

Rare books as socio-technical research infrastructure in hybrid digital libraries

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Abstract

Purpose – This paper examines the role of rare books in museum research libraries as active components of contemporary research infrastructure. This study challenges heritage and digitisation-centred framings by investigating how rare natural history publications continue to support scientific research within hybrid digital–physical environments. This study aims to demonstrate how rare books contribute to discovery, verification and interpretation in active research workflows and to position them within broader digital library discourse as socio-technical resources rather than static legacy collections.

Design/methodology/approach – This study adopts a qualitative institutional case study approach focused on the Australian Museum Research Library. It draws on documented research interactions, practitioner observation and researcher-authored reflections to analyse how scientists engage with rare books in practice. Attention is given to hybrid workflows in which researchers move between digitised surrogates, particularly through the Biodiversity Heritage Library, and physical consultation of original materials to support taxonomic, palaeontological and biodiversity research.

Findings – The findings of this study show that digitisation reshapes but does not replace the research use of rare books. Researchers rely on digital platforms for discovery and preliminary analysis, but continue to consult physical volumes for authoritative verification, visual scrutiny and contextual interpretation. Material features such as colour fidelity, scale, annotations and edition-specific variation retain epistemic value not fully captured in digital surrogates. Rare books, therefore, function as operational components of hybrid research infrastructures rather than passive heritage objects.

Research limitations/implications – This study is based on a single institutional case and a qualitative sample of research interactions, limiting its representativeness across disciplines or institutions. The findings do not aim to generalise researcher behaviour at scale, but instead provide in-depth insight into situated practices. Future research could extend this work through comparative case studies, structured user research or mixed-method approaches combining qualitative analysis with usage data across multiple research libraries.

Practical implications – For museum and research libraries, this study underscores the importance of aligning digitisation strategies, access policies and professional mediation with documented research practices. Digital collections should be designed to support discovery while enabling timely access to originals for verification and interpretation. Library staff play a critical role in guiding researchers across digital and physical environments, ensuring that rare books remain accessible, usable and integrated within contemporary research workflows.

Social implications – By foregrounding rare books as active research infrastructure, this paper supports more sustainable and meaningful engagement with historical scientific knowledge. Hybrid access models help balance preservation with use, ensuring that culturally and scientifically significant collections continue to inform research addressing biodiversity loss and environmental change. Recognising the ongoing epistemic value of rare books also strengthens public trust in libraries as stewards of reliable scientific knowledge in the digital age.



Originality/value – This paper contributes to digital library scholarship by conceptualising rare books as socio-technical research infrastructure embedded in hybrid digital–physical systems. Rather than focusing on digitisation outcomes alone, it foregrounds how researchers actually work with rare materials in practice. This study bridges digital library theory and museum research contexts, offering original insight into the continued research value of rare books within digitally mediated scientific environments.

Keywords Socio-technical systems, Digital libraries, Digitisation, Rare books, Museums, Research libraries

Paper type Research paper

Introduction

Rare books held in museum research libraries are often framed primarily as heritage assets, valued for their rarity, historical significance or aesthetic qualities, rather than as active components of contemporary research infrastructure. Within digital library discourse, digitisation initiatives have further reinforced this perception by positioning rare books as materials to be preserved and accessed digitally, rather than as resources that continue to shape research practices through direct scholarly engagement. This framing risks overlooking the ways in which rare books function as operational elements within digital library ecosystems, supporting discovery, interpretation and validation in active research workflows. Theoretical formulations of the archive highlight a persistent tension between the library as a site of heritage preservation and its role as an active scholarly infrastructure (Manoff, 2004).

In this paper, “research infrastructure” is used in a situated, practice-based sense: it refers to the arrangements, expertise, access systems and routines through which rare books support research within a specific institutional context. In this sense, infrastructure is relational and enacted in use (Star and Ruhleder, 1996), rather than understood as a large-scale standardised platform.

In natural history research, historical scientific literature remains essential for taxonomy, species identification and the interpretation of fossil and specimen records. Original descriptions, illustrations and nomenclatural decisions published in the 18th and 19th centuries often underpin present-day classification systems. While large-scale digitisation initiatives, most notably the Biodiversity Heritage Library [BHL (Biodiversity Heritage Library), 2020], have significantly expanded access to this legacy literature, digitisation does not fully replace the need for physical consultation.

This paper argues that rare books function as active research infrastructure within a hybrid digital-physical environment, rather than as passive heritage objects. Through a qualitative case study of the Australian Museum Research Library (AMRL), it demonstrates how these collections are integrated into the research lifecycle of scientists working in taxonomy, palaeontology and zoology. The AMRL case is particularly instructive because it highlights the challenges of navigating a socio-technical system where digital surrogates, whether hosted on global aggregators or local servers, cannot fully replace physical consultation. Within this environment, rare books support discovery, verification and interpretation in ways that are not fully captured by digital surrogates alone. Specific material factors, such as colour fidelity, scale and marginalia, remain critical for establishing scientific authority and nomenclatural accuracy, necessitating a sophisticated hybrid approach to collection access. This hybrid use foregrounds the role of the digital library as not merely an access platform but also a vital research infrastructure mediating between digital systems and embodied scholarly knowledge.

Rather than evaluating a specific technology, this paper examines how digital library infrastructures are enacted in practice through relationships between collections, platforms,

professionals and users. Methodologically, this study adopts a qualitative institutional case study approach grounded in documented research interactions, practitioner observation and researcher-authored reflections. By focusing on depth rather than scale, it offers transferable insights for designing digital library services that recognise the continuing research value of rare books.

Rather than reiterating the established importance of physical consultation, this paper demonstrates how rare books operate as functional nodes within hybrid digital–physical research workflows and how the library mediates those interactions.

Prior research and context

Digital libraries are increasingly understood as not merely technological platforms for access and storage but also socio-technical systems shaped by interactions between users, technologies, institutional practices and cultural contexts (Bishop *et al.*, 2003). Research emphasises that effectiveness depends on not only digitisation and system design but also how communities engage with digital resources in practice. This perspective foregrounds the role of libraries as mediators between digital infrastructures and scholarly work, particularly in research-intensive environments. Appropriation, the process by which people adopt and adapt technologies into their working practices, is critical to the success of these systems (Dourish, 2003). Within museum and research libraries, digital library ecosystems often integrate multiple components: digitised collections, external platforms, discovery systems and physical collections. Rather than replacing analogue resources, these systems support hybrid workflows in which researchers move between digital and material sources depending on the task at hand.

Digitisation of rare books and natural history collections

Digitisation has transformed natural history research by enabling global access to legacy literature. Wide-ranging projects, most notably BHL, function as shared discovery platforms that aggregate content from multiple institutions to support cross-collection research. While digitisation offers clear benefits, including reduced handling of fragile originals, broader access for geographically dispersed users and enhanced discoverability, critical work emphasises that digital surrogates are primarily access tools: they can foster unrealistic expectations about replacement while also introducing new preservation and quality dilemmas (Smith, 1999; Deegan and Tanner, 2002; Conway, 2010). Scholars have noted that researchers' experiences in the digital age are shaped by the persistent need for the physical attributes of the original (Blandford *et al.*, 2006). Material qualities that are difficult to capture digitally, such as colour accuracy, scale, texture and annotations, carry taxonomic or interpretive significance. While digitised surrogates support initial discovery, they do not always convey the full informational value required for authoritative research. As a result, digitisation reshapes, but does not eliminate, the role of physical consultation.

Digital libraries as research infrastructure

A growing body of literature distinguishes between digital libraries as access platforms and as research infrastructure. Infrastructure-oriented perspectives emphasise how digital libraries support the production, validation and reuse of knowledge, aligning with broader discussions regarding the integration of libraries into the research lifecycle (Marcum, 2001). In this context, rare books are typically discussed as objects of digitisation rather than as contributors to active research.

Studies of scholarly behaviour acknowledge that researchers adopt situated and task-specific strategies when using digital libraries (Palmer *et al.*, 2009). Discovery often begins

in digital environments before moving to physical consultation. Libraries play a crucial role in enabling this hybridity through “context-centered” mediation, guiding researchers from digital discovery to physical access and interpreting historical sources (Durrance and Fisher-Pettigrew, 2002). This paper builds on these strands by examining rare books as active components of a museum digital library ecosystem, addressing the gap between digital library theory and practice.

While scholarship has established the value of materiality and provenance in historical collections, fewer studies examine how these insights are operationalised within contemporary digital library infrastructures and day-to-day research decision-making.

Case study background

Established in 1836, AMRL is a specialised unit embedded within the Australian Museum (AM), Australia’s oldest museum (AM, 2018). The Library strategically supports the Australian Museum Research Institute (AMRI), whose scientists conduct research across biodiversity, taxonomy and palaeontology. Historically, the Library has been an integral component of the Museum’s research and knowledge infrastructure (AM, 2018; Stephens, 2013).

AMRL holds a significant collection of rare books and early scientific literature dating from the 18th and 19th centuries (Stephens, 2013). These materials, including foundational descriptions of Australian fauna and expedition logs, remain authoritative sources for nomenclatural stability and species identification (Cassell, 2025). For AMRI scientists, these materials function as specialised research infrastructure operating alongside modern genomic data.

From a digital library perspective, AMRL operates within a distributed and hybrid access environment. A portion of Australian Museum holdings is accessible via the BHL, which serves as AMRL’s primary discovery platform (Williamson, 2013). In addition to BHL, AMRL has digitised further content discoverable through the museum website (AM, 2022). However, these materials are not yet accessible through a unified public digital platform. This multi-layered access model reflects common conditions in museum research libraries, where digitisation progresses incrementally. The value of AMRL as a case study lies in its documented integration of rare books into active research workflows, where library staff mediate between discovery platforms and embodied consultation.

Methods

This study adopts a qualitative institutional case study approach to examine how rare books function as active components of a museum digital library ecosystem. Case study methodology is particularly appropriate for investigating socio-technical systems in context, where practices, relationships and infrastructures cannot be meaningfully isolated from their institutional setting (Yin, 2018). Rather than aiming for statistical generalisation, this study prioritises analytical depth and transferability, offering insights relevant to comparable museum and research library environments.

The AMRL is treated as a single, embedded case, selected because of its sustained integration of rare books into contemporary scientific research workflows and its operation within a hybrid digital–physical access environment. The focus on a single case responds to the necessity of understanding digital libraries as context-centred entities that provide specific value to defined user communities (Durrance and Fisher-Pettigrew, 2002).

Data for the case study derive from multiple qualitative sources collected through professional practice between 2022 and 2025. These include:

- documented research interactions between library staff and AMRI scientists relating to taxonomy, palaeontology and zoology;
- written reflections, emails and statements authored by researchers describing their use of rare books and digital surrogates;
- practitioner observation by library staff supporting research consultations, digitisation requests and access mediation; and
- project documentation associated with digitisation initiatives and public-facing research translation activities.

The four source types were organised in a working spreadsheet and reviewed iteratively for recurring patterns of discovery, verification, consultation and reuse across cases. This study uses a purposive sampling strategy, focusing on a small number of research interactions where rare books played a demonstrable role in discovery, verification or interpretation. While the sample is small, it enables a close examination of researcher participation within the digital library ecosystem, as research into non-probability sample sizes suggests that a limited number of deeply analysed interactions is sufficient to identify the most prevalent and significant thematic patterns within a specific context (Guest *et al.*, 2016). This focus allows for a detailed understanding of how scholars navigate between aggregated digital platforms, local discovery systems and physical collections depending on research needs.

Analysis is interpretive and practice-based, tracing patterns of use across digital discovery, physical consultation and knowledge reuse. No quantitative usage metrics or behavioural analytics are used; instead, this study foregrounds situated research behaviour and the mediating role of the library within hybrid workflows. As the research is based on analysis of professional practice and documented collaboration, no formal ethics approval was required.

Limitations include the absence of longitudinal user tracking and the focus on a single institutional context. However, by making these boundaries explicit, this study offers transferable insights for digital library professionals seeking to support research-intensive communities through hybrid digital–physical infrastructures.

Findings: rare books in practice

Taxonomy and species identification

Taxonomic research depends on the accurate identification, naming and classification of species, processes that are inherently historical as well as scientific. Within the AMRL digital library ecosystem, rare books function as critical research infrastructure by providing access to original species descriptions, illustrations and nomenclatural decisions that cannot always be reliably reconstructed from digitised surrogates alone.

Historically, these activities depended almost entirely on on-site consultation of printed sources; today, AMRI researchers typically begin with digital discovery, primarily via BHL and online catalogues, before requesting targeted access to physical copies for verification, comparison or detailed visual analysis.

Many species described during the late 18th and 19th centuries were documented in books and journals that remain foundational to zoological nomenclature. For species described before the standardisation of modern collecting, curation and registration practices, physical type specimens may no longer exist, may be fragmentary or may be held in overseas institutions with limited accessibility. In such cases, the first published description or illustration becomes the primary authoritative reference for taxonomic work. Although the term iconotype is not formally recognised under the *International Code of*

Zoological Nomenclature, illustrations that effectively function as surrogate types when holotypes are lost or absent play an important role in taxonomic practice. This is evidenced by recent efforts to catalogue primary taxonomic data solely from historical illustrations (Vane-Wright, 2021).

A well-documented example is the Red-bellied Black Snake (*Pseudechis porphyriacus*), first described by Shaw and Sowerby (1794). This publication, one of the earliest works devoted exclusively to Australian fauna, contains a hand-coloured plate depicting diagnostic morphological features of the species. While Shaw likely worked from specimens sent from Australia to England, the physical specimens he examined are now presumed lost. As a result, contemporary taxonomic understanding of this species continues to rely on the original description and illustration as the most authoritative sources. The precision of the hand-coloured plate, particularly in relation to body form and colour patterning, remains critical for distinguishing this species from closely related taxa and for interpreting subsequent taxonomic revisions. In practice, AMRI researchers first locate Shaw and Sowerby's plate via BHL and then consult the AMRL copy to assess colour fidelity, plate context and any edition-specific features that are not reliably represented in the digital surrogate.

Researcher interactions with such material typically follow a hybrid digital-physical workflow. Discovery usually begins in digital environments, most commonly BHL, which functions as the AMRL digital library's primary discovery environment for legacy natural history literature. However, when taxonomic questions depend on fine visual distinctions, researchers frequently request access to the physical volume to verify illustration quality, scale and colour fidelity. An illustrative case arises from research comparing 19th-century zoological illustrations presented together on an Australian Museum web page, including depictions of a tree kangaroo and the Red-bellied Black Snake; in this instance, preliminary species differentiation relied on subtle colour variation in the original drawings, which informed interpretive judgements about possible species boundaries. While high-quality digital surrogates support discovery and comparative analysis, the colour accuracy and tonal nuance required for this assessment could not be evaluated with full confidence without consulting the physical originals (Cassell, 2025). Although the researcher's findings were not formally published at the time, the case demonstrates how access to original illustrations can remain necessary for taxonomic verification, particularly where colour is a diagnostic feature.

The research value of rare materials, thus, extends beyond textual evidence to the scientific illustrations themselves, which often preserve morphological data, such as specific colouration, posture or life-size proportions, no longer observable in preserved specimens or fossils. While digital initiatives like the BHL have transformed discovery, digitised surrogates do not consistently capture the full informational richness required for authoritative taxonomic decision-making. Consequently, within AMRL, rare books continue to function as active components of a hybrid research infrastructure, where physical consultation is required to validate and interpret digital representations (Varnalis-Weigle, 2016).

Historical species distribution

Beyond their taxonomic value, rare books provide critical evidence for reconstructing historical species distributions. Before the emergence of systematic ecological surveys, geospatial data sets and standardised monitoring frameworks, naturalists documented species presence, abundance and habitat through narrative observation, correspondence and early scientific synthesis. These accounts constitute a foundational layer of biodiversity

knowledge that continues to inform contemporary research on environmental change and conservation status (Swetnam *et al.*, 1999). Historical publications frequently contain qualitative yet detailed observations of species distribution that predate large-scale landscape transformation. In many cases, these descriptions represent the only surviving evidence of former species ranges or population densities. For researchers working in conservation biology, historical ecology and biodiversity science, such material provides essential temporal baselines against which modern data can be interpreted.

A notable example is Krefft (1869), which documents the Broad-headed Snake (*Hoplocephalus bungaroides*) in the rocky bushland surrounding Sydney. Krefft observed that the species was already becoming less common by the mid-19th century, noting that “they are, however, not so numerous as they were six or eight years ago, their haunts having been invaded by the builder and the gardener.” This early recognition of anthropogenic impact on species distribution offers valuable historical context for contemporary conservation assessments. Today, *H. bungaroides* is listed as endangered, and current studies attribute its decline primarily to habitat fragmentation and urban development. Krefft’s account demonstrates that these pressures were already shaping species distribution more than 150 years ago (Cassell, 2025).

Such observations allow researchers to extend the temporal scope of biodiversity analysis beyond the limits of modern data sets. While 19th-century naturalists did not use standardised sampling methods, their qualitative evidence remains scientifically meaningful when interpreted alongside contemporary ecological research. Rare books, thus, function as longitudinal data sources within a hybrid digital library environment, supporting the reconstruction of environmental baselines and long-term change.

Rare books also play a crucial role in clarifying the chronology and geography of species documentation. In some cases, species were depicted or named in illustrations or drawings that predate later formal descriptions. For example, the Brush-tailed Rock-wallaby (*Petrogale penicillata*) is often cited as having been described by John Gray in 1827. Consultation of original sources, however, reveals that the species was illustrated and named in an earlier drawing by John Lewin dated to 1825, which is now recognised as the correct date of authorship. Establishing accurate timelines is essential for not only nomenclatural precision but also tracing the historical documentation and geographic spread of species.

The physical characteristics of rare books further enhance their value for distributional research. Hand-coloured plates, marginal annotations and edition-specific variations can contain information absent from later reproductions. In some volumes, authors or early owners recorded locality data, specimen provenance or observational notes directly within the book. Here, probabilistic materiality helps explain why annotations, colour variation and edition-specific differences matter: they add evidentiary value that cannot be fully resolved from digital surrogates alone (Drucker, 2009). For example, AMRL’s copy of *The Snakes of Australia* contains 19th-century marginal notes recording locality information absent from the printed text, and these notes have informed recent distributional analysis.

While digitisation initiatives have significantly expanded access to historical natural history literature, digitised surrogates may omit or obscure details critical to distributional analysis. Scans may exclude fold-out maps, reduce colour fidelity or fail to capture annotations made in pencil or ink. Through these practices, AMRL illustrates how rare books continue to support contemporary research into species distribution and environmental change. By mediating access between digital discovery systems and physical collections, the Library enables researchers to integrate historical observations into modern biodiversity science, reinforcing the role of museum research libraries as active components of digital research infrastructure.

Digitisation and research decision-making

Digitisation has fundamentally reshaped access to rare books, enabling researchers to consult historical scientific literature across geographic and institutional boundaries. Within AMRL, digitisation has expanded the reach of rare book collections while supporting conservation goals by reducing routine handling of fragile materials. Instead, it reconfigures research decision-making, positioning digital surrogates as tools for discovery and orientation within a broader hybrid research infrastructure.

Researchers typically begin their work in digital environments, using platforms such as the BHL to locate original descriptions, illustrations and early references. These platforms function as primary discovery systems within the AMRL digital library ecosystem, enabling rapid identification of relevant sources and preliminary assessment of their potential research value. At this stage, digitised surrogates allow researchers to determine whether a source is likely to contribute meaningfully to their analysis, but they do not always support the fine-grained verification required for taxonomic decisions.

The decision to consult original volumes is often driven by research questions requiring a high degree of precision, contextual interpretation or visual scrutiny. In taxonomic and historical research, critical information may be embedded in locations that are not always reliably captured or indexed in digitised copies, such as footnotes, illustration captions, indices or errata. Researchers at AMRI have noted that new genus or species names, publication dates or authorship details may appear outside the main narrative text, making them vulnerable to omission or misinterpretation when relying solely on digital surrogates, particularly where optical character recognition is inconsistent.

Image quality further influences research decision-making. Scientific illustrations in rare books often contain fine morphological detail, subtle colour variation or scale information essential for interpretation. While digitisation significantly improves accessibility, scans vary in resolution, colour calibration and fidelity. Hand-coloured plates, life-size illustrations and fold-out images may lose critical information through compression or standardised imaging workflows, so researchers often require access to physical copies to assess visual evidence with confidence.

Physical consultation also enables examination of material features that are absent from digital representations. Marginal annotations, edition-specific differences, paper quality and signs of correction or use can provide contextual insights into the production and reception of scientific knowledge. In some instances, annotations record locality information or observational data not preserved elsewhere, directly informing contemporary research.

AMRL supports a hybrid research model in which digitised collections facilitate discovery and preliminary analysis, while physical access is reserved for cases where verification, comparison or close examination is necessary. This approach balances access with preservation and reflects how researchers navigate between digital and material sources in practice.

From a digital library perspective, these findings highlight the importance of aligning digitisation strategies with documented research behaviours. Library staff play a critical role in guiding researchers through digital platforms, identifying gaps or ambiguities in digitised content and facilitating access to originals when required. In this way, rare books function as active components of a digitally mediated research infrastructure, shaped by scholarly decision-making rather than displaced by digitisation.

Participatory engagement beyond research

While rare books primarily support scholarly research, this study finds that they also function as infrastructural connectors between research and public knowledge systems. Digital library platforms and interpretive initiatives enable research content derived from rare books to circulate into public-facing contexts, where it is recontextualised through storytelling,

education and exhibition (Parry, 2010). This demonstrates how rare books operate as not only research infrastructure but also connective resources linking scholarly communities, digital systems and public audiences.

Digital storytelling initiatives provide an important mechanism for translating specialised research into accessible narratives. At the AM, platforms such as *Storybox* support the dissemination of research insights grounded in rare book consultation, allowing curators, scientists and library staff to collaboratively present historical sources within contemporary scientific and cultural narratives [AM (Australian Museum), 2023; Guidotti and Townsend, 2025]. Rather than functioning as stand-alone interpretive products, these stories operate as an additional layer within the digital library ecosystem, extending the reach of research activity while maintaining evidentiary integrity.

In this context, rare books are not treated solely as heritage artefacts but as authoritative sources underpinning interpretation. Original illustrations, early species descriptions and historical taxonomic literature are used to explain ongoing scientific questions, such as species identification, extinction and classification change. This approach aligns with best practices in digital storytelling, which emphasise using technology to bridge the gap between “curatorial authority” and “visitor experience” (Wyman *et al.*, 2011) and for maintaining “historical integrity” while fostering emotional engagement with scientific archives (Economou *et al.*, 2025).

Research activity involving rare books often generates content that can be selectively reused for public engagement. Comparative analysis of illustrations, verification of original descriptions and interpretation of nomenclatural changes inform digital features, videos and exhibitions. In these contexts, digitised surrogates are typically sufficient for public presentation, while interpretive authority remains grounded in prior physical consultation. This establishes a cyclical relationship in which rare books inform research, and research outputs, in turn, inform public interpretation through digital platforms (Cameron and Robinson, 2007).

A clear example of this hybrid approach is the *Sydney Science Trail*, where AMRI researchers who had used rare books in their taxonomic work co-designed interpretive content with library staff for both a public-facing event and a parallel researcher-focused programme, selecting specific plates and explaining their research significance alongside physical rare books, high-quality digital surrogates and replicas. As discussed in a recent professional reflection (Guidotti and Townsend, 2025), such hybrid configurations enable libraries to balance access, preservation and interpretation within a coherent digital library strategy. This matters because it shows that researcher participation extended beyond using rare books as sources and into shaping how historical evidence was translated for public interpretation.

Participatory engagement is further strengthened when researchers actively contribute to interpretive narratives. Scientists who consult rare books for research purposes frequently assist in identifying relevant sources, explaining their significance and clarifying how historical evidence is evaluated within contemporary scientific practice. This form of participation differs from traditional outreach by remaining closely embedded within research workflows (Theimer, 2011), allowing public narratives to reflect methodological complexity without oversimplification.

This case illustrates the evolving role of digital libraries as mediators between research and public knowledge. By embedding engagement initiatives within research-driven digital library ecosystems, institutions can extend the impact of rare books beyond academia while preserving their primary research function. For digital library practice, this suggests that participatory engagement is most effective when aligned with research workflows, discovery systems and hybrid access models, reinforcing the role of rare books as active components of community-oriented digital library infrastructures.

Discussion and implications

This case study demonstrates that rare books within a museum research library function as not simply heritage artefacts or digitisation targets but also active components of a local, distributed research infrastructure. Embedded in contemporary research workflows, rare natural history publications support taxonomy, species identification, nomenclature and historical ecology, operating across both digital and physical environments. Interpreting these findings through a digital library lens highlights the importance of practice-based, socio-technical perspectives, where infrastructure is understood not as a static object but as a relational element that “surfaces” during the performance of a task (Star and Ruhleder, 1996). The analytical contribution lies in showing that infrastructure here is not a static platform but a set of situated practices through which rare books become discoverable, verifiable and reusable across research and interpretation.

Within library and museum discourse, rare books are frequently positioned within heritage, conservation or exhibition frameworks, often separated from digital library strategy. The AMRL case challenges this separation. Researchers engage with rare books as functional scientific resources: authoritative sources for original descriptions, illustrations, nomenclatural decisions and historical evidence that remain central to contemporary inquiry. In taxonomic work, illustrations that effectively function as surrogate types when holotypes are lost or absent play an important role in establishing species identity and interpreting later revisions.

This ongoing use complicates narratives in which historical materials are rendered obsolete by digitisation or modern data sets. Instead, rare books persist as epistemic anchors within long-term knowledge systems. From a digital library perspective, this supports a shift from object-centred heritage models toward infrastructure-oriented understandings of special collections as contributors to active research. This reflects a broader transition in natural history toward “extended” collection models, where historical literature and physical specimens are integrated into a single, functional research ecosystem (Hedrick *et al.*, 2020).

The findings show that rare books intersect with multiple stages of the research lifecycle, including problem identification, methodological verification and interpretive analysis. These interactions position the library as a “hybrid” entity, one that must seamlessly integrate physical and digital assets to support the user’s movement between formats (Brophy, 2001). The validity of this hybrid approach is confirmed by recent metrics showing that while digital access has surged, physical consultation remains an irreplaceable core practice for authoritative scientific validation (Caspers *et al.*, 2024). Conceptually, rare books function as infrastructural nodes connecting specimens, digital discovery platforms like BHL and scholarly outputs.

Digitisation plays a crucial role in extending access to rare books, particularly through shared digital library platforms such as the Biodiversity Heritage Library. Digital surrogates support discovery, orientation and comparative analysis, often serving as the primary entry point into legacy scientific literature. For many research tasks, digitisation lowers barriers, accelerates work and enables cross-institutional comparison.

However, this study reinforces that digitisation does not substitute for physical consultation. Researchers consistently identified material characteristics, colour fidelity, scale, illustration detail, marginalia and edition-specific variation, that are difficult to capture digitally but essential for authoritative research (Varnalis-Weigle, 2016). Recognising digitised rare books as complementary rather than replacement infrastructure is, therefore, critical for realistic digital library planning.

The findings foreground the role of the research library as a socio-technical mediator. Librarians support navigation between digital platforms and physical collections, advise on edition differences, interpret illustrative material and manage access to fragile resources.

This mediation shapes how researchers assess evidence and make scholarly judgements, positioning professional expertise as a core component of digital library infrastructure.

In this hybrid environment, the digital library extends beyond platforms and content to include institutional knowledge, access protocols and collaborative practices (Dourish, 2003), in the continuum between physical materiality and digital narration (Pietroni, 2025). This reinforces practice-based models of digital libraries as systems sustained through human interaction as much as through technology.

The findings from this case study yield several critical implications for the strategic development of museum and research libraries. Most fundamentally, institutions must adopt a strategic framing that explicitly recognises rare books as active research infrastructure rather than treating them exclusively as heritage assets or digitisation targets. To support this, digitisation priorities should be research-informed, targeting materials that function as taxonomic references or iconotypes with enhanced imaging and deep bibliographic metadata to facilitate complex hybrid workflows (Dempsey, 2016). Furthermore, digital library expansion should not be viewed as a trajectory toward the total replacement of physical archives; instead, libraries must maintain hybrid access models that support controlled physical consultation in instances where material evidence is essential for scientific authority. Taken together, these findings support a hybrid digital library model in which rare books are integrated into research support, digitisation planning and institutional strategy. By grounding digital initiatives in observed scholarly practice, libraries can sustain both the research value and the long-term stewardship of rare collections.

Conclusion

This case study has argued that rare books in museum research libraries function as active components of contemporary research infrastructure, as not only heritage objects but also digitisation targets. Drawing on documented research interactions at AMRL, this paper has shown how rare natural history publications continue to play a critical role in taxonomy, species identification and historical ecological research. Researchers engage with these materials through hybrid workflows, moving between digitised surrogates and physical consultation to address questions of visual fidelity, scale, annotation and edition-specific variation that remain critical for scientific interpretation.

While digitisation initiatives such as BHL significantly expand access and support discovery, they do not eliminate the need for original materials. Instead, they reshape research practices and reinforce the role of libraries as mediators between digital systems, physical collections and scholarly expertise. The findings highlight the importance of recognising rare books as socio-technical resources embedded within research workflows, rather than as static legacy collections.

This study is limited by its qualitative scope and single-institution focus and does not claim representativeness across institutions or disciplines. Future research could build on this work through structured user studies, comparative case analyses or mixed-method approaches that combine qualitative insight with usage data to better understand researcher behaviour at scale.

For digital libraries, this paper reinforces the need to align digitisation priorities and access policies with demonstrated research use. By grounding digital library design in observed scholarly practice, libraries can ensure that rare collections remain intellectually productive, strategically relevant and sustainably integrated into contemporary research ecosystems.

Future research could compare similar cases across institutions and examine how researcher interactions with material and digital sources can be analysed systematically at scale.

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