CENTER FOR BIOLOGICAL RESEARCH COLLECTIONS

ANNUAL REPORT
SUBMITTED MARCH 7, 2025
This report covers the period of March 1, 2024, to March 1, 2025

I. Center for Biological Research Collections (CBRC)

Director, Claudia C. Johnson, Department of Earth and Atmospheric Sciences, until 7/2028
Executive Committee Members, P. David Polly, Department of Earth and Atmospheric Sciences
Ryan Kennedy, Department of Anthropology
Collections Manager -C.C. Johnson until 1/2026
Laboratory Manager, William R. Adams Zooarchaeology Laboratory, Samantha Couch, Department of Anthropology
Affiliate Member, Gary Motz, Head of Computer Systems, Information Science, Yale Peabody Museum

Governance
CBRC is run by a Director, Executive Committee, and Collections Manager consisting of faculty who oversee IU's formal paleontological and zooarchaeological natural history collections.

Operating Budget
CBRC is funded by the College of Arts and Sciences, Department of Anthropology, and Department of Geological Sciences.
External sources of funding include the National Science Foundation's Advanced Digitization of Biological Collections, and the Institute of Museum and Library Services, alumni donors, and private contributors.
New external funding is sought with grant submissions.
The operating budget for 2024-2025 was allocated for staff, graduate fee remission, health benefits and insurance, undergraduate student hourly salaries, equipment purchases for photography, photogrammetry, and materials for collections, travel for research presentations, equipment repair, contractual services for equipment maintenance, consortium dues, institutional membership dues, and warranties for technical equipment for digitization of specimens.

2. Description of CBRC

Executive Summary
CBRC holds core strengths in the current technological fields of 3D imaging and digital infrastructure development for Indiana University's integrated natural history collections. CBRC procures external funding from NSF and IMLS, and from the College to support its growing digital expertise. CBRC invests in training STEM and non-STEM graduate and undergraduate students in 3D technology for enhancement of academic and professional careers and to broaden workforce participation. Top priorities for scientific outreach are national and international academic research communities, and residents of the State of Indiana through elementary school corporations and local university-Bloomington engagement events and activities.

The Center for Biological Research Collections (CBRC) includes two natural history collections:

- The IU Paleontology Collections (IUPC), housed within the Department of Earth and Atmospheric Sciences, holds > 1.5 million fossil specimens, including more than 1,000 unique type specimens, representing more than 400 million years of Earth's history. The IUPC holdings are global in their geographic scope, but most are representative of the Paleozoic of North America, with many specimens from the State of Indiana.
- The William R. Adams Zooarchaeology Laboratory (WRAZL), located in the Department of Anthropology, houses over 10,000 modern comparative faunal specimens inclusive of mammals, reptiles, amphibians and fish. WRAZL holdings include species from across the globe, with the most depth being found in Midwestern fauna. Ongoing zooarchaeological research in WRAZL leverages the collection's breadth and includes projects in the American West, Gulf of Mexico, Chesapeake Bay, and Midwest.

The IU Paleontology Collection and William R. Adams Zooarchaeology Laboratory hold natural history specimens in formal research repositories. The specimens form the basis for research in paleontology, zooarchaeology, functional morphology, ecology and paleoecology, evolutionary biology, and related disciplines. The specimens are the primary sources of data on the structure and composition of organisms of the present and past, and they serve as tangible evidence that those organisms lived in particular places and times. Similar to archival research libraries, the materials in these collections are used by researchers at IU and around the world. CBRC and faculty and staff associated with the two collections thus carry out independent research on the collections, but they also maintain the integrity and accessibility of the collections for broader research communities. This arrangement works in kind; faculty and staff at other universities and museums provide IU researchers with equivalent access to collections around the world.

Vision

Indiana University's Center for Biological Research Collections supports the College of Arts and Sciences' vision of creating leaders and thinkers by developing digital infrastructure to advance a collaborative biodiversity platform, facilitate research on IU's natural history specimen collections, and promote educational enhancement to create citizen science leaders for the State of Indiana.

Mission

The mission of the Center for Biological Research Collections is to enhance collection-based research and education in biodiversity, zooarchaeology, paleontology, and related disciplines by providing shared infrastructure and data management support of IU's natural history collections. The Center's research focus is on 2- and 3D imaging of specimens, including biological, fossil, and archaeological remains, that have associated taxonomic, geographic, and temporal metadata. CBRC thereby provides stewardship for IU's formal paleontological and zooarchaeological repositories.

Principal Goals

CBRC supports data management platforms and digitization for research grants that use IU's natural history collections, coordinates policy, and develops external funding streams for upkeep and development of collection infrastructure.

CBRC actively promotes training in 3D imaging for STEM and non-STEM undergraduate and graduate students.

Primary Role in the College

CBRC is a pooled resource to support the natural history collections and the faculty who are responsible for them. CBRC serves as a vehicle for collaborative grants to enhance the collections and to support research; it maintains digital infrastructure such as collection management databases and digitization equipment and facilities; it provides training to faculty, graduate students, and undergraduates in

collection-based research methods and in collection care; and facilitates access and use by researchers by providing support in locating specimens, processing loans, and linking specimens with associated data.

Primary Role on Campus
CBRC collaborates with other collections and units to develop shared infrastructure and best practices. Partners include University Collections, Digital Library Project, Institute for Advanced Study, University Information Technology Services, Indiana Geological & Water Survey, IU Museum of Archaeology and Anthropology, Advanced Visualization Laboratory, the Data to Insight Center of the IU Pervasive Technology Institute, and the IU School of Education.

3. Overview of CBRC's contributions and activities

CBRC is not a degree-granting program or department yet its benefits to the College, Campus, and Bloomington community are significant and highlighted here.

CBRC Educates Students in Underrepresented Groups in STEM, thereby contributing to diversity, equity and inclusion goals of the College of Arts and Sciences and Indiana University.
CBRC enhances the teaching and research mission of Indiana University by training undergraduate students in digitization of zooarchaeology and fossil specimens and their associated metadata, and graduate students in enhanced specimen research and in training undergraduates on specimen-related, technological research, managerial and curatorial procedures.

CBRC Trains Students in 3-D Scanning Techniques, Workflows and Workshops
CBRC prioritizes purchase of 3D scanning equipment and provides training for graduate students to develop workflow documents and videos on procedures for scanning objects of varying sizes and densities. Students develop training documents as test runs prior to presenting formal workshops to the university community of engaged students and faculty researchers. These workflow documents and equipment lists are available on the CBRC website.

CBRC Prepares Students for Professional Careers
CBRC funds RA positions for graduate students to learn management and curatorial skills with physical specimens and 3D and digital data methods. Graduate student RAs, in turn, instruct undergraduate hourly workers, who then teach techniques and technologies to their peers. More than 50 students commonly express interest in the 12 hourly positions available each year. For many of our undergraduates, this work represents their first exposure to scientific research. Thus, their assignments have been designed to serve a dual purpose: to push the goals of CBRC, WRAZL, and IUPC forward, while simultaneously acting as an introduction to various aspects of the scientific process and the organization of contemporary research collections. CBRC-supported students consistently receive offers of admission to graduate programs, present research findings at conferences, and win scholarships and other awards, all serving as evidence that the training provided by CBRC is critical in students' professional development. In addition, all WRAZL and IUPC undergraduate workers have contributed to, and are responsible for, general collections upkeep, including maintaining equipment, supplies, and work areas within the two collections.

CBRC Provides Stewardship to the IU Paleontology and the W.R. Adams Zooarchaeology Collections
CBRC faculty, graduate students, and undergraduate hourly workers are trained in specimen management and collection practices, principles, and policy. The IUPC and WRAZL collections' specimens are formally curated in climate-controlled conditions supervised by building management personnel.

CBRC Coordinates Specimen and 3D-imaged Loans to the Academic Research Community
Formalized repository policies allow for exchange of specimens among members of the academic research community. When IU faculty request loans from other institutions for themselves or their students, official institutional loan papers and borrowed specimens are under the supervision of IU's curators and collection manager. The Institute for Advanced Study provides competitive funding for external researchers to visit the IUPC and examine specimens for their research. In early 2024 two awards were made to non-IU researchers using WRAZL specimens to to create a comprehensive reptile/amphibian osteology guide and produce 3D models of turtle shells to use in zooarchaeological and biological research.

CBRC Arranges Specimens and Training for Educational Use Across Disciplines
Specimen loans for classroom use, research projects, tours to public visitors, and outreach and collaboration with educational and research entities occur frequently throughout the academic year.
*Educational Offerings from CBRC Collections are listed in Appendix 1.

Faculty most involved in CBRC during 2024 were C. Johnson, R. Kennedy and D. Polly (through August when Polly entered administrative leave). These faculty members routinely trained graduate and undergraduate students, oversaw educational outreach, equipment purchases and maintenance, workflow document development, and creation of new pages for the website.

Major activities in 2024–2054

Highlights of CBRC's accomplishments of 2024-2025
MOST IMPORTANTLY, we

- submitted research grants, publications and presentations to support CBRC's goals
- advanced the transfer of databases of WRAZL specimen holdings to *SPECIFY* via successful *Faculty Assistance in Data Science* program support with 3 Luddy MA students
- created and strengthened international collaborative research to dramatically increase the use of WRAZL specimens as targets of research rather than simply as tools for identifying animal remains from archaeological sites
- discussed the preservation of CBRC's digitized images and their associated metadata with IU's *Research Technologies*
- conversed with IU faculty in Luddy to initiate cross-training of students in geosciences and informatics through formal coursework.
- continued pursuit of a joint CBRC-UNESCO partnership with CBRC Affiliated Member at Yale University, UNESCO, and IU faculty
- trained 6 graduate students and 12 undergraduate students to specialize in digitization of specimens and image processing associated with metadata identifiers for research and teaching purposes
- presented workshops to IU faculty and students to train in photogrammetry and software to produce 3D images

Highlighted here are CBRC's major activities unique to WRAZL and IUPC repositories that were undertaken to keep repositories functional, relevant, and in accordance with formal policy.

W.R. Adams Zooarchaeology Laboratory (WRAZL)
Dr. Ryan Kennedy, Assistant Professor in the Department of Anthropology, is Director of the W. R. Adams Zooarchaeology Laboratory.

Dr. Kennedy continued creating and strengthening research collaborations with outside scholars interested in analyzing WRAZL's specimens using a range of methods, including: zooarchaeology by mass spectrometry; stable isotope analysis; genetic analysis; and various modes of digitization, like photogrammetry and 3D scanning. This includes collections-based work being done in collaboration with researchers in Canada, the United Kingdom, and Norway, as well as with America researchers at multiple institutions (Stanford University, University of Oklahoma, Texas A&M University, and others). Together, this work is helping refine taxonomic identifications within WRAZL's collections and contributes to publications focused on zooarchaeological methods. Overall, these ***initiatives are part of a larger effort to dramatically increase the use of WRAZL specimens as targets of research*** rather than simply as tools for identifying animal remains from archaeological sites.

To increase the visibility of WRAZL's collection and in response to the CBRC External Review conducted in Spring 2023, Dr. Kennedy has continued efforts to improve and make WRAZL's specimen database accessible via the *SPECIFY* Database portal on the laboratory's website. This included Dr. Kennedy's participation in the National Endowment for the Humanities-funded "Networking Archaeological Data and Communities" two-year training program, which ended in Fall 2024. The WRAZL team for this training also includes Mr. Jeremy Floyd (University Archives), who will continue to collaborate on database work in the lab. Additionally, Dr. Kennedy successfully applied for *Faculty Assistance in Data Science* (FADS) support, which provides three Luddy MA students to help with WRAZL's data needs through the Spring 2025 semester. Work has begun on data cleaning and revamping the laboratory webpage, and ***we anticipate having a publicly available database by end of Spring 2025.***

WRAZL personnel, including ***10 different undergraduate student researchers supported by CBRC***, continue to make great progress on the lab's many ongoing analysis projects. This work relies on the extensive comparative skeletal collection in WRAZL, and it focuses on archaeological collections from the American West (California, Wyoming, Oregon), the Gulf of Mexico (Louisiana, Florida), and the Chesapeake Bay area (Maryland, Virginia). The depth and breadth of WRAZL's comparative collection enables projects across such vastly different environments with equally different local animal communities. Much of this work focuses on long-distance trade of animals to these sites, with a focus on the impacts of commodification and trade of fishes and turtles in the past.

As noted, a major focus in ***WRAZL has been building collections-based research collaborations across university units and beyond IU***. *Social Sciences Research Funding (SSRF) Program* supported stable isotope analysis of archaeological turtle remains, including a growing collaboration with Dr. Peter Sauer, Director of IU's Stable Isotope Research Facility and Co-PI of the SSRF project. Dr. Kennedy has also begun collaborative research on historical and archaeological elephant ivory trade with Dr. Jonathan Schlesinger and Dr. Kalani Craig, both faculty in the IU Department of History; this work has already produced a *National Science Foundation proposal*, and we are planning to submit a second proposal soon. Further, Dr. Kennedy continues to expand collaborations with Dr. Kristine Korzow (Texas A&M University), a leading expert in zooarchaeology by mass spectrometry (ZooMS), which uses mass spectrometry to assign taxonomic identifications based on collagen protein structure. Drs. Kennedy and Korzow are leveraging the breadth of WRAZL's comparative collection to create baseline data for numerous currently un- or understudied taxonomic groups that are well-represented in WRAZL. Finally, with support from the *Institute for Advanced Study*, Dr. Nabil Kahouadji (Northeastern Illinois State University) visited WRAZL and developed size estimation models for archaeological turtle remains. Drs. Kennedy and Kahouadji and several IU student researchers presented this work at the Society for Historical Archaeology meetings in early 2025, and they will be publishing these models in the coming academic year.

CBRC-funded personnel continued specimen processing, with a focus on adding specimens relevant to ongoing research projects. Around 50 animal carcasses were processed into cleaned and inventoried

skeletal specimens, which are critical for zooarchaeological analyses. Notable additions to the laboratory's collection include 30 fishes collected by Dr. Kennedy in Cairns, Australia (relevant to Chinese diaspora archaeological sites), and three large Pacific halibut carcasses that were donated by The Elm, a local restaurant that imports whole, fresh fish.

WRAZL continued efforts to ***procure animal carcasses to address gaps and add depth to the laboratory's comparative collection.*** Throughout the year, Dr. Kennedy purchased fish that are necessary for his ongoing research projects.

CBRC affiliates and students continue to use WRAZL specimens for digitization and photogrammetry projects. A ***CBRC-funded RA and undergraduate student workers digitized ~75 specimens***, with a focus on carnivore limb elements, turtle shells, and pig feet. Not only does this work support ongoing research projects (e.g., research on carnivore limb evolution), with coming changes to WRAZL's website we will be able to make these and future 3D models available to outside researchers and the public. In addition to digitizing WRAZL's comparative specimens, WRAZL personnel also digitized a variety of historical objects, including 19th-century canes decorated with shark vertebrae and opera glasses decorated with mollusk shells, as part of several ongoing projects led by Dr. Kennedy.

WRAZL staff continues to make ***progress on identifying "problem" specimens that need to be deaccessioned or returned to other facilities***. Many of these specimens are archaeological animal remains that lack obvious labels indicating where they are from or who they belong to; WRAZL staff continue to examine laboratory records for information about these specimens.

Further WRAZL activities

- Workspaces for CBRC, IUPC, and WRAZL were established in Microsoft Teams, including project and task boards to track activities, and training workers to use these central spaces.
- External loans from and visits to CBRC Collections were arranged and more for 2025 summer and fall are being processed.
- WRAZL's annual IU IBC protocol and permit paperwork have been filed.
- The Lab Manager and *CBRC-funded student workers created a plan to increase WRAZL's social media presence* that includes researching current media trends and creating a backlog of content. This will be implemented in 2025 following revisions to WRAZL's website.

IU Paleontology Collections (IUPC)

CBRC's strategy is to capitalize on training graduate and undergraduate students in advanced digitization techniques. For the 2024-2025 academic year CBRC's IUPC RA, graduate and undergraduate students produced products that aided in the accomplishment of CBRC's mission and vision, including:

- established new CBRC IU Supercomputer project accounts with Quartz with faculty advisors
- experimented with and tested photogrammetry equipment on different sized objects in the IUPC and WRAZL collections; developed and posted on CBRC website workflow documents and best practices for photography and 3D photogrammetry and image processing
- developed and presented photogrammetry workshops and workshop workflow documents for future photogrammetry training
    - Photogrammetry workshops held during the year:

        - Spring 2025: for students in geology classes, graduate students, and EAS visiting researcher
        - Spring 2025: two workshops were advertised to biology, geology, and archaeology students
        - Fall 2024: for new CBRC undergraduate workers at start of semester
        - Fall 2024: for WRAZL graduate students at end of semester
        - Fall 2024: Science Fest 2024 with WRAZL, showcasing the new photogrammetry setup in the Zooarchaeology lab space
- inventoried and posted on CBRC website an *equipment list*, and developed a list of recommended purchases for additional equipment
- developed and posted official CBRC *loan forms* for photogrammetry and photography equipment check out
- developed four themed projects focusing on IUPC research specimens to develop CBRC website pages; goal was to develop inventory database with photographs, select specimens for photogrammetry and develop 3D models, write scientific communication on the importance of the fossil group, and post on website; focused this year on conularids, sharks, scleractinian corals, rugose corals. This project is aimed at furthering database development and producing data for transfer to *SPECIFY*'s data management system. The work on the conularids resulted in a research project underway with Dr. H. Van Ito, Hanover College, Indiana.
- developed and implemented *public-facing hallway displays* on Geology Building's 5th floor showcasing invertebrate paleontology, vertebrate paleontology, special fossil donations from former students and donors, and CBRC's IU Paleontology Collections
- recommended and reviewed collections management systems official forms and accomplishment numerous collections management tasks associated with CBRC and IUPC specimens for digitization
- produced external drive back-up for photogrammetric data collected since Fall 2023 and moved all WRAZL scanned models and metadata from photogrammetry of the past academic year onto new external storage device
- Created Master Imaging List workbook for a list of photogrammetric data
- Taught these **skillsets and documented their use** by RAs, graduate students, and undergraduate student hourly workers for placement on each student's CV:
    - photography, photogrammetry, 3D model development and troubleshooting techniques; active research of new methodologies to improve current methods
    - placement of digitized collection materials into spreadsheets to create a database of specimens
    - GIS mapping to produce specimen map for webpage
    - written scientific communication for webpage development and social media postings
    - communication skills to present fossil and zoological specimens at IU's outreach events to viewers of all ages
    - skills acquired in creation and design of public-facing hallway displays
    - advertisement, development, and presentation of digitization workshops
    - increased experience in teaching and pedagogy and in supervisory roles with undergraduate hourly workers for various specimen-based projects

- general collections management skills including collections inventory and database recording

4. Plans for CBRC's future

CBRC works toward filling the external review committee's two primary recommendations: placing catalog specimen data in an electronic database to serve the collections data to the public, and digitizing specimens for individual research projects and in support of teaching.
Priority goals of these strategic plans integrated with the external committee's recommendations include:

- Working with IU's *Research Technologies* to develop long-term data storage solutions for 3D data generated in both WRAZL and IUPC, with plans to link these models to collections databases and make a subset of them publicly available via the CBRC and individual repositories' websites.
- Utilizing more fully the *SPECIFY* framework for collections metadata
- Exploring funding options to upgrade WRAZL's infrastructure, including to update the lab's walk-in specimen freezer and build a collagen extraction station to expand ZooMS and stable isotope analyses of the lab's comparative skeletal collection.
- Developing plans to invest in a data management staff through grant submissions
- Digitizing physical specimens in the IUPC and WRAZL with priority to research and teaching activities
- Prioritizing and purchasing equipment for digitization efforts
- Training the next generation of technology-trained STEM and non-STEM graduate and undergraduate students in 3D imaging techniques and in managing associated metadata.

CBRC is anticipating changes in operation improvements
Last year CBRC's budget request included a postdoctoral research position. CBRC's external review committee recommended that digitization support in the forms of investment in a collections data management system, and in data management staff with experience relevant to the zooarchaeology and paleontology disciplines be CBRC's top priorities - for the unified goal of serving WRAZL and IUPC specimen data to the public. The College's funds to CBRC dedicated an RA position in WRAZL for the SPECIFY work in Spring 2025. We are working toward an April 2025 NSF grant proposal submission, and if granted will take another step toward data management. We continue to work toward the goal of placing our holdings into the SPECIFY data management system.

CBRC has special issues and challenges that we are addressing.

1. Preserving individual digitized images and their associated metadata is a technology storage challenge that we are working to resolve with *Research Technologies*.
2. A collections manager position is filled temporarily by the CBRC director, but a longer-term solution will need to be discussed.
3. The challenge to inventory and reorganize specimens to reflect current taxonomy is continuous. Many of WRAZL's specimens retain outdated taxonomic identifications that reflect the time when the specimens were first processed (e.g., in the 1980s). Fortunately, *Faculty Assistance in Data Science* interns are currently helping with data cleaning, which will identify typos and other errors. ***Two College and CBRC-funded RAs working in WRAZL in Spring 2025*** are assisting with this work, including confirming proper taxonomic names are used. This work is also benefiting from ongoing ZooMS and genetic analyses that are helping to identify mislabeled specimens in the collections.

4. Maintaining digitization expertise as students graduate is stabilizing, as we are ensuring the expertise in digitization is passed from graduate student to graduate student and to undergraduates, and workflow documents are posted to the CBRC website.
5. We are communicating the Center's goals effectively from many voices – researchers, graduate students, undergraduates, and departmental chairs – in personal interviews and written documents. This is essential in securing a productive future for CBRC.
6. Formalizing the duties in the tenure track promotion line for faculty researchers with deep knowledge of the unique value of natural history collections who INHERIT the collections when they accept a position at IUB is a topic to consider.

Summary

CBRC personnel are dedicated to caring for the natural history specimens in their physical and digital forms with managerial and curatorial skills advocated by policy. With innovations in digital technology CBRC preserves the specimens, protects the history of the Earth embedded in these collections, and uses and shares these resources with researchers within and outside of the State of Indiana to introduce natural history and biological evolution of the Earth to the public. We value our opportunities to teach, train, and support the research and creative activities of all people interested in the natural history collections housed and under the care of Indiana University, and appreciate the strong support of the College in CBRC's endeavors.

ADDENDUM

Appendix I
CBRC OUTPUTS March 1, 2024 – March 1, 2025

External Grants

Completed

Chandroth, A. Geological Society of America Travel Grant. $ 600
Chandroth, A. Geological Society of America On to the Future Mentor Award. $ 800 (Total value)
Chandroth, A. STRATA Award North American Paleontology Convention Total Value - $800
LaBarge, T.W. The Isotopic Evolution of the Serengeti Ecosystem. The Exploration Fund Grant, The Explorers Club, $5,000.
Njau, J.K. Fifty Years After LUCY: The Eastern African Association for Paleoanthropology & Paleontology (EAAPP) conference, Addis Ababa, Ethiopia. *Wenner-Gren Foundation* ($20,000).
Zimmerman, A., and Johnson, C.C., NOAA 9/22-9/24; $40,000; Title: Ocean Protector: A game-based curriculum to teach the impacts of ocean acidification and positive actions to help. Ocean Acidification Program Education Mini-Grant Program

In Progress

Guiry, E.J. (PI), Kennedy, J.R. (Co-PI). Building millennial-scale records of turtle ecology in the Chesapeake Bay watershed. Chelonian Research Foundation, Juston Congdon and Nancy Dickson Research Fund, $4,750.
McHenry, L.J. (PI), Njau, J.K. (Co-PI). An East African Rift fluvio-lacustrine analog for Jezero crater, Mars. *NASA, #80NSSC21K1830*. Subaward to IU ($71,962).

In Review

Chandroth, A. Extinction risk of Exploited Marine Bivalves, Royal Commission 1851 Post-Doctoral Fellowship
Chandroth, A. Extinction risk of Exploited Marine Bivalves, Royal Society Post-Doctoral Fellowship

Hartzell, S. Scleractiniamorphs: Clarifying potential Paleozoic origins of modern Scleractinia. The Paleontological Society, Student Research Grant, $1200

Hartzell, S. Scleractiniamorphs: Clarifying potential Paleozoic origins of modern Scleractinia. The Geological Society of America, Graduate Student Research Grant, $3000

Johnson, C. C. (PI), Chakraborty, Sunandan (Co-PI), Njau, J.K. (Co-PI), Simms, J., (Co-PI), Zimmerman, A. (Co-PI), P.D. Polly (Co-PI). *Submission date is 4/2/25*. CAIG: AI-Enable Taxonomic Research in Geosciences. NSF, ~$1,500,000.

LaBarge, T.W. Isotopic Perspectives on the Trophic Dynamics of the Prehistoric Serengeti and the Evolution of Hominin Diet. The Leakey Foundation, Research Grant (PhD candidate), $19,893.00

LaBarge, T.W. Ontogenetic Variation in Diet and Osteophagy in *Tyrannosaurus rex*: Insights from Zinc Isotopes. The Jurassic Foundation, Research Grant, $2970.69

Njau, J.K. (PI), LaBarge, T.W. (Co-PI). Doctoral Dissertation Research: Isotopic and Ichnological Insights into Predator-Prey Interactions and Human Evolution at Olduvai Gorge and Laetoli. National Science Foundation, Biological Anthropology Program - Doctoral Dissertation Research Improvement Grants (BA-DDRIG) (NSF 23-504), $33,472.03

Schlesinger, J. (PI), Craig, K. (Co-PI), Kennedy, J.R., (Co-PI), Daniella Chusyd (Co-PI). ArchIvory: A Database and Deep Learning Toolkit for Integrating Non-destructive XRF analysis with Existing Destructive Approaches to Population-Level Testing of Elephant Ivory. National Science Foundation, Infrastructure Innovation for Biological Research (Innovation) (NSF 23-578), $397,670.

Grants Applied for and Not Received

Johnson, C. C. (PI), Chakraborty, Sunandan (Co-PI), Njau, J.K. (Co-PI), Simms, J., (Co-PI), Zimmerman, A. (Co-PI), P.D. Polly (Senior Personnel) 2024. CAIG: Addressing the urgent demand for taxonomic expertise and education in geosciences through innovative AI approaches. NSF, ~$1,500,000.

Wang, J. (PI), Ng, L. (Co-PI), Peterson, V. (Co-PI), Kennedy, J.R. (Co-PI). Chinese Diaspora Foodways Archaeology Network. American Council of Learned Societies Inaugural Luce/ACLS Collaborative Grant in China Studies, $88,163.

Internal Grants

In Progress

J.R. Kennedy (PI), E.J. Guiry (Co-PI), P. Sauer (Co-PI). 5/2023-5/2024. *Developing New Archaeological Approaches to Human-Turtle Relationships*. Indiana University Social Sciences Research Funding Program. $35,000.

Completed

LaBarge, T.W. Summer Pre-Dissertation Research Grant, Office of the Vice President for International Affairs, $3,500.

In Review

Hartzell, S. Scleractiniamorphs: Clarifying potential Paleozoic origins of modern Scleractinia. Patton Project Grant

Hartzell, S. Scleractiniamorphs: Clarifying potential Paleozoic origins of modern Scleractinia. Earth and Atmospheric Department Grant, $634

Grants Applied for and Not Received

LaBarge, T.W. Investigating the Influence of Hominin Evolution on the Isotopic Ecology of the Serengeti. McCormick Science Grant, College of Arts and Sciences, $3,500.

Peer-Reviewed Publications

Published

Guiry, E.J., Kennedy, J.R., Malcom, C., et al. 2024. Early evidence for long-term human impacts on sea-turtle foraging behavior. *Royal Society Open Science* 11:240120.

Guiry, E.J., Kennedy, J.R., Orton, D.C., et al. 2024. The ratting of North America: A 350-year retrospective on Rattus species compositions and competition. *Science Advances* 10(14).

Kennedy, J.R, Royle, T.C.A., Jackman, L.S., et al. 2024. Zooarchaeological and ancient DNA identification of a non-local gopher tortoise (*Gopherus polyphemus*) in New Orleans, Louisiana, USA. *Journal of Archaeological Science* 172.

Kodikara, G.R.L., McHenry, L.J., Stanistreet, I.G., Stollhofen, H., Njau, J.K., Toth, N., Schick, K. (2024) Wide & Deep Learning for predicting relative mineral compositions of sediment cores solely based on XRF scans, a case study from Pleistocene Paleolake Olduvai, Tanzania. *Artificial Intelligence in Geosciences* 5, https://doi.org/10.1016/j.aiig.2024.100088.

LaBarge, T. W., Gardner, J.D. & Organ, C. L. (2024). The evolution and ecology of gigantism in terror birds (Aves, Phorusrhacidae). Proceedings of the Royal Society B: Biological Sciences, 291(2021). http://doi.org/10.1098/rspb.2024.0235

LaBarge, T.W. & Njau, J.K. (2024). Taxonomic Reappraisal of *Nihilichnus* from Taphonomic Perspectives of Crocodile Predatory Ecology. *Ichnos*, 31(1), 40–55. https://doi.org/10.1080/10420940.2024.2353199

Lau-Ozawa, K. and J.R. Kennedy. 2025. Diaspora on The Block: Neighborhood Archaeology as Theory and Method. *Journal of Anthropological Archaeology* 77.

Royle, T.C.A., Kennedy, J.R., Guiry, E.J. 2024. Sharkaeology: Expanding understandings of historical Chinese diaspora shark fisheries in Monterey Bay, California, through the genetic species identification of archaeological Chondrichthyes remains. *Human Ecology* 52:479-495.

Smedley, R., Fenn, K., Stanistreet, I.G., Stollhofen, H., Njau, J.K., Schick, K., Toth, N. (2024) Age-depth model for uppermost Ndutu Beds constrains Middle Stone Age technology and climate-induced paleoenvironmental changes at Olduvai Gorge (Tanzania). *Journal of Human Evolution 186,* https://doi.org/10.1016/j.jhevol.2023.103465.

Taylor, C.E., Masao, F., Njau, J.K., Songita, A.V., Hlusko, L.J. 2024. OH 89: A newly described ~1.8-million-year-old hominid clavicle from Olduvai Gorge. *Peer Community Journal,* 4, https://doi.org/10.24072/pcjournal.372.

Torre, I.d.L., Doyon, L., Benito-Calvo, A., Mora, R., Mwakyoma, I., Njau, J.K., Peters, R.F., Theodoropoulou, A., d´Errico, F. 2025. Earliest evidence for systematic bone tool production at 1.5 million years ago. *Nature,* https://doi.org/10.1038/s41586-025-08652-5

Accepted

In Review

Kennedy, J.R., Royle, T.C.A., Guiry, E.J., Buckley, M., Kemp, B.M. David Starr Jordan, Chinese fishers, and the building of the Smithsonian Institution's Fish Collection: Zooarchaeological perspectives on the Chinese fishing village at Point Alones, California.

Salcido, C.J., Gill, P.G, Martinelli, A.G., Rawson, J.R.G., Corfe, I.J., Soares, M.B., Francischini, H., Schultz, C.L, and Rayfield, E.J. (2024). Functional morphology and biomechanics of an ontogenetic series of the Triassic cynodont Brasilodon quadrangularis and bite performance at the cynodont-mammalian boundary. In review.

Salcido, C.J. and Polly, P.D. (2024). The relationship between form and function of the carnivore mandible. In review.

Salcido, C.J. and Polly, P.D. (2024). Does form follow function in the evolution of carnivory amongst therians? In review.

Conference Paper Presentations

Chandroth, A., & Johnson, C.C. Role of Redundancy and Ecophenotypic Variations of Corals on Reef Stability. North American Paleontological Convention, 2024 (Oral presentation).

Chandroth, Anupama and Johnson, C., Impact of morpho-functoonal group redundancy on the origination and extinction of Caribbean corals. Abstract, 2024 Joint North-Central/South-Central Section Meeting Program, Springfield, MO, April 21-23.

Foti, P., Kennedy, J.R. 2024. "Comparative analysis of food production, waste, and socioeconomic dynamics in red light districts and brothel sites across three port cities during the American Industrial Revolution." Paper presented at the annual meeting of the Society for American Archaeology, New Orleans, LA, April 17-21.

Guiry, E.J., Kennedy, J.R., deFrance, S.D., Grant, C., Dawdy, S., Buckley, M., and Szpak, P. 2025. "An isotopic-zooarchaeology of 3000 animal lives in historical New Orleans." Paper presented at the annual meeting of the Society for Historical Archaeology, New Orleans, LA, January 7-11.

Hawley, Kirsten M. et al. (2024). Elemental and Mineralogical Analysis of Ceramics from Late Ceramic Age Sites in La Altagracia, Dominican Republic. Paper presented at the International Association of Caribbean Archaeology Bi-annual Meeting in Nevis, St. Kitts and Nevis.

Hawley, Kirsten M. et al. (2024). ICP-MS and petrographic investigation of archaeological ceramics from terrestrial and submerged environments, La Altagracia Province, Dominican Republic. Paper presented at the Society for American Archaeology Annual Meeting in New Orleans, LA.

Kennedy, J.R., Royle, T.C.A., Guiry, E.J., Buckley, M., Kemp, B.M. 2024. "David Starr Jordan, Chinese fishers, and the building of the Smithsonian's Fish Collection." Paper presented at the International Council for Archaeozoology Fish Remains Working Group Meeting, Toronto, Canada, August 12-15.

Kennedy, J.R., deFrance, S.D., Bingham, B., Guiry, E.J., Kemp, B.M. 2024. "The impact of fishing and transportation technologies on nineteenth-century fisheries and fish supply in New Orleans, Louisiana." Paper presented at the annual meeting of the Society for American Archaeology, New Orleans, LA, April 17-21.

Kennedy, J.R. 2024. "Incorporating ancient DNA analysis into the zooarchaeology of the Chinese diaspora." Paper presented at the annual meeting of the Society for Historical Archaeology, Oakland, CA, January 5.

Kennedy, J.R. 2024. "Food, trade, and connection in two 19th-century Chinese diaspora sites in the American West." Paper presented at the annual meeting of the Society for Historical Archaeology, Oakland, CA, January 5.

LaBarge, T.W. & Njau, J.K. (2024). The Neoichnology of *Nihilichnus* in the Serengeti. Society of Vertebrate Paleontology. Minneapolis, MN, October 30 – November 2

LaBarge, T.W. & Njau, J.K. (2024). The Isotopic Ecology of a Serengeti Insectivore and Applications to Hominin Paleoecology. American Association of Biological Anthropologists. Los Angeles, CA, USA March 20-23

Njau, J.K., Schick. K., Toth. N., Stollhofen, H., Stanistreet, I. (2024) New deep coring at Paleolake Olduvai depocenter. Eastern African Association for Palaeoanthropology and Palaeontology (EAAPP), Addis Ababa, Ethiopia.

Richter, K., Kennedy, J.R., Miller-Camp, J. 2024. "Tails from the animal storerooms: Case studies of the uses and limitations of natural history collections using multiproxy approaches." Paper presented at the annual meeting of the Society for American Archaeology, New Orleans, LA, April 17-21.

Royle, T.C.A., Falahati Anbaran, M., Boethius, A., Dütting, M.K., Enehaug, M.N., Enghoff, I.B., Ervynck, A., Gates St-Pierre, C., Hamilton-Dyer, S., Harland, J.F., Heinrich, D., Hufthammer, A.K., van der Jagt, I., Kennedy, J.R., Kristmanson, H., Krooks, B., Küchelmann, H.C., Locker, A., Lõugas, L., Magnell, O., Makowiecki, D., Maltin, E., Meijer, H.J.M., Nicholson, R., Quinlan, L., Quintana Morales, E., Ritchie, K., Russ, H., Van Neer, W., Welker, H., Barrett, J.H. 2024. "Casting a wide net: Documenting spatiotemporal variation in the species composition of northeastern North American and northern European fisheries through the meta-analysis of zooarchaeological

datasets." Paper presented at the International Council for Archaeozoology Fish Remains Working Group Meeting, Toronto, Canada, August 12-15.

Salcido, C.J. Evolutionary lag between changes in diet and changes in jaw function in Cenozoic carnivores. Oral presentation at 84th Annual Meeting of the Society of Vertebrate Paleontology Carnivora & Co. Technical Session; 2024 Nov 2; Minneapolis, MN.

Conference Poster Presentations

Bernard, H., Kennedy, J.R., Guiry, E.J., Sauer, P. 2024. Building an archaeological record of over three centuries of turtle use across the Chesapeake Bay region. Poster presented at the annual meeting of the Society for American Archaeology, New Orleans, LA, April 17-21.

Bernard, H., Kennedy, J.R. 2024. A spatial analysis of the archaeological turtles of the Chesapeake Bay Area. Poster presented at the Hutton Honors College Research Symposium and Poster Fair, April 13.

Hartzell, S., Johnson, C. 2024. Clarifying the origin of Order Scleractinia (class Anthozoa, subclass Hexacorallia. Poster presented at the Geological Society of America 2024 Joint North-Central and Southeastern Section Meeting, April 22.

Hartzell, S., Johnson, C. 2024. Evolutionary Paleoecology of the Discoidal body form within subclass Rugosa, order Scleractinia, and Scleractiniamorphs (Class Anthozoa). Poster presented at the Geological Society of America Connects 2024, September 25.

Hawley, Kirsten M. et al. ICP-MS and petrographic identification of geochemical differences between archaeological ceramics from terrestrial and submerged environments, La Altagracia Province, Dominican Republic. Poster presented at the 2024 North-Central South-Central Regional Meeting of the Geological Society of America, Springfield, MO.

Ho, J.W.I., Kennedy, J.R., Warinner, C., Richter, K. 2024. Identifying parrots, songbirds, and toucans with new zooarchaeology by mass spectrometry (ZooMS) markers. Poster presented at the annual meeting of the Society for American Archaeology, New Orleans, LA, April 17-21.

Ho, P.H.C., Richter, K., Kennedy, J.R., Warinner, C. 2024. Distinguishing cervids and bovids in the Americas using Zooarchaeology by mass spectrometry (ZooMS): Authentication and development of new peptide markers. Poster presented at the annual meeting of the Society for American Archaeology, New Orleans, LA, April 17-21.

Johnson. C. C., Polly, P. D., Njau J, K., Chandroth, A., Peltier, D. , The Indiana University Paleontology Collection (IUPC) - Current Status of Paleontological Resources, North American Paleontological Convention (2024), Ann Arbor, MI, USA (Poster presentation).

Kennedy, J.R., Guiry, E.J., Buckley, M., Royle, T.C.A., Kahouadji, N., Bernard, H., Fahl, A., Szpak, P. 2025. From turtle soup to turtle ecology: Zooarchaeological, isotopic, and ZooMS perspectives on human-turtle interactions in historical New Orleans. Poster presented at the annual meeting of the Society for Historical Archaeology, New Orleans, LA, January 7-11.

Lee, P., Kennedy, J.R. 2024. Zooarchaeological insights into foodways, tradition, and adaptation at a nineteenth-century Chinese diaspora site. Poster presented at the Hutton Honors College Research Symposium and Poster Fair, April 13.

Mazitov, A., Muckerheide, S.M., Beeker, C.D., Kennedy, J.R. 2025. Organics from the 16th century Punta Espada shipwreck in the Dominican Republic. Poster presented at the annual meeting of the Society for Historical Archaeology, New Orleans, LA, January 7-11.

Peltier, D.M., Njau, J.K., Polly, P.D. 2024. Modeling the influence of volcanic processes on speciation and its implication for hominin evolution. Annual Meeting of the Paleoanthropological Society, Los Angeles, CA, USA (poster)

Schwartz, S., Bernard, H., Kennedy, J.R., 2024. Comparing multiple methods of fish size estimation using sheepshead remains from New Orleans, Louisiana. Poster presented at the annual meeting of the Society for American Archaeology, New Orleans, LA, April 17-21.

Department Presentations

Johnson, C.C., American Institute of Professional Geologists, Kentucky Section, Darwin Lecture Series, title: Exploring the evolution of coral reefs: past, present and future
Johnson, C.C., Educating for Environmental Change, Title: Coral Reefs & Climate Change
Johnson, C.C., Departmental Colloquium, Colby College, Waterville, Maine
LaBarge, T.W. Crocodile Predation on Early Pleistocene Potamochoerini: Taphonomic Evidence from Olduvai Gorge, Tanzania. Ideas in Earth and Atmospheric Sciences. Indiana University Bloomington. September 2024

Book Reviews

Creative Works
Charles Salcido, Samantha Hartzell, Lorena Jevnikar, and IUPC undergraduate hourly workers, under the supervision of CBRC Director Johnson, created 3 webpages highlighting IUPC/CBRC collections and research of those collections including conulariids, scleractinian corals, and rugose corals. The first one has been published and the other two are near publishing on CBRC's website. A webpage on shark fossils in the IUPC is currently being developed.

Awards
Kirsten Hawley—Indiana University College of Arts and Sciences Dissertation Research Fellowship

Dissertations and Theses
Salcido, C.J. (2024). *Evolutionary Lag and the Evolution of Carnivory in Cenozoic Mammals.* (Doctoral dissertation, Indiana University)

Qualifying Exam Presentations
LaBarge, T.W. (Spring 2024). Uncovering the Evolution of the Serengeti Ecosystem through Stable Isotope Analysis: Insights into African Plio-Pleistocene Paleoecology and Human Origins (Qualifying Examination Proposal)

Workshops
Ryan Kennedy - Animal processing workshop for WRAZL student employees and members of Kennedy's Problems in Zooarchaeology course on October 8, 2024.
Charles Salcido - Photogrammetry in CBRC: How it Works and How to do it, Center for Biological Research Collections, Indiana University. February 2024, October 2024, December 2024; January 2025; February 2025.

Government Reports

Educational Outreach
Girls Inc. Sciencefest, Girls Inc. Center, February 8, 2025. Lorena Jevnikar coordinated the IU Paleontology Collection education table at the annual Girls Inc. Sciencefest. Roughly 40 families visited the table. Approximately 20 specimens both modern and fossil were loaned from the IUPC to educate visitors about paleontology, evolution, morphology, etc.
Sciencefest, Earth Sciences section, October 5, 2024. IU Paleontology Collection loaned 30 fossil and modern specimens.
CBRC Graduate Student Supervisor. Lorena Jevnikar volunteered in the IU Paleontology Collection Fall 2024 semester assisting with the training of undergraduates in photogrammetry, collections management and curation, and collecting information for the CBRC Scleractinian Coral webpage.
Ryan Kennedy and Sam Couch – hosted 25 students in Dr. Polly Sturgeon's Indiana Master Naturalist class in WRAZL, including discussion of Indiana's native fauna

Sam Couch – coordinated two WonderLab WonderCamps (Animal MD and Bugs!) at WRAZL, reaching ~20 elementary age students for each event.

Charles Salcido - April 2024 gave a demonstration of the Center for Biological Research Collections photogrammetry equipment during Science Fest

CBRC Graduate Student Supervisor. Samantha Hartzell volunteered in the IU Paleontology Collection during the Fall semester assisting with the training of undergraduates in photogrammetry, photography, collections management, specimen identification, coral morphology, and creating the CBRC Rugosan Coral webpage.

Exhibits

WRAZL provided numerous specimens for use in the *Taking a Bite Out of Science* (TABOOS) exhibit created by IU Collections at McCalla.

WRAZL provided a dolphin skull, hawksbill sea turtle scutes, and a lionfish skeleton to WonderLab Museum for a display that supplements the educational messages of their "Wonder Under the Waves" coral reef exhibit.

WRAZL provided a small number of specimens to be used in an upcoming exhibit on the Angel Mounds archaeological site at the IU Museum of Archaeology and Anthropology.

WRAZL personnel have been designing materials for use in the display cases outside of the lab in the Student Building. These will be installed in Spring 2025, with plans to rotate new exhibits in on a yearly basis.

Charles Salcido and CBRC – Finalized Geology Building 5th Floor Display cases highlighting Invertebrate Paleontology, Vertebrate Paleontology, and Indiana University Paleontological Collections with CBRC

Charles Salcido – 3D printed scans of Pleistocene fossils from IUPC to put on display on the ground floor of the Geology Building. Undergraduate hourly workers painted the 3D prints to appear similar to the original specimen

Social Media

Charles Salcido – February 2024; worked with undergraduate hourly workers to post on IUPC collections during #FossilFriday

Kirsten Hawley—November 2024; featured on @recuerdosdeBayahibe instagram account and Comunicador Guillermo Santana's Facebook page for an interview about archaeology around Bayahibe, Dominican Republic.

Media Coverage

LaBarge, T.W. Interview. In Smith, J.E. (2024), Where There's Joy in a Terror Bird. The New York Times

External loans from and visits to CBRC Collections

WRAZL loaned 6 turtle and snake skeletons to Beth Reinke (Northeastern Illinois State University) for use in a reptile osteology guide.

WRAZL loaned 2 zebra skeletons to Thomas LaBarge, a doctoral student in the Department of Earth and Atmospheric Sciences, whose research examines faunal remains from Olduvai Gorge, Tanzania.

WRAZL loaned samples from 10 North America artiodactyl species to Harley Bailey, a former IU undergrad and current MA student at University of Cincinnati. Harley will be using these samples to generate baseline ZooMS data for use in future studies.

WRAZL loaned 3 specimens (raccoon, bear, deer) to the IU Museum of Archaeology and Anthropology for an upcoming exhibit on the Angels Mounds archaeological site.

IUPC hosted Heyo Van Iten and his wife Tatiana of Hanover College to go through the IUPC conulariid collection as a part of research project involving Claudia Johnson and Charles Salcido

Total Educational Offerings from CBRC Collections This Year

Dinosaurs and Their Relatives (EAS G114). Introduction to paleontology and geology from the perspective of the clade Dinosauria. Introduction to the scientific process, morphology, phylogenetics, stratigraphy and geochronology, and Earth history.

Historical Archaeology (ANTH P330). This course focuses on the archaeology of the recent past, including European colonialism and the spread of capitalism around the globe. WRAZL specimens are used in several in-class activities focused on how archaeologists reconstruct past diets and trade networks.

Problems in Zooarchaeology (ANTH P425). This course focuses on theory and case studies in zooarchaeology, but the course meets in WRAZL and includes multiple hands-on activities using the lab's specimens. Activities include learning basic skeletal anatomy, analyzing butchery marks, and processing animal carcasses into skeletons. Students also have the opportunity to use archaeological and comparative specimens for their final class project.

Introduction to Archaeology (ANTH P200). This course includes a visit to WRAZL to learn about zooarchaeology and examine specimens.

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