Using museum collections for undergrad research: The case of small universities

Noé de la Sancha

Chicago State University

The Field Museum of Natural History

Natural History's Place in Science and Society

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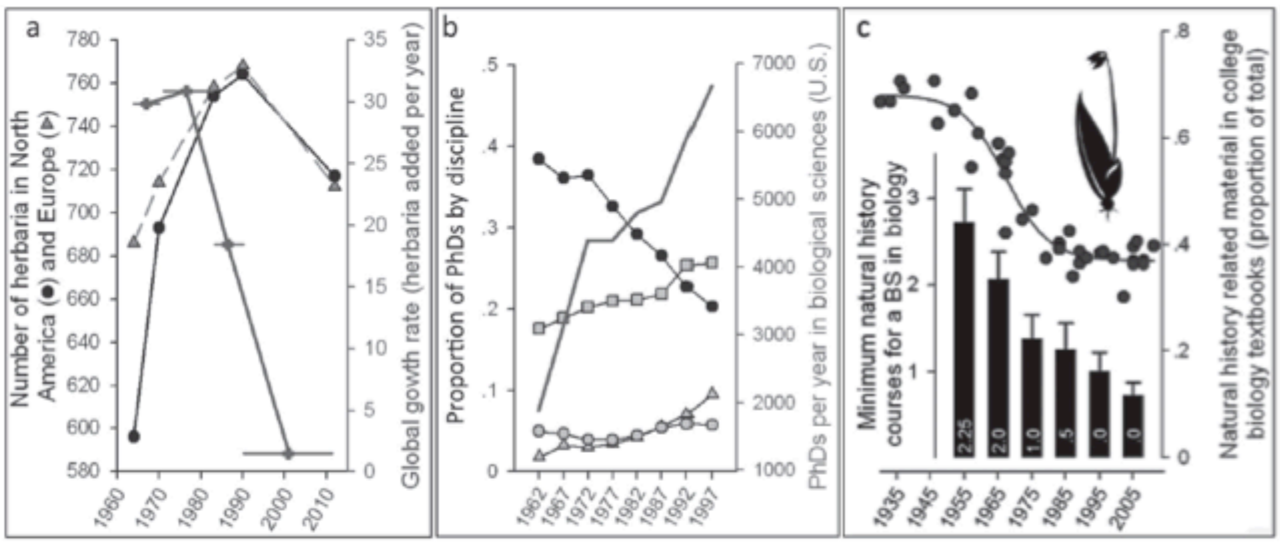


Figure 4. Declines in both access to and emphasis on natural history as illustrated through changes in (a) research collections, (b) graduate education, and (c) undergraduate education. (a) The number of registered herbaria in North America (the circles) and Europe (the triangles) and the global growth rate of herbaria (the solid line with barred circles, right axis) from the Index Herbariorum (Thiers 2014). The horizontal bars indicate the years over which each herbaria growth rate estimate was calculated. The consolidation of collections is also seen in vertebrate research collections (see the supplemental material). (b) The total number of PhDs in biology issued by US institutions from 1960 to 1995 (the line with no marked points) and the proportion of those PhDs granted in natural history–related disciplines (the solid circles), microbiology and molecular biology (the squares), biophysics and neurology (the triangles), and genetics (the gray circles). Source: The data are from Thurgood and colleagues (2006; see the supplemental material). (c) The minimum number of natural history–related courses required for a BS degree in biology in US institutions (the bars; the median is indicated within each bar) and the proportion of introductory biology texts devoted to natural history–related material (the circles, right axis; see the supplemental material). The error bars represent the (positive) standard error of the mean. Papercut art: Hannah Viano.

ECOLOGY

Avoiding (Re)extinction

Alternative methods of identification should be used to avoid collection of voucher specimens of threatened or rediscovered species.

Ben A. Minteer,[1] James P. Collins,[1] Karen E. Love,[1] Robert Puschendorf[2]

Field biologists have traditionally collected voucher specimens to confirm a species' existence. This practice continues to this day but can magnify the extinction risk for small and often isolated populations. The availability of adequate alternative methods of documentation, including high-resolution photography, audio recording, and nonlethal sampling, provide an opportunity to revisit and reconsider field collection practices and policies.

Cases such as the extinction of the great auk remind us what is at stake in taking animals from small and declining populations. The last wild great auk (*Pinguinus impennis*) was sighted in 1844 on Eldey Island, Iceland. Centuries of exploitation for food and feathers, and, to some degree, a changing climate, had stressed the species, but overzealous museum collectors also played a role in its extinction (*1*). As the bird's numbers dwindled in the 19th century, ornithologists and curators increasingly prized great auk skins and eggs, with museums and universities sending out collection parties to procure specimens. On Eldey, fishermen

LETTERS

Edited by *Jennifer Sills*

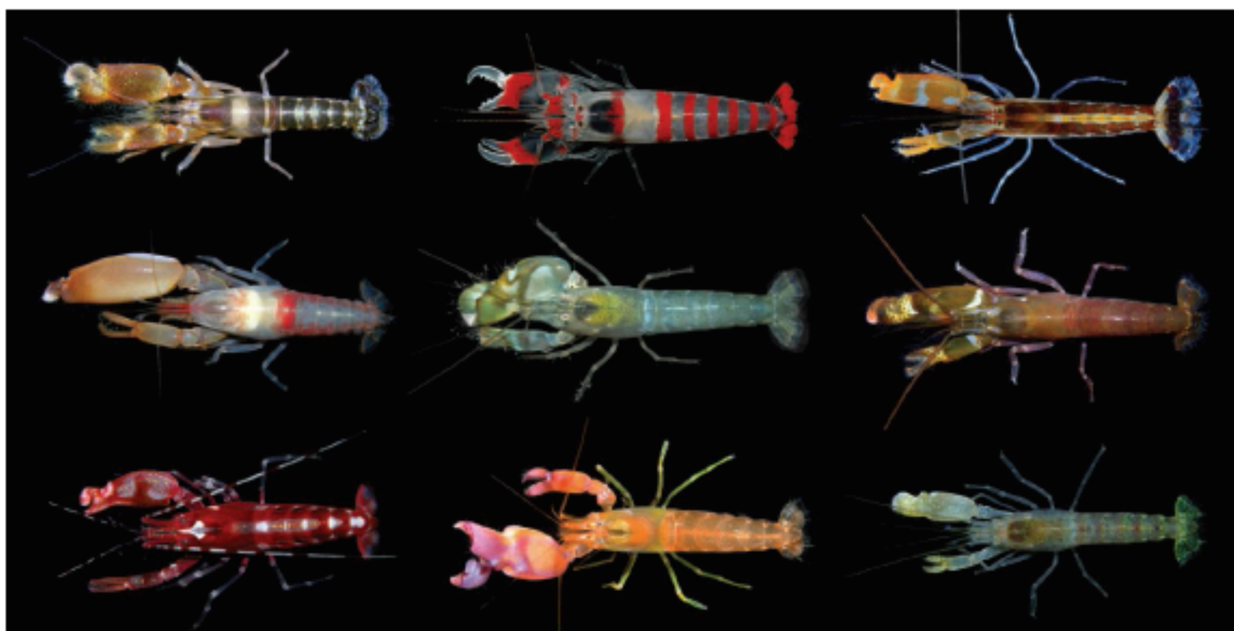
Specimen collection: An essential tool

COLLECTING BIOLOGICAL specimens for scientific studies came under scrutiny when B. A. Minteer *et al.* ["Avoiding (re)extinction," Perspectives, 18 April, p. 260] suggested that this practice plays a significant role in species extinctions. Based on a small number of examples (rare birds, frogs, and a few plants), the authors concluded that collection of voucher specimens is potentially harmful to many species, and that alternatives—photographs, audio recordings and nonlethal tissue sampling for DNA analysis—are sufficient to document biological diversity.

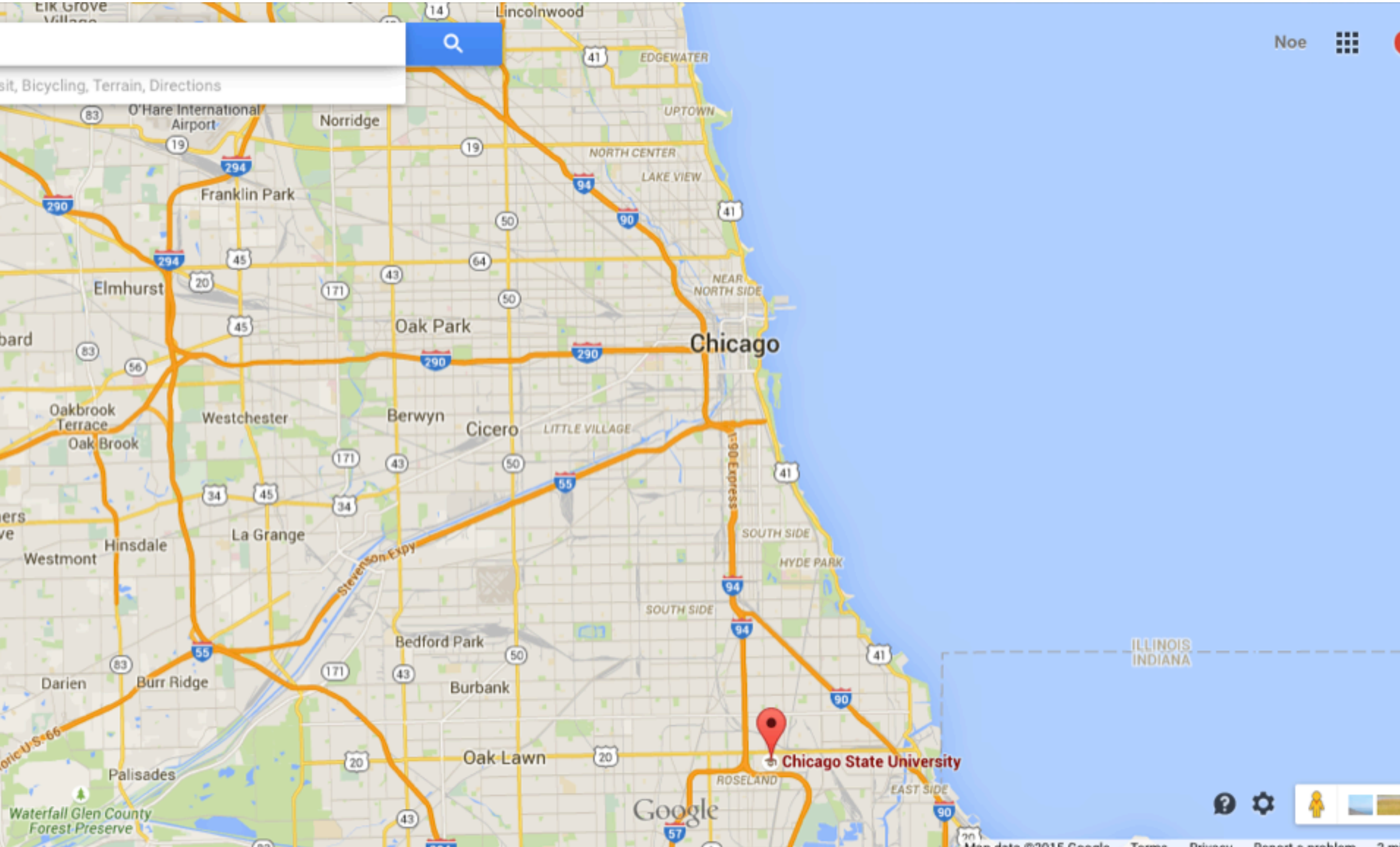
The isolated examples that Minteer *et al.* cited to demonstrate the negative impact of scientific collecting have been carefully analyzed, and none of these extinction events can be attributed to that cause (*1*–*3*). For example, only about 102 Great Auk specimens (*Pinguinus impennis*) exist today in scientific collections, many of

biodiversity is hidden deep in its habitat (see image)]. Moreover, identification is often not the most important reason to collect voucher specimens. Studies of morphological diversity and its evolution are impossible without whole specimens. Preserved specimens also provide verifiable data points for monitoring species health, distribution, and phenotypes through time. Both historical and new collections played a key role in understanding the spread of the chytrid fungus infection, one of the greatest current threats to amphibians (*5*). The decision to ban dichlorodiphenyltrichloroethane (DDT)

distract from the primary causes of modern extinction: habitat degradation and loss, unsustainable harvesting, and invasive species (*10*). It is important to distinguish protecting the lives of individuals from conserving populations and species. Individuals are lost every day to predation, natural death, and anthropogenic factors, hence it is the populations we try to save. Halting collection of voucher specimens by scientists would be detrimental not only to our understanding of Earth's diverse biota and its biological processes, but also for conservation and management efforts. Species descriptions, biodiversity



Undercover. Many Alpheidae shrimps live deep in the reef and are impossible to collect nonlethally.


Noe
Lincolnwood
EDGEWATER
UPTOWN
NORTH CENTER
LAKE VIEW
O'Hare International Airport
Norridge
Franklin Park
Elmhurst
Oak Park
NEAR NORTH SIDE
Chicago
Oakbrook Terrace
Oak Brook
Westchester
Berwyn
Cicero
LITTLE VILLAGE
I-90 Express
La Grange
Hinsdale
Westmont
Stevenson Expy
SOUTH SIDE
HYDE PARK
SOUTH SIDE
Bedford Park
Burbank
Darien
Burr Ridge
ILLINOIS
INDIANA
Oak Lawn
Chicago State University
ROSELAND
EAST SIDE
Palisades
Waterfall Glen County Forest Preserve
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Map data ©2015 Google
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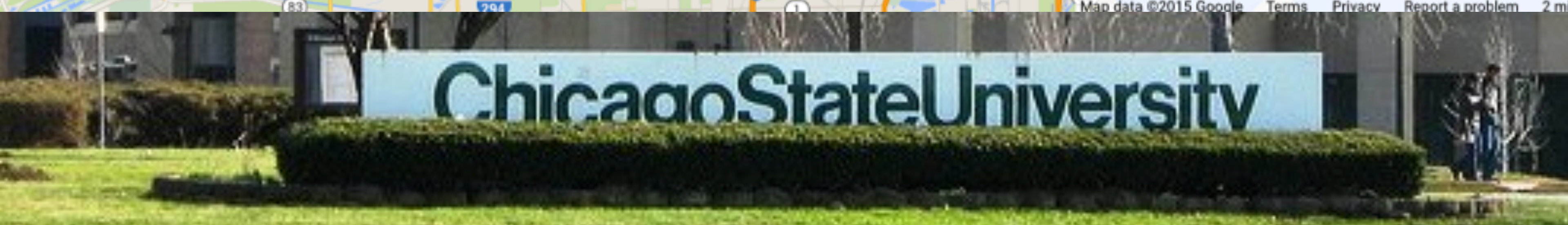
Report a problem

ChicagoStateUniversity

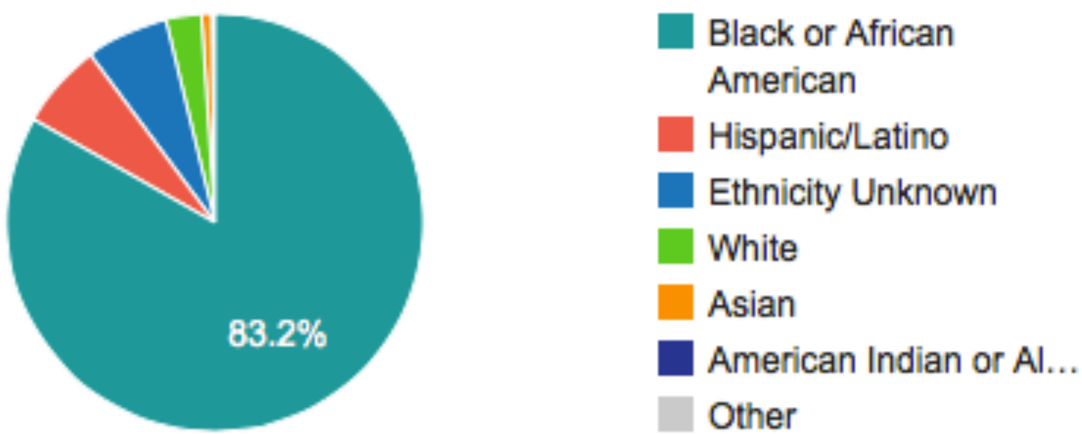
CHICAGO STATE UNIVERSITY

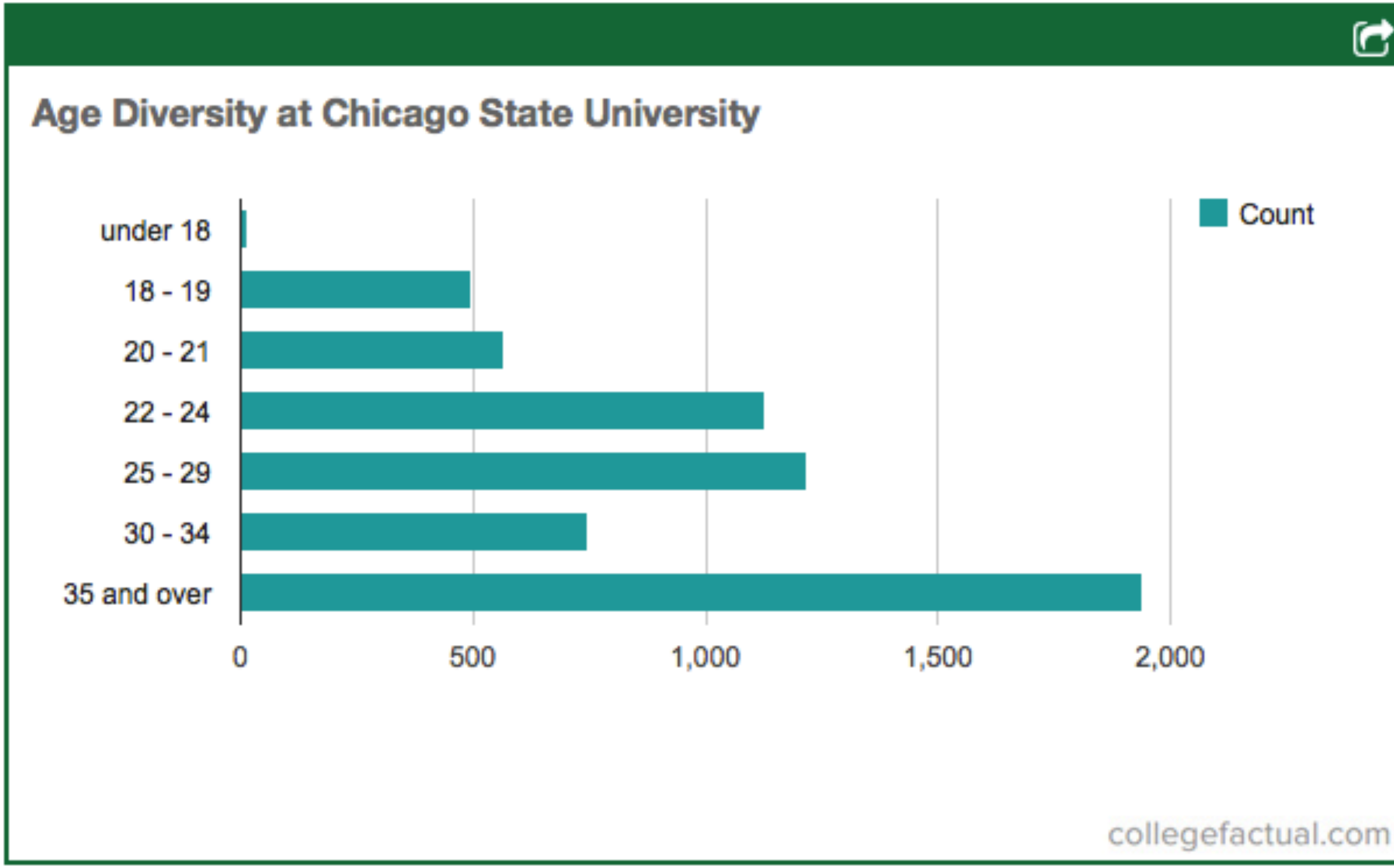
- ~ 7,000 students on campus, about 2/3 from the metropolitan area
- ~ 71% of our student are women.
- High proportion are first generation University students.
- High proportion non- traditional students 25+
- Primary $ winner in their house hold ect.
- Pre-med, Pharmacy, and Nursing programs.

Ethnic Diversity at Chicago State University

Undergraduate | Faculty

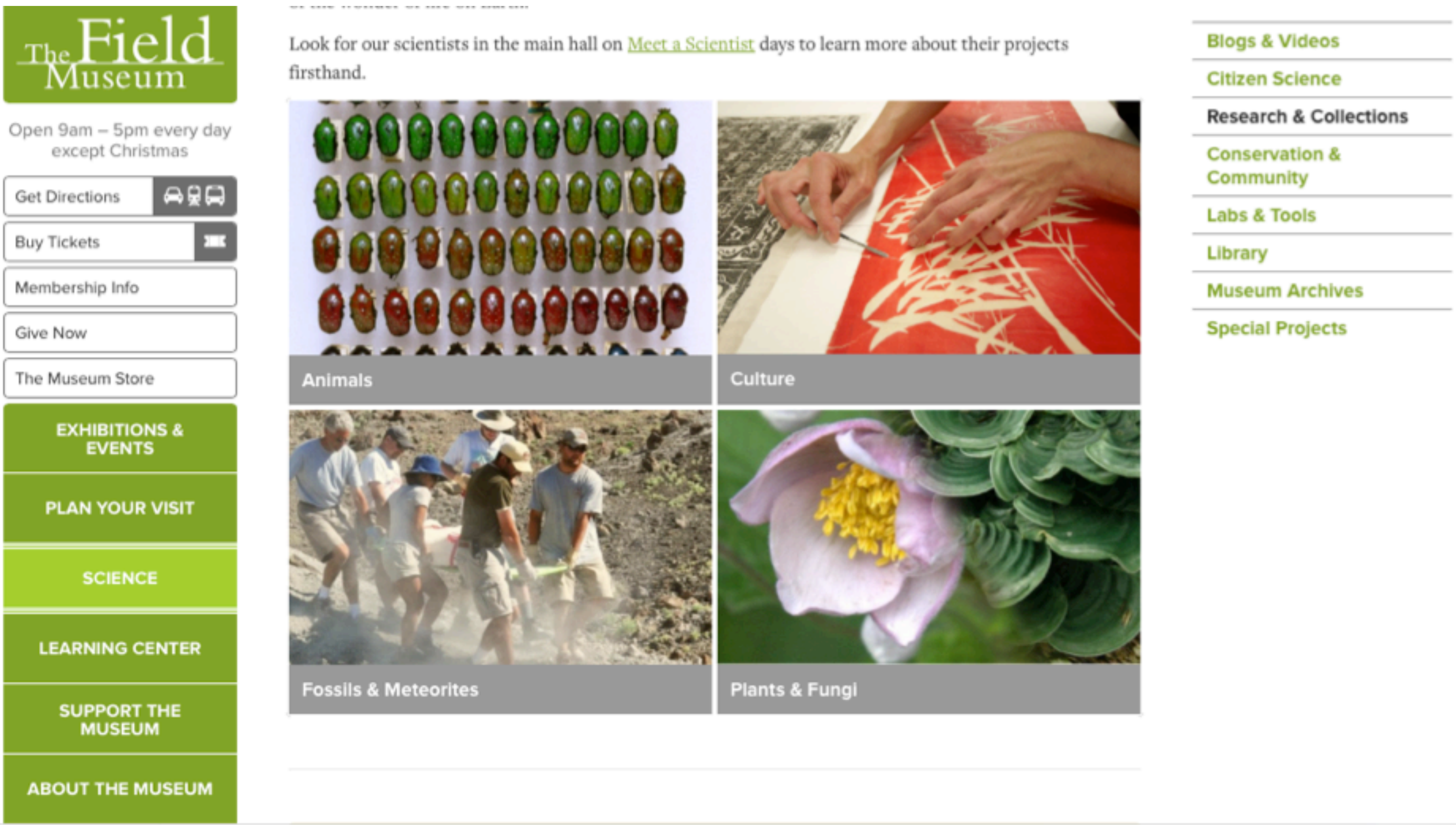
Chicago State University's ethnic diversity is below the national average.



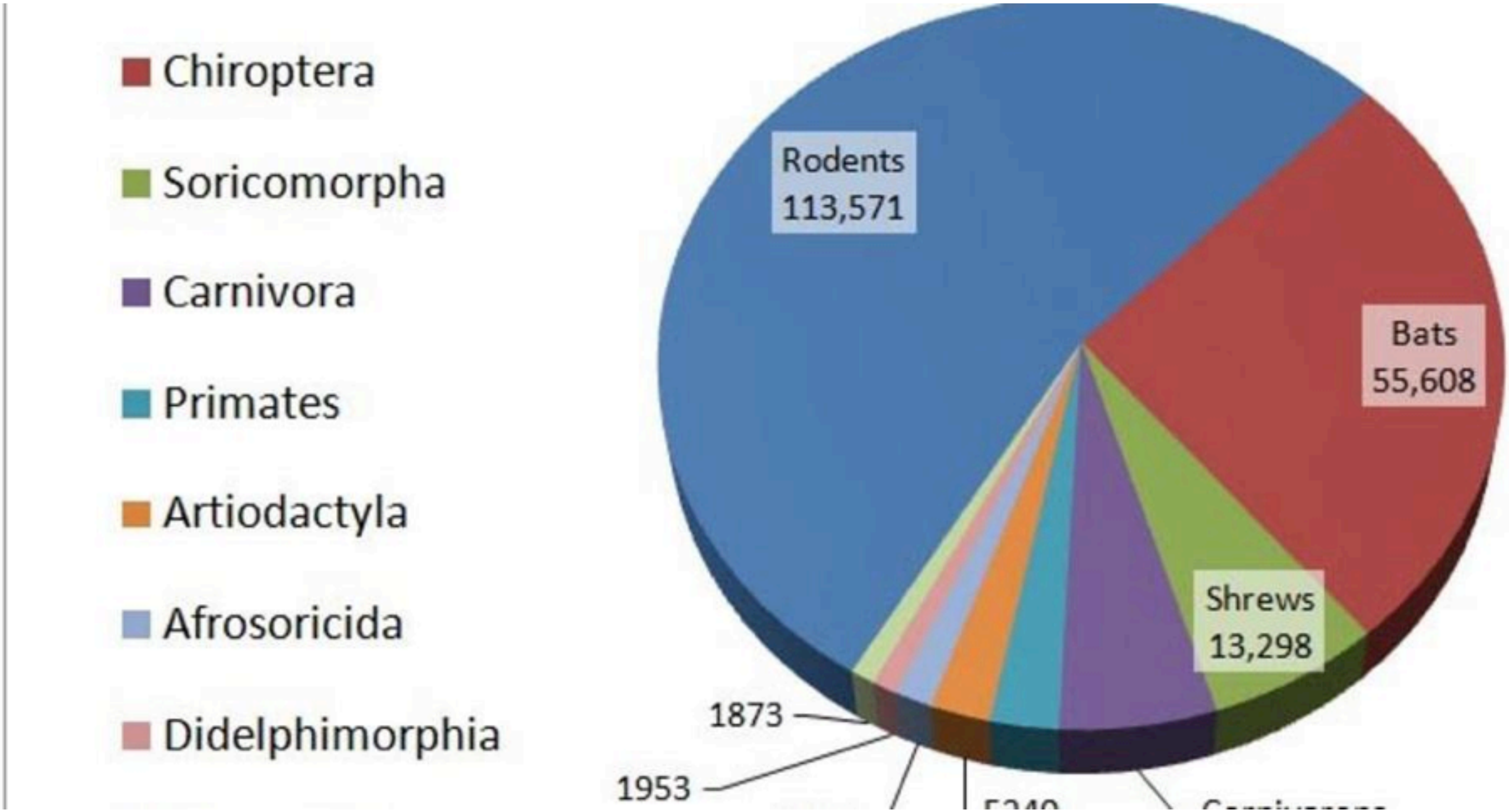


Age Diversity at Chicago State University
Count
under 18
18 - 19
20 - 21
22 - 24
25 - 29
30 - 34
35 and over
0
500
1,000
1,500
2,000
collegefactual.com

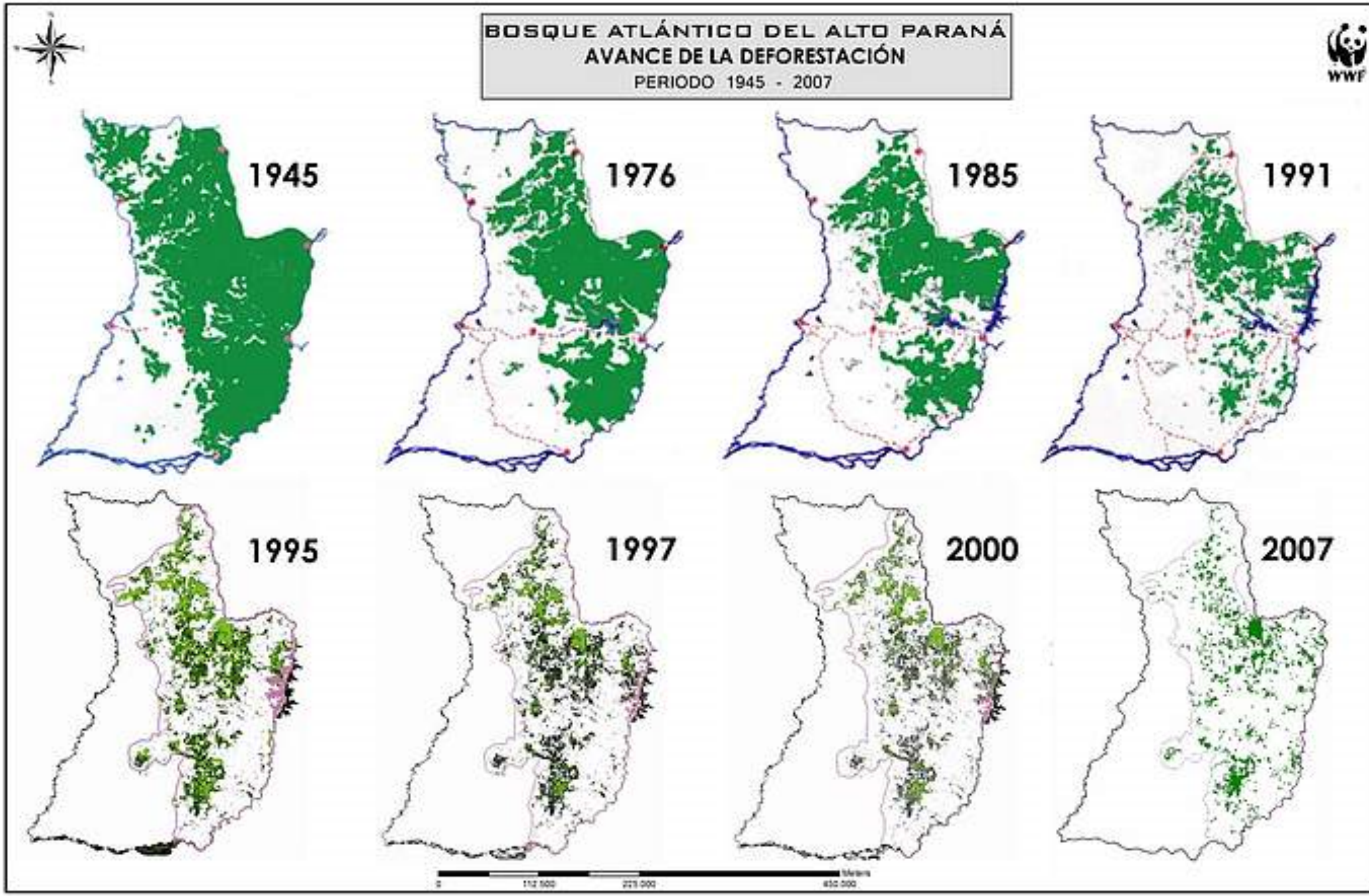

The
Field
Museum

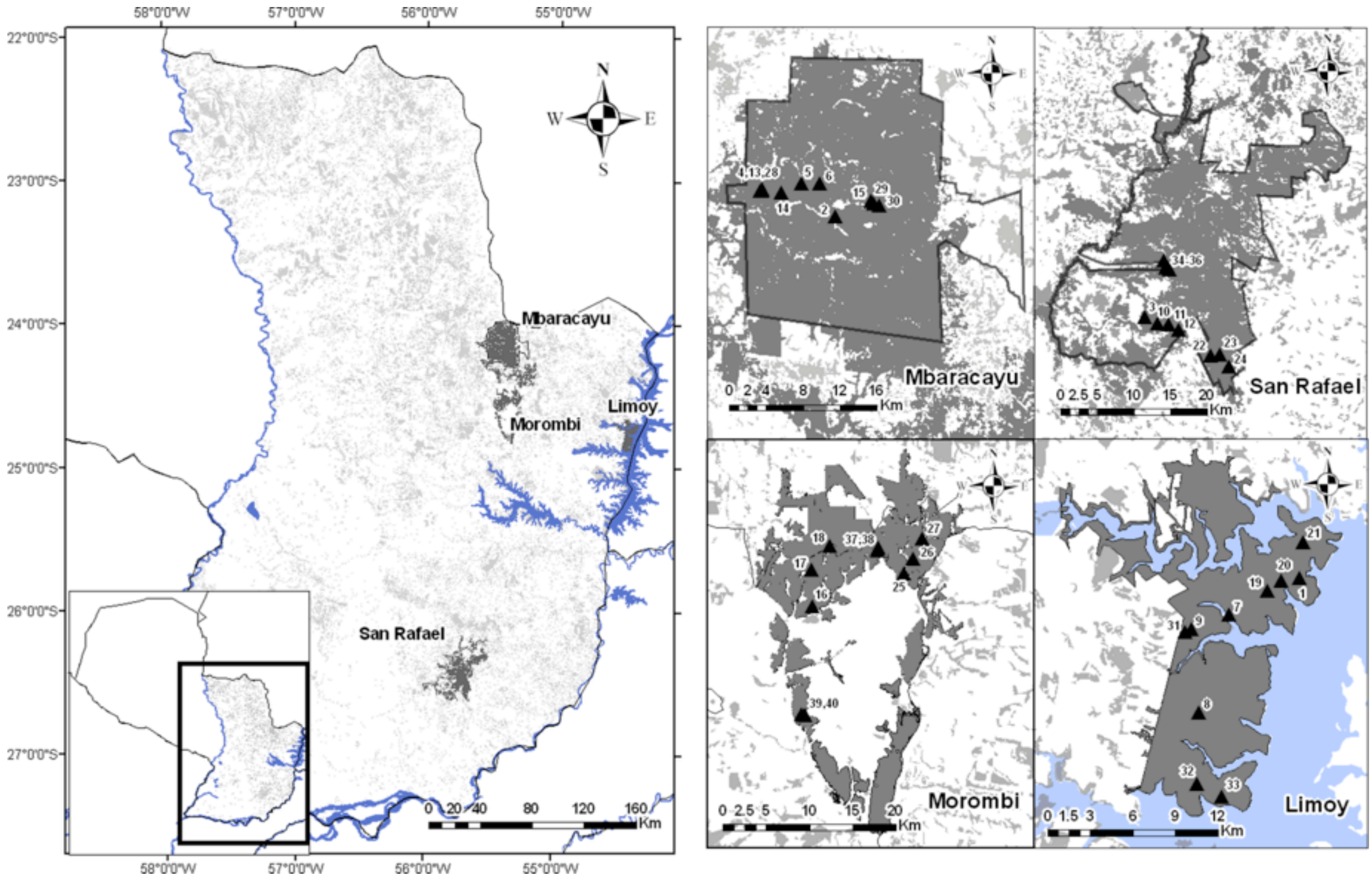


Arthropods- 4.1 million pinned insects and 8 million specimens
Birds- 500,000+ specimens
Fish- 1.7 million cataloged and uncataloged specimens in approximately 130,000 lots
Mollusca with more than 328,000 cataloged lots
Non-mollusk invertebrates are represented by ca. 14,500 cataloged lots
Mammals- 209,000+ specimens



Chiroptera
Soricomorpha
Carnivora
Primates
Artiodactyla
Afrosoricida
Didelphimorphia
Rodents
113,571
Bats
55,608
Shrews
13,298
1873
1953


BOSQUE ATLÁNTICO DEL ALTO PARANÁ
AVANCE DE LA DEFORESTACIÓN
PERIODO 1945 - 2007
WWF
1945
1976
1985
1991
1995
1997
2000
2007



Shapefile created by Oscar Rodas de Guyra Paraguay with Landsat of 2008.

Species Identification

- Morphology

eg. *Akodon*

DESCRIPTION OF A NEW SPECIES OF *AKODON* (RODENTIA: SIGMODONTINAE) FROM SOUTHERN BRAZIL

Alexandre U. Christoff,* Valéria Fagundes, Ives J. Sbalqueiro, Margarete S. Mattevi, and Yatiyo Yonenaga-Yassuda

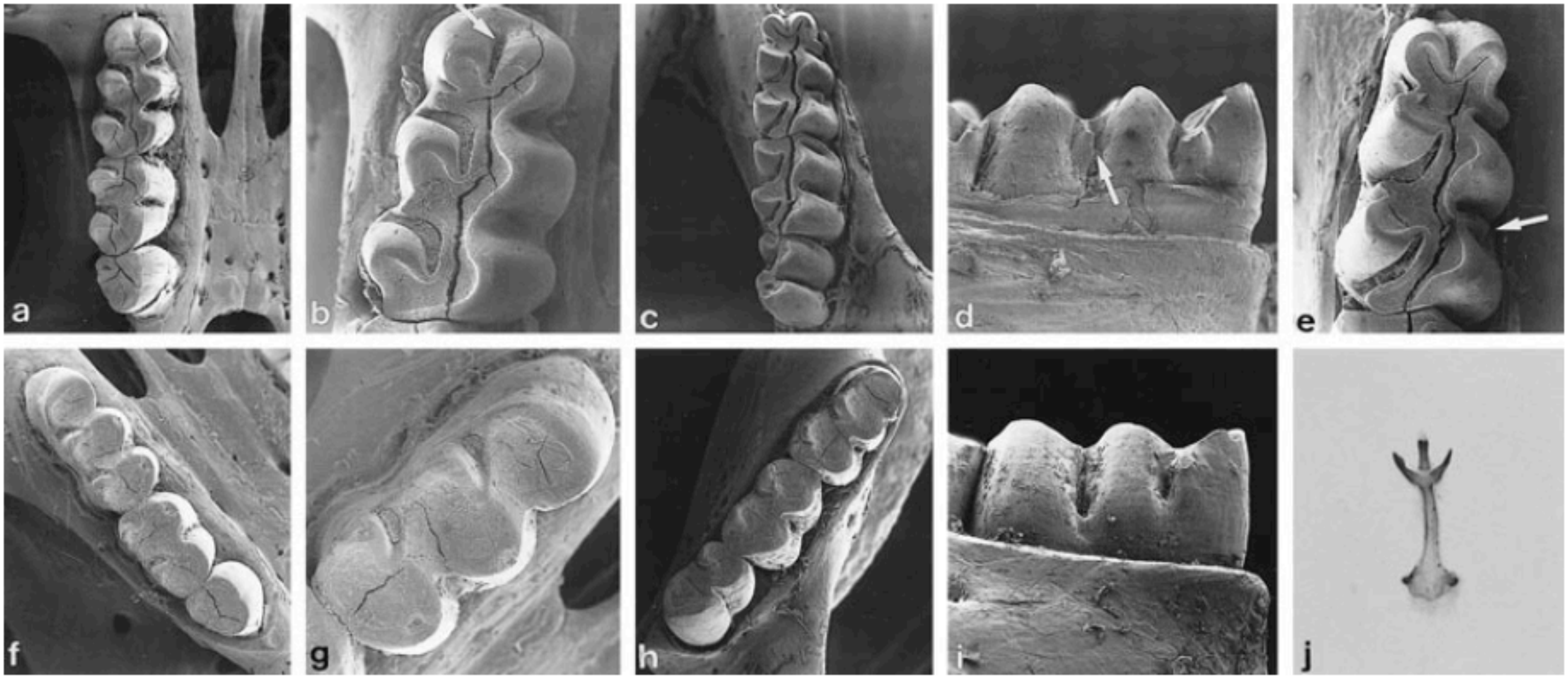


Fig. 1.—Dentition in *Akodon*. a–e) *A. paranaensis* (MZUSP 29124 and MZUSP 29125). f–i) *A. serrensis* (original number AC358). Upper tooth row (a and f); 1st right upper molar (b and g); lower tooth row (c and h); 1st right lower molar in lateral view (d and i); 1st right lower molar (e). Arrow points to anteromedian flexus (a and b)/flexid (c and e) and the ectolophid (d and e). j) Baculum of *A. paranaensis* with tridigital distal portion.

Journal of Mammalogy, 81(3):838–851, 2000

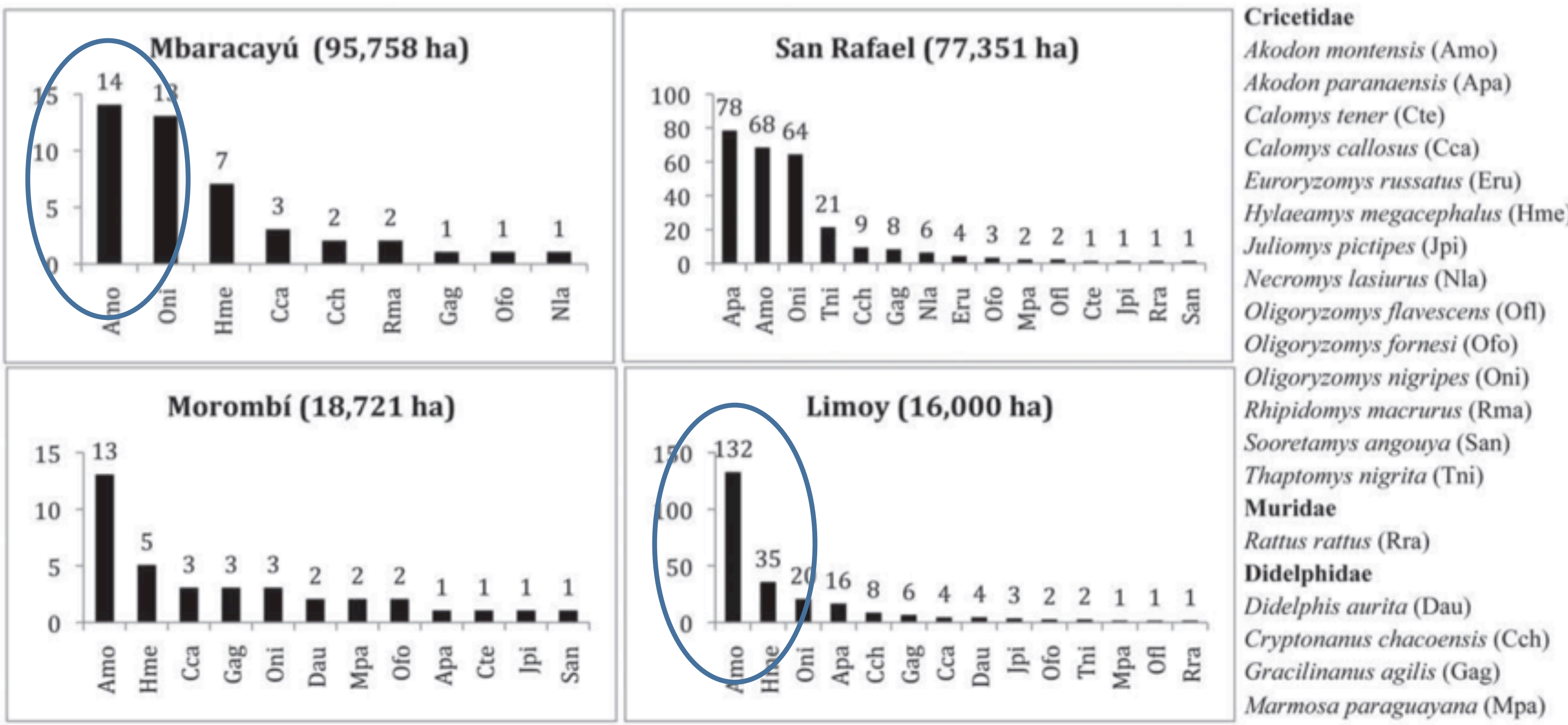
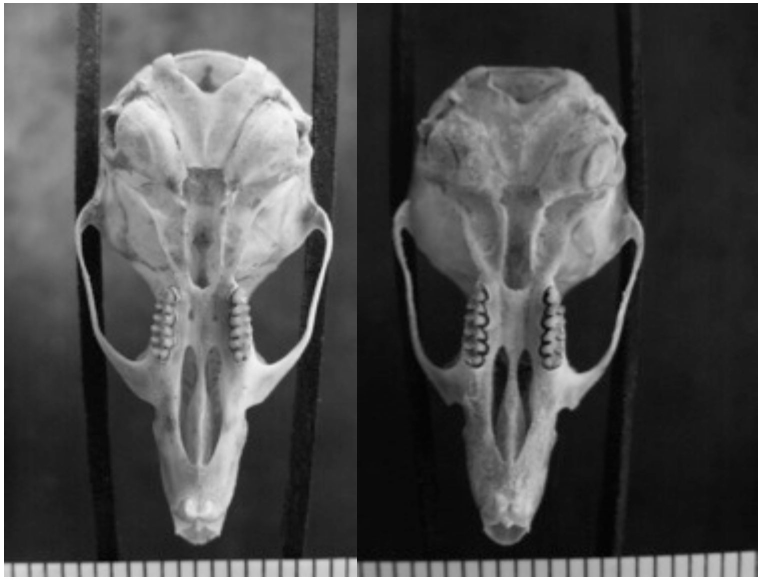


Figure 3 Abundance plots for each of the Paraguayan reserves, indicating the number of individuals per species captured.

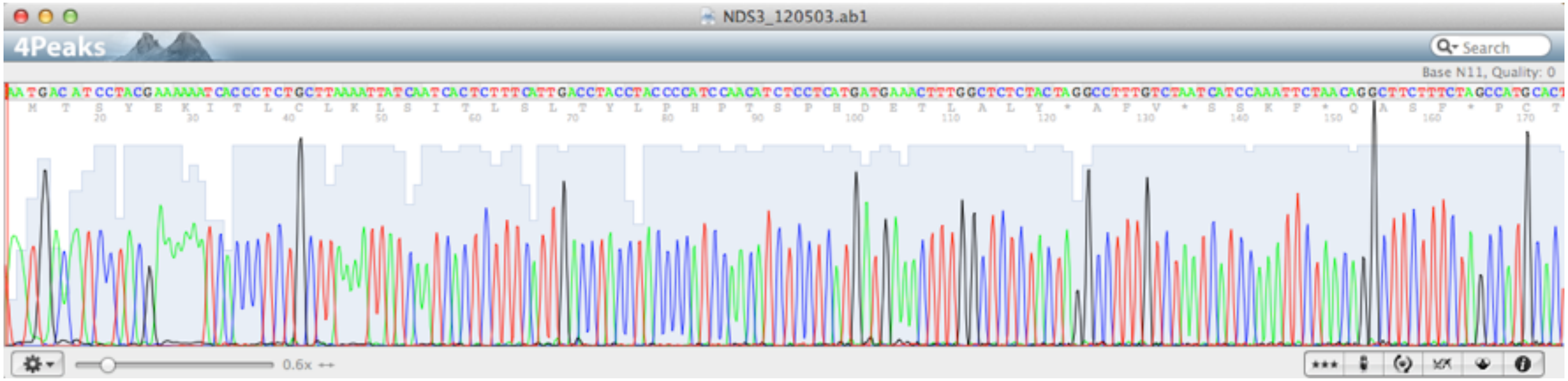
Species Identification

- Morphology

eg. *Akodon*

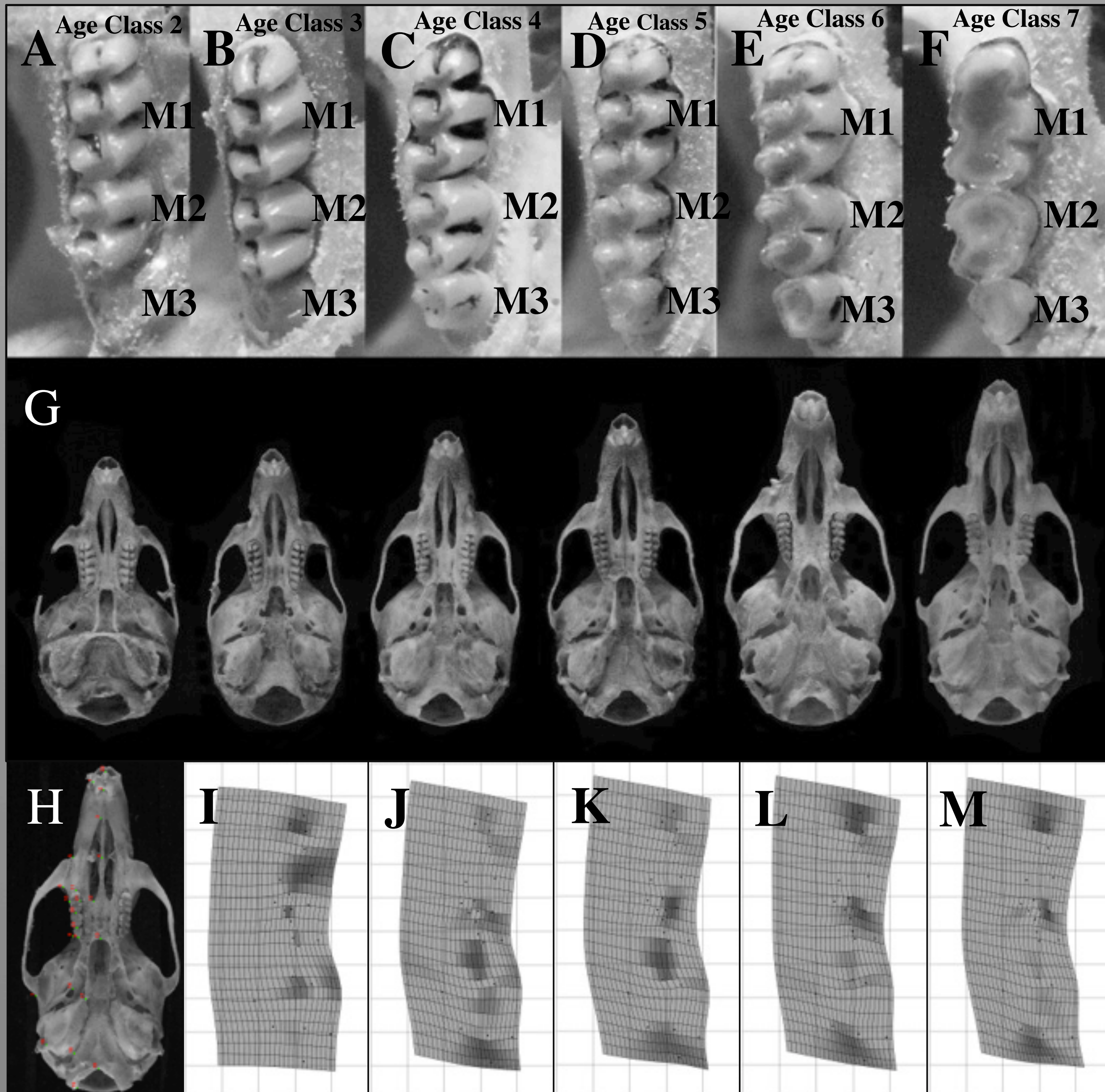


- Cytochrome *b* gene ~ 800 pb




DANIEL F. AND ADA L. RICE
DNA DISCOVERY CENTER
What is DNA?
ng on right here, right n
STEP 2 EXTRACT
STEP 3 AMPLIFY
DNA analysis is going on
ght here, right now
"DNA" stands for "deoxyribonucleic acid"


- Digitizing of specimens which will return to Paraguay.
- Ontogenetic variation.
- Species identification.
- Morphometrics.
- Citizen Science.



A
Age Class 2
B
Age Class 3
C
Age Class 4
D
Age Class 5
E
Age Class 6
F
Age Class 7
M1
M2
M3
G
H
I
J
K
L
M

Linear morphometrics

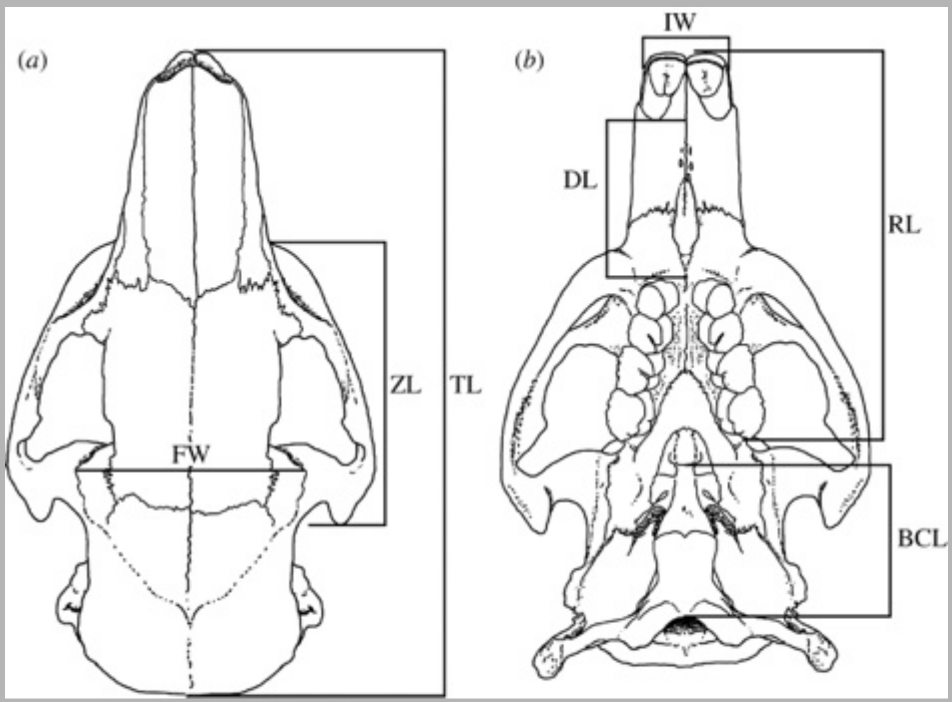


Image retrieved from The Royal Society publishing 4/14/15 <http://rspb.royalsocietypublishing.org/content/275/1637/923>

- Characters are often mixed.
- Redundant endpoints lead propagation errors.
- Reliability of caliper readings is difficult to check without repeated measurements (Strauss).
- Experience/skill of researchers in making measurements.

Geometric morphometrics

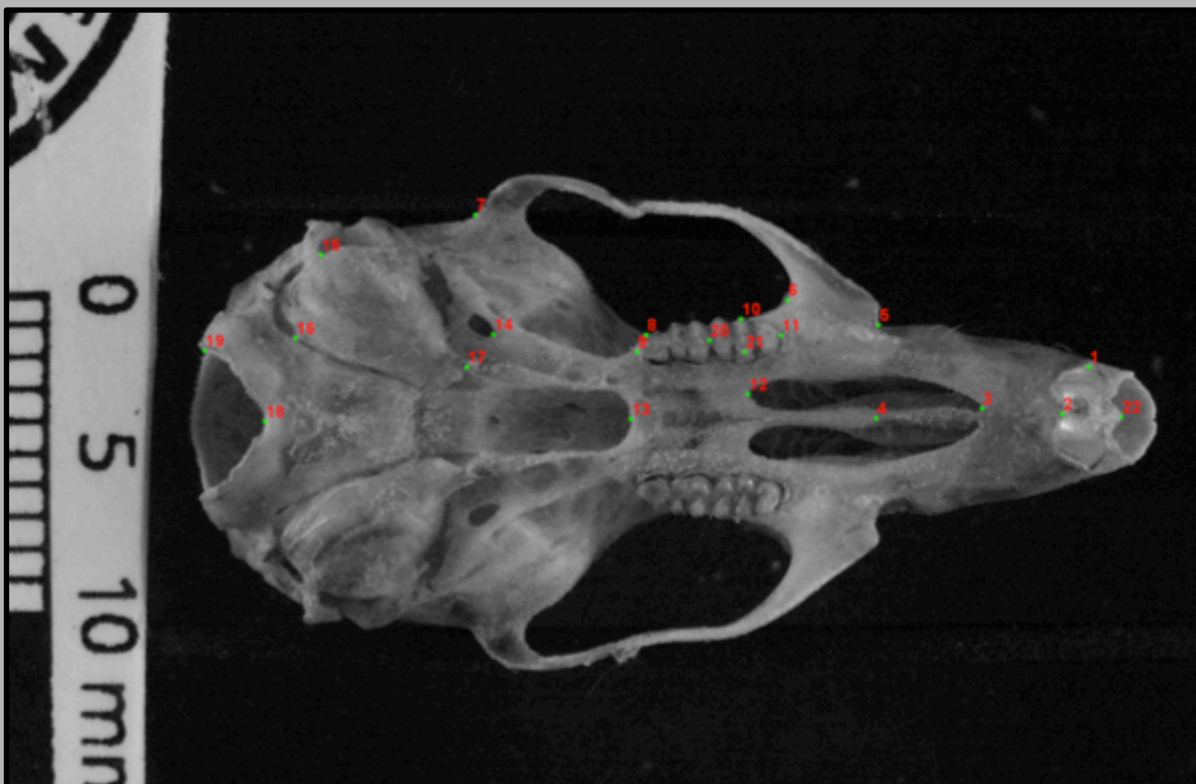
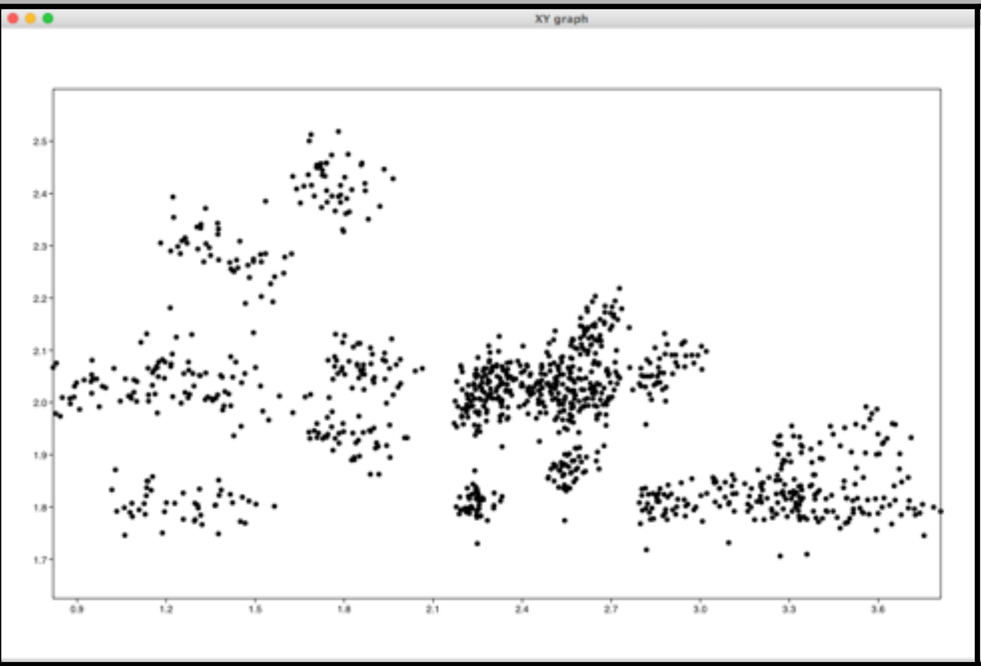


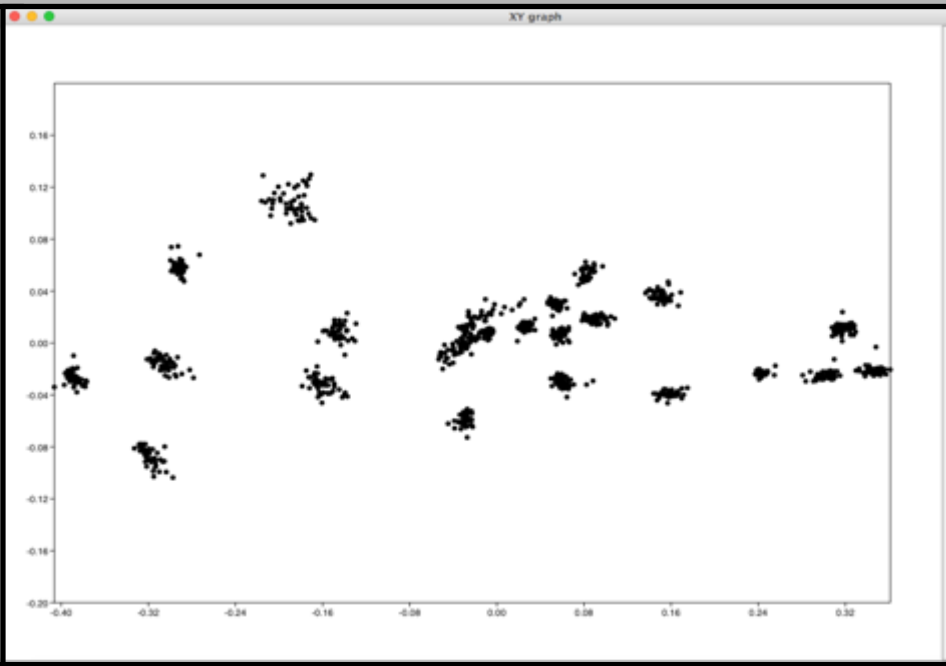
Image of *A. montensis* taken by Gabriel Hernandez at the Field Museum of Natural History.

- Uses coordinates of landmarks as to quantify and analyze shape.
- Places emphasis of homology on the landmarks rather than characters. (Strauss)
- Geometric morphometrics is more precise and less influenced by factors affecting measurement errors (Muñoz & Perpiñán 2010).

Digitizing Image & Introduction of Landmarks

Procrustes Transformation



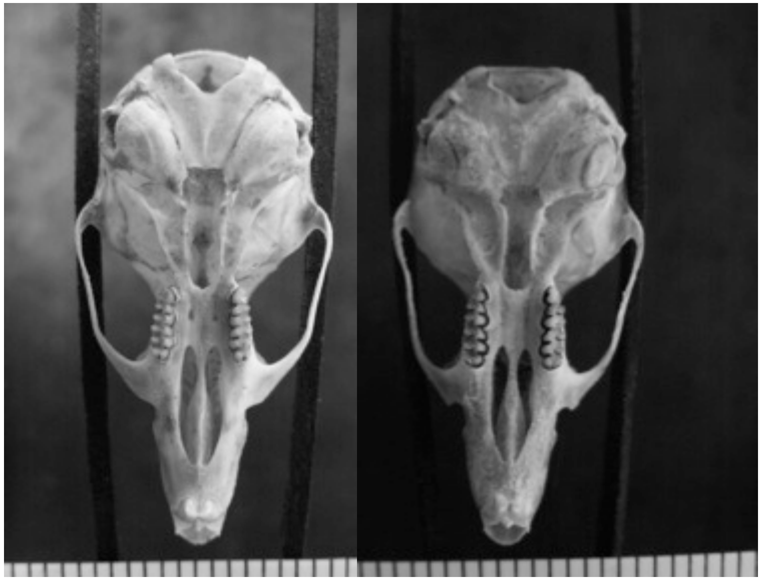


Images of untransformed data set (Left), transformed (right).

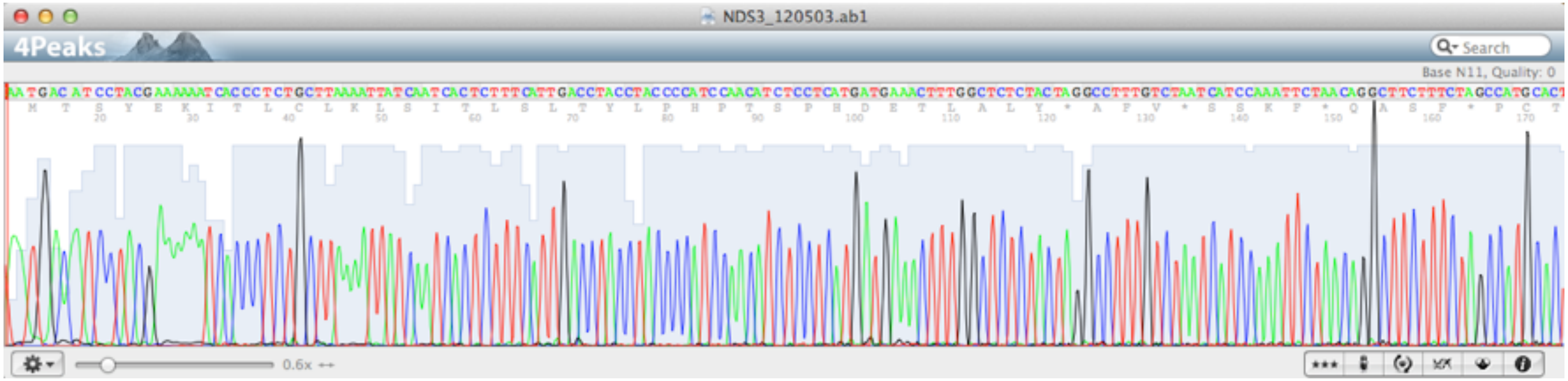
Species Identification

- Morphology

eg. *Akodon*



- Cytochrome *b* gene ~ 800 pb



Nuestras Aves 59: 24-27, 2014

PRESAS DEL BÚHO CAMPESTRE (*Asio flammeus*) EN UN AGROECOSISTEMA SUBTROPICAL DE PARAGUAY

Julio C. Torres[1], *Pablo Teta*[2] y *Noé U. de la Sancha*[3,4]

	Peso	N	N%	B%
MAMMALIA				
DIDELPHIMORPHIA				
Gracilinanus cf. *G. agilis*	27	11	5.0	3.8
CHIROPTERA				
Cynomops cf. *C. abrasus*	33	3	1.4	1.3
Chiroptera indet.	33	2	0.9	0.8
RODENTIA				
Akodon cf. *A. azarae*	28	109	49.8	38.9
Calomys spp.	30.9	71	32.4	28.0
Holochilus brasiliensis	326	2	0.9	8.3
Necromys lasiurus	35.4	22	10.0	9.9
Oligoryzomys spp.	17.6	9	4.1	2.0
Oxymycterus cf. *O. delator*	81.5	2	0.9	2.1
Rattus sp.	160	2	0.9	4.1
AVES				
Passeriformes	31	2	0.9	0.8

dad Nacional de Asunción, San Lorenzo, Paraguay, Casilla de
mystorres@gmail.com
ngel Gallardo 470, (C1405DJR) Buenos Aires, Argentina.
l S. King Drive, Chicago, IL 60628, USA.
00 S. Lake Shore Dr., Chicago, IL 60605, USA

iados en el hemisferio norte (Marks et al. 1999). Para ica del Sur existe muy poca información sobre su proveniente de muestreos puntuales (e.g., Cirignoli 2001), de cobertura estacional (e.g., Martínez et al. y/o con énfasis en un determinado tipo de presas

Chapter 4
Discriminating Groups of Organisms

Richard E. Strauss

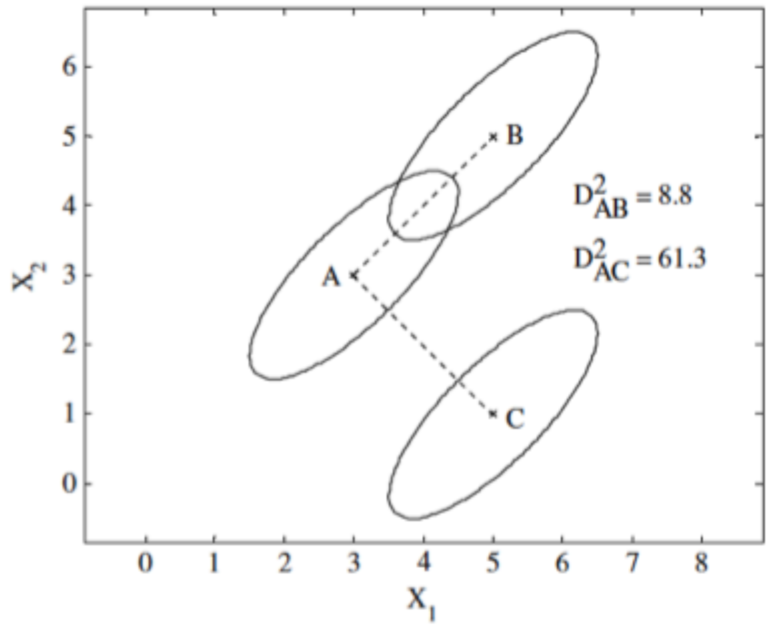


Fig. 4.5 Mahalanobis distances between centroids of groups. Variation within groups is indicated by 95% confidence ellipses for the data. Euclidean distances between centroids of A and B and of A and C are both 2.83. Corresponding Mahalanobis distances are indicated on plot

R.E. Strauss (✉)
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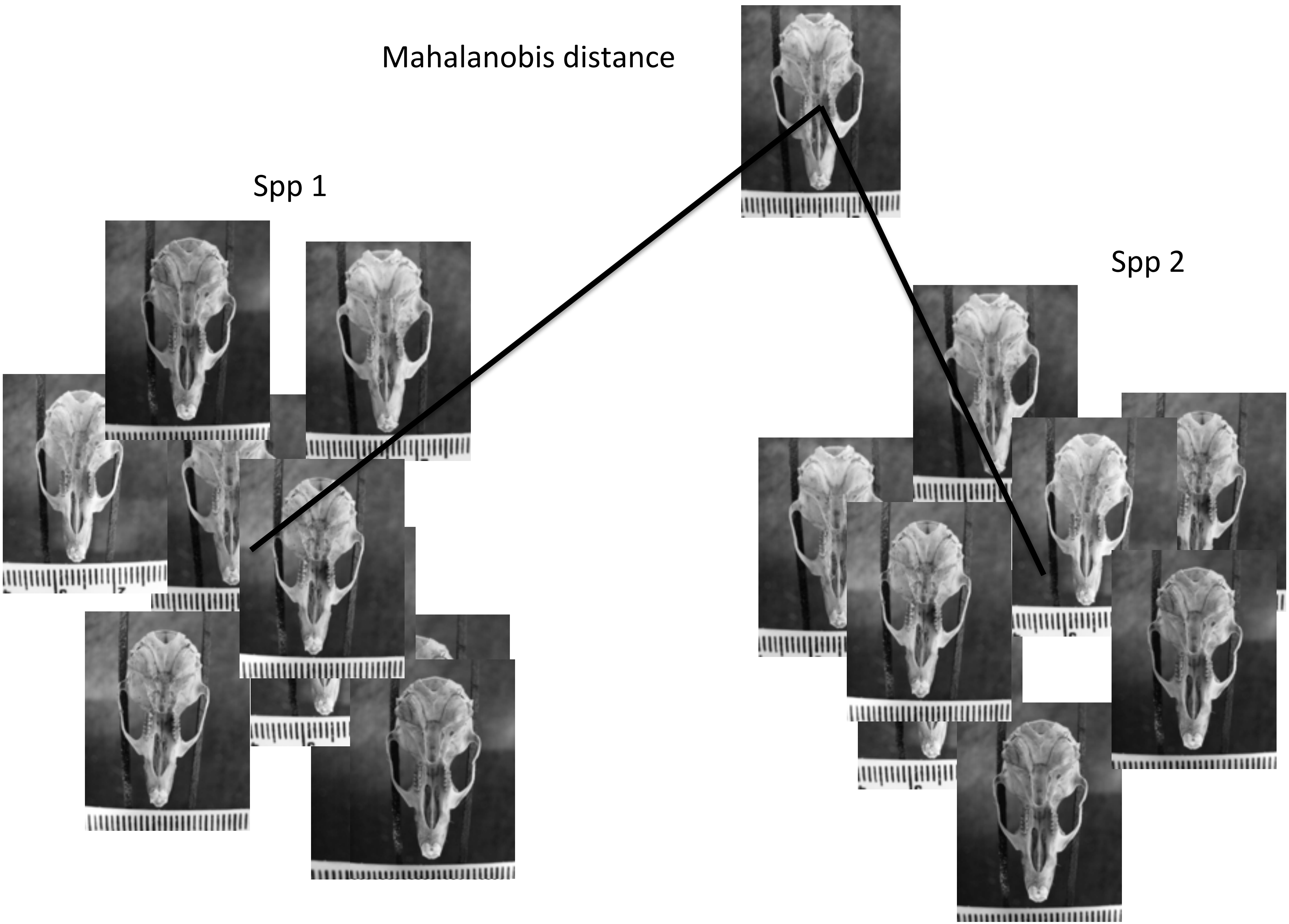
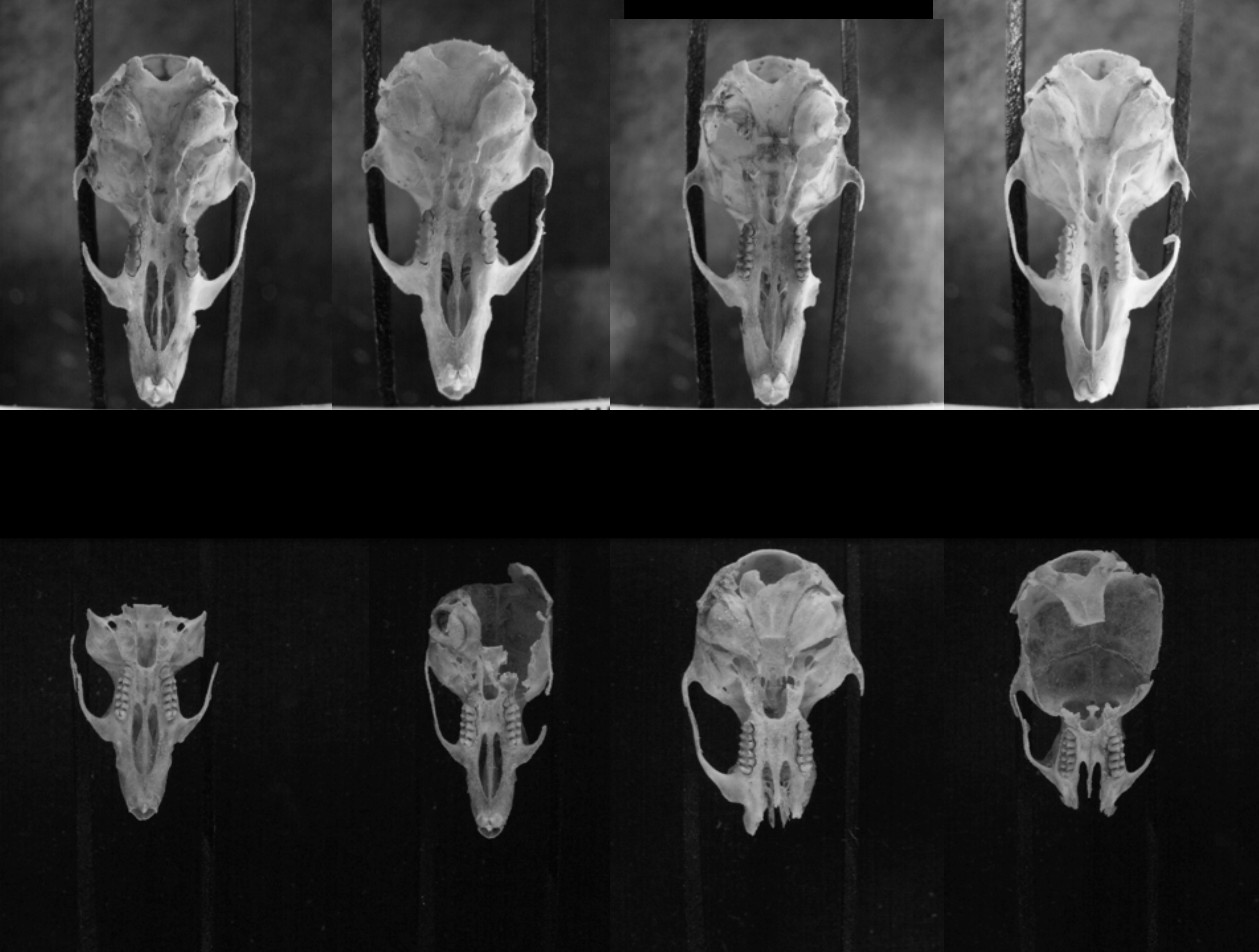
e-mail: Rich.Strauss@ttu.edu

A.M.T. Elewa (ed.), *Morphometrics for Nonmorphometricians*, Lecture Notes in Earth Sciences 124, DOI 10.1007/978-3-540-95853-6_4,


Mahalanobis distance
Spp 1
Spp 2



Biological Journal of the Linnean Society, 2006, 88, 309–328. With 10 figures

Determining best complete subsets of specimens and characters for multivariate morphometric studies in the presence of large amounts of missing data

RICHARD E. STRAUSS* and MOMCHIL N. ATANASSOV

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Received 2 April 2004; accepted for publication 18 April 2006

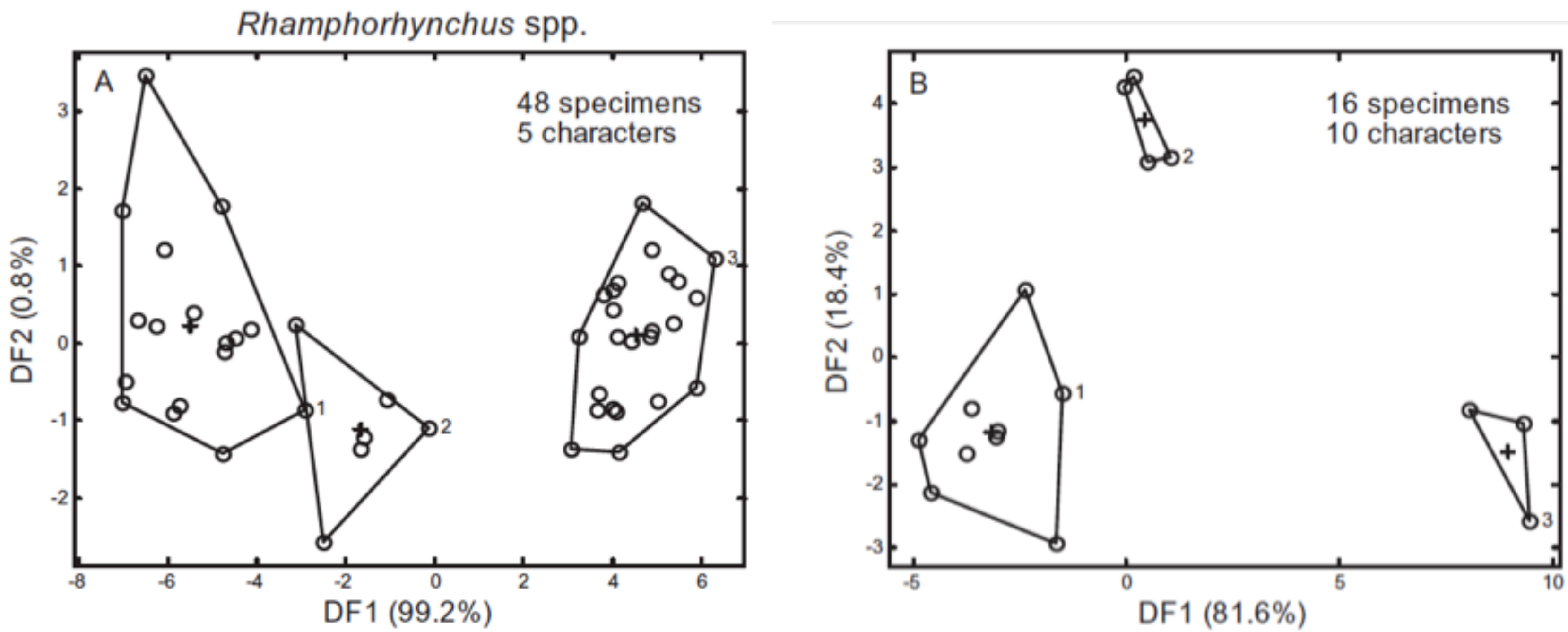

Figure 2. Discriminant analyses among species of *Rhamphorhynchus* based on two different complete submatrices of data. Species 1, *Rhamphorhynchus longicaudus*; 2, *Rhamphorhynchus intermedius*; 3, *Rhamphorhynchus muensteri*. A, discriminant function analysis (DFA) based on 48 specimens and five characters. B, DFA based on 16 specimens and 10 characters.

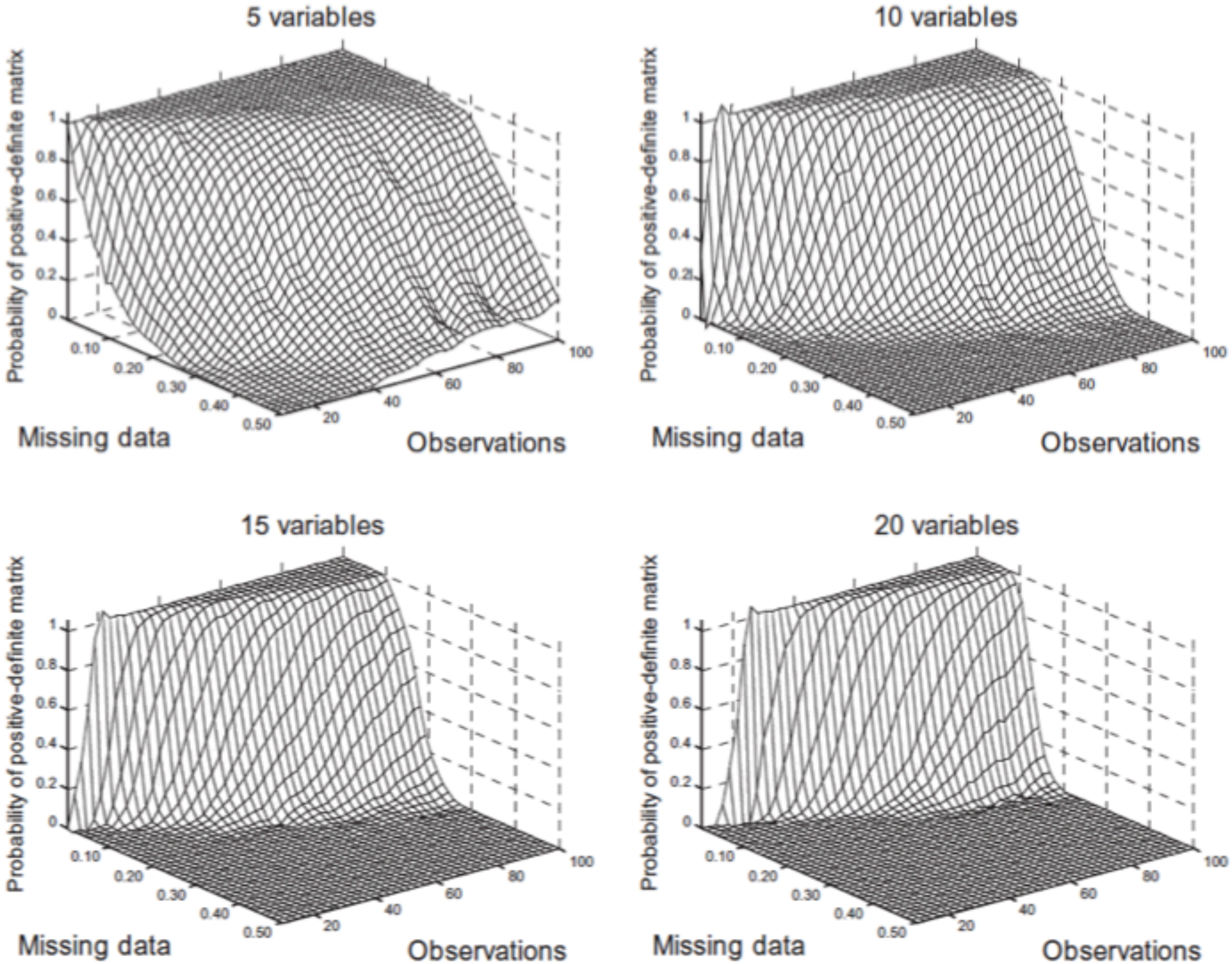

Figure 4. The estimated probability of a sample covariance matrix being positive-definite, as a function of the properties of the sample data matrix: number of variables, number of observations, and proportion of missing completely at random values. Interpolated probability surfaces were estimated by simulation, as described in the text.

Journal of Vertebrate Paleontology 23(2):284–296, June 2003

EVALUATION OF THE PRINCIPAL-COMPONENT AND EXPECTATION-MAXIMIZATION METHODS FOR ESTIMATING MISSING DATA IN MORPHOMETRIC STUDIES

RICHARD E. STRAUSS[1], MOMCHIL N. ATANASSOV[2], and JOÃO ALVES DE OLIVEIRA[3]
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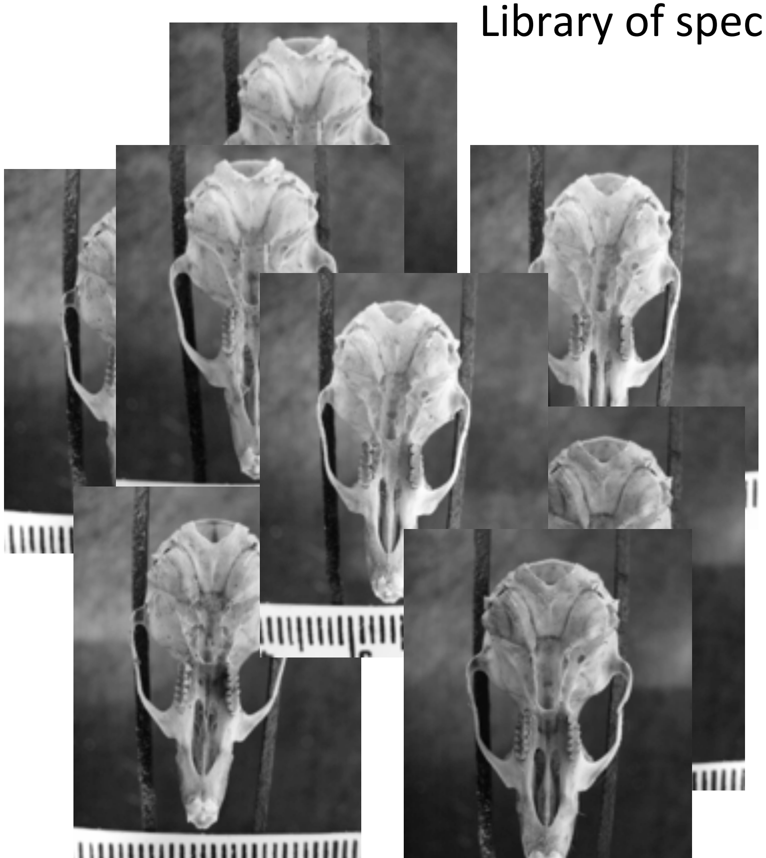
[2]Department of Geosciences, Texas Tech University, Lubbock, Texas 79409;
[3]Departamentos de Vertebrados, Museu Nacional (UFRJ), Rio de Janeiro, Rio de Janeiro, Brazil

Library of specimens



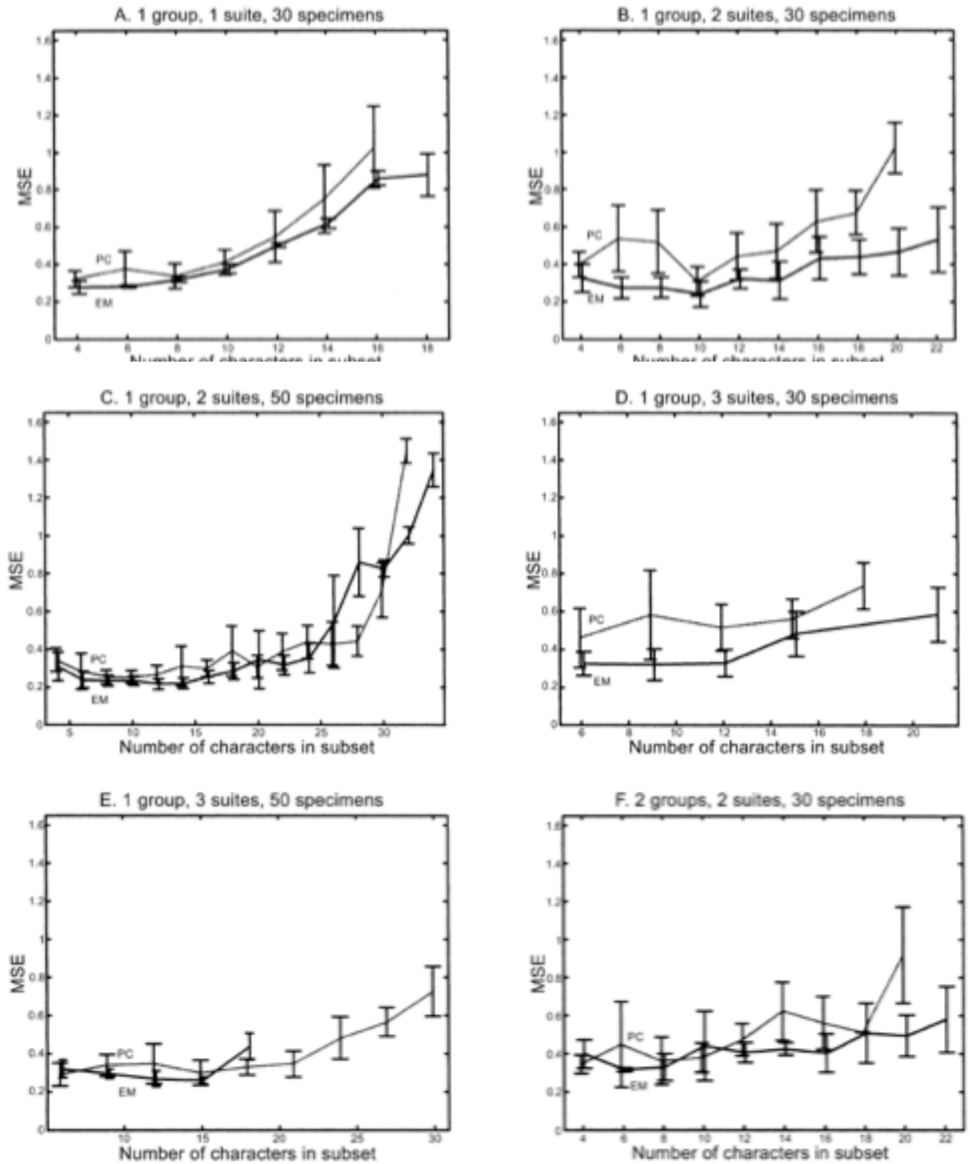


FIGURE 2. Plots of the mean square error of estimation (MSE) as a function of number of characters, for simulated heterogeneous data sets with varying combinations of numbers of specimen groups, character suites, and specimens. Shown are medians and 95% confidence intervals across bouts of 1,000 randomized subsamplings of characters from a complete data set, each bout for varying levels of missing data ranging from 1–49%. Solid lines: EM method; dotted lines: PC method.

Estimation Software

- R.E. Strauss at Texas Tech University
- http://www.faculty.biol.ttu.edu/Strauss/Matlab/Matlab.htm

- R packet "Amelia"

Journal of Mammalogy, 94(1):231–240, 2013

Enlarging rodent diversity in west-central Argentina: a new species of the genus *Holochilus* (Cricetidae, Sigmodontinae)

Ulyses F. J. Pardiñas,* Pablo Teta, Damián Voglino, and Fernando J. Fernández

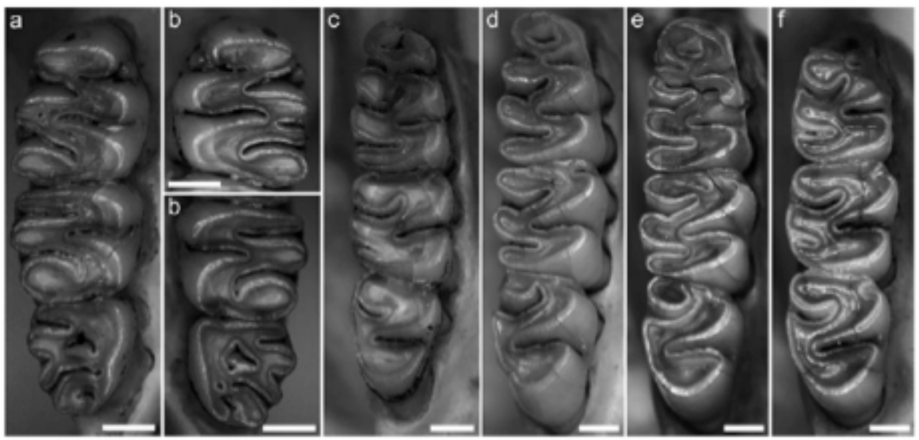


Fig. 3.—Occlusal view of upper and lower molars in *Holochilus lagigliai*, sp. nov., from Nihuil, Mendoza, Argentina; holotype (MHNSR-564), right (a) and left (b) upper and right lower (c) tooth rows; additional material, right lower tooth rows for MHNSR-231 (d), 650 (e), and 674 (f). Scale = 5 mm.

Fig. 1.—Holotype of *Holochilus lagigliai*, n. sp., from Nihuil, Mendoza, Argentina (MHNSR-564): skull in lateral (top), ventral (left), and dorsal (right) views, and left dentary in labial view. Scale = 5 mm.

Systematics and Biodiversity (2015), **13**(4): 403–412

Taylor & Francis
Taylor & Francis Group

Research Article

DNA from owl pellet bones uncovers hidden biodiversity

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[2]Departamento de Biologia & CESAM, Universidade de Aveiro, Campus de Santiago, Aveiro 3810-193, Portugal

(Received 3 February 2015; accepted 27 March 2015)

Table 1. Small mammal bone samples collected from Barn owl (*Tyto alba*) pellets and submitted to DNA extraction and amplification. Amplification success is given for both small (429 bp) and large (801 bp) *cytb* fragments (marked with an X). Molecular identification and GenBank accession numbers are given for successful, high high-quality sequences. UI: unidentified material based on morphological analysis.

Sample	Morphological ID	429 bp *cytb*	801 bp *cytb*	Molecular ID	GenBank
FSF3m	UI	X	X	*Cryptonanus* sp.	*KR190438*
FSF34m	UI	-	-	-	-
FSF35m	UI	-	-	-	-
FSF39m	UI	-	-	-	-
FSF52m	UI	-	-	-	-
FSF60m	UI	X	X	*Gracilinanus emiliae*	*KR190439*
FSF77m	UI	X	-	*Gracilinanus emiliae*	*KR190440*
FSF86m	UI	-	-	-	-
FSF92m	UI	X	X	*Gracilinanus emiliae*	*KR190441*
FSF118m	UI	-*	-	-	-
FSF133m	UI	X	X	*Marmosops pinheiroi*	*KR190442*
FVL11r	*Necromys lasiurus*	X	X	*Necromys lasiurus*	*KR190443*
FSF33r	*Holochilus sciureus*	X	-	*Holochilus sciureus*	*KR190444*
FSF34r	*Oecomys* sp.	X	X	*Oecomys* gr. *bicolor*	*KR190445*
FSF48r	*Oligoryzomys* sp.	X	X	*Oligoryzomys fornesi*	*KR190446*
FSF49r	UI	X	X	*Calomys tocantinsi*	*KR190447*
FSF53r	*Oecomys* sp.	X	X	*Oecomys* gr. *roberti*	*KR190448*
FLV54r	*Oligoryzomys* sp.	X	X	*Oligoryzomys fornesi*	*KR190449*
FLV55r	*Oligoryzomys* sp.	X	-	*Oligoryzomys fornesi*	*KR190450*
FSF56r	UI	-	-	-	-
FSF61r	*Euryoryzomys* sp.	-	-	-	-
FSF64r	UI	X	X	*Holochilus sciureus*	*KR190451*
FLV67r	*Oligoryzomys* sp.	X	-	*Oligoryzomys fornesi*	*KR190452*
FSF68r	*Oecomys* sp.	X	X	*Oecomys* gr. *roberti*	*KR190453*
FLV74r	*Calomys tocantinsi*	X	X	*Calomys tocantinsi*	*KR190454*
FLV88r	*Holochilus sciureus*	X	-	*Holochilus sciureus*	*KR190455*
FLV104r	*Necromys lasiurus*	X	X	*Necromys lasiurus*	*KR190456*
FLV107r	*Oecomys* sp.	X	X	*Oecomys roberti*	*KR190457*
FSF140r	*Oecomys* sp.	X	X	*Oecomys roberti*	*KR190458*
FSF141r	*Hylaeamys megacephalus*	-	X	*Hylaeamys megacephalus*	*KR190459*
FSF144r	*Hylaeamys megacephalus*	-*	-	-	-
FSF145r	*Calomys tocantinsi*	X	X	*Calomys tocantinsi*	*KR190460*
FSF149r	*Euryoryzomys* sp.	X	X	*Hylaeamys megacephalus*	*KR190461*

*Contamination (*Homo sapiens*).

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This search allows you to explore all of Field Museum's Division of Fishes records that have specimen images. With more than 1.7 million cataloged and uncataloged specimens in approximately 130,000 lots, our worldwide collections receive heavy use by US and international visitors and borrowers.

If you are through searching this database, we encourage you to contact us with any questions or requests.

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http://r .org/#/

MicroPlants
Classify
project
Sign up | Sign in
English
What is this
From macro scale
the environment a
microleaves, an a
pencil. Scientists
to keep a keen ey
most lush areas.
Learn: What is this
What are w
Measure a critical
(microleaf), from e
and describe new
Learn: What is a

Benefits of Museums, skulls, and Natural History

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- Cooler to look at skulls vs tubes.


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