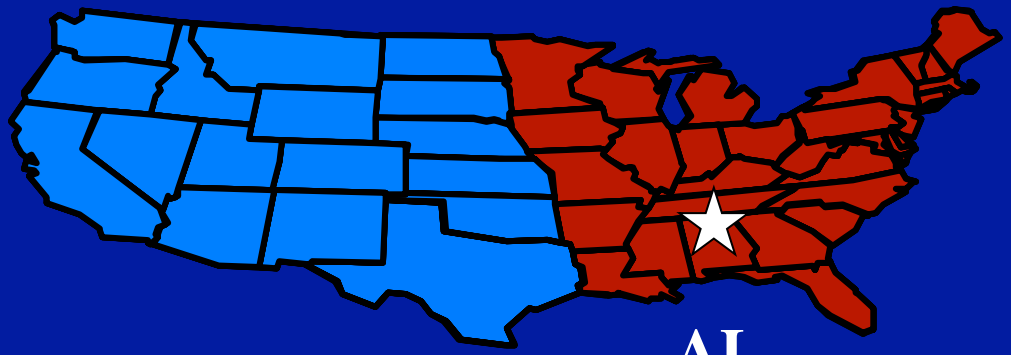
1980s



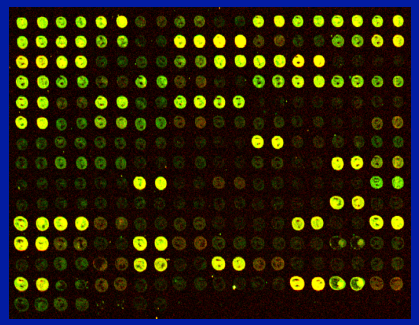
Mycoplasma unexposed areas

Mycoplasma exposed areas

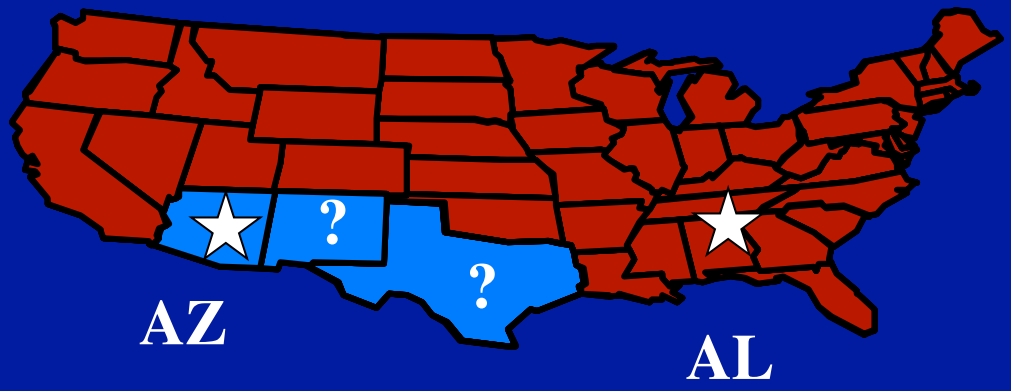
2001



Gene expression in exposed and unexposed populations



2007

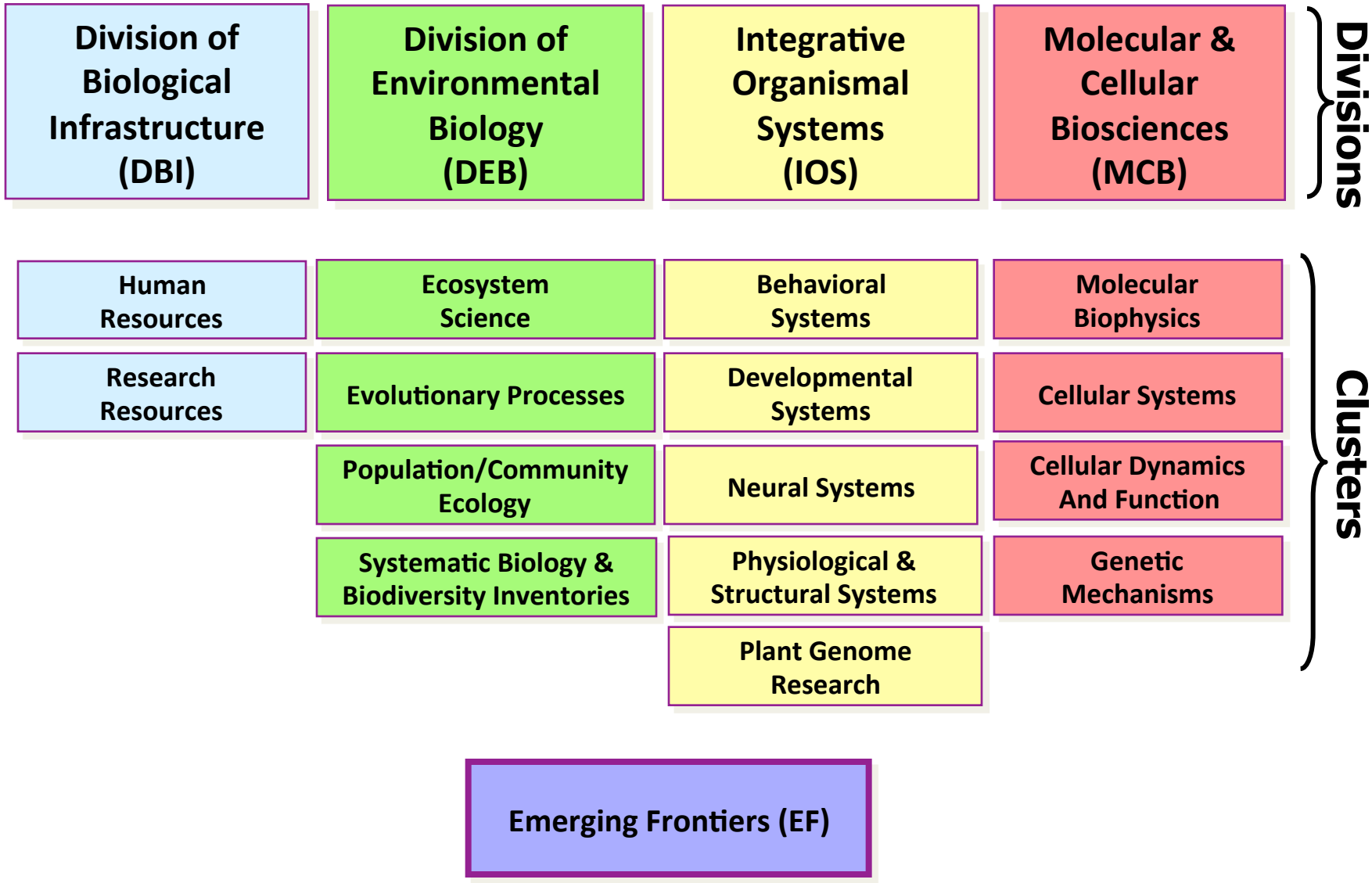


Wang et al. 2003 *Evolution*; Wang et al. 2006 *Mol. Ecol.*; Bonneaud et al. 2011 *PNAS*

NSF Overview

- Supports basic research and education
- Low overhead; highly automated
- Discipline-based structure
- Cross-disciplinary mechanisms
- Use of rotators and IPAs
- Annual budget ~$7 billion; >55,000 proposals; ~10,000 new awards per year supporting ~200,000 scientists, engineers, educators and students

Directorate for Biological Sciences



Emerging Frontiers (EF)

- Multidisciplinary research and networking activities that arise from advances in disciplinary research
  - Advancing Digitization of Biodiversity Collections (ADBC)
  - Dimensions of Biodiversity
  - Macrosystems Biology
  - Ocean Acidification

Division of Biological Infrastructure: Developing Research Resources for the Biological Sciences

Human Resources Cluster

- Research Coordination Networks (RCN-UBE)
- Postdoctoral Research Fellowships in Biology
- Research Experiences for Undergraduates (REU)

Research Resources Cluster

- Advances in Biological Informatics (ABI)
- Collections in Support of Biological Research (CSBR-previously BRC)
- Improvements in Facilities, Communications, and Equipment at Biological Field Stations and Marine Labs (FSML)
- Instrument Development for Biological Research (IDBR)

Centers

- NESCent, NIMBIOS, STCs (BEACON), etc.

Collections in Support of Biological Research (CSBR)

- **Supports**
  - Improvements to Natural History Collections and partial maintenance of vital Living Stock Collections
- **Challenges**
  - NHCs and LSCBRs have different needs
  - "Collections Conundrum"
  - Reduced institutional commitments to infrastructure = more desperate CSBR requests
  - Current scientific climate values NHC data, LSC resources for new discoveries

Collections in Support of Biological Research: Competitive Areas

- NATURAL HISTORY COLLECTIONS
- LIVING STOCK COLLECTIONS
- TRANSFER OF OWNERSHIP

Evaluation Criteria

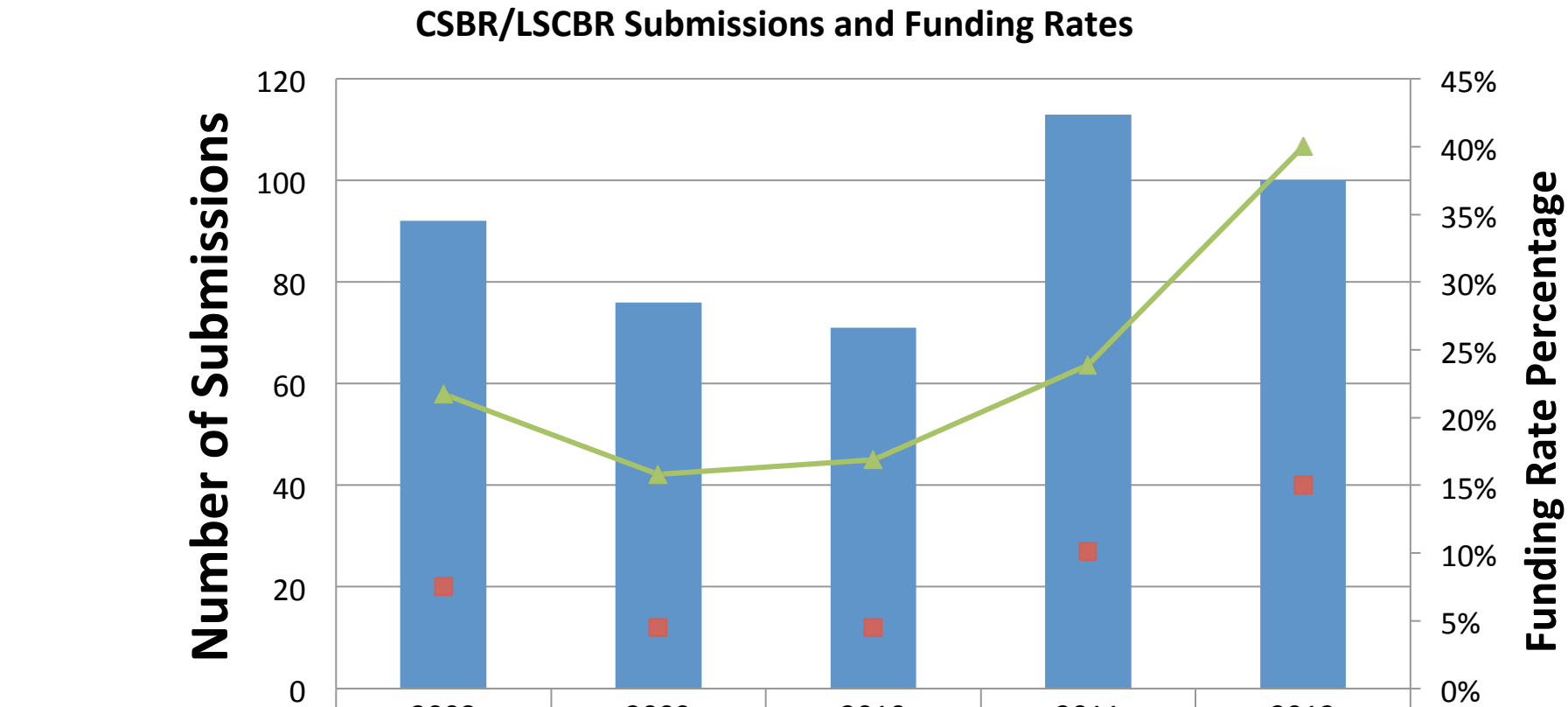
IMPORTANCE to NSF BIO-Funded Research Community

SECURITY Through Improvements

URGENCY Should be Clearly Demonstrated

BROADER IMPACTS through education and outreach

CSBR SUBMISSIONS AND FUNDING RATES

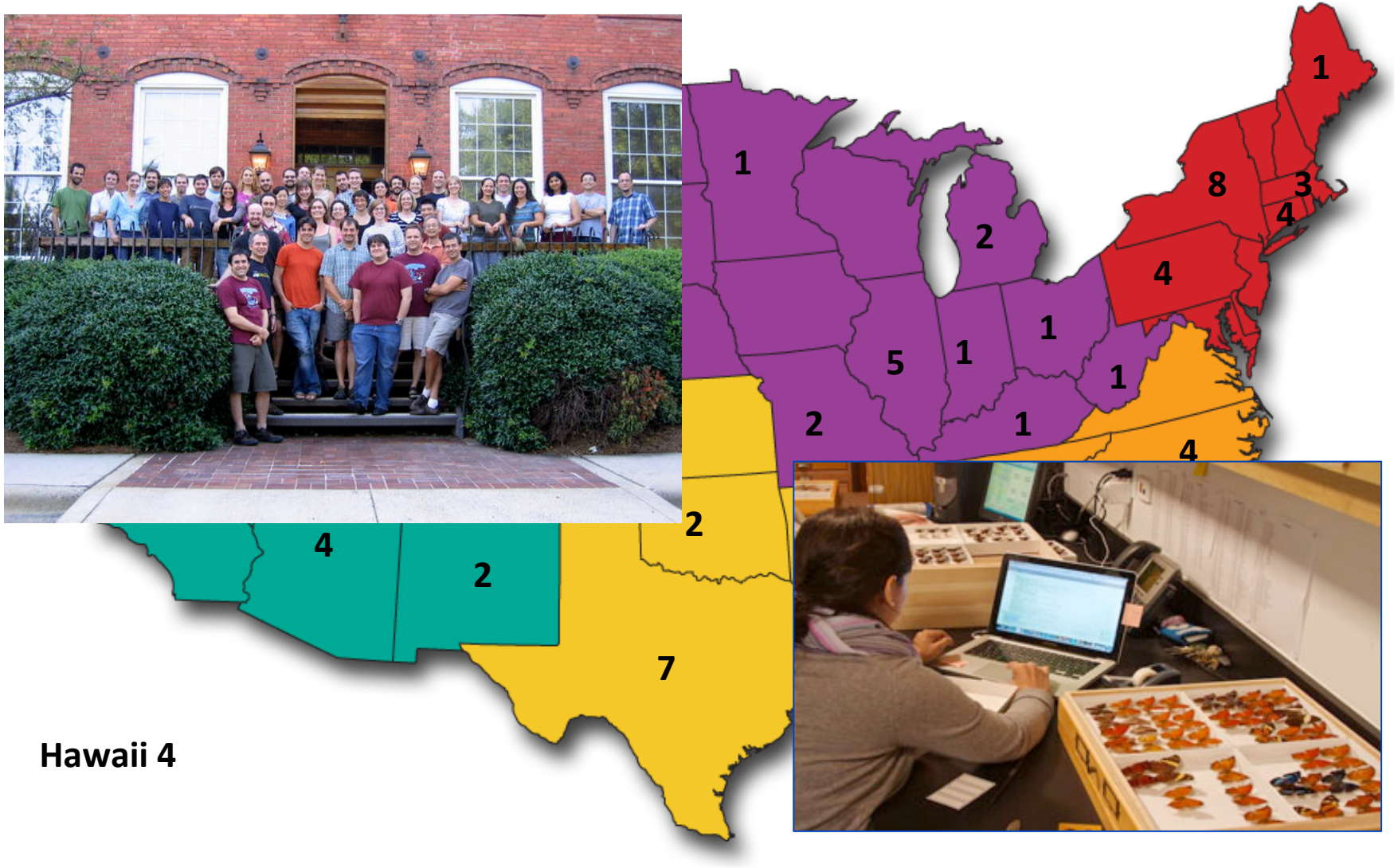


	2008	2009	2010	2011	2012
Unique Submissions	92	76	71	113	100
Awards	20	12	12	27	40
Funding Rate	22%	16%	17%	24%	40%

Ashley Hobbs

Awards by State FY09 – FY12

Alaska 1



Hawaii 4

Living Stocks Collections supported by DBI

Drosophila Species Stock Center

Like

Taxa	Since
lemurs	**1960**
axolotl (salamanders)	**1969**
Drosophila melanogaster	**1970**
E. coli	**1971**
FW algae	**1976**
Bacillus	**1978**
Chlamydomonas	**1979**
marine phytoplankton	**1980**
Peromyscus	**1985**
ATCC (bacteria, fungi, protists, yeast)	**1988, stopped in 2007**
fungi	**(various inst) 1988**
IVAM (fungi)	**1988**
***Drosophila* spp.**	**2000**

Fungal Genetics Stock Center

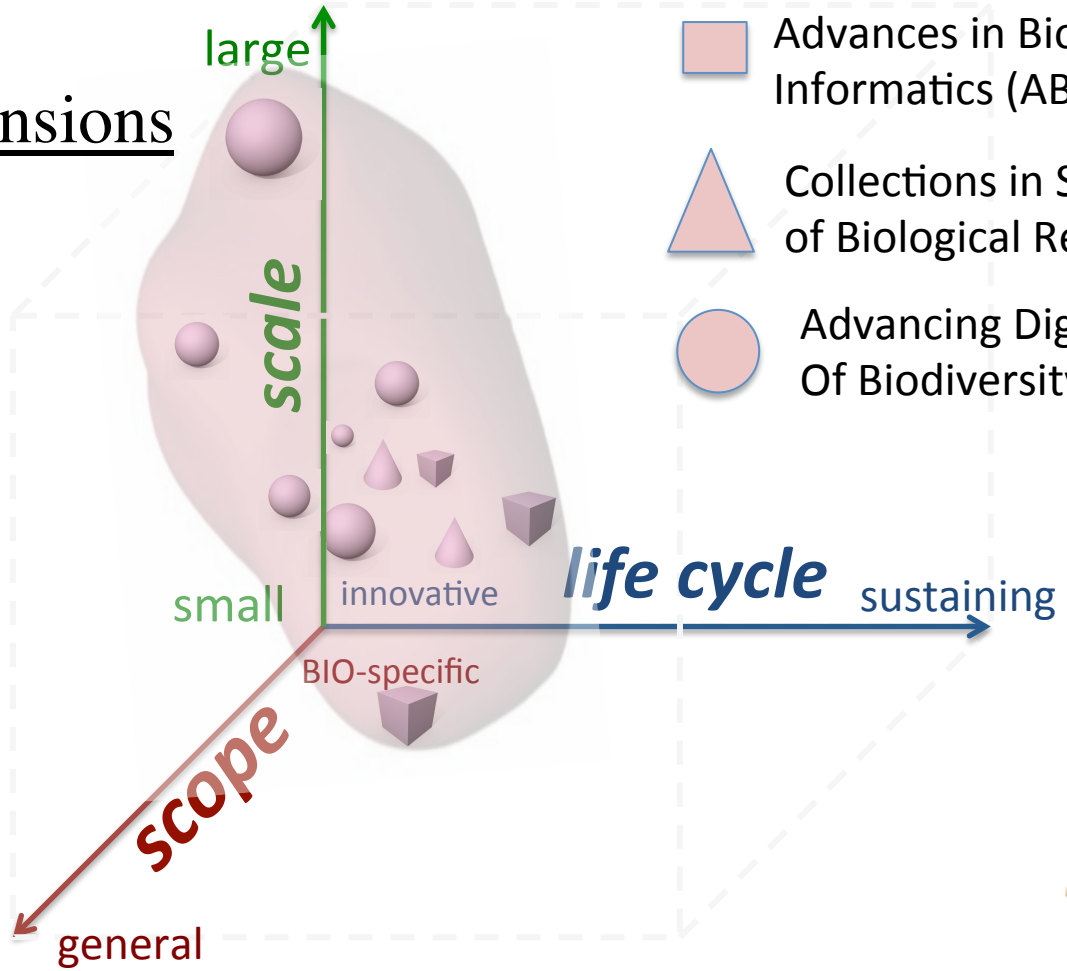
INVAM

International Culture Collection of (Vesicular) Arbuscular Mycorrhizal Fungi

DBI infrastructure portfolio: visualizing impact

3 portfolio dimensions

- Scope
- Scale
- Point in life cycle



Division of Environmental Biology

Genealogy of Life (GoLife)

PROGRAM GUIDELINES

Solicitation 14-527

DUE DATES

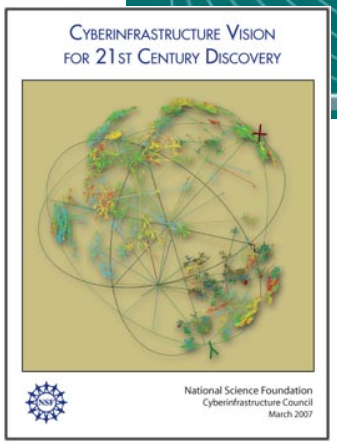
Full Proposal Deadline Date: March 25, 2015
Fourth Wednesday in March, Annually Thereafter

Fourth Wednesday in March

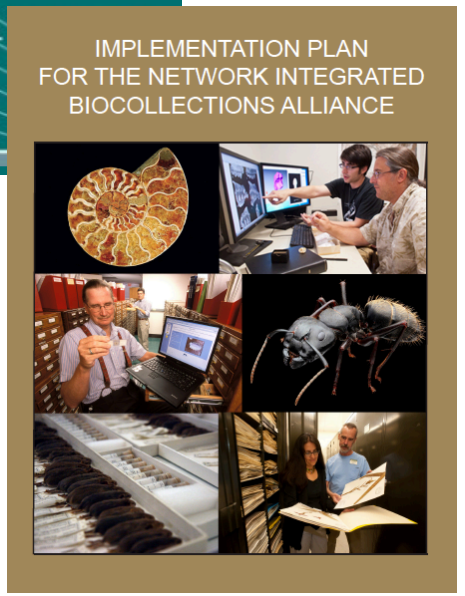
SYNOPSIS

All of comparative biology depends on knowledge of the evolutionary relationships (phylogeny) of living and extinct organisms. In addition, understanding biodiversity and how it changes over time is only possible when Earth's diversity is organized into a phylogenetic framework. The goals of the Genealogy of Life (GoLife) program are to resolve the phylogenetic history of life and to integrate this genealogical architecture with underlying organismal data.

Community discussions and NSF response: the example of ADBC



The Network Integrated Biocollections All

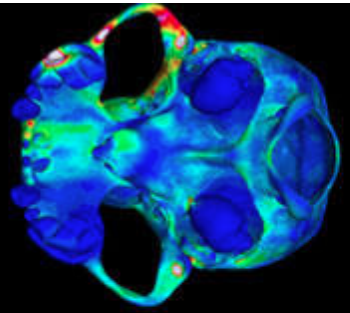


+ ….coordinated community input…+

= Advancing Digitization of Biodiversity Collections

Finite Element Analysis and Biological Collections
biomesh.org

FEA in Biology



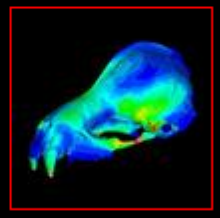
Finite element analysis (FEA) is a powerful computer-based tool widely used by engineers and scientists for understanding the mechanics of physical systems. Our goal is to provide shared resources, guidelines and tools for the biological community that facilitate the use of FEA in biological research. To see publications that have been facilitated by Biomesh, click here.

- Home
- About
- FE Models
- Materials Database
- FEA Basics
- Workshops
- FE Resources
- Teaching Resources

Notice Regarding Downloads (Updated)

We recently went through the process of rehosting and relinking our model/video downloads. If you encounter a link that we've somehow missed, please contact biomesh@bio.umass.edu so that we can correct it.

Sharlene E. Santana, Elizabeth R. Dumont



Lophostoma silvicolum (White-throated Round-eared Bat)

We investigated whether the skull of Lophostoma silvicolum is specialized for roost excavation relative to the ecologically similar species Tonatia saurophila and Micronycteris hirsuta, which do not excavate roosts. We conducted finite element analyses that simulated roost excavating and feeding behaviors in these three bats species.

View Model

Sustaining Biological Infrastructure via business models for Project Directors

ECOLOGICAL SOCIETY OF AMERICA esa | Sustaining Biological Infrastructure

Search …

HOME ABOUT COURSES FACULTY PROFILES HOW TO APPLY

Strategies for Success

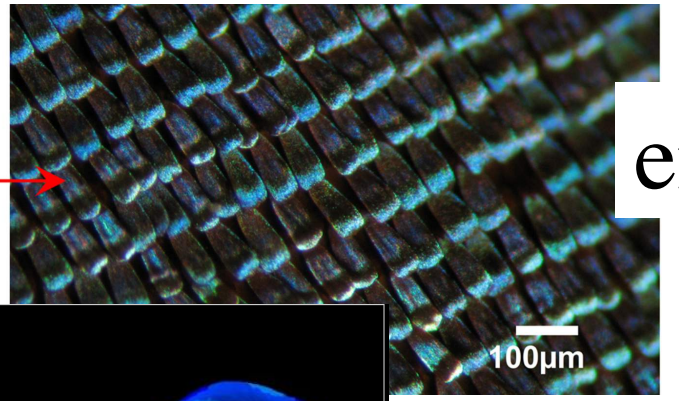
A Training Initiative for Project Directors

Successful biological research relies on access to a wide range of supporting infrastructure, including digital data resources, living stocks collections, museum collections, and field stations.

Directors of biological infrastructure face a number of challenges to ensure these resources are sustainable for the long-term. Sustainability is more than merely preserving existing content and services – it means being able to constantly adapt and develop the resource, increasing its value to the user community over time.

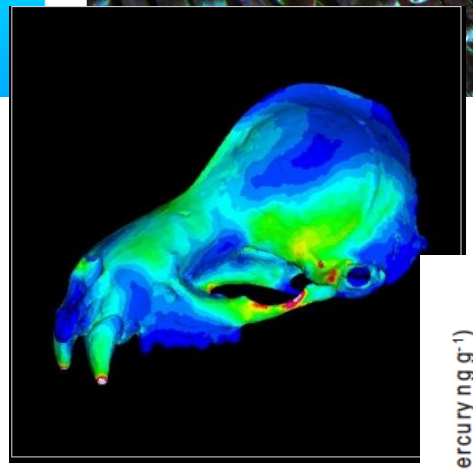
Our inaugural Strategies for Success Course will be held in the Washington DC Area

Broadening the scientific user base for collections



engineering

computer science

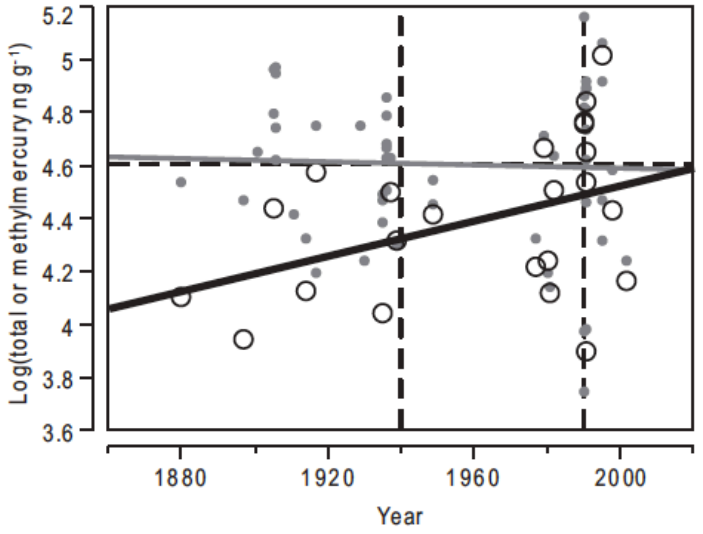


physics

chemistry

mathematics

toxicology



DBI – need for continued leadership

- Division Director
- Program Officer
- IPA versus Visiting Scientist
- Attractive aspects of a rotator position
  - Make your mark on NSF
  - Ensure the integrity of the review process
  - Independent research/development

Thanks to…

Anne Maglia
Roland Roberts
DBI
James Hanken
MCZ