University of Michigan Museum of Zoology's Mollusk Division: brief overview of the collection, recent digitization efforts, and future directions

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ABSTRACT

Here we report on characteristics of the University of Michigan Museum of Zoology's Mollusk Division and its collection. We include information about the division's establishment and growth as well as the facilities and personnel associated with the collection. We also describe the transformative improvements in digitization during the past twenty plus years as supported by several external awards. Finally, we present our vision for future priorities for collection development including further digitization efforts, enhancement of collections, and effective outreach.

Additional keywords: Mollusca, curation, specimens, malacology, outreach, database

BRIEF OVERVIEW AND HISTORY

The University of Michigan Museum of Zoology's (UMMZ) Mollusk Division currently holds approximately 251,000 lots of more than 5,000,000 specimens. The collection includes nearly 3,000 type-specimen lots, among them more than 450 holotypes. In addition to the type specimens, other highlights include large numbers of unionids and other freshwater mollusks from North America, lyophilized land snail specimens from French Polynesia (these were collected in 1970 before the introduction of *Euglandina rosea* to the islands), and sphaeriid and cone snail specimens. The collection has grown through efforts of division members and acquisition/deposition of collections/specimens from other institutes and malacologists and includes a diversity of mollusks, from most major habitats and geographic regions. Digitization work over the past 20 years has greatly increased the availability of information about specimens in the collection and improved their utility.

Although the UMMZ and Mollusk Division, one of six divisions in the UMMZ, were not formally established until 1913, the division's first major collections, approximately 1,500 specimens, were obtained by Joseph Beal Steere during a worldwide expedition from 1870–1875

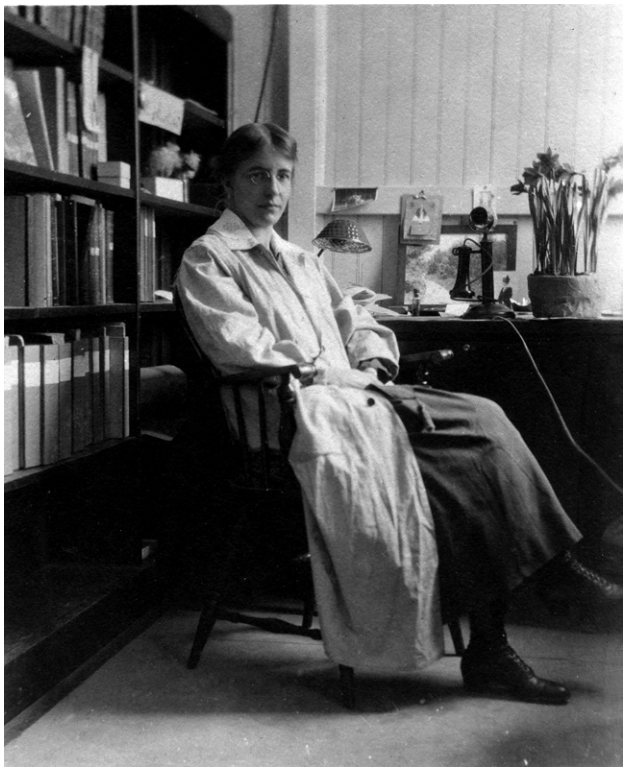

Figure 1. The first Curator of the Mollusk Division, Mina L. Winslow, who served from 1914 to 1929.

(Gaige, 1932). The collection grew further during the first part of the 20th century through work by Mina L. Winslow (Figure 1), the Mollusk Division's first Curator who served from 1914 to 1929, and Honorary Curators Bryant Walker (Figure 2) (see biography in Goodrich, 1936) and Calvin Goodrich (Figure 3) (see biography in van der Schalie, 1955) (van der Schalie, 1955, 1980, Burch 1981). Indeed, Walker's collection, which consisted of approximately 100,000 lots of mostly freshwater mollusks and land snails, contributed considerably to the size and importance of the division's holdings (van der Schalie, 1980; Burch, 1981). Early collecting efforts that focused on biodiverse southern drainages in the U.S. are now of particular importance because they occurred before the major wave of extirpation and extinction associated with 20th century watershed industrialization. The collection continued to grow through acquisitions of the Royal Ontario Museum's mollusk collection in the 1930s, A.W. Stelfox's sphaeriid collection in the 1960s, part of Alan J. Kohn's collection of specimens, tissues, gut contents, and radular preparations of Conidae in the 2010s (other materials were transferred earlier to the Field Museum of Natural History and Burke Museum of Natural History and Culture), and several other smaller collections. The size and breadth of the collection also increased through specimens collected for research by Mollusk Division Curators Henry van der Schalie (Russert-Kraemer and Berry, 1986; served from 1934 to 1977), John (Jack) B. Burch (1963 to 2002, although he continued serving as Emeritus Curator until 2019), Alexander Tompa (1977 to 1984), Douglas Eernisse (1986 to 1993), Diarmaid Ó Foighil (1995 to 2025), and Tom Duda (2004 to present). In addition, accessioned materials of around 80 graduate students who completed their Master's theses or PhD dissertations in the division also improved the collection.

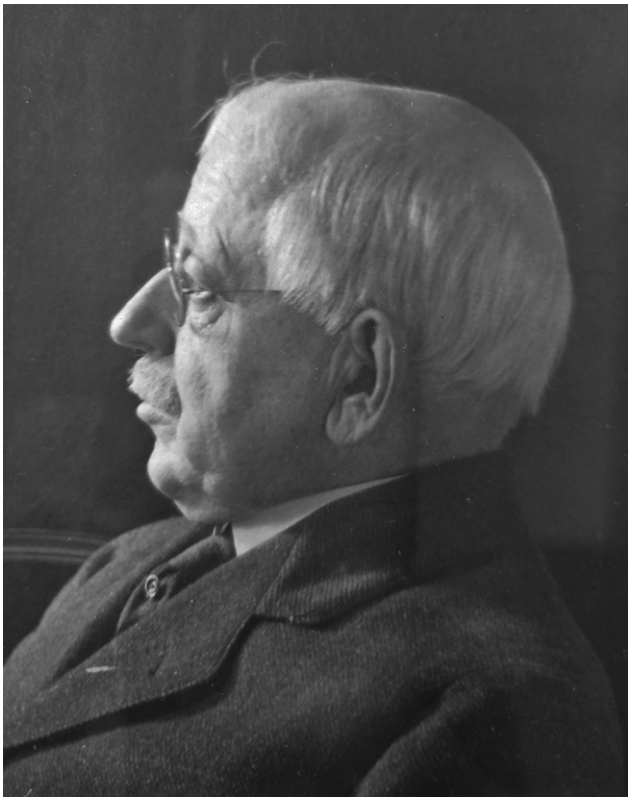

Figure 2. Bryant Walker, Honorary Curator of the Mollusk Division.

Figure 3. Calvin Goodrich, Honorary Curator of the Mollusk Division.

The Mollusk Division's collections were initially housed in the aptly named Museum Building from 1881 until 1928 when they were moved to the newly constructed Alexander B. Ruthven Building (Figure 4). In 2012, most of the UMMZ's fluid collections, including those of the Mollusk Division, were transferred to a newly renovated building, later to be named the Research Museums Center (RMC), approximately eight kilometers from the University of Michigan's (UM) central campus. Most of the UMMZ "dry" collections, including many lots of mollusks, and division libraries were moved to the RMC in 2018 and the RMC was established as the central location for collections of the UMMZ and UM Herbarium as well as paleontology and anthropology/archeology collections. Moving the Mollusk Division collection to the RMC provided improved conditions for maintaining specimens, including new metal cabinets and trays and climate-controlled spaces (Figure 5). Although UMMZ Collection Managers and laboratories for working with collections are located at

Figure 4. Mollusk Division dry collections space that was used to hold specimens in the Alexander B. Ruthven Building from 1928 to 2017. Curator Jack Burch examining specimens in trays in the original lower wooden cabinets with space above retrofitted to hold metal cabinets.

the RMC, Curators and their offices, laboratories, and students are at UM's central campus location in the recently constructed Biological Sciences Building where facilities are available for housing research collections for temporary use and study on campus.

Liath Appleton served as the division's first Collection Manager from 2003 to 2008 (Figure 6). Her work focused largely on the division's initial major efforts at digitizing its catalog (see below). Taehwan Lee, a former student of division Curators Jack Burch and Diarmaid Ó Foighil and an expert on sphaeriids and partulids, has served as Collection Manager of the division and a Research Scientist in the Department of Ecology and Evolutionary Biology since 2009. He has contributed to research, managed numerous National Science Foundation (NSF)-Thematic Collection Network (TCN) digitization projects in the division (see below), and recruited and supervised a large number of undergraduate students who have contributed to the digitization efforts (Figure 7).

The Mollusk Division hosted several meetings of the American Malacological Society (AMS) (formerly American Malacological Union). These include the 7th Annual Meeting in 1937; 24th in 1958 (Figure 8) which was organized by Henry van der Schalie, John B. Burch,

Figure 5. The Research Museums Center. Left: exterior view of building, center: updated cabinets and trays in dry collection space, right: shelving unit and Curator Jack Burch in the wet collection space in 2018.

Figure 6. Liath Appleton, first Collection Manager of the Mollusk Division.

Annette van der Schalie, and Paul F. Basch; 69th in 2003 (Figure 9) which was organized by Diarmaid Ó Foighil (President of AMS in 2003), Sandra Ahn, Liath Appleton, John B. Burch, Rafael Familiar, Yeonju Kim, Taehwan Lee, Reneé Sherman Mulchrone, Susan Jerrine Nichols, Fritz Paper, and Andrea Walther; and 81st in 2015 (Figure 10) which was organized by Tom Duda (President of AMS in 2015), Cindy Bick, Peter Cerda, Alexandria Friedman, Ryutaro Goto, Amanda Haponski, Alyssa Lawler, Taehwan Lee, Paula Teichholtz, and Andrew Wood. All but the 2015 meeting, which took place in Pellston, Michigan at the UM Biological Station, occurred at UM's Ann Arbor campus. The 2003 meeting featured a special session, "J.B. Burch – His Students Speak," to honor Jack Burch's contributions to student training as well as his recent retirement and continuation as Emeritus Curator.

FROM CATALOGS, CARD FILES, AND SPECIMEN LABELS TO DIGITAL RECORDS

For most of its history, the Mollusk Division collection could only be searched by inspecting the division's

Figure 7. Mollusk Division undergraduate student workers in the RMC. Left: entering label information into database (2018), right: photo-documenting lots (2016).

Figure 8. Group photo from the 1958 American Malacological Union Annual Meeting at the University of Michigan in Ann Arbor. Future Mollusk Division Curator Jack Burch is standing at far right of image. Mollusk Division Curator Henry van der Schalie is in second row, fourth from the left.

Figure 9. Group photo from the 2003 American Malacological Society Annual Meeting at the University of Michigan in Ann Arbor. Mollusk Division Curator Diarmaid Ó Foighil is in front row on the far right; recently retired Mollusk Division Curator Jack Burch is in first row, fifth person from left; Mollusk Division Collection Manager Liath Appleton is in first row, eighth person from left; future Mollusk Division Curator Tom Duda is in sixth row on far left; future Mollusk Division Collection Manager Taehwan Lee is in sixth row, approximately seventh person from left.

Figure 10. Group photo from the 2015 American Malacological Society Annual Meeting at the University of Michigan Biological Station in Pellston, Michigan. Mollusk Division Curator Tom Duda is in last row on the far right (in pink shirt); Mollusk Division Curator Diarmaid Ó Foighil is second to last row, third person from right; Mollusk Division Collection Manager Taehwan Lee is in middle row on far right (in blue shirt).

paper and card catalogs or browsing specimens in collection spaces. Since the early 2000s, several NSF awards and funds from UM have supported digitization of the Mollusk Division's records as well as improved curation of specimens (*e.g.*, updates to specimen boxes, etc.) (Figure 7). Awards include a Biological Research Collections grant in 2005 and four NSF-TCN grants that have either overlapped or run consecutively from 2014 to 2024 (Figure 11). In addition, more than 120 UM undergraduate students received training and collectively participated in these digitization efforts (Figure 7).

The first major digitization efforts in the Mollusk Division began in 2005 with a project (*Computerization of the University of Michigan Museum of Zoology's Mollusk Collection*) supported by an NSF award (award number 0447142) to division Curators Diarmaid Ó Foighil and Jack Burch. The five-year project established a Specify database, produced digitized records of nearly 70,000 lots, and enabled online searching of the database. Four TCN awards to Curator Diarmaid Ó Foighil, Curator Tom Duda, and/or Collection Manager Taehwan Lee also provided opportunities for further digitizing the collection, including the *InvertEBase TCN: Reaching Back to See the Future: Species-Rich Invertebrate Faunas Document Causes and Consequences of Biodiversity Shifts* (2014–2019; award number 1404964), *Great Lakes Invasives TCN: Documenting the Occurrence through Space & Time of Aquatic Non-indigenous Fish, Mollusks, Algae & Plants Threatening North America's Great Lakes* (2014–2018; award number 1405302), *PILSBRy TCN: Enhancing Access to Taxonomic and Biogeographical Data to Stem the Tide of Extinction of the Highly Imperiled Pacific Island Land Snails* (2019–2023; award number 1902119), and *ESB TCN: Mobilizing Millions of Marine Mollusks of the Eastern Seaboard* (2020–2024; award number 2001290). Together these efforts have resulted in digitization of over 230,000 lots and capturing of over 280,000 images of catalog entries, labels, and specimen lots (Figure 11).

FUTURE DIRECTIONS

Future priorities for the Mollusk Division's collection development include continued digitization efforts, enhanced specimen collection and preservation, and more impactful outreach.

As most of the past digitization work has largely focused on the division's "dry" collections and freshwater mollusks and land snails, in the coming years, we aim to digitize the remaining marine lots as well as fluid-preserved

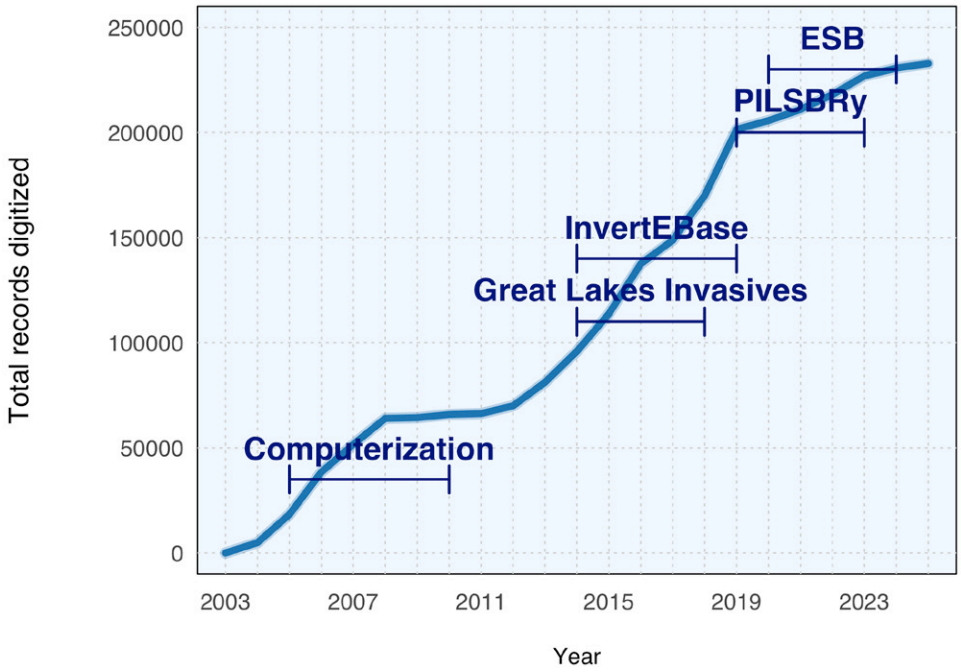

Figure 11. Progress in digitizing Mollusk Division specimen records from 2003 to 2025. Major digitization projects that were supported by NSF awards and their time spans are indicated in graph: "Computerization" = Computerization of the University of Michigan Museum of Zoology's Mollusk Collection award; others are TCN awards.

Figure 12. RMC cryogenic facility. Photo: Cody Thompson.

Figure 13. Micro computed tomography facility at the RMC.

Figure 14. Introductory Biology Lab visits to the Mollusk Division's dry collection space at the RMC. Mollusk Division personnel, Collection Manager Taehwan Lee (left image) and Curator Diarmaid Ó Foighil (right image), lead tours and discuss characteristics of the division's collection and the diversity of mollusks with UM undergraduate students. Photos: Ben Hess.

specimens, tissues, and genomic resources. We will also identify and complete records that lack critical data fields (e.g., collection dates and georeferencing locality data) to maximize their value.

We have transitioned to an "extended phenotype" model of specimen collection to capture and preserve as much biological information as possible for future generations of investigators. For instance, collection of cone snails may involve not just the shell and ethanol-preserved body (the traditional methods), but also fecal pellets (to determine prey species), DNA samples (for genomic studies), venom gland mRNA (for venom gene expression studies), and non-destructive anatomical characterization. This has been facilitated by new research facilities at the RMC, including dedicated liquid nitrogen cryogenic (Figure 12) and micro-computed tomography facilities (Figure 13).

Although the UMMZ is not a public-access museum, and most of our outreach activity is online (see above), we are increasingly engaged in targeted in-person outreach (in addition to student digitization training). Some of this engages with a malacological audience (*e.g.*, the Michigan Mussel Identification Certification Test and Class), but by far the largest effort concerns a more general audience: the large-sized Introductory Biology Laboratory course at UM which brings ~1,800 students a year through collections at the RMC (Figure 14). Exposure to our collection by large numbers of UM freshmen and sophomores among our student population pays dividends in increased awareness of and interest in our program, and in the possibility of working there.

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