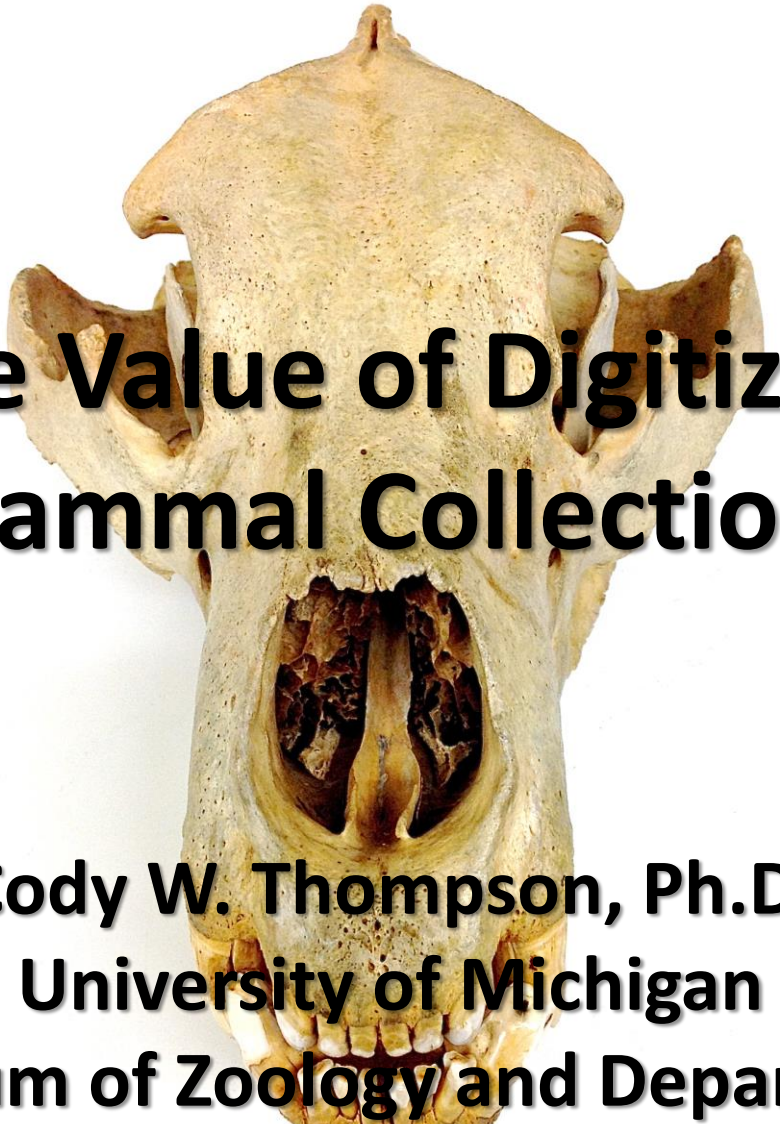


The Value of Digitizing Mammal Collections

Cody W. Thompson, Ph.D.
University of Michigan
Museum of Zoology and Department of Ecology & Evolutionary Biology

What is collection digitization?

- In the vertebrate collection community…
  - Digitization efforts often start and end at computerizing paper catalogs
  - May include georeferencing with resources available
  - Also might include imaging specimens, imaging paper collections, archiving media specimens, etc.
- So, where are we in the mammal collection community?
  - Good question!!!
  - Let's use UMMZ Mammals as an example

Looking at the UMMZ Mammals (1800s & 1900s)

- **1817 – University of Michigan founded**
- **1837 – Cabinet of Natural History established by the state of Michigan**
- **1913 – UMMZ formed as an independent research museum**
- **1977 – With *NSF* support, UMMZ Mammals begins to digitize paper catalog**

Looking at the UMMZ Mammals timeline (1980s & 1990s)

- **1982 – Full computerization achieved using Taxir on university's mainframe**
- **1984 – Additional *NSF* support completes digitization of UMMZ Mammals special collections**
- **1994 – UMMZ Mammals began using Filemaker on its own machines**
- **1994 – *NSF* supports the first grant to establish the Animal Diversity Web (more later…)**

Looking at the UMMZ Mammals timeline (2000s)

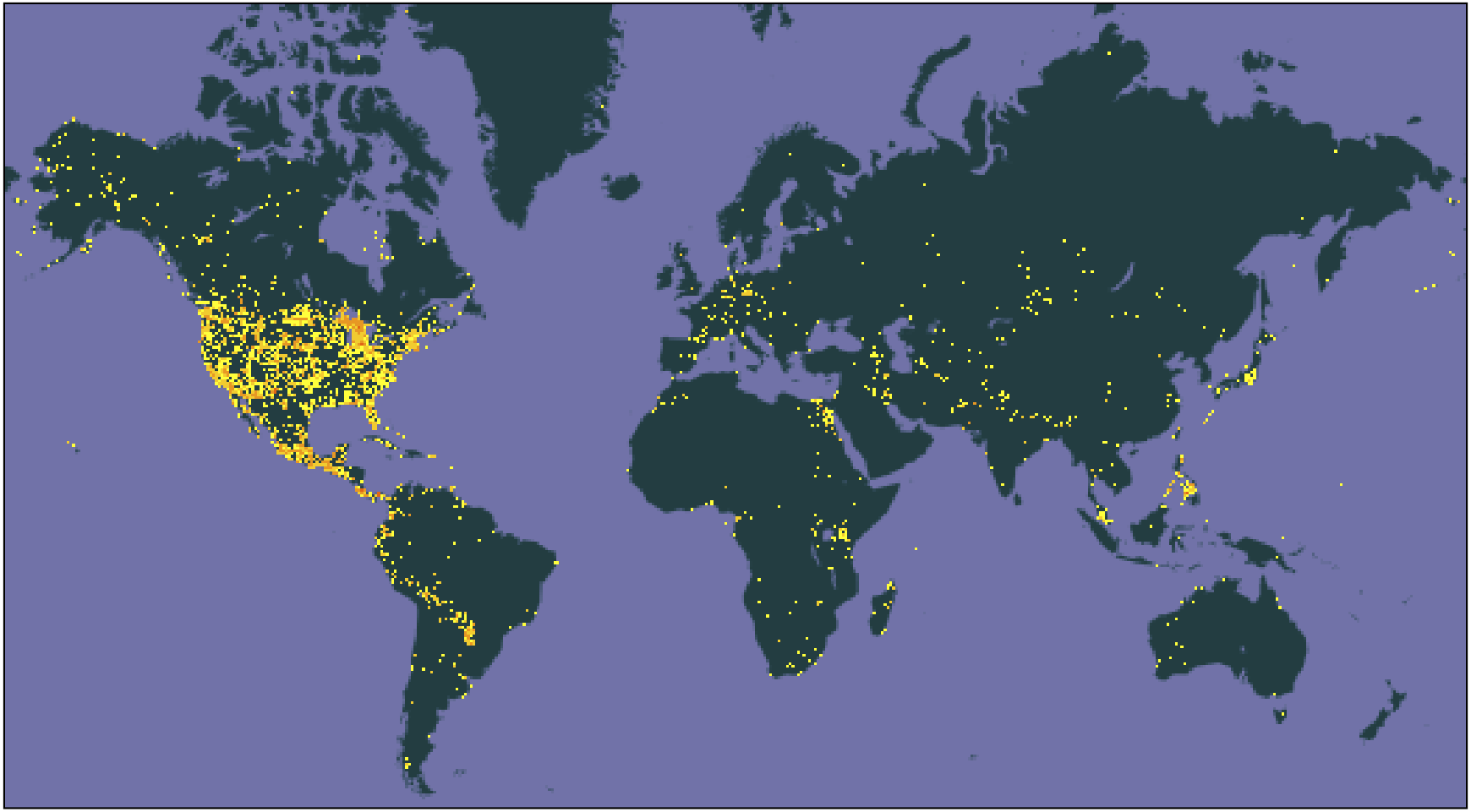
- **2001 – 17 mammal collections, including UMMZ Mammals, create the Mammal Networked Information System (MaNIS) formed with *NSF* support**
- **2001 – GBIF officially established**
- **2002 – UMMZ Mammals participates in Great Lakes flora and fauna project funded by *IMLS* (more later…)**
- **2007 – UMMZ Mammals fully georeferenced via Manis project**

Mammal Networked Information System MaNIS

Looking at the UMMZ Mammals timeline (2010s)

- **2010 – VertNet established with *NSF* funding**
- **2011 – iDigBio created with *NSF* support**
- **2013 – MaNIS goes offline**
- **2013 – UMMZ Mammals available on VertNet search portal**
- **2014 – UMMZ Mammals available on GBIF and iDigBio search portals**
- **2014 – Animal Diversity Web release ADW Pocket Guide for iOS**
- **2014 – UMMZ Mammals develops Google Scholar profile**
- **2015 – University of Michigan natural history collections join Specify project**

What does this mean?
-108,352 georeferenced records-



What does this mean?
-Increased Data Usage-

- **Traditional Annual Report Data (2014-2015)**
  - **Total Research Visitors – 61**
  - **Total Public Visitors – 614**
  - **Total Visitor Days – 1,132**
  - **Total Loans – 28**
  - **Total Specimens/Samples Loaned – 415**
  - **Total Data Requests – 25**
  - **Total Publications – 16 (that I know about)**

What does this mean?
-Increased Data Usage-

- **VertNet (1 April 2014 to 28 February 2015)**
  - **4,076 total searches (371 per month)**
  - **61,893 total records searched (5,627 per month)**
  - **838 total downloads (70 per month)**
  - **68,640 total records downloaded (70,408 per month)**

- **GBIF (15 March 2014 to 9 March 2015)**
  - **6,146 total downloads (~512 per month)**

- **iDigBio (1 January to 28 February 2015)**
  - **1,930 total searches (965 per month)**
  - **193,524 total records downloaded (387,524 per month)**

What does this mean?
-Increased Data Usage-

Table 1.---Rate of growth and collection use at the UMMZ, 2010-2015 (Note: 2015 only includes data through August).

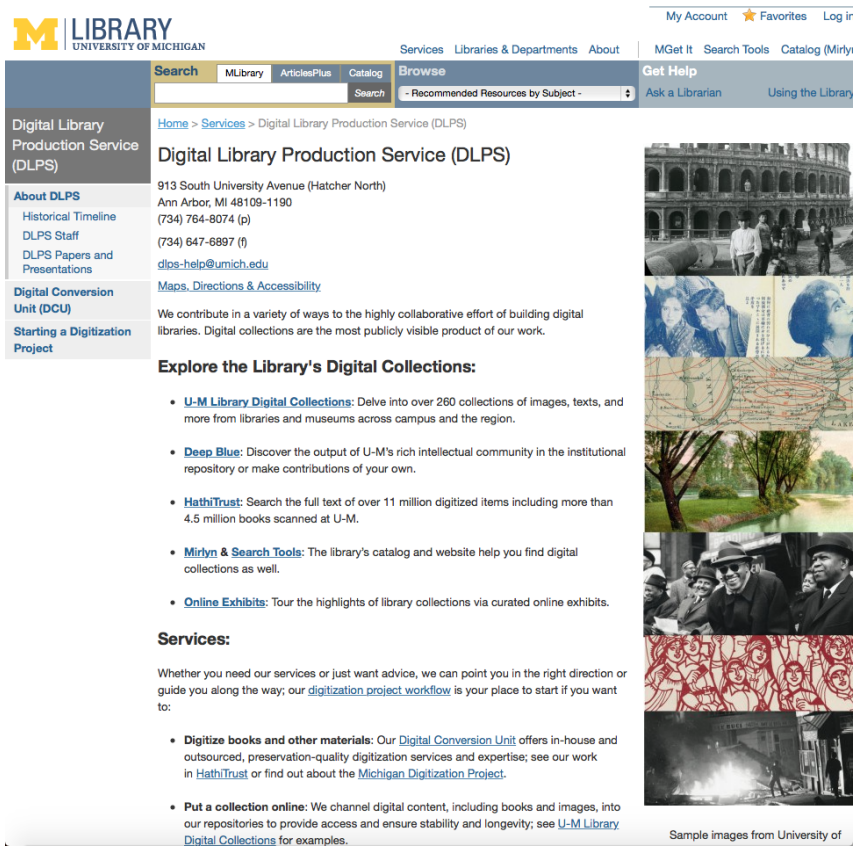
Category	2010	2011	2012	2013	2014	2015	Total	Mean
New Specimens	10,017	8,818	5,476	6,256	6,103	2,159	38,829	6,753
Researcher Loans	68	94	73	112	95	71	513	89
Student Loans	40	41	36	47	48	30	242	65
Research Visitors	121	85	101	118	122	114	661	115
Student Visitors	541	488	759	330	381	245	2,744	477
Public Visitors	750	660	745	323	598	242	3,318	577
Online Searches[1]	57,936	32,496	27,561	30,121	26,365	175,890[2]	350,369	60,934
Publications	125	110	122	102	123	43	625	125

[1]Data drawn from GBIF, iDigBio, MaNIS, ORNIS, VertNet, and UM Library repositories.
[2]UMMZ Birds, Mammals, and Reptiles and Amphibians fully available on iDigBio.

What does this mean?
-Increased Specimen Access-

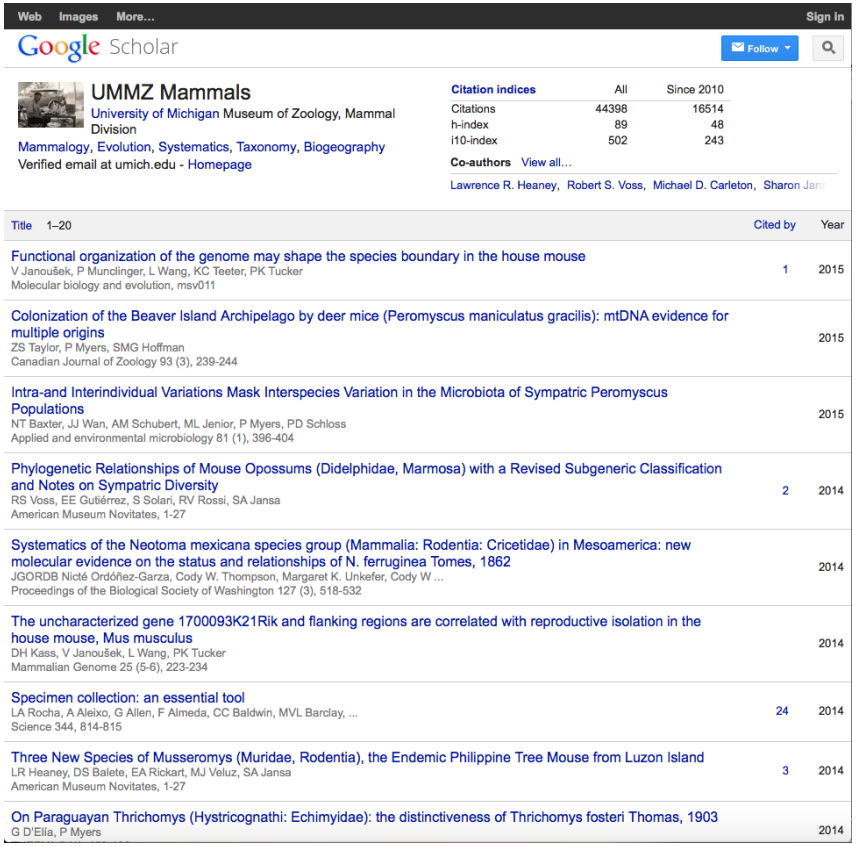
- **Great Lakes Flora & Fauna Project (UMMZ & UM Libraries collaboration)**
  - **Funded in 2002**
  - **Also included UMMZ Fishes and UM Herbarium**
  - **27,216 mammal specimen images**
  - **6,035 pages of field notes**
  - **146 historical maps**

Results – 132,094 page views since 2011! 66,686 page views in 2015 alone.



What does this mean?
-Increased Publications-

- **Google Scholar Profile (through 8 September 2015)**
  - **957 known citations**
  - **44,398 indirect citations**
  - **16,514 indirect citations since 2010**
  - **Citation indices?**



Web Images More... Sign in

Google Scholar Follow

UMMZ Mammals
University of Michigan Museum of Zoology, Mammal Division
Mammalogy, Evolution, Systematics, Taxonomy, Biogeography
Verified email at umich.edu - Homepage

Citation indices	All	Since 2010
Citations	44398	16514
h-index	89	48
i10-index	502	243

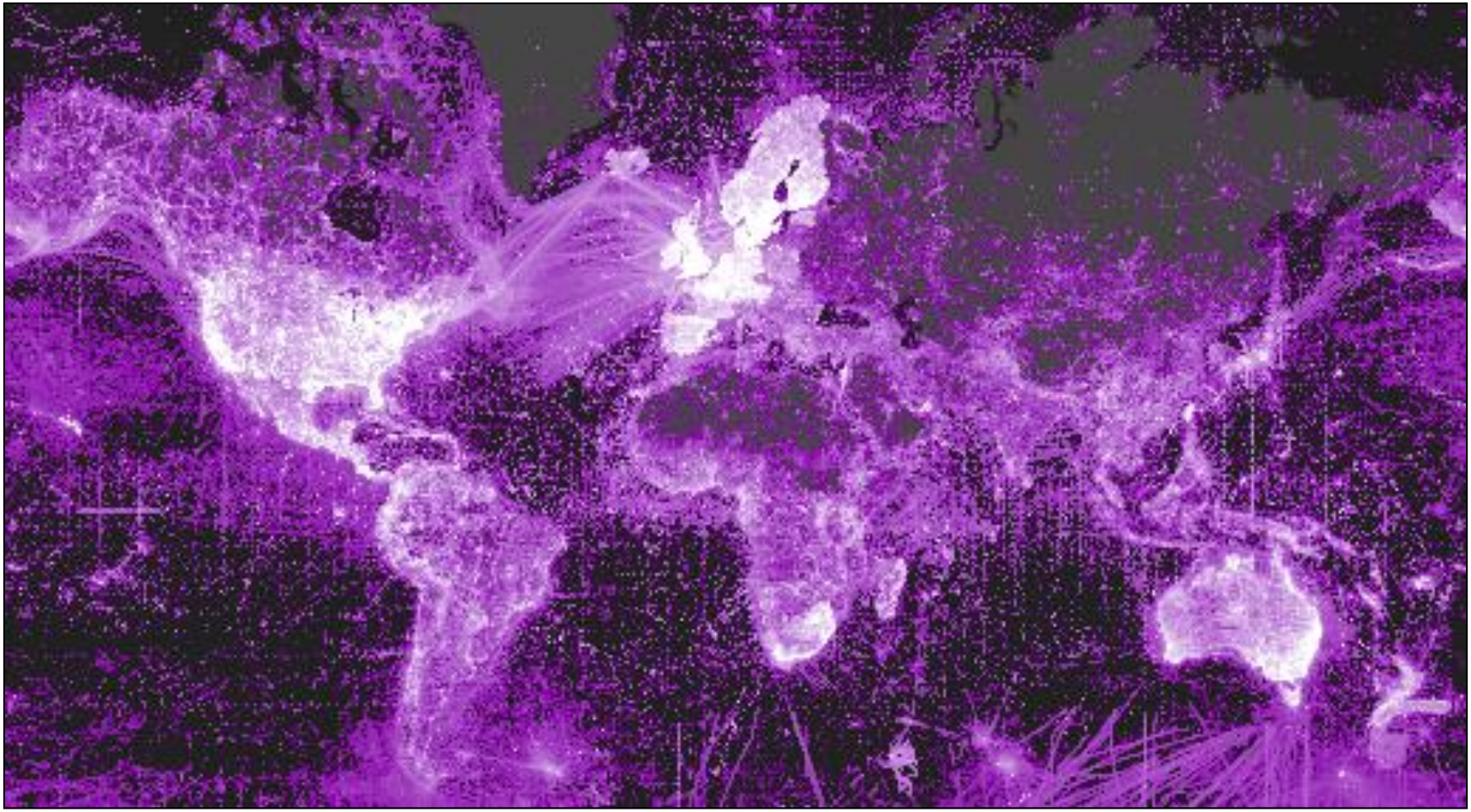
Co-authors View all...
Lawrence R. Heaney, Robert S. Voss, Michael D. Carleton, Sharon Jan

Title 1–20	Cited by	Year
Functional organization of the genome may shape the species boundary in the house mouse V Janoušek, P Munclinger, L Wang, KC Teeter, PK Tucker Molecular biology and evolution, msv011	1	2015
Colonization of the Beaver Island Archipelago by deer mice (Peromyscus maniculatus gracilis): mtDNA evidence for multiple origins ZS Taylor, P Myers, SMG Hoffman Canadian Journal of Zoology 93 (3), 239-244		2015
Intra-and Interindividual Variations Mask Interspecies Variation in the Microbiota of Sympatric Peromyscus Populations NT Baxter, JJ Wan, AM Schubert, ML Jenior, P Myers, PD Schloss Applied and environmental microbiology 81 (1), 396-404		2015
Phylogenetic Relationships of Mouse Opossums (Didelphidae, Marmosa) with a Revised Subgeneric Classification and Notes on Sympatric Diversity RS Voss, EE Gutiérrez, S Solari, RV Rossi, SA Jansa American Museum Novitates, 1-27	2	2014
Systematics of the Neotoma mexicana species group (Mammalia: Rodentia: Cricetidae) in Mesoamerica: new molecular evidence on the status and relationships of N. ferruginea Tomes, 1862 JGORDB Nicté Ordóñez-Garza, Cody W. Thompson, Margaret K. Unkefer, Cody W ... Proceedings of the Biological Society of Washington 127 (3), 518-532		2014
The uncharacterized gene 1700093K21Rik and flanking regions are correlated with reproductive isolation in the house mouse, Mus musculus DH Kass, V Janoušek, L Wang, PK Tucker Mammalian Genome 25 (5-6), 223-234		2014
Specimen collection: an essential tool LA Rocha, A Aleixo, G Allen, F Almeda, CC Baldwin, MVL Barclay, ... Science 344, 814-815	24	2014
Three New Species of Musseromys (Muridae, Rodentia), the Endemic Philippine Tree Mouse from Luzon Island LR Heaney, DS Balete, EA Rickart, MJ Veluz, SA Jansa American Museum Novitates, 1-27	3	2014
On Paraguayan Thrichomys (Hystricognathi: Echimyidae): the distinctiveness of Thrichomys fosteri Thomas, 1903 G D'Elía, P Myers		2014

So, where are we in the mammal collection community?

- **It is size and resource dependent…**
  - **Most large collections have digitized their specimen data; however, many small institutions have not!**
  - **Most large collections have georeferenced their specimen data; however, many small institutions have not!**
  - **Most large collections have connected to data aggregators; however, many small institutions have not!**

But it’s more than dots on a map!!!



Source: GBIF

So, where are we in the mammal collection community?

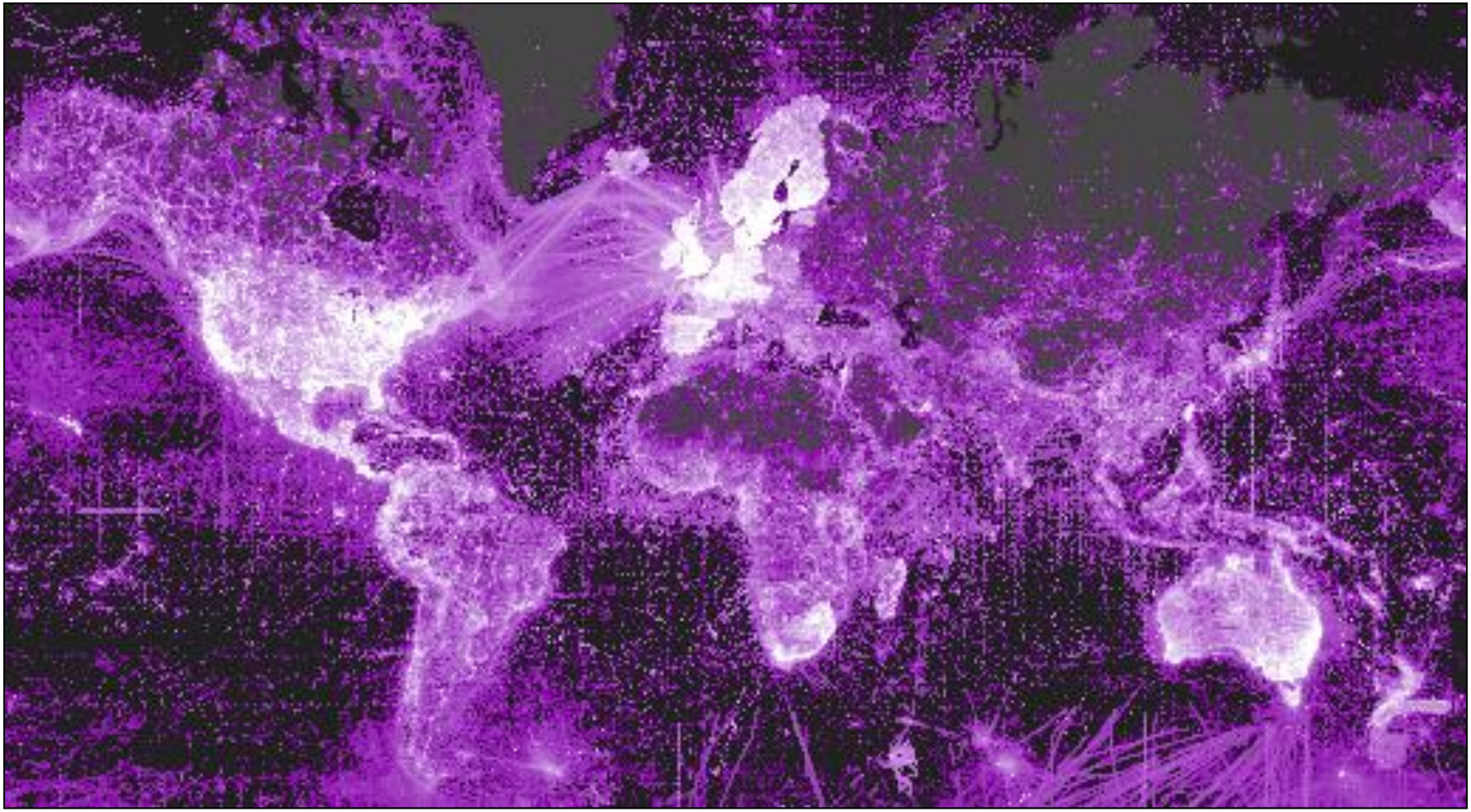
- **However…**
  - **Few collections have begun imaging their specimens!**
  - **Few collections have begun imaging their paper collections!**
  - **Few collections have begun archiving media specimens!**

- **Answer: We still have a long ways to go!!!**

So, why should we digitize?

- **Increasing loss of biodiversity**
  - **We are now in the Anthropocene!!!**
  - **Habitat fragmentation**
  - **Habitat degradation**
  - **Climate change**
  - **86% of taxa remain unknown to science (Mora et al. 2011)**
  - **Need more collecting (Rocha et al. 2014)**

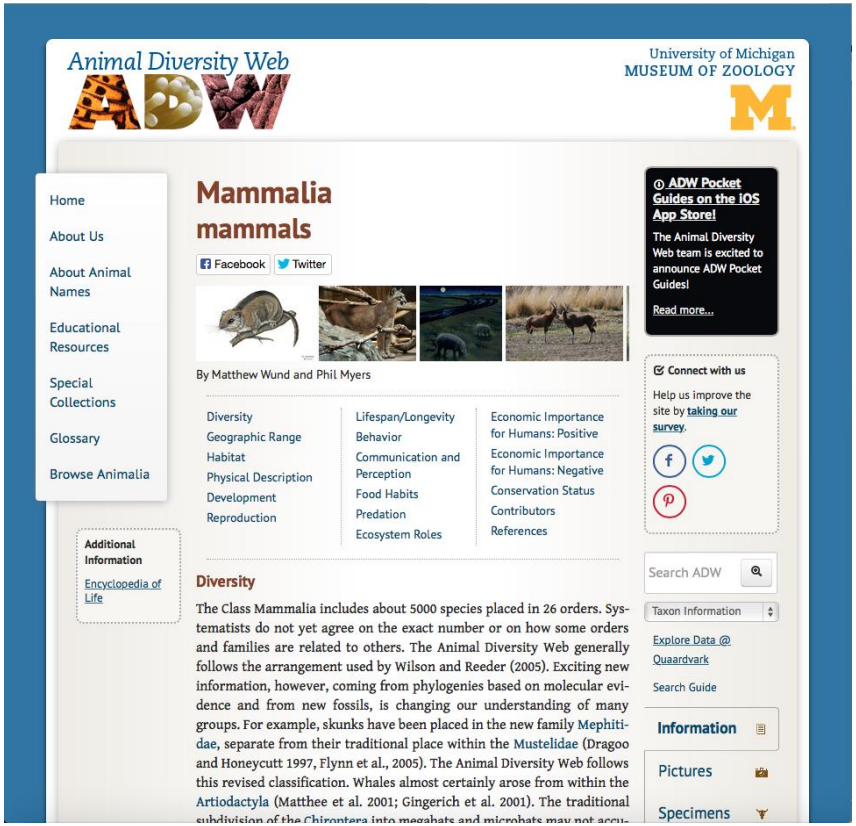
Those dots are important!



Source: GBIF

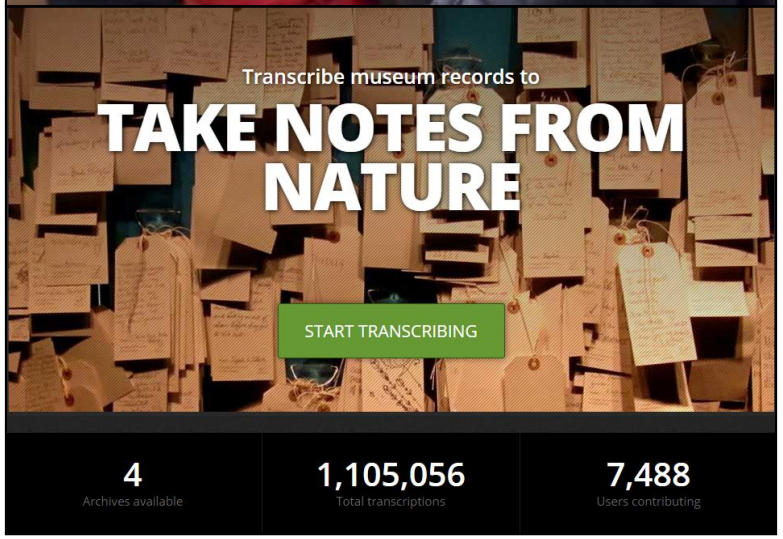
So, why should we digitize?

- **Increasing interest in STEM education**
  - **Students learn better when they are able to interact with real data (Parr et al. 2005)**
  - **Integrating natural history collections into online resources provide richer experience (e.g., ADW; Yahnke et al. 2013)**



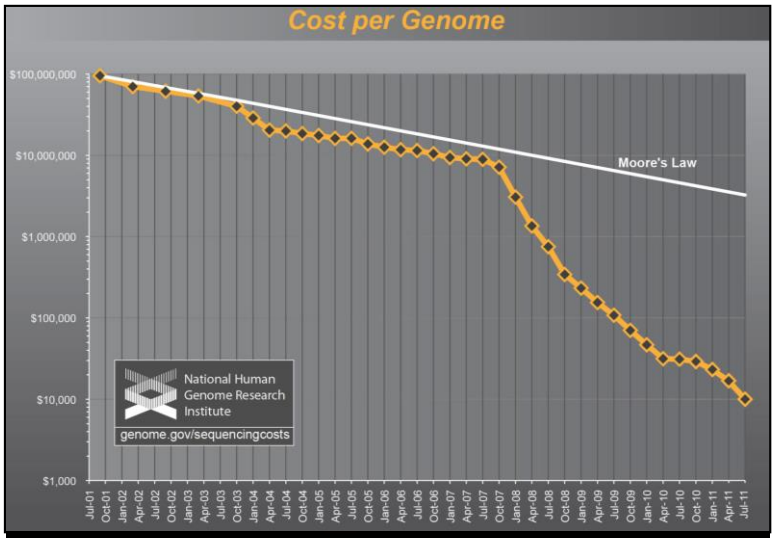
So, why should we digitize?

- Increasing the general public's science literacy
  - Children growing up in digital world, providing opportunities to interact with them at the digital level is important!
  - Citizen science efforts at an all-time high!
    - Lab of Ornithology
    - Notes from Nature



So, why should we digitize?

- The technology is there
  - We are now in an era of big data (Hampton et al. 2013)
  - Costs are decreasing, and data is increasing!
  - Museums now more than ever can connect with constituents and affect change (Given & McTavish 2010)



Source: UM Museum of Paleontology

So, why should we digitize?

- **The better question is why not!**
  - **Continue efforts to get collections online, especially small collections**
  - **Continue to standardize methodology**
  - **Continue to leverage imaging technology for sharing specimens (e.g., T&E species, valuable items)**
  - **Continue to advocate for our collections with our administrators, legislators, and general public**

Pink-Fairy Armadillo (*Chlamyphorus truncatus*)

THE PICHOCIEGO 6777
(Chlamydophorus truncatus)

The Pichey, as it is commonly called, is a very rare and remarkable member of the Armadillo family. It is a real dwarf when compared with even the smallest of the known Armadillos, while it forceably reminds one of a mole in its shape and habits.

The eyes are small and hidden under the hair which falls over them. The ear is without an external conch. The incisor and canine teeth are absent. The animal lives in sandy plains, and like the mole digs tunnels underground. Very little is known of its habits, as it is seldom seen even by the natives.

It is only known from the western part of Argentine Republic. This particular specimen was taken in the Chilian Andes, and was presented to the Museum by His Excellency, D. F. Sarmiento, formerly President of Argentine Republic.