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# INTERCONNECTED PATTERNS OF NATURAL HISTORY: THE CAREER AND CONTRIBUTIONS OF LANCE GRANDE

BY

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## INTRODUCTION

Over the past four decades, Lance Grande has made outstanding contributions to our understanding of the morphology, systematics, and biogeography of fossil and living fishes. With an emphasis on freshwater taxa from the Late Cretaceous and early Cenozoic of North America, Lance's work has refined our understanding of the fossil history and interrelationships of sturgeons, paddlefishes, gars, bowfins, bony-tongues, herrings, beaked salmon, catfishes, suckers, pikes, pirate perches, and more. This paper is the first of a series to be published in Contributions from the Museum of Paleontology in honor of Lance and his career. Many of these papers are based on presentations delivered in the "Interconnected Patterns of Natural History: a Tribute to the Career and Contributions of Lance Grande" symposium at the 12th North American Paleontological Convention held in June 2024 in Ann Arbor, Michigan.

## EARLY LIFE AND EDUCATION

Roger Lansing Grande—known to all as Lance from the time of his grade-school years—was born in Minneapolis, Minnesota on February 16, 1951. Lance's father, Roger Grande, was manager of the Toy and Lawn and Garden departments at a Montgomery Ward store, and his mother, Shirley, was a stay-at-home mother before becoming a secretary. Lance began going by his middle name (Lance, short for Lansing) in elementary school because his mother felt it was too confusing for him to have the same name as his father. He was the oldest of five siblings and the only boy. When he was six years old, Lance's family moved to Richfield, a town just south of Minneapolis described as "Minnesota's first suburb" (Johnson, 2008) and which served as a nourishing environment for his budding interests. His interest in natural history—specifically fossils and fishes—was first sparked in his childhood when he collected gastropod fossils from the crushed Ordovician limestone that paved his family's driveway. He often went fishing during weekend visits to his grandparents' lake cabin in northern Minnesota, further developing his natural history hobbies.

After he graduated from Richfield High School in 1969, Lance worked part-time jobs to put himself through Normandale Community College, graduating in 1973 with an Associate Degree in business and economics. He then transferred to the University of Minnesota in Minneapolis. Lance recalls, "My undergraduate progress took me a couple of extra years, because I had to work my way through college with part-time jobs. Among the various jobs I had during that time, one was working in the complaint department of a Montgomery Ward store, which actually gave me some experience that came in handy for administrative work I did later in my academic career!" Another interruption to his college progress came in the form of enlisting in the United States Army Medical Corps and serving two months of basic training at Fort Polk, Louisiana, followed by three months of medical training at Fort Sam Houston in Texas. Following these five months of active duty, he was in the reserves for five and a half years, during which he served one weekend per month in the Hennepin County

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Hospital emergency room in Saint Paul, Minnesota and two weeks per year at various Army hospitals around the country. During this time, the U.S. was involved in the Vietnam War, and Lance's lottery number for the draft was 2 of 365. Knowing he would almost assuredly be drafted into the infantry and sent to Vietnam to fight, Lance decided that enlisting in the Medical Corps was a better alternative for him.

Following his active service in Louisiana and Texas, Lance returned to the University of Minnesota to continue his studies as an economics major. It was at this point that the trajectory of Lance's life changed. A childhood friend, Hans Radke, gave him a small fossil fish that he had acquired as a souvenir near Kemmerer, Wyoming. This fossil piqued Lance's interest and wonder. In an effort to learn more about this fish, Lance took it to Robert E. Sloan (1929–2019), the paleontologist at the University of Minnesota (https://profjoecain.net/interview-robert-evan-sloan/; Accessed September 14, 2024). "He looked at it for a while, smiled, and then looked at me," Lance recalls, "and said, 'I won't identify it for you, but if you take my paleontology course, you will be able to identify it yourself!'" Lance took the paleontology course and ultimately changed his major to Geology, completing his Bachelor's degree in 1976. Lance continued his studies at the University of Minnesota as a dual Master's degree in Geology, under R.E. Sloan, and Zoology, under James C. Underhill (1920–2000; https://arctos.database.museum/agent/21342733; Accessed November 16, 2024). Entranced by that small souvenir fossil—a specimen of †*Knightia eocena*—Lance conducted a review of the fish fauna of the Eocene Green River Formation. This research allowed him to conduct collecting trips, beginning in 1976 and continuing annually until 2023 (with the exception of 2020 and 2021 due to COVID-19 restrictions). This early experience with the Green River Formation also resulted in Lance's first two scientific papers, the description of †*Hiodon* (†*Eohiodon*) *falcatus* (Grande, 1979) and a review of the decapod fauna from this formation (Feldman et al., 1981). Lance's Master's thesis, completed in 1979, was a comprehensive overview of the Green River Formation with an emphasis on the fish fauna. His thesis was published as a monograph by the Geological Society of Wyoming (GSW), which had been looking for just such a synthesis; this book would go through two editions (Grande, 1980, 1984).

By submitting his Master's thesis as a *Bulletin of the Geological Survey of Wyoming*, a second life-altering happenstance helped shape Lance's career. The editors at the GSW had sent the manuscript for review to Colin Patterson (1933–1998; Fortey, 1999) at the then British Museum (Natural History), now the Natural History Museum, London. Patterson was impressed with the manuscript and in it saw Lance's potential as a student of fossil and living fishes. Patterson contacted Lance directly and encouraged him to pursue his Ph.D. in New York City, under the guidance of Donn E. Rosen (1929–1986; Nelson et al., 1987) and Gareth Nelson (b. 1937) at the American Museum of Natural History, with whom Patterson and other colleagues in London, including Peter L. Forey (1945–2016; Richter et al., 2016) and Brian G. Gardiner (1932–2012; Reid et al., 2012), were working the time at the intersection of the systematics and morphology of fossil and living fishes, cladistics, and biogeography. Lance moved to the American Museum to work with Rosen and Nelson on fossil and living clupeomorph fishes for his Ph.D. dissertation, with focused projects on the systematics of the genera †*Diplomystus* (Grande, 1982a) and †*Knightia* (Grande, 1982b), in part extending from his experience with the Green River fauna. A third major publication that came from his Ph.D. dissertation research was Lance's *Bulletin of the American Museum of Natural History*, a monograph with the understated title "Recent and fossil clupeomorph fishes with materials for revision of the subgroups of clupeoids" (Grande, 1985). This nearly 150-page monograph established the modern definition of Clupeomorpha, and has served as the basis for much of the phylogenetic analyses of these fishes since. While this contribution represents a major milestone in ichthyology, Lance's four years as a student at the AMNH were noteworthy for other reasons, foreshadowing his impact on ichthyology and systematic biology generally. During the late 1970s and early 1980s, the AMNH was one of the centers of a revolution in systematic biology that led to the rise of cladistics as an approach to reconstructing systematic relationships among organisms. Nelson and Rosen were at the epicenter of this revolution. As Lance noted in the acknowledgments for his dissertation, "I am indebted to Drs. Donn E. Rosen and Gareth J. Nelson. Dr. Nelson kindled my interest in clupeomorph fishes, and gave freely of his time to me for discussions about systematic theory, historical biogeography, and various other subjects. Dr. Rosen also gave much of his time



FIGURE 1 — Lance Grande at the Field Museum, November 29, 1983. Field Museum image number GN83625_8.jpg. Courtesy of: R. Testa. © Field Museum of Natural History. CC BY-NC 4.0. https://mm.fieldmuseum.org/88906c91-4175-42d2-97fc-2cb38ea19dac.

to me for discussions about fish anatomy and systematics, and was a constant, affable source of encouragement and information throughout my stay (1979–1983).” Much has been written to document the so-called “cladistics wars” (e.g., Hull, 1990), and Lance was there with them, absorbing and participating as a student of two of the war’s generals.

## A CAREER AT THE FIELD MUSEUM

Upon receiving his Ph.D. in 1983, Lance was offered and accepted the position of Curator of Fossil Fishes in the Geology Department at the Field Museum in Chicago, Illinois. With that he returned to the Midwest, where he would spend his entire career, retiring from the Field Museum after 40 years in 2023 (Fig. 1). The Geology Department could perhaps be better named the Paleontology Department, for in its recent history, curators focused on the study of vertebrate and invertebrate paleontology and paleobotany, with a lesser emphasis on pure geological subjects such as meteoritics. In addition to Geology, three other departments were home to research curators at that time: Anthropology, Botany, and Zoology. As Lance’s career progressed, he worked with others, including Peter Crane (curator of Paleobotany from 1982 to 1992, Vice President of FMNH from 1993 to 1995, and Director of FMNH from 1995 to 1999), to grow the research reputation of the museum and attract and hire new research curators. These were happy years, for the Museum’s mission in basic research was a central goal.

Things began to change following the departure of Peter Crane to serve as Director and CEO of Kew Gardens. Lance recognized the imminent financial challenges that the Field Museum was facing in the early 2000s and, hoping to mitigate the impact to the Museum’s research mission, staff, and collections, Lance stepped into an administrative role. From 2004 until 2013, Lance served as the Senior Vice President and head of the Collections and Research programs of the museum, using these roles to secure funds from foundations to support the Field Museum’s research mission. In 2013, upon stepping down from his administrative role, Lance returned to the newly restructured institutional organization of the research arm of the Museum (that reorganization essentially dissolved the former four-part departmental structure to form the Research and Collections division of the Museum). Lance was appointed as the first Distinguished Service Curator of Field Museum, a position he held until his retirement in 2023.

## RESEARCH IMPACT

In 2018 Lance was named as an honorary member of the Society of Vertebrate Paleontology in recognition of his outstanding lifetime contributions to the discipline. As further recognition for his contributions to paleontology, to date nine taxa have been named in his honor (a selection of which are shown in Fig. 2): the crinoid †*Eoparisocrinus grandei* Brower, 1995 (Crinoidea, Euspirocrinidae), the fossil birds †*Zygodactylus grandei* Smith et al., 2018 (Zygodactylidae), †*Nahmavis grandei* Musser and Clarke, 2020 (Neoaves), and †*Paaknawatavis grandei* Musser and Clark, 2024 (Anseriformes), the ginglymodian (Ginglymodi) †*Kyphosichthys grandei* Xu and Wu, 2012, the gars (Lepisosteidae) †*Atractosteus grandei* Brownstein and Lyson 2022 and †*Grandemarinus gherisensis* Cooper et al., 2023, the round herring (Clupeidae, Dussumierinae) †*Nardoclupea grandei* Taverne, 2002, and the percomorph (Percomorpha) †*Hendrixella grandei* Bannikov and Carnevale, 2009.

Lance’s research productivity includes (to date) nearly 100 peer-reviewed publications on a broad range of topics, seven monographs, a co-edited volume, and eight books. In these works, Lance contributed broadly to the anatomy and systematic biology of many taxonomic groups of fossil and living fishes, including Holocephali (chimaeras, Ward and Grande, 1981), Batoidea (skates and rays, Carvalho et al., 2004), “†Paleonisciformes” (basal actinopterygians, Hilton et al., 2004; Schultze et al., 2021), Acipenseriformes (sturgeons and paddlefishes, Grande and Bemis, 1991, 1996; Bemis and Grande, 1992, 1999; Bemis et al., 1997; Grande and Hilton, 2006; Hilton and Grande, 2006, 2023; Grande et al., 2002 Hilton et al., 2011, 2020, 2023), Amiiformes (bowfins, Grande, 1996; Grande and Bemis, 1998, 1999; Forey and Grande, 1998; Brito et al., 2008; Yabumoto and Grande, 2013), Lepisosteiformes (gars, Kammerer et al., 2006; Grande, 2010), Osteoglossomorpha (mooneyes, arowanas, and relatives, Grande and Cavender, 1991; Li et al., 1997a, b; Hilton and Grande, 2008), Clupeomorpha (shads, herrings, and anchovies, Grande and Nelson, 1985; Chang and Grande, 1997), Gonorynchiformes (sandfishes, L. Grande and T. Grande, 1999, 2008; T. Grande and L. Grande, 2008), Catostomidae (suckers, Grande et al., 1982), Siluriformes (catfishes, Grande, 1987; Grande and Lundberg, 1988; Grande and de Pinna, 1998), Esocidae (pickerels, Grande, 1999), “Paracanthopterygii” (cods and their relatives, Grande, 1988; Eastman and Grande, 1991), Trachichthyoidei (slimeheads, Grande and Chatterjee, 1987), Notothenioidei (icefishes, Eastman and Grande, 1989), and Percomorpha (perches, basses, and their relatives, Grande, 2013).

His research is based on an empirical approach to systematic biology rooted in direct observation of specimens. Lance recalls, “I made every effort to examine as many species as I could within the families I worked with, even when that took me to challenging, hard-to-get-to places. This involved a lot of travel. Besides visiting museum collections throughout North America and much of Europe, I also visited paleontological collections in Lebanon, Israel, Moscow, Kenya, and Kyushu, Japan, often with my colleague Willy” (Fig. 3). Through all of his work, Lance set a high standard for detailed illustration in systematic ichthyology, principally with regard to the comparative skeletal anatomy of fishes. Central to this output was his work with, and in some instances training of, talented fossil preparators, scientific illustrators, and photographers. He would work closely with these professionals to extract and document the morphology of the fishes under study. In a book review published in *Science* for the monograph on

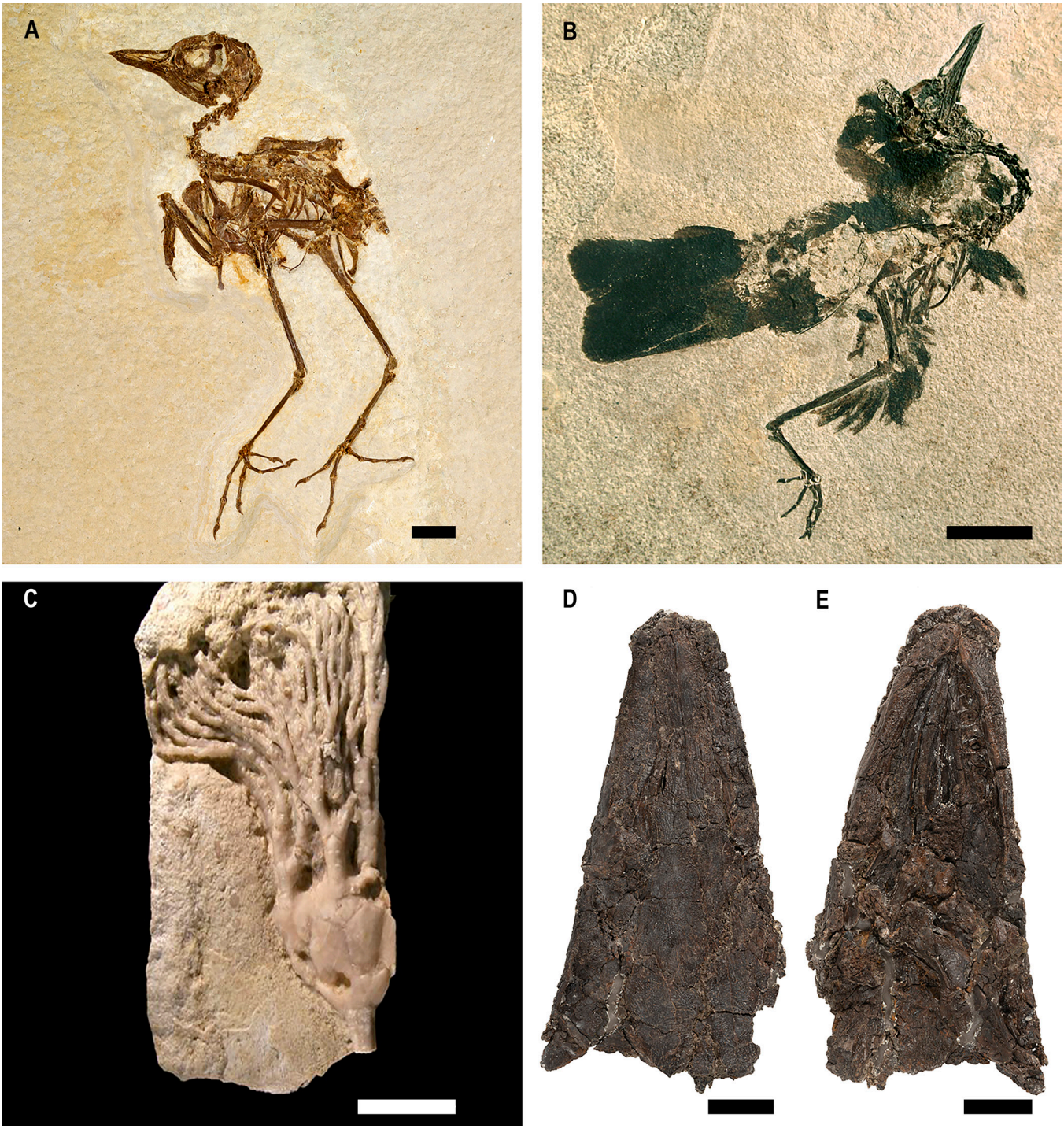



FIGURE 2 — Species named in honor of Lance Grande. A, †*Zygodactylus grandei* Smith et al., 2018 (Zygodactylidae; early Eocene, Green River Formation, WY); scale bar = 1 cm; Field Museum image number GEO86891_142Ad.jpg. Courtesy of: J. Weinstein; © Field Museum of Natural History. https://mm.fieldmuseum.org/0b2dd8d6-9e1e-43f2-9532-f49a1ac7ce50. B, †*Nahmavis grandei* Musser and Clarke, 2020 (Neognathidae; early Eocene, Green River Formation, WY); scale bar = 5 cm; Field Museum image number GEO86891_130d.jpg. Courtesy of: J. Weinstein; © Field Museum of Natural History. https://mm.fieldmuseum.org/c8cc2b4a-4be0-4d52-9d62-2fc713bf43e3. C, †*Eoparisocrinus grandei* Brower 1995 (Crinoidea, †Euspirocrinidae; Middle Ordovician, Dunleith Formation, Iowa); scale bar = 1 cm; © University of Iowa. https://digital.lib.uiowa.edu/islandora/object/ui%3Apaleo_385. D, Dorsal and E, Ventral views of the skull of †*Atractosteus grandei* Brownstein and Lyson 2022 (Lepisosteidae; Fort Union Formation, ND); scale bars = 5 cm; photos courtesy T. Lyson.



FIGURE 3 — Lance Grande with colleagues during a research visit to the Natural History Museum, London in early 1990s, with a specimen of †*Chondrosteus acipenseroides* (BMNH P.7793). Left to right: William E. Bemis, Colin Patterson, Lance Grande, and Peter L. Forey. Photo courtesy of William E. Bemis.

Amiiformes coauthored by William E. Bemis, Janvier (1998) referred to this work as "revenge of comparative biology" that "technically … reaches perfection."

Lance first became captivated by the fishes of the Green River Formation through a souvenir herring being given to him by a friend, and became the foremost expert on this locality, one of the richest and most productive fossil sites anywhere in the world. For more than 40 years Lance made annual collecting trips to the Green River Formation and developed a close working relationship with Jim E. Tynsky, a commercial fossil quarry operator in Kemmerer, Wyoming (Fig. 4) in whose quarry Lance collected, as well as with several other Green River Formation quarries. Through these efforts, Lance developed the most extensive collection from this Lagerstätte anywhere in the world at the Field Museum. Many of his collecting trips were in association with an undergraduate course offered through the University of Chicago that he taught annually between 2004 and 2023 (with 2020 and 2021 skipped due to COVID restrictions). Not only has Lance personally described, re-described, or reviewed many of the fossil fishes known from this locality (see citations above, and Grande, 2001), he has collaborated broadly to describe other component of the Green River fauna including amphibians (Amphiumidae, Rieppel and Grande, 1998; Anomocoela, Henrici et al. 2013), mammals (†Pantolestidae, Koenigswald et al. 2005a; Rose et al. 2014; †Apatemyidae, Koenigswald et al. 2005b; Flynn and Grande, *in review*), reptiles (Varanidae, Rieppel and Grande, 2007; Conrad et al., 2008; Polychrotidae, Conrad et al., 2007), and birds (Ksepka et al., 2019), †Halcyornithidae, Ksepka et al., 2011; Ciconiiformes, Smith et al., 2013; Pan-apodiformes, Ksepka et al., 2013; †Psittacopedidae, Ksepka et al., *in review*). Lance's scholarship on the Green River Formation, and in particular the Fossil Butte Member of the formation, extends beyond the vertebrate fauna to other components of the plant (Fig. 5) and animal life found in this system (e.g., the crayfish and damselfly faunae; Feldman et al., 1982 and Bechly et al., 2021, respectively), as well as the environment and stratigraphy (Grande, 1994; Grande and Buchheim, 1994), taphonomy (Sullivan et al., 2012), and modes of preservation (Elson, 2023). All of this expertise culminated in his book *The Lost World of Fossil Lake: Snapshots from Deep Time* (Grande, 2013), which won the Prose Award from The Association of American Publishers for the year's best publication in Earth sciences. The fossils of the Green River Formation contribute to extensive permanent exhibits at the Field Museum (e.g., the Evolving Planet exhibit) and are a frequent highlight of the Members' Nights behind-the-scenes events (Fig. 6).

Much of Lance's research program also focuses on general issues in systematic biology, such as faunal reviews apart

from his work on the Green River Formation (e.g., Grande and Eastman, 1986, 1989; Grande and Micklich, 1993), taxonomy (e.g., Carvalho et al., 2014), and biogeography (Grande, 1985b, 1990), with fishes being the central examples of each. Several of these more philosophical and epistemological topics, such as the interpretation of morphological variation (Grande, 2004), repeating patterns in systematic biology (Grande, 1994a), or the role of paleontology in systematics and evolutionary studies (Grande, 2000), permeated Lance's research program. Lance co-edited a book, *Interpreting the Hierarchy of Nature* (Grande and Rieppel, 1994), that collected papers showing the power of cladistic methods for recovering patterns to use as a framework for studying evolutionary processes.




FIGURE 4 — Lance Grande (left) and Jim E. Tynsky (right) in the field at Tynsky's quarry of the Fossil Butte Member of the Green River Formation. Field Museum image number GN90602_33O.jpg. Courtesy of: J. Weinstein. © Field Museum of Natural History. https://mm.fieldmuseum.org/b7397259-a4b4-4469-953a-952dca6b8b17.



FIGURE 5 — Lance Grande with a specimen of an elephant ear (*Colocasia* sp.; Araceae) from the early Eocene Green River Formation, WY. Field Museum image number GEO86743_01d.jpg. Courtesy of: J. Weinstein. © Field Museum of Natural History. https://mm.fieldmuseum.org/0598e8f5-7775-4af8-9001-32c2a7a08699.



FIGURE 6 — Lance Grande discussing the fossils of the Green River Formation to visitors at the Field Museum's Members' Night event on May 19, 2016. Field Museum image number GN92262_257Ad.jpg. Courtesy of: J. Weinstein. © Field Museum of Natural History. https://mm.fieldmuseum.org/a3143ad1-5d06-427f-b82f-ab5d43f654f9.

Especially in the 10 years prior to retiring, Lance was very active in writing book-length contributions to vertebrate biology among other subjects. He was a co-author on the third edition of the popular comparative anatomy textbook *Functional Anatomy of the Vertebrates* (Liem et al., 2001). Outside of the broad realm of systematic biology of vertebrates, Lance has authored several books, including *Gems and Gemstones* (Grande and Augustyn, 2009), which also won the Prose Award from The Association of American Publishers for best publication in Earth sciences. This book resulted from the development of an exhibit at the museum, and offered Lance a chance to return to his roots as a geology major and draw from his mineralogy experience as an undergraduate in Minnesota. Other books include *Curators* (Grande, 2017), an autobiographical and personal reflection on colleagues who are curators at natural history museums and the passion that drives their curiosity about specimens. His most recent book, *The Evolution of Religions* (Grande, 2024), is a scholarly treatise on the connections between many of the world's religions from the vantage point of a systematic biologist. By drawing from his experience as an evolutionary comparative biologist, Lance shows that these same methods (i.e., cladistics) can be used to approach topics such as the evolution of human social systems (e.g., religions) without falling to the traps of bigotry and racism that beset early attempts of such analyses. As he writes in the introduction (Grande, 2024: 3), "The hierarchical organization of modern classification is not meant as a qualitative ranking or ladder of progress. It is instead simply an efficient organization of nested groups within groups, according to increasing levels of certain shared characteristics." This unifying principle brings together all of Lance

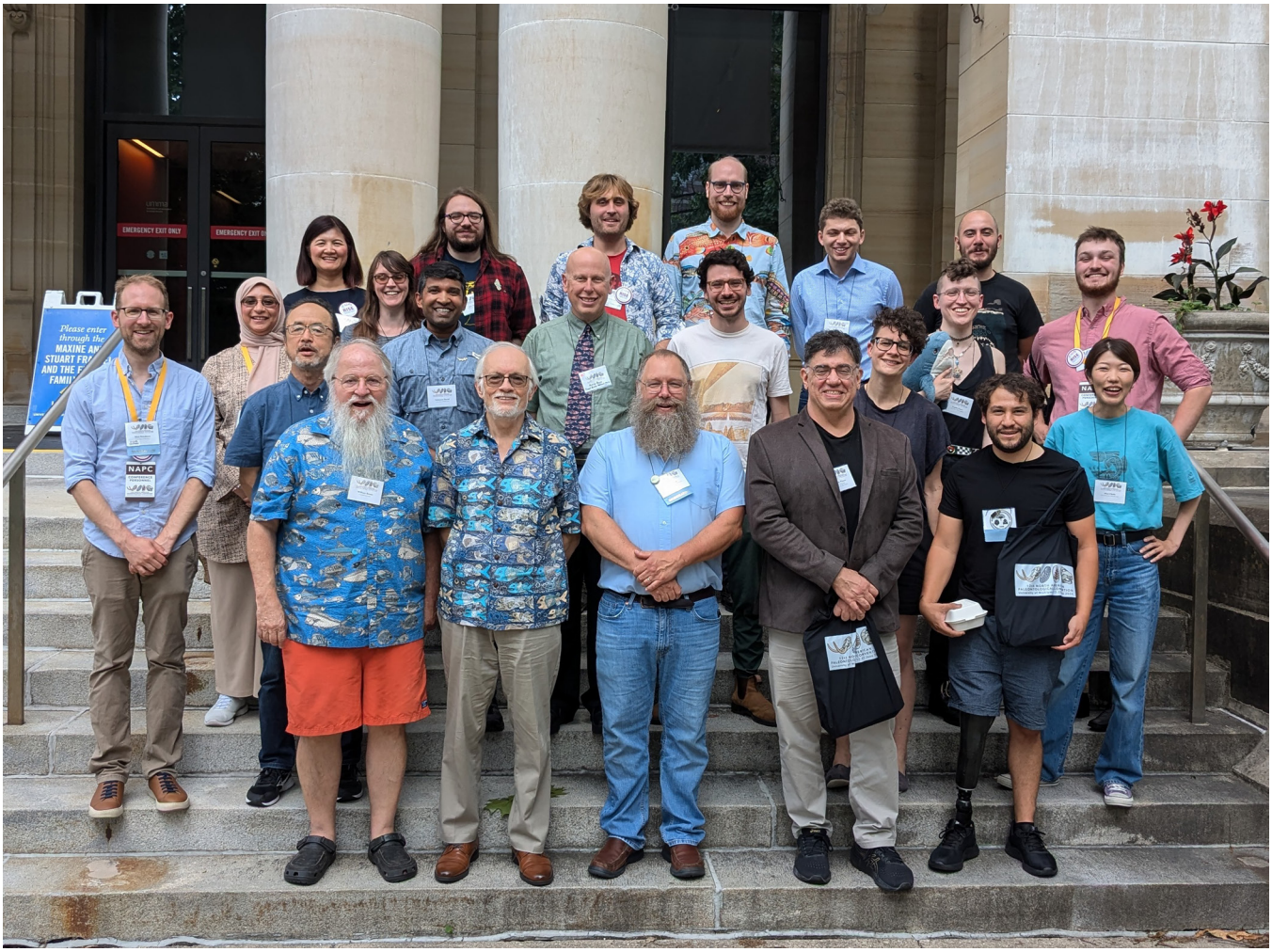



FIGURE 7 — Participants in the symposium "Interconnected Patterns of Natural History: a Tribute to the Career and Contributions of Lance Grande" held at the 12th North American Paleontological Convention, June 20, 2024 in Ann Arbor, Michigan. Front row (left to right): William E. Bemis, Lance Grande, Eric J. Hilton, Mario de Pinna, Miguel Montalvo. Second row (left to right): Matt Friedman, Yoshitaka Yabumoto, Sam Giles, Mori Chida. Third row (left to right): Sanaa El-Sayed, Kathryn Mickle, Solomon David, Arvid Aase, James Andrews, Soph Fasey, Zach Lyons-Weiler. Back row (left to right): Juan Liu, James Atterby, Donald Davensne, Alessio Capobianco, Chase Brownstein, Rodrigo Figueroa.

Grande's scholarship: the ideal of identifying patterns—the hierarchy—as a way to explain processes of evolution.

## ACKNOWLEDGEMENTS

We thank Lance Grande for years of collaboration, mentorship, and friendship. It is our honor to present this collection of papers by Lance Grande's colleagues and friends, many of which were presented as parts of a symposium at the 12th North American Paleontological Convention held in June of 2024 in Ann Arbor, Michigan (Fig. 7), reflect a range of topics: comparative anatomy of fishes, systematic biology, historical biogeography and more. We thank the participants of the NAPC symposium who helped celebrate the contributions and inspiration Lance has provided to us all. Nina Cummings (FMNH) directed us to many of the images used for figures in this paper in the Field Museum Archive she so ably has managed. We thank the University of Iowa Paleontology Repository for providing the image of †*Eoparisocrinus grandei* Brower 1995 used in Figure 2C and T. Lyson for providing the images of †*Atractosteus grandei* used in Figure 2D. E.

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