

**AIM-UP! @ Asilomar, CA**  
**Thursday 27 February 2014**

Twitter hashtag: [#aimup14](#)  
n = 24 participants\*

Morning

**Joe Cook: presentation “Aim-Up! Introduction and Update”**

**Challenges**

- Limited use of natural history collections in undergraduate education
- Limitations of museum digital data
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**Kayce Bell: presentation “Overview of Educational Modules**

<http://www.aim-up.org/educational-modules>

**Scott Edwards: presentation “Overview of NSF Education Efforts”**

**Charles Marshall: presentation “Global Change Biology and Museums”**

Afternoon

**Pam and Doug Soltis: Research Methods in Plant Evolutionary Biology**

**Botany course at U Florida inspired by Aim-Up and iDigBio and OpenTree of Life**

- Involves Field, Museum, & Research Lab
- Students directly involved in research activities from beginning to end
- What have students learned so far:
  - collection and prep of specimens
  - potential research using museum specimens
  - georeferencing and niche modeling
  - synthesis of knowledge from other courses
- What Pam and Doug learned:
  - enthusiastic, curious students because of different format and course size
  - traditional courses don't challenge them as much
  - more enjoyable experience teaching an experiential course
  - Students were very invested – even emotionally – in their work; ownership

**Tali Hammond and Eileen Lacey: Morphology and Genetics Educational Module**

**Losing it: limb loss in a phylogenetic context....rodents with modified hind limbs**

- Key Concepts:
  - Adaptation, Convergence, Form and Function, Phylogenetic principles
- Introduction to online databases
- Designed for introductory biology students
- Case study: Rodent digit loss and limb morphology
- Activity

### **Steffi Ickert-Bond: Potential Topics for New Modules**

- Climate change research and education
- Module ideas using specimen data: Move, Adapt or Die!
  - Move: latitude change, elevation change, move anywhere (invasive species)
  - Adapt: body size change, life history changes, physiology, phenology
- Dissemination of learning modules
  - Journals: Evolution Education and Outreach
  - Training postdocs and future faculty

### **Video Questions**

- 1) What are the key ways that museum collections can be brought in to teach core concepts in fundamental undergraduate biology courses --- ecology and evolution core courses?
- 2) How do you use those collections in the courses you teach?
- 3) How do these experiences working with collections have an impact on student perspectives about biology and biodiversity?
- 4) What are the broader societal outcomes of having strong links between museum collections and collections data and undergraduate training?
- 5) How are museum collections important to YOU? Why should we care about them?
- 6) You can learn a lot about \_\_\_\_\_ from museum collections
- 7) What are museum collections and why are they important (to undergraduate education)?

### **Discussion About Modules: Climate Change & Undergraduate Biology**

- Grinnell Resurvey Project
- Climate warming as a selective pressure
  - Linking physiology, genetics/evolution, and niche biology
  - Evolutionary perspective in climate change
  - E-Bird use
    - phenology mismatch
    - link to fitness (decreased recruitment)
    - Emphasis that having a specimen would make this data stronger
    - Emphasize the importance of having meta-data (date, time, place collected, etc.)
  - Plant phenology
    - Bud-burst timing in observational/field studies/citizen science vs. museum collections
    - Introduction to diverse resources available online
- Phenological Mismatch
  - community shifts, non-analog communities, species interactions (eg. pollination, competition, etc.)
- Niche Modelling
  - Using projections of future climate change vs. current change
  - Patterns of distribution changing
  - “Sky islands” and upwards shifts

- Be aware of the risk of oversimplifying by using naive expectations vs. better-informed predictions...Not everything will move upslope or disappear, some things may expand.
    - Need broad taxonomic breadth and diversity of outcomes
      - eg. Scrub plants currently rare should do better with climate change
      - eg. Some species in FL are moving south
      - eg. Many species aren't changing at all
  - Part A of module: simplistic trends illustrating the naive expectation
  - Part B of module: giving more information on the reality of the heterogeneity of range shifts and demographic changes
  - Range shifts vs. Demographic Shifts (where is the population center?)
- **GENERAL IDEAS**
  - Walk students through a specific example from a particular species, then assign them to do something similar for the group of their own choosing
  - Discuss global change and not just climate change
    - urbanization, sea level rise, human use, land-use
    - urban species and invasive species
    - relationship of non-anthropogenic change to the environmental change occurring over evolutionary time (emphasis on a shift in the rate of change)
    - Let students submit their data to citizen science efforts (eg. iNaturalist)
    - Importance of diverse datasets (observational, specimens, geo-referenced, etc.)
  - Address uncertainty
    - Differences in model projections depend on climate scenario
    - Importance of variety of climate variables, not just temperature
    - Be aware uncertainty may leave people with wrong impression
    - Uncertainty/lack of knowledge can be exciting...Things are changing, there is always more to explore, science is a dynamic field.

## NOTES FROM SUB-GROUPS

**TEAM: H Bart, M Daly, R Guralnik, THammond, E Lacey, PSoltis, J Whorley**

- **Museum Collections for Establishing Ecological Baselines**
  - **Question: How do we assess conservation status using museum specimens?**
  - Museums geographic and temporal dimensions showing dynamic nature of populations
  - Time-series data from museums used to inform forward-projecting models
  - How we understand conservation issues: use a specific group as a case study
  - Discuss ways to assess threat status (IUCN, etc.), focusing on range
  - Museum establish ecological baselines and to know about change.
    - eg) Range maps come from museum collections
  - Relating this biology back to policy decisions
  - Patterns predicted by future models can be seen in contemporary trends.
  - **Activities**
    - 1. Using museum data, separate specimens into historic and modern species

- eg) FL plants
- eg) GRSP small mammals
- eg) Ohio fish data
- 2. Map the range of each temporal period
  - Integrate uncertainty into these maps
  - Discussion Point: The issue of the lack of absence data
    - Discuss with students how to interpret null data (presence only vs. presence/absence. Not everything that was encountered was collected...How to address this when modelling ranges and changes). How to understand absences? Importance of field notes.
    - Discuss sampling biases...How well sampled are various places? Where are gaps in the data?
    - Instructors can choose how much to discuss this issue with students?
  - Look at maps for a series of species in a community. Look at how fixed or fluid a community is, how different species will change.
    - “What species live in your backyards? What are some species that co-occur?”
    - GBIF as a tool for looking at species composition in specific communities
    - Co-occurrence on different levels
      - Larger communities
      - Ectoparasites or microbiota living on larger animals
    - Trophic interactions, functional roles in the community
    - eg. Central CA coast marine community
- 3. Ecological Niche Modelling? (for an Ecology course)
  - Simple niche modelling: correlating species occurrence with environmental data
  - Fundamental vs. realized niche
  - Community composition and environmental change
  - Pick a keystone species or habitat engineer and look at how other species depend on it?
  - Discussion Point: To what extent do biotic associations vs. abiotic factors determine species ranges? Emphasize the over-focus on abiotic variables and the need to integrate biotic elements into these models, the importance of species associations and dependencies.
- 4. Conservation Biology Connection (for a Conservation Biology course)
  - Patches/Fragmentation
  - Principles from island biogeography
  - What traits are most important to consider when designing a protected area?

**Team: J Cook, S Edwards, T Heath, C Welch**

- Questions: how to incorporate this information in a classroom setting? How do you get to the point of teaching phenological mismatch?
  - Reproduction, data for bats, birds
- First think about for certain species are there enough data?
- Morphology, reproductive biology, geography, distribution
- Ask students what they think the most important factor is that affects the species range.
- Some bird data can be good for this
- Maps of land use change
- Sites in New Mexico that are sampled by natural history courses
- Shouldn't there be a massive effort to collect right now because of the massive growth in places like Atlanta?
- Help identify areas that need to be resurveyed.
- How to quantify sampling effort?
  - Field notes, which are becoming more available online
    - can assign students to read and find field notes
    - write field notes
- Fishing pressure changing: <http://www.npr.org/blogs/kruhwich/2014/02/05/257046530/big-fish-stories-getting-littler>
- Notes from nature: <http://www.notesfromnature.org/>
- Identify sites that have enough data to benefit additional collecting effort
- Body size
- Fundamental question is really to identify what data are there to address a particular question
  - Which groups have good field notes for areas with repeated visits
    - plants, birds, some mammals (depending on the mammalogist)
- How do you identify a causal factor for change? Weigh the different possible drivers of species change?
- California Condors as an example
- Disease – hanta, lyme, chronic wasting
- NSF sponsored projects to increase the data stream
- Think about NEON sites  
([http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=13440&org=DBI](http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13440&org=DBI))
- Feral/invasive species – like *Mus*, *Rattus*, there aren't really many of those in museum collections, but could be very interesting/informative

**Subgroup: K Bell, J McCormack, M Fitzpatrick, E Lessa**

**Move, adapt, or die**

**Adapt: Body Size Module**

Body Size vs. Temp or Latitude – look for correlations

Bergman's Rule

Body size shrinking in contemporary time with climate change

- Yom-Tov: marten body size change in Alaska
- Adaptive reasons behind Bergman's Rule (physiological reasons)
- Where Bergman's Rule works and doesn't work
- Where predictions can be made on body size changes with climate change and where we don't know what will happen

## **Die: Extinction Module**

Mismatch between climate-based and vegetation-based niche models to model where extinctions or extirpations

Start with specific area:

1. Ask what collections exist from 1800s or 1960s
2. See what is not there now
3. Ask why?
4. Bring in niche models, maps of vegetation, Google map of temperature change, literature
  - a. One example where we see that vegetation is no longer there
  - b. One example where it seems habitat is there, so there must be some other reason → lit search

Potential problems:

1. Too much reliance on niche models
2. Maxent can be a black box
3. ArcGIS is complicated and expensive

Notes from breakout group 3: Ideas for Collection-based Global Change Modules

**J Salazar-Bravo, S Ickert-Bond, D Soltis, A Monfils R Williams**

1. Use of Bison Database to mine GBIF for occurrence dates of flowering plants (Anna) – routines to graph occurrence dates by year for any taxon. Can choose taxa where records have phenological meaning (e.g., flowering in spring ephemeral plants). Plot change in flowering times from earliest to most recent records. Very coarse, not filtered by locality or reproductive state (can this be done?), but patterns are apparent for some species.
2. Emphasis of modules on predictive nature of science; use of past or present distributions (and climate envelopes) to predict future distributions or track changes over time. “Use of past patterns to predict future change”.
3. Use present distributions and niche modelling (MaxEnt) to predict future distributions.
4. How to deal with bias and gaps in collection data, uncertainty of locality data? Are historical shifts an artifact of sampling bias? Many specimens lack fine-scale locality data. Most have information on state and county which may be good enough to see long-term changes in distributions.
5. Look at changes in distributions of invasive species. Track first occurrences and spread with collections. Use niche modelling to examine characteristics of native habitats of invasive species – how

similar to environments where introduced and invasive? Risk assessment for invasiveness of a species in a given area?

6. Adaption theme. What morphological characters can be measured from digital specimens that might reflect adaptive change through time or space? Leaf and flower size for plants can be measured directly from images. Shape analysis? Can also refine descriptions of plant phenology from images (early, mid, late flowering).

7. What taxa will work best to look at effects of climate change? Pick pairs or groups of contrasting taxa to examine effects – comparative approach. Make predictions based on differences in physiology (ecto and endotherms; annuals vs. perennials; shrubs vs. herbs, etc.).

Potentially Relevant Papers:

<https://www.dropbox.com/sh/c0j4671ptzskxsa/9Ipw3p6KRN>

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## **Friday 28 February 2014**

Morning

### **Social media**

The blog hasn't been used much

Facebook

Twitter; can be linked up to Facebook

The site could be advertised through society's listings

Webinars can be posted; there will be a webinar for small collections network

Short videos could be posted as well

### **Discussion of conferences to present talks/poster promoting AIM-UP.**

John and Tracy will be beefing up presence of Aim-UP on social media.

Doug and Pam will be giving a presentation on their new course at Botany conference.

Pam talked about iDigBio project, aims and education activities. Mentioned recent workshop on comprehensive and integrated activities. Also planning to do a REU sites project for bringing students together to work in collections. Rob mentioned Aim-UP partnering with iDigBio for a joint education activity. John McCormack will be presenting the Aim-UP poster at the Ornithology meeting.

- SPNHC - June (poster and possible presentation)
- NABT (Nat'l Association of Biology Teachers) Nov 12-15 Cleveland (Register March 15) Meg will go (poster or talk--will decide)
- BSA/ASPT meetings--talk by Solti on course, Steffi (Poster on a specific module)
- MiCOB - October
- ASB - April

- Small Collections Network Workshop - April (Kurt Galbreath)
- SVP – Berlin Nov 5-8 (poster -- Tracy)
- Small Herbaria workshop poster-BSA - July/Aug - Pam & Anna
- plan symposium for SPNHC 2015 in Gainesville
- Northwest Biology Instructors meetings - May 2-4; Josh Whorley
- SCCDistrict meeting - Josh Whorley
- Intermountain Region Herbarium Network - April or May - Rick will give presentation
- Consortium of Pacific Northwest Herbaria - Rick will add link to AIM-UP on webpage

Scott: we should look at modules developed already. Lois: students struggling with modules she has tried (difficulty navigating databases). Multiple: better packaging of modules (powerpoints, screenshots showing how to do things, screencast software, more instructional materials). Also need better publicity of fact that Aim-UP exists. John M: students generally have lots of basic questions about collections that can be answered with general information gather from other sources. We should develop a list of FAQs re NHC to initially orient students to collections.

Morning Breakout: Two subgroups led by Scott: reviewing existing modules; two subgroups dealing with FAQs re collections (John); new Climate Change related modules (Eileen).

#### Breakout Discussion:

Previously developed modules: Scott: looked at module on cryptic species using image J to take measurements on specimens and analyze shape variation. Meg: modules on phylogenetics and molecular data (mitochondrial and ancient DNA). These were more like case studies (pdfs). Would be nice to develop these further and implement them as an actual course module. Rob: Module on mapping species distribution; a lot has happened in three years. Rob is happy to make richer and simpler based on his Map of Life project. Lois: Geographic barriers (art biology) module. Josh: some of the modules he looked at lacked specific and visible learning outcomes and lacked ties between outcomes and the activities that students will complete to achieve them. Joe sent around module development document for these people to edit; comment on.

Joe: website needs improvement. Anna: work with graphic design classes in Art departments. Things can be done to raise the profile of website. This group will reconvene to discuss needs of previous modules in more detail.

John: FAQs: start up page with three topics: what are collections, why so many specimens, and type specimens. Other FAQ/answers could be added. Capstone idea would be a student activity to develop a video answering questions. Already a page on Aim-Up website called exploring natural history collections.

New Climate Change Modules: Steffi: C3/C4 module, how different groups of plant will change; start with basic anatomy, develop list of species (based on literature review provided by instructor), collect specimens, go into physiology of C3/C4 pathways; make sure students understand where data are coming from (individual provider herbaria). Module could be scalable to different grade levels. Could have different time horizons. Phylogenetic context for physiology. Niche modeling aspect of grasslands in a



changing environment (past, present and future images). Pam: New multi-layered module on how plant changes influence stream ecosystems, include trophic interactions among invertebrates and fish, stable isotopes (analysis of museum specimens)!

Eileen: Grinnell resurvey module, rich dataset of small mammals, plants, invertebrates. Audience would be undergraduates at all levels (with increasing, specialization). Key concepts would be environmental change, adaptation, ecological niches and modeling, specialists vs. generalist, communities, conservation biology principles. Skills: use of databases, spatial analysis, ?. Resources: Arctos, Prism, Genbank, Historical photos, Berkeley Mapper. Initial focus on changes in chipmunk species in Yosemite. Instructors could then plug in other modules on niche modules, occupancy modeling, genetic variation. Could be expanded to other mammal groups and other groups of organisms from the area

Afternoon? Modifying modules to alter them into more inquiry based teaching.

Details on DNA case studies

These are PDF presentations of excellent case studies on how collections can be used to understand major issues in evolution.

The mtDNA case study looks at ancient DNA focusing on the question of Neanderthal human relationships. GenBank searching, tree building, support of relationships, searching/interpreting mutation (character optimization). The case study needs more clarity about what the questions are (a slide added) and some background on what/why mtDNA to be more appropriate for undergrad-level courses.

The Ring Species case study starts with the Biological Species concept, and then introduces ring species as a contrast to the BRC. There are several examples, and then an in-depth study of warblers. The case study walks through the testing of the warbler example using museum data. The example is excellent, and includes treatment of GenBank, morphological data and image manipulation, geospatial data. This is an exceptional case study or template for subsequent inquiry-based work.

Resources for the webpage:

**NESCent 2014 Evolution Film Festival/Video Contest**

**Interesting links:**

[http://www.nytimes.com/2014/03/02/magazine/the-mammoth-cometh.html?\\_r=0](http://www.nytimes.com/2014/03/02/magazine/the-mammoth-cometh.html?_r=0)

<http://www.npr.org/blogs/codeswitch/2013/08/08/207348197/science-rap-b-a-t-t-l-e-s-bring-hip-hop-into-the-classroom>

Evaluation: Eileen: need to develop survey instruments for evaluating 1) modules, 2) RCN generally, 3) overall courses developed and taught and what they teach students about collections.

Afternoon—Monterrey Bay Aquarium Tour

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## Saturday 1 March 2014

Video by Peter [Applause]

Rob presents on using GIS to grab environmental data from Alaskan plants

- Using QGIS freeware of ArcGIS
- Idea to show undergrads simply how to access underlying environmental data
- Downloaded simple raster layers from WorldClim (e.g., elevation)

Anna on partnership with iDigBio: undergrads digitize University of Central Michigan collection

- Surveyed what students working in collections are learning
- What are they doing? 50% entering data, 50% research, 50% field collection
- Outcomes: they are learning a lot about science
- Student wanted more professional development

Joe makes the point of value of students delivering tours

Joe asks about linking survey questions to AIM-UP! web site

Corey asks about inquiring about retention rates within majors

Maria Paz: ways to pull more out of narrative answers

Eileen on assessment: ways to evaluate modules, perhaps have subgroup think about that

Meg: ease of assessment important to implementation

Eileen: discussing what is a module vs. activity vs. case study

Maria Paz: module could be something more complex comprising many activities

Meg: need to AIM-DOWN on the modules--simpler

Megan: modules are the over-arching themes comprising many activities or case studies

General discussion on idea hierarchy and stream-lining

Eileen: paper focusing on how collections can help teach about climate change.

Subgroups:

1. Evaluation and assessment
2. Organization of web site and materials
3. Ideas for the paper

Subgroup on web site organization presented a Powerpoint slide

Break for Lunch

Subgroup presentation on the climate change paper

Next year's meeting in New Mexico – larger meeting – call for speakers

Hank comments on RCN CollectionsWeb and continuation of AIM-UP RCN

Someone needs to step up and lead the next RCN effort.