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ARTICLE

Connecting Objects and Literature: A Case Study with Khipus, the "Khipu-Biblio Cross-Reference"

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Abstract

Within disciplines that aim to understand past cultures by studying the objects they made, research methodologies can move between example-based object-specific investigations and whole-of-corpus data-driven analyses. And when the count of extant objects is relatively small, every single individual object has the potential to uniquely contribute to new knowledge or transform existing paradigms. But how does a researcher know how many objects there are, where they are, how they have been studied and written about in the past, and which may be awaiting closer examination? This article introduces an object-literature framework that connects objects to the literature that mention them and creates an error-corrected resource that enables the tracing of objects through published literature and through time. The specific example described here applies the framework to khipus (knotted-cord recording devices from the Andes), to create the "khipu-biblio cross-reference." Key findings include comprehending the pattern of khipu publications, identifying understudied khipus, and updating the count of known khipus and their locations. By applying the framework to any collection of objects, researchers and collections teams can draw substantial benefits and accelerate the generation of new knowledge.

Resumen

En las disciplinas que tienen como objetivo comprender culturas antiguas mediante el estudio de los objetos que fabricaron, las metodologías de investigación pueden alternar entre estudios basados en ejemplos de objetos específicos y análisis de datos de todo el corpus. Cuando el recuento de objetos disponibles es relativamente pequeño, cada ejemplar puede contribuir de manera única a nuevos conocimientos o transformar paradigmas existentes. Pero, ¿cómo se sabe cuántos objetos hay, dónde están, cómo se han estudiado y descrito en el pasado y cuáles merecen nuevos análisis? Este artículo presenta un marco de literatura y objetos (*object-literature framework*) que conecta objetos con textos que los menciona y ofrece un recurso verificado que permite rastrear objetos individuales a través de trabajos publicados a lo largo del tiempo. El ejemplo específico que se trata aquí aplica el marco a khipus (registros andinos de cuerda anudada) para formar la "referencia cruzada khipu-biblio" (*khipu-biblio cross-reference*). Entre las principales contribuciones destacan la comprensión del patrón de publicaciones sobre khipus, la identificación de khipus poco estudiados y la actualización del inventario de khipus conocidos y sus ubicaciones. Al aplicar este marco a cualquier colección de objetos, investigadores y especialistas de colecciones pueden obtener importantes beneficios e impulsar la generación de nuevos conocimientos.

Keywords: collections as data; cultural heritage; digital heritage; khipu (quipu); literature review

Palabras clave: colecciones como datos; patrimonio cultural; patrimonio digital; khipu (quipu); revisión de la literatura

Within the disciplines that aim to understand past cultures by studying the objects they made—for example, archaeology, anthropology, and other cultural heritage fields—research methodologies include

Figure 1. Archaeologists Percy Dauelsberg and Junius Bird with one of the few photographs of the largest khipu known to date, KH0082/AS69; its current whereabouts are not known. (Permission to reproduce image courtesy of Museo Chileno de Arte Precolombino).

the examination of textual and visual representations, example-based investigations using the objects themselves, consistent and structured recording of object characteristics and features, and numerical and machine-learning analyses of an entire body of feature data. The systemic collation and parsing of the data available from the objects themselves are critical to advancing understandings of the material culture and the humans who made them.

Where the count of extant objects is relatively small, every single individual object has the potential to uniquely contribute to new knowledge. When researching in a field with a limited set of objects to draw upon, how do you know exactly how many there are? How do you know where they are? And if you are working on a particular object, how do you ensure you have reviewed all previously published literature related to that object, without (re)reading hundreds of pieces of literature to identify a small number of specific references?

A data collection and organizational framework, with accompanying standards of practice, has been created in response to the last question and has proved useful for answering the first two, and more. The resource connects objects and literature: for each object, a listing of where it has been mentioned; for each piece of literature, a listing of the objects it mentions. The specific example described in this article is the "khipu-biblio cross-reference" (KBCR), for the objects in question are khipus (also written as "quipus"): three-dimensional objects made with cord, often knotted, used by Andean peoples to record and communicate information (Figure 1 shows the largest khipu found to date).

This article describes why and how the KBCR was created and advances the framework as a model for researchers working in collection- and object-based disciplines, as well as collection management teams. Insights from the KBCR are detailed to demonstrate the value of such a resource, the most important being an update/revision of the estimated count of known khipus.

Why an Object-to-Literature Connection Resource?

The following four problem statements motivated the creation of the resource detailed in this article. These issues are not specific only to khipu research but beset many disciplines.

Problem #1: How can an overarching view of collections holding a particular kind of object be collated, so that research can be both contextualized and targeted, and collections management coordinated and enhanced? Collected object-literature data can facilitate the confirmation, review, or update of the count of extant objects, as will be demonstrated for khipus in this article. If museum or collection information

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(as present in the literature) is also included in the data, the survey count can be split by location. With such an overall understanding, individual collection managers can conceive of their collection in relationship to the corpus. For example, a small or medium-sized museum may consider that holding seven khipus is nothing particularly extraordinary (especially if it is not a core focus of their collection or storytelling), until a survey makes it evident that it is in fact one of the largest collections of that type in the country.

For rare material classes, any single object may hold the key to critical knowledge development. Researchers can use such a resource to identify objects that appear to be understudied and therefore direct the prioritization of future research. Further, tracing of an individual object through collections and literature becomes possible, as will also be shown.

Problem #2: With a publication history that spans centuries, and with items moving between collections, objects can be referred to in various ways; how can a researcher (or collections manager) ensure they are aware of all references? Collating object and literature connections in a systematic way expands and embeds the consistent use of a chosen set of unique object identifiers (e.g., for khipus, see Brezine et al. 2024). Moreover, it means that previous labels can be connected to the current identifier, which can be important for building provenance and object biographies. FitzPatrick (2024) describes the experience of putting together a khipu's biography, and that navigating the various reference identities—the specific khipu of interest has alternately been referred to as AS30, UR43, and its current identification 41-70-30/3110—posed an unexpected and time-consuming challenge. Uniform application of unique object identifiers is an essential precursor to progressing shareable research and leveraging digital tools and data-driven analyses. With a resource such as the KBCR, objects can be efficiently furnished with more complete backgrounds, honoring preceding research and enriching current work.

Problem #3: Researchers spend significant time (re)reading literature that does not end up referring to the object they are studying. The KBCR was initially constructed for khipu scholars in response to a request for a listing of literature for each khipu in the Khipu Field Guide (KFG).[1] It was anticipated that it would reduce and focus the body of literature needed to be (re)read to find references to an individual object. It can be used by anyone wanting an efficient means of obtaining a complete view of literature published for a specific object, an audience that includes curators and collection managers.

Problem #4: Errors in published literature can be perpetuated over time, misleading scholars, and a persistent place is needed to hold corrections. A resource like the KBCR serves as a repository of accurate, corrected, data about which objects are mentioned in the reviewed literature. As many researchers will know, mistakes can unfortunately creep into published text. While an experienced eye may spot a wrongly captioned object or museum identification number and self-correct, such errors (or absence of sufficient information) are unintentionally misleading and can lead to faulty scholarship when perpetuated without correction. FitzPatrick (2024) also experienced the time-wasting impact of a publication error: one publication stated that the khipu they were investigating was photographed in a 1967 book, though the image was not in fact of the expected khipu (evidently that reference was included in the wrong khipu section in the original text). Had FitzPatrick had access to a resource such as the one discussed in this article, the research pathway would have been less confusing and more efficient.

The next section will describe the creation of the KBCR as a case study of creating an object-literature cross-reference database. This is then followed by examples of findings from that object-specific information. But first, a brief overview outlines existing resources akin to the KBCR.

Object–Literature Parallels

The KBCR might be considered an extension of a literature review or bibliographic database and could be created by anyone using tools as simple (and labor-intensive) as a listing written on paper or as sophisticated as a relational database structure. It was created prior to investigating whether similar resources existed; however, these are worth briefly considering for context and contrast.

Unfortunately, there are few avenues for discovering resources like KBCR made by individual researchers or collection managers for their own or their teams' use. With respect to public websites that link literature to specific objects, some of the sciences have found such a resource important to develop and maintain. For example, BioNames (bionames.org) has been connecting taxonomic names

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(life sciences) to literature for more than a decade (Page 2013, 2018, 2023), and Simbad (simbad.cds.unistra.fr/simbad) has undertaken similar connection-building for astronomical objects for over 20 years (Wenger et al. 2000). Both incorporate elements of cross-referencing multiple identifiers for the same species (BioNames) or astronomical object (Simbad). Differences between these and KBCR include the scale of both the material and contribution teams, maturity, and that identifying individual objects (and thus a survey count) is not relevant for BioNames. Another parallel (and inspiration for KBCR future presentation and collaborative input development) is the Electronic Literature Knowledge Base (elmcip.net/knowledgebase), which has been connecting individual creative works with critical writing about those works for more than a decade (Rettberg 2013), though it might be said that creative works might rarely face the issue of multiple or changing identifiers. Turning to the archaeology field, while there are many websites publishing databases of distinct object types—for example, Plain of Jars (plain-of-jars.org), and the *Espirit* collection of engraved prehistoric plaques of Portugal and Spain (iberian.its.uiowa.edu)—the author is yet to find a publicly available resource that connects an entire class of archaeological objects to all relevant literature.

The Khipu-Biblio Cross-Reference

This section describes the form and creation of the KBCR as a concrete example of the object-literature framework. The reader is encouraged to consider any modest-count object type where khipus are specified. The KBCR takes the form of three tables:

1. a table of all literature reviewed, where each piece of literature is given a unique code;
2. a table of the literature-to-object connections: for each piece of literature, there is a row for each object (or bundle) mentioned, and each individual object has a unique code;
3. *bundle* definitions: groups of objects commonly referred to as a set are given a unique bundle code.

An additional element—the *image bank*—was critical to the work and will be described shortly.

Literature

The literature table has one row for each piece of literature reviewed for the KBCR. Along with a formally structured citation and links to an online source, where available, the information collected includes author(s), year published, language, and whether it is a reprint of a previous publication. Each piece of literature is given a unique *literature-reference* code, which is used in the connection table (described shortly). Each chapter in an edited book is given its own unique code and entry in the literature table, alongside a standalone entry for the edited book.

The KBCR creator is monolingual, and reliance was placed on Google Translate for literature written in languages other than English. This was considered suitable for this purpose but would not be appropriate for heavily technical language or if nuance or sentiment analysis were required. Only the most recent literature was in digitized form, which could be put through Translate as a full document. Earlier literature was available as photocopies, scans, and occasionally as photographs of the material, and in these cases the text was handtyped prior to translation. This might have been sped up by applying OCR (optical character recognition) software, though its efficacy would have been minimal for text from the 1800s, particularly for low-resolution renderings of German gothic typeface, for example.

For the field of khipu research, the KBCR contributes to the body of work gathering and systematically analyzing literature following (in the original order of publication) Locke (1923), Radicati di Primeglio (2008a), Ascher and Ascher (1972), Urbizagástegui Alvarado (2014), and Medrano and Brokaw (2023). In the 2014 bibliography listing, over 800 pieces of literature were identified as relevant to khipu study; of course, more has been written since. The KBCR differs from preceding overviews in that it is focused on connections to real khipus (further described shortly). Literature is now published predominantly in English and Spanish, but older publications covered various languages, and KBCR compiles all of these to uplift awareness of the vast record beyond linguistic boundaries.

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Connections

The connection table has one row for each khipu mentioned in each piece of literature reviewed for the KBCR. The core data for each connection are the literature-reference code and the *khipu-code* (described shortly). Other information collected includes the page(s) the khipu mention occurs on, whether the mention is text and/or includes a full or partial image, and data to aid unique identification, such as museum and identification number and provenance, if known.

If the khipu is present in the KFG, the unique khipu-code in the KBCR reflects how that khipu is identified in the KFG database. While this is usually the same identifier (beginning with "KH" standing for khipu) used by the Open Khipu Repository (OKR; see Brezine et al. [2024] for an important discussion on naming conventions), there are some khipus in the KFG that are not in OKR and do not have a KH identifier; in these cases, the unique KFG identifier is used. Where there are other historic identifiers, these are included in the KBCR khipu-code for completeness. For the khipus that are not in OKR or the KFG, a unique khipu-code has been created specifically for use in the KBCR. This code uses the year the khipu first appeared in the literature, and often the museum identifier or find place.

The first time a khipu is mentioned in literature was a point of interest, and the count of *first mentions* effectively counts the unique objects. When a new connection was made to a khipu already in the listing, care was taken to check against previous or subsequent connections to be sure the first mention was accurately marked, and (for those not in the KFG) to adjust the khipu-code if necessary. If the information in the literature was insufficient to definitively establish that the khipu was the same as one already identified in the KBCR (e.g., a museum identifier, a KFG code, an image, or a description), it was given a unique khipu-code. However, it must be acknowledged that some of these khipus may already be listed elsewhere in the KBCR; but without detailed information to permit cross-reference confirmation, they necessarily remain uniquely identified and counted.

Authors regularly refer to groups of khipus without discussing the individual objects, such as the Santa Valley group (e.g., "a set of six colonial-era khipus found together in a tomb in the Santa Valley" [Hyland 2016:503]) or those from the Lake of Condors (e.g., "quipus found at Laguna de Los Cóndores" [Hamilton 2016:92]). It was decided it was inappropriate for the KBCR to assume that each khipu in the collective description was being individually mentioned, and so groupings or bundles were created. A bundle is given a unique *bundle-code* (each begins with "_bundle_"), which is used in the connections table instead of listing individual khipu-codes.[2]

The goal of KBCR specifically was to connect real khipus to the publications that mention them. Therefore, paper khipus—data reconstructions of khipus from information in transcriptions or textual evidence (Medrano 2021a:290)—were not included. Both modern-day funerary khipus (e.g., Tun and Zubieta Núñez 2016) and khipu boards (e.g., Hyland et al. 2014) were also excluded. Two khipus from the earliest literature, while considered apocryphal, are in the KBCR: that described by Sansevero di Sangro in his 1750 *Lettera Apologetica*, and the Strong khipu first published in 1827. These were included because historical literature regularly interleaves discussion of these with real, archaeological khipus. Other than these special treatments, all objects identified as khipus are included (for the khipu specialist, this includes Inca-style, Wari, *canutos*, etc.).

Making the Object-Literature Connections

Reading. In choosing how to approach over two centuries of literature for the KBCR, surveys of previous literature and khipus were taken as the starting point: in the original order of publication, Locke (1923), Radicati di Primeglio (2008a), Ascher and Ascher (1972, 1978, 1988), Urbizagástegui Alvarado (2014), Urton (2017), and Medrano (2021b). The work began with the earliest literature and worked forward in time. References and citations from each publication were added to the literature listing, and the earliest reviewed before moving forward in time again. This was useful in building an understanding of the chronological development of the field, which was especially relevant to the *first mention* data field. Where a piece of literature was found not to refer to real khipus, it remained in the listing as evidence of review.

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Building the connection table combined close reading with scanning and skim-reading of the literature. Sometimes a khipu was referred to using a museum identifier, or a researcher identifier like those first developed by Marcia and Robert Ascher (1972) and adopted by many subsequent scholars, where a khipu was uniquely identified in their study cohort by using two letters derived from their name followed by a number representing study order; for example, AS11, UR67 (Gary Urton), or HP10 (Hugo Pereyra) (see Brezine et al. 2024). However, not all literature used this convention, most obviously the literature prior to the 1970s.

Close reading was necessary to recognize descriptive references. For example, "dos quipus calendáricos" (two calendrical khipus; Zuidema 2014:397) refers to khipus with the identifiers KH0242 and KH0113. This could be quite challenging where an author referred to a khipu without discussing it in detail. For example, in the preface to his first publication, Erland Nordenskiöld lists the khipus he had access to but did not publish in detail; for example, "I have borrowed from the Linden Museum two well-preserved quipus" (1925a:4). One of these Linden Museum khipus appeared again in the literature only once, in 1969 (Menninger 1969:253), where it was presented as a photograph without further textual elucidation. For the KBCR, it was matched to khipu MM020 in the KFG by morphology.

Images. Images of the khipus, and any morphological descriptions or the presence of identifying features, were important for verifying which khipu was being referred to. There was a surprising number of errors in the literature, where the text or caption had the wrong khipu museum identifier or researcher-specific khipu-code (e.g., in Urton [2017], four plates [9, 10, 11, 12] are captioned with the incorrect identifier). These were corrected in the KBCR where it was obvious, which was usually where an image was also present; however, misidentifications may remain in the KBCR where information in the text was not sufficient to recognize an error.

Consequently, an *image bank*—a collection of all drawings and photographs from the assessed literature—developed into a crucial component in the process of populating the KBCR connection table. In earlier literature, visual representations of khipus were often inadequately identified, with some presented without a caption. Determining which khipus were represented sometimes required detailed visual investigation, either relying on the image bank or on making a comparison with the schematics in the KFG.[3] The image bank was also required for recent literature, where errors in captions and text mentions were more prevalent than expected.

Underdescribed Objects. Some literature referred to the existence of khipus without further elucidation. Where the count of khipus was modest, these were added as connections; for example, if there were 10 khipus found at an archaeological dig, each was given a unique khipu-code and added to the connections table. Subsequent literature occasionally gave more detail, from which individual khipu-codes could be updated.

However, it became evident that creating these placeholder khipu-codes for large collections was too onerous and error-prone. This situation was faced in assessing literature that worked with whole collections, or surveyed extant khipus (e.g., Ascher and Ascher 1978, 1988; Medrano 2021b; Urton 2017). For example, Medrano (2021b) counts 402 khipus in the collection of the Ethnologisches Museum in Berlin (EMB) (via Loza 1999) and 256 for the Museo Nacional de Arqueología, Antropología e Historia del Perú (MNAAHP) in Lima (via Adawi Schreiber et al. 2011). For the KBCR, it was decided that khipus from the EMB and MNAAHP collections that are alluded to but not individually identified would not be entered into the connection table. That is, only unambiguously identified khipus were included for these two museums. A similar decision was made for the "examined but not detailed" and "unexamined" khipus in Ascher and Ascher (1978, 1988) and the "unstudied" khipus in Urton (2017).

Findings from the KBCR

At the time of writing 599 pieces of literature, published up to the end of 2024, were assessed for the KBCR,[4] from which 3,886 connections were made to khipus or bundles. Of the connections so far made between literature and khipus (visualized in Figure 2):

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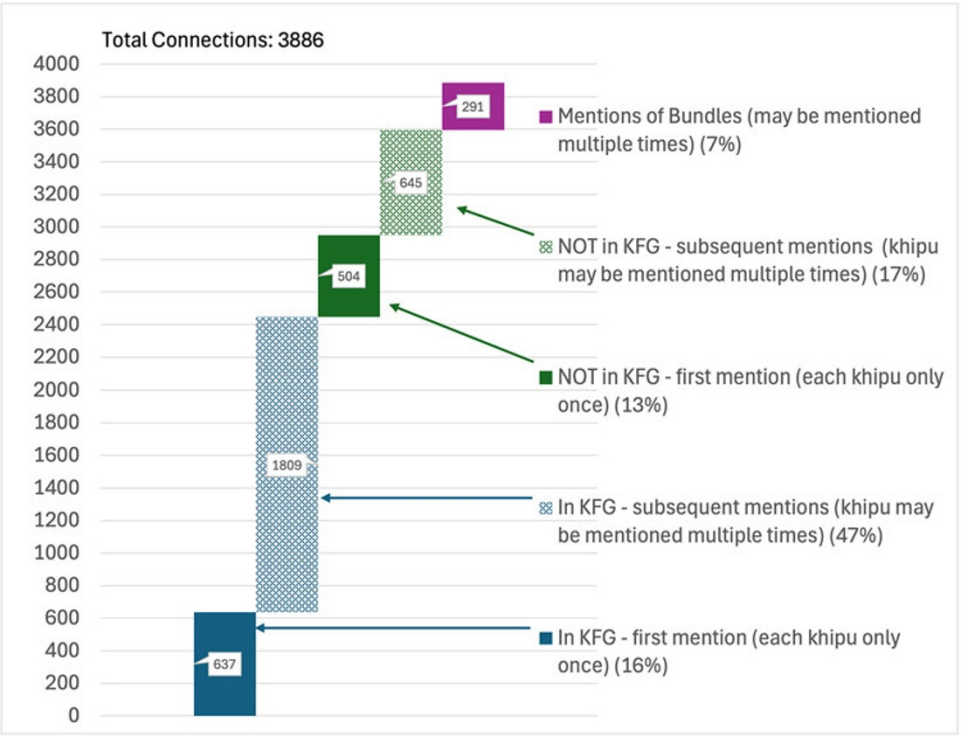

Figure 2. Makeup of all KBCR khipu connections.

- 1,141 (637 + 504; 30%) of these represent the first time a khipu is mentioned; there is one first mention per khipu, and this is effectively a count of unique khipus.
- 2,454 (63%) are subsequent mentions, following the first mention.
- 291 (7%) are references to bundles (groups of khipus, not individual khipus).

Patterns in Published Literature. Data from the KBCR allow for analysis of patterns in publication of information about khipus over the years.[5] For example, as shown in Figure 3, there has been a significant increase in literature mentioning real khipus since the early 1980s (also observed by Medrano 2021b).

This can be further interrogated by identifying when each unique khipu was first mentioned in the published literature. In Figure 4, each dot is a year with at least one publication with a khipu connection, and the line traces the cumulative mentions of unique khipus over time (up to a total of 1,141). The impact of individual publications can be observed as jumps in the line.

The KBCR highlights that 504 khipus mentioned in the literature have not yet been included in open khipu databases like the KFG. For example, the fact that almost as many khipus are included in the KFG database as are absent from it, and which therefore cannot contribute to investigations using data-driven methodologies (see Clindaniel 2019; Medrano and Khosla 2024), is a reminder of the gaps in current knowledge and a call to a concerted effort to study and include them.

Case Study 1: Building an Object Story from Published Text and Images

As a demonstration of the insights possible from an object-literature connection resource, this case study used the KBCR to trace two khipus through the literature. Images of these khipus, taken decades apart, also record the deterioration of the object(s) through time. They also hinted that the two khipus were the same object. A subsequent interrogation of the literature suggested no other author had associated them, and this historiography in miniature reveals the difficulties in khipu care and study.

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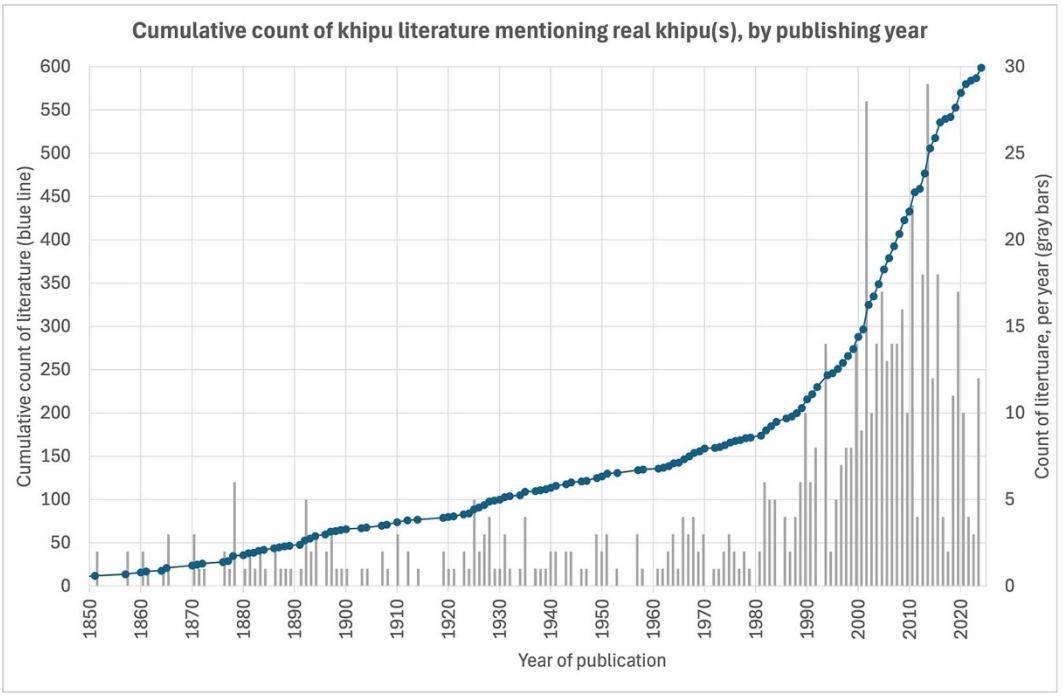

Figure 3. Count of all literature reviewed to date for the KBCR, by publishing year.

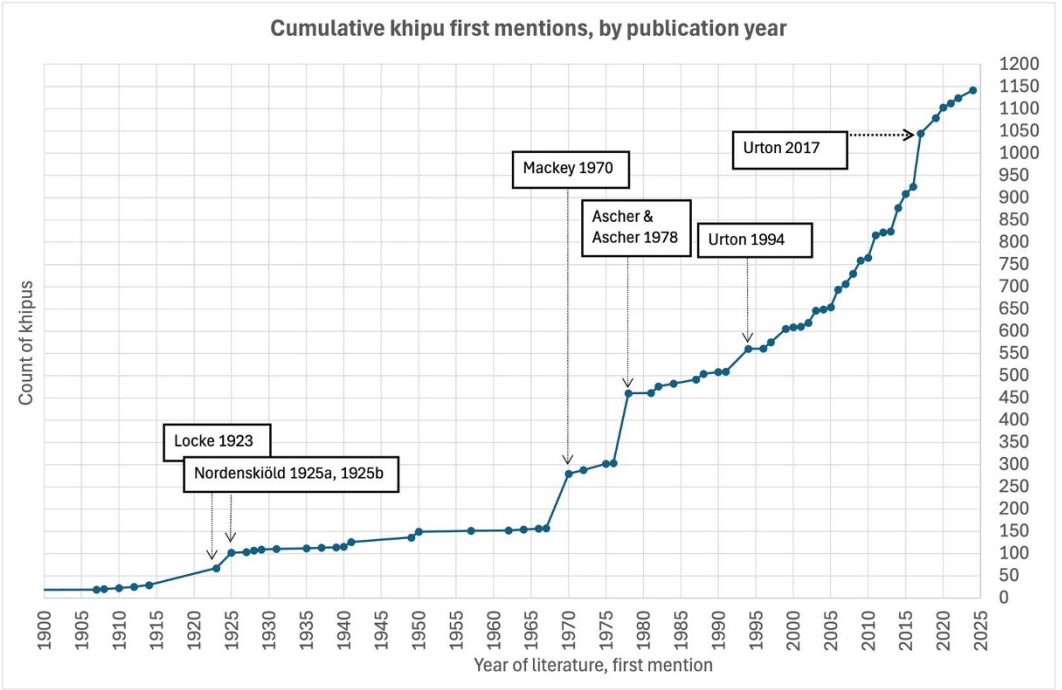

Figure 4. Graph of unique khipus, by the year of literature they were first mentioned.[6]

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Figure 5. Reproduction of image in Pacheco Zegarra (1881:plate following p. 328; reproduced here under fair use).

To the best of our current knowledge, the first photograph of a khipu was published in 1881.[7] Pacheco Zegarra represented the collector Dr. José Mariano Macedo at the Congreso Internacional de Americanistas in Madrid, and the photograph (Figure 5) was published in the proceedings (Pacheco Zegarra 1881:plate after p. 328; referred to as "1881-Macedo" in this section). The khipu is described as "Un quipu perfectamente conservado, el major conservado de cuantos hasta el presente se conocían" (A perfectly preserved quipu, the best preserved of those known to date; Pacheco Zegarra 1881:323). In the same year, the collector listed this khipu as #1497 of their collection: "Un grand rouleau de 'Quipus' ou écriture des Indiens formée de fils et de nœuds de différentes couleurs" (A large scroll of "Quipus" or Indian writing made up of threads and knots of different colors; Macedo 1881:69). Hamy briefly mentions the khipu when discussing Macedo's collection: "parmi lesquels se trouvent deux grands *quippus* qui présentent un extreme intérét" (among which are two large quippus which are of extreme interest; 1882:1:68).

In 1888 the *Archiv für Post und Telegraphie* published a line drawing (Figure 6; referred to as "1888-Post" in this section) of a khipu, from the Museum für Völkerkunde in Berlin (MfVB; now the EMB), with no discussion in the text (Anonymous 1888). Hamy (1897) briefly suggests comparing a khipu from the Musée du Trocadéro (Paris) with this line drawing: "On pourra comparer cette curieuse pièce à celle du *Museum für Völkerkunde* de Berlin publiée en 1888, par l'*Archiv für Post un Telegraphie*" (We can compare this curious piece with that of the Museum für Völkerkunde in Berlin published in 1888, by the *Archiv für Post un Telegraphie*; Hamy 1897:110). And in a footnote in an 1897 article, Uhle rather disparagingly describes the 1888 drawing as an example of khipus "reproduced more for the sake of curiosity than with any intention of explaining them" (1897:58n1).

In Locke's 1923 book, the 1881-Macedo khipu is listed as #35; the image in Figure 5 is reproduced on plate XLIII, with the following statement in the text: "It is not possible from the cut to determine the nature of the beads or shells used to group the strands" (Locke 1923:29). This proposal—that the 1881-Macedo khipu has beads or shells—is repeated in Altieri (1937:2), Radicati di Primeglio (2008a:83), and Ruiz Estrada (1981:30; Ruiz Estrada in fact appears to believe that the 1881-Macedo khipu is different from that presented as #35 in Locke [1923]). These materials, however, are likely to have been removable elements used for mounting and display by the collector, not shells or beads.

The 1888-Post khipu is separately listed in Locke (1923) as #36, and the line drawing in Figure 6 reproduced on plate XLIV titled "A Fine Drawing of Quipu No. 36 and a Section of the Same Quipu." Radicati di Primeglio also refers to 1881-Macedo and 1888-Post as two different khipus in both his 1951 and 1976 publications (respectively, Radicati di Primeglio 2008a:82–83, 2008b:305), the latter also included a reproduction of the image in Figure 5 (Radicati di Primeglio 2008b:307).

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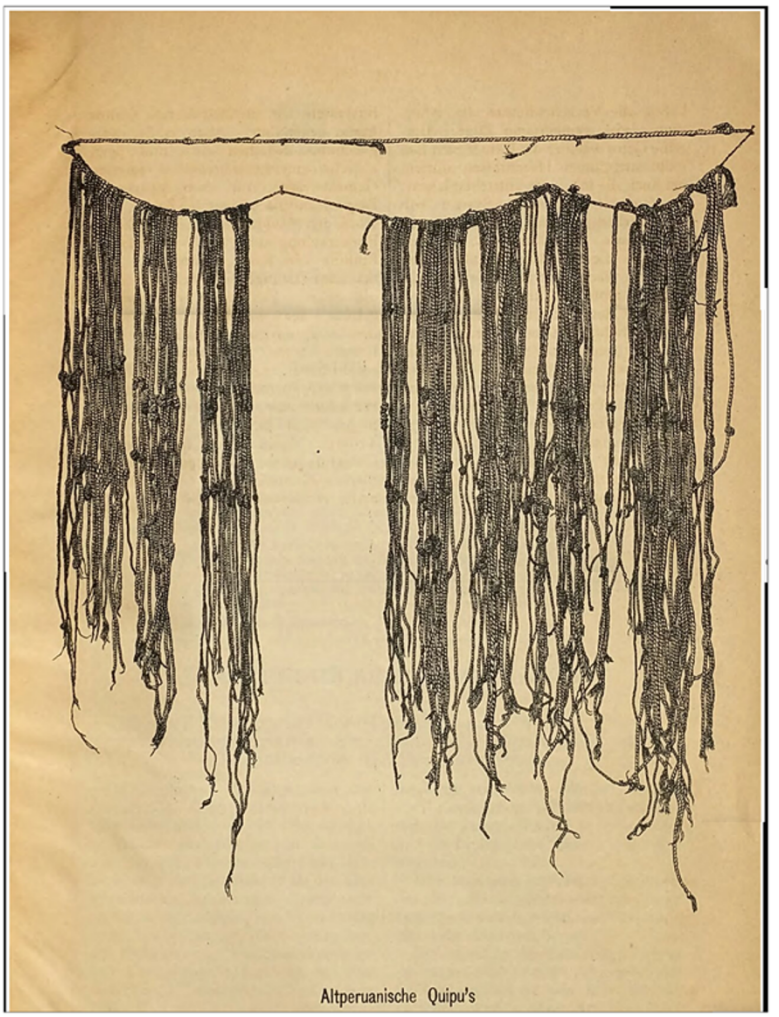

Figure 6. Reproduction of image in *Archiv für Post und Telegraphie* (Anonymous 1888:plate after p. 594; reproduced here under fair use).

Upon closer examination of the two images, it is evident that the morphology of the objects is consistent. That is, the 1881-Macedo and 1888-Post khipus are the same khipu. Figure 7 shows the top part of each khipu, with the 1888-Post khipu flipped along both the vertical and horizontal axis for easier comparison: the red arrows identify striking similarities in the cord groupings along the primary cord, and the boxes highlight particularly a remarkable alignment of knot patterns. Figure 8 shows the similarity in the patterning of the cord lengths. In reading both diagrams, it is important to be cognizant of the fact that one is a drawing and that its fidelity to the referent is unprovable.

Other literature tells us that the khipu was in Macedo's collection in 1881 but in the MfVB by 1888. It has been noted elsewhere that Macedo sold much of his collection to the MfVB in this period, this becoming the museum's second khipu (Gänger 2014:150, 153), and that Macedo donated a khipu to the MfVB in 1884 (Loza 1999:53). The latter publication is the first time a museum number was ascribed to the 1881-Macedo khipu(s) (three associated objects, VA4319a-c),[8] accompanied by an image of a set of three khipu fragments (Figure 9A). As Loza refers to the 1888-Post khipu as "a drawing of a fully displayed *quipu* that had originally been in the hands of Théodor de Ber" (Loza 1999:61; information attributed to Hamy), it appears that Loza considered them to be two different khipus.

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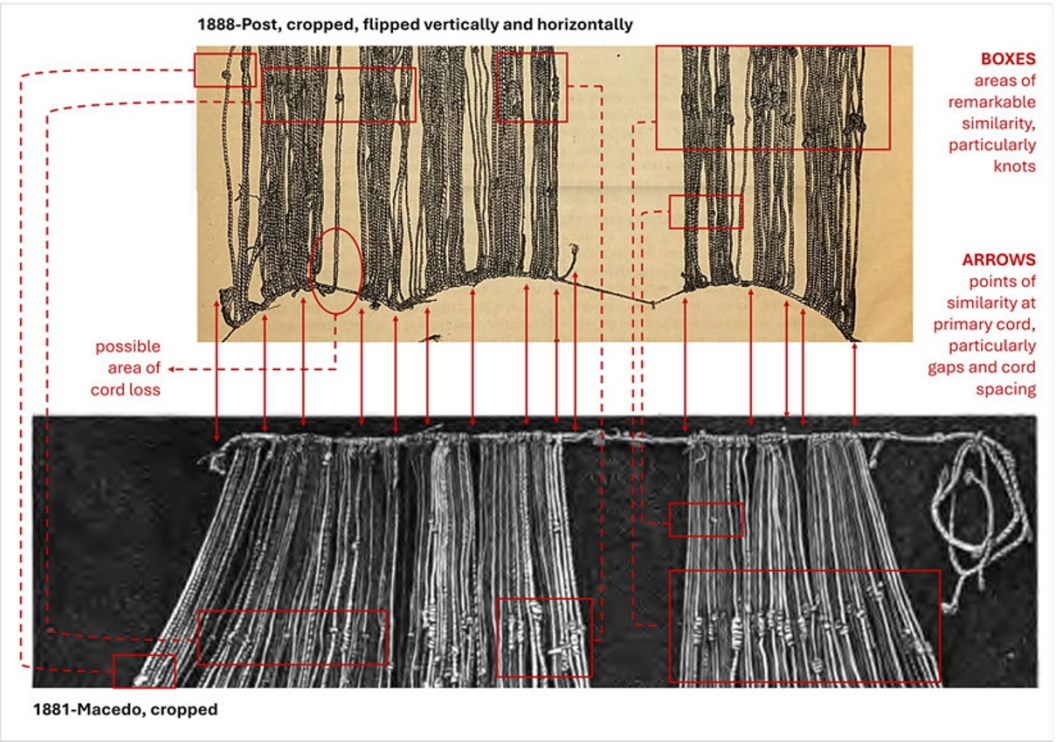

Figure 7. Comparison of 1881-Macedo, bottom, and 1888-Post, top; composite drawing made by author.

Returning to Gänger, Macedo's collecting history is detailed in a chapter (Gänger 2014:101–159), and an image of the khipu from the MfVB is included (Gänger 2014:102; Figure 9B). While a footnote in the text (Gänger 2014:155n218) refers to the 1888 *Archiv für Post* article while discussing Macedo's khipu, no explicit connection is made between the 1888-Post and 1881-Macedo khipus. It is also stated that "Macedo's notebooks retain detailed descriptions and measurements of the khipu in his collection" (Gänger 2014:127), giving hope to the possibility that the original khipu data could be reconstructed. Such a reconstruction of data would give us more information about this object than is available in its current state.

This case study has shown the value of tracing an object through a comprehensive literature survey—it has generated new knowledge about this khipu that had been treated as two different and separate objects until now. The partial loss of this khipu over time serves as an acute reminder of the fragile nature of khipu materiality and the challenges that collections face in their storage, care, and conservation. This exercise may not in itself be novel—many researchers undertake similar in-depth object- and literature-based investigations; however, the innovation is that the KBCR has facilitated the finding of all relevant literature in a way that was less time-consuming than a traditional research approach (recall FitzPatrick's [2024] difficulties).

Case Study 2: Revised/Updated Object Survey

As a second demonstration of the insights possible from an object-literature connection resource, this case study describes the revision/update to the count of known khipus. The detail will be of interest to khipu researchers, and the methodology and considerations are generalizable for any similar exercise with any other object-literature dataset.

While the exact number of khipus to have survived to the present day is not confidently known, early work by Ascher and Ascher (1978), and updated in Ascher and Ascher (1988), estimated the khipu count to be around 560. In 2017 Urton updated this to 923, though when corrected for some errors

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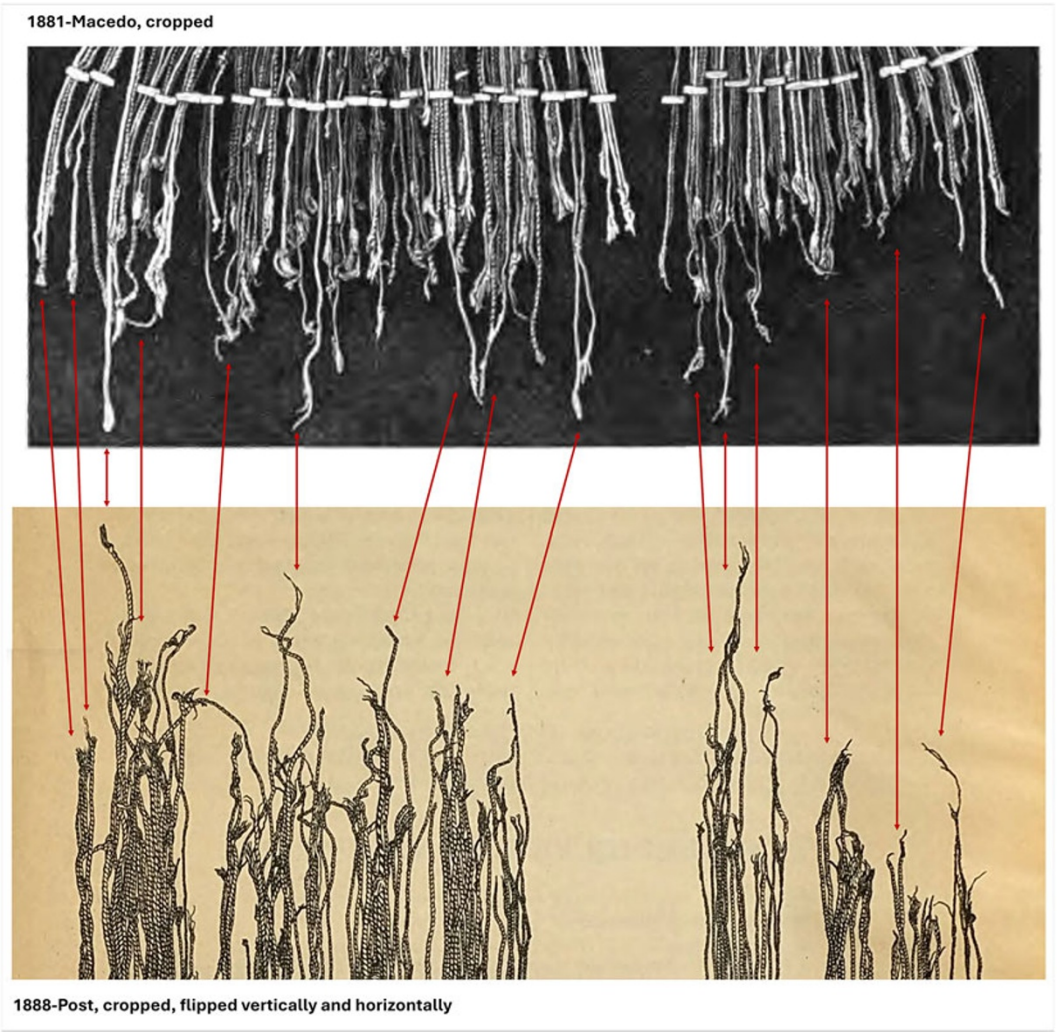

Figure 8. Overlaying 1888-Post over 1881-Macedo (flipped on vertical axis), detail; composite drawing made by author.

(detailed in the Supplementary Table 1) this becomes 918. The most recent formal survey undertaken by Medrano (2021b:147–162) greatly expanded the publicly available information about khipus with confirmed collection locations, and increased the count to 1,386.

The data collected for the KBCR were compared with Medrano's survey (the detailed revised survey and reconciliation is provided as Supplementary Table 1). Before comparing the numbers, it must be acknowledged that the 2021 survey was focused on counting khipus in collections. To that end, it is understood that several khipus in the KBCR were known of but not included in the published listing because their location could not be established. Concomitantly, it is important to state that for the KBCR data the location of a khipu (with some exceptions, which will be described shortly) has been taken directly from the literature and has not been independently confirmed. Additionally, more than 40 of the khipus in the KBCR have first appeared in the literature since 2021, after the Medrano survey was published.

This updated khipu count includes three special treatments. The first: direct adoption of Medrano's count for the two largest collections (item B2 in the numbers in Figure 10; for reasons already described). The second: direct adoption of Medrano's count where they were based on documents or correspondence that were not consulted for this study (items C2 and D2). The third treatment refers to three museum

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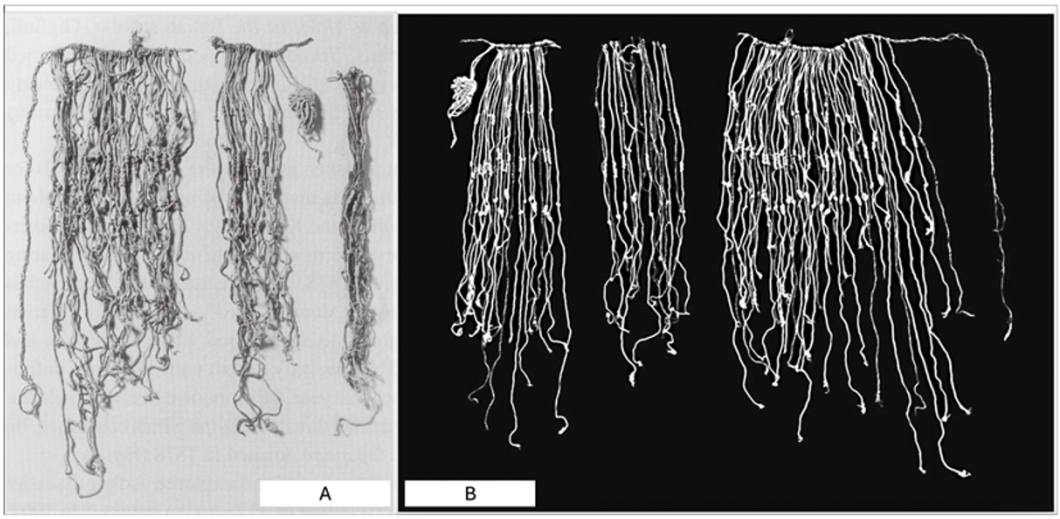

Figure 9. (A) Reproduction of image and caption in Loza (1999:54); (B) reproduction of image in Gänger (2014:102), noted as accession number VA4319 (Gänger 2014:155n219). (Both images originally from Staatliche Museen zu Berlin, Ethnologisches Museum, therefore reproduced here under CC BY-NC-SA 4.0).

counts that were supplemented by additional information obtained by the author. The khipu count for the American Museum of Natural History (AMNH) was revised based on information from their collections database,[9] which indicates they hold 105 individual khipus (not including fragmentary cords; split in Figure 10 by Medrano count [s1], additional in KBCR [s2], and the balancing count [s3]). The khipu count for the Phoebe A. Hearst Museum of Anthropology was consolidated using information from the museum,[10] and that for the Herrett Centre for Art and Science was based on a visit by the author (together making up item X1).[11]

The resulting count of khipus with location information, including private collections—which started with Medrano's listing and added data from the KBCR and above—is revised/updated to 1,656 (item H). The difference is made of (1) 54 from the AMNH, in addition to those listed in Medrano (items s2 and s3); (2) 104 from other collections where the KBCR count is different to the Medrano count (item F2; detailed by collection in Supplementary Table 1); (3) 53 from collections not in Medrano listing (item G); and (4) 55 additional khipus gleaned from a review of online museum collection data (item X2).

This total count increases if the 25 khipus identified in the KBCR as being in community (item I), such as those in Tupicocha and Rapaz, are added (noting that Medrano's listing was not intended to include this subset, and Rapaz is counted as one object for this purpose).[12] Similarly, the additional 40 khipus in the KBCR without museum information (item K) are not present in Medrano. The total count then increases to 1,721 if these two sets are included and the 10 apocryphal khipus and quipolas are excluded (item J), and this might be considered the maximum count of unique khipus based on the data. Figure 11 graphically maps the numbers in Figure 10, building the revised/updated survey count (middle column) by beginning with Medrano data (left column) and supplementing with new information (right column).

However, a count of 1,721 is almost certainly an overstatement. As previously discussed, it is likely that some khipus currently uniquely coded in the KBCR are already listed but cannot be linked owing to insufficient information; that is, they are counted more than once. Further, it is possible that a portion of the khipus labelled as "unstudied" or "unexamined" by Aschers and Urton have since been accounted for in the KBCR. If half of these elements (items C2 and F2)—as an exaggerated portion, for the sake of argument—were possible duplicates and removed from the count, it falls to around 1,650. The likely reality is somewhere between 1,650 and 1,721, and "around 1,700" may be a suitable approximate

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	Count of Khipus		South America	North America	Rest of World	TOTAL	
A	**Total in original Medrano 2021a**		**629**	**195**	**562**	**1386**	A = (B1 to F1)
B1	Large Collections (MNAAHP and EMB)	in KBCR	90		206	**296**	
B2		not in KBCR	166		196	**362**	**658**
s1	Special: AMNH (new information from collection)	in KBCR and Medrano		51		**51**	
s2		in KBCR not Medrano		23		**23**	
s3		not in either		31		**31**	**105**
C1	Collections with Medrano count > KBCR; with 'Unstudied' / 'Unexamined' (updating KBCR too difficult)	in KBCR	56	10	23	**89**	
C2		not in KBCR	24	16	19	**59**	**148**
D1	Collections with Medrano count > KBCR; unseen literature, Medrano personal observation and communications	in KBCR	9	7	28	**44**	
D2		not in KBCR	46	17	16	**79**	**123**
E	Collections where Medrano and KBCR agree on count		64	55	26	**145**	
F1	Collections with Medrano count changed in KBCR; additions from KBCR data	Medrano	174	39	48	**261**	
F2		Δ from KBCR	95	10	-1	**104**	**365**
G	Collections not in Medrano	Δ from KBCR	18	24	11	**53**	
X1	Additional: from correspondence	not in either		4		**4**	
X2	Additional: from museum website review (to April 2025)	not in either	4	14	37	**55**	
	not in KCR : gap / khipu is not in observed in literature; count is presumed from Medrano						
	Δ from KBCR : adjustment to Medrano counts based on data from KCR + AMNH						
H = sum of above	**NEW SURVEY TOTAL, with identified museum**		**746**	**301**	**609**	**1656**	also, H = A + F2 + G + X1+X2
I	In Community (eg. Tupicocha, Rapaz, Collata)		25			**25**	Rapaz counted as 1
J	not real khipus + quipola		—	—	—	**10**	not split by region
K	in KBCR but without Museum information		—	—	—	**40**	not split by region
L = B1 / B2s1+s2 + C1 + D1 + (E to G) + (I to K)	**Total unique khipus codes in KBCR**		531	219	341	**1141**	
N = H + I + K	**MAXIMUM possible given data available**		—	—	—	**1721**	

Figure 10. Reconciliation of updated/revised khipu survey counts.

count of khipus as supported by the information from Medrano and the KBCR data sources. The *actual* count of extant khipus is potentially higher, for there may still be unidentified khipus held in collections.

The KBCR as a Model

A resource like the KBCR can be created for almost any collection of objects. One could imagine this might be applied to the body of ancient perforated bone batons (e.g., Conard and Rots 2024),[13] copper bells from southwestern and Central America (e.g., Hawley 1953), pieces of *Opus anglicanum* embroidery (e.g., Michael 2017), Roman glassware, paintings of a particular artist or movement or material, or even immovable heritage such as the pyramids of Egypt. The only limiting factors are the scale of the body of literature and the count of objects of interest—the larger these are, the greater the time or size of contribution team that will be needed for the data collection to be completed. That said, insights were made, and anomalies uncovered, throughout the KBCR creation (and in fact, more so in the earlier stages), and the data collection and compilation are important pursuits in themselves, though there are

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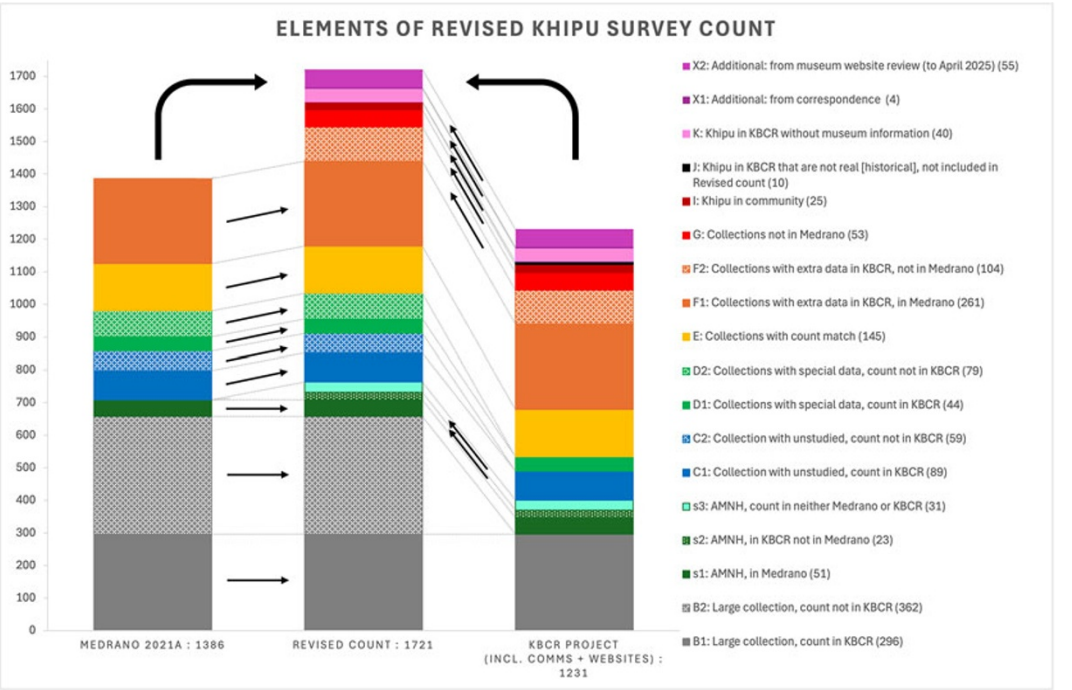

Figure 11. Explanation of elements of revised/updates khipu count.

material classes that might not be suitable for this resource, particularly those where there are so many items that they rarely are individually identified, such as pottery sherds or small lithic flakes.

While the KBCR was created in Microsoft Excel (see the Data Availability Statement), it could certainly have used other tools, including database structures. Excel was chosen for its ease of use, particularly the filtering and linking functions (the latter enabled changes to khipu-codes without manual search and typing), and because it is a widely accessible, simple tool with a low hurdle for inexperienced users (unlike some database software). Interoperability is enabled through exporting each tab as a .CSV file for use in other software. The addition of newly published or sourced literature to the KBCR will be undertaken at the end of each calendar year by the author. Future developments are planned for permanent hosting, website-fronted access, visualization, and collaborative contribution.

It is important to note that in its current form the KBCR cannot be used for a citation/reference or network analysis. The listing does not record all references cited in each piece of literature, nor has any judgement been made as to the quality (in depth or brief cursory mention) or sentiment (i.e., positive, neutral, negative) of any specific khipu connection. These elements could be incorporated if considered important aspects of the research. Google Translate would be insufficient for this purpose, and fluent readers in the languages of the literature would need to be part of the project team. There are additional complications around determining sentiment which would be best addressed by bringing a linguistic expert into the project team. An additional challenge yet to be considered is "Where does literature end?" Substantive knowledge is being shared online outside of academic and peer-reviewed literature channels, and criteria need to be developed to determine how these references may be introduced into the KBCR framework.

Closing Remarks

The KBCR collates, corrects, and organizes mentions of khipus from over 200 years of multilingual literature: for the first time, a comprehensive, error-corrected resource that traces which khipus have been written about through time is now available for researchers. It serves as the most complete listing

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to date of khipus known to the field from publications, with different identifiers for each aligned where feasible. The insights made possible by the compiled data include counting and locating objects, and drawing historiographies of the field and individual objects. The KBCR offers researchers and collection teams efficiencies in finding the exact literature they need and furnishes a more complete background for each khipu to honor preceding research and enrich future investigations. The KBCR is freely available (details in the Data Availability Statement), and individual connections are now integrated into the KFG for khipus in that database, so that each khipu's page includes a listing of the literature mentioning that khipu.

While many individuals and research teams certainly have created similar datasets, or extended their literature listings and bibliographies, to the best of the author's knowledge there is nothing similar to the KBCR that consolidates all known published information for a whole corpus (i.e., actual artifacts) of an archaeological object type, has corrected the data, and made them freely available in a simple format. The framework outlined for the KBCR creation serves as a model for databases of object collections. Datasets like the KBCR, when built for other object-based collections, particularly those of interest to archaeologists, will create new pathways for improving findability of what has been uncovered, conceptualizing an entire body of evidence, and ensuring that material can effectively contribute to the creation of new knowledge.

As research in many disciplines moves between object example-based and corpus-wide data-driven methodologies, resources such as the khipu-biblio cross-reference build a bridge between these two pillars that will become increasingly vital.

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Data Availability Statement. The KBCR is available on FigShare: https://doi.org/10.26188/25661322. The KBCR is available as an Excel spreadsheet. For interoperability, each tab from the Excel spreadsheet is also saved as a .CSV file. The data form lends itself to a database structure; however, using simpler data formats lowers the hurdle for effective use. The article's author welcomes corrections and suggestions. The Khipu Survey and related graphs are also available on FigShare: https://doi.org/10.26188/28786049, and these will be updated as the KBCR is updated.

Competing Interests. The author has no competing interests to disclose.

Supplementary Material. The supplementary material for this article can be found at https://doi.org/10.1017/aap.2025.3.

Supplementary Table 1. Revised Khipu Survey Split Out by Collection Where Known and Compared to Previous Surveys.

Notes

1. To address the need for organizing khipu data in a structured way that could be shared online, in 2002 the khipu database (KDB) project was launched, and in 2021 was rebadged as the Open Khipu Repository (OKR; https://github.com/khipulab/open-khipu-repository) (Medrano 2021b:60). Separately, more than five years ago, data from the publicly available KDB were used as the foundation for the KFG (https://www.khipufieldguide.com/). Data were thoroughly cleaned, some khipu data reconstructed from faulty data, and analyses further developed by independent scholar Ashok Khosla. Both OKR and the KFG are freely available online.
2. With thanks to an anonymous reviewer for pointing out that the Rapaz khipu (more in note 13) ought to be treated as a "bundle," and a future development is for "bundles" to be categorized according to the nature of their connection (e.g., association, same primary cord, tied primary cord).
3. For example, for the schematic of the largest khipus known to date, KH0082/AS69, see https://www.khipufieldguide.com/sketchbook/khipus/AS069/html/AS069_sketch.html.
4. The count of pieces of literature reviewed for the KBCR is fewer than the count of literature in the Urbizagástegui Alvarado (2014) bibliography (over 800). Much of that list relates to the study of the Spanish chronicles, which do not refer to real khipus.
5. Chapters in edited books are counted individually in the KBCR; for example, six of the seven pieces of literature in these data published in 1990 are from one edited book by Mackey and colleagues (1990).

6. This graph (Figure 4) differs from a similar graph in Medrano (2021b:117, Figure 14) because data for each were collected for different purposes. Medrano maps digitization dates, the KBCR does not. Medrano defines the "year" of introduction/mention, which sometimes differs from that in the KBCR.

7. Prior to 1881, the only khipus to have appeared in published literature were (1) *Letter Apologetica*, apocryphal (Sansevero di Sangro 1750); (2) Strong's (1827) quipola; a later watercolor drawing is often reproduced; (3) the large khipu found by von Tschudi (1846) in Lurin, often republished as partial line drawings; (4) a description and line drawing of a khipu in the Philadelphia Exposition (Saffray 1876); and (5) the fleetingly described existence of one in Germany—"ein baumförmig gestalteter befindet sich im Berliner Museum" (there is a tree-shaped one in the Berlin Museum; Andree 1878:195).

8. VA4319a: https://recherche.smb.museum/detail/4410/khipu-fragmente. VA4319b: https://recherche.smb.museum/detail/2006541/khipu-fragmente. VA4319c: https://recherche.smb.museum/detail/2006542/khipu-fragmente.

9. With thanks to Mary Lou Murillo, Senior Museum Specialist, Textiles, Division of Anthropology at the AMNH; data provided are publicly available through the AMNH online collection search (amnh.org/research/anthropology/collections/collections-database). The AMNH uses the catalog number for an object's unique identifier, whereas most museums use the accession number. Some of these khipus are listed with "sub-catalog" numbers (i.e., with suffix "a," "b," etc.), and therefore the count exceeds the number of unique catalogue numbers used for khipus in this collection.

10. With thanks to Melissa LaFortune, Collections Manager, Phoebe A. Hearst Museum of Anthropology, University of California, Berkeley, California, USA.

11. With thanks to Shelby Hamblem, Director, Herrett Center for Arts and Science, within College of Southern Idaho, Twin Falls, Idaho, USA.

12. With thanks to an anonymous reviewer for requesting this clarification: an important note about the Rapaz khipu is that it is counted in the KBCR as one single object, though it is acknowledged that "contrary to often repeated assertions about a unitary 'giant khipu,' it is, in fact, an assembly of 263 discrete cord objects" (Salomon and Peters 2009:111).

13. Nicholas Conard, in an interview (https://www.youtube.com/watch?v=Q8X9l42ZgsU), states that they do not know how many of these items have been found (from time 11m06s).

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