Integrated Inventories:
The Avian Perspective

Christopher C. Witt

Museum of Southwestern Biology Division of Birds

Department of Biology

University of New Mexico

Albuquerque NM 87131 USA

Overview

- Avian inventory methods and the role of museum collecting in inventory work.
- How should we allocate limited resources for collecting and curating specimens?
- Event-based versus object-based collections?

Avian inventory methods

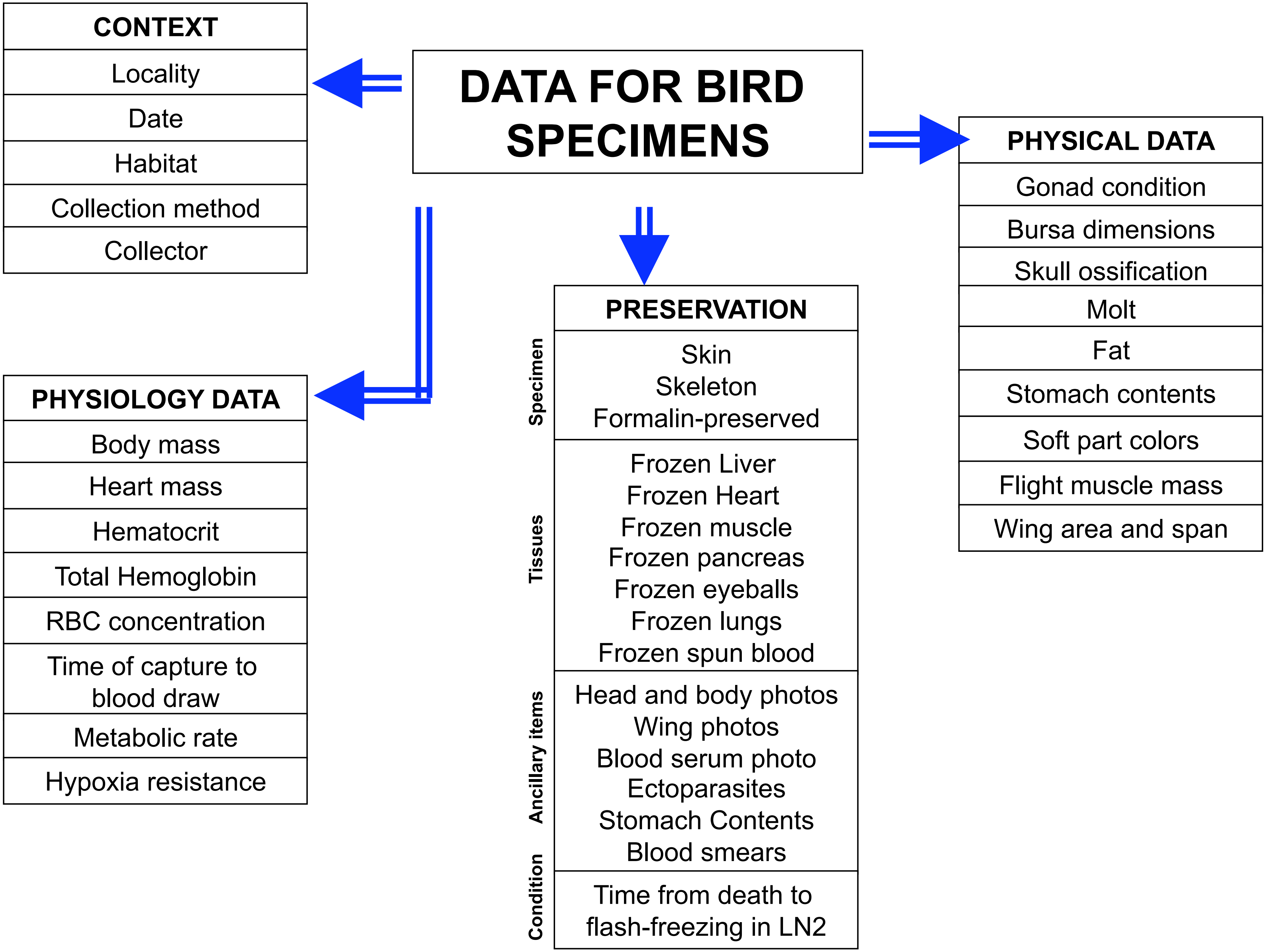

L.L.Bean
Sharpie

Overview: Preparing a Bufflehead

Photos: Cindy Ramotnik

“I like Mason’s idea of linking ancillary data to a voucher,” (Anonymous)

This has always been the model in museum ornithology. Only the language and the methods have changed over the centuries…. and we’re still trying to figure out the best way to do it!


DATA FOR BIRD SPECIMENS
CONTEXT
Locality
Date
Habitat
Collection method
Collector
PHYSIOLOGY DATA
Body mass
Heart mass
Hematocrit
Total Hemoglobin
RBC concentration
Time of capture to blood draw
Metabolic rate
Hypoxia resistance
PRESERVATION
Specimen
Skin
Skeleton
Formalin-preserved
Tissues
Frozen Liver
Frozen Heart
Frozen muscle
Frozen pancreas
Frozen eyeballs
Frozen lungs
Frozen spun blood
Ancillary items
Head and body photos
Wing photos
Blood serum photo
Ectoparasites
Stomach Contents
Blood smears
Condition
Time from death to flash-freezing in LN2
PHYSICAL DATA
Gonad condition
Bursa dimensions
Skull ossification
Molt
Fat
Stomach contents
Soft part colors
Flight muscle mass
Wing area and span

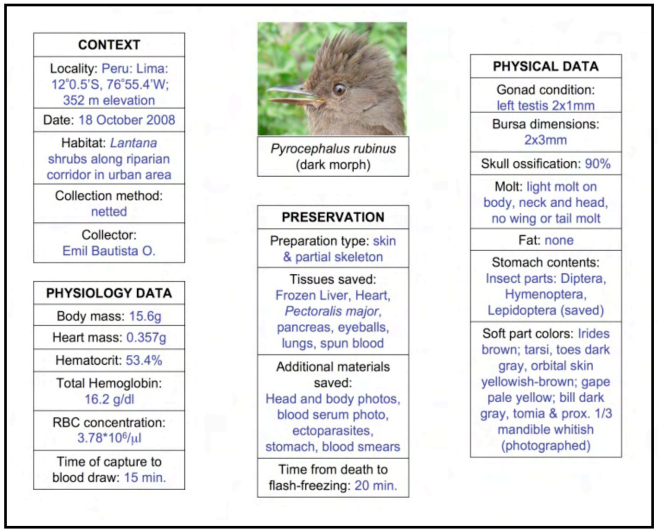
CONTEXT
Locality: Peru: Lima: 12°0.5'S, 76°55.4'W; 352 m elevation
Date: 18 October 2008
Habitat: *Lantana* shrubs along riparian corridor in urban area
Collection method: netted
Collector: Emil Bautista O.

PHYSIOLOGY DATA
Body mass: 15.6g
Heart mass: 0.357g
Hematocrit: 53.4%
Total Hemoglobin: 16.2 g/dl
RBC concentration: $3.78*10^6/\mu l$
Time of capture to blood draw: 15 min.

Pyrocephalus rubinus (dark morph)

PRESERVATION
Preparation type: skin & partial skeleton
Tissues saved: Frozen Liver, Heart, *Pectoralis major*, pancreas, eyeballs, lungs, spun blood
Additional materials saved: Head and body photos, blood serum photo, ectoparasites, stomach, blood smears
Time from death to flash-freezing: 20 min.

PHYSICAL DATA
Gonad condition: left testis 2x1mm
Bursa dimensions: 2x3mm
Skull ossification: 90%
Molt: light molt on body, neck and head, no wing or tail molt
Fat: none
Stomach contents: Insect parts: Diptera, Hymenoptera, Lepidoptera (saved)
Soft part colors: Irides brown; tarsi, toes dark gray, orbital skin yellowish-brown; gape pale yellow; bill dark gray, tomia & prox. 1/3 mandible whitish (photographed)



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Online database

http://arctos.database.museum/SpecimenSearch.cfm

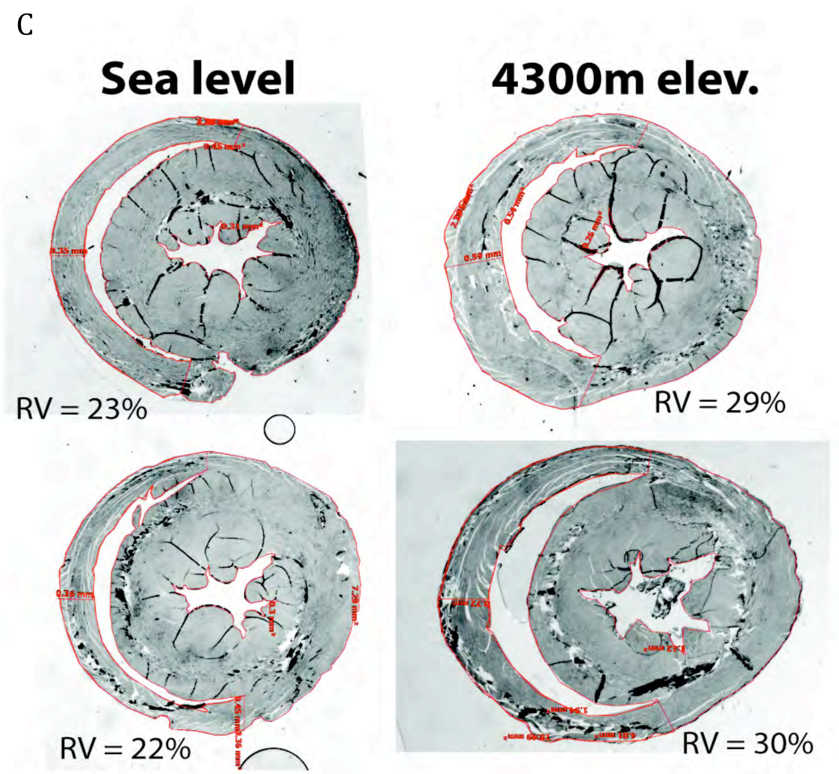
CATALOG NUMBERS:
Tissue #
Preparator #
Museum Catalog #

Specimen-based Projects that MSB Bird Division collects for right now

- Evolution of physical characteristics of blood across elevational gradients
- Phylogeny, phylogeography, population genetics of birds in Peru and NM
- Heart and lung size and structure across elevational gradients
- Flight muscle, wing and body size across elevational gradients
- Blood parasites: host relationships, prevelance, and diversity
- Genome size in birds
- Hypoxia resistance in hummingbirds
- Metabolic rate of hovering hummingbirds
- Tracheal morphology and vocal formant spacing
- Pancreas variation in conjunction with diet and trophic level
- Retinal protein variation in birds
- Hemoglobin isomeric composition and O2 affinity
- Chewing louse taxonomy and phylogeny
- West Nile Virus: host relationships, prevelance, and diversity

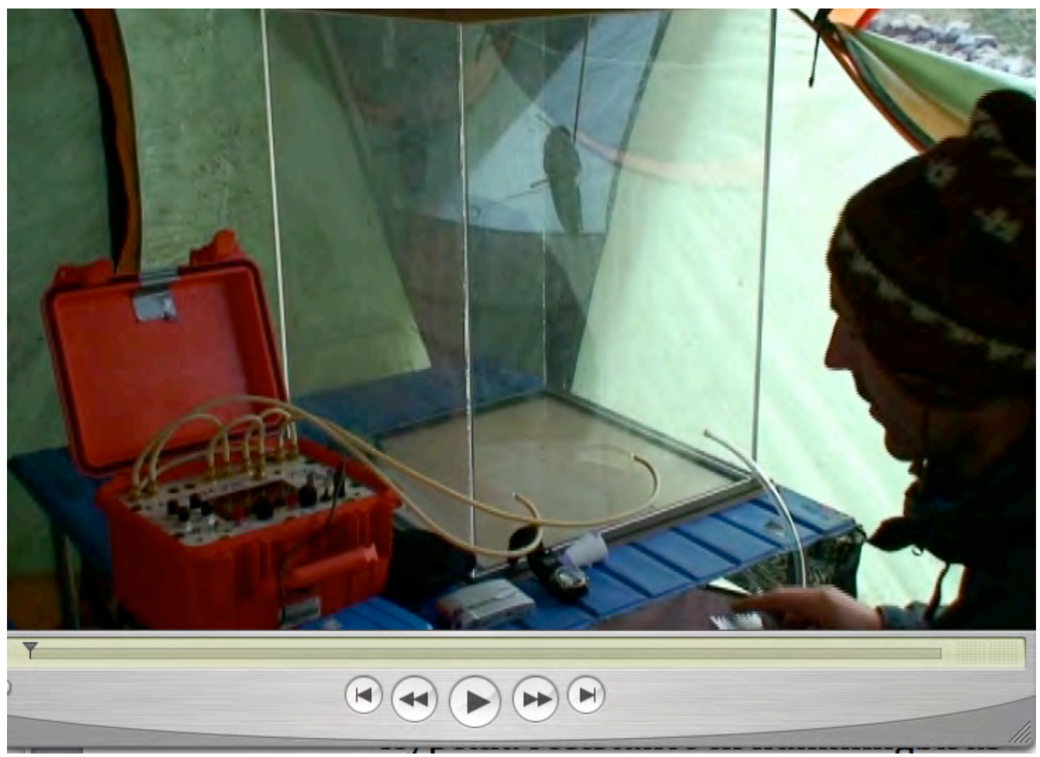
Ancillary data: Example I

House Wren heart cross sections



Ancillary data: Example 2

Videos of flight performance in Hypoxia



ORNITOLOGIA NEOTROPICAL 20: 535–552, 2009

AVIFAUNAL SURVEY OF THE RÍO CHIPAOTA VALLEY IN THE CORDILLERA AZUL REGION, SAN MARTÍN, PERU

Christopher L. Merkord[1], Todd Mark[2], Dora Susanibar[3], Andrew Johnson[4], & Christopher C. Witt[4]

355 species of birds

97 spp.: specimen

142 spp.: recording/photo

116 spp: seen/heard only

Effort documented in article

- 4003.5 net hours
- judicious collecting by shotgun

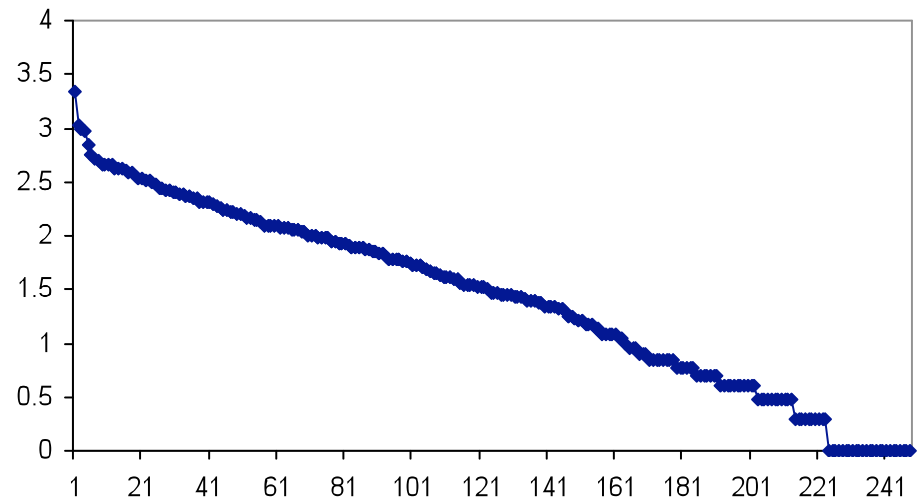
Effort NOT documented:

- 550 specimens collected
- Proportion of netted birds that were collected (99%)
- Number of hours spent hunting
- Use of playback

Lognormal rank abundance distribution: long tail of rare species

Number of detections

Log number of detections



Species rank

Satellite imagery reveals new critical habitat for three endangered bird species in the high Andes of Peru

Phred M. Benham[1], Elizabeth J. Beckman[1], Shane G. DuBay[1], L. Mónica Flores M.[2], Andrew B. Johnson[1], Michael J. Lelevier[1], C. Jonathan Schmitt[1], Natalie A. Wright[1], and Christopher C. Witt[1].

- Collected 40 of 52 species found at this super-high elevation site

- Figure shows position of mistnets

Specimen-based Inventories: Problems

- Lots more work per ‘observation’ than other methods
- Very difficult to sample uncommon species thoroughly
- Species are sampled very unevenly due to:
  - Collector motivation bias
  - Mist-net capture bias
  - Variation in difficulty of collecting
- Events not traditionally tracked in museum databases

Do Inventories warrant a fundamental shift in the way we collect birds?

Current collecting activities are project driven.

- Randomized sampling designs are rare, and there’s no way to randomly sample anyway: e.g. mistnet and mesh size biases.

- Sampling is always directed towards one or more immediate research purpose.

- This generates presence data, but not absence data.

- If we do a good survey as part of our work, we publish it, with description of effort in the publication linked to specimen.

Do Inventories warrant a fundamental shift in the way we collect birds?

Quantification of effort?

We quantify net-hours opportunistically, but don't record them in specimen database

How can you quantify motivation? An avifauna of 50-500 species may be completely prioritized in the minds of a collector for ongoing projects, colleagues' projects, potential projects… resulting in biased sampling of species

What do specimens add to an inventory?

- **Detailed taxonomic study & challenging identifications**

- **Genetic characteristics** of populations collected: diversity, uniqueness, relationships, allele and genotype frequencies at any locus.

- **Parasite and pathogen studies**

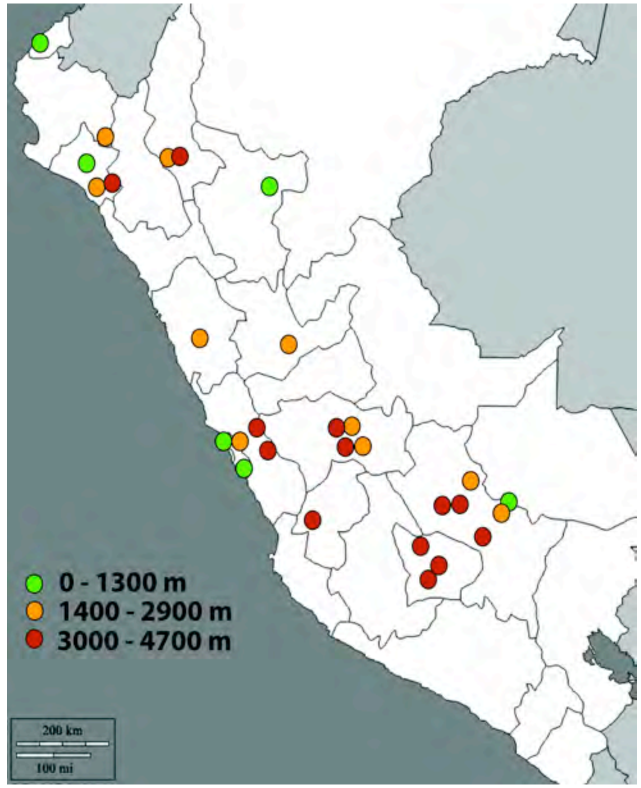
- **Isotope ratios in any tissue type**

- **Detailed, repeatable study of any physiological and structural characteristic**

- **Unanticipated future work involving physical specimens**

- **None of these studies would require a measure of effort**

Is the goal to sample every population at every generation?

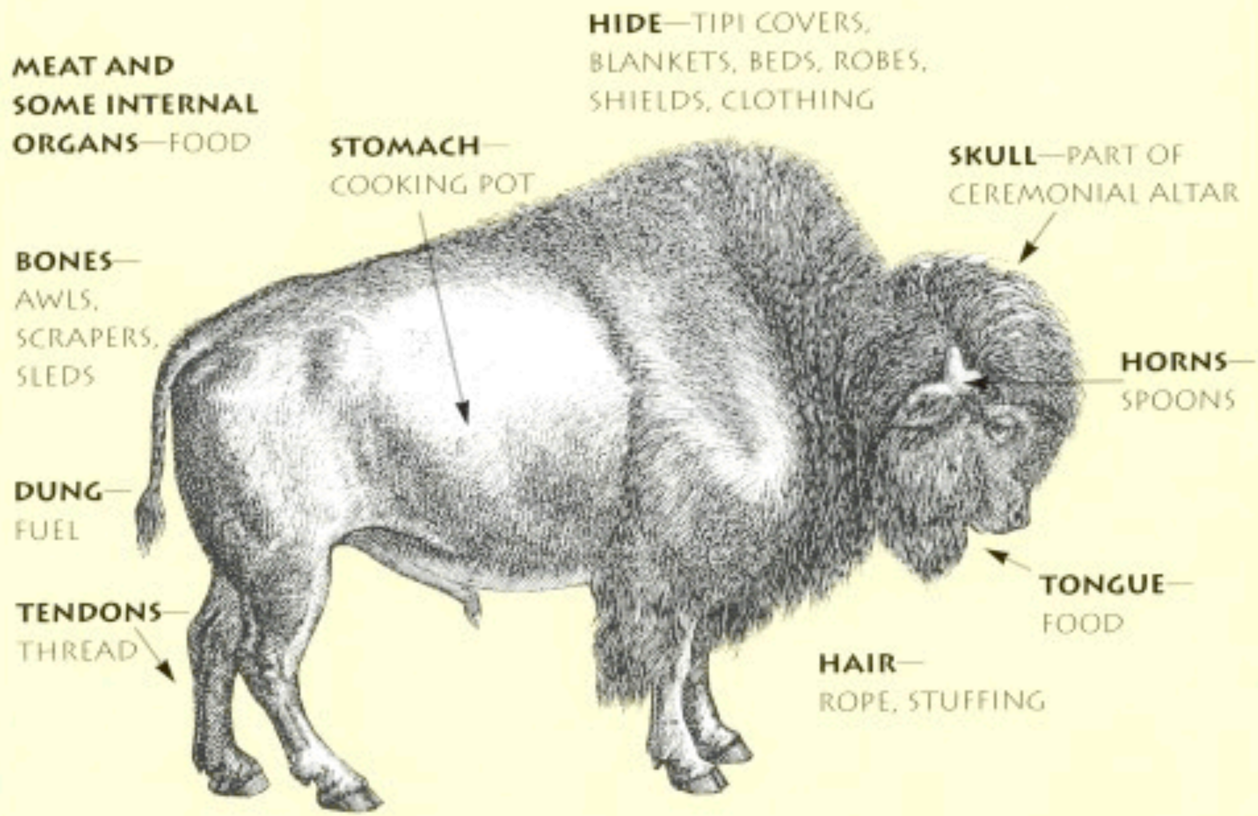


29 Field sites in Peru , 2007-2010

NO. Comprehensive collecting in space and time is impossible

USES OF THE BISON

Shown here are some of the many ways the Plains peoples made use of the bison.



How should we make the allocate our limited time?

(1) making more value from each buffalo

(2) collecting more buffalos (the herd is huge)

(3) worrying about how we cull the buffalo so that we sample them in an robotic, unbiased way in order that computer-based peoples of the future can model buffalo distributions with one fewer bad assumption

Birds track their Grinnellian niche through a century of climate change

Morgan W. Tingley[a,b,1], William B. Monahan[c], Steven R. Beissinger[a,b], and Craig Moritz[b,d]

Departments of [a]Environmental Science, Policy, and Management and [d]Integrative Biology, and [b]Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720; and [c]Audubon California, 4225 Hollis Street, Emeryville, CA 94608

Edited by David B. Wake, University of California, Berkeley, CA, and approved August 11, 2009 (received for review March 16, 2009)

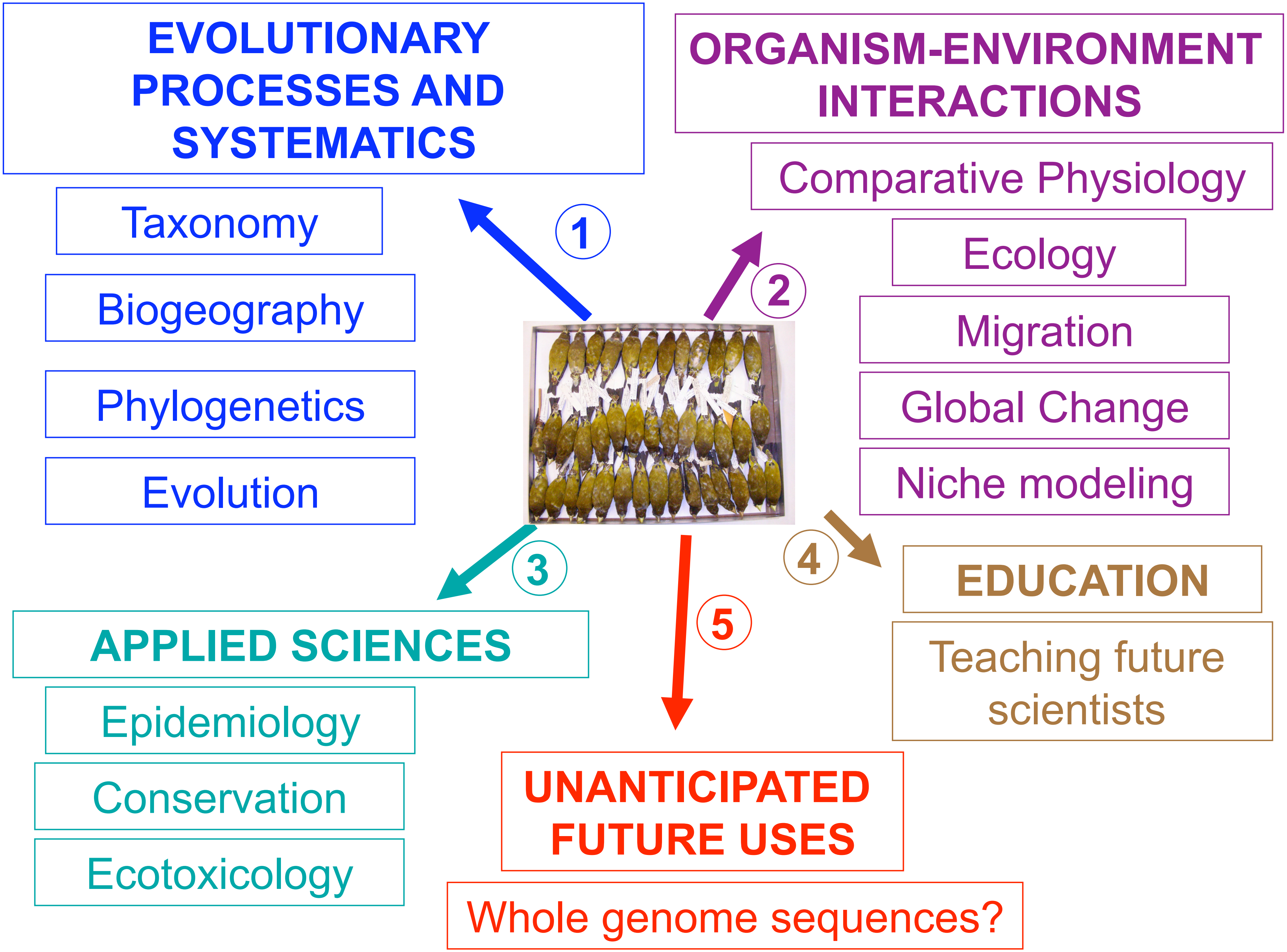
In the face of environmental change, species can evolve new physiological tolerances to cope with altered climatic conditions or

over the time scale of comparison, then species ranges should also move across the landscape as averages and extremes of

- Only "presence" data was derived from historical museum specimens… geo-referenced specimens were used for niche-modeling

Why are specimens important to science?

- **Same reasons they are a key component in inventory work**


EVOLUTIONARY PROCESSES AND SYSTEMATICS
Taxonomy
Biogeography
Phylogenetics
Evolution
1
ORGANISM-ENVIRONMENT INTERACTIONS
Comparative Physiology
Ecology
Migration
Global Change
Niche modeling
2
3
APPLIED SCIENCES
Epidemiology
Conservation
Ecotoxicology
4
EDUCATION
Teaching future scientists
5
UNANTICIPATED FUTURE USES
Whole genome sequences?