

Systematics, Taxonomy and Management: A Case Study on the Implementation of a Digital Repository in the Collection of Natural Heritage in the Amazon

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Jéssica Tarine Moitinho de Lima

Federal University of Pará (UFPA), Brazil

jessicatarine@ufpa.br

ORCID: <https://orcid.org/0000-0002-2481-1225>

Bárbara Sepúlveda

Federal University of Pará (UFPA), Brazil

bsepulveda@gmail.com

ORCID: <https://orcid.org/0000-0001-9946-286X>

Sue Anne Regina Ferreira da Costa

Federal University of Pará de Pará (UFPA), Brazil

suecosta@ufpa.br | ORCID: <https://orcid.org/0000-0002-3314-5148>

Translated by Richard Addison

ABSTRACT

Technological innovations have become part of everyday life, making it impossible to manage collections without considering its benefits. This RESEARCH ARTICLE discusses the implementation of *Tainacan*, a computerized museum documentation system in the Natural Heritage Collection of the Universidade Federal do Pará (UFPA, Universidade Federal do Pará), in the Brazilian Amazon. This process employed a four-step methodology, including the research of the collection's documentation history, analysis of its technical characteristics, and interdisciplinary discussions with experts to construct and treat data. It also details the difficulties which arose from the transition from a previous documentation method to a fully digital platform. The results indicate that using digital platforms positively impacts the efficiency and quality of data management and access.

KEYWORDS

documentation, natural history collection, *Tainacan*, university heritage

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In recent decades, technological innovations have become an integral part of daily life, both in private and public contexts so that it is almost impossible to consider the possibility of not taking advantage of the benefits of information technology (Lima & Silva, 2022, p. 14).¹ In recent years, we have witnessed a significant transformation in the manner in which collections and museums engage with documentation. This shift has been catalyzed by the ever-expanding realm of the internet and the burgeoning influence of cyberculture. Gone are the days when documentation was confined to physical records and insular museum walls. The digital age has ushered in an era where documentation transcends physical boundaries, allowing for unprecedented accessibility, interactivity, and global reach. Museums and collections, once siloed in their practices, now embrace the opportunities of the virtual realm, revolutionizing how they curate, share, and engage with their invaluable cultural and natural heritage. This dynamic evolution underscores the growing significance of adapting to the digital landscape.

Preserving scientific achievements is crucial for humanity's development, as it encompasses tangible and intangible knowledge from nature to space, known as Scientific Heritage. This includes artifacts, specimens, and exhibits that preserve our understanding of science and technology throughout time, known as cultural heritage of Science and Technology. These elements are featured in collections containing precious documents and books, including museums, observatories, gardens, and landscapes (Lima, 2021, p. 17; Granato, Ribeiro & Araújo, 2017, p. 17; Lourenço & Wilson, 2013, p. 745; Museu, 2017, p. 3). Here, we will examine how each component contributes to safeguarding our *scientific heritage*.

Systematics, taxonomy, and management are everyday terms used in a collection of scientific heritage linked to natural history, also part of the cultural heritage of Science and Technology. Here, these themes are articulated to demonstrate this case study of the implementation of the, *Tainacan*, in a natural heritage collection belonging to the museum course at the Federal University of Pará (UFPA).

The UFPA is the largest public university in the Amazon, established by Law No. 3.191 on July 2, 1957, with the mission to create and disseminate knowledge in the region, fostering an inclusive and sustainable society (Universidade, s. d.). This institution offers an undergraduate course in museology linked to the Faculty of Visu-

¹ This article follows the standards of the Brazilian Association of Technical Standards (ABNT) and specifically NBR 6023-2018 - Information and documentation: References- Elaboration

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al Arts. The museology course plays a crucial role in research and extension programs supporting this case of study, with professionals and students mostly from this course. The course's interest and fruition cycle extends beyond the collection's valuation within the course to the community's.

The Natural Heritage Collection (NHC/UFPA) began in 2017 under the demand to safeguard fossils donated by paleontological rescue campaigns at a limestone mining company located in the State of Pará. However, this was not the only way used to acquire scientific items for the collection. Some of them are also conducted in outcrops in the same state. These are carried out as undergraduate disciplines, together with museology course students, but also through research and extension projects, scholarship holders, and volunteers who work in the technical reserve (Lisboa et al., 2019, p. 2).

The NHC/UFPA has an extensive paleontology collection, and in May 2023, it registered more than 700 assets, with material from the Pirabas Formation. This stratigraphic unit occurs on the coast of the State of Pará to Piauí and represents the best record of the Brazilian marine Cenozoic (Araujo, Rodrigues & Neto, 2010, p. 208). Fossils deposited in the collection were mostly marine or estuarine, represented by mollusk shells, echinoderm shells, fish teeth, decapods, bryozoans, and sirenian bone fragments, among others. The potential for expansion of this collection extends to other typologies within the extensive nature area, including collections in zoology, botany, and geology.

Universities have formed collections that are crucial to building a scientific heritage in geosciences, particularly geology. These collections include various types of fossils, rocks, minerals, and meteorites. However, curators face challenges in managing the storage, documentation, valuation, and internal communication of these heterogeneous materials (Lima & Carvalho, 2022, p. 205; Lima & Carvalho, 2020, p. 18). University Cultural Heritage includes material and immaterial items representing the values, habits, and social functions of universities. They reflect the practice and experience of teaching, research, and extension of all areas of knowledge (Lima, 2021, p. 38; Ribeiro, Segatini & Granato, 2019, p. 51).

The NHC/UFPA as a university collection, operates under the educational tripod of teaching, research, and extension. Thus, the collection is used as a didactic resource in undergraduate courses, as a scientific asset for academic research, and for knowledge activities for the population. These characteristics are linked to the fact that the collection is subordinated to the museology course,

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enabling views on the scientific heritage involving communication in a democratic way and with a focus on its social function.

It is considered a collection with museological potential because it is already operating in all aspects like a museological institution, namely conservation, investigation, communication, interpretation, and exhibition (Ley nº 11.904, art. 1). For the purposes of this article, the focus will be on investigating the collection in terms of documentation processes.

Musealization process alters the meaning of objects by creating gaps in their origin and function. Formal recognition of cultural assets and collections is crucial and can be achieved through various tools such as inventories, heritage books, registration books, ordinances, and instructions, which help manage technical information (Lima, 2021, p. 60; Delvene et al., 2018, p. 458, Museu, 2017, p. 5; Alves, 2012, p. 40; Green, 2001, p. 12). Museum documentation, whether through the inventory process or the use of databases, is a relatively common practice (Lima & Sborja, 2022, p. 11).

Documentation is crucial to minimizing information gaps resulting from the musealization process. It serves as an essential source of meaning for objects and provides the detailed information necessary for full comprehension. Selecting relevant parameters for information collection should align with the collection's purpose and potential future applications. Considering the possible research opportunities that may arise over time is also important for the collection's recognition and importance (Lima, 2021, p. 60).

University collections preserve cultural/natural heritage through networking, which fosters identity, shares information, and reduces differences. Interdisciplinary dialogue is important for acquisition, disposal processes, conservation, and sustainable use. Synergy is vital for the uniqueness and deference of museological heritage (Carvalho, 2008, p. 19; Serres, 2012, p. 58; Alves, 2012, p. 52, Novaes, 2018, p. 119; Lima, 2021, p. 214)

Efforts to map and integrate university collections and museums at UFPA have yielded significant results over the last decade. The teaching project *Theory and Museological Practice in the Science Museums of UFPA* between 2016 and 2018 identified five collections with museological potential: Núcleo de Astronomia (Astronomy Core); Museu Interativo da Física (Interactive Physics Museum); Museu de Geociências (Geoscience Museum); Laboratório de Anatomia Humana Funcional/Museu de Anatomia (Functional Human Anatomy Laboratory/Anatomy Museum) and the Laboratório Museu de Zoologia (Zoology Museum Laboratory) (Santos & Costa, 2018, p. 257; Costa, 2016a, p. 3, b, p. 4). The extension

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program *Museums and Collections at the Federal University of Pará: Building a Network Articulation* from 2019 to 2021 aimed to map, quantify, and classify museums and collections belonging to UFPA (Lott, 2018; Lott & Cardoso, 2020; Lott & Gomes, 2019, p. 60). In 2019, the University Museums Research Project was launched, aiming to identify and problematize university museums, characterize them, and identify their power symbolism (Lott et al., 2019; Lott et al., 2020, p. 147; Lott et al., 2021, p. 281).

Previous projects were started with the intention of mapping museum and university collections at UFPA but were cut short due to difficulties in accessing information. To address this, a new project called *Policy of Management and Curation of Museological Collections at UFPA (Belém Campus)* was launched in 2022. The plan aims to address issues related to the management, preservation, and dissemination of objects. The UFPA Collections and Museums Network was subsequently implemented to enhance the potential of the museum course with interdisciplinary expertise. The network implementation relies on interdisciplinary expertise from other courses at UFPA to fully leverage the potential of its museology course (Lima, 2022b; 2023).

The network collaborated with NHC/UFPA to implement a new documentation methodology for the collection, using the *Tainacan* on-line software.²

THEORETICAL BACKGROUND

Before we can fully address the objectives outlined in this article, it is imperative to lay the foundation with a concise yet comprehensive theoretical background. This theoretical framework is not merely a preliminary step but, rather, the intellectual scaffolding upon which our research objectives will be erected. By offering a brief exposition of the key theoretical concepts and underpinning principles relevant to our study, we aim to provide the reader with the essential knowledge and context necessary to engage with the subsequent discussions. This theoretical grounding will clarify the conceptual landscape and serve as a roadmap, guiding readers through the intricate terrain of our research and ultimately enabling a more profound and informed exploration of the digital repository implementation at the NHC/UFPA in the Brazilian Amazon.

² *Tainacan* is an open-source solution developed by the Federal University of Goiás and managed by the University of Brasília, providing a free and efficient alternative for creating institutional and thematic repositories that is easy to use and configure while meeting professional requirements (Martins et al., 2017, p. 6; Martins, 2020, p. 14; Oliveira & Feitosa, 2021, p. 78).

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The importance of metadata in documentation processes extends beyond its mere application. While the introduction has so far set the stage by describing the context of the project, it is imperative to delve into a more profound debate on the subject. Metadata, in its essence, serves as the connective tissue that bridges the tangible and intangible aspects of cultural and natural heritage preservation. It is not just a set of technical descriptors but a realm where the ontologies of heritage, knowledge representation, and information organization intersect.

Metadata encompasses a wide range of specific information types that are generated or collected from various resources. This term is often used to refer to machine-readable data and, at other times, to describe records related to electronic resources. It plays a fundamental role in understanding the content stored within a resource, serving as a repository for both semantic and syntactic information. Think of it as a labeling system that aims to clarify how, when, and by whom a resource was archived and how it's structured. These descriptive details can include information such as the author, title, publication date, keywords, physical characteristics, and more. Importantly, metadata applies to a wide variety of resource types, including audio files, scientific datasets, digital images, museum catalogs, books, and many others (Lima, Santos & Segundo, 2016, p. 52).

The lack of a thoughtfully structured model can jeopardize the ability to effectively capture and describe key attributes of information items within a collection. This, in turn, hampers the process of locating, identifying, selecting, accessing, and navigating through the stored materials. Employing cataloguing rules in information organization systems, especially within collections, assumes paramount importance. These rules serve as guiding principles, dictating the content and suitable data values necessary for populating the metadata elements within their respective databases. These meticulously organized components can also double as potential indexes in contemporary information retrieval systems, facilitating efficient search and navigation, thus underscoring the indispensability of a well-structured framework (Ramos & Lemos, 2023, p. 150).

In this discussion, we will navigate the nuanced dimensions of metadata, unpacking its role as a critical element that not only catalogues and classifies but also frames our understanding of heritage, shaping the narrative of what we preserve and why. This exploration will offer insights into the conceptual and theoretical foundations, positioning it as a cornerstone of the documentation process in the ever-evolving landscape of heritage management.

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Metadata simplifies the process of understanding the connection between information and data presented in various forms and settings. To achieve this, various standards exist, with some tailored to specific domains and others being more general, each serving distinct purposes (Lima, Santos & Segundo, 2016, p. 54). Metadata plays a pivotal role in documenting cultural and natural heritage, facilitating the systematic cataloging and classification of heritage items. It acts as the informational bridge that connects these valuable artifacts to the broader context of history and science, enabling a comprehensive understanding of their significance and origins. By providing descriptive details about authorship, provenance, categorization, and contextual information, metadata not only ensures the effective organization of heritage collections but also underpins the preservation and accessibility of our cultural and natural treasures for future generations.

Utilizing standards within museum collections streamlines the exchange of data among those that adopt these common standards, enabling the automated retrieval of information and fostering uniformity in database management. This, in turn, simplifies the seamless sharing of information between institutions. The comprehensive set of standards, encompassing content, external guidelines, codes, and regulations, all play a dual role. Not only they contribute to standardizing the syntax of data, but they also play a crucial role in homogenizing the values used for representation. These guidelines serve as foundational components in ensuring consistency and interoperability in the realm of museum documentation and data management (Zeng & Qin, 2008, p. 95).

The influence of metadata on the interpretation of heritage items is a nuanced and essential aspect of cultural and natural artifact management. Acts as a powerful lens through which we perceive and comprehend these precious relics. It goes beyond mere documentation; it contextualizes and enriches the narrative surrounding each artifact. Them, including information about an item's origin, historical context, cultural significance, and physical attributes, shapes our understanding of heritage items. It bridges the gap between the object and its meaning, revealing the stories, traditions, and knowledge encapsulated within. The meticulous crafting of descriptive metadata breathes life into these artifacts, enabling a more profound connection between the past and the present and encouraging a richer, more informed exploration of our cultural and natural heritage.

The role of metadata in shaping the narrative of heritage is paramount. It serves as a guiding hand, meticulously crafting the sto-

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ries we tell about our cultural and natural history. In its descriptive and organizational capacities, lends depth and meaning to heritage items, bestowing upon them a voice and context that resonate through time. By encapsulating details about an artifact's origin, historical significance, and cultural relevance, metadata enriches the narrative surrounding each piece of heritage. It transforms the cold facts into vibrant stories, connecting the past with the present and shaping a compelling narrative that transcends generations. In this way, becomes the storyteller, preserving the essence of our cultural and natural history and ensuring that these tales continue to captivate and educate those who engage with our heritage.

Several reference ontologies and metadata standards play a pivotal role in the exchange of information among cultural heritage institutions, particularly in domains such as works of art, architecture, and imagery. Notably, The International Organization of Standardization (ISO 21127, 2014) provides comprehensive guidelines for this purpose. Specific standards tailored to cultural heritage, such as the *Categories for the Description of Works of Art (CDWA)* and *The Visual Resources Association (VRA) Core*, are instrumental in ensuring the accurate recording of vital information. These standards not only facilitate automated retrieval but also foster uniformity across databases, simplifying the migration of data to new systems. To effectively describe the content of works and their accompanying images, the *Cataloging Cultural Objects (CCO)* serves as a content standard designed for professionals working in the realm of art, architecture, and cultural artifacts' description. Furthermore, value standards like the *Art & Architecture Thesaurus (AAT)* and the *Union List of Artist Names (ULAN)*, both maintained by the Getty Foundation and accessible through their website, further enhance the consistency and richness of metadata within the cultural heritage domain (Lima, Santos & Segundo, 2016, p. 58).

As mentioned earlier, various initiatives for museum collections, such as the Canadian Heritage Information Network (CHIN), Museum Initiative for Digital Information Interchange Standards (MIDIIS) and Europeana, have made significant progress. Nevertheless, in Brazil, the absence of a unified solution remains evident. The museum sector, grappling with the absence of standardized description frameworks, has resorted to developing specific, tailored solutions to address their collection management needs (Lima, Santos & Segundo, 2016, p. 59).

Another issue intertwined with these challenges is the shortage of qualified suppliers. Europe currently enjoys the conditions of a mature market, with companies dedicated to providing soft-

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ware solutions for museum collection management. In contrast, Brazil's museums predominantly relied on software adapted from library systems to fulfill their documentation requirements. However, the market is gradually evolving, witnessing the emergence of specialized companies that adhere to standards rooted in the International Council of Museums Committee for Documentation (CIDOC) and Spectrum. This promising development reflects a shift towards aligning with international standards and best practices (Lima, Santos & Segundo, 2016, p. 59).

A notable effort aimed at achieving interoperability emerged over a decade ago through the Documentation Standards Working Group (DSWG) within CIDOC of the International Council of Museums (ICOM). This initiative, known as the *Conceptual Reference Model (CRM)*, was established to foster compatibility and consistency in the field of cultural heritage documentation. In this context, *interoperability* signifies the capacity of various systems to seamlessly exchange and utilize data generated by other systems, promoting cohesion and synergy within the cultural heritage community.

The CIDOC *Conceptual Reference Model (CRM)* endeavors to foster a unified comprehension of cultural heritage information by furnishing a versatile and widely applicable semantic framework to encompass all aspects of cultural heritage. This framework serves as a shared language, aiding domain experts and implementers in articulating the prerequisites for information systems while also offering guidance on sound conceptual modeling practices. In essence, the CRM acts as the "semantic glue" for bridging the gaps between diverse sources of cultural heritage information, including those disseminated by museums, libraries, and archives. It plays a pivotal role in harmonizing and integrating the wealth of knowledge related to cultural heritage for the benefit of the broader community (Lima, Santos & Segundo, 2016, p.60).

Over the years, numerous initiatives have been established to standardize information within the realm of art. International Organizations such as the Getty Research Institute, the ICOM, and the Collections Trust, along with *Brazil's Normative Resolution No. 02*, updated from *Normative Resolution No. 06*, both developed by the Brazilian Institute of Museums (IBRAM), have played important roles in this effort. Brazilian cultural institutions have frequently crafted their own databases for managing their assets, considering local circumstances and operational requirements. Examples include the *Simba/Donato Project (1990's)* at the National Museum of Fine Arts in Rio de Janeiro, the *Protection Inventory of the Cultural Collection of Minas Gerais (1984)* by the State Institute of Historical

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and Artistic Heritage of Minas Gerais, and the *Cataloguing of the Espaço Art Gallery University at the Federal University of Espírito Santo (2013)*. It's worth noting that despite the diversity and flexibility in metadata composition, there are common elements across all schemes, sharing semantic, definitional, and functional aspects, either precisely or in a closely approximate manner (Ramos & Lemos, 2023, p. 150).

Metadata creation and management present numerous challenges. There are two major challenges: consistency and accuracy. Maintaining uniformity and precision across diverse collections and systems can prove to be a complex endeavor. Striking the right balance between maintaining standardized metadata formats and accommodating specific contextual requirements is essential. Additionally, discussions often touch upon controversies, with issues of cultural sensitivity and representation often arising. The need to accurately represent diverse cultures and heritage while respecting cultural sensitivities can be a delicate balancing act. Metadata should not inadvertently perpetuate biases or misrepresent cultural narratives and exploring these complexities is vital to ensuring that its creation and management evolve in ways that are both respectful and inclusive, ultimately contributing to a more comprehensive and equitable portrayal of our heritage.

As technology advances and our understanding of heritage management evolves, emerging trends in metadata are poised to reshape the landscape of heritage documentation. These trends encompass various facets, such as linked open data, machine learning, and semantic web technologies. The adoption of these trends promises to streamline the documentation process, improve data retrieval, and facilitate greater interconnectivity between heritage resources. Simultaneously, innovative approaches to metadata have begun to take center stage, offering new avenues for enhancing heritage preservation and understanding. Examples include the integration of immersive technologies like augmented and virtual reality into metadata, enabling users to engage with heritage artifacts in novel and interactive ways. These innovations herald a future where heritage is not only documented with greater precision but also make it more accessible, immersive, and engaging for a wider audience, ensuring the continued vitality and appreciation of our cultural and natural heritage.

In summary, the discussion underscores the imperative role of metadata in heritage preservation. It serves as a critical bridge that enriches the narrative of our cultural and natural heritage and influences how we interpret heritage items, ensuring a more

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profound understanding of their historical and cultural significance. Metadata creation and management come with challenges, including the need for consistency and accuracy, as well as addressing controversies surrounding cultural sensitivity and representation. However, emerging trends and innovative approaches in metadata offer exciting possibilities for enhancing heritage preservation and understanding, making our past more accessible, immersive, and engaging. Ultimately, the critical role of metadata in shaping the narrative of heritage preservation cannot be overstated, as it ensures that our cultural and natural heritage is passed on to future generations.

METHODOLOGY

This study's methodology includes meetings carried out in the first half of 2022 with the collection members and users to understand the actual need and application of each field in the previous documentation sheet, prioritizing the exchange of information and experiences. A user manual for the collection's documentation was also transcribed, and brief training was provided to researchers to understand and use the *Tainacan* software.

Subsequently, new meetings were held to discuss how each field could be transposed to the tool's metadata. These were essential to ensuring all fields in the documentation sheet were properly transposed into the tool's metadata to meet the specific needs and uses of the collection. All activities were conducted to guarantee the quality and efficiency of the transposition process from the fields into the tool's metadata.

To migrate and open a database, technical steps must be executed in a logical and coordinated sequence. These steps involve procedures for dealing with information, such as understanding the current organizational structures and converting them into other forms of data representation and organization. Steps include changing technical standards, cleaning, treatment, and normalization. To achieve these objectives, defined methodological stages of working with the information were established, which are described below.

Before proposing the repository, we conducted a survey of all the collection's previously attempted documentation activities. This helped us determine whether the parameters used were up to date and if data could be migrated from a pre-existing base. We also conducted a thorough analysis of the technical characteristics of the collections to identify metadata standards, copyright and dig-

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itization policies, cataloguing rules, and more. This step involved constant dialogue with institutions to identify digital resources available as open data for public access through the internet.

The construction of the metadata began, and once they were defined, the digital repository was constructed using the *Tainacan* tool. The subsequent stage involved content validation and creation, with testing of the platform for information retrieval to identify migration issues and data correction needs from earlier stages.

RESULTS AND DISCUSSION

Choosing the *Tainacan* Digital Repository

The implementation of the *Tainacan* platform in this collection is in line with the trend towards the digitization of cultural and natural collections in Brazil, and the regulatory framework of the museological field, including the National Museum Policy and the Statute of Museums (Ministério da Cultura, 2007, 2003). Digitizing cultural or natural content can expand the reach and visibility of cultural institutions, but implementing and sustaining it poses challenges. Digital repositories are a practical solution because they are open and interoperable information systems designed to manage information and store files in different formats. They enable preservation and sharing of metadata across protocols. However, creating a digital repository requires meticulous planning and staff training to ensure the database is structured in a way that enables users to browse, search, and find what they need (Lima, 2022a, p. 20; Martins, 2020, p. 12; Torino, 2017, p. 94; Martins et al., 2017, p. 7).

Digital repositories offer institutions various advantages, including facilitating access to cultural and intellectual products. These repositories aim to preserve and enhance knowledge, making it available to the public and increasing institutional visibility. Digitizing collections has become a popular solution for democratizing public access to cultural and natural heritage in Brazil, where many collections sadly remain hidden in storage and are rarely displayed. By digitizing and making museum collections available online, a greater number of people can access the information generated, processed, and preserved by museums (Martins, 2020, p. 19).

Previous activities

Before 2022, NHC/UFGA assets were registered using two methods. The first was through filling in a registration book with metadata

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such as biological identifications, place of origin, geological formation, geological age, method of acquisition, and dimensions. The second method was through catalog sheets that were created for each individual item using the Microsoft's Office Word program. These catalog sheets contained three groups of metadata: identification of the object, conservation, and historical analysis. The identification group contained general information about the scientific asset, such as registration number, identification, date of acquisition and collection, origin, lithology and geological age, acquisition mode, measurements, description of the object, and image. The conservation analysis group contained information about the conditions of the property, such as conservation status, interventions carried out, loss of material, recommendations, and conservation diagnosis. The historical analysis group contained data on the publication of the items in journals, books, and information regarding the removal of museological assets from the collection.

The digital repository proposal not only optimized data retrieval but also addressed the issue of inconsistency in filling out fields. The previous system of individual word documents lacked standardization and guidance, resulting in confusion and the need for a documentation review.

The NHC/UFPa is in the technical reserve of the museology course alongside the Amazonian collection, but in separate rooms. Originally, an interoperability plan between collections was envisioned, resulting in a form (Figure 1) based on an existing collection model, modified to fit the paleontology collection. However, the adaptations did not result in effective interoperability between fields due to different rules and information. It should be noted that the collection was designed to expand into other areas of natural knowledge, but the document sheet used did not reflect this, posing a problem for collection management.

The NHC/UFPa collection includes objects that are not only part of a scientific collection but also serve as didactic-expository materials for exhibitions. Due to frequent handling, these objects are at risk of becoming fragmented or contaminated. To ensure proper preservation, it is essential to have documentation that includes metadata for conservation diagnoses. The old documentation for NHC/UFPa did not provide a database that could be automatically migrated to a new platform, and the metadata needed to be revised. Thus, manual data entry was required for the new digital repository. Updating the museological documentation model for NHC/UFPa was necessary to optimize movement data and conservation diagnoses.

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FICHA CATALOGRÁFICA DO ACERVO DIDÁTICO-CIENTÍFICO DE HISTÓRIA NATURAL		
1 IDENTIFICAÇÃO DO OBJETO		
1.1 ACERVO: História Natural	1.2 COLEÇÃO: Paleontologia	1.3 N° DE REGISTRO: RTM.8.1.626
1.4 IDENTIFICAÇÃO: Invertebrado		1.5 IDENTIFICAÇÃO BIOLÓGICA: Cubitosrea spp.
1.6 COLETOR: Equipe Quatro Estações		
1.7 DATA: 14/12/2018	1.8 DATA DE AQUISIÇÃO: 16/05/2022	1.9 ORIGEM: Primavera/FA
1.10 PROCEDÊNCIA: Área 17-10m	1.11 LITOLOGIA: Carbonato	1.12 IDADE/FORMAÇÃO GEOLÓGICA: Formação Pirabas
1.13 MODO DE AQUISIÇÃO: Doação	1.14 DIMENSÕES: Altura: 3,33 cm Largura: 3,07 cm Profundidade: 0,95 cm	
1.15 LOCALIZAÇÃO: (x) Reserva Técnica () Exposição () Outros ESPECIFIQUE:		
1.16 IMAGEM DO OBJETO		1.17 DESCRIÇÃO DO OBJETO
		Valva esquerda de bivalve Cubitosrea spp.
1.18 FOTOGRAFIAÇÃO: Bárbara Sepúlveda DATA: 16/05/2022		

2 ANÁLISE DE CONSERVAÇÃO	
2.1 CONSERVAÇÃO: (x) BOM () REGULAR () RUIM () PÉSSIMO	2.2 PERDA DE MATERIAL: () SIM (x) NÃO
2.3 INTERVENÇÕES: (x) SIM () NÃO	2.4 RECOMENDAÇÕES: -
2.5 DESCRIÇÃO DO DIAGNÓSTICO DE CONSERVAÇÃO: Foi feita a limpeza mecânica com uso de espátula e pinos; também foi feito o uso de ácido acético na limpeza externa, ajudando na remoção de sedimentos da matriz.	
3 ANÁLISE HISTÓRICA	
3.1 DADOS HISTÓRICOS:-	
3.2 PUBLICAÇÕES:-	
3.3 REFERÊNCIAS ARQUIVÍSTICAS E BIBLIOGRÁFICAS:-	
3.4 OBSERVAÇÕES:-	
Dados de Preenchimento da ficha	
Responsável pelo preenchimento: Bárbara Sepúlveda	Data: 16/05/2022
Revisor: Sônia Cordovil	Data: 16/05/2022

FIGURE 1. Form template used prior to 2022, created using Microsoft Office Word (Photograph: Jéssica Lima, Bárbara Sepúlveda and Sue Costa, 2023).

Analysis and construction of metadata

UFPA installed the plugin on WordPress, providing an access address through the Center for Information and Communication Technology. Some of the researchers in the group were already familiar with the application, which made the process faster and easier.

The basic inventory was built using the National Inventory of Museum Cultural Assets (INBCM, Brazil) as a basis. This instrument is discussed in the National Policy on Museums (Ministerio da Cultura, 2003, p. 11; 2007, p. 26) and in the Statute of Museums (Lei nº 11.904, art. 41). In the process of analyzing the documentation of the collection, inconsistent metadata was identified, which did not have a defined function. To address this issue, it was reinterpreted to meet the needs of the collection and to prepare for possible expansion to other Natural History collections. The INBCM, used to periodically add data on cultural assets in Brazilian museums' collections, has specific elements for the description of scientific objects that were adapted to the new form (Resolução Normativa IBRAM No. 6, 2021, art. 7). This adaptation will allow interoperability at a federal level and ensure the identification, safeguarding, and preservation of the collection, in compliance with the National Policy on Museums.

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We chose to create a manual that includes guidelines for filling out the form and migrating it from its physical format onto the digital platform, as the latter provides a field to specify the method of completion. In meetings, we discussed the metadata requirements, available types (from *Tainacan*'s options), a description of the filling guidelines, and their corresponding status on the platform (Figure 2).



UNIVERSIDADE FEDERAL DO PARÁ

INSTITUTO DE CIÊNCIAS DA ARTE

FACULDADE DE ARTES VISUAIS



PANAA

MANUAL DE PREENCHIMENTO DOS METADADOS DE CATALOGAÇÃO

COLEÇÃO DE HISTÓRIA NATURAL

TIPO	METADADO	DESCRIÇÃO	STATUS / PREENCHIMENTO
Arquivo	IMAGEM*	Incluir imagens, de mais de uma posição do bem científico, com no mínimo frente e verso. Quando possuir jaqueta, incluí-la em um registro. Na imagem devem estar presentes uma escala numérica, uma escala de cores e o número de registro do bem observado. O fundo para a imagem deve ser, sempre que possível, preto, podendo ser cinza escuro ou branco. A escolha do fundo deve ser feita levando em conta o melhor contraste entre bem e fundo. O fundo, independente do tamanho deve ser sempre na qualidade infinita. É importante seguir o procedimento de documentação, de forma que, o preenchimento do livro físico ocorrerá antes da ficha virtual. Apenas após o inventário que o bem científico obterá o número de registro. É o número único que identifica cada bem. Esta numeração precisa obedecer ao seguinte formato: Sigla da reserva técnica = RTM Número em romano da sala na reserva técnica = II Número da coleção sequencial = 1 (para paleontologia) Número da coleção sequencial = 2 (para zoologia) 0000 = sequência de quatro dígitos com o número do bem Todos esses itens devem ser separados por pontos. Exemplo: RTM.II.0029 Fragmentos - Fragmentos devem ser numerados alfabeticamente em sequência. O registro da quantidade e tamanho das partes	OBRIGATÓRIO

FIGURE 2. Metadata formatting document and description of filing rules (Photograph: Jéssica Lima, Bárbara Sepúlveda and Sue Costa, 2023).

The new digital documentation sheet has 55 metadata fields in sequence, with 14 mandatory fields (marked with asterisks in Figures 3 and 4). *Tainacan* only displays the filled fields to external researchers, avoiding lengthy forms with empty fields. One debated issue was whether the field should be open to the public or kept private. To ensure the security of the property, metadata such as location, loss of material, interventions, conservation report, and preservation recommendations were standardized as private and restricted for internal use only.

The new version of the form is structured into distinct sections, although this structure may not align with the organization within the system. The initial section focuses on item characterization, with a focus on highlighting metadata elements that deviate from the typical standards of museological collections to avoid the inclusion of redundant information.

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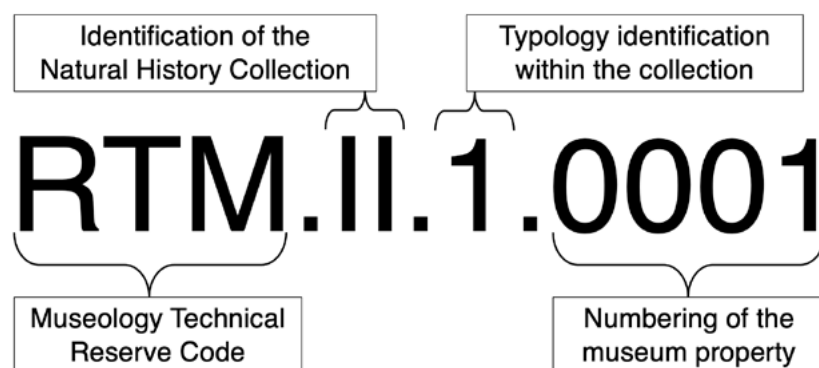
PROPERTY CHARACTERIZATION		PRESERVATION	COMUNICACION
Registration number*	Location*	Conservation state*	Image*
Other numbers	Related Items	Material loss	Reproduction conditions
Segments	Dimensions	Interventions	Permission for educational use
Number of parts	Height (cm)	Conservation report	
Nature	Width (cm)	Preservation recommendations	
Size of each part	Depth (cm)	Treatment carried out	
Situation*	Diameter (cm)	Packing data	
Classification*	Weight (kg)		
Title	Material*		
Descriptive summary*	Technique		
	Registrations		

Captura de Pantalla

FIGURE 3. Listing of metadata belonging to the groups: property characterization, preservation, and communication present in the new form used by NHC/UFPa in *Tainacan* (Photograph: Jéssica Lima, Bárbara Sepúlveda and Sue Costa, 2023).

The registration number field serves to identify and control an object within the collection. The NHC/UFPa uses a specific code for their numbering system, which includes information about the storage location, collection typology (paleontology or zoology), and identification sequence. This alphanumeric code provides the collection curator with essential information on the object (Figure 4).

FIGURE 4. Detailed example of the registration number used for NHC/UFPa (Photograph: Jéssica Lima, Bárbara Sepúlveda and Sue Costa, 2023).



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It's a common occurrence in natural history collections for scientific items to be fragmented or be part of a set originating from the same source. To retain this data, we have included fields for segment, number of parts, and nature. These fields document the number of fragments or parts within a set and identify their characteristics. This information is also useful for exhibition purposes, particularly when materials become fragmented during handling.

The classification metadata is essential for organizing the collection. While controlled vocabularies like the *Thesaurus for Museum Collections* or the *Thesaurus of Cultural Heritage Objects in Brazilian Museums* are commonly used, they may lack the necessary depth for natural history collections. In our case, we considered using scientific collection thesauri such as the *Thesaurus of Scientific Collections* in Portuguese Language and the *UNESCO Thesaurus*, but we couldn't find a fully compatible thesaurus. As a result, we adapted the metadata to align with the biological classification hierarchy, which includes Kingdom, Phylum, Class, Order, Family, Genus, and Species. We are gradually building this taxonomy as we enter each specimen into the database.

Another adapted field is the title. Generally, scientific objects do not have titles. This name is given to the object assigned by the author, curator, or documentation professional (Resolução Normativa IBRAM No. 6, 2021, Art. 7º, §2º, IV). It was decided to take advantage of the field to provide the common name of the property, thus allowing the first steps towards communicative actions and the popularization of science. It is believed that this database can now be used by individuals at all levels of education.

The fields of measurement of scientific assets may vary according to the needs of the collection; here, we adopted the measurement of height, width, depth, diameter, and weight. Measuring their mass is particularly interesting for collection management, since with this information, it is possible to organize the collection in the technical reserve, respect the limits of the furniture, and plan new ways of storage and display.

The state of conservation includes mandatory information on how the object is found on the date of the information's insertion (Resolução Normativa IBRAM No. 6, 2021, Art. 7º, §2º, XI). To minimize subjectivity in classification, the filling manual provides specific criteria for each sub-item. These criteria include categorizing items as *Good* —undamaged with identifiable gender and preserved diagnostic characteristics—, *Regular* —damaged but still with preserved diagnostic characteristics—, or *Bad* —significantly damaged with no preserved diagnostic characteristics—. Addition-

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ally, there's a category for items with biological infestations that require quarantine. This metadata allows for the generation of reports that can help to inform conservation and restoration projects.

In the field of fossils and geological materials, various tools, such as hammers, chisels, brushes, dental instruments, and needles, are commonly employed for preparation (Teofilo-Guedes et al., 2019, p. 1). It is essential to thoroughly document all actions taken on these items, including regular reports on their conservation status, to monitor factors that may lead to deterioration. These reports should encompass general conservation preparations and actions, complemented by images to visually demonstrate the various stages of the process (Lima, 2021, p. 127).

To ensure the preservation and effective management of the collection, documenting fossil preparation is of paramount importance. To achieve this, we have introduced the *interventions* metadata, where the presence of any interference in the structure of the scientific item can be indicated with a simple *yes* or *no*. This includes all preparation and restoration procedures. Additionally, we have created the *Treatment Carried Out* metadata to provide a detailed account of the materials and techniques employed during the conservation process.

To help researchers and museologists exhibit or handle objects well, *preservation recommendation* metadata was created, where preservation recommendations should be included whenever the object needs special care. If the condition is poor or terrible, the item must be intervened first.

The packaging or storage methodology was also recorded including: the materials used, the professionals who performed the activity, the date of execution, possible difficulties encountered, final measurements of the packaging, and other useful information regarding the same must be described in detail. Registering this information is essential for monitoring the aging and degradation of the methods used in packaging and storage materials.

However, updating the collection documentation in the Tainacan software makes it possible for all this information to be in the same file, thereby reducing the risk of loss or file confusion. At that moment, a copyright policy was created since photographs of the collection are available to the public in the repository.

Metadata was created to record the movement of scientific assets in the collection for museological communication activities. This includes participation in exhibitions, lending, and other collection activities. By documenting these actions, various extensions and research projects in museology can be properly reportadas.

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ACQUISITION DATA		LIFE AND RESEARCH		REGISTRATION DATA	
Acquisition mode*	Coordinates	Movement data		Documentarist*	
Origin	Outcrop	Subjects		Registration Date*	
Collector	Depth	Publications		Proofreader	
Donor data	Pit	Comments		Revision Date	
Collection Date	Area			Photographer's Name	
Entry date	Age*				
Origin	Geological formation				

FIGURE 5. Listing of metadata belonging to the groups: acquisition and life data, life and research, and registration data, present in the new form used by NHC/UFGA in *Tainacan* (Photograph: Jéssica Lima, Bárbara Sepúlveda and Sue Costa, 2023).

According to the INBCM (Resolução Normativa IBRAM No. 6, 2021, art. 7), there are three types of subjects: main, chronological, and geographic. The primary subject has been adopted, where the information regarding the key topics addressed by the object is described. In the case of the NHC/UFGA form, the themes that contextualize the property must be provided in the form of a list. This can be achieved through the school curriculum or specific knowledge acquired through research. Additionally, this list includes the names of significant references, such as scientists who conducted research on or published work related to this asset.

Finally, the metadata of publications must be filled in with research information (articles, theses, dissertations, etc.) that contains one or more scientific assets from the collection as an object of study. It must be registered using the ABNT format.³ Geology and paleontology collections have the potential to boost academic research through the direct actions of curators. This potential can be achieved mainly through the disclosure of various forms (Lima & Carvalho, 2022, p. 226).

Including information on reproduction conditions of the images in the catalogue sheets is crucial for the proper management and preservation of collections. The metadata "Conditions of Reproduction" indicates any restrictions that may limit the reproduction or dissemination of images of the property through various means

³ In Brazil, the Standards of the Brazilian Association of Technical Standards (ABNT) are mostly used to construct academic and scientific references. It is the equivalent of APA, Vancouver, or Chicago in terms of the styles for bibliographic citations and references.

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or dissemination tools (Resolução Normativa Ibram No. 6,2021, Art. 7º, §2º, XIV). Since the collection is linked to a public university, the standard filling model adopted is Attribution-NonCommercial-NoDerivs 4.0 International ([CC BY-NC-ND](#)) and another method may be used when the institution's internal policies dictate so or when specifics to the acquisition process arise.

In an innovative approach, distinct metadata has been developed for classroom or educational projects. To facilitate pedagogical use, requests for permission should be submitted with the aim of identifying items suitable for educational purposes. By introducing an affirmative statement in this category, specific samples have been granted authorization for educational use. The selection of these items is based on specific criteria, including whether the property is not a holotype, has never been utilized in scientific publications, and if there are other specimens from the same collection.

Content validation and training

The testing phase of the digital repository for NHC/UFGA provided an opportunity for researchers to review and enhance the quality of the data entered into the system. This review process involved rectifying grammatical errors and refining the technical vocabulary and taxonomy used in the documentation. This phase was crucial in pinpointing any deficiencies in the data collection process and enhancing its overall efficiency.

It is important to note that despite being a museological collection within a museum course, NHC/UFGA did not incorporate museological classification or a thesaurus into its documentation process. The use of such a classification system would facilitate information retrieval within the collection, making it more user-friendly for the public. Future updates to the documentation process should address this metadata gap.

The utilization of an online file storage and synchronization service is a significant advantage for the collection, as it minimizes the risk of data loss. However, the absence of technical metadata for photographs (such as ISO, angle, shutter speed, and diaphragm) is a limitation that should be addressed to ensure the credibility of the photographic representation in the database. Additionally, donor information is crucial and should be accurately documented. Simplified donor data can lead to issues in managing new partnerships, so it's essential to introduce a new form that captures more detailed donor information and establishes relationship with the documentation form in use. Enhancing

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metadata in these areas will improve the collection's management and accessibility.

CONCLUSIONS

The collaboration between the NHC/UFPa collection and the Collections and Museums Network is a crucial aspect for the preservation and dissemination of cultural and natural heritage. Through increased access to artifacts and knowledge, the collection can have a greater impact on society, and the exchange of experiences and knowledge between professionals fosters innovation and improvements in museological practices. The implementation of a digital repository has positively impacted the efficiency and quality of data management and access, allowing for greater accessibility to the collection worldwide. However, annual training sessions are necessary to inform all those who work with the collection of procedures and policies to be adopted, given the high turnover of students in the university environment.

The implementation of a digital repository is just the first step towards an efficient collection policy. The NHC/UFPa collection is expanding quickly, so it is essential to start with efficient and optimized documentation to achieve further progress. Policies such as the collection use policy, collection disclosure policy, and acquisition and disposal policy will also be implemented over the next two years, integrating all the fundamental information of a museum collection.

The enrichment of data in a digital repository is essential for providing users with a more complete and meaningful experience. By including information such as the item's history, origin, cultural and social context, relationships with other items in the collection, and significance to the community, museum documentation sheets can be more comprehensive and meaningful. It also promotes the preservation of the university's scientific heritage by accurately documenting important information about the assets and providing a source of information for future research. Lastly, a public access repository guarantees democratic access to museological knowledge, promoting the dissemination and appreciation of cultural and natural heritage for current and future generations.

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ABOUT THE AUTHORS

Jéssica Tarine Moitinho de Lima

Federal University of Pará (UFPA), Brazil

jessicatarine@ufpa.br

ORCID: <https://orcid.org/0000-0002-2481-1225>

PhD in Sciences (Geology), Master in Preservation of Scientific Collections and Bachelor in Museology. She is the coordinator of the Collections and Museum Networks Program at the Federal University of Pará (UFPA), part of the Research Laboratory for Technical Reserves (LAPRET) and the Laboratory for Preventive Conservation of Movable Heritage (LCPPM). She has experience in museological practices, with an emphasis on collection management in the following areas: management, preservation, curatorship of scientific collections, documentation, assembly, and maintenance of exhibitions.

Bárbara Sepúlveda

Federal University of Pará (UFPA), Brazil

bsepulveda@gmail.com

ORCID: <https://orcid.org/0000-0001-9946-286X>

Doctoral student at the Graduate Program in Science Education at the Federal University of Pará (UFPA), Master's degree in Environmental Sciences at UFPA) and Licentiate in Biological Sciences at UFPA). She has collaborated on the Natural History Collection of the Federal University of Pará since 2017.

Sue Anne Regina Ferreira da Costa

Federal University of Pará (UFPA), Brazil

Suecosta@ufpa.br

ORCID: <https://orcid.org/0000-0002-3314-5148>

Doctor Professor in the Undergraduate courses in Museology and Post-Graduation in Cultural Heritage Sciences. PhD in Geology and Geochemistry. Master in Zoology. Bachelor of Biological Sciences Mod Biology. She is part of the Research Laboratory for Technical Reserves (LAPRET) and the Laboratory for Preventive Conservation of Movable Heritage (LCPPM) with Natural History collections. Also develops research on Museums, Collections and Natural Heritage, with a focus on decolonization and specificities of the Amazon region.



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Sue Anne Regina Ferreira da Costa

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