Summary of 2013 Cambridge Meeting

AIM-UP! All-Hands Genomes and Museums Meeting

April 11-13, 2013

Harvard University

Thursday, 11 April 2013 - Day 1

Welcoming Remarks & Participant Introductions:

Jim Hanken – Director MCZ

Scott Edwards – Curator Ornithology in MCZ provided overview of 2013 AIM-UP! course (Genomes and Museums) Harvard hosted and broadcast to UC Berkeley, Occidental College, and University of New Mexico

- Topics from human genetics, GIS, phylogeography, to systematics,
- 13 students developing projects for the classroom

Scott Federhen – head of taxonomy at GenBank, helped link Arctos to GenBank

Pam Soltis – Florida Museum of Natural History, iDIG-BIO PI

- Julie Allen – Illinois Natural History Survey, Postdoctoral Associate, developing web app to look at diversity in spatial context and then pull up phylogeny
- Joe Cook – Director, Museum of Southwestern Biology, also CollectionsWeb, VertNet, Arctos
- Tania Bettis – structural support team, Integrative Biology, UC Berkeley

Eileen Lacey – Curator of Mammals and Associate Director at MVZ (to host meeting in 2014)

Corey Welch – program coordinator for undergrad training program at MVZ

Tracy Heath – post-doc with John Huelsenbeck at UC Berkeley working on project to develop educational modules using trilobite data to teach about

Andrea Sequeira – teaches at Wellesley College

Kurt Galbreath – Assistant Professor at Northern Michigan University

- small collection – interested in enhancing student engagement in collections directly

Kim Cooper – post-doc Harvard, evo-devo integrated into specimens

Kayce Bell – PhD student, UNM---excited about education and collections

Mark Liu—Harvard Postdoctoral Associate, organizer of AIM-UP class, studies house finches

Doug Soltis – Florida MNH

- flowering plant phylogeny, polyploidy, Open Tree of Life project

Ana Carnaval – CUNY

- comparative phylogeography, physiology, works with AMNH & NY Botanical Garden

Chris Himes- STEM Program Manager, Massachusetts College of Liberal Arts

(Also attending from Harvard—Allison Schulz, Breda Zimkus, Linda Ford)

Presentations and Discussions from Day 1

Joe Cook - Introduction to AIM-UP

What do collection based approaches add to education?

- Scale, integration, complexity-multiple views, web-based discovery, database exposure, scientific process, experiential vs passive
- Challenges to incorporating museum based approaches

Aim-UP! Goals

- develop new ways to use collections/data
- increase data accessibility/data portals (front end for database)
- partner with non-traditional users
- international collaborations – e.g., translate modules into Spanish

AIM-UP! Products

- coordinating diverse efforts related to collections/databases and teaching
- survey educators and students
- promote interdisciplinary use
- publications
- educational modules

Recap 5 AIM-UP! Themes

AIM-UP! Educational Modules - examples

- Island Biogeography module – focused on species richness in Alexander Archipelago
- Genomics topics
  - Tree of Life
- Spatial and temporal genetic variation
- Scientific process - replication/vouchers, independent genes
- Connecting big data (GIS, GenBank)

Other efforts

- PULSE – Partnership for Undergraduate Life Sciences Education
  - follow-up to 2011 Vision and Change Report – reinvent undergrad education

Jim Hanken - NIBA Implementation Plan for the Network Integrated Biocollections Alliance overview

- NIBA - big push to digitize collections to improve record keeping and accessibility
- Advances in the Digitization of Biological Collections –NIBA ($100M)

Encyclopedia of Life (EOL) would be an excellent outlet for modules/promoting teaching tools

Kayce Bell - Developing Modules – examples from UNM

Core elements: Identify audience, key concepts, skills, evaluate/assess

Modules

- Samples posted on AIM-UP.org, provide starting points for expansion
- Mammalogy class (Fall 2012, senior level) - Students given open-ended inquiry-based question (18 in class), Steep learning curve, but students

- appreciated freedom

A few challenges:

- track use of modules, refinement by instructors, need more modules (stand alone or in series), broaden scope of existing modules

Doug Soltis – Open Tree of Life

Darwin, Haeckel etc. recognized tree of life, but no rigorous framework until late 1900s

- Many "tree of life" projects, but still no complete tree
- Problem-80% of published trees and data alignments are lost – never archived
- OToL – goal to create draft of tree 1.8 million named species (including fossils)
  - may be marginal, but hopefully can stimulate further development
  - will accommodate dispute and ambiguity
  - allow scientists to make changes and additions
- Design tools to provide services to the community to enhance workflow
  - automated updating of tree
- Workshops to engage broader community, educators
- Engage public in biodiversity science and motivate new understanding
- Teaching biological concepts (extinction, tree thinking, diversity, etc.)

Draft of tree by end of 2013

- What part of tree is represented by museum specimens?
- Future expansion – allow exploration to intraspecific variation?
- Nomenclature – standardizing among major diversity communities
- Educational opportunities - emphasize to students what we don't know

Joe – discussion on Goals for Workshop

- publication about AIM-UP!
- Build broader links with other communities (e.g., teachers)
- Workshops at meetings (NABT, American Society of Mammalogists 2014)?
- What kinds of data are applicable to wider audiences? Key concepts from specimens
- International links
- Native American education?
- Developmental biologists evo-devo and phenoscape project
- Teaching non-majors about collections and evolution
- Community colleges – have massive enrollments
- Potential to cast wide net – K-12, community college, undergrad majors & non-majors,
- Need to incentivize use of collections/data

Afternoon session Day 1

Eileen Lacey—Evaluation and Surveys

- What do students know (or think they know) about museums? – survey undergrads for opinions about natural history museums
- Fall and Spring 2011 semesters – Berkeley
- Survey other populations?
  - TAs, faculty, community colleges, universities without/with museums,
- Pre/post surveys
  - in universities with collections – freshman vs seniors to see if collections mattered
  - between student bodies of universities with and without collections?
- Uses – demonstrate need for continued efforts on museum , publications
- Collections-based societies – disseminate survey to other universities?

Pam Soltis – iDigBio – integrated digitized biodiversity collections

- funding supports development of portals, workshops, outreach, etc.,
  - hub for NSF's ADBC-funded projects (TCNs)
- 7 TCNs – thematic collections networks
  - 3-4 TCNs are funded each year
    - InvertNet, plants, herbivores, parasitoids, lichens/bryophytes, fossils, macrofungi, northeastern vascular plants, southwest arthropods
- Enable digitization – develop standards, build connections/partners
- Engage users,
- Ensure sustainability
- Monthly meetings of TCNs
- NSF now requiring collaboration with iDigBio for all collections-based projects
- Workshops funded by iDigBio

Scott Federhen – linking sequences with specimens

3 ways to link out to specimens from GenBank record

- No established standard that is universally applied
  - problem with genome projects not vouchering their species…
- BUT – important to recognize that GenBank is supportive of keeping the voucher data linked to the sequence data

Examples of Entrez queries and tools:

Two example Entrez queries - formal names of mammalian species in taxonomy, and gerbil sequences in nucleotide Entrez.

http://www.ncbi.nlm.nih.gov/taxonomy/?term=specified%5Bprop%5D+AND+mammalia%5Borgn%5D

http://www.ncbi.nlm.nih.gov/nuccore/?term=Gerbillinae%5Borgn%5D

If you click the 'Save search' link below the query box you can register to get periodic email updates (daily, weekly, monthly) whenever anything new satisfies the query.

E-utils is a scripting interface to the Entrez system.

http://www.ncbi.nlm.nih.gov/books/NBK25501/

E-bot is a tool to help naive users turn an Entrez query into a Perl retrieval script.

http://www.ncbi.nlm.nih.gov/Class/PowerTools/eutils/ebot/ebot.cgi

Educational resources page

http://www.ncbi.nlm.nih.gov/education/

Kim Cooper – expanding usefulness of museum collections for evodevo

- Uniting cell and molecular and development with evolutionary perspective
- Understand macro-evolutionary processes
- Aesthetics – evo-devo is appealing
- Comparative methods are easy to incorporate in undergrad research
- Links between “skin in” and “skin out”
- Using museum skeletons to be able to study evolution of hindlimbs, toe loss
- Anatomy of embryo – describing pattern of development
- Gene expression – candidate genes (e.g., BMP4) associated with limb development –
- Develop links to ecology and behavior
- Evo-devo projects need perspective on natural history

Reception at MCZ—Museum of Natural History Exhibits

19:15-21:15 - Dinner/Discussion at Tanjore

Adjourn

Friday 12 April 2013, Day 2:

Tania Bettis - “ARCTOS and Evolution: A first attempt at a teaching module”

(Use of ARCTOS and Evol. in Intro. Biol. at Berkeley)

- A first attempt at a teaching module
- End of first two years – have results from students response on module
- Goals for class
- Increase students understanding of science
- Build computational skills
- Introduce them to the organisms and not just computer-based
- Students were not aware of museum collections
- Used database, use mapping tools to locate substrate the mice occur on—compare to color
- Have questions to answer—observations and hypothesis
- Students liked the approach—make their own observations

Discussion of module:

- Exciting approach
- Is Arctos best to use (limited in scope)?
- Other organisms could be used in other locations
- Simulation tools are generic
- Many places will not have a museum to use for specimens
- Tweak this for different regions using different organisms
- build quant./computational skills
- use methods/tools currently used in biology

Student activities:

a. Observation

- Categorizing Chaetopidus pelage color

ARCTOS provides georeference data and berkeley mapper tool

b. Leads to Hypotheses

- diversity differences, migration/selection, H-W Eq.
- simulation tools

c. Student responses to the lab were mostly positive.

- Struggled with hypothesis formation and evaluation.

d) From teachers perspective:

- Challenges
  - population variation was too low
  - add genetic data
  - more structure/training on hypothesis formation
- Positives:
  - Database access and MVZ exposure
  - Sets up future lab using GenBank data and phylogenetic analysis

Existing Sources for teaching modules and lesson plans:

- MERLOT
- Cure-net
- Science.Casenet http://sciencecasenet.org/
  - (RCN funded): clearing house of liberal arts lesson plans. No museum pieces on the website. [Invite them to next year's meeting]
- Ana--NCEP

Joe - Humanizing science. Museum collections tied back to the natural environment.

Mongolian fieldwork: http://www.youtube.com/watch?v=iQ3AjIw2OY0

- From field expedition to specimen prep

Profiles of Research Scientists via the Berkeley Paleo Museum.

Discussion of Modules: Genomes and museums focus.

Brainstorming topics related to modules that should be addressed:

- Dissemination-- NABT meeting
- Proposal for TUES
- Bioscience paper
- Community Colleges

Discussion in larger breakout groups (2)

1. Virtual Roadshow (aka 1000 Points of Light)

Idea: Develop Webinar

- What do they want/need?
- Show modules
- Have faculty apply to (~10) attend AIM-UP in Berkeley for module beta-testing?

2. No specimen left behind!

Bioscience Article Discussion:

- Key message: Natural history collections are a tremendous, dynamic, and untapped resource that is revolutionizing undergraduate science education. Using specimens from the moment students take introductory courses will energize student participatory learning, as well as train them in understanding the essential linkages between organisms and environment.

Discussion of the Module Audience and focus of the material (type of course and level):

Rob discusses VertNet and Map of Life

- Demonstration of Map of Life and some new features
  - Show taxon range based on habitat preferences--can observe species range maps over time; uses deductive models
- Rob provides background on “big data”
  - Assembling data into shared repos
    - taxonomic concepts, geography, genes/genomes, phenotypes and traits
- VertNet
  - The cost of maintaining networks for existing databases is increasing
  - VertNet intends to streamline the network and cost of maintenance
  - Integration with citizen science efforts
  - Runs a training workshop; 2nd one summer 2013

Demo of Zooniverse

- Combined effort from several different museums
- Notes from Nature (for herbarium specimens, insects, and birds)

Julie Allen - demonstrates PhyloGEOtastic

- PhyloTastic project aims to provide tools to query existing phylogenetic trees
- PhyloTastic has both educator tools and researcher tools
- PhyloGEOtastic queries GBIF to provide a tree of species living in a given area
- Uses iNaturalist, another citizen science effort

Discussion about iNaturalist

Potential Modules

Kayce provides overview of existing modules

UNM modules are targeted to evolution & ecology course to prep students Phylogeny demo on building a tree using PhyML from GenBank sequences

- Phylogeny practical requires they do this on their own
- Second part covers ancestral character reconstruction of continuous traits (body-size)
- Lab on polyploidy

Discussion

- Scott suggests using phylogeny visualization tools to demonstrate the change in a continuous character over the tree

Mark - Overview of modules students are working on creating in the Harvard group--targeted toward students who have already had intro bio

- Island biogeography
- Ring species
- Neanderthal/human disease resistance evolution
- Phylogenetic reconstruction using morphological data versus molecular data using insects

Ana talks about how cool Genious was for teaching her NYC ToL; if a course had the full version, can download, align, and reconstruct a tree in the same program.

Discussion of tomorrow's plans and potential modules:

We shared examples of potential modules to study evolution using Museum populations:

- Scott: House Finch and Mycoplasma gallisepticum (MG) disease and rapid natural selection story.
- Visualization is important
- Rob: global (climate) change over time, landscape genetics, metapopulation scale, integrating fossils and ancient DNA, niche modeling to get at historical biogeography; integrative methods and concepts; species distribution data over short time-scales
- Genetic variation over time (change in glacial coverage)?

Query the museum community about resurvey efforts? What examples are there? Make a list of case studies.

Kayce - 1st lab background; 2nd lab, phylogeny -building with phyml; build their own tree; then answer questions with phylogeny; polyploidy exercise; then they are given species - build tree and then ask questions and answer.

Mark/Scott

- Student projects.
- Genomic data from Neanderthal - disease; arthropods-morphology vs molecular data.

Andrea - Island systems for models.

- Geography
- Genetic variation over time
- Finches as model of change over time or space
- Grinnell Resurvey—change over 100 years
- Tools for looking at variation in natural populations—viz tools
- Museums as mechanism for surveys—projecting to the past as well as the future
- Developing systems for the last 50-70 years

Saturday, 13 April

Discussion about proposed manuscript for Bioscience

Modules - general discussion:

- web resources already available - incorporate those
- focus on genetics, ties to spatial variation and climate change
- Word doc from Joe on modules now in a google doc (from Julie)
- focus on Module Content, esp. key concepts:
  - big table on board... genetics/genomics example

3. Overview of Friday (Corey and Doug)

4. Back to the modules- break into 3 groups to discuss new module themes.

A) Chris, Tracy, Eileen, Tania: locomotion-related

B) Corey, Scott, Scott: limbs, trait evolution; cryptic diversity; evol @ molecular level and adaptation; evolution of sensory abilities; gene duplication and adaptation; evolution of domestication (Russian foxes, dogs, mustard plants); ring species; evolution of gliding ability

C) Kayce, Rob, Julie: molecules to ecosystems in space and time; glaciation effects, across landscapes; infectious disease

D) Doug, Pam, Ana: plant diversity, phylogeny, biogeography, climate change

E) Mark, Kurt, Joe: genomics-related concepts; pop gen to species level: phylogeography, processes that structure genetic variation within species, gene trees vs species trees, macroevolution, reconstruction of ancestral states; community assembly: history of populations in space and time; glaciation; parasites/emerging disease; stress gene trees vs species trees early on; phylogenies as hypotheses; genes in other realms: genes and morphology, selection (e.g. cytb)

NEEDED: PIORITIZE SPECIMEN DIGITIZATION FOR EDUCATIONAL PURPOSES;

Develop a list of good examples and everything that needs to be digitized

WRAP UP:

- Post-evaluation
- Final review