College of Literature, Science, and the Arts
Ecology and Evolutionary Biology Department
EEB Museums 2019 Annual Report
1 January 2019 to 31 December 2019

Compiled by Benjamin M. Hess
EEB Museums Registrar

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EXECUTIVE SUMMARY – Submitted by the Associate Chair for Collections for the EEB Museums

The University of Michigan (UM) College of Literature, Science, and the Arts Department of Ecology and Evolutionary Biology (EEB) supports two museums: the UM Herbarium (Herbarium) and the UM Museum of Zoology (UMMZ). The Herbarium and the UMMZ dedicate their efforts to study and understand the evolutionary origins, history, maintenance and conservation of the worlds' biota. These two museums and its staff enhance and maintain research collections to support research, education and outreach at a local and global level.

2018 marked the first combined annual report for the Herbarium and UMMZ. The 2019 Annual Report improves the consistency in recording and reporting within divisions, and gives additional details about shared functions or special collections/labs across divisions. The annual report gives in-depth statistics on collections growth, transactions, digitization activities, online views and downloads of digital records through global aggregators and data portals. It also chronicles research, educational and outreach activities that took place in 2019 within and between our two museums at the RMC. Some noteworthy numbers in this report that serve to document the impact of our collections and associated activities for biodiversity research and education both locally, at Michigan, and around the world.

During 2019, 192 individuals including professors, graduate and undergraduate students, postdoctoral fellows, collection managers, project managers, technicians and volunteers were engaged in museum-related activities at the RMC. Nine different NSF-sponsored infrastructure grants for specimen digitization and five UM-sponsored/private grants (totaling $1,867,918) were active resulting in 179,535 specimen, 246,543 locality, and 535,767 attachment/image additions or modifications to collection object records in the database. Our digitization efforts have a profound impact on research and educational access to museum resources. The Herbarium and UMMZ records connected to global aggregators had 1,339,824,318 online views, with 1,796,168 records downloaded. The UMMZ microCT digitized specimens were downloaded 17,578 times with 3,877 download users. 73,792 new specimens (over 65,000 from the Insect Division) were accessioned into our collections and 12550 specimens were sent as a loan, gift or transfer.

During 2019, the EEB museums documented 312 visits comprising 756 individuals visiting the collections at the RMC for research and educational purposes. The annual report also provides information on the size, taxonomic breadth and geographic distribution of our digitized holdings available on *Specify*, a biological collections management system. As we are actively engaged in specimen digitization, this information captures a fraction, approximately 73%, of the combined Herbarium and UMMZ world-class collections comprising nearly 15,600,000 specimens.

Christopher W. Dick
Associate Chair for Museum Collections; EEB Museums Director
Curator of Vascular Plants, University of Michigan Herbarium
Professor, LSA Department of Ecology and Evolutionary Biology (EEB)

COMBINED MICH & UMMZ STATISTICS

INFRASTRUCTURE GRANTS – active in 2019 (total $1,867,918)

Herbarium
National Science Foundation (NSF): Advances in Biological Informatics (ABI) Innovation: Authors in the driver's seat: fast, consistent, computable phenotype data and ontology production. $228,167

NSF, Advancing Digitization of Biodiversity Collections (ADBC), Digitization Thematic Collections Networks (TCN): Collaborative Research: The Pteridological Collections Consortium: An integrative approach to pteridophyte diversity over the last 420 million years. $279,003

NSF, ADBC, Digitization TCN: Collaborative Research: Digitizing "endless forms": Facilitating Research on Imperiled Plants with Extreme Morphologies. Subcontract under Missouri Botanical Garden. $94,033

NSF, Collections in Support of Biological Research (CSBR): Ownership Transfer of University of Maine Chytrid Fungal Collection to University of Michigan. $79,416

UMMZ Fish Division
Michigan Institute for Data Science (MIDAS) / Propelling Original Data Science (PODS) Grant: CHANGES: Collections, Heterogeneous data, and Next Generation Ecological Studies. $90,000

UMMZ Insect Division
University of Michigan Office of Research (UMOR) Faculty Grants & Awards. Michigan's Hidden Triple Threat: Hymenoptera Pollinators, Parasitoids, & Predators. ($6,298 UM LSA, $6,298 UM EEB cost matching) $25,192

University of Michigan Undergraduate Research Opportunity Program (UROP) Supplementary Research Funding. Collection Detective: Deciphering the Forster Dragonfly collection. $1,500

UROP Supplementary Research Funding. Role call! Developing Museum Species Checklists. $1,500

NSF, ADBC, Collaborative Research: Digitization TCN: Digitizing collections to trace parasite-host associations and predict the spread of vector-borne disease. $367,004

UMMZ Mammal Division and Reptiles & Amphibians
NSF, ADBC, Digitization TCN: Collaborative Research: oVert: Open Exploration of Vertebrate Diversity in 3D. $207,250

UMMZ Mammal Division
Huron Mountain Wildlife Foundation. Assessing hybridization in flying squirrels (*Glaucomys*) of the Huron Mountains. $9,285

NSF, ADBC, Digitization Partner to an Existing Network (PEN): Functional Quantitative Characters for Ecology and Evolution (FuncQEE). $180,041

UMMZ Mollusk Division
NSF, ADBC, Collaborative Research: Digitization TCN: InvertEBase: Reaching Back to See the Future: Species-rich Invertebrate Faunas Document Causes and Consequences of Biodiversity Shifts. $250,746

NSF, ADBC, Digitization TCN: Collaborative Research: Enhancing Access to Taxonomic and Biogeographical Data to Stem the Tide of Extinction of the Highly Imperiled Pacific Island Land Snails. $54,781

COMBINED MICH & UMMZ STATISTICS

PERSONNEL – Details below reflect 192 unique individuals. Some divisions share personnel.

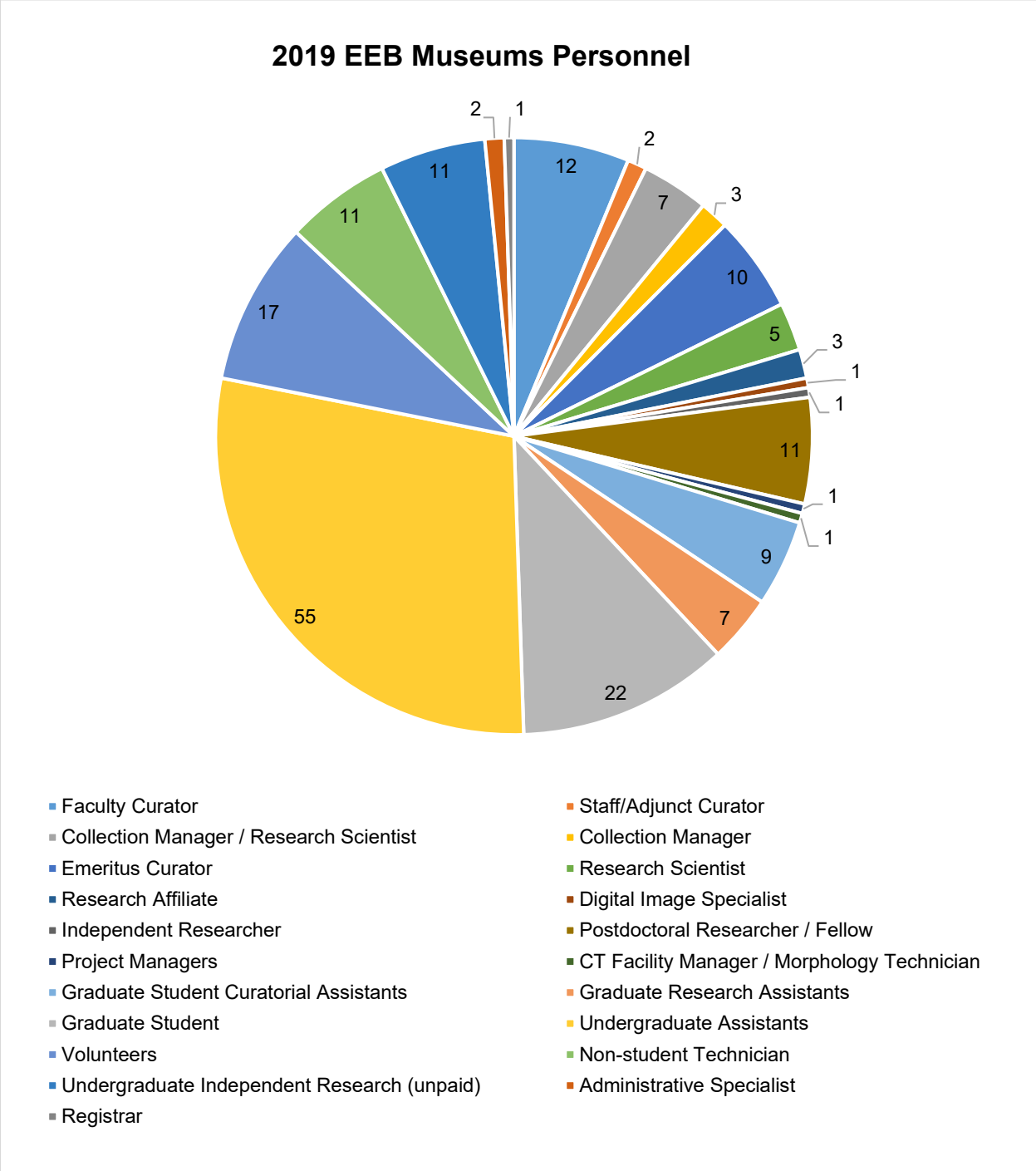


Figure 1: Pie chart of the 192 total personnel within the EEB Museums (UM Herbarium and UMMZ) in 2019. The working title categories correspond to the pie chart sections by color in the following way: the working titles read left-to-right and then top-to-bottom, while the matching chart section begins at the top (i.e., 12:00 on a clock) and rotates clockwise through the working titles with the total number of individuals indicated per title. Of this total, 104 (54.17%) individuals were either a graduate student (38 individuals) or undergraduate (66 individuals).

COMBINED MICH & UMMZ STATISTICS

RELATIVE SIZE AND PERCENT DIGITIZED OF COLLECTIONS – An asterisk (*) after the total number of specimens reflects the best estimate for the respective division.

Museum / Division	Total Specimens	Total in Database	% Databased
UM Herbarium	1,750,000 *	989,602	56.55%
UMMZ Birds	213,652	213,652	100.00%
UMMZ Fishes	3,493,783	3,493,783	100.00%
UMMZ Insects	4,500,000 *	385,493	8.57%
UMMZ Mammals	178,776	178,776	100.00%
UMMZ Mollusks	5,000,000 *	2,425,000	48.50%
UMMZ Reptiles & Amphibians	438,305	438,305	100.00%
TOTAL	**15,574,516**	**8,073,940**	**73.37%**

COLLECTION GROWTH / DATA ENHANCMENT

Category	Herbarium	Birds	Fish	Insects	Mammals	Mollusks	Reptiles & Amphibians	TOTAL
Accessions	23	0	6	330	12	6	13	**390**
Accessions - Total # of Specimens	1,413	0	4,512	65,066	1,526	495	780	**73,792**
Specimens Prepared	2,509	688	0	11,781	0	503	0	**15,481**
Data Entries Modified	56,259	750	2052	88,097	513	31,228	636	**179,535**
Locality Modified	148,747	178	883	73,358	496	22,377	504	**246,543**
Attachments / Images Added	518,075	0	0	17,465	0	227	0	**535,767**

OUTGOING COLLECTION TRANSACTIONS – From the University of Michigan

Category	Herbarium	Birds	Fish	Insects	Mammals	Mollusks	Reptiles & Amphibians	TOTAL
Loans	35	13	22	27	27	8	19	**151**
Loaned Specimens	300	1,273	1,702	5,068	274	346	532	**9,495**
Exchanges / Transfers	0	0	3	0	0	0	3	**6**
Exchanged / Transferred Specimens	0	0	2,408	0	0	0	18	**2,426**
Gifts / Permanent Loans (Tissues)	16	13	2	4	0	0	10	**45**
Gift/Permanent Loan Specimens	224	170	22	16	0	0	197	**629**
Total Research Transactions	47	17	25	21	15	5	29	**159**
Total Education Transactions	4	8	2	10	9	3	3	**39**
Total Art Transactions	0	1	0	0	3	0	0	**4**

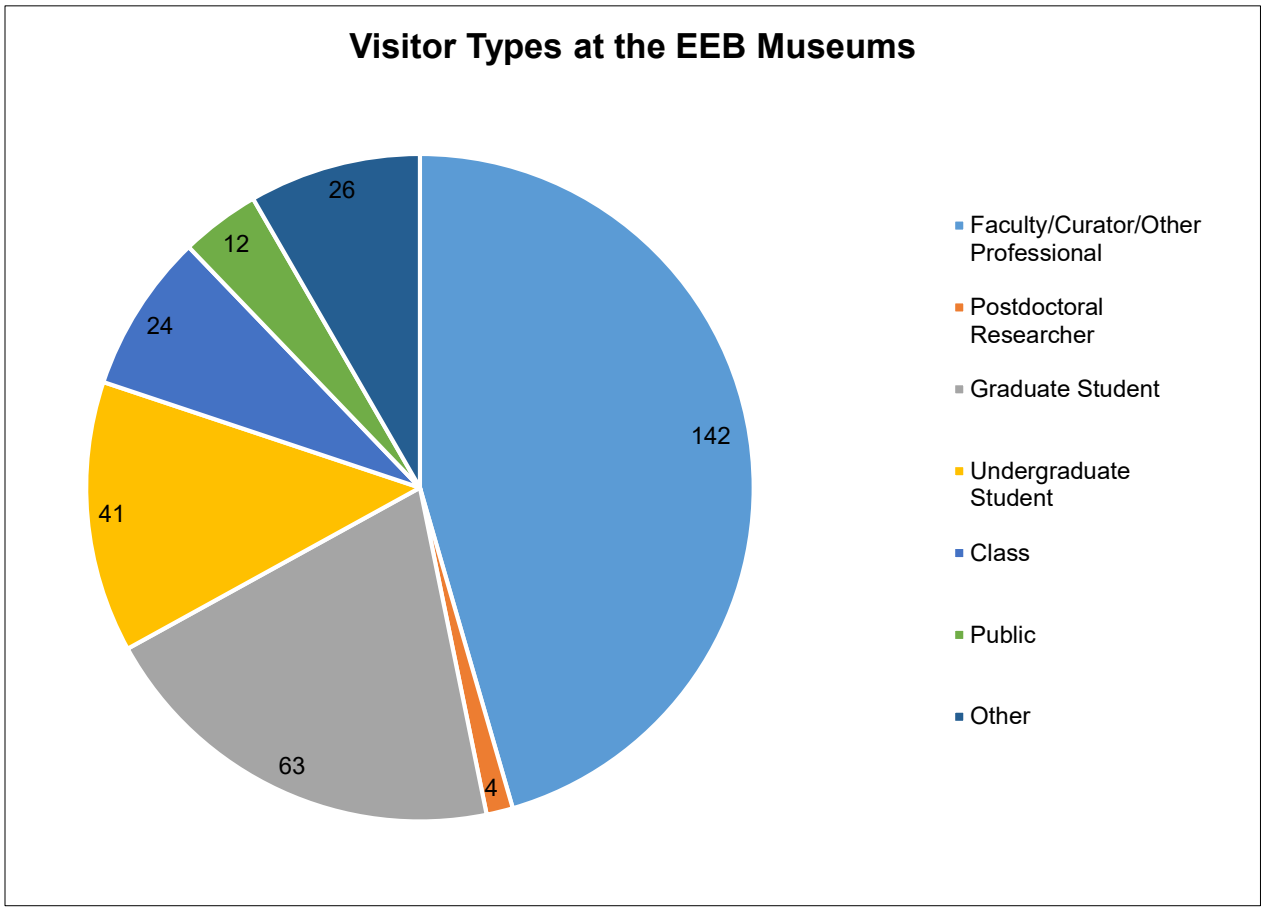
COMBINED MICH & UMMZ STATISTICS

INQUIRIES AND DATA REQUESTS

Category	Herbarium	Birds	Fish	Insects	Mammals	Mollusks	Reptiles & Amphibians	TOTAL
General Inquiries	16	2	15	22	190	22	15	**282**
Data Request	4	10	10	22	11	26	10	**93**

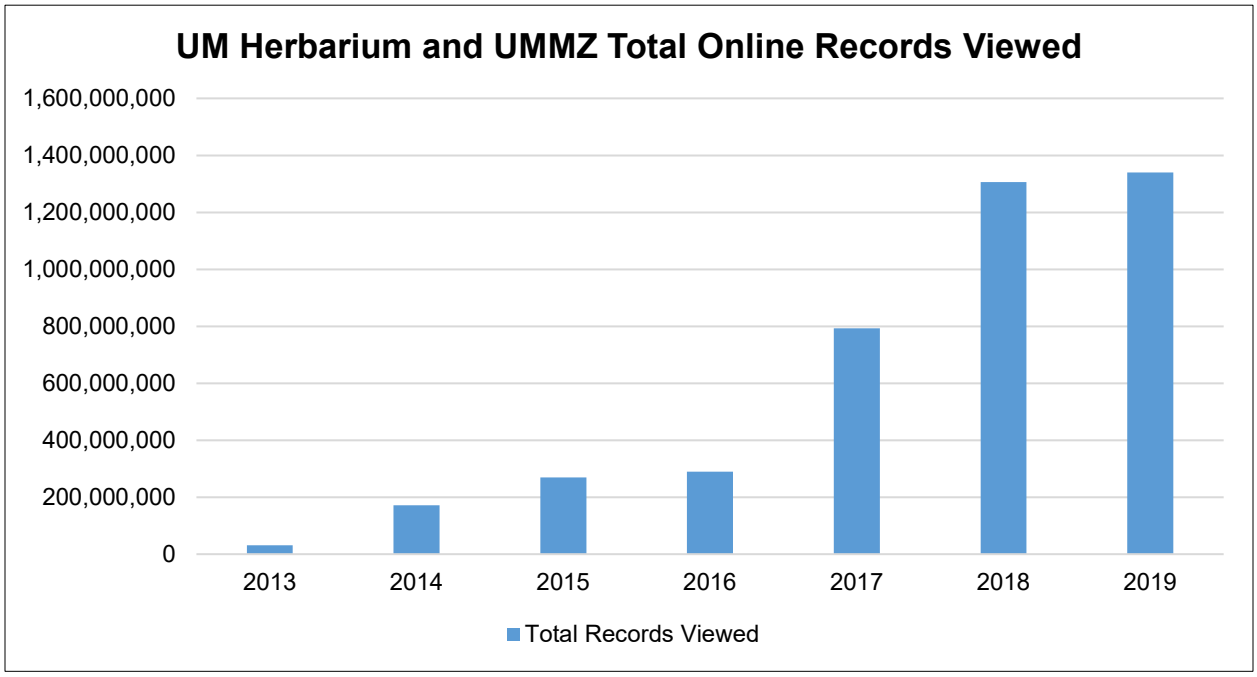
VISITATION TO THE COLLECTION – numbers reflect total number of visits (on-line and register books)

Category	Number
Visits / Individuals	**312 visits** (233 UMMZ, 69 Herbarium, 10 Other) / **756 individuals**
Unique Individual / Institution	215 unique individuals, 135 unique institutions/departments



COMBINED MICH & UMMZ STATISTICS

GLOBAL AGGREGATORS / DATA PORTALS



Year	Total Records Viewed	Number of On-line Portals with Use-statistics
2013	30,938,624	4
2014	171,862,000	7
2015	269,169,750	15
2016	289,584,030	19
2017	793,222,043	18
2018	1,306,502,892	28
2019	1,339,824,318	27
TOTAL (2013-2019)	**4,201,103,657**	
AVERAGE (2013-2019)	**600,157,665**	

COMBINED MICH & UMMZ STATISTICS

GLOBAL AGGREGATORS / DATA PORTALS – Usage statistics from 01 Jan 2019 to 31 Dec 2019

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium & VertNet)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Herbarium	23,150	569,786,148	569,786,148	569,786,148	from 23 Jan 2019
GBIF Bird	14,213	154,072,458	154,072,458	154,072,458	from 8 Feb 2013
GBIF Fish	8,171	129,600,142	129,600,142	129,600,142	from 2 Aug 2018
GBIF Insect	3,757	153,516,822	153,516,822	153,516,822	from 21 Dec 2018
GBIF Mammal	13,189	98,616,113	98,616,113	98,616,113	from 22 Apr 2013
GBIF Mollusk	5,281	86,275,747	86,275,747	86,275,747	from 13 Jul 2018
GBIF Reptile/Amphibian	6,176	143,230,999	143,230,999	143,230,999	from 11 Dec 2013
iDigBio Herbarium Bryophtye	111,018	31,023	34,290	34,290	from Jan 2015
iDigBio Herbarium Lichen	6,399	5,880	18,080	18,080	from Jan 2015
iDigBio Herbarium Macroalgal	69,024	64,991	117	64,991	from Mar 2015
iDigBio Herbarium Midwest Herbaria	156,587	422,803	282	422,803	from Aug 2015
iDigBio Herbarium Mycology	17,386	30,397	64,804	64,804	from Jan 2015
iDigBio AquaticInvasives Fish	112,697	42,548	95	42,548	from Oct 2016
iDigBio AquaticInvasives Mollusks	7,418	1,711	2	1,711	from Oct 2016
iDigBio Bird	198,515	455,403	44,369	455,403	from Jan 2015
iDigBio Fish	598,093	520,610	2,268	520,610	from Aug 2018
iDigBio Insect	18,703	18,052	26	18,052	from Apr 2019
iDigBio Mammal	81,201	210,816	51,378	210,816	from Jan 2015
iDigBio Mollusk	32,946	66,667	58	66,667	from Jul 2018
iDigBio Reptile/Amphibian	225,217	349,423	60,828	349,423	from Jan 2015
FishNet2 Fish	Active portal, but no usage statistics in 2019				from Aug 2011
VertNet Bird	21,028	259,624	933,437	933,437	from Apr 2014
VertNet Fish	Active portal, but no usage statistics in 2019				from Nov 2019
VertNet Mammal	12,977	182,048	224,782	224,782	from Apr 2014
VertNet Reptile/Amphibian	14,072	145,794	126,075	145,794	from Apr 2014
USGS BISON Bird	9,325	332,270	332,270	332,270	stats since 2019
USGS BISON Mammal	214	319,267	319,267	319,267	stats since 2019
USGS BISON Mollusk	12,449	199,318	199,318	199,318	stats since 2019
USGS BISON Reptile/Amphibian	16,962	300,823	300,823	300,823	stats since 2019
JSTOR Herbarium	Active portal, but no usage statistics in 2019				from Jan 2016
MI Flora Herbarium	Active portal, but no usage statistics in 2019				~2012
Pteridophyte Herbarium	Active portal, but no usage statistics in 2019				from Mar 2019
TOTAL COMBINED	**1,796,168**	**1,339,057,897**	**1,337,810,998**	**1,339,824,318**	

COMBINED MICH & UMMZ STATISTICS

MEDIA VIEW STATISTICS – iDigBio – Integrated Digitized Biocollections

Year	Division						Year TOTAL
	iDigBio Herbarium Bryophtye	iDigBio Herbarium Lichen	iDigBio Herbarium Macroalgal	iDigBio Herbarium Midwest Herbaria	iDigBio Herbarium Mycology	iDigBio Aquatic Invasives Fish	
2015	47,894	22,162	36	11	55,808	------	**125,911**
2016	90,908	41,957	162	225	136,986	------	**270,238**
2017	44,079	7,241	6,240	1,528	23,724	------	**82,812**
2018	19,124	10,161	18	383	35,823	8	**65,517**
2019	11,262	6,259	33	89	26,267	1	**43,911**
TOTAL (2015-2019)	**213,267**	**87,780**	**6,489**	**2,236**	**278,608**	**9**	**588,389**
AVERAGE (2015-2019)	**42,653**	**17,556**	**1,298**	**447**	**55,722**	**5**	**117,678**

MORPHOSOURCE – Digital repository containing 3D media (raw micro-CT data and surface meshes) from UMMZ specimens; 2018 totals represent July 2013 through 31 December 2018; See UMMZ MICRO(μ)-CT SCANNING LABORATORY section (page 25) for more details.

About MorphoSource (https://www.morphosource.org/About/home)

"MorphoSource is a digital repository where researchers, museum curators, and the general public can find, download, and upload 3D media representing physical objects, most commonly biological specimens. If you are a researcher, you can use MorphoSource to locate and download 3D media for analysis, and archive and share 3D media you have generated or are currently working on with collaborators, the community, and/or the public. If you are a museum curator, you can use MorphoSource to make digital media representing your collections available to scientific and lay communities. If you are a member of the general public, MorphoSource allows you to virtually explore the "raw data" of evolutionary biology and other sciences through digitally interacting with the biological specimens and other physical objects that underpin cutting-edge scientific thought."

UMMZ Division	Download Requests	Unique Specimens Requested	Unique Media File Downloads	Total Downloads	Total Download Users
Bird	11	8	10	32	22
Fish	2	2	2	6	4
Mammal	457	242	1,172	20,804	4,694
Reptile/Amphibian	1,290	514	738	3,332	2,085
2019 TOTALS	1,760	766	1,922	24,174	6,805
2018 TOTALS	224	129	1,027	6,596	2,928
INCREASE	1,536	637	895	17,578	3,877

COMBINED MICH & UMMZ STATISTICS

MORPHOSOURCE – continued (User and Use data taken as July 2013 through 31 December 2019)

TYPE OF USER OF CT SCAN DATA

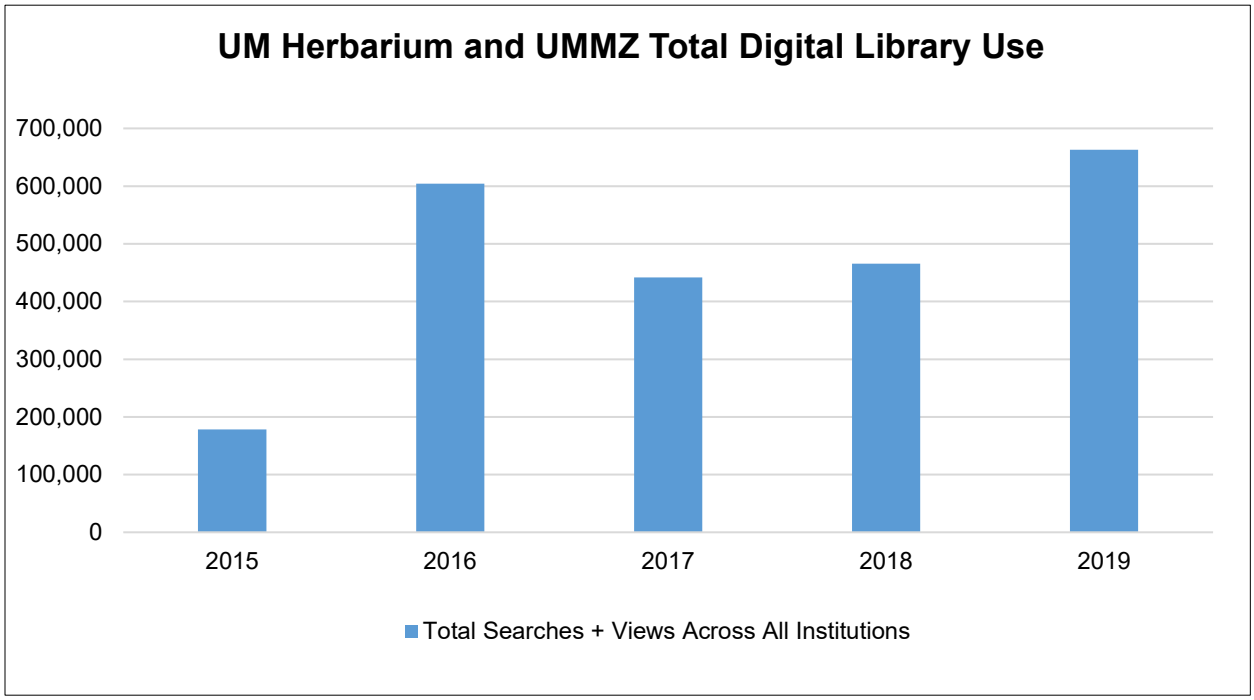
UMMZ Division	Type of user of CT scan data as defined by individual using data. 11,170 total users documented.									
	Researcher	Student	Artist	Graduate Student	Museum	Private Individual	College Student	Museum Staff	Faculty	College Faculty
Bird	14	16	0	10	0	0	6	0	6	6
Fish	0	4	0	4	0	0	0	0	0	0
Mammal	2,238	1,121	1,295	991	195	192	120	136	132	124
Reptile / Amphibian	1,354	693	308	501	260	160	176	164	119	119
2019 TOTALS	**3,606**	**1,834**	**1,603**	**1,506**	**455**	**352**	**302**	**300**	**257**	**249**
% of 11170	**32.28%**	**16.42%**	**14.35%**	**13.48%**	**4.07%**	**3.15%**	**2.70%**	**2.69%**	**2.30%**	**2.23%**
Cumulative Sum	**3,606**	**5,440**	**7,043**	**8,549**	**9,004**	**9,356**	**9,658**	**9,958**	**10,215**	**10,464**
Cumulative % of 11170	**32.28%**	**48.70%**	**63.05%**	**76.54%**	**80.61%**	**83.76%**	**86.46%**	**89.15%**	**91.45%**	**93.68%**

INTENDED USE OF CT SCAN DATA

UMMZ Division	Intended use of CT scan data as defined by individual using data. 25,834 uses of data documented.									
	Research	Art	Education	3D Print	Education at Museum - Public Outreach	Personal Interest	Education for College	School	General Education	School - Post-Secondary
Bird	28	0	0	0	0	0	0	0	0	0
Fish	6	0	0	0	0	0	0	0	0	0
Mammal	16,356	1,642	678	846	484	272	94	120	40	74
Reptile / Amphibian	2,364	592	616	252	278	484	166	82	144	56
2019 TOTALS	**18,754**	**2,234**	**1,294**	**1,098**	**762**	**756**	**260**	**202**	**184**	**130**
% of 25834	**72.59%**	**8.65%**	**5.01%**	**4.25%**	**2.95%**	**2.93%**	**1.01%**	**0.78%**	**0.71%**	**0.50%**
Cumulative Sum	**18,754**	**20,988**	**22,282**	**23,380**	**24,142**	**24,898**	**25,158**	**25,360**	**25,544**	**25,674**
Cumulative % of 25834	**72.59%**	**81.24%**	**86.25%**	**90.50%**	**93.45%**	**96.38%**	**97.38%**	**98.17%**	**98.88%**	**99.38%**

COMBINED MICH & UMMZ STATISTICS

UM DIGITAL LIBRARY



Year	Total Searches + Views Across All Institutions	Number of Library Collections
2015	178,210	21
2016	604,489	22
2017	441,845	24
2018	465,776	24
2019	662,892	26
TOTAL (2015-2019)	**2,353,212**	
AVERAGE (2015-2019)	**470,642**	

LIBRARY

UM Digital Library Production Service
university of michigan

COMBINED MICH & UMMZ STATISTICS

UM DIGITAL LIBRARY

Collection	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	Origin Date
Herbarium Algae Type Collection (herb6ic)	4,484	623	13.89	4,691	417	8.89	since 2015
Herbarium Bryophtye Type Collection (herb3ic)	4,384	559	12.75	3,712	19	0.51	since 2015
University of Michigan Herbarium Catalog Collection (herb00ic)	3,327	707	21.25	123,262	2,484	2.02	since 2019
Herbarium Fungus Collection Database (herb5ic)	10,441	612	5.86	25,121	334	1.33	since 2015
Herbarium Fungus Monographs (fung1tc)	712	8	1.12	44,164	11	0.02	since 2015
Herbarium Fungus and Lichen Type Collection (herb4ic)	4,699	582	12.39	5,627	72	1.28	since 2015
Herbarium Vascular Plant Type Collection with Specimen Image (herb2ic)	5,284	656	12.41	45,553	1,339	2.94	since 2015
Herbarium Fungus Collection Database (fung1ic)	2,414	189	7.83	5,438	6	0.11	since 2015
Herbarium Fungus Image Database (fung2ic)	2,221	185	8.33	117,811	178	0.15	since 2015
Herbarium Herbs (herb1ic)							ended in 2019
Herbarium Krieger's Watercolors of Fungi (fuwatic)	2,661	194	7.29	28,781	905	3.14	since 2015
UMMZ Amphibian and Reptile Audio Files (amph2ic)	2,011	196	9.75	259	29	11.20	since 2015
UMMZ Amphibian and Reptile Catalogue (amph3ic)	5,099	366	7.18	11,783	84	0.71	since 2015
UMMZ Amphibian and Reptile Type Specimens (amph1ic)	2,599	225	8.66	6,335	966	15.25	since 2015
UMMZ Distribution Maps of Michigan Fishes (fish4ic)	2,097	192	9.16	5,077	244	4.81	since 2015
UMMZ Fish Collection Database (fish1ic)	2,726	192	7.04	10,434	9	0.09	since 2015
UMMZ Fish Field Notes (fish3ic)	2,105	185	8.79	4,528	26	0.57	since 2015
UMMZ Fish Species Descriptions (fish5ic)	2,163	186	8.60	1,251	2	0.16	since 2015
UMMZ Fish Specimen Image Collection (fish2ic)	2,793	185	6.62	22,845	252	1.10	since 2015
UMMZ Herpetology Field Notebooks (rept2ic)	1,842	153	8.31	25,889	4,803	18.55	available since 2018
UMMZ Herpetology Predator and Prey Collection (rept3ic)	2,032	170	8.37	15,889	5,027	31.64	available since 2018
UMMZ Herpetology Radiographs (rept1ic)	7,128	115	1.61	48,223	1,052	2.18	available since 2016

COMBINED MICH & UMMZ STATISTICS

UM DIGITAL LIBRARY – Continued

Collection	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	Origin Date
UMMZ Mammal Division Collection Database with Specimen Images (mam1ic)	3,176	197	6.20	19,305	237	1.23	since 2015
UMMZ Mammal Division Field Notes (mam3ic)	2,237	195	8.72	2,780	520	18.71	since 2015
UMMZ Mammal Division Division Maps (mam2ic)	2,009	184	9.16	2,568	87	3.39	since 2015
UMMZ, Insect Division Collection (insect2ic)	496	72	14.52	840	660	78.57	** since 2019
UMMZ, Insect Field Notebooks (insect1ic)	426	65	15.26	4,208	2,977	70.75	** since 2019
TOTAL	**81,566**	**7,056**	**8.65**	**581,326**	**19,103**	**3.29**	

UM DIGITAL LIBRARY – Year Totals

Year	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = All Searches + All Views
2015	25,029	3,040	12.15	153,181	1,773	1.16	178,210
2016	84,193	4,165	4.95	520,296	11,971	2.30	604,489
2017	65,890	15,502	23.53	375,955	14,850	3.95	441,845
2018	44,744	6,432	14.38	421,032	19,991	4.75	465,776
2019	81,566	7,056	8.65	581,326	19,103	3.29	662,892
TOTAL	**301,422**	**36,195**	**12.01**	**2,051,790**	**67,688**	**3.30**	**2,353,212**

Digital Collections
https://quod.lib.umich.edu/lib/colllist/
Brought to you by Digital Content & Collections (DCC)

ANIMAL DIVERSITY WEB – Submitted by Phil Myers

University of Michigan Museum of Zoology
Animal Diversity Web

MISSION

The Animal Diversity Web (ADW – https://animaldiversity.org/) is an online database and encyclopedia of animal natural history, built through contributions from students, photographers, and many others. It is a rich and flexible resource designed both as an encyclopedia for exploring biodiversity and for use in formal, inquiry-based education.

OVERVIEW

ADW was created by Phil Myers (EEB Professor / UMMZ Mammal Curator Emeritus) and associates with initial support from LSA and a small grant from the Dean's office. Phil was asked by EEB and the Museum to start a new course, an introduction to animal diversity, and he wanted to supplement the textbook. Very quickly, that idea morphed into creating a database that students could use to discover for themselves the patterns and processes that underlie ecology, evolutionary biology, and conservation biology. To expedite the process, they recruited students in classes at UM and elsewhere to help; to date, over 3,500 students at 75 institutions have participated in building the project. To improve the "searchability" of the site, they designed a template that students fill in when they write species accounts. When the account is finished and approved, its contents from the template are broken down into categories and stored in an SQL database. This information is tied together in a massive program (Mousetrap), which is used to manage the project including added systems to control classification, copyrights, contributor information, etc. Between its inception in 1995 and Myers' retirement in 2014, the project brought in over $11,000,000 in grants, many as partner with faculty in the UM School of Education. The current ADW platform is hosted by LSA with modifications that have security, but lacks the ability to grow and improve without funding to modernize its software infrastructure

PERSONNEL

Title	Name(s)
Director and Founder	Dr. Philip Myers – EEB Professor / UMMZ Mammal Curator Emeritus
Co-director and Content Expert	Dr. Tanya Dewey – Colorado State University; previously with UM (curriculum consultant, all around ADW zookeeper)
Technical Lead	Roger Espinosa – UM Digital Library (content management, XML templates, search engines, taxonomy database, general software wizard)
Content Expert	George Hammond – Ann Arbor Natural Area Preservation (curriculum consultant, all around ADW zookeeper)
Educational Researcher	Dr. Tricia Jones – UM Dental School (assessment, usability coordinator)

ANIMAL DIVERSITY WEB - continued

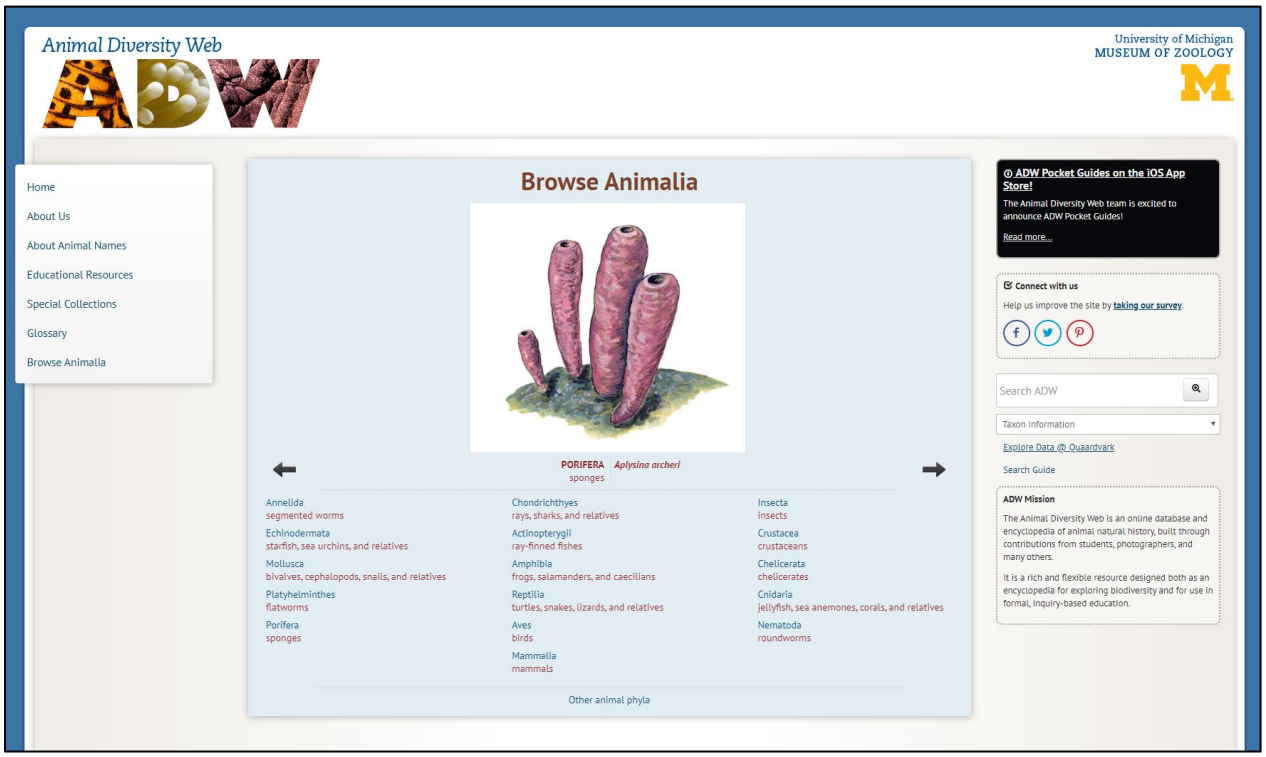


Figure 1: Animal Diversity Web (ADW – https://animaldiversity.org/) entry page.

GOOGLE ANALYTICS USAGE STATISTICS

ADW first connected to Google Analytics in 2009. From 1 January 2009 through 31 December 2019, more than 37 million users have connected with ADW for an average of more than 3.3 million users per year. There has been over 50 million search sessions (over 4.5 million average per year) and more than 170 million page views (over 15.4 million average per year) during this time. Users from an average of 234 countries per year search the ADW site, and searches occur from every state in the United States.

2019 Usage Statistics – Between 1 January 2019 and 31 December 2019, over 3.2 million users connected with ADW for more than 4.5 million sessions and more than 10.7 million pageviews. The users were from 239 different countries, with over 1.9 million users in the United States including every state. For more details about the 2019 ADW site use, please see the Google Analytics section on page 109.

Five Year Usage Statistics – Over the last five years (1 January 2015 through 31 December 2019), many categories of uses have shown an increase: ADW users, sessions and pageviews have all gradually increased. For more details and 5-year trend of ADW site use, please see the Google Analytics section on page 111.

DESCRIPTION – ADW is a multimedia natural history database created and maintained for teaching and outreach at the University of Michigan (UM). With 6,120 animal species accounts, 350 accounts of higher taxa, and over 20,000 high quality images and 725 sound files, it is one of the largest and most actively used natural history databases worldwide. It serves an audience encompassing academics, schoolchildren, writers, natural resource planners, retirees and many others. Its database structure makes it unique among widely used animal databases because of the ease with which biological attributes of species can be identified, displayed and compared.

ANIMAL DIVERSITY WEB – continued

Figure 2: ADW species account. Each species account was created with specific parameters to create consistency for the number of students who wrote them.

Online since 1995, ADW is one of UM College of Literature, Science, and the Arts (LSA) largest outreach projects. It effectively displays UM's strength in organismal biology to the public and, of particular interest to LSA, an audience of enormous numbers of elementary and high school students that may someday be interested in attending UM. Besides its primary viewer base described above, the ADW includes a subsidiary project created from ADW accounts and designed for use by schoolchildren, the Critter Catalog (http://www.biokids.umich.edu/critters/). It receives 90,000 visitors per month. In addition, viewers access our materials through the widely used Encyclopedia of Life (EOL – http://eol.org). We support users from the general public as they explore the diversity of animal species, including animal FAQs, informational essays, and a feedback system for communicating errors, suggestions, and questions. The ADW is widely cited and usually appears at or near the top of the results of Google searches for information on individual species. Consequently, people seeking information about natural history often come to us first, giving us a remarkable opportunity to influence biodiversity education.

User surveys suggest that more than half of site visitors use the ADW for formal educational purposes, including K-20 students and instructors, and the ADW supports learning at many levels. Many students visit the site to learn about species of animals. Species accounts contain structured text, keywords, and numeric data, making effective searching of the entire database possible through simple or advanced search engines; these searches allow students to extract natural history data for use in inquiry. In addition to the widely-used species accounts, the ADW includes teaching materials for more advanced courses, including formal descriptions of families and orders and annotated diagrams showing adaptations and diagnostic features.

ANIMAL DIVERSITY WEB – continued

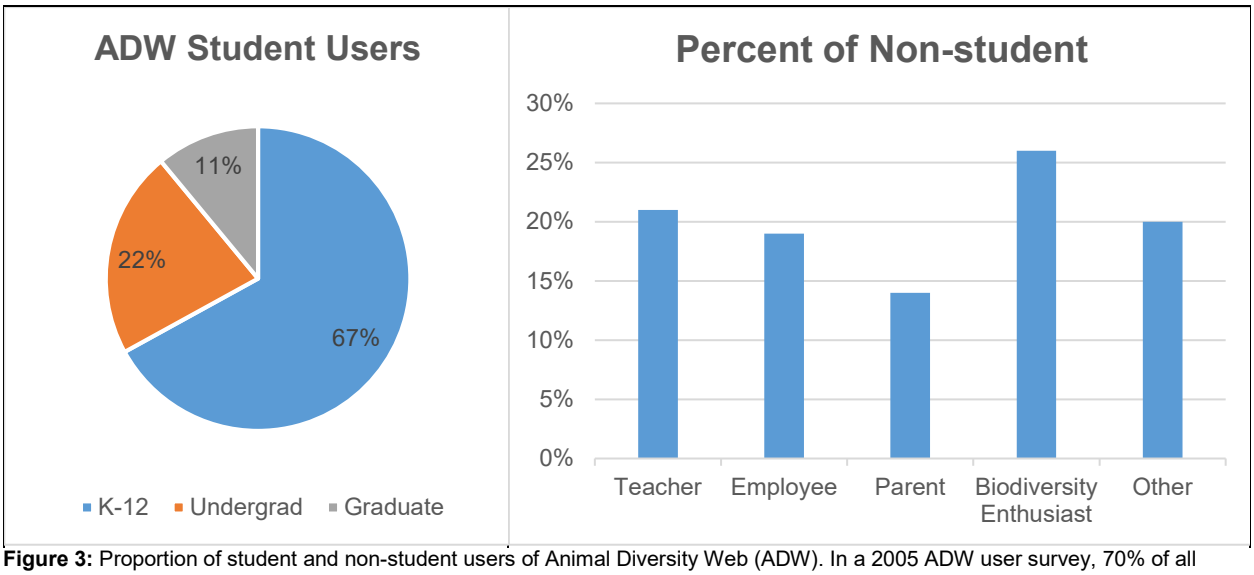


Figure 3: Proportion of student and non-student users of Animal Diversity Web (ADW). In a 2005 ADW user survey, 70% of all users categorized themselves as students, while the remaining 30% categorized themselves as a non-student. Recreated with permission by Phil Myers.

Students also benefit from the project because we grow the underlying database of natural history information by recruiting classes whose undergraduate and graduate students write species accounts as part of their coursework. We support this activity in several ways, including by providing templates that guide students in this process, and by guiding, reviewing and editing student' work. An important aspect of this activity is to help students find and evaluate traditional and online resources, and to use them as they learn about writing in the discipline.

The ADW also provides users with access to the specimens held in research collections, including large collections of photographs of skeletal materials, making those specimens available universally for research and teaching. The ADW's innovative content management system is designed to permit rapid and virtually unlimited expansion. It is well suited, for example, to the new kinds of digitization products being produced by museums (for example, the recently funded OVert project), providing not only ecological/natural history context for those materials but also guaranteeing their exposure to our very large user base. A further advantage of the ADW's structure is that its taxonomic database updated readily reflect changes in our understanding of evolutionary relationships among animals.

Figure 4: Dorsal, ventral and lateral view images of golden-capped fruit bat (*Acerodon jubatus*) skull – UMMZ-Mammals-158519. Phil Myers took many ADW specimen and skeletal images. Used with permission from https://animaldiversity.org/accounts/Chiroptera/specimens/.

ANIMAL DIVERSITY WEB – continued

The ADW's design allows content to be customized for specific audiences and learning goals, which has been central to ADW and UM School of Education faculty collaborations. The BioKIDS project, carried out with Prof. Nancy Songer (now at Drexel University), was the first of these. It focused on teaching children authentic science inquiry through biodiversity exploration and produced substantial learning gains on standardized tests. One product of BioKIDS, the Critter Catalog, provides ADW animal information tailored for elementary schoolchildren in the Great Lakes region, which is still widely used today 15 years after the project formally ended. In a second project with Prof. Songer and the Lifemapper (http://lifemapper.org) group at the University of Kansas, we designed, tested, and implemented a climate change biology curriculum for middle and high school students that focused on the ecological impacts of climate change on natural ecosystems.

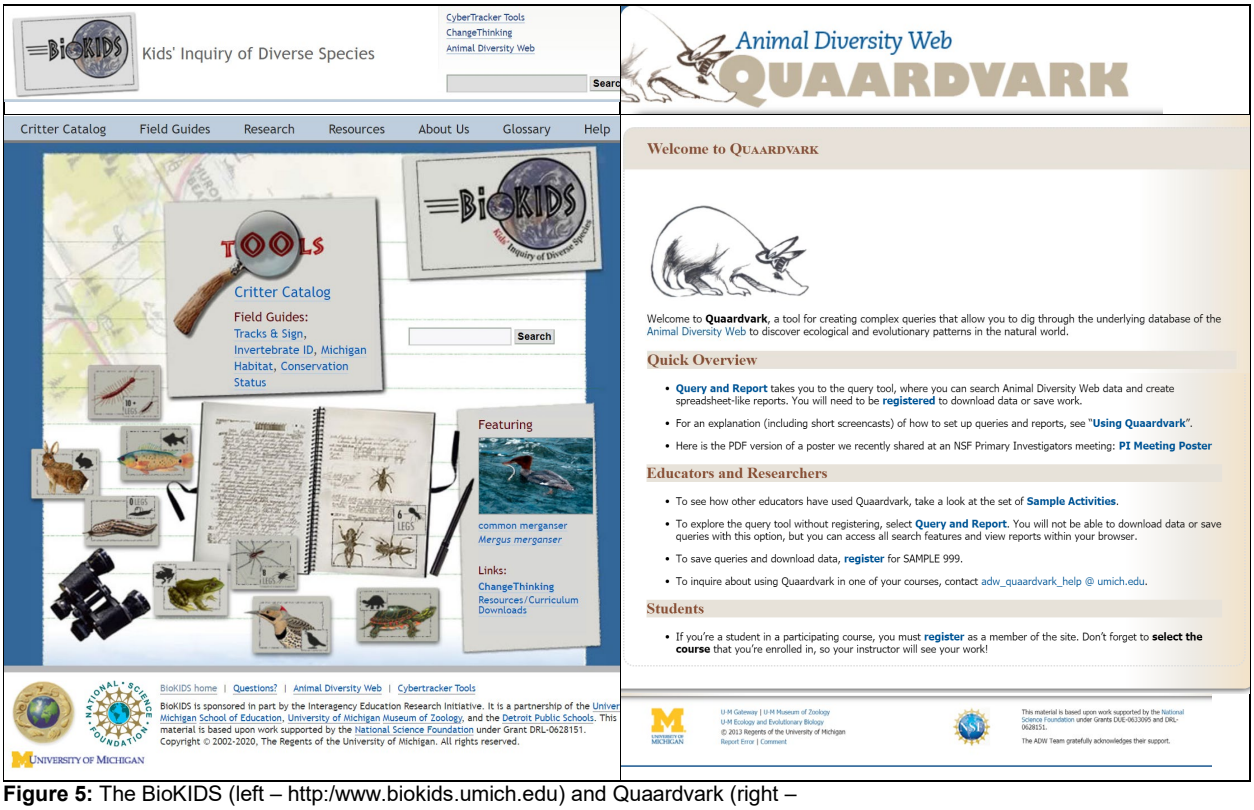


Figure 5: The BioKIDS (left – http:/www.biokids.umich.edu) and Quaardvark (right – https://animaldiversity.ummz.umich.edu/quaardvark/) webpages. These two products of the ADW allow for a wide age group of users for all levels of education.

The ADW's NSF-supported Quaardvark project represents an important innovation in providing opportunities for college and university students to test hypotheses with real data engaging true scientific inquiry. Quaardvark supports searching the database for traits of animals (including morphological, behavioral, and ecological) and retrieving information in user-specified format. It has been used in over 30 undergraduate classrooms (from community colleges to R1 institutions) in a wide variety of courses, impacting a large audience of students yearly (in the two years of the NSF support, over 3000 students were evaluated to test the effectiveness of the activities).

Previous funding sources for ADW in part include the U.S. Interagency Educational Research Initiative, National Science Foundation, Homeland Foundation, University of Michigan Museum of Zoology, and the University of Michigan College of Literature, Science and the Arts.

UM HERBARIUM AND UMMZ BIOREPOSITORY – Submitted by Cody Thompson

Description – The University of Michigan Herbarium and Museum of Zoology (UMMZ) jointly administer the Research Museums Center (RMC) Biorepository. The RMC Biorepository is one of several key-shared research facilities within the RMC. The purpose of the RMC Biorepository is to provide the Herbarium and UMMZ a stable archival solution for tissues obtained and accessioned into the collections of each unit. Given the samples held in the RMC Biorepository are accessioned, the facility requires specialized training for access and is not meant for active research.

2019 Update – In 2019, the RMC Biorepository had several key facility upgrades that improved personnel and sample safety, as well as increased overall sample capacity. Facility upgrades included the addition of 24/8 safety lighting in the room, the connection of the space to backup generators, and the installation of a new gas detection system. The new gas detection system provides real-time monitoring of oxygen levels in the space and communicates directly with the university's building automated monitoring system (UM BAS), contacting essential personnel when an alarm is activated. In addition, each freezer sensor was upgraded to enable monitoring of all alarm states. And finally, a Custom Biogenic Systems V3000-AB was added late in the fall, increasing the overall capacity of the RMC Biorepository to 152,945 2ml tissue vials.

Figure 1: Old gas detection system. Issues with faulty oxygen sensor revealed inability to record oxygen levels in Biorepository. Connection to UM BAS only allowed 30 minute interval recording.

Figure 2: New gas detection system allows oxygen levels to be recorded and downloaded at desired intervals. New system is connected to UM BAS and allows for real time date retrieval.

Figure 3: Open Custom Biogenic Systems V5000-AB (40,300 2ml vial capacity) was thawed to allow source alarm sensors to reset, and items shifted to V3000-AB (22,100 2ml vial capacity).

Figure 4: Postdoctoral Fellow D. Rabern Simmons, installing specimens for chytrid fungus research into V5000EH-AB (46,500 2ml vial capacity). All chytrid fungus collection now stored in V3000-AB.

COLLECTION OF ZOOSPORIC EUFUNGI – Submitted by Timothy Y. James and D. Rabern Simmons

Description – The Collection of Zoosporic Eufungi at the University of Michigan (CZEUM) is the world's largest repository of cryopreserved cultures of Chytridiomycota, Monoblepharomycota, and Blastocladiomycota fungal isolates, colloquially known as chytrid fungi. The CZEUM was created in 2018 by the consolidation of the University of Maine Culture Collection (UMCC or JEL) maintained by Dr. Joyce E. Longcore and the University of Alabama Chytrid Culture Collection (UACCC) administrated by Dr. Martha J. Powell. Supplemental to the JEL and UACCC, the CZEUM was expanded to include the personal *Allomyces* collection of Dr. Ralph Emerson, previously held by the Fungal Genetic Stock Center at Kansas State University. Additionally, the mycology group at U-M has continued to grow the collection, adding 14 new isolates. New strains were also sent for safeguarding from two external researchers, one of which is an ex-type strain.

The CZEUM holds 1210 cryopreserved cultures, with 816 thus far proven viable, and 78 are ex-type cultures. The goals of the CZEUM are to maintain these cultures as physical representations of the past efforts of chytrid fungi biologists and to make these cultures available for study by interested researchers and educators.

2019 Usage Statistics – Between 1 January 2019 and 31 December 2019, researchers attempted to revitalize 340 cryopreserved cultures for DNA extraction and restocking efforts. When materials were viable, DNA was extracted, and cryopreserved stocks were replenished with up to five replicates each. Additionally, nearly 100 cultures provided to the CZEUM as active cultures were grown for DNA extraction and cryopreservation. These efforts were led by postdoctoral fellow Dr. Rabern Simmons, with the aid of 1 undergraduate student and 1 recent graduate of the University of Michigan. Since 2018, researchers have generated quantifiable DNA extracts from 503 CZEUM cultures, and these extracts are kept at -20 °C in the Biological Sciences Building on the University of Michigan Central Campus. Additionally, 25 CZEUM isolates were requested by 11 researchers from 11 institutions in 3 countries (USA; Canada; UK) to facilitate work on amphibian and algal pathogenic systems, fungal physiology, and phylogenetics.

Figure 1: Alex Glasco (U-M class of '20, left) and Rebecca Clemons (U-M class of '19) accessioning CZEUM cryopreserved cultures from the JEL collection after delivery of a dry nitrogen shipper to the RMC. Image in Figure 1 and Figure 2 used with permission by photographer Rabern Simmons.

Figure 2: Dr. Peter M. Letcher at the University of Alabama preparing UACCC cryopreserved cultures at -80 C for overnight transport to the RMC and inclusion into the CZEUM.

Figure 3: Postdoctoral Fellow D. Rabern Simmons, installing specimens for chytrid fungus research into 2ml vial box tower in liquid nitrogen tank at RMC Biorepository. Image used with permission by photographer Benjamin Hess.

UMMZ MICRO(μ)-CT SCANNING LABORATORY – Submitted by Ramon Nagesan

Description – The University of Michigan Museum of Zoology (UMMZ) Micro(μ)-CT Scanning Laboratory allows researchers to generate high resolution tomographic data of bones, fossils, and contrast enhanced (diceCT) tissues. These data include 3D surface visualization of anatomy and morphology that facilitate morphometric studies, phylogenetics analysis, and biomechanics modelling.

The UMMZ μCT Scanning Laboratory owns and operates a Nikon XT H 225ST μCT Scanner. The UMMZ μCT Scanning Laboratory operates under all LARA, MIOSHA, and OSEH safety guidelines. The Lab Manager (i.e., CT Facility Manager / Morphology Technician), Ramon Nagesan, conducts or supervises all scanning.

The UMMZ scanning process produces raw—or "slice"—data comprised of hundreds of radiograph images in packages containing stacks of TIFFs and other files used for building 3D reconstructions. Each package totals 12-18 GB per package that will potentially amount to several terabytes (TB) for the project as a whole. Data preprocessing includes converting files from a Nikon proprietary format to a more accessible TIFF stack. All data scanned at the UMMZ CT lab for the oVert project is made available to the public via MorphoSource and UM Deep Blue Data Repository.

2019 Usage Statistics – Between 1 January 2019 and 31 December 2019, the Nikon XTH225st microCT scanner has produced 1758 scans (see details below). These scans include birds, insects, mammals, reptiles, and a pot from the UM Museum of Anthropological Archaeology. The UMMZ is one of five scanning intuitions that is a part of the NSF funded oVert project and has scanned 709 species from 18 different collections representing 10 different institutions. During this time lab has also been used to train 3 post-docs, 5 graduate and 3 undergraduate students in μ CT scanning, data visualization, and analysis techniques.

Institution Owning Scanned Material	Number of Scans per Institution (Scan Number does not Equal Total
Academy of Natural Sciences Philadelphia (ANSP)-birds	10
Academy of Natural Sciences Philadelphia (ANSP)-fish	26
California Academy of Sciences (CAS)-mammals	5
California Academy of Sciences (CAS)-herps	109
Carnegie Museum (CM)-birds	22
Carnegie Museum (CM)-mammals	5
University of Kansas (KU)-herps	67
Michigan State University (MSU)-mammals	9
Museo de Historia Natural, Peru (MUSM)-herps	27
Museum of Vertebrate Zoology, Berkeley (MVZ)-herps	69
Museum of Vertebrate Zoology, Berkeley (MVZ)-mammals	53
Royal Ontario Museum, Toronto (ROM)-ichthyology	26
South Australia Museum, Adelaide (SAMA)-herps	105
UM Museum of Zoology (UMMZ)-birds	37
UM Museum of Zoology (UMMZ)-fish	211
UM Museum of Zoology (UMMZ)-herps	729
UM Museum of Zoology (UMMZ)-insects	5
UM Museum of Zoology (UMMZ)-mammals	149
UM Museum of Archaeological Anthropology	1
University of Tennessee (UT)-fish	2
Yale Peabody Museum (YPM)-mammals	25
Yale Peabody Museum (YPM)-birds	53
22 TOTAL INSTITUTIONS	**1758 TOTAL SCANS**

UMMZ MICRO(μ)-CT SCANNING LABORATORY – continued

Figure 1: Ramon Nagesan explaining the scanning process during an EEB PhD Recruitment event at the RMC. Image by Benjamin Hess.

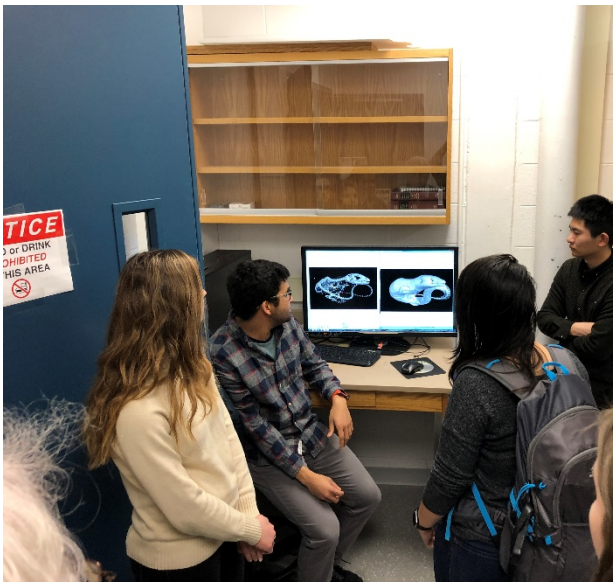


Figure 2: Ramon Nagesan explaining the 3D surface regeneration during an EEB PhD Recruitment event at the RMC. Image by Benjamin Hess.

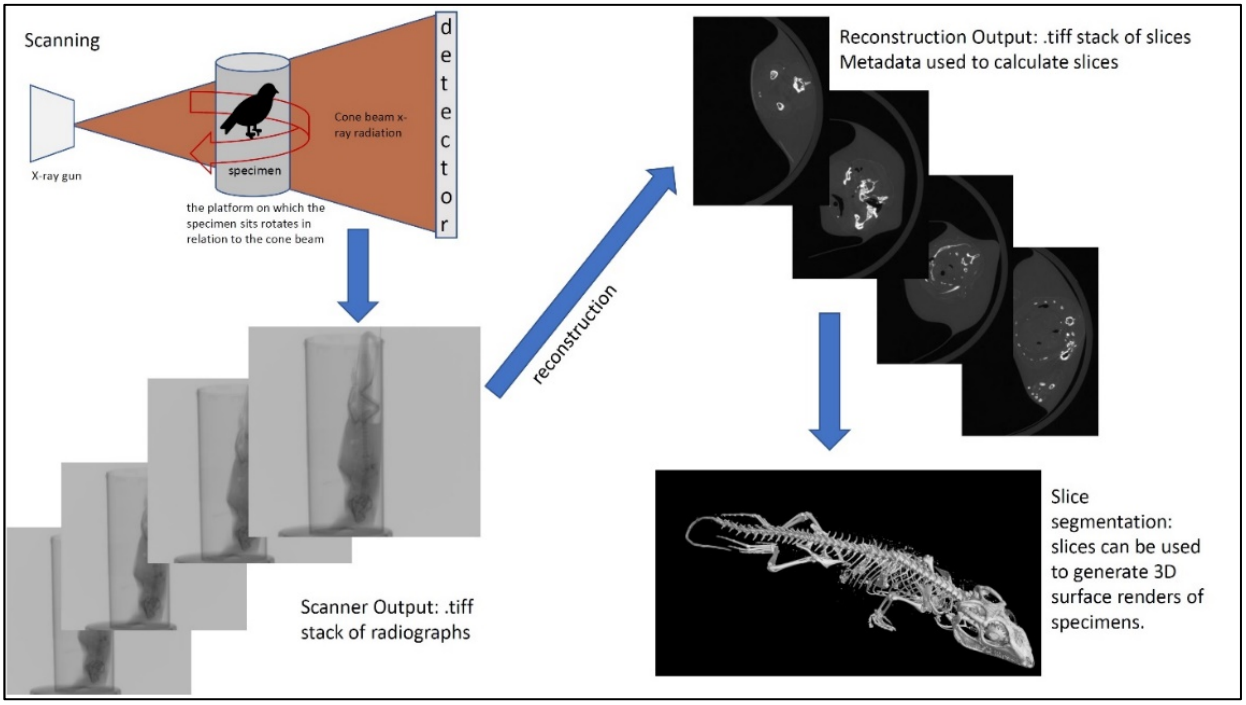


Figure 3: The scanning process in simplified form.

UMMZ MICRO(μ)-CT SCANNING LABORATORY – continued

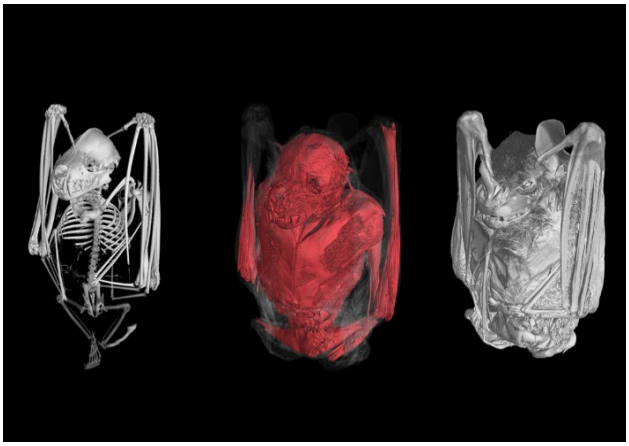


Figure 4 (above): *Artibeus jamaicensis* 3D skeletal render, contrast enhanced muscle render, and skin render. This specimen is accessioned at the UMMZ mammal collection and was scanned at the UMMZ CT lab.

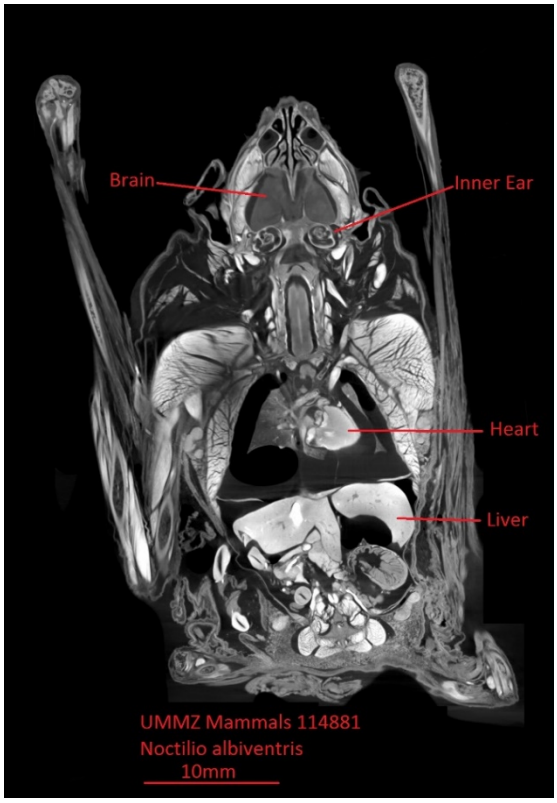


Figure 5 (right): *Noctilio albiventris*, contrast enhanced scan to show soft tissue anatomy. This kind of scanning allows for digital dissection of anatomy only otherwise accessible via destructive means. Scanned at UMMZ.

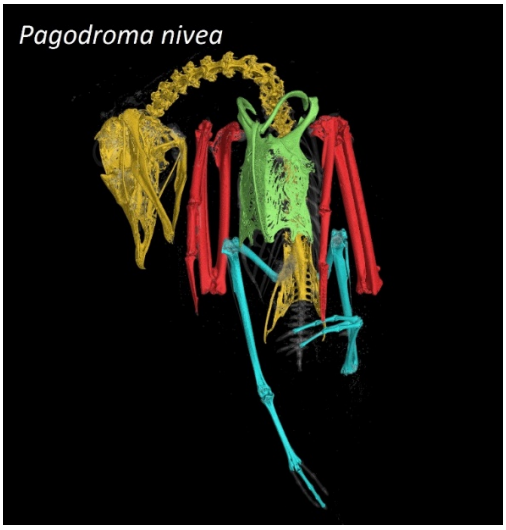


Figure 6: *Pagodroma nivea*, skeletal render segmented to show different regions of the body. Scanned at UMMZ.

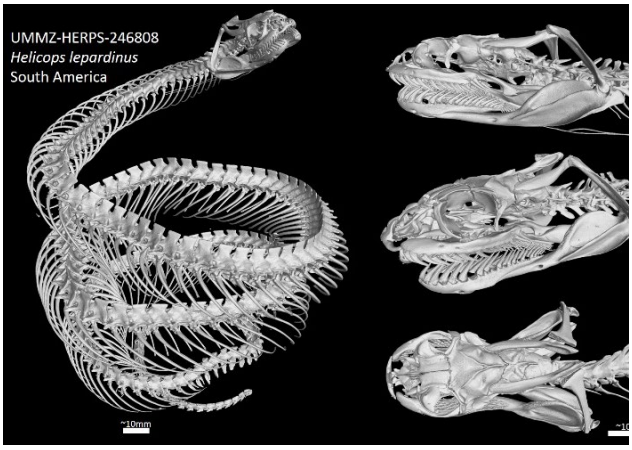


Figure 7: *Helicops lepardinus*, skeletal scan with high resolution scan of the skull for increased morphological data. Scanned at UMMZ.

UMMZ DERMESTID BEETLE LAB (DERMESTARIUM) – Submitted by Benjamin Hess and Cody Thompson

Description – The University of Michigan Museum of Zoology (UMMZ) maintains a colony of dermestid beetles (*Dermestes maculatus*), also known as a dermestarium, at the Research Museums Center (RMC). The dermestid beetles are also known as hide, carrion, or skin beetles, and their name is derived from the Greek word *dermis*, or skin. These beetles have been utilized to clean skeletal material at the UMMZ since 1937, but prior to this, bone preparation was done by water, soil or manure maceration.

Dermestid beetles of this species have an approximate life span of 4-5 months, and go through a complete life cycle. An adult female can produce seve ral hundred eggs, which may remain an egg for 2-4 days. After the egg, the larval stage will persist for seven instars or growth periods, growing quickly depending upon the food choice often exceeding 10 mm in length. The larval stage varies from 1-7 months depending upon food and environment. The pupae stage uses the last larval skin as protection, and lasts 7-8 days on average. If the conditions are optimal, the life cycle from egg to adult can happen as quickly as 42-48 days.

(1) 

(2) 

(3) 

(4) 

(5) 

(6) 

Figures 1 – 6: Life cycle images of the dermestid beetle (*Dermestes maculatus*): (1) lateral view of larva, (2) dorsal view of larva, (3) lateral view of pupa, (4) lateral view of adult, (5) dorsal view of adult, (6) ventral view of adult. Used with permission by photographer Joyce Gross, University of California, Berkeley. Images from Bugguide.Net - https://bugguide.net/node/view/39729, 39728, 47458, 47459, 39726, and 39727 respectively.

UMMZ DERMESTID BEETLE LAB (DERMESTARIUM) – continued

2019 Usage Statistics – The UMMZ Bird, Fish, Mammal and Reptile & Amphibian Divisions use the dermestarium to prepare skeletal material for the dry collections. Many smaller specimens for the Fish and Reptiles & Amphibians Divisions are cleared and stained for the examination of specimen skeletons, where the Bird and Mammal Divisions primarily use dermestids.

In 2019, 386 specimens were cleaned by student collection assistants working in the Mammal Division. The most notable specimens were a North American porcupine and some large fish taxa from Florida. Two student collection assistants supported the UMMZ Dermestid Colony. They were Lexi Frank (EEB '19) and Michael Lyons.

Figure 1 – 3: UMMZ Mammal Division volunteer Michael Lyons working in the dermestarium. **Left** – Frass is the layer at the bottom of the tanks composed of the larval exoskeleton, excrement and the beginning substrate material. **Middle** – Each specimen is placed in separate containers, where the paper towels help to maintain optimal light, temperature and humidity around the specimen. The paper towels also enable the ease of larvae mobility. **Right** – Specimens are frozen after the desired bone cleaning is completed by the dermestids. Each specimen is handpicked with forceps to separate the bones from the remaining dermestids, followed by additional cleaning steps. Images used with permission by Michael and photographer Benjamin Hess.

For more information about the UMMZ dermestarium, please see https://webapps.lsa.umich.edu/ummz/mammals/dermestarium/default.asp.

OUTREACH AND TOURS

Public outreach is not the primary function of the UM Herbarium and UMMZ research museums, but most staff contribute to educating UM students and staff, and those not affiliated with the University about their taxonomic disciplines and the collections. Tours of the UM Herbarium and UMMZ collection space at the Research Museums Center (RMC) are often one of the ways staff educate others about the significance of these research collections. Museum curators teach courses offered by the Ecology and Evolutionary Biology (EEB) Department where specimens and collections are used for student learning. Graduate students involvement in the museums require staff to promote the museums as a valuable resource, and the EEB PhD Recruitment Event includes a day at the RMC where curators talk about these opportunities (Figure 1).

The UMMZ Insect Division is beginning a prairie restoration project at the RMC, where they raked thatch (Figure 2) and applied the first round of a cover crop in 2019. This project included outreach for elementary age students in 2018 and community involvement with the preparation of the prairie.

The preservation of specimens and associated data for current and future research is a core component of the EEB museums. Digitizing specimens makes the associated data easily accessible in a digital format, but may also include making original documentation publically available. Images digitization makes specimens even more valuable and accessible. The UM Herbarium and UMMZ have made the digitization of specimens, records and images a major initiative. Many of the collections are available through global data aggregators and the UM Digital Library. In 2019, the UM Digital Library and the UM Copyright Office staff came to the RMC (Figure 3) to see firsthand how these resources are preserved and managed.

Figure 1 – 6: EEB PhD Recruitement Event at the RMC on 9 February 2019. The EEB holds an annual recruitment weekend involving collection tours at the RMC and discussing graduate student opportunities with the museums. **Top-row (left to right):** Priscilla Tucker – Mammal Curator, Tony Reznicek – Herbarium Curator, Hernan Lopez-Fernandez – Fish Curator; **Bottom-row (left to right):** Diarmaid O'Foighil – Mollusk Curator, Dan Rabosky – Reptiles & Amphibians Curator, and Ramon Nagesan – CT Facility Manager / Morphology Technician. Images used with permission by photographer Benjamin Hess.

OUTREACH AND TOURS – continued

Figure 7: Prairie Restoration Project: thatch cleanup community event on 23 March 2019 at the Research Museums Center. Insect Division Erika Tucker and PhD student Sasha Bishop organized two thatch clean-ups and one cover crop seed spreading in 2019. Image used with permission by photographer Benjamin Hess.

Figure 8 - 10: Behind the scenes tour for U-M Digital Library and Copyright Office Staff on 20 Jun 2019. (**Left**) UMMZ Reptiles & Amphibians Division Collection Manager Greg Schneider gives an overview of the wet collections, (**Middle**) UMMZ Insect Division Curator Barry OConnor gives tour of the dry collections, and (**Right**) Greg gives details database records. The UM Herbarium and UMMZ have 26 collections stored with UM Digital Library. Images used with permission by photographer Benjamin Hess.

MAKING SCIENCE VISIBLE – STAMPS School of Art & Design, Winter 2019

Description – The University of Michigan, Penny W. Stamps School of Art and Design, Making Science Visible Class visited the Research Museums Center for material for class assignments. 2019 marked the sixth time that Dr. Brad Smith (https://stamps.umich.edu/people/detail/brad_smith) has taught this class, with the past courses occurring in 2009, 2011, 2013, 2015 and 2018. Students take five distinct approaches to depicting (making visible) the natural world. They have five assignments to investigate and portray a biological subject (bird, fish, insect, mammal, mollusk, or reptile/amphibian) from the University of Michigan Museum of Zoology. They observe, measure, depict, and document their subject. Each approach results a new interpretation of their subject.

UMMZ Collection Visits – Tours of the UMMZ collections help determine a specimen for student projects.

Figure 1-7: Left-to-right, top-to-bottom: UMMZ collection and staff giving tour or talk. Birds (Collection Manager Brett Benz), Fish (Collection Manager Doug Nelson), Insects (Collection Manager Erika Tucker), Mammals (Collection Manager Cody Thompson), Mollusks (PhD Student Andrew Wood), Mollusks (Collection Manager Taewan Lee), Reptiles & Amphibians (Collection Manager Greg Schneider). Photos by Dr. Brad Smith, except Mollusk Division photos (5 and 6) by Benjamin Hess.

MAKING SCIENCE VISIBLE – STAMPS School of Art & Design, Winter 2019

Online Information – For more details, see the following sites:

- Tumblr site: Making Science Visible 2019, 2018, 2015, 2013, 2011, 2009 (https://makingsciencevisible.tumblr.com/)
- Blog post: One Specimen, Five Ways of Seeing. Making Science Visible (http://playgallery.org/blog/entry/one_specimen_five_ways_of_seeing)
- EEB post May 2015: Getting to know you: unique scientific illustration class explores UMMZ collections (https://lsa.umich.edu/eeb/news-events/all-news/archived-news/2015/05/getting-to-know-you--unique-scientific-illustration-class-explor.html)
- EEB post March 2018: Art and science collide in “Making Science Visible” course (https://engaged.umich.edu/news-features/science-and-art-collide-in-making-science-visible-course/)
- Lightroom shares: Making Science Visible 2018 (https://lightroom.adobe.com/shares/ec3c9d769d624aa3b50d315e208f5713)

Student Class Assignments

Students use direct observation, optical photography, radiology, research, and personal experience to inform and generate their drawings, images, illustrations and objects. 2019 Making Science Visible students represented in details: Calla Beers, Stephanie Francalancia, Leila Mullison, Jenna John.

Direct Observation – Make detailed drawings of the subject from direct observation.

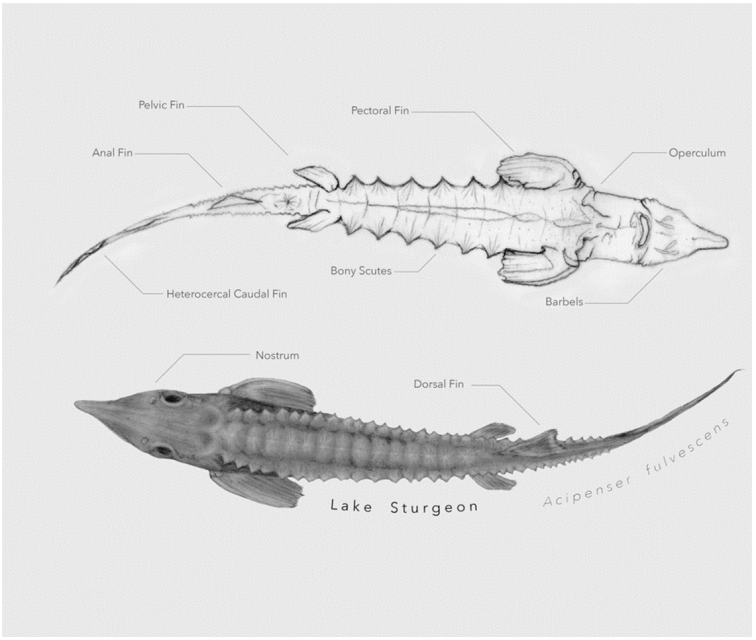


Figure 8: Direct observation illustration of a lake sturgeon (*Acipenser fulvescens*). Used with permission by artist Calla Beers.

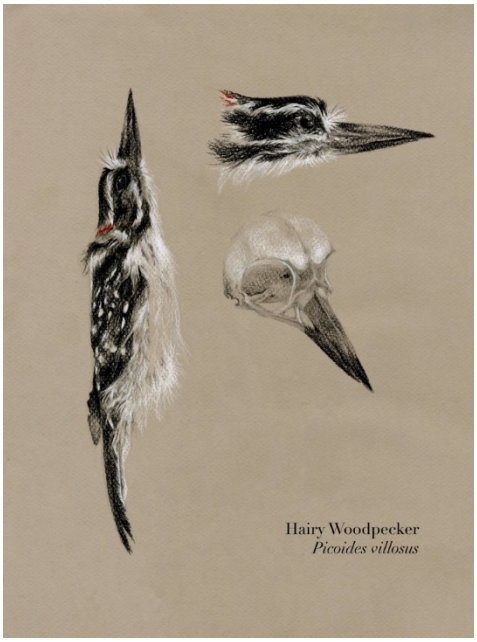


Figure 9: Direct observation illustration of a hairy woodpecker (Picoides villosus). Used with permission by artist Stephanie Francalancia.

MAKING SCIENCE VISIBLE – STAMPS School of Art & Design, Winter 2019

Optical photography – Record the subject using a camera.

Figure 10: Optical photography art of an American kestrel (*Falco sparverius*). Used with permission by artist Leila Mullison.

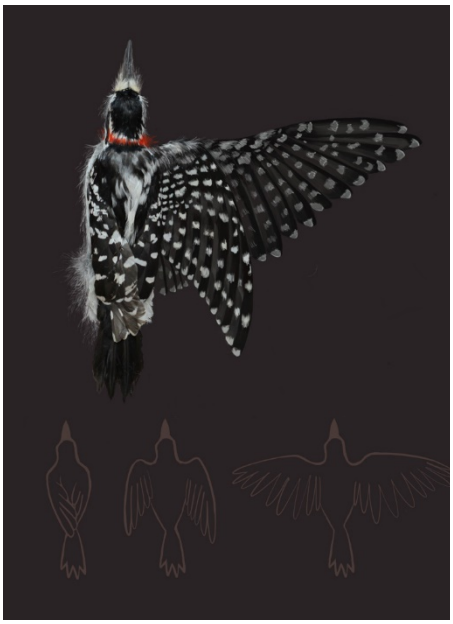


Figure 11: Optical photography of a hairy woodpecker (*Picoides villosus*). Used with permission by artist Stephanie Francalancia.

Radiology – Expose the subject using x-rays.

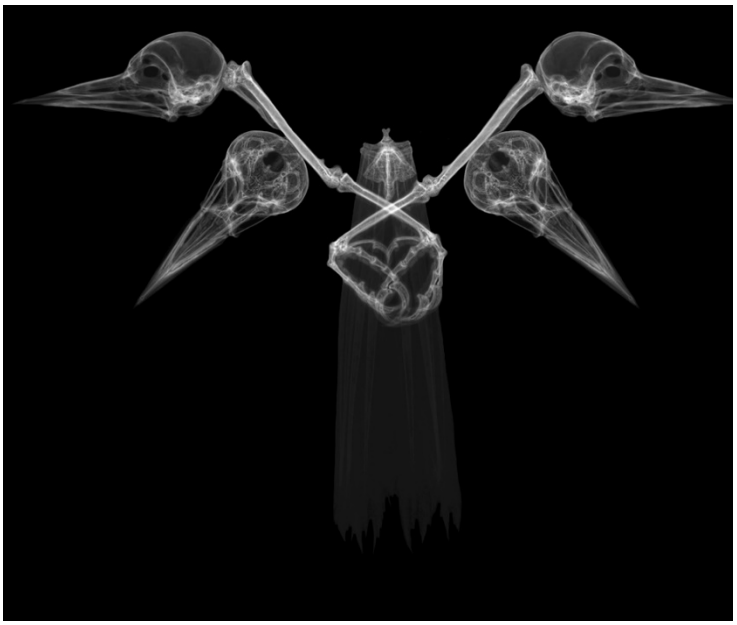


Figure 12: Radiology generated art of a hairy woodpecker (*Picoides villosus*). Used with permission by artist Stephanie Francalancia.

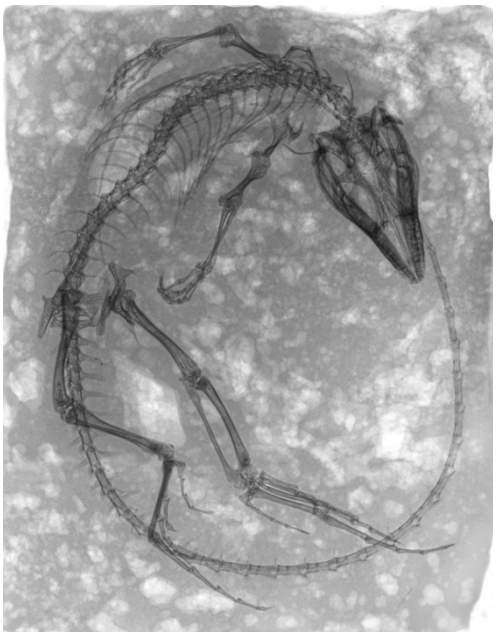


Figure 13: Radiology generated art of an Aruba whiptail (*Cnemidophorus arubensis*). Used with permission by artist Jenna John.

MAKING SCIENCE VISIBLE – STAMPS School of Art & Design, Winter 2019

Illustration – Illustrate scientific information (concepts, ideas) about the subject, such as life cycles, migration patterns, evolutionary processes, feeding behavior…

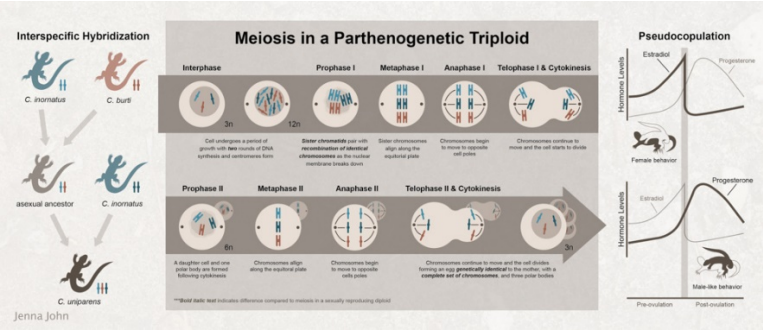


Figure 14: Scientific information illustration of an Aruba whiptail (*Cnemidophorus arubensis*). Used with permission by artist Jenna John.

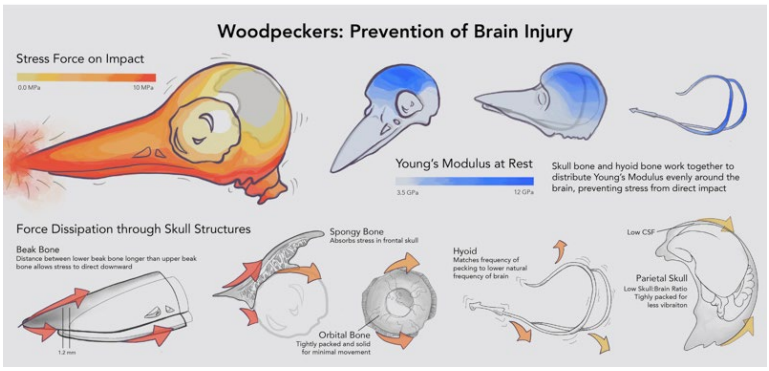


Figure 15: Scientific information illustration of a hairy woodpecker (*Picoides villosus*). Used with permission by artist Stephanie Francalancia.

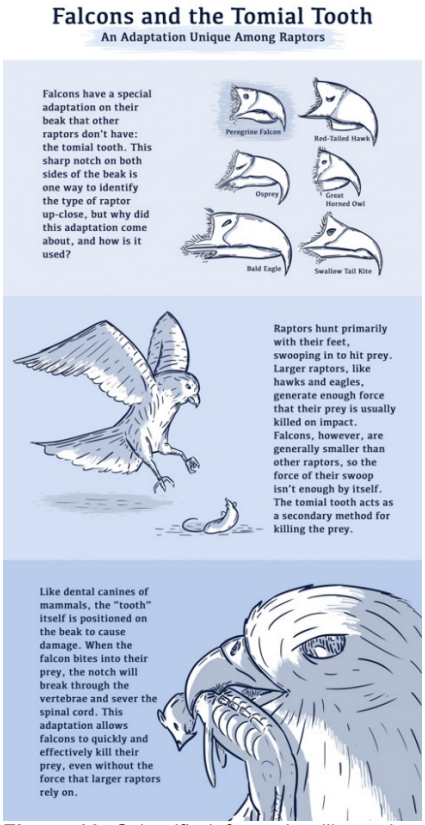


Figure 16: Scientific information illustration of an American kestrel (*Falco sparverius*). Used with permission by artist Leila Mullison.

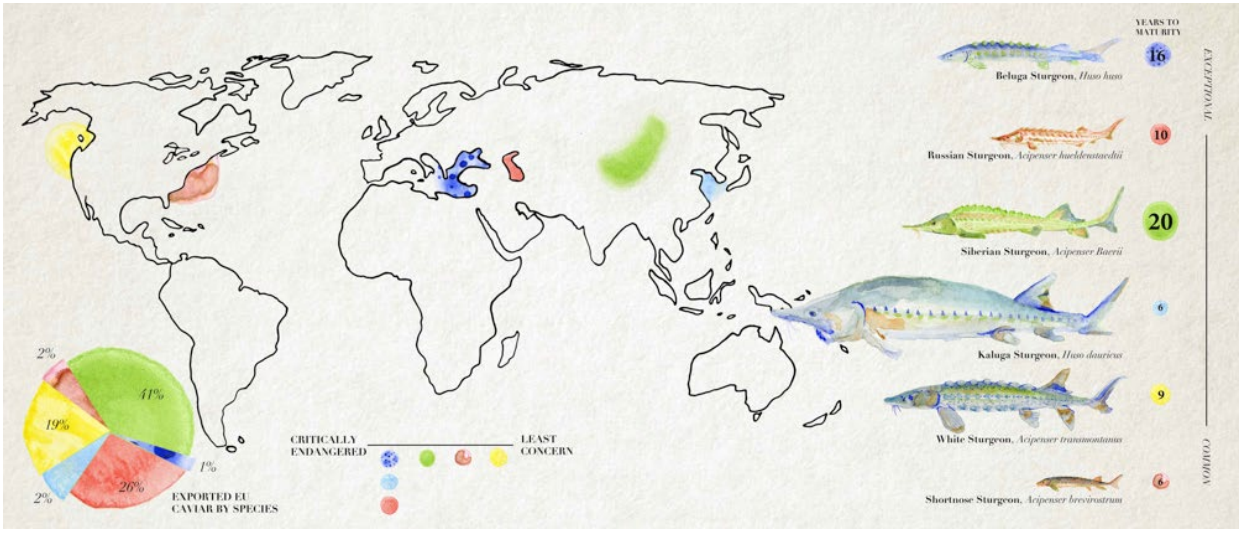


Figure 17: Scientific information illustration of a lake sturgeon (*Acipenser fulvescens*). Used with permission by artist Calla Beers.

MAKING SCIENCE VISIBLE – STAMPS School of Art & Design, Winter 2019

Response – Create an expressive or emotional response to the interaction with the specimen using any medium or process.

Figure 18: Expressive response art of an Aruba whiptail (*Cnemidophorus arubensis*). Used with permission by artist Jenna John.

Figure 19: Expressive response art of a lake sturgeon (*Acipenser fulvescens*). Used with permission by artist Calla Beers.

DIVISION STATISTICS DEFINED – For calendar year 1 January though 31 December

OVERVIEW – written summary of the calendar year events
PERSONNEL – list of working titles and individuals within these titles for the calendar year
COLLECTION GROWTH / DATA ENHANCMENT – added specimens and data records during the calendar year
TAXONOMIC BREAKDOWN / TYPES / DATABASE STATUS – tally of database records at end of calendar year
GLOBAL LOCALITY (variations exist within divisions)
United States: Continent = North America, Country = United States
Canada: Continent = North America, Country = Canada
Mexico: Continent = North America, Country = Mexico
Central America: Continent = North America, Country 'in' Belize, Costa Rica, El Salvador, Guatemala,
Honduras, Nicaragua, Panama
Other North America: Continent = North America, Country NOT 'in' United States, Canada, Mexico, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama
South America: Continent = South America
Asia: Continent = Asia
Australia and New Zealand: Continent = Oceania, Country 'in' Australia, New Zealand
Other Oceania: Continent = Oceania, Country NOT 'in' Australia, New Zealand
Europe: Continent = Europe
Africa: Continent = Africa
Atlantic Ocean
Indian Ocean
Pacific Ocean (incl. HI)
Atlantic Islands
Indian Islands
Middle East
Pacific Islands (incl. HI)
Indomalaysian Islands
No geography defined (minus total of all others above)
REGIONAL LOCALITY
Michigan: Continent = North America, Country = United States, State = Michigan
Midwest USA: Continent = North America, Country = United States, State = North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, Ohio
Great Lakes US (w/PA & NY): Continent = North America, Country = United States, State = Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York
Great Lakes US (no PA & NY): Continent = North America, Country = United States, State = Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio
Ontario Province, Canada: Continent = North America, Country = Canada, State (Province) = Ontario
North America TOTAL: Continent = North America, OR Totals from Global Locality (United States + Canada + Mexico + Central America + Other North America)
COLLECTION TRANSACTIONS – any loan/borrow/gift/information request of specimens or the data from specimens occurring during the calendar year
INQUIRIES AND DATA REQUESTS – any documented questions about the collection, images, identifications, or general information about the taxonomic group
VISITATION TO THE COLLECTION – a visitor to the collection is anyone using the collection as a resource for their needs (e.g., art, education, research, etc.); this is documented in the online RMC visitor registration, or in division visitor catalogs

DIVISION STATISTICS DEFINED – For calendar year 1 January though 31 December

CITATIONS – Published work by curatorial staff, students, and from external collection use; Google Scholar citations citing specimens; Google Scholar total citations (from first setting up divisional Google Scholar page, last five years, recent year)

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS – list of general collection activities or accomplishments throughout the calendar year

CONFERENCES/MEETINGS/WORKSHOPS – any taxonomic, collection, or data related event attended to present or gain new knowledge (title, date, location, participant)

OUTREACH AND TOURS – any talks, presentations, or related event meant to educate the public; any tours within the collection space for UM or public education

GRANTS / AWARDS – list of all current, pending and finished grants during the calendar year; totals represent amount for the duration of the grant

GLOBAL AGGREGATORS / DATA PORTALS – details from all aggregators where data from collection specimens are shared. GBIF, iDigBio, USGS BISON, VertNet, JSTOR Herbarium, Pteridophyte Herbarium, MI Flora Herbarium, FishNet2, Morphosource

UM DIGITAL LIBRARY – Divisional digitized collections (e.g., catalogs, images, field notes, etc.) maintained and publically available through the University of Michigan Library Digital Content & Collections

UM HERBARIUM – Division Details provided by Rich Rabeler and Pat Rogers

OVERVIEW

Work in the Herbarium continued on many fronts in 2019. All collection records in the Specify database are now shared via an Integrated Publishing Toolkit (IPT) with Global Biodiversity Information Facility (GBIF) since January 2019, and also shared on the Symbiota Pteridophyte Collections Consortium portal since March 2019. A major effort was started to "clean" our digital image archive and transfer master copies to the UM Digital Library so links to them can be shared via the IPT. The Herbarium attached over 500,000 images of Fungi and Plantae to the records in Specify as the last steps of grants from the National Science Foundation. In addition to images, the Herbarium updated over 120,000 locality records and created new georeferencing standards.

Improvement and additions to the collection records are ultimately due to an increase in staff in 2019. The Herbarium hired a new Collection Manager (Brad Ruhfel) and a new Project Manager (Garth Holman), who have helped to drive this initiative. An increase in undergraduate and graduate students increased productivity. With more staff, the Herbarium was able to make great strides in the following projects: 1. organizing the collection of plant tissues stored in silica gel collection accumulated from Paul Berry's field research, 2. Improved georeferencing of Michigan specimens for the Michigan Flora Project, and 3. imaging and databasing records connected to grant funded projects.

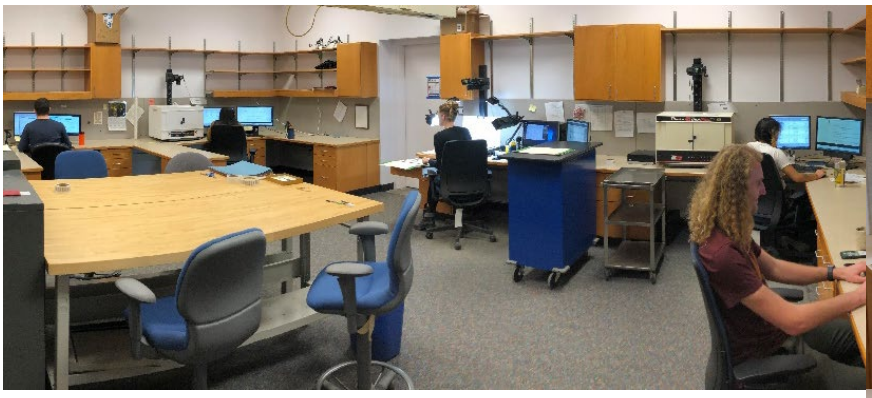


Figure 1: (TOP LEFT) A busy day of specimen digitization in the UM Herbarium. Students from left to right: Dominic Hayes, Sydney Toundaian, Dana Van Huis, Jessica Cortez, and Joe Schuler.

Figure 2: (TOP RIGHT) Graduate student Dana Van Huis imaging specimens from Michigan in support of the Michigan Flora project.

Figure 3: (RIGHT) A happy group of digitization technicians, from left to right: Jessica Cortez, Teresa Dorado, Hannah Reierson, Jennifer Wen, Dominic Hayes, Joe Schuler, Lijun Zhao, and Dana Van Huis. Photos by Benjamin Hess.

UM HERBARIUM

PERSONNEL – 43 total staff members in 2019

Title	Name(s)
Faculty Curator	Chris Dick (Plantae) and Tim James (Fungi)
Associate Curator (Dry Appointment)	Y.L. Qiu and Stephen Smith
Staff Curator / Research Scientist	Tony Reznicek
Collection Manager / Research Scientist	Rich Rabeler
Collection Manager / Assistant Research Scientist	Brad Ruhfel (from 28 Jan 2019)
Collection Manager	Pat Rogers
Emeritus Curator	Paul Berry, Robyn Burnham and Mike Wynne
Digital Image Specialist	Bev Walters (from Oct 2019 – retired Herbarium Collection Manager)
Research Scientist	Chris Anderson (to 30 Jun 2019, then Emerita) and Florence Anderson (deceased Oct 2019)
Research Affiliate	Mike Penskar
Project Manager / Research Lab Technician	Garth Holman (Endless Forms and Pteridophyte Collections Consortium TCNs, from 25 Feb 2019)
Independent Researcher	Hannah-Maria Jacques (also with UMMZ Insect Division)
Postdoctoral Researcher	Rabern Simmons (oversight of the CZEUM living collection)
Graduate Student Curatorial Assistants	Buck Castillo (winter) and Lijun Zhao (fall)
Non-student Technician	Kailyn Atkinson, Amanda Criss, Kristina Elkins, Amanda Klain, Rachel Pernik and Nancy Stoll
Graduate Student	Teresa Dorado, Dominic Hayes, Dana Van Huis, Maggie Foley, Molly Ng and Hanna Reierson
Undergraduate Assistants	Alexandra Eason, Cody Ladd, Kyle Lough, Maddie Parsnick, Lizi Rott, Joe Schuler, Syd Toundaian, Zach Watson and Jen Wen
Administrative Specialist	Michael Ehnis
Registrar	Benjamin Hess (across Herbarium and all UMMZ divisions)

COLLECTION GROWTH / DATA ENHANCEMENT

Category	Division	Number
Accessions	Herbarium	23 accessions (1,413 specimens) - 20 MI, 1 IL, 1 MD, 1 eastern U.S.
	Fungi	2 accessions (51 specimens)
	Plantae	21 accessions (1,362 specimens)
Mounted Plants	Plantae	75 treatment events (2,509 specimens) – with 8 individuals preparing specimens
Data Entries	Herbarium	10,935 created, 13,275 cataloged, 56,259 modified
	Fungi	1,393 created, 1,393 cataloged, 14,915 modified
	Plantae	9,518 created, 11,858 cataloged, 41,312 modified

UM HERBARIUM

COLLECTION GROWTH / DATA ENHANCEMENT – continued

Category	Division	Number
Locality	Herbarium	71,244 created, 148,747 modified
	Fungi	8,740 created, 36,539 modified
	Plantae	62,475 created, 112,159 modified
Images Added	Herbarium	518,004 images (jpg), 518,075 attachments created
	Fungi	220,411 images (jpg), 220,419 attachments created
	Plantae	297,461 images (jpg), 297,524 attachments created

TAXONOMIC BREAKDOWN

Taxa Represented	2018 Total in Specify	Increase 2018 to 2019	2019 Total in Specify
Families	963	2	965
Genera	10,102	34	10,136
Species	82,813	310	83,123

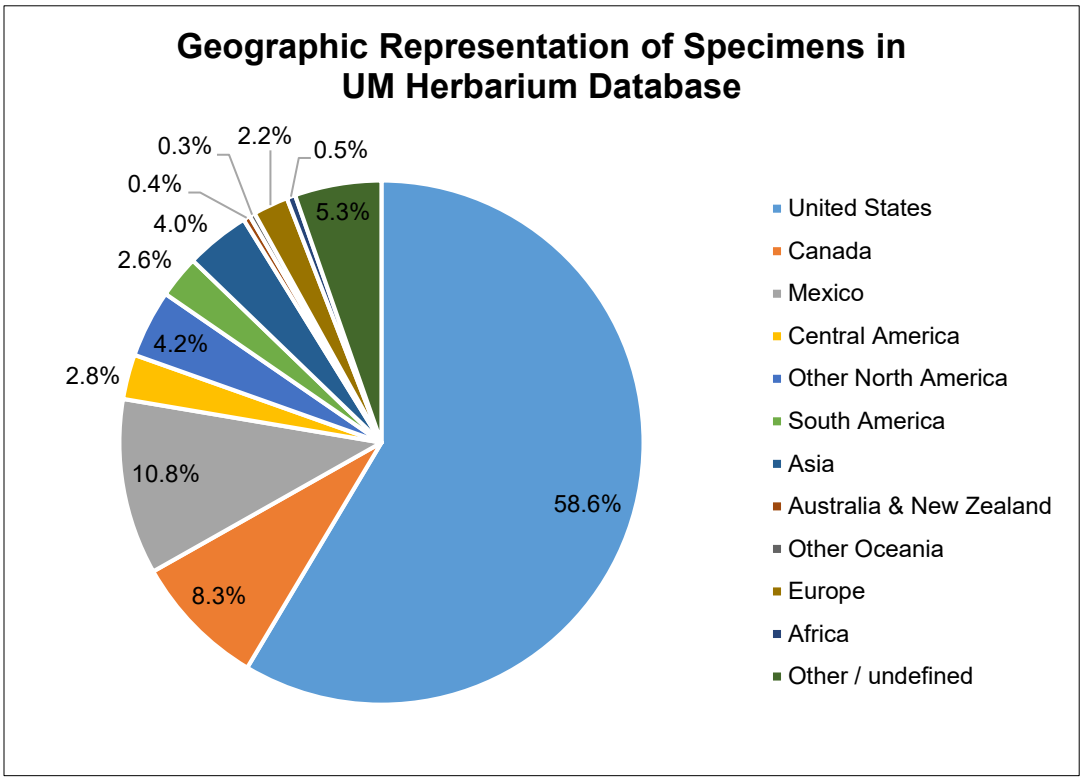
TYPES / DATABASE STATUS

Category	Division	Number
Types Represented	Herbarium	24,942 type specimens (33 new in 2019; indicated in Specify Statistics tab): 12 Isotypes, 10 Paratypes, 8 Isoparatypes, 5 Holotypes
High Catalog Number	Herbarium	1,750,000
Percent Databased	Herbarium	56.55% of specimens in Specify (989,602/1,750,000)
Percent of Georeferenced Specimens	Herbarium	31.29% of specimens in Specify (309,603/989,602)
	Fungi	15.31% of specimens in Specify (49,112/320,759)
	Plantae	38.94% of specimens in Specify (260,395/668,632)
Percent of Georeferenced Specimens in MI	Herbarium	53.95% (128,541/238,255)
	Fungi	26.66% (23,966/89,910)
	Plantae	70.50% (104,490/148,214)

UM HERBARIUM

GEOGRAPHIC DISTRIBUTION

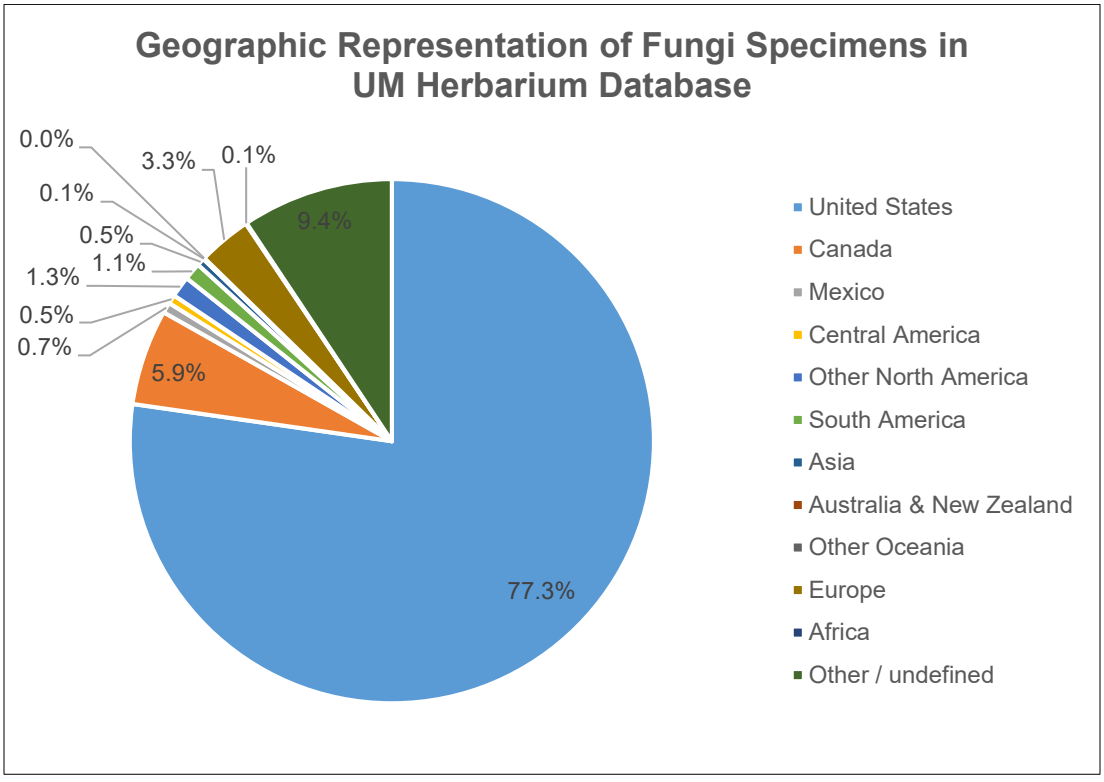
Global Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
United States	566,641	12,847	579,488
Canada	80,007	1,767	81,774
Mexico	106,093	1,240	107,333
Central America	26,693	669	27,362
Other North America / West Indies	40,789	422	41,211
South America	24,324	1,610	25,934
Asia	38,245	1,051	39,296
Australia & New Zealand	4,046	181	4,227
Other Oceania	3,156	189	3,345
Europe	21,183	284	21,467
Africa	4,298	952	5,250
Other / undefined	63,328	-10,413	52,915
TOTAL	**978,803**	**10,799**	**989,602**



UM HERBARIUM → Kingdom = Fungi

GEOGRAPHIC DISTRIBUTION

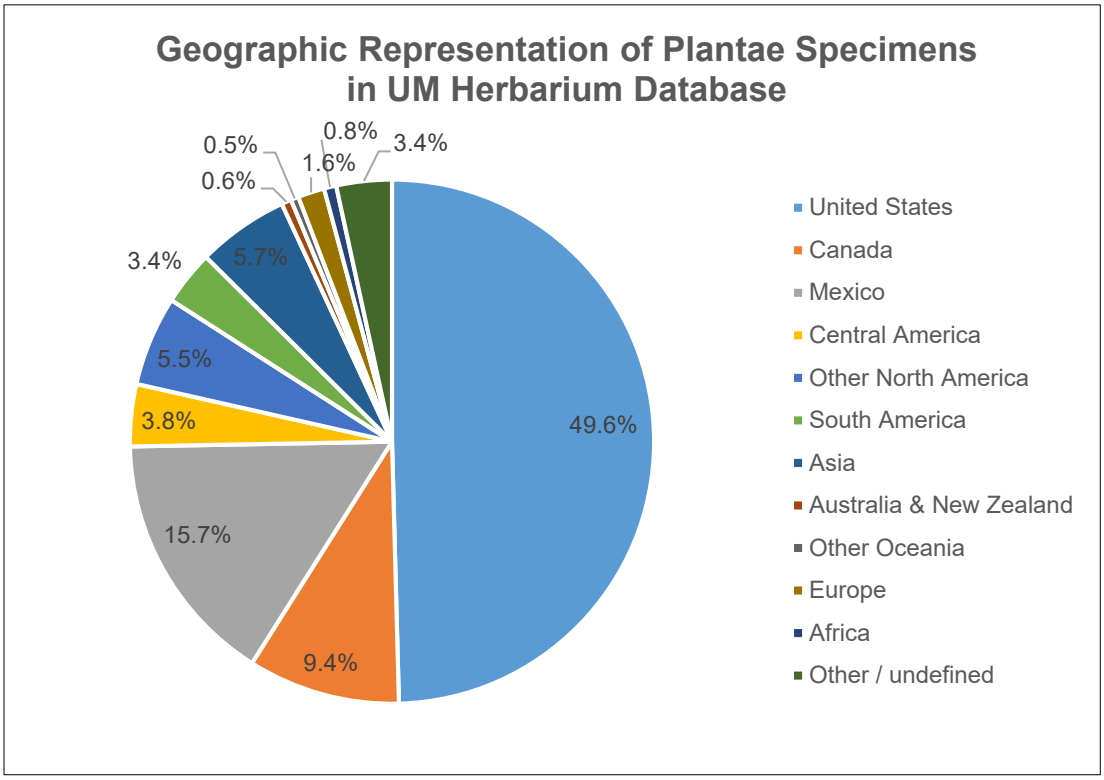
Global Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
United States	241,241	6,615	247,856
Canada	17,995	966	18,961
Mexico	1,638	461	2,099
Central America	1,346	418	1,764
Other North America / West Indies	4,064	100	4,164
South America	2,392	1,037	3,429
Asia	1,463	52	1,515
Australia & New Zealand	158	6	164
Other Oceania	106	9	115
Europe	10,394	108	10,502
Africa	194	2	196
Other / undefined	39,153	-9,159	29,994
TOTAL	**320,144**	**615**	**320,759**



UM HERBARIUM → Kingdom = Plantae

GEOGRAPHIC DISTRIBUTION

Global Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
United States	325,400	6,090	331,490
Canada	62,012	800	62,812
Mexico	104,455	773	105,228
Central America	25,347	251	25,598
Other North America / West Indies	36,725	320	37,045
South America	21,932	570	22,502
Asia	36,782	998	37,780
Australia & New Zealand	3,888	175	4,063
Other Oceania	3,050	180	3,230
Europe	10,789	176	10,965
Africa	4,104	947	5,051
Other / undefined	24,175	-1,307	22,868
TOTAL	**658,659**	**9,973**	**668,632**



UM HERBARIUM

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Herbarium TOTAL in 2018	Increase 2018 to 2019	Herbarium TOTAL in 2019
Michigan	235,738	2,517	238,255
Midwest USA	280,671	4,419	285,090
Great Lakes US (w/PA & NY)	290,387	4,039	294,426
Great Lakes US (no PA & NY)	269,302	3,546	272,848
Ontario Province, Canada	33,046	1,258	34,304
North America	820,223	16,945	837,168

UM HERBARIUM → Kingdom = Fungi

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Fungi TOTAL in 2018	Increase 2018 to 2019	Fungi TOTAL in 2019
Michigan	89,382	528	89,910
Midwest USA	107,404	1,904	109,308
Great Lakes US (w/PA & NY)	110,732	1,328	112,060
Great Lakes US (no PA & NY)	102,869	1,155	104,024
Ontario Province, Canada	5,223	717	5,940
North America	266,284	8,560	274,844

UM HERBARIUM → Kingdom = Plantae

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Plantae TOTAL in 2018	Increase 2018 to 2019	Plantae TOTAL in 2019
Michigan	146,356	1,858	148,214
Midwest USA	173,267	2,381	175,648
Great Lakes US (w/PA & NY)	179,655	2,578	182,233
Great Lakes US (no PA & NY)	166,433	2,258	168,691
Ontario Province, Canada	27,823	541	28,364
North America	553,939	8,234	562,173

UM HERBARIUM

COLLECTION TRANSACTIONS

Category	Division	Number and Purpose
Loans	Herbarium	35 loans (300 specimens) - 13 unique institutions (22 domestic, 13 foreign); 31 research, 4 exhibit/education
	Fungi	22 loans (141 specimens) - 12 domestic, 10 foreign; 21 research, 1 exhibit/education
	Plantae	13 loans (159 specimens) - 10 domestic, 3 foreign; 10 research, 3 exhibit/education
Borrow / Loan from Other Institution	Plantae	3 loans (139 specimens) - 3 unique institutions (2 domestic, 1 foreign); 3 research
Gifts	Herbarium	16 gifts (224 specimens) - 13 unique institutions (10 domestic, 6 foreign); 16 research
	Fungi	6 gifts (31 specimens) - 1 domestic, 5 foreign; 6 research
	Plantae	10 gifts (193 specimens) - 9 domestic, 1 foreign; 10 research
Loans Closed (Returns)	Herbarium	18 returns (1032 specimens) - 14 unique institutions (14 domestic, 4 foreign); 18 research
	Fungi	10 returns (324 specimens) - 9 unique institutions (8 domestic, 2 foreign); 10 research
	Plantae	8 returns (708 specimens) - 5 unique institutions (6 domestic, 2 foreign); 8 research
Information Request	Plantae	4 requests (30 specimens) - 3 domestic, 1 foreign; 4 research
TOTAL	**Herbarium TOTAL**	**76 transactions (1725 specimens) - 50 unique institutions (51 domestic, 25 foreign); 72 research, 4 exhibit/education**
	Fungi TOTAL	**38 transactions (496 specimens) - 27 unique institutions (21 domestic, 17 foreign); 37 research, 1 exhibit/education**
	Plantae TOTAL	**38 transactions (1229 specimens) - 25 unique institutions (30 domestic, 8 foreign); 35 research, 3 exhibit/education**

INQUIRIES AND DATA REQUESTS

Category	Number
Image Requests	4
Specimen Holding Questions	10
Data Requests	1 (for 115 specimen records)
Loan Returns	2
General Inquiries	1
TOTAL	**18**

UM HERBARIUM

VISITATION TO THE COLLECTION

Category	Number
Visits / Individuals	74 visits / 247 individuals
Unique Individual / Institution	51 unique individuals, 37 unique institutions/departments
Individual Visitor Type	40 Faculty/Curator/Other Professional, 0 Postdoctoral Researcher, 19 Graduate Student, 2 Undergraduate Student, 6 Class, 1 Public, 6 Other

CITATIONS – Published work by curatorial staff, students, and from external collection use

Recorded in Google Scholar, where the h-index combines productivity (i.e., number of papers produced) and impact (number of citations) in a single number, and the i10-index refers to the number of paper with 10 or more citations.

Category	Number
Citations	86,586 total (26,556 since 2015)
h-index	137 total (71 since 2015)
i10-index	1,001 total (388 since 2015)
Citations in GBIF	45 total (16 in 2019)

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS

Details
Partial data from collection catalog through the Specify database put onto the Integrated Publishing Toolkit (IPT) to connect to global aggregators
All specimen records now shared with GBIF (Jan 2019) and Symbiota Pteridophyte portal (Mar 2019)
Began organization of the silica tissue collection with Graduate Student Curatorial Assistant.
Incorporation of most data/images from two TCN and one CSBR Grant projects.
Switch from serving TIFF files to DNG files to UM Digital Library - reducing digital space requirements

CONFERENCES / MEETINGS / WORKSHOPS

Details
Society for the Preservation of Natural History Collections (SPNHC) Annual Meeting, 28-31 May 2019, at the Field Museum, Chicago, Illinois. (participant Rich Rabeler)
Third Annual Digital Data in Biodiversity Research Conference, 10-12 June 2019, at Yale Peabody Museum, Yale University, New Haven. (participant Brad Ruhfel)
The Ninth Annual Advancing Digitization of Biodiversity Collections (ADBC) Summit, 1-3 October 2019, in Gainesville, Florida. (participant Garth Holman)
Ruhfel, B. 2019. Imperiled plants of tropical rivers: phylogeny, biogeography, and systematics of Podostemaceae. UM EEB Lunch Seminar. University of Michigan, Ann Arbor, Michigan. 1 October.

UM HERBARIUM

OUTREACH AND TOURS – Including 5 undergraduate classes

Details
15+ talks and tours done by Tony Reznicek (UM Botanical Garden, Birmingham Botanical Club, UM Stamps School of Art & Design – Florilegium Class, Huron Valley Chapter – Michigan Botanical Club, UM Mcubed Executive Director – Engineering, National Sanitation Foundation tour - including alumni from Herbarium and EEB, UM Museum Studies Class, UM Architecture Studio Class (ARCH 662), UM Anthropological Archaeology 407 Class, UM EEB Recruitment Weekend at RMC, University of Georgia Provost Office, UM Frontiers Masters Recruitment, Grand Rapids Public Museum)
Michigan Mushroom Hunters Club – lecture and tour by Tim James
Paleobotany Class with Selena Smith (Earth 432: Plant Paleobiology) – lecture and tour by Robyn Burnham and Garth Holman

GRANTS / AWARDS – Totals represent amount for the duration of the grant

Total Amount	Details
$228,167	National Science Foundation (NSF): Advances in Biological Informatics (ABI) Innovation: Authors in the driver's seat: fast, consistent, computable phenotype data and ontology production.
$280,453	NSF, Advancing Digitization of Biodiversity Collections (ADBC), Digitization Thematic Collections Networks (TCN): Collaborative Research: The Pteridological Collections Consortium: An integrative approach to pteridophyte diversity over the last 420 million years.
$95,330	NSF, ADBC, Digitization TCN: Collaborative Research: Digitizing "endless forms": Facilitating Research on Imperiled Plants with Extreme Morphologies. Subcontract under Missouri Botanical Garden.
$79,416	NSF, Collections in Support of Biological Research (CSBR): Ownership Transfer of University of Maine Chytrid Fungal Collection to University of Michigan.
$683,366	**TOTAL FROM GRANTS**
	(Submitted in 2019) NSF, ADBC: Digitization Thematic Collections Network (TCN): Collaborative Research: Bringing Asia to digital life: mobilizing underrepresented Asian herbarium collections in the US to propel biodiversity discovery. $290,873 (declined and resubmitted in 2020)
	(Submitted in 2019) NSF, TCN: Collaborative Research: Building a global consortium of bryophytes and lichens: keystones of cryptobiotic communities. Subcontract under the Illinois Natural History Survey. $97,411 (Awarded in 2020)

UM HERBARIUM

GLOBAL AGGREGATORS / DATA PORTALS – The Symbiota software sponsors 7 active portals with Herbarium specimens: Pteridophyte Collections Consortium, Consortium of North American Bryophyte Herbaria, Consortium of North American Lichen Herbaria, Macroalgal Herbarium Consortium Portal, Mycology Collections Data Portal (MycoPortal), Great Lakes Invasives Network (plants), Consortium of Midwest Herbaria

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Herbarium	23,150	569,786,148	569,786,148	569,786,148	registered 23 Jan 2019
iDigBio Herbarium Bryophtye	111,018	31,023	34,290	34,290	from Jan 2015
iDigBio Herbarium Lichen	6,399	5,880	18,080	18,080	from Jan 2015
iDigBio Herbarium Macroalgal	69,024	64,991	117	64,991	from Mar 2015
iDigBio Herbarium Midwest Herbaria	156,587	422,803	282	422,803	from Aug 2015
iDigBio Herbarium Mycology	17,386	30,397	64,804	64,804	from Jan 2015
JSTOR Herbarium	Active portal, but no usage statistics in 2019				from Jan 2007
Pteridophyte Collections Consortium	Active portal, but no usage statistics in 2019				from Mar 2019
MI Flora Herbarium	Active portal, but no usage statistics in 2019				Update coming in 2020
TOTAL	**383,564**	**570,341,242**	**569,903,721**	**570,391,116**	
AVG / MONTH	**31,963.67**	**47,528,436.83**	**47,491,976.75**	**47,532,593.00**	

GBIF – Global Biodiversity Information Facility; Registered 23 January 2019

Statistic Category	2019 Year Total	Average per Month
Number of Download Events (Search)	23,150	1,929.17
Number of Records Downloaded (total # of specimens)	569,786,148	47,482,179.00
Number of Downloads Requiring Georeferenced Records	6,247	520.58
Number of Downloads Using a Polygon Locality Region	2,279	189.92
Number of Downloads Based on a Country/Specific Locality Search	4,371	364.25
Percent of Searches Requesting Georeferenced Specimens	26.98	26.98
Maximum Percent Requesting Georeferencing, Polygon or Locality *** (see below)	55.71	55.71

*** GBIF Maximum percent assumes that georeferencing, polygon and country search are independent - data is not available to separate this. Maximum percent represents the greatest percent possible for searches looking for locality information.

UM HERBARIUM

iDigBio – Integrated Digitized Biocollections; 2019 Year Total

Statistic Category	Search – instances a record from this recordset matched a search query	Download – instances a record from this recordset was downloaded	Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	Records Viewed – how many specimen records were opened and viewed in full detail	Media Viewed – how many media records were opened and viewed in full detail
iDigBio Herbarium Bryophtye	19,544,139,760	111,018	31,023	34,290	11,262
iDigBio Herbarium Lichen	6,645,027,606	6,399	5,880	18,080	6,259
iDigBio Herbarium Macroalgal	11,722,835,958	69,024	64,991	117	33
iDigBio Herbarium Midwest Herbaria	29,784,797,331	156,587	422,803	282	89
iDigBio Herbarium Mycology	40,060,560,637	17,386	30,397	64,804	26,267
TOTAL	**107,757,361,292**	**360,414**	**555,094**	**117,573**	**43,910**

iDigBio – Integrated Digitized Biocollections; 2019 Monthly Average

Statistic Category	Search – instances a record from this recordset matched a search query	Download – instances a record from this recordset was downloaded	Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	Records Viewed – how many specimen records were opened and viewed in full detail	Media Viewed – how many media records were opened and viewed in full detail
iDigBio Herbarium Bryophtye	1,628,678,313.33	9,251.50	2,585.25	2,857.50	938.50
iDigBio Herbarium Lichen	553,752,300.50	533.25	490.00	1,506.67	521.58
iDigBio Herbarium Macroalgal	976,902,996.50	5,752.00	5,415.92	9.75	2.75
iDigBio Herbarium Midwest Herbaria	2,482,066,444.25	13,048.92	35,233.58	23.50	7.42
iDigBio Herbarium Mycology	3,338,380,053.08	1,448.83	2,533.08	5,400.33	2,188.92
AVERAGE	**8,979,780,107.67**	**30,034.50**	**46,257.83**	**9,797.75**	**3,659.17**

UM HERBARIUM

UM DIGITAL LIBRARY – Herbarium Catalog Collection (herb00ic) added and Herbs (herb1ic) removed in 2019; All other collections active since 2015

Collection	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
Herbarium Algae Type Collection (herb6ic)	4,484	623	13.89	4,691	417	8.89	9,175
Herbarium Bryophtye Type Collection (herb3ic)	4,384	559	12.75	3,712	19	0.51	8,096
University of Michigan Herbarium Catalog Collection (herb00ic)	3,327	707	21.25	123,262	2,484	2.02	126,589
Herbarium Fungus Collection Database (herb5ic)	10,441	612	5.86	25,121	334	1.33	35,562
Herbarium Fungus Monographs (fung1tc)	712	8	1.12	44,164	11	0.02	44,876
Herbarium Fungus and Lichen Type Collection (herb4ic)	4,699	582	12.39	5,627	72	1.28	10,326
Herbarium Vascular Plant Type Collection with Specimen Image (herb2ic)	5,284	656	12.41	45,553	1,339	2.94	50,837
Herbarium Fungus Collection Database (fung1ic)	2,414	189	7.83	5,438	6	0.11	7,852
Herbarium Fungus Image Database (fung2ic)	2,221	185	8.33	117,811	178	0.15	120,032
Herbarium Herbs (herb1ic)							
Herbarium Krieger's Watercolors of Fungi (fuwatic)	2,661	194	7.29	28,781	905	3.14	31,442
TOTAL	**40,627**	**4,315**	**10.62**	**404,160**	**5,765**	**1.43**	**444,787**

Year TOTAL	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	Browse ***	TOTAL = Search Total + View Total + Browse
2015	10,681	1,148	10.75	131,167	1,352	1.03	86	141,934
2016	20,275	1,556	7.67	310,841	10,537	3.39	205	331,421
2017	25,186	5,425	21.54	253,590	10,467	4.13	272	279,048
2018	17,197	2,176	12.65	250,650	4,846	1.93	220	268,067
2019	40,627	4,315	10.62	404,160	5,765	1.43	172	444,959
TOTAL 2015-2019	**113,966**	**14,620**	**12.83**	**1,350,508**	**32,967**	**2.44**	**955**	**1,465,429**
AVERAGE 2015-2019	**22,793**	**2,924**	**12.83**	**270,102**	**6,593**	**2.44**	**191**	**293,086**

*** Browse statistic is recorded each year within the Herbarium Fungus Monographs (fung1tc) collection only. This total is not recorded in the 2019 UM Digital Library Collection details for the Herbarium above.

UMMZ BIRD DIVISION – Division Details provided by Brett Benz

OVERVIEW

2019 marked the first year in 45 years without Janet Hinshaw as the UMMZ Bird Division Collection Manager, as Brett Benz began in January 2019. We greatly appreciate her years of service. With an expansion of the Michigan salvage program and its expeditionary collecting efforts abroad, the Bird Division saw accelerated growth in 2019. Division Curator Ben Winger and Collection Manager Brett Benz led a month-long collecting expedition in June, sampling 4 sites across Manitoba, Canada. In collaboration with students and staff from the UMMZ and Cleveland Museum of Natural History, the team added important specimens to the UMMZ collection, filling in key biogeographic sampling gaps. Whole genome sequencing and morphometric analyses are underway for several migratory songbird species sampled on this trip, as part of the Winger Lab's ongoing research examining the evolutionary ecology of migration in the North American boreal avifauna.

With the move and transition to the RMC facility largely completed in 2018, the Bird Division turned much of its attention to several long-standing curation issues in the collection. These included consolidation and rehousing of the frozen tissue collection, databasing the ornithology teaching collection housed at the BSB, and clearing the 10+ year backlog of salvage specimens from the bird division freezers. In anticipation of increasing use and growth of the fluid specimen collection, the division began a large rehousing and specimen labeling project in the last months of 2019 and will continue into 2020.

Figure 1: Janet Hinshaw retirement party - 8 Dec 2018. Photo by Kathy Telfer.

Figure 2: Aerial view of boreal forest in Manitoba, Canada. Photo by Brett Benz.

Figure 3: Manitoba crew preparing bird specimens in – left to right: Brett W. Benz, Mary Margaret Ferraro, and Eric R. Gulson. Photo by Andy Jones.

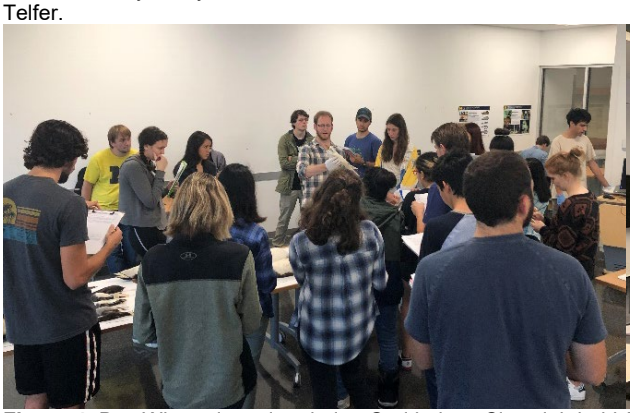


Figure 4: Ben Winger lecturing during Ornithology Class lab held at the Research Museums Center. Photo by Benjamin Hess.

Figure 5: Brett Benz preparing a bird specimen to demonstrate process for Ornithology Class. Photo by Ben Winger.

UMMZ BIRD DIVISION

PERSONNEL – 23 total staff members in 2019

Title	Name(s)
Curator	Benjamin Winger
Collection Manager / Assistant Research Scientist	Brett Benz (from 14 Jan 2019)
Librarian for the Wilson Ornithological Society	Janet Hinshaw (retired Collection Manager Dec 2018)
Postdoctoral Fellows	Jacob Berv, Shane Dubay, Brian Weeks and Marketa Zimova
Graduate Student Curatorial Assistants	Rachel Wadleigh
Graduate Students	Susanna Campbell, Eric Gulson-Castillo, Teresa Pegan and Kristen Wacker
Non-student Technician Research Assistant	Mary Margaret Ferraro
Undergraduate Assistants	Michael Lyons and Vera Ting
Volunteers	Benjamin Hack, Astrid Fortier Muller-Karger, Bruce O'Brien, Deborah Stone-Richard, Kathy Telfer and Rosemary Ziemba
Administrative Specialist	Robbin Murrell (across all UMMZ divisions)
Registrar	Benjamin Hess (across Herbarium and all UMMZ divisions)

COLLECTION GROWTH / DATA ENHANCEMENT

Category	Number
Specimens Prepared	688 specimen (283 from Manitoba, Canada; 405 from RMC lab)
Skeletal Material Prepared	270
Accessions	0 new accessions (416 specimens added to amended accessions)
Data entries	139 created, 445 cataloged, 750 modified
Locality	28 created, 178 modified
Images	0

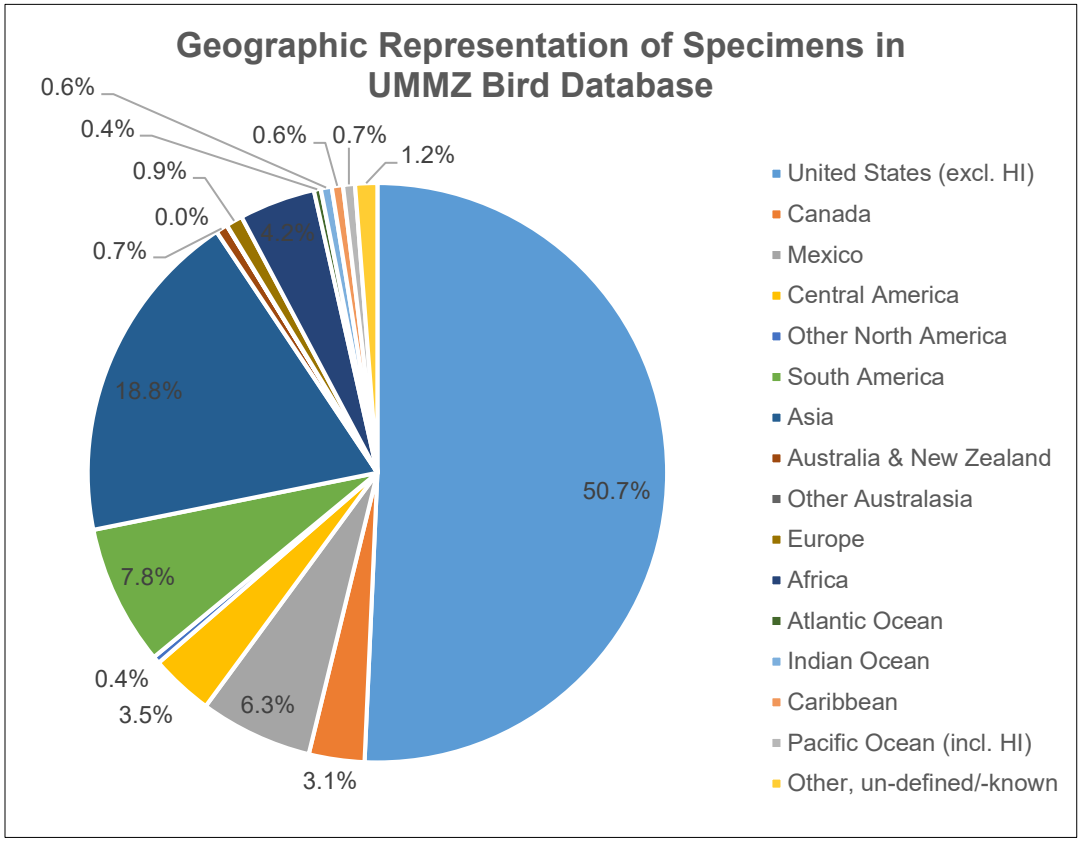
TAXONOMIC BREAKDOWN / TYPES / DATABASE STATUS

Category	Number
Taxa Represented	230 families, 2,028 Genera, and 6,706 species
Types Represented	552 type specimens (indicated in Specify Statistics tab): 12 Cotype, 463 Holotype, 3 Lectotype, 9 Paratype, 5 Syntype, 60 Topotype
Percent of Georeferenced Specimens	91.51% of specimens in Specify (185 newly georeferenced)
Highest Catalog Number	247,171
Percent Databased	~ 100% of present collection digitized (86.44% of specimens in Specify – 213,652/247,171)

UMMZ BIRD DIVISION

GEOGRAPHIC DISTRIBUTION

Global Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
United States (excl. Hawaii)	108,149	190	108,339
Canada	6,629	0	6629
Mexico	13,424	0	13,424
Central America	7,526	1	7527
Other North America	865	0	865
South America	16,708	0	16,708
Asia	40,151	0	40,151
Australasia	1,398	0	1,398
Other Australasia	44	0	44
Europe	1,969	0	1,969
Africa	9,070	0	9,070
Atlantic Ocean	821	0	821
Indian Ocean	1,309	0	1,309
Caribbean	1,338	0	1338
Pacific Ocean (incl. Hawaii)	1,419	-1	1,418
Other, un-defined/-known	2,694	-52	2,642
TOTAL	**213,514**	**138**	**213,652**



UMMZ BIRD DIVISION

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
Michigan	44,284	150	44,434
Midwest USA	54,238	149	54,387
Great Lakes US (w/PA & NY)	48,492	152	48,644
Great Lakes US (no PA & NY)	47,332	149	47,481
Ontario Province, Canada	1,209	0	1,209
North America	129,039	7,745	136,784

COLLECTION TRANSACTIONS

Category	Number and Purpose
Education Loans	7 loans (837 specimens) – 4 unique institutions (7 domestic); 775 specimens were from the research collection for Ornithology Class
Loans	6 loans (436 specimens) - 5 unique institutions (6 domestic); 4 research, 1 art/education, 1 exhibit/education
Gifts	13 gifts (170 specimens) - 12 unique institutions (13 domestic); 13 research (tissues and skin/toe clips for DNA)
TOTAL	**26 transactions (1,443 specimens) - 19 unique institutions (26 domestic); 17 research, 1 art/education, 8 exhibit/education**

INQUIRIES AND DATA REQUESTS

Category	Number
Image Request	14 requests; 67 images to 5 US and 3 International institutions
Research Requests	12 research related inquiries
Public Information	11 public inquiries
TOTAL	**37 inquiries and requests**

VISITATION TO THE COLLECTION

Category	Number
Visits / Individuals	27 visits / 172 individuals
Unique Individual / Institution	12 unique individuals, 13 unique institutions/departments
Individual Visitor Type	10 Faculty/Curator/Other Professional, 0 Postdoctoral Researcher, 3 Graduate Student, 1 Undergraduate Student, 11 Class, 0 Public, 2 Other

UMMZ BIRD DIVISION

CITATIONS – Published work by curatorial staff, students, and from external collection use

Category	Number
Total Citations	Benz: 691
Citations Since 2015	Benz: 374
Citations in GBIF	101 total (48 citations in 2019)
	Google Scholar publication list being created in 2020

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS

Details
Specimen use documented with BISON (data pulled from GBIF since 2013)
Ornithology teaching collection (728 specimens) cleaned, cataloged, labeled, and databased.
Tissue collection re-organized by implementing a cryo-collection cataloging and number system.
Michigan salvage specimen backlog (10+ years) prepared, databased, and curated.
Consolidation organization of paper collections, archival supplies, and field supplies.

OUTREACH AND TOURS

Details
Tours: University of Georgia Provost Office, Grand Rapids Public Museum, UM EEB Recruitment Weekend, UM Frontiers Masters Recruitment, UM Stamps School of Art & Design (Making Science Visible), UM Applied Liberal Arts: Tours of the Past (ALA 301)
Ornithology Class (EEB 433) – Taught by Ben Winger, including multiple labs at the RMC
Science Café: Ben Winger and Shane DuBay about the UMMZ Bird collections: https://lsa.umich.edu/ummnh/news-events/events.detail.html/66191-16719565.html

Figure 6: Community High School (Ann Arbor MI) bird identification workshop held at the EEB Biological Sciences Building. Image used with permission by Ben Winger.

UMMZ BIRD DIVISION

GLOBAL AGGREGATORS / DATA PORTALS

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium & VertNet)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Bird	14,213	154,072,458	154,072,458	154,072,458	from 8 Feb 2013
iDigBio Bird	198,515	455,403	44,369	455,403	from Jan 2015
VertNet Bird	21,028	259,624	933,437	933,437	from Apr 2014
USGS BISON Bird	9,325	332,270	332,270	332,270	from Jan 2019
TOTAL	**243,081**	**155,119,755**	**155,382,534**	**155,793,568**	
AVG / MONTH	**20,256.75**	**12,926,646.25**	**12,948,544.50**	**12,982,797.33**	

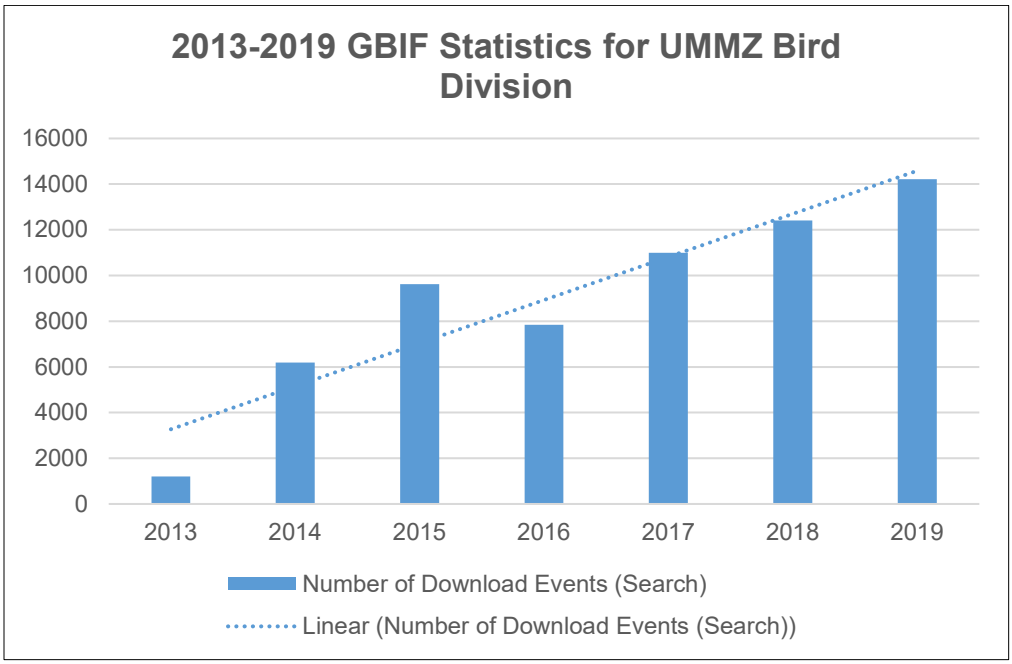
GBIF – Global Biodiversity Information Facility

Statistic Category	2019 Year Total	Average per Month
Number of Download Events (Search)	14,213	1,184.42
Number of Records Downloaded (total # of specimens)	154,072,458	12,839,371.50
Number of Downloads Requiring Georeferenced Records	3,983	331.92
Number of Downloads Using a Polygon Locality Region	1,800	150.00
Number of Downloads Based on a Country/Specific Locality Search	9,457	788.08
Percent of Searches Requesting Georeferenced Specimens	28.02	28.02
Maximum Percent Requesting Georeferencing, Polygon or Locality *** (see below)	107.23	107.23

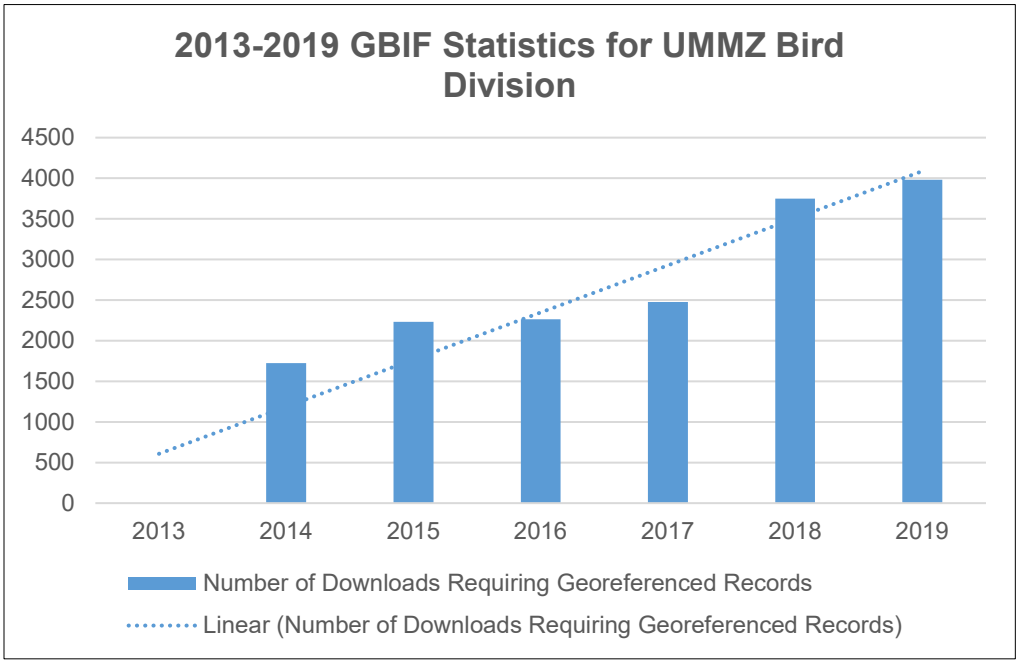
*** GBIF Maximum percent assumes that georeferencing, polygon and country search are independent - data is not available to separate this. Maximum percent represents the greatest percent possible for searches looking for locality information.

UMMZ BIRD DIVISION

GBIF – Global Biodiversity Information Facility; Number of Download Events



GBIF – Global Biodiversity Information Facility; Number of Downloads Requiring Georeferenced Records



UMMZ BIRD DIVISION

iDigBio – Integrated Digitized Biocollections

Statistic Category	2019 Year Total	Average per Month
Search – instances a record from this recordset matched a search query	31,646,274,779	2,637,189,564.92
Download – instances a record from this recordset was downloaded	198,515	16,542.92
Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	455,403	37,950.25
Records Viewed – how many specimen records were opened and viewed in full detail	44,369	3,697.42
Media Viewed – how many media records were opened and viewed in full detail	0	0.00

VertNet – Vertebrate Network

Statistic Category	2019 Year Total	Average per Month
Number of searches that retrieved data from the resource	21,028	1,752.33
Number of records retrieved in searches / were pulled to screen	259,624	21,653.33
Number of different countries where searched have been originated	361	30.08
Number of download events retrieved data from the resource / pulled records from the resource 2018	1,646	137.17
Total number of records downloaded	933,437	77,786.42
Number of different countries that downloaded records	162	13.50
Percent that the resource appeared on all download events this month	148.78	12.40

UMMZ BIRD DIVISION

USGS BISON – Biodiversity Information Serving Our Nation (BISON) - Explore and download North American species occurrence data and maps from Canada, USA, US Territories, and US Marine Exclusive Economic Zones.

Statistic Category	2019 Year Total	Average per Month
Search indicates when any records from the dataset are included in the results of a front end search.	9,325	777.08
Download indicates when any records from the dataset are included in a front end download request.	0	0.00
SOLR indicates when any records from the dataset are included in the results of a SOLR query.	11,695	974.58
WMS (Web Map Services) indicates when any records from the dataset are included in the results of a WMS query.	311,250	25,937.50
All Requests is a combination of Search + Download + SOLR + WMS.	332,270	27,689.17

MORPHOSOURCE – Digital repository containing 3D media (raw micro-CT data and surface meshes) from UMMZ specimens

Year	Download Requests	Unique Specimens Requested	Unique Media File Downloads	Total Downloads	Total Download Users
2013-2018	0	0	1	2	2
2019	11	8	9	30	20
TOTAL	**11**	**8**	**10**	**32**	**22**

TOTAL is metrics from 1 Jul 2013 to 31 Dec 2019

UMMZ FISH DIVISION – Division Details provided by Randy Singer

OVERVIEW

The theme for the UMMZ Fish Division for 2019 was modernization. We focused on setting the foundation for rapid expansion, digitization and accessions. An emphasis was also placed on improving data sharing and storage. With the assistance of our Graduate Student Curatorial Assistant Jackie Popma, we developed a tissue workflow and organized repository in the RMC Biorepository (i.e., liquid nitrogen facility). Through her aid, we organized and cataloged over 2,200 tissues into the collection using this detailed workflow. We can now better access and utilize the rapidly growing tissue collection, and better serve the tissue requests of the broader scientific community. The fish division is also collaborating with the UM School of Information, SEAS and the Library on a successful MIDAS/PODS grant to crowd source the data entry of valuable field notes. This will hopefully lead to a nationwide effort to link field notes and museum specimens in a machine-readable way. In the same vein, we improved our collection curation through the utilization of a Datamax thermal transfer printer and new ground glass jar with polypropylene lids, which will improve specimen and data storage. We are also providing our data to global aggregators (e.g., FishNet2, GBIF, and iDigBio) and tracking publications though our own Google Scholar profile. The Fish Division strives to improve our participation in digital aggregation, informatics research and mobilization as the university works towards hiring someone to assist us in this endeavor.

Aside from curation and modernization, the collection has been rapidly growing via collecting efforts by the Curator (Hernan Lopez-Fernandez) and the Collection Manager (Randy Singer). In the last year, we have increased the tissue collection by over 900%, and we are making fast work of cataloging and labeling our large teaching collection. Newly accessioned specimens have ranged from Neotropical, to large Florida invasives, to deep-water Lake Michigan fishes. We hope to continue this rapid rate of specimen and tissue addition in the coming years to assert our place in the international collections community. With the ramping up of the collection as a center for ichthyological research, we have increased our visitation, specimen loans and student assistance in the collection. Going forward into 2020, we expect to continue cataloging, improving curation and workflows and continue to further the UMMZ Fish Division's prominence as a world-renowned center for ichthyological research.

Figure 1: Doug Nelson talking about sawfish to Making Science Visible class. Doug retired in May 2019 after 35.5 years of service to the UMMZ Fish Division. Photos in Figures 1, 2 and 3 taken by Benjamin Hess.

Figure 2: Hernán López-Fernández talking about the fish collections during the annual EEB PhD recruitment weekend.

Figure 3: Randy Singer tranferring a bowfin into large tank. Randy became the new collection manager in 2019.

UMMZ FISH DIVISION

PERSONNEL – 17 total staff members in 2019

Title	Name(s)
Curator	Hernan Lopez-Fernandez
Collection Manager / Assistant Research Scientist	Randy Singer (from 1 Apr 2019)
Collection Manager	Douglas W. Nelson (retired 26 Apr 2019)
Emeritus Curators	William L. Fink and Gerald R. Smith
Postdoctoral Fellow	Samuel Borstein, Henrique Varella (University of São Paulo, Brazil)
Graduate Student Curatorial Assistant	Jacqueline Popma
Graduate Students	Thomas Morgan and Benjamin Nicholas
Undergraduate Assistants	Maria Gedris, Michael Grabda, Coen Long, Luke McGill and Katherine Quinlan
Administrative Specialist	Robbin Murrell (across all UMMZ divisions)
Registrar	Benjamin Hess (across Herbarium and all UMMZ divisions)

COLLECTION GROWTH / DATA ENHANCEMENT / PREPARATIONS

Category	Number		
Accessions	6 accessions (406 lots, 4,512 specimens) - 6 unique institutions (5 domestic, 1 foreign)		
Data Entries	1,083 created, 431 cataloged, 2,052 modified (edited)		
Locality	875 created, 883 modified		
Preparations	**Prep Type**	**Preparations/Lots**	**Specimens**
	C&S	3,215	10,444
	CT Scan	1	1
	EtOH	195,475	3,472,869
	Skeleton	3,667	10,470
	Special Preparation	10	12
	Tissue	696	1,503
Unique Specimens	**C&S + EtOH + Skeleton**	**202,357**	**3,493,783**

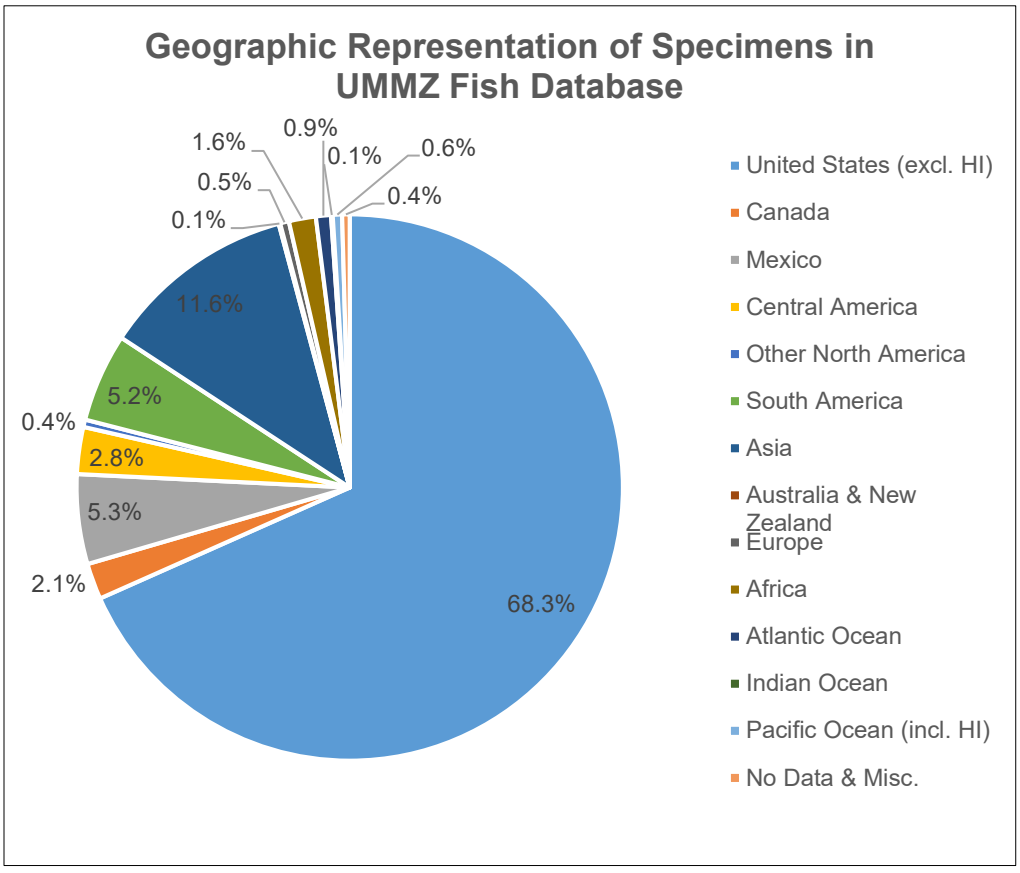
TAXONOMIC BREAKDOWN / TYPES / DATABASE STATUS

Category	Number
Taxa Represented	426 Families, 3,002 Genera, 11,308 species (from Specify Statistics Holdings tab – increase of 35 Families, 97 Genera and 941 species)
Types Represented	5,406 type specimens (indicated in Specify Statistics tab): 4,331 Paratypes, 541 Holotypes
Percent of Georeferenced Specimens	89.11% of LOTS in Specify (81 newly georeferenced: 2019 total 178,013, 2018 total 177,932)
Highest Catalog Number	252,270 (in database); 707 new (659 in Specify)
Percent Databased	79.19% of LOTS in Specify (199,770/252,270)

UMMZ FISH DIVISION

GEOGRAPHIC DISTRIBUTION

Global Locality	Total Lots in Specify in 2018	Increase 2018 to 2019	Total Lots in Specify in 2019
United States (excl. Hawaii)	136,514	19	136,533
Canada	4,265	0	4,265
Mexico	10,594	9	10,603
Central America	5,537	10	5,547
Other North America	0	874	874
South America	9,535	927	10,462
Asia	22,846	275	23,121
Australia & New Zealand	167	6	173
Europe	956	86	1,042
Africa	3,162	23	3,185
Atlantic Ocean	1,877	-95	1,782
Indian Ocean	199	-7	192
Pacific Ocean (incl. Hawaii)	1,098	2	1,100
No Data & Misc.	1,782	-891	891
TOTAL	**198,532**	**1,238**	**199,770**
TOTAL SPECIMENS	**3,471,350**	**22,433**	**3,493,783**



UMMZ FISH DIVISION

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Total Lots in Specify in 2018	Increase 2018 to 2019	Total Lots in Specify in 2019
Michigan	36,813	354	37,167
Midwest USA	69,063	665	69,728
Great Lakes US (w/PA & NY)	57,582	622	58,204
Great Lakes US (no PA & NY)	53,254	610	53,864
Ontario Province, Canada	3,433	0	3,433
North America	156,910	465	157,375

COLLECTION TRANSACTIONS

Category	Number and Purpose
Loans (out)	22 loans (167 lots, 1,702 specimens) - 17 unique institutions (20 domestic, 2 foreign); 20 research, 2 exhibit
Gifts Sent	2 gifts (3 lots, 22 specimens) - 2 unique institutions (1 domestic, 1 foreign); 2 research
Exchanges	3 exchanges (203 lots, 2,408 specimens) - 1 unique institutions (0 domestic, 3 foreign); 3 research
TOTAL	**27 transactions (373 lots, 4,132 specimens) - 18 unique institutions (21 domestic, 6 foreign); 25 research, 2 exhibit**

INQUIRIES AND DATA REQUESTS

Category	Number
Number of Inquiries Answered	30+
Number of Data Requests	10+

VISITATION TO THE COLLECTION

Category	Number
Visits / Individuals	49 visits / 197 individuals
Unique Individual / Institution	38 unique individuals, 29 unique institutions/departments
Individual Visitor Type	31 Faculty/Curator/Other Professional, 2 Postdoctoral Researcher, 2 Graduate Student, 0 Undergraduate Student, 11 Class, 1 Public, 2 Other

UMMZ FISH DIVISION

CITATIONS – Published work by curatorial staff, students, and from external collection use

Category	Number
Publications Referencing UMMZ Fish Specimens	40+ (Google Scholar search for "UMMZ Fish 2019" – looking only at first 15 pages beginning with 2019)
	Andrade, M.C., H. López-Fernández & E. A. Liverpool. 2019. New *Myloplus* from the Essequibo River basin, Guyana (Characiformes: Serrasalmidae), with discussion of the taxonomic status of *Myleus pacu*. *Neotropical Ichthyology 17(4):e190026*
	K. Feilich & H. López-Fernández. 2019. When does form reflect function? Acknowledging and supporting ecomorphological assumptions. *Integrative and Comparative Biology* 59: 358-370. doi.org/10.1093/icb/icz070
Citations in GBIF	17 total (7 citations in 2019)
	Google Scholar publication list being created in 2020

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS

Details
Tissues: Started the tissue collection in a more formal capacity. Mapped and named all 30+ towers within the LN2 freezer and created an associated workflow for adding, cataloging and finding tissues.
Increased tissue collection from roughly 200 tissues to over 2,000 tissues
Teaching collection: Inventoried all specimens at RMC, Dana, and off campus facilities. Created a labeling system and associated Specify catalog. Created new labels unique to teaching collection.
Google Scholar account for tracking collection use through publication citation
Cataloging Neotropical expedition material from 2018 and 2019
Cataloged material from S Florida expedition
Cataloged valuable deep water fishes from Lake Michigan
Singer, R., S. Ellis and L. M. Page. 2019. Awareness and use of biodiversity collections by fish biologists. Journal of Fish Biology 96: 297–306. https://doi.org/10.1111/jfb.14167

CONFERENCES / MEETINGS / WORKSHOPS

Details
Singer, R. 2019. Big Heads or Long Tails: How Smaller Fish Collections Contribute to Collections Based Biodiversity Research. The American Society of Ichthyologists and Herpetologists Annual Meeting. Snowbird, Utah. 24 June.
Singer, R. 2019. Big Heads or Long Tails: How Smaller Fish Collections Contribute to Collections Based Biodiversity Research. Society for the Preservation of Natural History Collections (SPNHC) Annual Meeting. The Field Museum, Chicago, Illinois. 28-31 May.
Singer, R. 2019. Fantastic fishes and where to find them - using historical natural history data and robots to explore deep sea fish biodiversity. UM EEB Lunch Seminar. University of Michigan, Ann Arbor, Michigan. 24 September.

UMMZ FISH DIVISION

OUTREACH AND TOURS

Details
Multiple class visits to Research Museum Center, Ann Arbor, Michigan.
Digital class visits for learning about fishes
Randy helped with the Sturgeon event/exhibit. 27 February 2019. UM Museum of Natural History, Ann Arbor, Michigan.
Fishes lent specimens to the public museum for molds etc. Three separate occasions. UM Museum of Natural History, Ann Arbor, Michigan.
Videos about collection for social media: https://www.youtube.com/watch?v=35mRea0HpIM
Fish and Wildlife invasive species workshop. March 2019. Research Museum Center, Ann Arbor, Michigan. Participants: Hernan Lopez-Fernandez, Douglas W. Nelson, and Randy Singer

GRANTS / AWARDS – Totals represent amount for the duration of the grant

Total Amount	Details
$90,000	Michigan Institute for Data Science (MIDAS) / Propelling Original Data Science (PODS) Grant: CHANGES: Collections, Heterogeneous data, and Next Generation Ecological Studies, Karen Alofs (School for Environment and Sustainability), Andrea Thomer (School of Information), Hernan Lopez-Fernandez and Randy Singer (Ecology and Evolutionary Biology and Museum of Zoology). https://midas.umich.edu/pods-grants/
	Society for the Preservation of Natural History Collections (SPNHC) – Randy Singer awarded Member at Large status
$90,000	**TOTAL FROM GRANTS**

UMMZ FISH DIVISION

GLOBAL AGGREGATORS / DATA PORTALS

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium & VertNet)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Fish	8,171	129,600,142	129,600,142	129,600,142	from 2 Aug 2018
iDigBio AquaticInvasives Fish	112,697	42,548	95	42,548	from Oct 2016
iDigBio Fish	598,093	520,610	2,268	520,610	from Aug 2018
FishNet2 Fish	Active portal, but no usage statistics in 2019				from Aug 2011
TOTAL	**718,961**	**130,163,300**	**129,602,505**	**130,163,300**	
AVG / MONTH	**59,913.42**	**10,846,941.67**	**10,800,208.75**	**10,846,941.67**	

GBIF – Global Biodiversity Information Facility; Registered 2 August 2018

Statistic Category	2019 Year Total	Average per Month
Number of Download Events (Search)	8,171	680.92
Number of Records Downloaded (total # of specimens)	129,600,142	10,800,011.83
Number of Downloads Requiring Georeferenced Records	2,734	227.83
Number of Downloads Using a Polygon Locality Region	1,506	125.50
Number of Downloads Based on a Country/Specific Locality Search	597	49.75
Percent of Searches Requesting Georeferenced Specimens	33.46	33.46
Maximum Percent Requesting Georeferencing, Polygon or Locality *** (see below)	59.20	59.20

*** GBIF Maximum percent assumes that georeferencing, polygon and country search are independent - data is not available to separate this. Maximum percent represents the greatest percent possible for searches looking for locality information.

UMMZ FISH DIVISION

iDigBio – Integrated Digitized Biocollections: Aquatic Invasives (former TCN grant project) Fish Division and Fish Division

Statistic Category	Search – instances a record from this recordset matched a search query	Download – instances a record from this recordset was downloaded	Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	Records Viewed – how many specimen records were opened and viewed in full detail	Media Viewed – how many media records were opened and viewed in full detail
iDigBio Aquatic Invasives Fish Division	5,216,037,958	112,697	42,548	95	1
iDigBio Fish Division	28,596,522,906	598,093	520,610	2,268	0
TOTAL	33,812,560,864	710,790	563,158	2,363	1
AVG / MONTH	2,817,713,405.33	59,232.50	46,929.83	196.92	0.08

MORPHOSOURCE – Digital repository containing 3D media (raw micro-CT data and surface meshes) from UMMZ specimens

Year	Download Requests	Unique Specimens Requested	Unique Media File Downloads	Total Downloads	Total Download Users
2013-2018	0	0	2	0	0
2019	2	2	0	6	4
TOTAL	2	2	2	6	4

TOTAL is metrics from 1 Jul 2013 to 31 Dec 2019

UMMZ FISH DIVISION

UM DIGITAL LIBRARY – All collections active since 2015

Collection	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
UMMZ Distribution Maps of Michigan Fishes (fish4ic)	2,097	192	9.16	5,077	244	4.81	7,174
UMMZ Fish Collection Database (fish1ic)	2,726	192	7.04	10,434	9	0.09	13,160
UMMZ Fish Field Notes (fish3ic)	2,105	185	8.79	4,528	26	0.57	6,633
UMMZ Fish Species Descriptions (fish5ic)	2,163	186	8.60	1,251	2	0.16	3,414
UMMZ Fish Specimen Image Collection (fish2ic)	2,793	185	6.62	22,845	252	1.10	25,638
TOTAL	**11,884**	**940**	**7.91**	**44,135**	**533**	**1.21**	**56,019**

Year TOTAL	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
2015	6,300	831	13.19	10,777	159	1.48	17,077
2016	12,749	1,104	8.66	42,991	215	0.50	55,740
2017	16,148	4,382	27.14	26,655	327	1.23	42,803
2018	9,707	1,539	15.85	43,814	895	2.04	53,521
2019	11,884	940	7.91	44,135	533	1.21	56,019
TOTAL 2015-2019	**56,788**	**8,796**	**15.49**	**168,372**	**2,129**	**1.26**	**225,160**
AVERAGE 2015-2019	**11,358**	**1,759**	**15.49**	**33,674**	**426**	**1.26**	**45,032**

UMMZ INSECT DIVISION – Division Details provided by Erika Tucker

OVERVIEW

During 2019, the UMMZ Insect Division added approximately 2,430 new specimens to its holdings, while digitizing and/or databasing 54,042 specimens in the collection. Additionally, 58,833 Acari lot records were migrated from the FileMaker Pro to Specify database this year including the Atyeo mite collection (prominent Acarologist). We completed the Insect Field Notebook Digitization project, which is now available through the UM Digital Library Collections, as well as the specimen collection. In addition to the public-accessible UM Digital Library Collections, the Insect Collection is now available through the following global data aggregators: GBIF (December 2018), iDigBio (April 2019), and Symbiota Collections of Arthropods Network (April 2019).

We are in the midst of a number of large-scale projects including Orthoptera specimen digitization, National Science Foundation (NSF) – Thematic Collections Networks (TCN) parasite digitization, Hymenoptera survey of southern Michigan, and the RMC prairie restoration project. Smaller ongoing projects include seven Undergraduate Research Opportunity Program (UROP) projects digitizing a range of Hymenoptera as well as Odonata in the collection. The NSF-TCN grant included acquiring a-state-of-the-art imaging system for the collection. In addition to this new system, procedural and setting changes have greatly improved all Insect Division imaging in 2019 allowing expedited scanning, renaming and barcoding images. Simplified student imaging is also now possible with UROP funded tablets and accessories with high quality cameras, and new barcode scanners. Lastly, the prairie restoration project allowed community involvement for two thatch cleanups and one cover crop seeding events.

Figure 1: Blacklighting at the E.S. George reserve with Phil Myers 2019 and the Insect Division. Insect / Mammal Division field trip. Dominique Brown (Doris Duke Conservation Scholar E.M. Tucker Lab) in front of picture.

Figure 2: Peregrine Ke-Lind (Museum Technician) demonstrating new, easier to use, tablet insect digitizing imaging equipment.

Figure 3: Ricardo Mariño-Pérez (Postdoc Knowles Lab), testing camera setup and making improvements for insect imaging procedures.

UMMZ INSECT DIVISION

PERSONNEL – 42 total staff members in 2019

Title	Name(s)
Curators	L. Lacey Knowles
Collection Manager / Assistant Research Scientist	Erika Tucker
Emeritus Curators	Thomas Moore and Barry OConnor (retired Dec 2018)
Researcher Staff	Pavel Klimov (Associate Research Scientist) and Hannah-Maria Jacques (Independent Researcher)
Postdoctoral Fellow	Ricardo Mariño-Pérez (Knowles Lab)
Graduate Student Curatorial Assistants	Sasha Bishop (Spring 2019) and Michelle Fearon (1/3 of Fall 2019)
Graduate Students	Beth Weiler (Summer-Fall 2019)
Undergraduate Assistants	Neha Bhomia, Zoe Bliss, Alan Ching, Troyer Wallace Evans, Ellen James, Madeleine Klemz, Siena McKim, Henry Smith and Chloe Weise
Non-student Technicians	Peregrine Ke-Lind, Yeaeun Park, Michael Andrew Joseph
Undergraduate Independent Researchers (Unpaid)	Dominique Brown, Liana Meisner-Driscoll, Sara Hezi, Pieter Kraayeveld, Eric Ma, Kevin Moore Jr., Hadley Samarco, Lydia Sandefur, Anna Southton, Sumaia Al-Suraimi and Matthew Tenglin
High School Volunteer	Max Manduca
Volunteers	Hagan Capnerhurst, Peregrine Ke-Lind, Pieter Kraayeveld, Andrea Lin, Aaron O'Hagan, Yeaeun Park, Audrey Parks, Elliot Smith and Kayla Thomas
Administrative Specialist	Robbin Murrell (across all UMMZ divisions)
Registrar	Benjamin Hess (across Herbarium and all UMMZ divisions)

COLLECTION GROWTH / DATA ENHANCEMENT

Category	Number
Accessions	330 accessions (65,066 specimens) - including 62 lots (~6,200 specimens)
Specimens Prepared	11,781 hymenoptera specimens prepared since summer 2019
Data Entries	11,657 cataloged, 87,341 timestamp created, 88,097 modified
Locality	73,283 created, 73,358 modified
Images Added	17,465 TOTAL

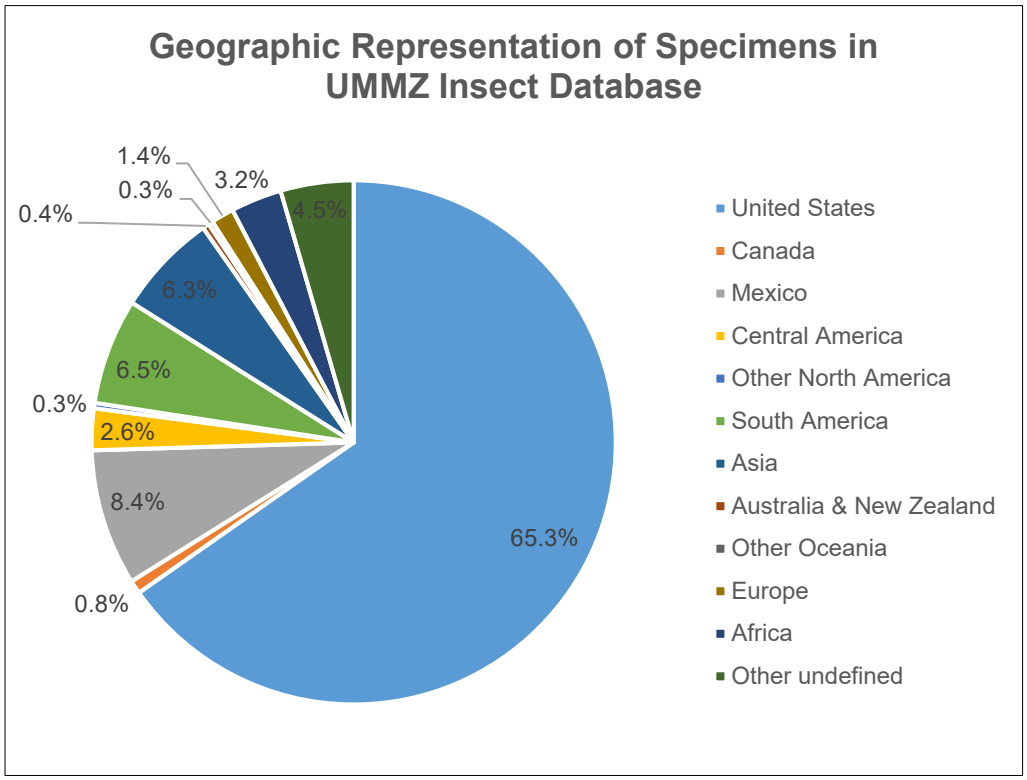
TAXONOMIC BREAKDOWN / TYPES / DATABASE STATUS

Category	Number
Taxa Represented	269 Families, 1,866 Genera, 6,393 species (from Specify Statistics Holdings tab – increase of 63 Families, 203 Genera and 605 species)
Types Represented	7 holotype, 735 paratype, 7 topotype (from Specify Statistics tab)
Percent of Georeferenced Specimens	13.11% of specimens in Specify (379 newly georeferenced: 2019 total 50,541, 2018 total 50,162)
Highest Catalog Number	4,500,000 (Estimated number of specimens in collection)
Percent Databased	08.57% of specimens in Specify (385,493/4,500,000)

UMMZ INSECT DIVISION

GEOGRAPHIC DISTRIBUTION

Global Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
United States	228,730	22,916	251,646
Canada	2,841	350	3191
Mexico	28,723	3,697	32,420
Central America	7,543	2,352	9895
Other North America	493	798	1,291
South America	17,339	7,847	25,186
Asia	1,855	22,474	24,329
Australia & New Zealand	99	1,456	1,555
Other Oceania	64	1,007	1071
Europe	2,693	2,734	5,427
Africa	1,138	11,008	12,146
Other and undefined	8,236	9,100	17,336
TOTAL	**299,754**	**85,739**	**385,493**



UMMZ INSECT DIVISION

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
Michigan	67,554	10,880	78,434
Midwest USA	91,453	11,952	103,405
Great Lakes US (w/PA & NY)	81,035	13,484	94,519
Great Lakes US (no PA & NY)	79,017	11,516	90,533
Ontario Province, Canada	1,773	43	1,816
North America	268,330	30,113	298,443

COLLECTION TRANSACTIONS

Category	Number and Purpose
Loans (Outgoing Shipments)	27 loans (5,068 specimens) - 17 unique institutions (21 domestic, 6 foreign); 20 research, 3 education, 4 exhibit
Loans Closed (Returns)	17 returns (4,689 specimens) - 12 unique institutions (12 domestic, 3 foreign); 13 research, 2 education
Gifts	4 gifts (16 specimens) - 2 unique institutions (3 domestic, 1 foreign); 1 research, 3 exhibit/education
Borrows (Loans From Other Institutions)	3 borrows (64 specimens) - 3 unique institutions (2 domestic, 1 foreign); 3 research
TOTAL	**51 transactions (9,837 specimens) - 28 unique institutions (40 domestic, 11 foreign); 39 research, 5 education, 7 exhibit**

INQUIRIES AND DATA REQUESTS

Category	Number
Specimen Inquiries	161 specimen details requested: 31 identification, 15 information, 45 donation, 70 loan
Advisement	73 inquiries: 67 requests for technical or expert advice, 6 for non-specimen information
Lab/Collection Visit	28 requests: 17 requests to visit the collection, 11 requests to work in the lab/collection
Outreach	7 requests to participate with outreach events
TOTAL	**269 inquiries and requests**

VISITATION TO THE COLLECTION

Category	Number
Visits / Individuals	68 visits / 220 individuals
Unique Individual / Institution	43 unique individuals, 32 unique institutions/departments
Individual Visitor Type	15 Faculty/Curator/Other Professional, 0 Postdoctoral Researcher, 11 Graduate Student, 18 Undergraduate Student, 10 Class, 7 Public, 7 Other

UMMZ INSECT DIVISION

CITATIONS – Published work by curatorial staff, students, and from external collection use

Category	Number
Publications Referencing UMMZ Insect Specimens	31+ (Google Scholar search for "University of Michigan Museum of Zoology Insect Division 2019" – looking only at first 33 pages)
Citations in GBIF	7 total (4 citations in 2019)
	Google Scholar publication list being created in 2020

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS

Details
Nearly 50,000 records prepared in Mbox or Google Drive to be transcribed in Specify
Collection records shared across 4 data aggregators: UM Digital Library (2019), Symbiota Collections of Arthropods Network (SCAN), iDigBio (Apr 2019), GBIF (Dec 2018)
1 publication: Tucker, E. M. and S. M. Rehan. 2019. Wild bees (Hymenoptera: Apoidea) of the Ossipee Pine Barrens. Northeastern Naturalist 26(2): 379-391. https://doi.org/10.1656/045.026.0211.
Migrated UMMZ Mite & Atyeo Mite FileMaker databases into Specify
Started prairie restoration fund (https://leadersandbest.umich.edu/find/#!/give/basket/fund/335911)
Continuing work on research on changes in Michigan bees overtime (digitization and data collection of all MI bees). Collaboration with the Isaacs (MSU) and Valdivinos (UM EEB) labs.
Improved specimen imaging with Ricardo Mariño-Pérez: new TCN grant funded imaging system (Macropod Pro), procedure/setting changes on stationary cameras, new UROP funded tablets and accessories with high quality cameras for simplified imaging (with faster image transfer due to internet connection).
Student projects started: digitizing and imaging Odonata collection from the collector Forester; digitizing Hymenoptera (Braconids, Ichneumonids, Sphecids, and Pompilids) in the collection.
Solicited a volunteer software engineer to create a script that automatically scans and renames image files, imbeds the barcode number (i.e., catalog number) in the image, and saves hundreds of paid person hours.
Field expedition to Mexico, 25 Nov - 15 Dec 2019. Hidalgo, Mexico. (participant Ricardo Mariño-Pérez)

CONFERENCES / MEETINGS / WORKSHOPS

Details
Tucker, E. M. 2019. Plenary speech: Conserving wild bees (& other important insects) through collections and collecting. Michigan Entomological Society. Luther, Michigan. 21–22 June.
Tucker, E. M. and G. Hammond. 2019. Insect Identification And Monitoring At Restoration Sites. Field trip, discussion and hands on demonstrations. Professional Stewards Hike. Whitmore Lake, Michigan. 9 August.
Tucker, E. M. 2019. EEB Retreat, field trip: Insects. Hike, discussion and hands on collection training. E.S. George Reserve, Pinckney, MI. 7 September.
Tucker, E. M. and B. M. OConnor. 2019. Parasite Collection & Digitization Plan: University of Michigan Museum of Zoology Insect Division. The Ninth Annual Advancing Digitization of Biodiversity Collections (ADBC) Summit. Gainesville, Florida. 1-3 October.

UMMZ INSECT DIVISION

CONFERENCES / MEETINGS / WORKSHOPS – continued

Details
Tucker, E. M. 2019. Metamorphosis complete: Reintroducing the UMMZ Insect Collection after the big move. Entomological Collections Network Annual Meeting. St. Louis, Missouri. 16-17 November.
Tucker, E. M. 2019. Pollinators, Predators and Parasitoids: The amazingly diverse world of Hymenoptera. UM EEB Departmental Lunch Seminar. University of Michigan, Ann Arbor, Michigan. 26 November.
Mariño-Pérez, R. 2019. Online course: Orthoptera Morphology and Taxonomy: Locust management: a preventive approach. Organized by the International Organization for Agricultural Health (OIRSA) mainly for Latin America. 10 October (in Spanish).
Mariño-Pérez, R. 2019. One-day Course: Orthoptera Diversity and Taxonomy. Mexican Association of Arthropod Systematics at Biology Institute, National Autonomous University of Mexico. 6 September. (presented to 20 students in Spanish)
Mariño-Pérez, R. 2019. Phylogenetic systematics and evolution of the Gaudy grasshopper family Pyrgomorphidae (Insecta: Orthoptera). Entomological Society of America Annual Meeting. St. Louis, Missouri. 17-20 November. (Ricardo was the 2019 Snodgrass Memorial Research Award winner)
Mariño-Pérez, R. 2019. Climate change: perspective from an entomological approach. 6th International Congress on Climate Change and Sustainable Development. Monterrey, Nuevo León, Mexico. 6-7 June. (in Spanish)

OUTREACH AND TOURS

Details
Prairie Restoration Project: thatch cleanup community event. Research Museums Center, Ann Arbor, Michigan. (participants: Erika Tucker and Sasha Bishop). 23 March 2019
Prairie Restoration Project: thatch cleanup community event. Research Museums Center, Ann Arbor, Michigan. (participants: Erika Tucker and Sasha Bishop). 6 April 2019
Washington Elementary Science Olympiad Team visit and tour of the UMMZ Insect Division Collection. Research Museums Center, Ann Arbor, Michigan. (participant: Erika Tucker). 9 May 2019
Prairie Restoration Project: cover crop seed application community event. Research Museums Center, Ann Arbor, Michigan. (participants: Erika Tucker and Sasha Bishop). 18 May 2019
UM Children on Campus program: Youth Volunteer Entomological Enthusiasts Program. Research Museums Center, Ann Arbor, Michigan. (participant: Max Manduca). once a week since 28 June 2019
Insect biodiversity and educational outreach event: University of Michigan Towsley Children's House. Ann Arbor, MI. (participants – Hannah-Maria Jacques, Chloe Weise (Museum Technician), Dominique Brown (Doris Duke Conservation Scholar Tucker Lab). 23 July 2019
SACNAS Science Expo with Little Traverse Bay Bands of Odawa Indians. Petoskey, Michigan. (participants: Sasha Bishop: Insect GSCA and Knowles Lab PhD student). 15 November 2019
STEM outreach event with Cesar Chavez Middle School. University of Michigan Center for Educational Outreach/UMPDA/SACNAS, Ann Arbor, Michigan. (participants: UMMZ Insect Division UROP student Matthew Tenglin, along with members of Fernanda Valdovinos' Lab). 5-6 December 2019

UMMZ INSECT DIVISION

OUTREACH AND TOURS – continued

Figure 4: Top-left. Prairie Restoration Project: thatch cleanup community event led by Erika Tucker and Sasha Bishop. Photo by Benjamin Hess.

Figure 5: Top-right. Insect collection tour for the Washington Elementary Science Olympiad Team. Photo of Erika Tucker and students by Veronica Dimick.

Figure 6: Bottom-right. STEM outreach event with Cesar Chavez Middle School. Matthew Tenglin (far left), along with members of Fernanda Valdovinos' Lab. Photo by Melissa Duhaime.

GRANTS / AWARDS – Totals represent amount for the duration of the grant

Total Amount	Details
$25,192	University of Michigan Office of Research (UMOR) Faculty Grants & Awards. Michigan's Hidden Triple Threat: Hymenoptera Pollinators, Parasitoids, & Predators. ($6,298 UM LSA, $6,298 UM EEB cost matching, UMOR provides half of total – awarded in 2018)
$1,500	University of Michigan Undergraduate Research Opportunity Program (UROP) Supplementary Research Funding. Collection Detective: Deciphering the Forster Dragonfly collection.
$1,500	UROP Supplementary Research Funding. Role call! Developing Museum Species Checklists.
$367,004	National Science Foundation, Advancing Digitization of Biodiversity Collections (ADBC), Collaborative Research: Digitization Thematic Collections Networks (TCN): Digitizing collections to trace parasite-host associations and predict the spread of vector-borne disease.
$395,196	**TOTAL FROM GRANTS**
	Mohamed bin Zayed Species Conservation Fund. Saving the bees one prairie at a time: Restoring native habitat for the Rusty Patched Bumble Bee. (Submitted in 2019)
	SeaWorld & Busch Gardens Conservation Fund. Bee REC: Saving the bees through Restoration, Education, and Conservation. (Submitted in 2019)
	Michigan Botanical Foundation. Native flora required: Michigan prairie land restoration and education. (Submitted in 2019)

UMMZ INSECT DIVISION

GLOBAL AGGREGATORS / DATA PORTALS

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium & VertNet)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Insect	3,757	153,516,822	153,516,822	153,516,822	from 21 Dec 2018
iDigBio Insect	18,703	18,052	26	18,052	from Apr 2019
Symbiota Collections of Arthropods Network (SCAN)	Active portal, but no usage statistics in 2019				from Apr 2019
TOTAL	**22,460**	**153,534,874**	**153,516,848**	**153,534,874**	
AVG / MONTH	**1,871.67**	**12,794,572.83**	**12,793,070.67**	**12,794,572.83**	

GBIF – Global Biodiversity Information Facility; Registered 21 December 2018

Statistic Category	2019 Year Total	Average per Month
Number of Download Events (Search)	3,757	313.08
Number of Records Downloaded (total # of specimens)	153,516,822	12,793,068.50
Number of Downloads Requiring Georeferenced Records	928	77.33
Number of Downloads Using a Polygon Locality Region	550	45.83
Number of Downloads Based on a Country/Specific Locality Search	7	0.58
Percent of Searches Requesting Georeferenced Specimens	24.70	24.70
Maximum Percent Requesting Georeferencing, Polygon or Locality *** (see below)	39.53	39.53

*** GBIF Maximum percent assumes that georeferencing, polygon and country search are independent - data is not available to separate this. Maximum percent represents the greatest percent possible for searches looking for locality information.

UMMZ INSECT DIVISION

iDigBio – Integrated Digitized Biocollections; Registered 12 April 2019

Statistic Category	2019 Year Total	Average per Month
Search – instances a record from this recordset matched a search query	29,561,805,150	3,284,645,016.67
Download – instances a record from this recordset was downloaded	18,703	2,078.11
Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	18,052	2,005.78
Records Viewed – how many specimen records were opened and viewed in full detail	26	2.89
Media Viewed – how many media records were opened and viewed in full detail	0	0.00

UM DIGITAL LIBRARY – All collections active since 2019

Collection	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
UMMZ, Insect Division Collection (insect2ic)	496	72	14.52	840	660	78.57	1,336
UMMZ, Insect Field Notebooks (insect1ic)	426	65	15.26	4,208	2,977	70.75	4,634
2019 TOTAL	**922**	**137**	**14.86**	**5,048**	**3,637**	**72.05**	**5,970**

Year TOTAL	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
2019	922	137	14.86	5,048	3,637	72.05	5,970

UMMZ MAMMAL DIVISION – Division Details provided by Cody Thompson

OVERVIEW

The UMMZ Mammal Division had a productive 2019. Most notably, two of its PhD students, Marcela Baiz and Beatriz Otero Jiménez, successfully defended their dissertations. Marcela examined the genetic architecture of speciation in a primate hybrid zone, and Beatriz studied rodent population connectivity in coffee agroecosystems. The division (along with the Division of Reptiles and Amphibians) also started its third year of the oVert TCN, and received additional NSF support for the FuncQEE PEN project. FuncQEE is a collaboration between Cody Thompson and collaborators at Chicago State University, University of Florida, University of New Mexico, and the Sandia National Laboratories. The FuncQEE project is a partner grant with the oVert TCN, but is focused on producing CT data exclusively for rodent taxa.

The Mammal Division CT data is deposited with the Morphosource aggregator. In 2019, there were 219 unique specimens requested and 426 download requests, for a total of 14,750 downloads. These values greatly exceeded the 2013-2018 combined values.

Figure 1: Priscilla Tucker giving a tour of the Mammal Collection during a EEB PhD Recruitment weekend in Feb 2019. Photo by Benjamin Hess.

Figure 2: Cody Thompson giving a tour for Making Science Visible Class. Photo by Benjamin Hess.

Figure 3: Greg Pandelis and Cody Thompson after the preparation of a porcupine and a mink. Image permission from Cody Thompson

UMMZ MAMMAL DIVISION

PERSONNEL – 23 total staff members in 2019

Title	Name(s)
Curator	Priscilla Tucker
Collection Manager / Assistant Research Scientist	Cody Thompson
Emeritus Curator	Phil Myers
Adjunct Curators/Researchers	Barb Lundrigan
Research Associates	Don Swiderski
Postdoctoral Fellow	Talia Moore (Research Associate - Fall 2019)
CT Facility Manager / Morphology Technician	Ramon Nagesan
Graduate Student Curatorial Assistants	Jacqueline Popma
Graduate Students	Marcella Baiz, Beatriz Otero-Jimenz and Lisa Walsh
Graduate Research Assistant	Stephanie Triplett
Undergraduate Assistants	Collection Assistants: Lexi Frank and Michael Lyons; Research Assistants: Coen Long, Shion Otsuka, Greg Pandelis and Rhea Rajani
Volunteers	Michael Loviska
Affiliates	Giorgia Auteri and Susanna Campbell
Administrative Specialist	Robbin Murrell (across all UMMZ divisions)
Registrar	Benjamin Hess (across Herbarium and all UMMZ divisions)

COLLECTION GROWTH / DATA ENHANCEMENT

Category	Number
Accessions	12 accessions (1,526 specimens) - 9 unique institutions/donors (12 domestic)
Vouchers	0 acquisitions, 0 cataloged
Tissues	0 acquisitions, 0 cataloged
Data Entries	29 created (timestamp created), 0 cataloged, 513 modified (edited)
Locality	467 created, 496 modified

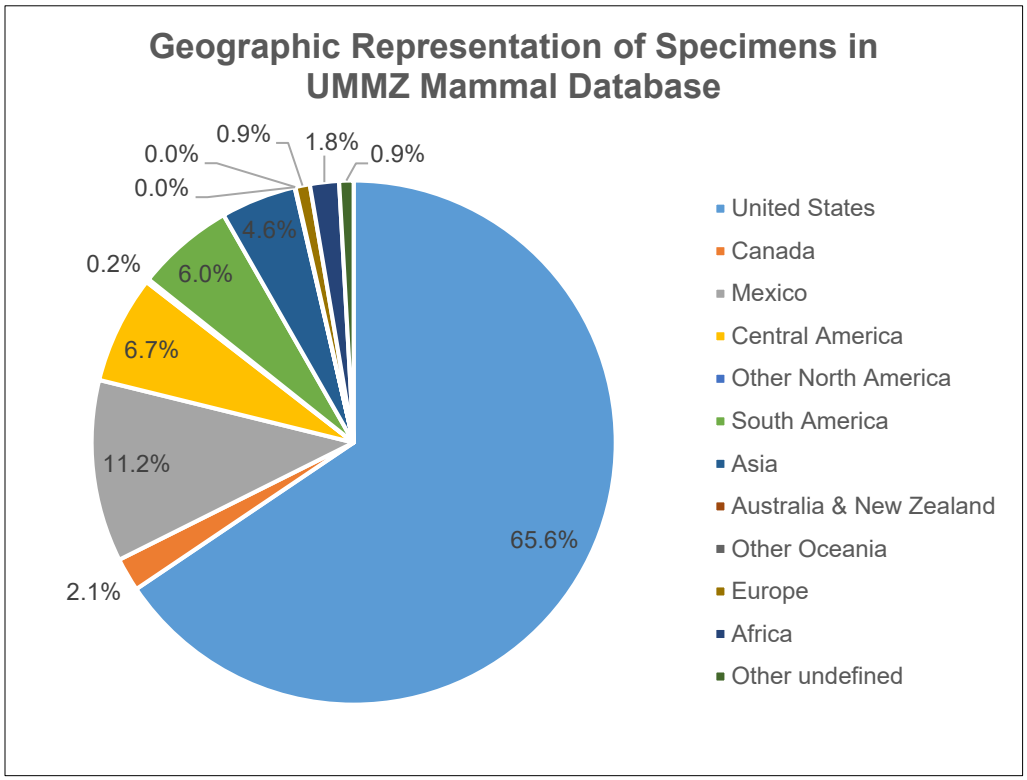
TAXONOMIC BREAKDOWN / TYPES / DATABASE STATUS

Category	Number
Taxa Represented	132 Families, 1,693 Genera, 4,782 species
Types Represented	130 types (127 holotypes, 3 neotypes)
Percent of Georeferenced Specimens	84.32% of specimens in Specify (0 newly georeferenced: 2019 total 108,018, 2018 total 108,018)
Highest Catalog Number	178,776
Percent Databased	~ 100% of present collection digitized (71.66% of specimens in Specify) – early specimens cataloged as a group with unassigned numbers

UMMZ MAMMAL DIVISION

GEOGRAPHIC DISTRIBUTION

Global Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
United States	83,778	209	83,987
Canada	2,643	1	2644
Mexico	14,370	0	14,370
Central America	8,528	0	8528
Other North America	262	0	262
South America	7,726	0	7,726
Asia	5,954	0	5,954
Australia & New Zealand	50	0	50
Other Oceania	7	0	7
Europe	1,144	0	1,144
Africa	2,294	0	2,294
Other and undefined	1,349	-210	1,139
TOTAL	**128,105**	**0**	**128,105**



UMMZ MAMMAL DIVISION

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
Michigan	21,363	205	21,568
Midwest USA	33,378	205	33,583
Great Lakes US (w/PA & NY)	25,165	205	25,370
Great Lakes US (no PA & NY)	24,641	205	24,846
Ontario Province, Canada	707	0	707
North America	109,581	210	109,791

COLLECTION TRANSACTIONS

Category	Number and Purpose
Loans (Outgoing)	29 loans (306 specimens or samples) – 9 unique institutions (29 domestic, 0 foreign); 17 research, 6 education, 3 exhibit, 3 art
Loans Returns (Closed)	29 loan returns (326 specimens) – 11 unique institutions (29 domestic, 0 foreign); 17 research, 4 education, 1 exhibit, 4 art, 3 other
Borrows (Incoming)	12 borrows (561 specimens) – 8 unique institutions (8 domestic, 0 foreign); 12 research
Borrow (Loan) Returns	5 borrow returns (87 specimens) – 4 unique institutions (4 domestic, 0 foreign); 5 research
Gifts (Outgoing)	2 gifts (3 specimens) – 2 unique institutions (2 domestic, 0 foreign); 2 research
Information Requests	10 requests (2,254 specimens) - 9 unique institutions (7 domestic, 2 international); 10 research
TOTAL	**87 transactions (3,537 specimens) – 31 (43 maximum) unique institutions (85 domestic, 2 foreign); 63 research, 10 education, 4 exhibit, 7 art, 3 other (taxidermy return)**

INQUIRIES AND DATA REQUESTS

Category	Number
Number of Inquiries Answered	129

VISITATION TO THE COLLECTION

Category	Number
Visits / Individuals	63 visits / 222 individuals
Unique Individual / Institution	42 unique individuals, 30 unique institutions/departments
Individual Visitor Type	23 Faculty/Curator/Other Professional, 2 Postdoctoral Researcher, 17 Graduate Student, 5 Undergraduate Student, 11 Class, 1 Public, 4 Other

UMMZ MAMMAL DIVISION

CITATIONS – Published work by curatorial staff, students, and from external collection use; Google Scholar Citations set up for the UMMZ Mammal Division

Category	Number
Total Citations	68,741
Citations Since 2015	18,945
Citations of Papers Published in Last 5 Years	1,362
Citations in GBIF	87 total (41 citations in 2019) – may be some overlap with Google Scholar

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS

Details
Progress from grants: Huron Mountain Wildlife Foundation, NSF oVert-TCN, NSF FuncQEE-PEN
Organized & labeled skin collection (near completion)
Inventoried film negatives, including possible nitrate
Coordinate BSB cabinet repairs with Delta Designs LTD.

CONFERENCES / MEETINGS / WORKSHOPS

Details
99th Annual Meeting of the American Society of Mammalogists, 28 Jun 2019 - 2 Jul 2019, at the Hyatt Regency Washington on Capitol Hill, Washington, DC. (participant Cody Thompson).
The Ninth Annual Advancing Digitization of Biodiversity Collections (ADBC) Summit, 1-3 October 2019, in Gainesville, Florida. (participant Cody Thompson)

OUTREACH AND TOURS

Details	
Class Visits	UM Dental School - Frontiers in TMD & Orofacial Pain, Clinical Neuroscience, and Technology
	UM STAMPS Art School - Making Science Visible (11 separate visits)
	UM History - Tours of the Past
	UM Anthropology - Methods in Hominoid Evolution
Public Visits	Grand Rapids Public Museum
	University of Georgia – Provost Office
	Huron Mountain Wildlife Foundation

UMMZ MAMMAL DIVISION

GRANTS / AWARDS – Totals represent amount for the duration of the grant

Total Amount	Details
$207,250	National Science Foundation (NSF), Advancing Digitization of Biodiversity Collections (ADBC), Digitization Thematic Collections Networks (TCN): Collaborative Research: oVert: Open Exploration of Vertebrate Diversity in 3D.
$9,285	Huron Mountain Wildlife Foundation. Assessing hybridization in flying squirrels (*Glaucomys*) of the Huron Mountains.
$180,041	NSF, ADBC, Digitization Partner to an Existing Network (PEN): Functional Quantitative Characters for Ecology and Evolution (FuncQEE). Joined the oVert TCN as a PEN.
$396,576	**TOTAL FROM GRANTS**

UMMZ MAMMAL DIVISION

GLOBAL AGGREGATORS / DATA PORTALS

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium & VertNet)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Mammal	13,189	98,616,113	98,616,113	98,616,113	from 22 Apr 2013
iDigBio Mammal	81,201	210,816	51,378	210,816	from Jan 2015
VertNet Mammal	12,977	182,048	224,782	224,782	from Apr 2014
USGS BISON Mammal	214	319,267	319,267	319,267	from Jan 2019
TOTAL	**107,581**	**99,328,244**	**99,211,540**	**99,370,978**	
AVG / MONTH	**8,965.08**	**8,277,353.67**	**8,267,628.33**	**8,280,914.83**	

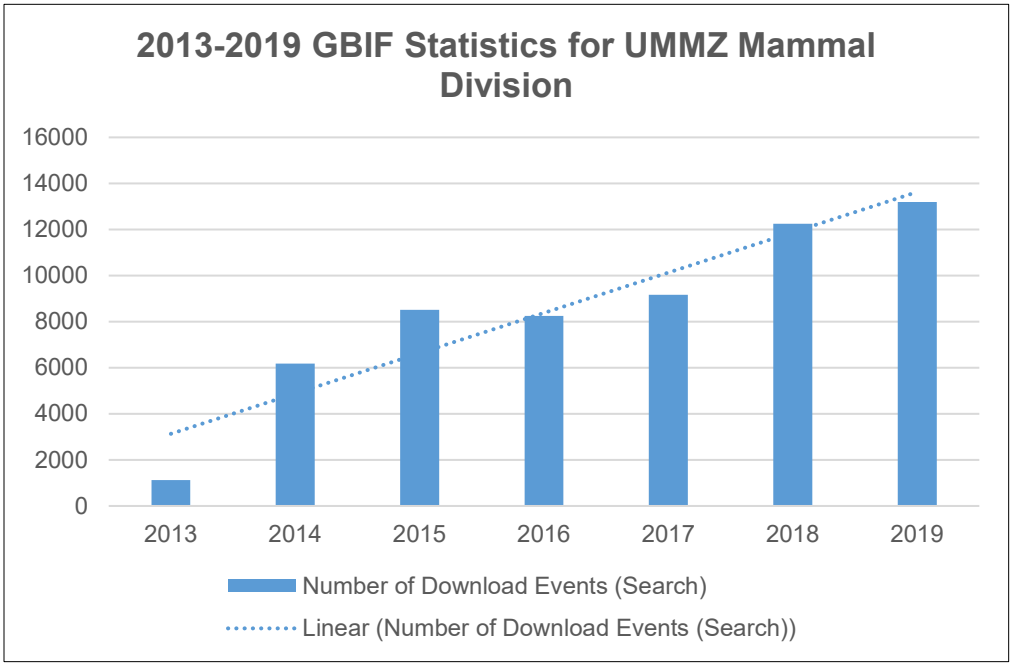
GBIF – Global Biodiversity Information Facility

Statistic Category	2019 Year Total	Average per Month
Number of Download Events (Search)	13,189	1,099.08
Number of Records Downloaded (total # of specimens)	98,616,113	8,218,009.42
Number of Downloads Requiring Georeferenced Records	4,064	338.67
Number of Downloads Using a Polygon Locality Region	1,590	132.50
Number of Downloads Based on a Country/Specific Locality Search	8,465	705.42
Percent of Searches Requesting Georeferenced Specimens	30.81	30.81
Maximum Percent Requesting Georeferencing, Polygon or Locality *** (see below)	107.05	107.05

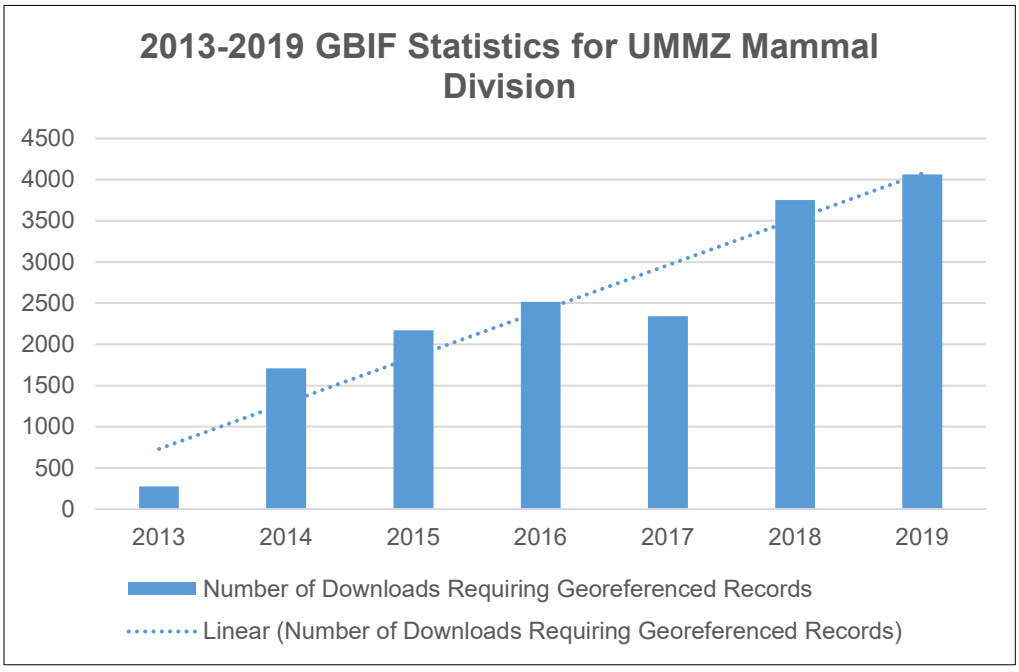
*** GBIF Maximum percent assumes that georeferencing, polygon and country search are independent - data is not available to separate this. Maximum percent represents the greatest percent possible for searches looking for locality information.

UMMZ MAMMAL DIVISION

GBIF – Global Biodiversity Information Facility; Number of Download Events



GBIF – Global Biodiversity Information Facility; Number of Downloads Requiring Georeferenced Records



UMMZ MAMMAL DIVISION

iDigBio – Integrated Digitized Biocollections

Statistic Category	2019 Year total	Average per Month
Search – instances a record from this recordset matched a search query	19,224,933,262	1,602,077,771.83
Download – instances a record from this recordset was downloaded	81,201	6,766.75
Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	210,816	17,568.00
Records Viewed – how many specimen records were opened and viewed in full detail	51,378	4,281.50
Media Viewed – how many media records were opened and viewed in full detail	0	0.00

VertNet – Vertebrate Network

Statistic Category	2019 Year Total	Average per Month
Number of searches that retrieved data from the resource	12,977	1,081.42
Number of records retrieved in searches / were pulled to screen	182,048	15,170.67
Number of different countries where searched have been originated	273	22.75
Number of download events retrieved data from the resource / pulled records from the resource 2018	1484	123.67
Total number of records downloaded	224,782	18,731.83
Number of different countries that downloaded records	109	9.08
Percent that the resource appeared on all download events this month	136.22	11.35

UMMZ MAMMAL DIVISION

USGS BISON – Biodiversity Information Serving Our Nation (BISON) - Explore and download North American species occurrence data and maps from Canada, USA, US Territories, and US Marine Exclusive Economic Zones.

Statistic Category	2019 Year Total	Average per Month
Search indicates when any records from the dataset are included in the results of a front end search.	12,109	1,009.08
Download indicates when any records from the dataset are included in a front end download request.	340	28.33
SOLR indicates when any records from the dataset are included in the results of a SOLR query.	1	0.08
WMS (Web Map Services) indicates when any records from the dataset are included in the results of a WMS query.	186,868	15,572.33
All Requests is a combination of Search + Download + SOLR + WMS.	199,318	16,609.83

MORPHOSOURCE – Digital repository containing 3D media (raw micro-CT data and surface meshes) from UMMZ specimens

Year	Download Requests	Unique Specimens Requested	Unique Media File Downloads	Total Downloads	Total Download Users
2013-2018	31	23	876	6,054	2,589
2019	426	219	296	14,750	2,105
TOTAL	**457**	**242**	**1,172**	**20,804**	**4,694**

TOTAL is metrics from 1 Jul 2013 to 31 Dec 2019

UMMZ MAMMAL DIVISION

UM DIGITAL LIBRARY – All collections active since 2015

Collection	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
UMMZ Mammal Division Collection Database with Specimen Images (mam1ic)	3,176	197	6.20	19,305	237	1.23	22,481
UMMZ Mammal Division Field Notes (mam3ic)	2,237	195	8.72	2,780	520	18.71	5,017
UMMZ Mammal Division Division Maps (mam2ic)	2,009	184	9.16	2,568	87	3.39	4,577
2019 TOTAL	**7,422**	**576**	**7.76**	**24,653**	**844**	**3.42**	**32,075**

Year TOTAL	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
2015	3,574	503	14.07	4,532	155	3.42	**8,106**
2016	6,550	669	10.21	126,253	342	0.27	**132,803**
2017	9,038	2,628	29.08	20,383	619	3.04	**31,569**
2018	5,833	989	16.96	25,736	791	3.07	**31,569**
2019	7,422	576	7.76	24,653	844	3.42	**32,075**
TOTAL 2015-2019	**29,212**	**3,726**	**12.76**	**206,910**	**2,923**	**1.41**	**236,122**
AVERAGE 2015-2019	**5,842**	**745**	**12.76**	**41,382**	**585**	**1.41**	**47,224**

UMMZ MOLLUSK DIVISION - Division Details provided by Taehwan Lee

OVERVIEW

In September 2019, The UMMZ Mollusk Division completed the five-year Thematic Collections Networks (TCN) project, “InvertEBase: Reaching back to see the future: species-rich invertebrate faunas document causes and consequences of biodiversity shifts." During the grant period, we entered almost 110,000 new mollusk specimen records, imaged more than 11,000 lots, and georeferenced 33% of the total localities in the UMMZ mollusk database. This was a collective effort involving 53 participating students: 6 graduate, 45 undergraduate and 2 high school students. Training and mentoring students is a key role of the UMMZ. The 2019 Mollusk Division Graduate Student Curatorial Assistant, Andrew Wood, received his PhD in July 2019 (Figure 1). Under the direction of Tom Duda, Andrew’s work on the adaptive radiation of cone snails examined what genetic attributes promote the diversity seen within this group. The Mollusk Division was awarded a new TCN grant: “PILSBRY: Enhancing access to taxonomic and biogeographical data to stem the tide of extinction of the highly imperiled Pacific island land snails.” This collaborative network (Figure 2) will develop comprehensive online resources that will enable time-sensitive assessment of the systematics and conservation status of Pacific island land snails. With this new grant, the Mollusk Division will digitize ~100,000 specimens and associated ledger, field notes and references.

Emeritus Curator John (“Jack”) B. Burch turned 90 this year (Figure 3). Jack completed his PhD studies in Zoology at the University of Michigan (UM) in 1959. He served as a Research Associate in the UMMZ from 1959 to 1963, and was then appointed as a faculty member of the Department of Zoology and a Curator in the UMMZ. During his time at UM, he also served as Curator of Molluscs at the Australian Museum (1975-1976) and a Regents Fellow at the Smithsonian Institution (1983-1984). He served as the Chairman of the Department of Ecology and Evolutionary Biology from 1979 to 1981. Jack’s research encompasses varied topics in malacology and is global in scope. During his career, he published more than 270 scientific articles and books, and has been recognized through numerous awards from malacological and scientific societies. Jack advised numerous graduate students and postdoctoral research associates who have themselves gone on to contribute to the field of malacology in research and academic positions in the US and abroad.

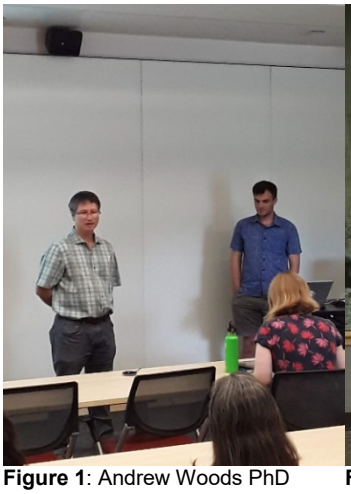


Figure 1: Andrew Woods PhD Dissertation Defense: 18 Jul 2019 - Genetic drivers of diversification in the *Conus* adaptive radiation. Andrew’s field studies took place in Okinawa, American Samoa, and Samoa.

Figure 2: PILSBRY TCN participants gathered at the 2019 ADBC (Advancing Digitization of Biodiversity Collections) Summit, Oct 2-3, 2019 Gainesville, FL. From left to right: Richard Pyle (Bishop Museum), Norine Yeung (Bishop Museum; Lead PI), Rüdiger Bieler (Field Museum), Petra Sierwald (Field Museum), John Slapcinsky (Florida Museum of Natural History), Taehwan Lee (UMMZ) and Jim Boone (Bishop Museum).

Figure 3: Jack Burch: Emeritus Curator Jack Burch became 90 years old in August. He served as Mollusk curator from 1963 to 2000. His contributions have been in parasitology, cytology and taxonomy of mollusks.

UMMZ MOLLUSK DIVISION

PERSONNEL – 36 total staff members in 2019

Title	Name(s)
Curator	Tom Duda and Diarmaid O'Foighil
Collection Manager / Associate Research Scientist	Taehwan Lee
Emeritus Curator	John B. Burch
Postdoctoral Fellow	Amanda Haponski
Graduate Student Curatorial Assistants	Andrew Wood
Graduate Students	Peter Cerda, Trevor Hewitt and Andrew Wood
Graduate Research Assistants	Rochelle Campbell, Julia Dellick, Edward Lo, Emily Nagy, Lorena Cortes Torres and Benjamin Woerner
Undergraduate Research Assistant (Student Temp)	Brij Banerji, Emily Brown, Tatiana Cuevas, Alexander Davis, Pagie Dotson, Madeleine Klemz, Katherine Klier, Kaitlin Koshurba, Cameron Leitz, Myah McCormick, Rachel Niesen, Hailey Pantaleo, Julie Pastorino, Austin Potter, Sihan Wang, Cody Williams, Olivia Young and Siyi Zhang
Volunteers	Alex Choi (High School Volunteer)
Administrative Specialist	Robbin Murrell (across all UMMZ divisions)
Registrar	Benjamin Hess (across Herbarium and all UMMZ divisions)

COLLECTION GROWTH / DATA ENHANCEMENT

Category	Number
Specimens Prepared	132 wet lots (490 specimens), 1 dry lot (5 specimens), 8 tissue lots (8 specimens)
Added to Collection	133 lots (132 wet, 1 dry)
Accessions	6 accessions (133 lots, 495 specimens) - 5 domestic, 1 foreign (Czech Republic)
Data Entries	30,808 created (timestamp created), 30,768 cataloged (collection object date), 31,228 modified (edited)
Locality	8,588 created, 22,377 modified
Images Added	1 JPG image (227 TOTAL attachments)

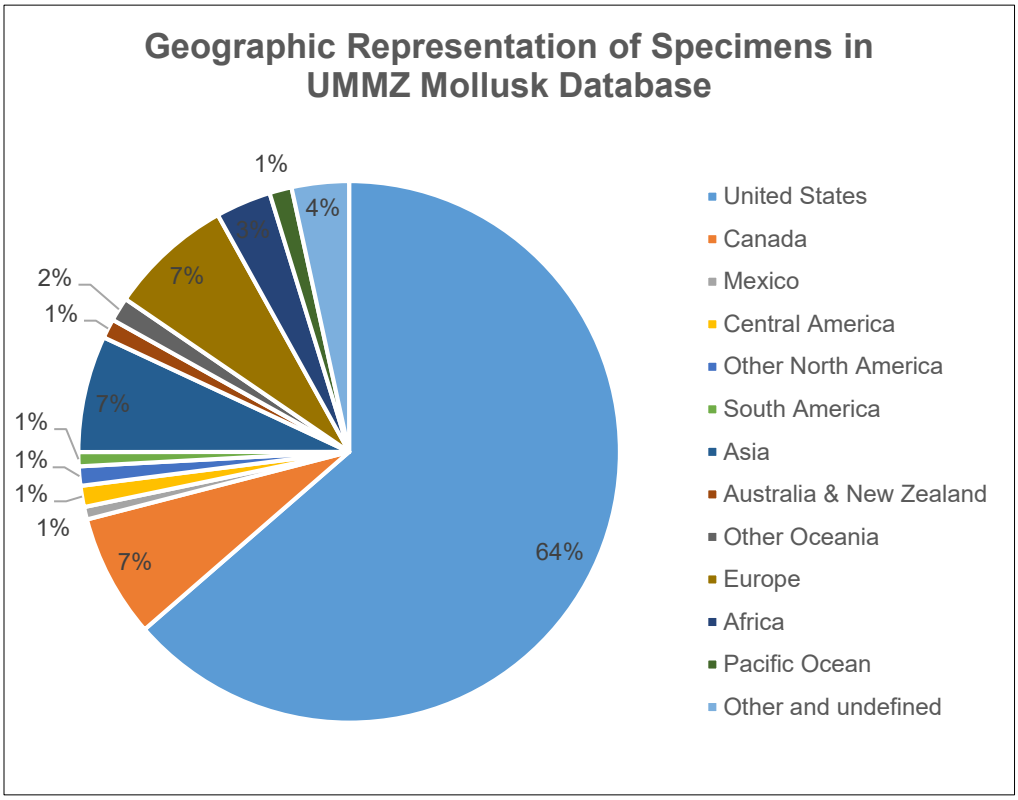
TAXONOMIC BREAKDOWN / TYPES / DATABASE STATUS

Category	Number
Taxa Represented	190 Families, 1,825 Genera, 14,832 species (from Specify Statistics Holdings tab – increase of 26 Families, 416 Genera and 3,546 species)
Types Represented	1,515 type specimens (177 new in 2019; indicated in Specify Statistics tab): 125 new topotypes, 79 new cotypes, 63 new paratypes
Percent of Georeferenced Specimens	42.49% of Specify entries
Highest Catalog Number	400,180 (highest cataloged lot – 5,000,000 estimated specimens)
Percent Databased	48.50% of lots in Specify (194,068/400,180) – 75% of dry collection

UMMZ MOLLUSK DIVISION

GEOGRAPHIC DISTRIBUTION

Global Locality	Total Lots in Specify in 2018	Increase 2018 to 2019	Total Lots in Specify in 2019
United States	114,273	9,193	123,466
Canada	12,983	1,307	14,290
Mexico	1,403	49	1,452
Central America	2,296	153	2,449
Other North America	1,585	651	2,236
South America	1,408	228	1,636
Asia	10,431	3,075	13,506
Australia & New Zealand	1,968	282	2,250
Other Oceania	2,264	517	2,781
Europe	11,090	3,280	14,370
Africa	5,420	1,001	6,421
Pacific Ocean	2,293	283	2,576
Other and undefined	5,553	1,082	6,635
TOTAL	**172,967**	**21,101**	**194,068**



UMMZ MOLLUSK DIVISION

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Total Lots in Specify in 2018	Increase 2018 to 2019	Total Lots in Specify in 2019
Michigan	31,672	2,791	34,463
Midwest USA	55,870	4,673	60,543
Great Lakes US (w/PA & NY)	53,656	4,314	57,970
Great Lakes US (no PA & NY)	50,453	4,077	54,530
Ontario Province, Canada	10,850	1,195	12,045
North America	132,540	11,353	143,893

COLLECTION TRANSACTIONS

Category	Number and Purpose
Loans	8 loans (45 lots, 346 specimens) - 8 domestic; 5 research, 2 exhibit/education, 1 education
Loans closed (returns)	1 loan (5 lots, 62 specimens) - 1 domestic; 1 education
TOTAL	**9 transactions (50 lots, 408 specimens) - 7 unique institutions; 9 domestic; 5 research, 2 exhibit/education, 2 education**

INQUIRIES AND DATA REQUESTS

Category	Number
Specimen Inquiries	39 inquiries: 25 about collection, 11 image requests, 3 identification
General Requests	19 requests: 16 information about mollusks, 2 georeferencing request, 1 publication questions
TOTAL	**58 inquiries and requests**

VISITATION TO THE COLLECTION

Category	Number
Visits / Individuals	33 visits / 161 individuals
Unique Individual / Institution	23 unique individuals, 13 unique institutions/departments
Individual Visitor Type	7 Faculty/Curator/Other Professional, 0 Postdoctoral Researcher, 2 Graduate Student, 13 Undergraduate Student, 9 Class, 0 Public, 2 Other

CITATIONS – Published work by curatorial staff, students, and from external collection use

Category	Number
Citing Specimens	4
Curator/Student	4
Citations in GBIF	6 total (2 citations in 2019)

UMMZ MOLLUSK DIVISION

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS

Details
5,000+ dry specimens of the land snail superfamilies Helicoidea, Sagdoidea, Punctoidea, Testacelloidea and Urocoptoidea were reorganized according to the updated taxonomy.
Terrestrial gastropod taxonomic authority file registered in the Specify database were updated.
Cepaea specimens, land snails introduced from Europe during the nineteenth century, were collected locally by Tom Duda and his students and added to wet collection.
Paratype specimens of the newly described land snail species, *Euconulus fresti*, were deposited by Jeffrey Nekola (Masaryk University, Czech Republic)

CONFERENCES / MEETINGS / WORKSHOPS

Details
ADBC Summit 2019: Advancing Digitization of Biodiversity Collections (ADBC) ninth annual summit Oct 2-3, 2019 Gainesville, FL (participant Taehwan Lee)
Data Meeting: Digital Data in Biodiversity Research Conference June 10-12, 2019 Yale Peabody Museum, Yale University, New Haven (participant Taehwan Lee)
World Congress of Malacology, Aug. 11-16, 2019, Pacific Grove, CA (participants Diarmaid Ó Foighil and Amanda Haponski)
Evolution of freshwater bivalves presentation - The Freshwater Mollusk Conservation Society in San Antonio TX, April 14-18, 2019 (participant Trevor Hewitt)
Poster: Unraveling cryptic morphological diversity in a marine snail species complex using nuclear sequence data. Peter Cerda, Trevor Hewitt, Amanda Haponski, Thomas Duda, Jr. Society for the Study of Evolution, Providence, Rhode Island. RI on June 21-25 (participant Peter Cerda)
Workshop: “A Comprehensive Petrochemical Vulnerability Index for Improved Decision-Making and Marine Biodiversity Risk Assessment in the Gulf of Mexico Large Marine Ecosystem” at Parque Nacional Peninsula de Guanahacabibes in western Cuba, June 2019. (participant Tom Duda)

GRANTS / AWARDS – Totals represent amount for the duration of the grant

Total Amount	Details
$250,746	National Science Foundation (NSF), Advancing Digitization of Biodiversity Collections (ADBC), Digitization Thematic Collections Networks (TCN):: InvertEBase: Reaching back to see the future: species-rich invertebrate faunas document causes and consequences of biodiversity shifts. (Completed in Sep 2019)
$54,781	NSF, ADBC, Digitization TCN: Collaborative Research: Enhancing Access to Taxonomic and Biogeographical Data to Stem the Tide of Extinction of the Highly Imperiled Pacific Island Land Snails. (PILSBRY grant)
$305,527	**TOTAL FROM GRANTS**
	NSF, TCN: Mobilizing Millions of Marine Mollusks from the Eastern Seaboard (ESB) of the United States. $25,574 (Submitted in 2019, Awarded in July 2020)

UMMZ MOLLUSK DIVISION

GLOBAL AGGREGATORS / DATA PORTALS

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium & VertNet)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Mollusk	5,281	86,275,747	86,275,747	86,275,747	from 13 Jul 2018
iDigBio AquaticInvasives Mollusks	7,418	1,711	2	1,711	from Oct 2016
iDigBio Mollusk	32,946	66,667	58	66,667	from Jul 2018
GreatLakesIN Mollusk					23 Mar - 31 Aug 2018
IvertEBase Mollusk					23 Mar - 24 August 2018
USGS BISON Mollusk	12,449	199,318	199,318	199,318	from Jan 2019
TOTAL	**58,094**	**86,543,443**	**86,475,125**	**86,543,443**	
AVG / MONTH	**4,841.17**	**7,211,953.58**	**7,206,260.42**	**7,211,953.58**	

GBIF – Global Biodiversity Information Facility

Statistic Category	2019 Year Total	Average per Month
Number of Download Events (Search)	5,281	440.08
Number of Records Downloaded (total # of specimens)	86,275,747	7,189,645.58
Number of Downloads Requiring Georeferenced Records	1,648	137.33
Number of Downloads Using a Polygon Locality Region	1,039	86.58
Number of Downloads Based on a Country/Specific Locality Search	539	44.92
Percent of Searches Requesting Georeferenced Specimens	31.21	31.21
Maximum Percent Requesting Georeferencing, Polygon or Locality *** (see below)	61.09	61.09

*** GBIF Maximum percent assumes that georeferencing, polygon and country search are independent - data is not available to separate this. Maximum percent represents the greatest percent possible for searches looking for locality information.

UMMZ MOLLUSK DIVISION

iDigBio – Integrated Digitized Biocollections: Aquatic Invasives (former TCN grant project) Mollusk Division and Mollusk Division

Statistic Category	Search – instances a record from this recordset matched a search query	Download – instances a record from this recordset was downloaded	Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	Records Viewed – how many specimen records were opened and viewed in full detail	Media Viewed – how many media records were opened and viewed in full detail
iDigBio Aquatic Invasives Mollusk Division	3,355,332,148	7,418	1,711	2	0
iDigBio Mollusk Division	22,924,103,629	32,946	66,667	58	0
TOTAL	**26,279,435,777**	**40,364**	**68,378**	**60**	**0**
AVG / MONTH	**2,189,952,981.42**	**3,363.67**	**5,698.17**	**5.00**	**0.00**

USGS BISON – Biodiversity Information Serving Our Nation (BISON) - Explore and download North American species occurrence data and maps from Canada, USA, US Territories, and US Marine Exclusive Economic Zones.

Statistic Category	2019 Year Total	Average per Month
Search indicates when any records from the dataset are included in the results of a front end search.	12,109	1,009.08
Download indicates when any records from the dataset are included in a front end download request.	340	28.33
SOLR indicates when any records from the dataset are included in the results of a SOLR query.	1	0.08
WMS (Web Map Services) indicates when any records from the dataset are included in the results of a WMS query.	186,868	15,572.33
All Requests is a combination of Search + Download + SOLR + WMS.	199,318	16,609.83

UMMZ REPTILE AND AMPHIBIAN DIVISION – Division Details provided by Gregory E. Schneider

OVERVIEW

The UMMZ Division of Reptiles and Amphibians was quite productive in 2019 with collection, education and research endeavors. We processed accessions from Nicaragua and Peru including over 500 specimens and tissues, which we identified, sorted, cataloged and incorporated into the collections. The Division acquired several thousand radiographs of nesting turtles amassed over a few decades by Justin Congdon's work at the Edwin S. George Reserve. We have begun organizing and digitizing these to catalog them into the physical and digital collections.

Alison Davis Rabosky taught Biology of Amphibians and Reptiles (EEB 450) in the spring semester at the Biological Sciences Building (BSB), which included two class trips to Research Museums Center (RMC) collections. This was the first offering of this course in four years, and required the loan and transport of specimens from the RMC to the BSB. As part of this effort, we moved the teaching collections from the RMC to the new collection space at the BSB. The UM Stamps School of Art & Design visited the UMMZ for the Making Science Visible class, where several students used reptile and amphibian specimens for their art assignments. CT scans were utilized for this class, and CT scanning projects utilized reptile and amphibian specimens for the NSF sponsored oVert project (Digitization TCN: oVert: Open Exploration of Vertebrate Diversity in 3D), the MorphoSource Scan all Snakes project, and various individual research projects.

Lastly, the University of Michigan is hosting the 2021 Study of Amphibians and Reptiles (SSAR) Annual Meeting. The UMMZ Reptile & Amphibian Division is part of the planning committee for this meeting, and is responsible for coordinating events and symposia. In addition, we are assembling a commemorative book, "Letters from Michigan Herpetology", to be published in the UMMZ series. At present, the commemorative book project has 28 authors, all U of M affiliates (undergrad, grad, post doc, former curator, and CM).

Figure 1: Alison Davis Rabosky, Assistant Curator, teaching Biology of Amphibians and Reptiles within the RMC collection space.

Figure 2: Joanna Larson, EEB PhD Candidate and Outstanding Graduate Student Instructor Award for 2020 by the Rackham Graduate School, leading a lab in the collection space.

Figure 3: Greg Schneider, Collection Manager, teaching about collections during Biology of Amphibians and Reptiles within the main wet lab space at the RMC.

UMMZ REPTILE AND AMPHIBIAN DIVISION

PERSONNEL – 27 total staff members in 2019

Title	Name(s)
Curators	Daniel Rabosky and Alison Davis Rabosky
Collection Manager	Gregory E. Schneider
Emeritus Curator	Ronald A. Nussbaum
Research Scientist	Fred Kraus
Postdoctoral Fellows	Rudi von May and Talia Moore (Research Associate - Fall 2019)
CT Facility Manager / Morphology Technician	Ramon Nagesan
Graduate Student Curatorial Assistants	Iris Holmes and Michael Grundler
Graduate Students	Joanna Larson, Iris Holmes, Peter Cerda, John David Curlis, Briana Sealey and Imani Russell
Undergraduate Research Assistants	Sean Callahan, Coen Long, Daniel Nondorf, Greg Pandelis, Molly S., Paul Hampel, Tim Renney and Ashley Thompson
Non-student Technician	Courtney Whitcher
Work Study	Molly McKenna
Volunteer	Andrea Zaha
Administrative Specialist	Robbin Murrell (across all UMMZ divisions)
Registrar	Benjamin Hess (across Herbarium and all UMMZ divisions)

COLLECTION GROWTH / DATA ENHANCEMENT

Category	Number
Cataloged Units Added	537
Skeletal Cataloged Units	0 (total: 14,159 through UMMZ 248830)
Accessions	13 accessions (780 specimens)
Tissues Cataloged	2,229 (total 18,911)
Digital Images Cataloged	592 (total: 4,462)
Other Media Cataloged	0 microslides (455 boxes representing 31,365 slides); 0 x-rays (through X-2939); 0 color slides (total 7,303)
Data Entries	537 timestamp created, 0 cataloged, 636 modified
Locality	493 created, 504 modified

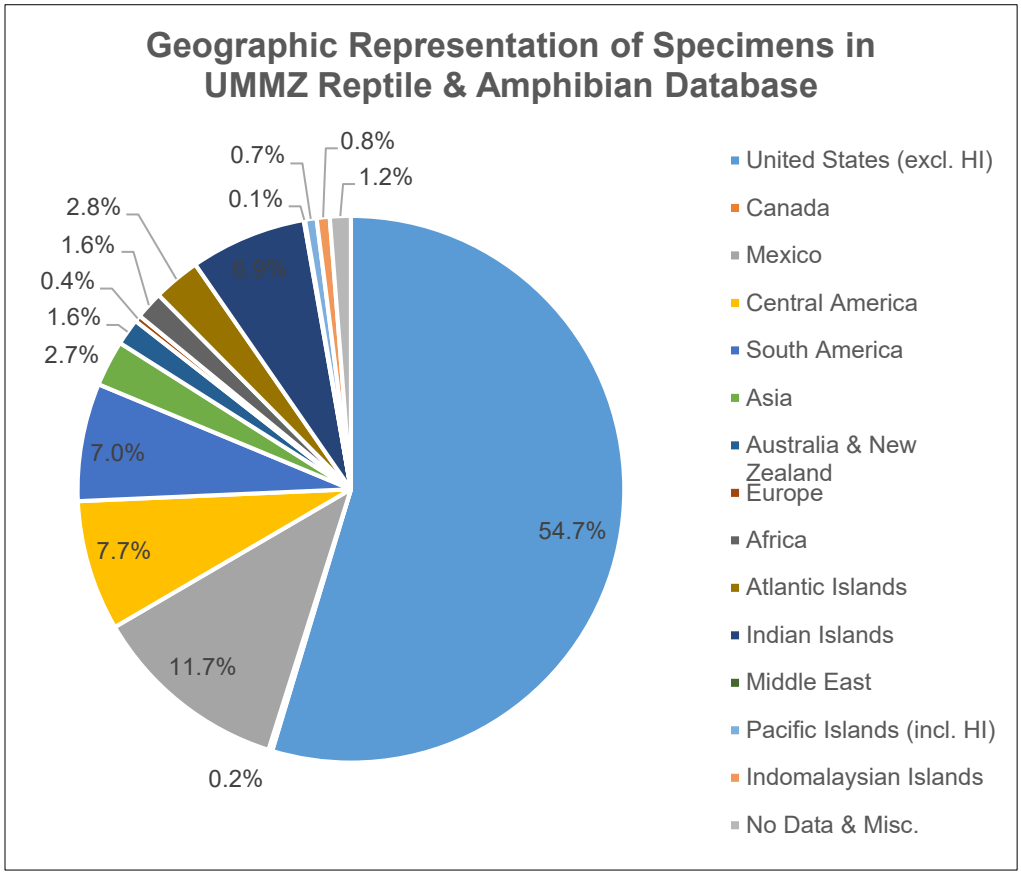
TAXONOMIC BREAKDOWN / TYPES / DATABASE STATUS

Category	Number
Taxa Represented	93 Families, 1,082 Genera, 5,502 species (2 new species in 2019)
Types Represented	479 (representing 431 taxa): 2 Holotypes, 5 Paratopotypes added in 2019
Paratype Specimens	5,644 (representing 817 taxa)
Percent of Georeferenced Specimens	91.66% of cataloged units in Specify (187,334/204,386)
Highest Catalog Number	248,917
Percent Databased	100% of cataloged units in Specify (204,386/204,386)

UMMZ REPTILE AND AMPHIBIAN DIVISION

GEOGRAPHIC DISTRIBUTION

Global Locality	2018 Total Specimens through UMMZ 248380	Specimens Added 2018 to 2019	2019 Total Specimens through UMMZ 248917
United States (ex. Hawaii)	239,543	5	239,548
Canada	989	0	989
Mexico	51,336	0	51,336
Central America	33,742	67	33,809
South America	30,207	334	30,541
Asia	11,892	0	11,892
Australia & New Zealand	6,895	0	6,895
Europe	1,661	0	1,661
Africa	7,184	0	7,184
Atlantic Islands	12,203	1	12,204
Indian Islands	30,125	0	30,125
Middle East	317	0	317
Pacific Islands	2,873	130	3,003
Indomalaysian Islands	3,370	0	3,370
No Data & Misc.	5,431	0	5,431
TOTAL	**437,768**	**537**	**438,305**



UMMZ REPTILE AND AMPHIBIAN DIVISION

REGIONAL DISTRIBUTION – Regional and North American Representation of Specimens in Database

Regional Locality	Total Specimens in Specify in 2018	Increase 2018 to 2019	Total Specimens in Specify in 2019
Michigan	39,224	1	39,225
Midwest USA	67,346	1	67,347
Great Lakes US (w/PA & NY)	60,689	1	60,690
Great Lakes US (no PA & NY)	57,822	1	57,823
Ontario Province, Canada	753	0	753
North America	325,610	73	325,683

COLLECTION TRANSACTIONS

Category	Number and Purpose
Loans (Outgoing Shipments)	19 loans (485 lots, 532 specimens) - 11 unique institutions (19 domestic); 16 research, 2 education, 1 Exhibit
Loans Closed (Returns)	14 returns (181 specimens) - 11 unique institutions (11 domestic, 3 foreign); 14 research
Gifts	10 gifts (197 specimens) - 5 unique institutions (8 domestic, 2 foreign); 10 research (tissues)
Borrows (Loans from Other Institutions)	1 borrows (44 specimens) - 1 unique institutions (1 domestic); 1 research
Transfers Sent	3 transfers (18 specimens) - 3 unique institutions (2 domestic, 1 foreign); 3 research
TOTAL	**47 transactions (972 specimens) - 27 unique institutions (41 domestic, 6 foreign); 44 research, 2 education, 1 exhibit**

INQUIRIES AND DATA REQUESTS

Category	Number
Number of Inquiries Answered	15+
Number of Data Requests	10+

VISITATION TO THE COLLECTION

Category	Number
Visits / Individuals	53 visits / 295 individuals
Unique Individual / Institution	35 unique individuals, 32 unique institutions/departments
Individual Visitor Type	23 Faculty/Curator/Other Professional, 0 Postdoctoral Researcher, 7 Graduate Student, 0 Undergraduate Student, 15 Class, 2 Public, 6 Other

UMMZ REPTILE AND AMPHIBIAN DIVISION

CITATIONS – Published work by curatorial staff, students, and from external collection use

Category	Number
Publications Referencing UMMZ Reptiles & Amphibians Specimens	50+ (Google Scholar search for "UMMZ Herps 2019" and "UMMZ Herpetology 2019" – looking only at first 13 pages beginning with 2019)
Citations in GBIF	55 total (22 citations in 2019)
	Google Scholar publication list being created in 2020

KEY CURATION ACTIVITIES / ACCOMPLISHMENTS

Details
Processed 212 specimens from Nicaragua and 334 specimens from Peru
Received several thousand turtle radiographs from Edwin S. George Reserve; Of these, we digitized 1004 Blanding's turtle plates
729 oVert CT Scans completed
Scanning all Snakes project completed
Moved the teaching collection from the Research Museums Center to the Biological Sciences Building
Assembling a commemorative book, "Letters from Michigan Herpetology", to be published in the UMMZ series. At present, the commemorative book project has 28 authors, all U of M affiliates (undergrad, grad, post doc, former curator, and CM)

OUTREACH AND TOURS

Details
Biology of Amphibians and Reptiles (EEB 450) – 2 class visits in Spring 2019
U-M Digital Library and Copyright Office Staff – 20 Jun 2019
UM Stamps School of Art & Design visited the UMMZ for the Making Science Visible class – Winter 2019

GRANTS / AWARDS – Totals represent amount for the duration of the grant

Total Amount	Details
$207,250	National Science Foundation (NSF), Advancing Digitization of Biodiversity Collections (ADBC), Digitization Thematic Collections Networks (TCN): Collaborative Research: oVert: Open Exploration of Vertebrate Diversity in 3D.
$207,250	**TOTAL FROM GRANTS**

UMMZ REPTILE AND AMPHIBIAN DIVISION

GLOBAL AGGREGATORS / DATA PORTALS

Portal & Division	Download	Seen / Viewed	Records Viewed (iDigBio Herbarium & VertNet)	Higher viewed number (Seen / Viewed versus Records viewed)	Origin or Time Frame
GBIF Reptile/Amphibian	6,176	143,230,999	143,230,999	143,230,999	from 11 Dec 2013
iDigBio Reptile/Amphibian	225,217	349,423	60,828	349,423	from Jan 2015
VertNet Reptile/Amphibian	14,072	145,794	126,075	145,794	from Apr 2014
USGS BISON Reptile/Amphibian	16,962	300,823	300,823	300,823	from 2019
TOTAL	**262,427**	**144,027,039**	**143,718,725**	**144,027,039**	
AVG / MONTH	**21,868.92**	**12,002,253.25**	**11,976,560.42**	**12,002,253.25**	

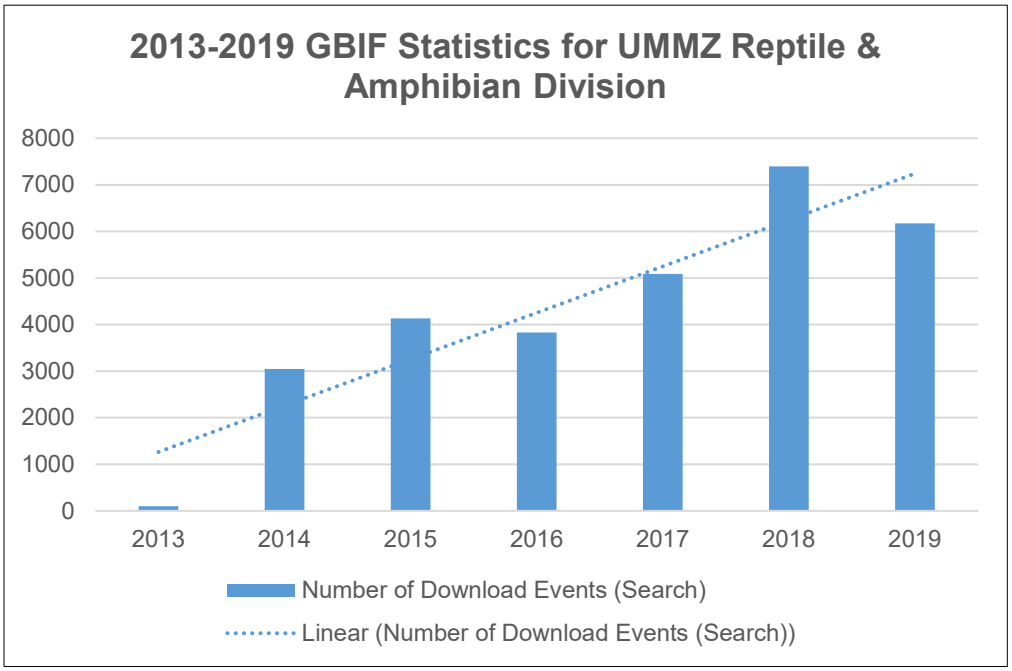
GBIF – Global Biodiversity Information Facility

Statistic Category	2019 Year Total	Average per Month
Number of Download Events (Search)	6,176	514.67
Number of Records Downloaded (total # of specimens)	143,230,999	11,935,916.58
Number of Downloads Requiring Georeferenced Records	2,142	178.50
Number of Downloads Using a Polygon Locality Region	1,495	124.58
Number of Downloads Based on a Country/Specific Locality Search	3,622	301.83
Percent of Searches Requesting Georeferenced Specimens	34.68	34.68
Maximum Percent Requesting Georeferencing, Polygon or Locality *** (see below)	117.54	117.54

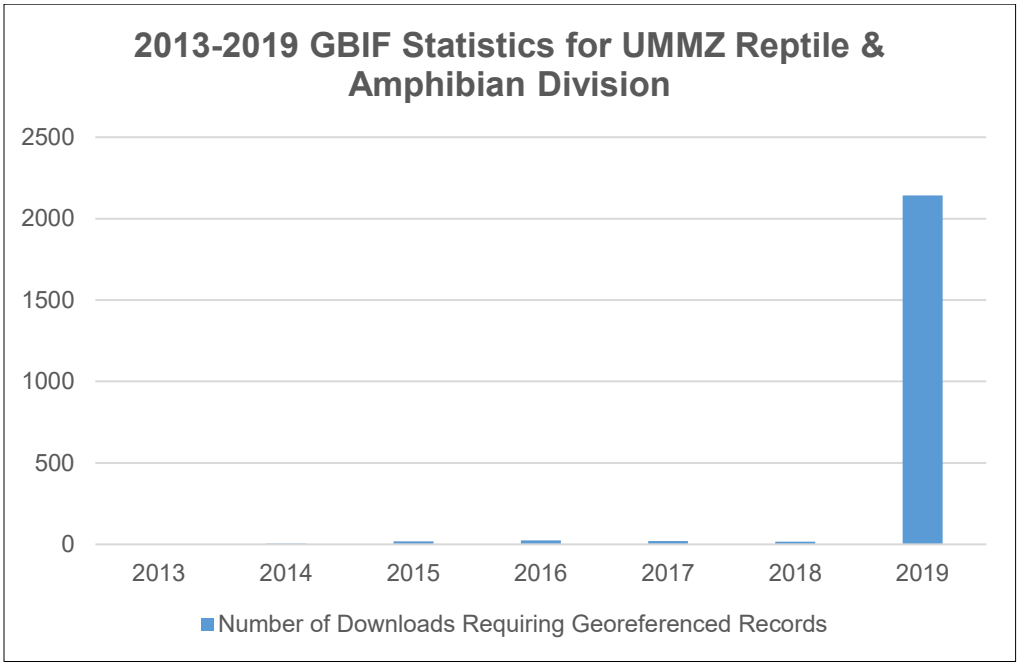
*** GBIF Maximum percent assumes that georeferencing, polygon and country search are independent - data is not available to separate this. Maximum percent represents the greatest percent possible for searches looking for locality information.

UMMZ REPTILE AND AMPHIBIAN DIVISION

GBIF – Global Biodiversity Information Facility; Number of Download Events



GBIF – Global Biodiversity Information Facility; Number of Downloads Requiring Georeferenced Records



UMMZ REPTILE AND AMPHIBIAN DIVISION

iDigBio – Integrated Digitized Biocollections

Statistic Category	2019 Year Total	Average per Month
Search – instances a record from this recordset matched a search query	30,015,556,914	2,501,296,409.50
Download – instances a record from this recordset was downloaded	225,217	18,768.08
Seen – instances a record from this recordset appeared (visually) in the search results in a browser window	349,423	29,118.58
Records Viewed – how many specimen records were opened and viewed in full detail	60,828	5,069.00
Media Viewed – how many media records were opened and viewed in full detail	0	0.00

VertNet – Vertebrate Network

Statistic Category	2019 Year Total	Average per Month
Number of searches that retrieved data from the resource	14,072	1,172.67
Number of records retrieved in searches / were pulled to screen	145,794	12,149.50
Number of different countries where searched have been originated	345	28.75
Number of download events retrieved data from the resource / pulled records from the resource 2018	1,654	137.83
Total number of records downloaded	126,075	10,506.25
Number of different countries that downloaded records	170	14.17
Percent that the resource appeared on all download events this month	152.47	12.71

UMMZ REPTILE AND AMPHIBIAN DIVISION

USGS BISON – Biodiversity Information Serving Our Nation (BISON) - Explore and download North American species occurrence data and maps from Canada, USA, US Territories, and US Marine Exclusive Economic Zones.

Statistic Category	2019 Year Total	Average per Month
Search indicates when any records from the dataset are included in the results of a front end search.	16,962	1,413.50
Download indicates when any records from the dataset are included in a front end download request.	0	0.00
SOLR indicates when any records from the dataset are included in the results of a SOLR query.	2,288	190.67
WMS (Web Map Services) indicates when any records from the dataset are included in the results of a WMS query.	281,573	23,464.42
All Requests is a combination of Search + Download + SOLR + WMS.	300,823	25,068.58

MORPHOSOURCE – Digital repository containing 3D media (raw micro-CT data and surface meshes) from UMMZ specimens

Year	Download Requests	Unique Specimens Requested	Unique Media File Downloads	Total Downloads	Total Download Users
2013-2018	193	106	148	540	337
2019	1,097	408	590	2,792	1,748
TOTAL	1,290	514	738	3,332	2,085

TOTAL is metrics from 1 Jul 2013 to 31 Dec 2019

UMMZ REPTILE AND AMPHIBIAN DIVISION

UM DIGITAL LIBRARY – Collections amph2ic, amph3ic, amph1ic active since 2015; rep1ic active since 2016; rept2ic and rept3ic active since 2018

Collection	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
UMMZ Amphibian and Reptile Audio Files (amph2ic)	2,011	196	9.75	259	29	11.20	2,270
UMMZ Amphibian and Reptile Catalogue (amph3ic)	5,099	366	7.18	11,783	84	0.71	16,882
UMMZ Amphibian and Reptile Type Specimens (amph1ic)	2,599	225	8.66	6,335	966	15.25	8,934
UMMZ Herpetology Field Notebooks (rept2ic)	1,842	153	8.31	25,889	4,803	18.55	27,731
UMMZ Herpetology Predator and Prey Collection (rept3ic)	2,032	170	8.37	15,889	5,027	31.64	17,921
UMMZ Herpetology Radiographs (rept1ic)	7,128	115	1.61	48,223	1,052	2.18	55,351
TOTAL	**20,711**	**1,225**	**5.91**	**108,378**	**11,961**	**11.04**	**129,089**

Year TOTAL	Search Total Across All Institutions	Search Total within U-M	Percent of Searches within U-M	View Total Across All Institutions	View Total within U-M	Percent of U-M Views	TOTAL = Search Total + View Total
2015	4,474	558	12.47	6,705	107	1.60	11,179
2016	44,619	836	1.87	40,211	877	2.18	84,830
2017	15,518	3,067	19.76	75,327	3,437	4.56	90,845
2018	12,007	1,728	14.39	100,832	13,459	13.35	112,839
2019	20,711	1,225	5.91	108,378	11,961	11.04	129,089
TOTAL 2015-2019	**97,329**	**7,414**	**7.62**	**331,453**	**29,841**	**9.00**	**428,782**
AVERAGE 2015-2019	**19,466**	**1,483**	**7.62**	**66,291**	**5,968**	**9.00**	**85,756**

GOOGLE ANALYTICS – Submitted by Benjamin Hess

OVERVIEW

GOOGLE ANALYTICS

Google Analytics is the most widely used web analytics service offered by Google that tracks and reports website traffic. We use Google Analytics to see how the webpages within Animal Diversity Web (ADW), the UM Herbarium (HERB), and the UM Museum of Zoology (UMMZ) are viewed and to examine information about the users of each of these websites. Google Analytics are available for ADW since 2009, and available for HERB and UMMZ since 2016.

In 2019, there has been over 10 million pageviews for the ADW, HERB, and UMMZ websites. Of this total, nearly 83,000 pageviews are from the HERB and UMMZ, with the remainder being viewed within the ADW website. Although the majority of users are from the United States, a global audience views all three websites. Over the past few years, these websites have had an increase in total users, sessions and pageviews; however, there has been a general decrease in the average number of pageviews per session and the session duration. The average user tends to bounce more often to a new page for a shorter session, and view less pages within each session. It will be interesting to see if these trends continue in the future.

DEFINITIONS – Google Analytics defines each statistic as shown below

Category	Definition
Pageviews	A pageview is recorded every time a page is viewed. Or, more technically, a pageview is recorded every time the Google Analytics pageview tracking method is executed. When a user hits the back button, a pageview is recorded. When a visitor hits refresh, a pageview is recorded. Every time a page is opened in the browser, regardless of whether it has been cached, a pageview is recorded.
Sessions	Sessions are incremented on the first hit of a session, regardless of hit type. There may be a discrepancy between Entrances and Pageviews or Screenviews for properties where the first hit of a session can be an event hit.
User	Google Analytics sends a unique identifier with each User with each hit. This is the total number of hits, regardless of the identifier.
New User	New Users are only the total of the unique identifiers, and the total is normally less than the User total.
Unique Pageviews	Counts a page once even if it was viewed multiple times within a single session.
Pages Per Session	The average number of pageviews in each session.
Average Time	Average time spent per session (Avg. Session Duration)
Entrances	Entrances are incremented on the first pageview or screenview hit of a session.
Bounce Rate	Bounce rate is the percentage of sessions with a single pageview. A visit with one pageview, no matter how long the visitor was on the page or how they left, is a visit with only one interaction. A bounce is reported when a user's session only contains a single pageview, and they 'bounce' away and leave after only viewing a single page.

GOOGLE ANALYTICS

OVERALL AUDIENCE PAGEVIEWS

GOOGLE ANALYTICS

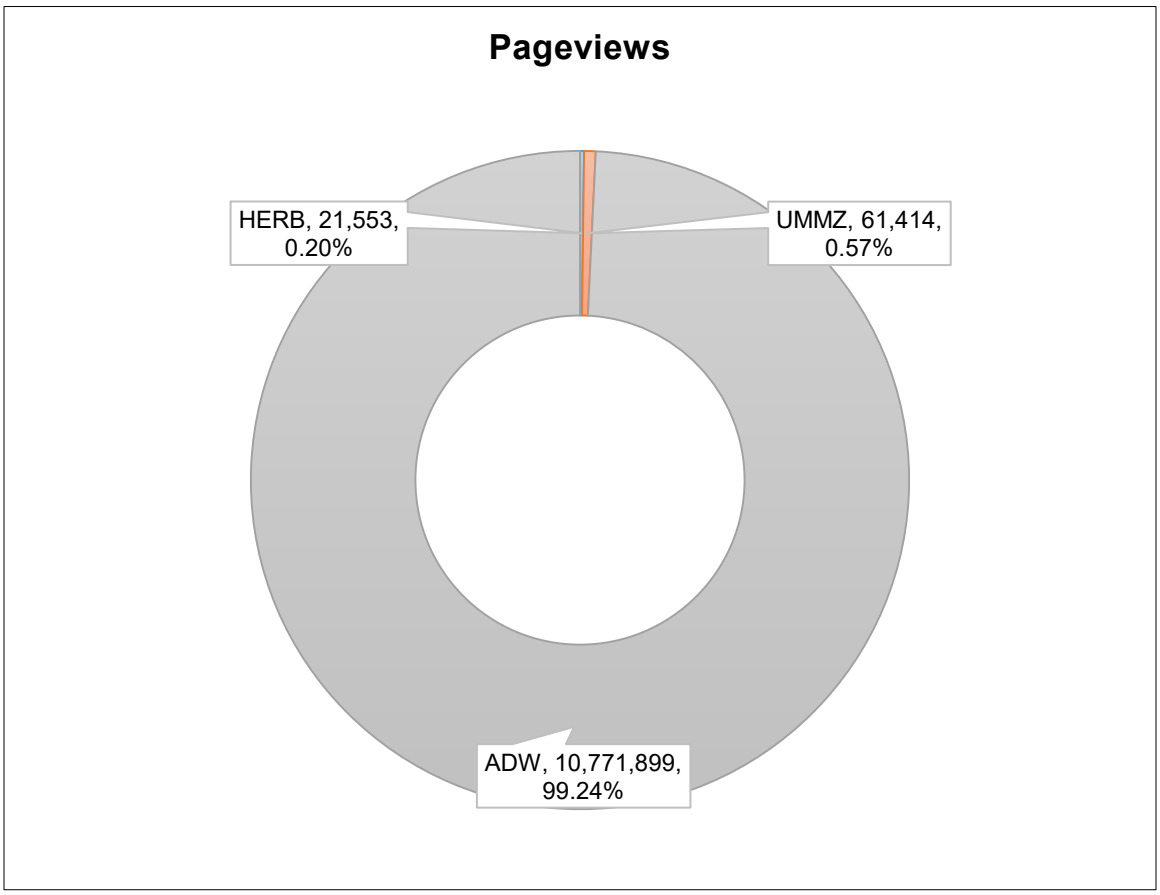


Figure 1: Comparison of pageviews for Animal Diversity Web (ADW), UM Herbarium (HERB) and UM Museum of Zoology (UMMZ). Pageviews, like other statistical categories, are proportionate between ADW, HERB and UMMZ. ADW is more than 100 times larger for the yearly total audience overview values when compared to the combined values of HERB and UMMZ. The UMMZ has yearly total audience overview values that are more than 2.5 times larger than the HERB values.

COMBINED AUDIENCE OVERVIEW – Data collection about website visitors and their interactions for Animal Diversity Web (ADW), UM Herbarium (HERB), and UM Museum of Zoology (UMMZ)

Division	Pageviews	Sesions	Users	New Users
ADW/HERB/UMMZ 2019 TOTAL	10,854,866	4,599,516	3,268,131	3,239,235
HERB/UMMZ only 2019 TOTAL	82,967	38,985	30,220	28,152
HERB/UMMZ only 2019 Monthly AVERAGE	6,913.92	3,248.75	2,518.33	2,346.00

GOOGLE ANALYTICS

ADW 2019 AUDIENCE OVERVIEW

GOOGLE ANALYTICS

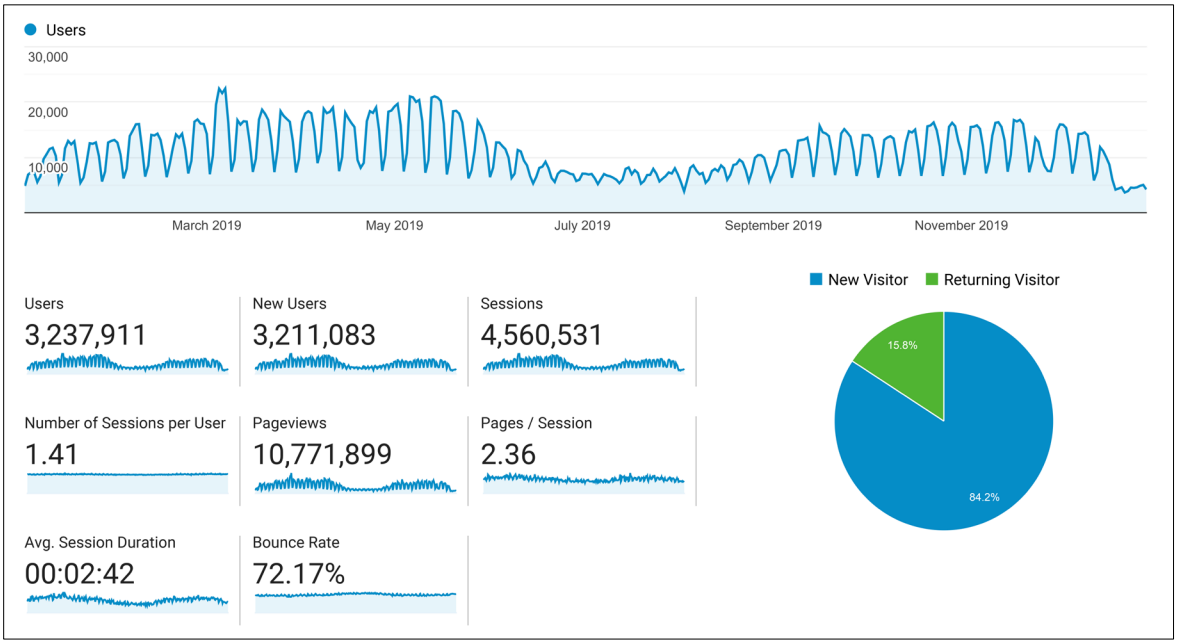
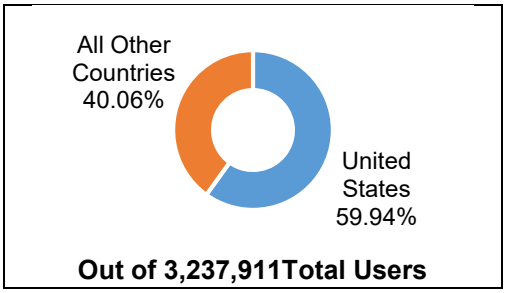
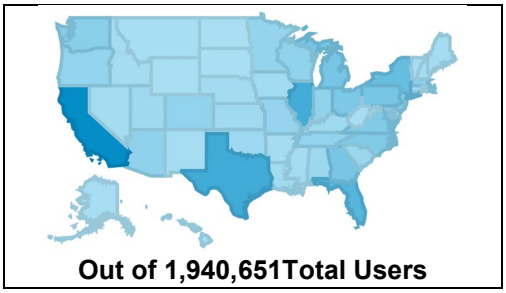


Figure 2: ADW 2019 Audience Overview. The users of ADW show a bimodal distribution with slightly more users in the spring than the fall. This distribution follows its utility as and educational resource with less users in the summer and winter.

ADW 2019 LOCATION OVERVIEW – Top 10 Countries (out of 239) and States in the United States





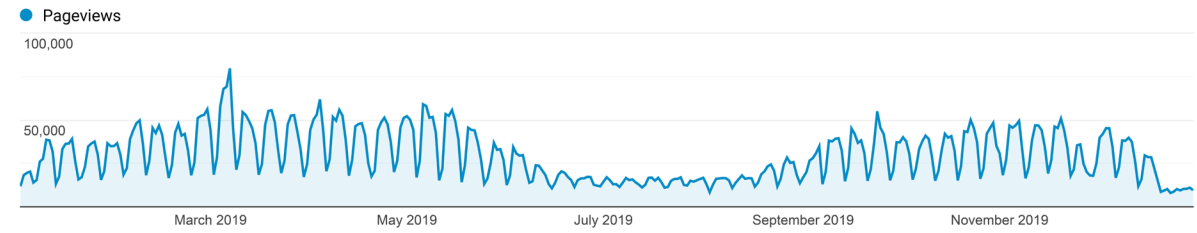
Country	Users
United States	1,940,651
India	194,498
Canada	131,900
Australia	99,514
United Kingdom	96,183
Philippines	67,978
Indonesia	43,638
Nigeria	34,587
Mexico	33,118
Brazil	26,194
Top 10 TOTAL	**2,668,261**
% of all users	**82.41**

State	Users
California	229,273
Texas	147,926
Illinois	143,984
Florida	118,228
New York	95,387
Michigan	73,719
Pennsylvania	73,310
Georgia	72,834
Ohio	66,647
Virginia	59,729
Top 10 TOTAL	**1,081,037**
% of all users	**55.70**

GOOGLE ANALYTICS

ADW 2019 TOP 20 PAGEVIEWS

GOOGLE ANALYTICS

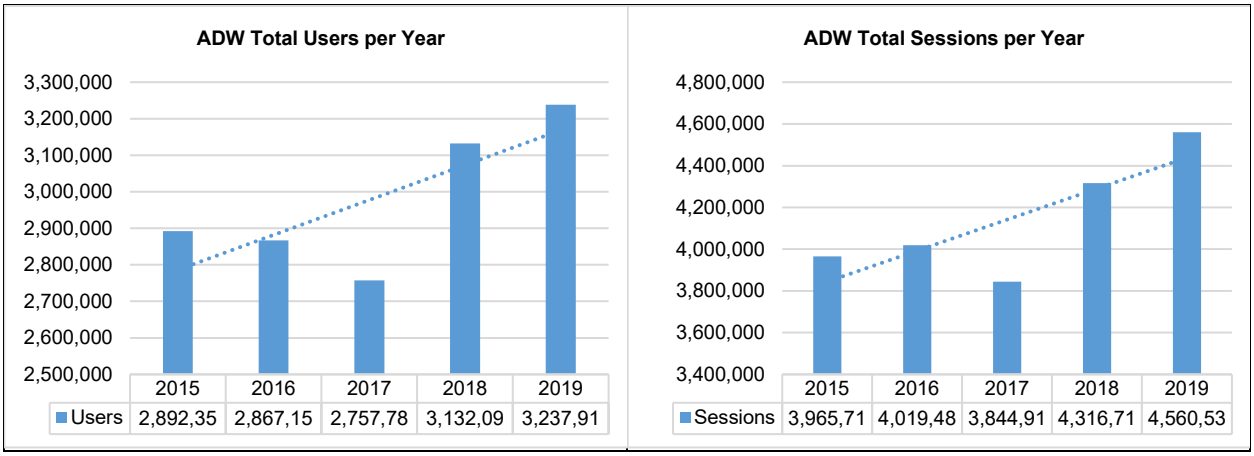


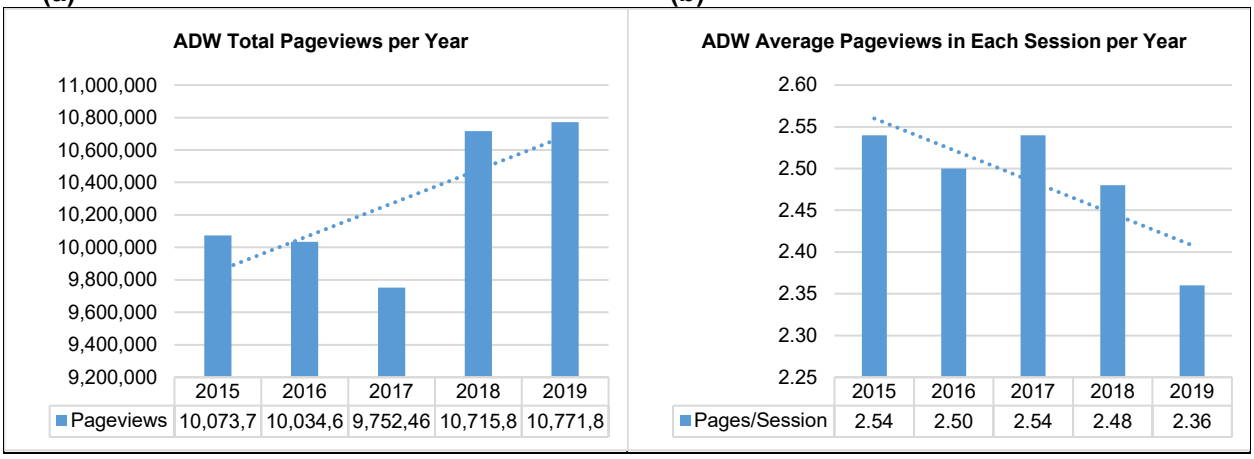
Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
	10,771,899 % of Total: 100.00% (10,771,899)	**8,405,285** % of Total: 100.00% (8,405,285)	**00:01:59** Avg for View: 00:01:59 (0.00%)	**4,560,297** % of Total: 100.00% (4,560,297)	**72.17%** Avg for View: 72.17% (0.00%)	**42.34%** Avg for View: 42.34% (0.00%)	**$0.00** % of Total: 0.00% ($0.00)
1. /	**753,459** (6.99%)	499,075 (5.94%)	00:01:03	442,068 (9.69%)	30.91%	25.46%	$0.00 (0.00%)
2. /accounts/Animalia/	**117,847** (1.09%)	87,678 (1.04%)	00:01:14	36,228 (0.79%)	74.70%	32.85%	$0.00 (0.00%)
3. /accounts/Mammalia/	**66,680** (0.62%)	45,030 (0.54%)	00:02:00	13,200 (0.29%)	59.12%	27.11%	$0.00 (0.00%)
4. /animal_names/	**40,919** (0.38%)	29,770 (0.35%)	00:00:19	1,318 (0.03%)	43.93%	10.29%	$0.00 (0.00%)
5. /animal_names/scientific_name/	**31,878** (0.30%)	28,471 (0.34%)	00:03:21	24,946 (0.55%)	87.98%	78.19%	$0.00 (0.00%)
6. /glossary/	**28,757** (0.27%)	22,272 (0.26%)	00:00:22	1,075 (0.02%)	39.35%	8.91%	$0.00 (0.00%)
7. /accounts/Canis_lupus/	**22,480** (0.21%)	16,861 (0.20%)	00:03:18	9,751 (0.21%)	78.44%	53.43%	$0.00 (0.00%)
8. /teach/	**22,337** (0.21%)	16,863 (0.20%)	00:00:28	1,200 (0.03%)	59.42%	17.21%	$0.00 (0.00%)
9. /about/	**22,120** (0.21%)	16,624 (0.20%)	00:00:46	1,935 (0.04%)	50.59%	19.91%	$0.00 (0.00%)
10. /accounts/Annelida/	**21,718** (0.20%)	16,948 (0.20%)	00:03:08	8,005 (0.18%)	75.37%	45.23%	$0.00 (0.00%)
11. /accounts/Panthera_leo/	**21,639** (0.20%)	16,658 (0.20%)	00:03:41	11,559 (0.25%)	78.64%	59.91%	$0.00 (0.00%)
12. /accounts/Porifera/	**20,400** (0.19%)	16,118 (0.19%)	00:03:58	10,322 (0.23%)	77.68%	54.31%	$0.00 (0.00%)
13. /accounts/Aves/	**19,951** (0.19%)	14,419 (0.17%)	00:01:25	3,613 (0.08%)	66.18%	24.61%	$0.00 (0.00%)
14. /accounts/Panthera_tigris/	**19,798** (0.18%)	14,569 (0.17%)	00:03:44	7,470 (0.16%)	76.98%	51.07%	$0.00 (0.00%)
15. /accounts/Nematoda/	**19,480** (0.18%)	15,917 (0.19%)	00:03:59	10,444 (0.23%)	78.90%	56.91%	$0.00 (0.00%)
16. /collections/	**19,111** (0.18%)	13,658 (0.16%)	00:00:18	655 (0.01%)	53.59%	10.26%	$0.00 (0.00%)
17. /accounts/Sciurus_carolinensis/	**18,657** (0.17%)	15,423 (0.18%)	00:02:27	11,200 (0.25%)	71.95%	57.01%	$0.00 (0.00%)
18. /collections/frog_calls/	**18,469** (0.17%)	9,575 (0.11%)	00:00:51	9,070 (0.20%)	67.28%	46.35%	$0.00 (0.00%)
19. /accounts/Reptilia/	**17,470** (0.16%)	12,627 (0.15%)	00:01:40	2,917 (0.06%)	68.91%	25.21%	$0.00 (0.00%)
20. /accounts/Chordata/	**17,137** (0.16%)	12,421 (0.15%)	00:02:05	2,532 (0.06%)	71.72%	21.92%	$0.00 (0.00%)

GOOGLE ANALYTICS

ADW FIVE-YEAR TREND

GOOGLE ANALYTICS





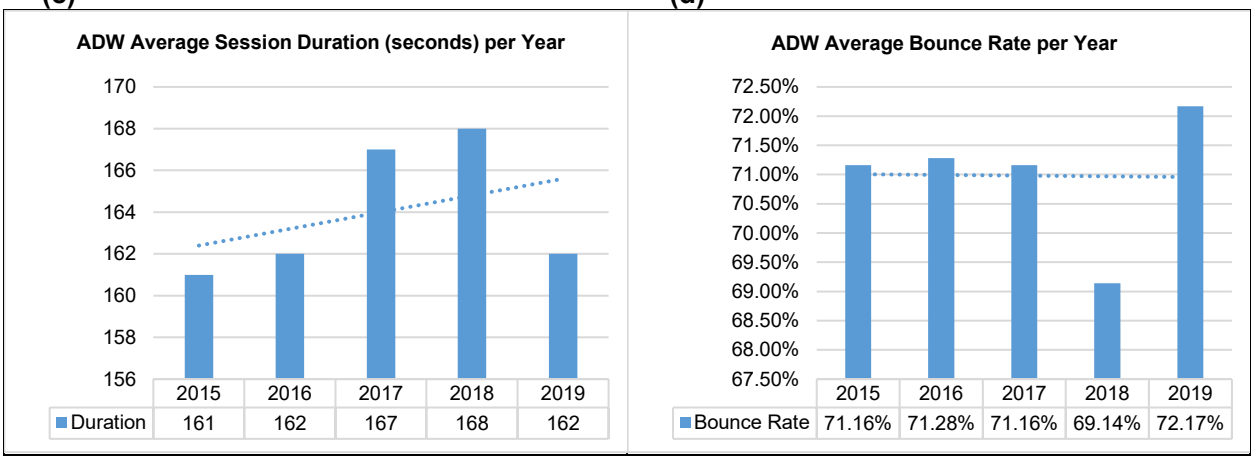


Figure 3 (a-f): Five-year trend (2015-2019) for Animal Diversity Web (ADW) Google Analytics Audience Overview. ADW has had a general increase in users, sessions and pageviews, with 2017 being a low year. The pages per session have declined, while the duration increased except for 2019. The bounce rate in 2019 was the highest in the last five years suggesting a future increase.

GOOGLE ANALYTICS

HERB 2019 AUDIENCE OVERVIEW

GOOGLE ANALYTICS

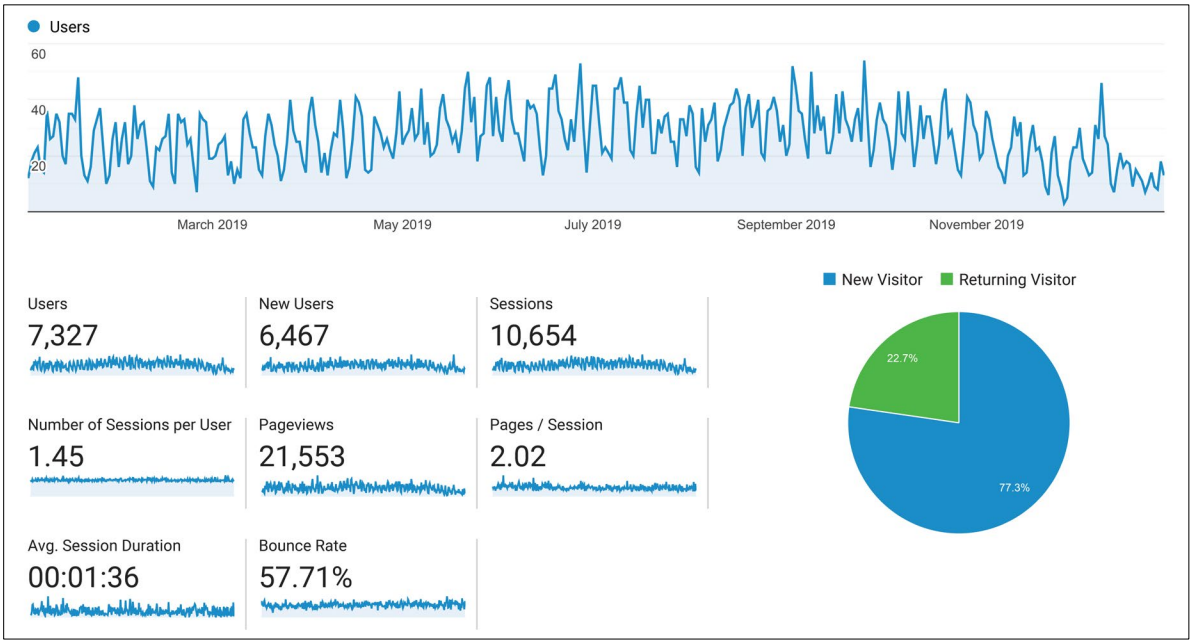
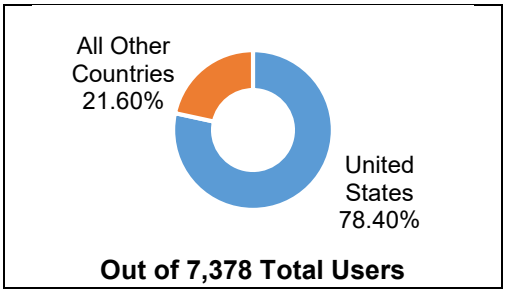
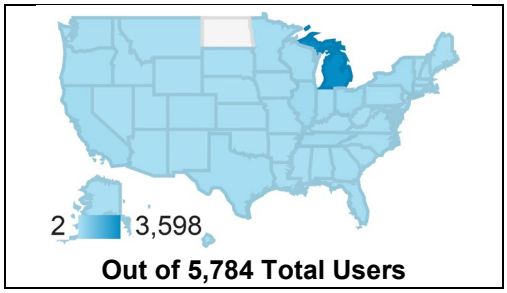


Figure 4: HERB 2019 Audience Overview. The users of HERB show a steady yearly distribution with slightly more users in the summer than the winter.

HERB 2019 LOCATION OVERVIEW – Top 10 Countries (out of 99) and States in the United States



Out of 7,378 Total Users



Out of 5,784 Total Users

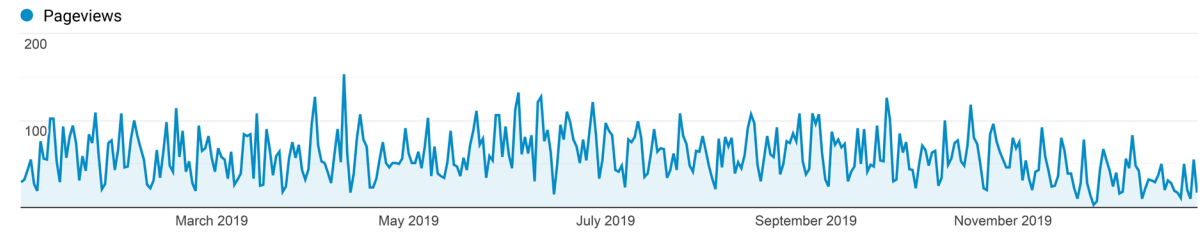
Country	Users
United States	5,784
Canada	442
South Korea	141
Mexico	106
India	94
China	89
Brazil	87
United Kingdom	52
Colombia	48
Japan	30
Top 10 TOTAL	**6,873**
% of all users	**93.16**

State	Users
Michigan	3,598
Illinois	243
Ohio	198
New York	184
Tennessee	160
California	150
Wisconsin	140
Indiana	84
Minnesota	83
Texas	79
Top 10 TOTAL	**4,919**
% of all users	**85.04**

GOOGLE ANALYTICS

HERB 2019 TOP 20 PAGEVIEWS

GOOGLE ANALYTICS

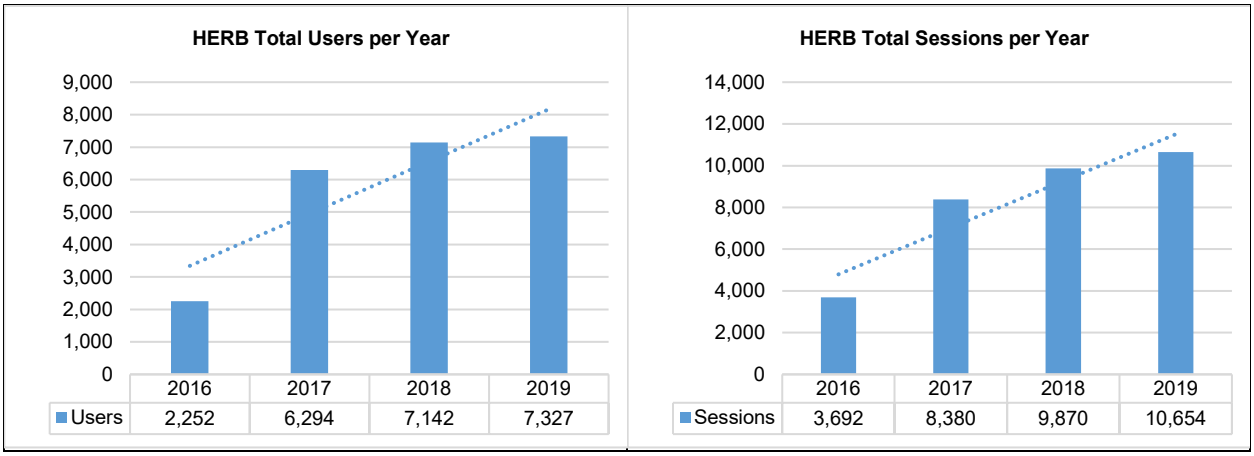


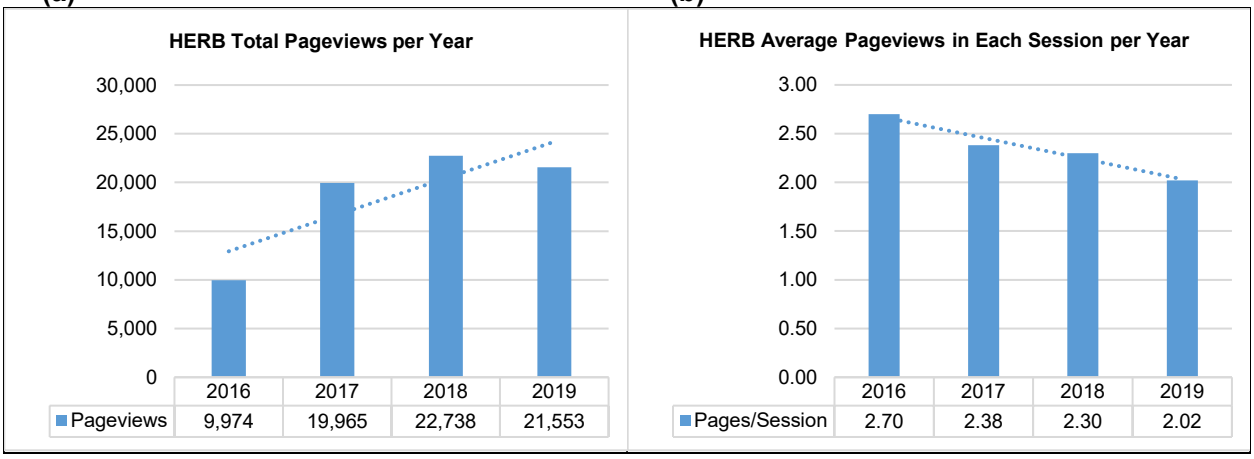
Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
	21,553 % of Total: 100.00% (21,553)	**16,931** % of Total: 100.00% (16,931)	**00:01:33** Avg for View: 00:01:33 (0.00%)	**10,641** % of Total: 100.00% (10,641)	**57.71%** Avg for View: 57.71% (0.00%)	**49.37%** Avg for View: 49.37% (0.00%)	**$0.00** % of Total: 0.00% ($0.00)
1. lsa.umich.edu/herbarium	**9,418** (43.70%)	7,316 (43.21%)	00:01:58	7,181 (67.48%)	52.68%	57.39%	$0.00 (0.00%)
2. lsa.umich.edu/herbarium/databases.html	**1,947** (9.03%)	1,244 (7.35%)	00:02:11	359 (3.37%)	21.27%	48.54%	$0.00 (0.00%)
3. lsa.umich.edu/herbarium/people.html	**759** (3.52%)	530 (3.13%)	00:01:26	55 (0.52%)	61.82%	31.75%	$0.00 (0.00%)
4. lsa.umich.edu/herbarium/collections.html	**723** (3.35%)	594 (3.51%)	00:00:39	95 (0.89%)	46.81%	23.65%	$0.00 (0.00%)
5. lsa.umich.edu/herbarium/people/staff/reznicek.html	**416** (1.93%)	360 (2.13%)	00:02:13	282 (2.65%)	79.08%	68.99%	$0.00 (0.00%)
6. lsa.umich.edu/herbarium/library.html	**374** (1.74%)	307 (1.81%)	00:00:43	104 (0.98%)	51.43%	39.30%	$0.00 (0.00%)
7. lsa.umich.edu/herbarium/about.html	**347** (1.61%)	285 (1.68%)	00:01:08	47 (0.44%)	57.45%	31.70%	$0.00 (0.00%)
8. lsa.umich.edu/herbarium/research.html	**316** (1.47%)	231 (1.36%)	00:00:28	15 (0.14%)	53.33%	19.62%	$0.00 (0.00%)
9. lsa.umich.edu/herbarium/publications.html	**261** (1.21%)	214 (1.26%)	00:00:54	42 (0.39%)	57.14%	27.20%	$0.00 (0.00%)
10. lsa.umich.edu/herbarium/news-events/all-news/search-news/three-new-chanterelle-mushrooms-discovered-in-the-midwest.html	**255** (1.18%)	223 (1.32%)	00:05:37	218 (2.05%)	88.07%	86.67%	$0.00 (0.00%)
11. lsa.umich.edu/herbarium/online-exhibits.html	**239** (1.11%)	204 (1.20%)	00:00:25	6 (0.06%)	50.00%	16.74%	$0.00 (0.00%)
12. lsa.umich.edu/herbarium/students.html	**227** (1.05%)	178 (1.05%)	00:01:51	20 (0.19%)	52.38%	35.68%	$0.00 (0.00%)
13. lsa.umich.edu/herbarium/people/staff/peberry.html	**217** (1.01%)	184 (1.09%)	00:03:15	152 (1.43%)	67.32%	66.36%	$0.00 (0.00%)
14. lsa.umich.edu/herbarium/publications/all/mosses-of-the-great-lakes-forest.html	**208** (0.97%)	178 (1.05%)	00:01:43	168 (1.58%)	76.79%	74.52%	$0.00 (0.00%)
15. lsa.umich.edu/herbarium/people/staff/rburnham.html	**188** (0.87%)	176 (1.04%)	00:04:11	153 (1.44%)	85.62%	77.13%	$0.00 (0.00%)
16. lsa.umich.edu/herbarium/people/staff.html	**178** (0.83%)	127 (0.75%)	00:00:57	6 (0.06%)	66.67%	26.97%	$0.00 (0.00%)
17. lsa.umich.edu/herbarium/collections/visitors.html	**176** (0.82%)	136 (0.80%)	00:00:31	10 (0.09%)	70.00%	14.77%	$0.00 (0.00%)
18. lsa.umich.edu/herbarium/maps---directions.html	**169** (0.78%)	144 (0.85%)	00:01:40	33 (0.31%)	84.85%	55.03%	$0.00 (0.00%)
19. lsa.umich.edu/herbarium/contact.html	**167** (0.77%)	135 (0.80%)	00:01:30	17 (0.16%)	76.47%	41.32%	$0.00 (0.00%)
20. lsa.umich.edu/herbarium/collections/collection-policies.html	**139** (0.64%)	115 (0.68%)	00:00:50	31 (0.29%)	77.42%	30.22%	$0.00 (0.00%)

GOOGLE ANALYTICS

HERB FOUR-YEAR TREND

GOOGLE ANALYTICS





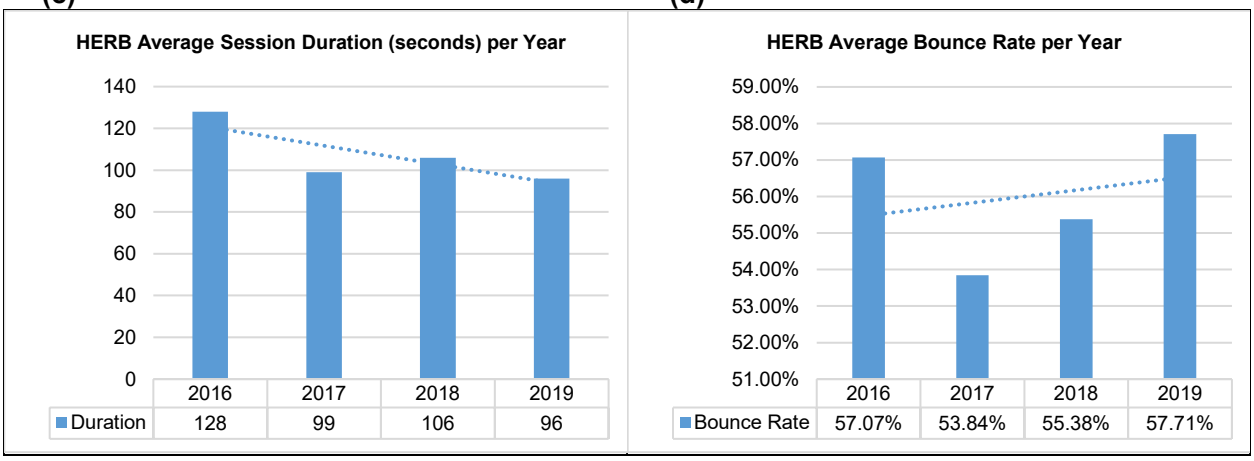


Figure 5 (a-f): Four-year trend (2016-2019) for the UM Herbarium (HERB) Google Analytics Audience Overview. HERB has had a general increase in users, sessions and pageviews, with 2017 being a low year. The pages per session and duration have declined, while the bounce rate increased with lower bounce rates in 2017 and 2018.

GOOGLE ANALYTICS

UMMZ 2019 AUDIENCE OVERVIEW

GOOGLE ANALYTICS

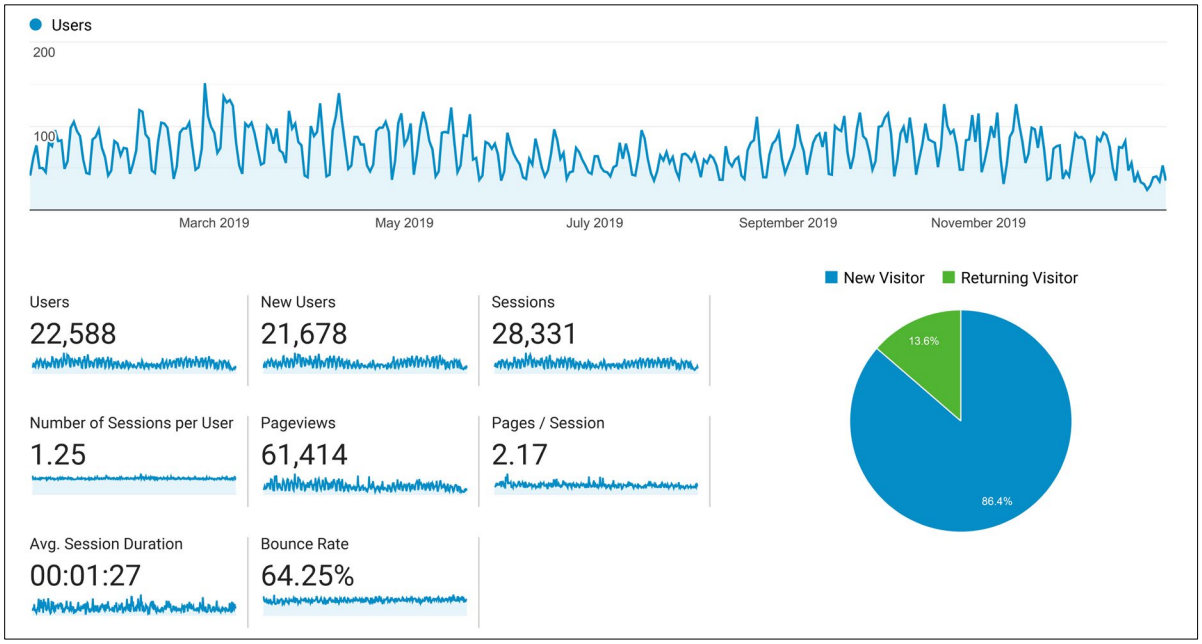
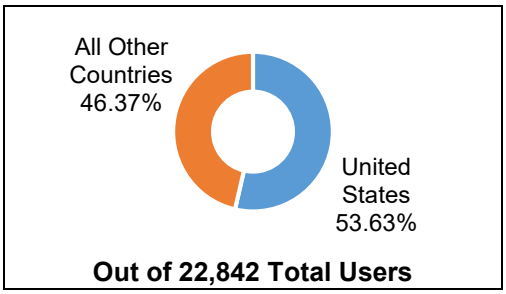
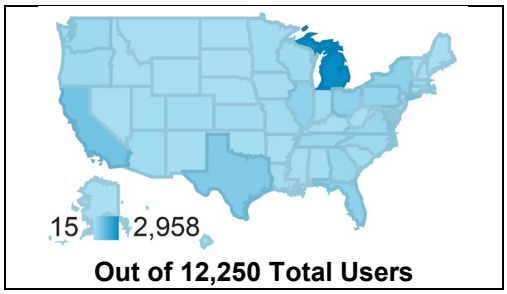


Figure 6: UMMZ 2019 Audience Overview. The users of UMMZ show a light bimodal distribution with slightly more users in the spring than the fall. This distribution may indicate its utility as a resource during the academic semester.

UMMZ 2019 LOCATION OVERVIEW – Top 10 Countries (out of 163) and States in the United States



Out of 22,842 Total Users



Out of 12,250 Total Users

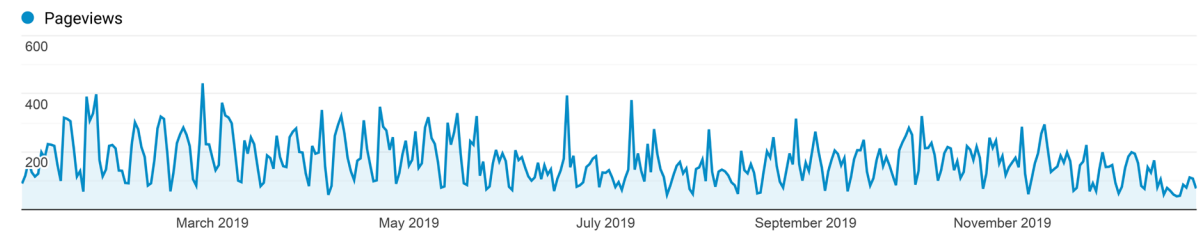
Country	Users
United States	12,250
India	2,247
Nigeria	1,412
Philippines	792
Pakistan	499
Canada	497
United Kingdom	337
Kenya	332
Mexico	281
Australia	279
Top 10 TOTAL	**18,926**
% of all users	**82.86**

State	Users
Michigan	2,958
California	994
Texas	754
New York	526
Ohio	495
Florida	491
Illinois	482
Pennsylvania	425
Virginia	342
Georgia	306
Top 10 TOTAL	**7,773**
% of all users	**63.45**

GOOGLE ANALYTICS

UMMZ 2019 TOP 20 PAGEVIEWS

GOOGLE ANALYTICS

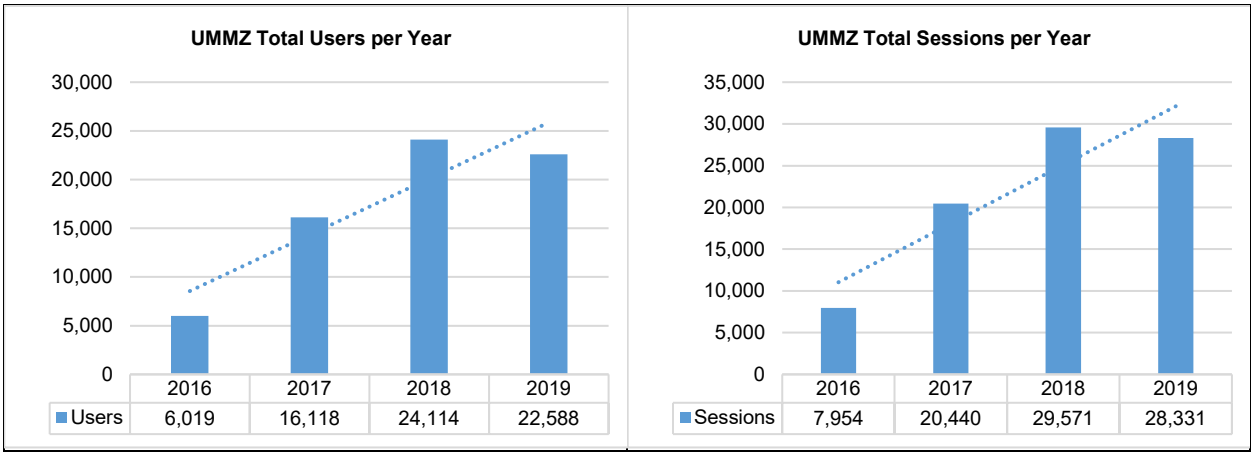


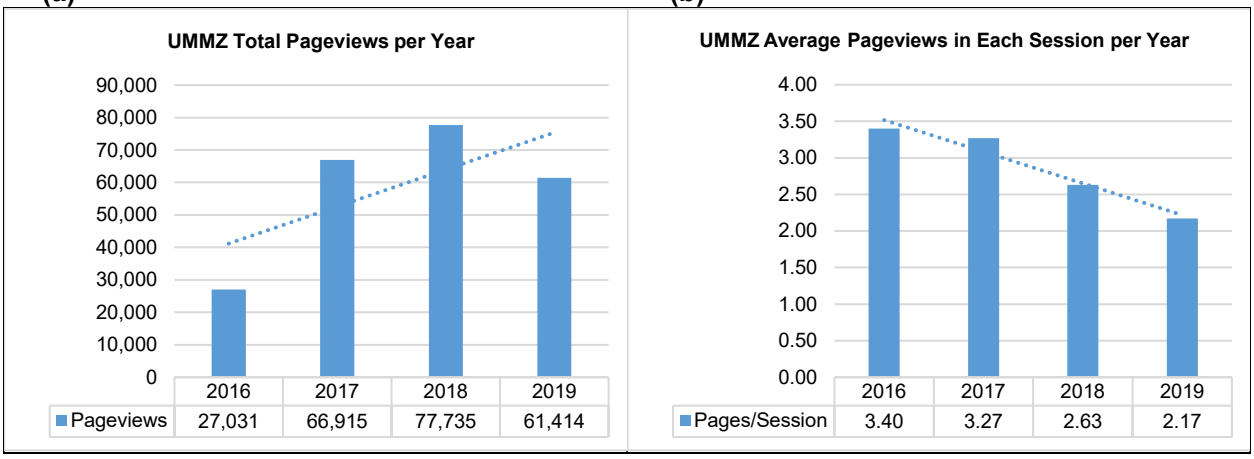
Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
	61,414 % of Total: 100.00% (61,414)	**47,979** % of Total: 100.00% (47,979)	**00:01:14** Avg for View: 00:01:14 (0.00%)	**28,302** % of Total: 100.00% (28,302)	**64.25%** Avg for View: 64.25% (0.00%)	**46.08%** Avg for View: 46.08% (0.00%)	**$0.00** % of Total: 0.00% ($0.00)
1. lsa.umich.edu/ummz/herps/collections/preservation-techniques.html	**11,342** (18.47%)	9,852 (20.53%)	00:05:30	9,774 (34.53%)	88.14%	85.73%	$0.00 (0.00%)
2. lsa.umich.edu/ummz	**10,846** (17.66%)	8,803 (18.35%)	00:01:05	8,455 (29.87%)	55.32%	55.35%	$0.00 (0.00%)
3. lsa.umich.edu/ummz/mammals/animal-diversity-web.html	**3,171** (5.16%)	2,459 (5.13%)	00:01:10	2,233 (7.89%)	43.22%	59.04%	$0.00 (0.00%)
4. lsa.umich.edu/ummz/mammals.html	**1,356** (2.21%)	1,005 (2.09%)	00:00:41	151 (0.53%)	32.45%	21.90%	$0.00 (0.00%)
5. lsa.umich.edu/ummz/birds.html	**1,283** (2.09%)	909 (1.89%)	00:00:41	306 (1.08%)	33.12%	20.42%	$0.00 (0.00%)
6. lsa.umich.edu/ummz/herps.html	**1,278** (2.08%)	981 (2.04%)	00:00:34	428 (1.51%)	29.77%	23.71%	$0.00 (0.00%)
7. lsa.umich.edu/ummz/insects.html	**1,186** (1.93%)	855 (1.78%)	00:00:49	480 (1.70%)	43.04%	27.40%	$0.00 (0.00%)
8. lsa.umich.edu/ummz/fishes/collections.html	**1,079** (1.76%)	638 (1.33%)	00:02:15	311 (1.10%)	15.97%	42.26%	$0.00 (0.00%)
9. lsa.umich.edu/ummz/fishes.html	**975** (1.59%)	718 (1.50%)	00:00:30	258 (0.91%)	33.46%	18.77%	$0.00 (0.00%)
10. lsa.umich.edu/ummz/mammals/collections.html	**913** (1.49%)	694 (1.45%)	00:00:56	90 (0.32%)	30.43%	27.27%	$0.00 (0.00%)
11. lsa.umich.edu/ummz/collections.html	**861** (1.40%)	638 (1.33%)	00:00:35	338 (1.19%)	13.78%	15.45%	$0.00 (0.00%)
12. lsa.umich.edu/ummz/herps/collections.html	**823** (1.34%)	490 (1.02%)	00:01:39	55 (0.19%)	25.45%	31.83%	$0.00 (0.00%)
13. lsa.umich.edu/ummz/about.html	**801** (1.30%)	630 (1.31%)	00:00:59	98 (0.35%)	44.90%	24.34%	$0.00 (0.00%)
14. lsa.umich.edu/ummz/publications.html	**728** (1.19%)	402 (0.84%)	00:00:33	162 (0.57%)	25.00%	15.25%	$0.00 (0.00%)
15. lsa.umich.edu/ummz/people.html	**700** (1.14%)	494 (1.03%)	00:00:41	29 (0.10%)	51.72%	22.00%	$0.00 (0.00%)
16. lsa.umich.edu/ummz/birds/bird-collections.html	**693** (1.13%)	456 (0.95%)	00:00:25	69 (0.24%)	14.49%	10.10%	$0.00 (0.00%)
17. lsa.umich.edu/ummz/mollusks.html	**579** (0.94%)	452 (0.94%)	00:00:37	141 (0.50%)	31.69%	20.21%	$0.00 (0.00%)
18. lsa.umich.edu/ummz/insects/personnel.html	**570** (0.93%)	328 (0.68%)	00:01:05	33 (0.12%)	63.64%	23.51%	$0.00 (0.00%)
19. lsa.umich.edu/ummz/insects/collections.html	**534** (0.87%)	338 (0.70%)	00:00:24	110 (0.39%)	31.19%	13.48%	$0.00 (0.00%)
20. lsa.umich.edu/ummz/mollusks/publications/malacological-review.html	**514** (0.84%)	374 (0.78%)	00:02:42	347 (1.23%)	34.48%	62.45%	$0.00 (0.00%)

GOOGLE ANALYTICS

UMMZ FOUR-YEAR TREND

GOOGLE ANALYTICS





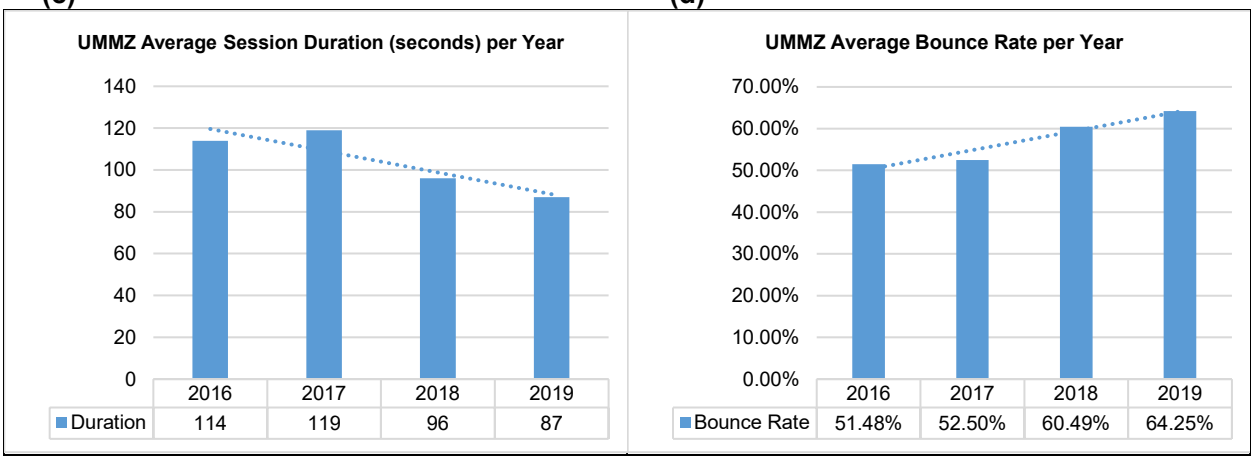


Figure 7 (a-f): Four-year trend (2016-2019) for UM Museum of Zoology (UMMZ) Google Analytics Audience Overview. UMMZ has had a general increase in users, sessions and pageviews, with 2019 being slightly lower than 2018. The pages per session and duration have declined, while the bounce rate has gradually increased over the four years.

REGISTRAR'S REPORT – Submitted by Benjamin Hess, EEB Museums Registrar

OVERVIEW

In 2011, the University of Michigan (UM) Herbarium (HERB) and the UM Museum of Zoology (UMMZ) became part of the Department of Ecology and Evolutionary Biology (EEB). The position of the EEB Museums Registrar was created in 2015 to act as a central administrative point to oversee compliance for importing and exporting specimens, and to determine if the process of accessioning specimens and samples was adequate for the EEB Museums. In addition, the Registrar could standardize forms and processes (e.g., gifts, exchanges, loans, transfers) consistently across the HERB and UMMZ. The first Registrar created forms for the HERB, but with a different form per process requiring multiple signatures, revision of this was necessary. The UM General Counsel approved these forms for use by the HERB, but they did not approve similar forms for use by the UMMZ at that time.

In 2016, the first Registrar created a combined annual report for all the UMMZ divisions, but it did not include any details for the HERB. Historically, the HERB and each UMMZ division produced their own annual reports. In 2018, I created the first annual report combining both the HERB and UMMZ. The 2019 annual report improves the consistency of reporting across all divisions for the HERB and UMMZ, and it includes specialty collection details and events across multiple divisions. This annual report, like all previous reports, serves as a permanent record that documents the work and accomplishments of the HERB and UMMZ. I would like to thank all the HERB and UMMZ personnel for their contributions to improve this annual report.

KEY 2019 ACTIVITIES / ACCOMPLISHMENTS

Details
Created a new employee information document for RMC EEB Museum staff
Drafted first EEB Museums (Herbarium and UMMZ) Annual Report – completed May 2019
Created a new Incoming Transaction Record (ITR) Form – approved by General Counsel for use by the Herbarium and UMMZ
Received signing authority from Office of Vice President for Development, along with EEB Museums Director, to sign and approve incoming material
Updated draft of Herbarium and UMMZ Policies and Procedures – requires Curator approval, EEB and LSA approval
Created Herbarium Controlled Substance Policy for DEA regulated species – wrote proposal and secured funding to purchase two designated herbarium cabinets through Delta Designs, Ltd.
Created new format and procedures for Herbarium – Activity Report for Grand Rapids Public Museum; signed new long-term loan agreement for Herbarium
Created Georeferencing Specimens in Specify document – contacted Andy Bentley (KU and Specify) and Nelson Rios (GEOLocate) to confirm details
Wrote a Fireproof Cabinet Proposal to secure Herbarium and UMMZ Artwork for risk assessment
Presented seminar: Hess, B.M. 2019. Best Practices for Specimen Acquisition. UM EEB Lunch Seminar. University of Michigan, Ann Arbor, Michigan. 29 February.
Combined details for Herbarium and UMMZ Nitrate Film Negatives – digitization and disposal proposal in process for LSA funding
Coordinated domestic and international shipping and acquisition of material to EEB Museums
Created and edited (with Curator and Collection Manager comments) EEB Museums Acquisition Policy
Created a communication protocol for all international imports – including U.S. Customs and Border Protection