

## Biodiversity Committee

### Committee members (44):

E. Abreu, J. Alston, T. Androski, M. Becker, C. Burgin, C. Calderón-Acevedo, J. Colella, E. Craig, G. D'Elia, T. Demos, J. Esselstyn, P.-H. Fabre, A. Feijó, A. Ferguson, J. Frey, K. Gorman, M. Hawkins, V. Hayssen, S. Hess, A. Hinckley, D. Huckaby, B. Kohli, T. Lee, S. Liphardt, S. Maher, V. Mathis, M. McDonough, S. Mech, P. Moehlman, A. Mychajliw, J. Nations, R. Norris, G. Oliver, C. Parker, B. Patterson, N. Pradhan, D. Reeder, M. E. Rodríguez-Posada, L. Ruedas, B. Tanis, H. Taylor, N. Upham (chair), J. Widness, J. Zijlstra

Cross-committee links: African Research Fellowship (Alston, Demos, Ferguson, McDonough, Norris); Conservation (Ferguson, Upham), Human Diversity (Alston), Informatics (Maher, Kohli, Tanis), Nomenclature (Burgin, McDonough, Norris, Pradhan, Reeder), Mammal Images Library (Huckaby, Tanis), Public Education (Mech), Publications (Ruedas), Systematic Collections (D'Elia, Upham).

**Mission:** The Biodiversity Committee compiles and maintains the Mammal Diversity Database (MDD), an updatable online database of mammal taxonomic and biodiversity information hosted by ASM at <http://mammaldiversity.org/>. This database aims to provide the latest information on species-level and higher taxonomic changes, thereby promoting more rigorous study of mammalian biodiversity worldwide. The initial objective has been to aggregate, curate, and compile new citations on species descriptions and taxonomic revisions into regular releases that are downloadable in comma-delimited format. Downstream goals include the expanded hosting of ecological, geographic, and taxonomic concept data. Overall, this initiative aims to promote the ASM's role as a leader in high quality research on mammalian biology.

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### Member changes since June 2022 (+8, -1):

Add: V. Hayssen, A. Hinckley, K. Gorman, S. Hess, T. Lee, P. Moehlman, H. Taylor, J. Zijlstra  
Drop: I. Rochon

### Information items:

I. Activities of the ASM Biodiversity Committee from April 2022 – May 2023 included:

a. We released 2 versions of the MDD taxonomy (v1.10 and v1.11; see <https://doi.org/10.5281/zenodo.4139722> for all versions, and Table 1):

[Version 1.11](https://doi.org/10.5281/zenodo.7830771) 10.5281/zenodo.7830771 Apr 15, 2023

[Version 1.10](https://doi.org/10.5281/zenodo.7394529) 10.5281/zenodo.7394529 Dec 3, 2022

b. Our core group of taxonomic curators consisted of the following people, as tied together via regular contact on a Slack group that we formed in 2020:

Nate Upham	Connor Burgin	Jane Widness	Madeleine Becker	Camilla Parker	Schuyler Liphardt	Ingrid Rochon	David Huckaby
Chair, Biodiversity Committee	Student Taxonomic Curator	Student Research Assistant	Student Research Assistant	Student Research Assistant	Web Developer	Type Specimen Curator	Chair, Mammal Images Library

<b>Nate Upham</b>	<b>Connor Burgin</b>	<b>Jane Widness</b>	<b>Madeleine Becker</b>	<b>Camilla Parker</b>	<b>Schuyler Liphardt</b>	<b>Ingrid Rochon</b>	<b>David Huckaby</b>
Arizona State University	University of New Mexico	Yale University	George Mason University	Central New Mexico Comm Coll	UNM / Univ Montana	Smithsonian Mammals	Emeritus, CSU Long Beach

**Table 1.** Mammalia taxonomies compared among previous compendia: Mammal Species of the World (MSW), International Union for the Conservation of Nature (IUCN), and 12 versions of the ASM Mammal Diversity Database (MDD).

Taxa	MSW3 2005	IUCN 2008	MDD v1.0 2018	MDD v1.1 2019	MDD v1.2 2020	MDD v1.3 2020	MDD v1.4 2021	MDD v1.5 2021	MDD v1.6 2021	MDD v1.7 2021	MDD v1.8 2022	MDD v1.9 2022	MDD v1.10 2022	MDD v1.11 2023
Species														
<i>Total</i>	5,416	5,513	6,495	6,526	6,485	6,513	6,533	6,554	6,557	6,567	6,591	6,596	6,615	6,649
<i>Extinct</i>	75	79	96	100	103	103	103	103	103	101	101	101	101	105
<i>Living</i>	5,341	5,436	6,399	6,426	6,382	6,410	6,430	6,451	6,454	6,466	6,490	6,495	6,514	6,544
<i>Domestic</i>	0	0	16	17	19	19	19	19	19	19	19	19	20	18
<i>Flagged</i>	0	0	212	212	29	29	29	29	29	28	28	34	33	21
<i>Wild &amp; valid</i>	5,341	5,436	6,171	6,197	6,334	6,362	6,382	6,403	6,406	6,419	6,443	6,442	6,461	6,505
Genera	1,230	1,226	1,314	1,322	1,331	1,330	1,332	1,335	1,341	1,343	1,342	1,342	1,347	1,345
Families	153	149	167	167	167	167	167	167	167	167	167	167	167	167
Orders	29	24	27	27	27	27	27	27	27	27	27	27	27	27

- c. We continued to release ‘**Tracked Differences**’ files with every release of the MDD taxonomy (e.g., v1.9-v1.10), which contain detailed changes made to the recognized Mammalia taxonomy between versions. These ‘diff’ files have been extensive recently due to enhanced activity — including as related to two new partnerships with the [batnames.org](http://batnames.org) and [hesperomys.com](http://hesperomys.com) databases (see item 1d below) — which led to a whopping 117 changes from v1.9 to v1.10 and 194 changes from v1.10 to v1.11 (compares to ~30 changes between previous versions). For example, v1.11 of the MDD included 64 new species recognized (15 de novo, 49 split), 29 synonymizations (lumps, including 2 domestic species: *Bos domesticus* into *Bos javanicus*, and *Bos indicus* into *Bos taurus*), 1 species removal (*Makalata obscura*, now considered nomen dubium), 36 species with genus name changes, 5 genus additions (*Otohyalomys*, *Baeodon*, *Neusticomys*, *Poecilictis*, and *Parachoerus*) and 7 genus lumps (*Crossogale*, *Aeorestes*, *Dasypterus*, *Koopmania*, *Pediolagus*, *Petropseudes*, *Catagonus*), 5 species epithet changes to clear up confusion, 47 species epithet spelling changes to match gender or the original description (this was a major emphasis of this version), and 1 error fix in the spelling of the common name “Australian Humpback Dolphin.” In total, there was a net increase of 34 species and net decrease of 2 genera of recognized extant or recently extinct mammals since MDD v1.10.
- d. A key source of activity this year has been the establishment of two partnerships with external databases: (i) [batnames.org](http://batnames.org) (also called “Bat Species of the World: A taxonomic and geographic database”) as run by Nancy Simmons and Andrea Cirranello and advised

by the [Global Bat Taxonomy Working Group](#) of the IUCN SSC Bat Specialist Group; and (ii) [hesperomys.com](#) (also called “The Hesperomys Project”) as run by Jelle Zijlstra. Connor Burgin has been very active in engaging both of these databases, and in making substantial updates to the MDD in the process (kudos to Connor!). While [batnames.org](#) focuses on global bat taxonomy, [hesperomys.com](#) spans all mammals, including fossils spanning back to the Triassic, and emphasizes providing references to original citations for an extensive array of names. Both new partnerships have focused on pairwise comparisons with MDD data on accepted and synonymous taxonomic names. All databases benefited by uncovering errors of omission, orthography, gender, and new literature that had previously been overlooked. Gender agreement was a major focus, with Connor and Jelle working to establish rules of species epithet naming consistent with the ICZN and then apply these across a wide variety of names. These rules have also helped bring closer alignment between the MDD and batnames.org, with now fewer than 30 species-level differences between these databases.

- e. The MDD took the leap toward publishing subjective taxonomic decisions in collaboration with the group at the Global Bat Taxonomy Working Group, focusing on three separate cases for which multiple publications had reached differing conclusions. This was an important move for our MDD team, both to increase transparency and to move toward greater ‘taxonomic authority’ as regards maintaining this global list of accepted and synonymous mammal species. These decisions were posted on Zenodo and are linked on the [MDD About](#) page:

2023. Francis, C. M., Simmons, N. B., Van Cakenberghe, V., Upham, N. S., and Burgin C., on behalf of the Global Bat Taxonomy Working Group of the IUCN SSC Bat Specialist Group. On the taxonomy of *Lasiurus*. Zenodo. <https://doi.org/10.5281/zenodo.7696845>

2022. Francis, C. M. and Simmons, N. B. on behalf of the Global Bat Taxonomy Working Group of the IUCN SSC Bat Specialist Group. On the taxonomy of *Myotis lucifugus*. Zenodo. <https://doi.org/10.5281/zenodo.7338575>

2022. Upham, N. S. and Francis, C. M. on behalf of the Global Bat Taxonomy Working Group of the IUCN SSC Bat Specialist Group. *On the taxonomy of Myotis keenii and Myotis evotis*. Zenodo. <https://doi.org/10.5281/zenodo.7336341>

- f. The MDD taxonomy now has **associated species-level range maps** as aligned to v1.2 of the taxonomy (version of September 2020). These maps were created as part of a collaboration with the Map of Life team at Yale University, and resulted in a publication in the *Journal of Biogeography* that documents how these MDD maps differ from two other newly made map sets (*Checklist of the Mammals of the World 2020* and the *Handbook of the Mammals of the World 2009-2019*) and relative to the 2020 version of IUCN mammal species range maps. This article underscores the often-vast differences in species name usages (i.e., taxonomic concepts) between authoritative taxonomies, and how those differences affect our spatial understanding of mammal biodiversity:

2022. Marsh, C.J., Sica, Y.V., Burgin, C.J., Dorman, W.A...[142 other authors]..., Upham, N.S., Jetz, W. Expert range maps of global mammal distributions harmonised to three taxonomic authorities. *Journal of Biogeography*.

<https://doi.org/10.1111/jbi.14330> | Range map data on Zenodo:  
<https://zenodo.org/record/6644198>

- g. We are working to create an **R Package to access MDD data** (“mdd” package) with the help of ASU PhD student Ángel Luis Robles Fernandez (Upham Lab; [Github profile](#)).
- h. The MDD backend remains on Github for easy editing and transparency in an open science framework (<https://github.com/mammaldiversity/mammaldiversity.github.io>). This followed from 2021 advice from Jorrit Poelen, web programmer for the Global Biotic Interactions database (GloBI), and the efforts of Web Programmer Schuyler Liphardt. This MDD website and database critically remain *updatable directly by students and volunteers of the ASM Biodiversity Committee*.

## II. Public usage of Mammal Diversity Database data:

- a. In previous annual reports, we have listed the amount of annual web traffic to the <https://mammaldiversity.org> website (e.g., ~14,000 unique visitors in 2021). However, we have now learned that the traffic numbers from InMotion Hosting are entirely erroneous — they show activity in the chat forum from the old MDD website, which is entirely populated by bots, so not indicative of real people using the new MDD site.
- b. To obtain reliable usage numbers, on 19 May 2023 we set up a Google Analytics tracker to detail user activities on <https://mammaldiversity.org>. In the 7 days from 19-26 May 2023, this Google tracker logged 623 visits to the website from 10 countries, 51% of those from unique users, including 30 downloads of the MDD.zip taxonomy file from 7 countries (Fig. 1). If we extrapolate these figures to 52 weeks, we expect ~16,000 unique users and ~1,500 downloads of the MDD taxonomy annually.



Figure 1. One week of user traffic at <https://mammaldiversity.org>, with detail on the countries with file downloads.

- c. The archived versions of [MDD taxonomy on Zenodo](#) have also garnered a large number of total views (14,515) and downloads (6,880) since this page was launched in 2020. The v1.11 of the MDD taxonomy has been downloaded 346 times since being released on 15 April 2023 (i.e., ~8 times per day), and v1.10 garnered 1,148 downloads in 4 months.
- d. The 2018 *Journal of Mammalogy* article about v1.0 of the Mammal Diversity Database taxonomy (“[How many species of mammals are there?](#)”) has now been viewed >92,000 times and cited 802 times. This summary is one of the ASM’s most visible products.

## III. Continued plans for a summary article of the forthcoming v2.0 MDD taxonomy:

- a. The taxonomic updates to the MDD since v1.0 have unified insights from the *Handbook of the Mammals of the World* series (Volumes 1-9) and *Checklist of the Mammals of the*

*World* (2020) with our independent understanding from updated literature surveys, as well as more recent publications. Species- and genus-level synonyms have in particular been a focus of recent curation efforts.

- b. In parallel, the MDD team has been curating country-level and US State geographic ranges for each species in the MDD taxonomy. That effort, led by Connor Burgin, Madeleine Becker, and David Huckaby, has involved updating the listings from *Checklist of the Mammals of the World* using additional literature and IUCN records to match the taxonomic concepts in the MDD. These data are now in pipe-separated format in the ‘countryDistribution’ and ‘subregionDistribution’ fields of the CSV download.
  - i. Using these data, we are now writing an article titled “**How many species of mammals are there now? An update of geographic and taxonomic diversity**” relative to this updated information. Our 2022 plans to submit this were delayed, so our updated plan is now to assemble this work to submit to the *Journal of Mammalogy* by the end of 2023.

#### IV. Continued goals for work the ASM Mammal Diversity Database (2023 and beyond):

- a. **Synonyms.** Our work in this area has been strong, led by Madeleine Becker, Connor Burgin, and Jane Widness. Due to their efforts in the in 2022-2023, we now have a vetted synonym list containing 27,687 equivalencies to accepted MDD species names. This information is not yet published, but will be included in the v2.0 MDD release, including for both species- and genus-level synonymies of nominal names. The collaboration with hesperomys.com has additionally helped improve synonym information including full references for an increasingly complete list of names.
- b. **Type specimens.** Thanks to the volunteer efforts of Ingrid Rochon, we now have all of the species-level holotypes from the Smithsonian Mammal Collections allied to our MDD taxonomy, plus additional holotypes from some other collections including the Field Museum (thanks to Bruce Patterson, and data integration by Madeleine Becker). The ‘holotypeVoucher’ field now lists 2,731 accepted species with specimen identifiers from 138 museum collections thanks to the efforts of the MDD team (including 35 NA's that indicate a real lack of holotype voucher—in need of neotype).
- c. **Type localities.** We now have type locality information for all species in the MDD accepted list, and are working to gather decimal latitude and longitude for all type localities. We currently have geocoordinates for only 1,192 species of the ~6,500 total.

#### V. Obtaining non-ASM funding support:

- a. In July 2022, Chair Upham re-submitted a collaborative proposal to the NSF-DBI-ICBR (Capacity: Cyberinfrastructure) program along with D. Reeder (Bucknell), N. Simmons (AMNH), and J. Cook (UNM) as PIs, with the goal of establishing long-term funding support for the Mammal Diversity Database and related efforts. This proposal, titled “**Collaborative Research: Mammal Species of the World Next (MSWx): platform for curating taxonomic intelligence to extend biodiversity data,**” was first submitted in Sept 2021 and declined in April 2022. In Jan 2023, our re-submission was also declined, this time with mixed feedback of Excellent, Good, and Fair. The ‘meritorious’

panel ranking suggested that the while “the design of the project is outstanding” it “will likely not be a tool that is adopted and sustained by the community.” Our team is now considering taking a more question-driven approach that would build infrastructure to directly address core phylogenetic and geospatial questions.

## **VI. Establishment of External Taxonomic Subcommittees for the ASM MDD (2023-2024):**

- a. Long-standing goal; new plans.** The Biodiversity Committee has been having discussions about how to best form external taxonomic subcommittees since 2019. Each year at the ASM meetings we have gained some momentum toward doing this, however, each year we have hit a variety of obstacles toward meeting this goal. Taking a step back, it seems clear now that we have lacked a go-to person that could commit, e.g., the 10 hours per month needed to organize a wide array of communications and data inputs from a globally distributed group of taxonomic experts. Our need is for **student organizers** to help execute our plan for establishing these subcommittees. This is why we are requesting a budget line for this item in 2024 (see below). Our current plan is as follows:
- i. Starting from the initial list of per-clade ASM members and non-member specialists that has been curated the last few years (see [this Google Sheet](#) for a draft view), we will issue a General Call of Interest on the Mammal-L;
  - ii. We will amplify this General Call at the IMC / ASM meetings in Alaska this July, including with a scheduled [MDD / MSWx Workshop](#) on Monday of the meeting;
  - iii. The Call will include core responsibilities for these subcommittees as follows:
    1. Quantification of supporting evidence for all currently accepted species following a modified version of the ‘traffic-light system’ proposed by Kitchner et al. ([2022 Mammalian Biology](#)). The goal would be to assemble a system by which the per-taxon subcommittees could rank levels of support for particular changes – e.g., mtDNA only vs. mtDNA + nDNA vs. DNA + morphology + behavior – and then use those rankings as a way to justify the issuing of any subjective opinions;
    2. Regular communication via a joint Slack workspace — leveraging the existing MDD Slack, which can include up to 250 members thanks to a free Slack for Nonprofits membership acquired in 2022;
    3. Authoring any subjective taxonomic opinions with subcommittee members, as needed based on recent publications that contain disagreements or grossly unsupported taxonomic changes;
    4. General improvement and maintenance of taxonomic information for their group’s targeted taxa (e.g., synonyms, subspecies, type specimens); and
    5. Oversight of range-map updates for their targeted taxa, as coordinated with the broader MDD group.
  - iv. Establish a method of collecting feedback from the per-taxon subcommittees (e.g., Google Sheets or Google Forms);
  - v. Establish a method of integrating the resulting feedback into the MDD, including the outcomes of the subjective opinions issued by these subcommittees; and
  - vi. Reinforce the stability of paying for the hourly effort of student researchers in coordinating these tasks, including by applying to NSF or other outside funding.
- b.** To facilitate the above plans, we herein request to **hire two Student Organizers for Taxonomic Subcommittees (StOaTS)**, who will be tasked with managing

correspondence with subcommittee members via email/Slack, coordinating group efforts, and leading data integration task with the broader MDD. This ask involves a moderate increase in our 2024 budget, see below.

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**RECAP OF BUDGET 2022**

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**1. Website maintenance:**

- 2022 approved (~60 hrs @ \$20/hr) ..... \$1,200.00
- Spent during 2022 (Liphardt) ..... \$0.00

**2. Student research assistant(s):**

- 2022 approved (~5 hrs/w @ \$15/hr, 4 graduate students, 18 weeks) ..... \$5,400.00
- Spent during 2022 (Burgin, Widness, Parker, and Becker) ..... \$4,660.00

TOTAL BUDGET APPROVED (2022) ..... \$6,600.00  
Spent during 2022 ..... \$4,660.00

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**TO DATE BUDGET 2023 (Jan – May)**

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**1. Website maintenance:**

- 2023 approved (~60 hrs @ \$20/hr) ..... \$1,200.00
- Spent to date (not yet hired) ..... \$0.00

**2. Student research assistant(s):**

- 2023 approved (~5 hrs/w @ \$15/hr, 4 graduate students, 18 weeks) ..... \$5,400.00
- Spent to date (Burgin, Widness, Parker, and Becker) ..... \$1,860.00

TOTAL BUDGET APPROVED (2023) ..... \$6,600.00  
Spent to date 2023 ..... \$1,860.00

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**PROPOSED BUDGET 2024**

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**1. Website maintenance:**

- Website stability, updates to content and interface, feature modifications
  - 2024 proposed (~20 hrs @ \$25/hr) ..... \$500.00

**2. Student research assistants:**

- We plan to continue needing 2-4 student assistants employed at ~5/hrs per week. These student assistants will facilitate integration of updated taxonomic data, specifically:
  - (i) “bottom-up” data gathering from recent and historical publications relevant to mammal taxonomic changes; and (ii) “top-down” data gathering efforts in terms of parsing, matching, and curating mammal databases relative to MDD data.
  - 2024 proposed (~5 hrs/w @ \$20/hr, 2-4 students, 18-27 weeks) ..... \$5,400.00

**3. Student Organizers for Taxonomic Subcommittees (StOaTS):**

- We request to hire 2 student organizers at ~2.5/hrs per week (see section V.b. above).
  - 2024 proposed (~2.5 hrs/w @ \$20/hr, 2 students, 18-21 weeks) ..... \$2,100.00

**TOTAL BUDGET REQUESTED (2024) ..... \$8,000.00**



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## **SUMMARY**

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Overall, we expect that the MDD will continue to establishing value as a global authority for mammal taxonomy in 2023-2024. Plans remain in motion for the IUCN Small Mammal Specialist Group (SMSG) to adopt the MDD taxonomy for their upcoming re-assessments, which are set to be completed in 2025. For the ASM to continue to show support for the MDD initiative, including by developing a broader base of external oversight from taxonomic experts in the community, will serve to bolster confidence in the MDD and expedite this SMSG effort. This is a tangible type of impact that the ASM can have on the mammal biodiversity research community: providing up-to-date information for global assessments like the IUCN RedList, Intergovernmental Panel on Biodiversity and Ecosystem Services (IPES), and the UN Biodiversity Conference (COP), as well as for more local country-level efforts. As the SARS-CoV-2 pandemic has demonstrated, there is a major need for real-time taxonomic knowledge about the mammalian hosts of zoonotic pathogens. The ASM Biodiversity Committee is well positioned to lead curation efforts for the accuracy and completeness of this knowledge, and should continue to do so. Keeping track of “How many species of mammals are there?”, “in which countries?”, “according to who?”, and “with what ecologies?” are questions that are only growing in importance in our changing world.

**Respectfully submitted,**

Nathan S. Upham, Chair (nathan.upham@asu.edu)