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# An exceptional assemblage of archaeological plant fibres from Windmill Way, southeast Cape York Peninsula

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**ABSTRACT**

To date only a handful of Australian archaeological sites with plant-based objects from the Mid-to-Late Holocene are known. This paper substantially increases this dataset by describing an assemblage of more than 500 fibre fragments from the site of Windmill Way in southeast Cape York Peninsula, Queensland. These objects predominantly represent the end stages of fibre processing, primarily comprising string and netted and looped fabric, with an age range spanning from 1,700–1,589 cal BP to 252–75 cal BP. While the highly fragmented nature of the Windmill Way assemblage makes definitive identification of individual objects difficult, double looping, rather than knotting, was the preferred means of construction, with many pieces clearly deriving from dillybags. Rarer pieces may be fragments of pubic tassel belts or mourning strings. The string, knots, mesh, gauge and loops were all relatively uniform through time, demonstrating intergenerational knowledge of a refined and stable practice. The presence of only two post-contact items (a hooked piece of wire and a strip of red cloth), combined with the radiocarbon sequence, suggests that the site was abandoned around the time Europeans invaded the region in 1874, when wide-scale frontier conflict commenced. Detailed microscopic analysis of the fibres to identify plant species, as well as analyses of the macrobotanics, resins and other organic material culture items recovered from the site are ongoing.

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Fibrecraft; Cape York Peninsula; dillybag; string; netting; Laura; bast fibre; late Holocene; material culture

## Introduction

Organic materials, and string in particular, have played a critical role in the lives of people throughout antiquity. To date, the oldest known direct evidence for string production is a fragment of 3-ply cord made from bast (inner bark) adhering to a stone artefact at the Neanderthal site of Abri du Maras in France, dating from 52±2–46±5 ka (Hardy et al. 2020). Indirect evidence also points to early string technology, including use-wear patterns on stone artefacts in the Philippines dating from 39–33 ka (Xhauflair et al. 2023) and the presence of deliberately pierced shell beads, probably strung as necklaces, found variously in Morocco (82 ka) (Bouzouggar et al. 2007), South Africa (77 ka) (d'Errico et al. 2005; Henshilwood et al. 2004) and Israel (135–100 ka) (Bar-Yosef Mayer et al. 2009; Vanhaeren et al. 2006).

While Balme (2013) has convincingly argued that the late Quaternary peopling of Australia affords indirect evidence of the oldest string use in this continent, local preservation conditions are rarely conducive to the survival of organics. Excavation and recovery methods may also limit their retrieval. As such, researchers have often turned to other sources to understand Australian ancient string production, drawing on ethnographic and ethnohistorical accounts of fibre manufacture and use (e.g. Clement and Schmeltz 1903; Davidson 1933; McConnel 1953; Roth 1901; Withnell 1901), archaeologically recovered beads (e.g. Balme and O'Connor 2019; Hook et al. 2024; Morse 1993) and residues on grinding stones (e.g. Hayes et al. 2018), and depictions of fibre objects and plants in rock art (e.g. Grey 2023, 2024; Hayward et al. 2018; Miller 2016, 2021; Veth et al. 2018). To date, direct evidence of Indigenous-made plant fibres has been recovered from 21 archaeological sites nationwide (Table 1 and Figure 1).

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**Table 1.** Summary of Australian archaeological finds of plant fibre objects.

| Site | Age | Geology | Description of finds | Reference |
|---|---|---|---|---|
| Kongarati Cave, Fleurieu Peninsula, SA | Late Holocene | Limestone | Strips of fish nets, wads of chewed, unspun fibre, cord used to stitch a kangaroo skin cloak. | Tindale and Mountford (1936) |
| Currarong, coastal NSW | Late Holocene <2 ka | Limestone | One wad of unspun fibre and one knotted piece of 2-ply plant string. | Lampert (1971) |
| Paribari, East Alligator Rivers region, NT | Late Holocene <3 ka | Sandstone | Total number ambiguous, but includes three fragments of woven fibre, several pieces of rolled fibre, wooden and grass-stem objects, 'soiled bark fibre string' on a woomera head and an impression of string in resin on a fragment of *Phragmites* fish spear. Twined fibres were analogous to matting and baskets documented locally in the nineteenth century, each varying in appearance and gauge, suggesting discrete objects. Several pieces of string were tentatively identified as 'either *Hibiscus tiliaceus* (cottonwood tree) or *Brachychiton paradoxum* [red-flowered kurrajong]'. | Schrire (1982:64, 66) |
| Jimeri, East Alligator Rivers region, NT | Late Holocene <0.5 ka | Sandstone | A 'few strands' of rolled plant fibre. | Schrire (1982) |
| Anbangbang, Kakadu National Park, NT | Late Holocene <1 ka | Sandstone | 65 objects, including string segments, bundles, one fragment of bast netting, fur and hair fibres in 2-, 3- and 4-ply. | Clarke (1985, 1987) |
| Kawambarai Cave, Warrumbungle National Park, NSW | Late Holocene (~1.9 ka to surface) | Sandstone | 'leaf and stem … twisted in a similar manner to string'; several pieces of knotted spun and unspun fibre. | Beck and Dotte-Sarout (2013); Murphy (1992) |
| Djuwarr, Kakadu National Park, NT | Late Holocene | Sandstone | Bast fibre string. | Clarke (1988:125–126) |
| Magnificent Gallery, Jowalbinna Station, Qld | Late Holocene | Sandstone | String. | Morwood and Jung (1995) |
| Swan Reach, Lower Murray River, SA | Likely post-contact period | Limestone | Two fragments of coiled sedge basketry, string and netting. | Hemming et al. (2003) |
| Djurray, Arnhem Land, NT | | | Dillybag, two skeins of cord (one of which was 'tassled and ochred'). | Gunn et al. (2017) |
| Dillybag site, East Quinkan Reserve, Qld | Post-contact period | Sandstone | Dillybag. | McLay (2023); McLay et al. (2024) |
| Blue Figures, Deighton Block, Qld | Post-contact period | Sandstone | A woven net. | Cole (1991) |
| Kens Cave, Central Highlands, Qld | Late Holocene | Sandstone | Two segments of plant fibre string. | Morwood (1981) |
| Brremangurry, WA | Late Holocene <0.5 ka | Sandstone | A 1.5 cm long fragment of 2-ply string, adhering to a small piece of quartzite. | Mark Moore (pers. comm. 2021) as cited in Balme et al. (2022:2) |
| Carpenters Gap 1, Kimberley, WA | Mid-to-Late Holocene <3.8 ka | Limestone | Six fragments of 2-ply bast fibre string. | Balme et al. (2022) |
| Riwi 1, Kimberley, WA | Late Holocene <2.7 ka | Limestone | Six fragments of 2-ply bast fibre string. | Balme et al. (2022) |
| Wongulla Series, Lower Murray River, SA | Likely Late Holocene | Limestone | Fragment of string bag. | Westell et al. (2024) |
| Caurnamont, Lower Murray River, SA | Likely Late Holocene | Limestone | Chewed rush fibre. | Westell et al. (2024) |
| Mobilong, Lower Murray River, SA | Likely Late Holocene | Limestone | Chewed fibre and twisted rope or cord. | Westell et al. (2024) |
| Murkbo Flat, Lower Murray River, SA | Likely Late Holocene | Limestone | Fragment of woven rush. | Westell et al. (2024) |
| BALN00245, Gaarraay National Park, Qld | Post-contact | Sandstone | Plant string hafts on four wooden spear shafts. | Wallis and Burke (2024) |

The largest known assemblage derives from Anbangbang I, a sandstone rockshelter in Kakadu National Park, Northern Territory (NT). Excavated in 1981, 65 segments and seven bundles of plant string (including *Pandanus*) were recovered from Anbangbang, including fragmentary parts of a probable dillybag (Clarke 1985:90, 92, 1987:157, 1988)[1]. All objects were made from 2-, 3- and 4-ply bast fibre featuring a range of knots, and dated to the last 1,000 years (Allen and Brockwell 2020:147).

More recently, Balme et al. (2022) reported on fibres from the rockshelters of Riwi and Carpenters Gap 1 in the southwest Kimberley, Western Australia (WA). Preservation in these limestone sites was generally regarded as excellent, with eight fragments of string (six of plant and two of human hair) recovered from Riwi and 11 (six of plant and five from possum hair) from Carpenters Gap 1. These items, dated from the recent past to potentially 3,800 years ago, led Balme et al. (2022) to conclude that the

[1]The Anbangbang I fibre assemblage represented only a 20% sub-sample of the site (Sally Brockwell, pers. comm. 2025); unfortunately, the unsorted plant material stored at the Australian National University's Weston Store facility was destroyed in the 2003 bushfires (Swete Kelly and Phear 2004).

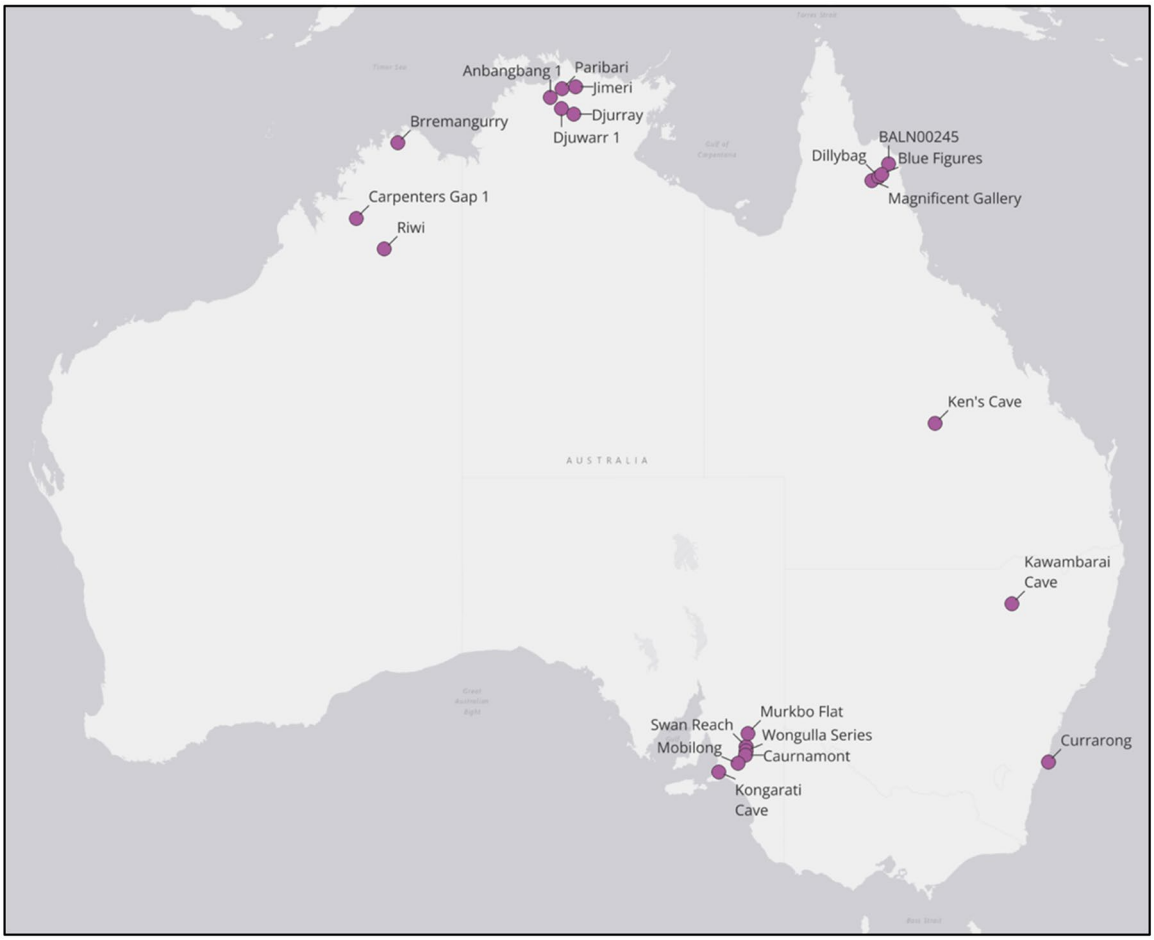


**Figure 1.** Locations of archaeological sites with plant fibres in Australia.

finds were demonstrative of regional continuity of string manufacturing techniques. While their small size prevented definitive identification of the purpose of any of the items, some were associated with feather barbules, and two from Riwi were also ochred, suggestive of an ornamental function (Balme et al. 2022:11).

Beyond these sites, most plant fibres recovered from Australian sites comprise a small number of fragments and have been the subject of limited study, though it is worth noting plant fibres thought to derive from either binders or brushes were recovered from paints in the Quinkan region (Cole and Watchman 1992), and a woven net was observed on the floor of the Blue Figures site (Cole 1991). Here we report on the analysis of an assemblage of more than 535 fibre fragments recovered from the site of Windmill Way, in the National Heritage listed Quinkan Country of Queensland (Qld). To understand what objects these fragments might derive from, and observe manufacturing details omitted from ethnohistoric accounts, they were compared to fibre objects held in the Queensland Museum (QM) and provenanced to the same general—or, in the case of the Dillybag site [cf. McLay 2023; McLay et al. 2024]—specific region. Our findings provide a rare insight into the use of string material culture by the *Bama* (Aboriginal people) who occupied Windmill Way in the Late Holocene.

## Windmill Way

Windmill Way is located on Welcome Station, 19 km northeast of the Laura township in southeast Cape York Peninsula (CYP), at the junction of the Battlecamp Sandstones and Laura Lowlands subregions of the Laura Sandstone Basin (Morgan et al. 1995:5; Figure 2 upper left). The site was named by the Laura Land and Sea Rangers, who first recorded it, and who are part of the *Koko Warra* Native Title holding group, although the 'Laura mob' is composed of multiple cognatic descent groups. It was recorded and excavated as part of the collaborative Agayrr Bamangay Milbi (ABM) Project.

Located on the southern side of the sandstone scarp, Windmill Way faces west and consists of several low-ceilinged, roughly circular alcoves collectively measuring 29 m in length by 4.6 m in width. The walls and ceiling of the shelter contain a rich rock art assemblage, including painted, drawn and stencilled motifs in a wide array of colours (Figure 2 centre right), as well as an engraving. Shallow sediment has accumulated on the

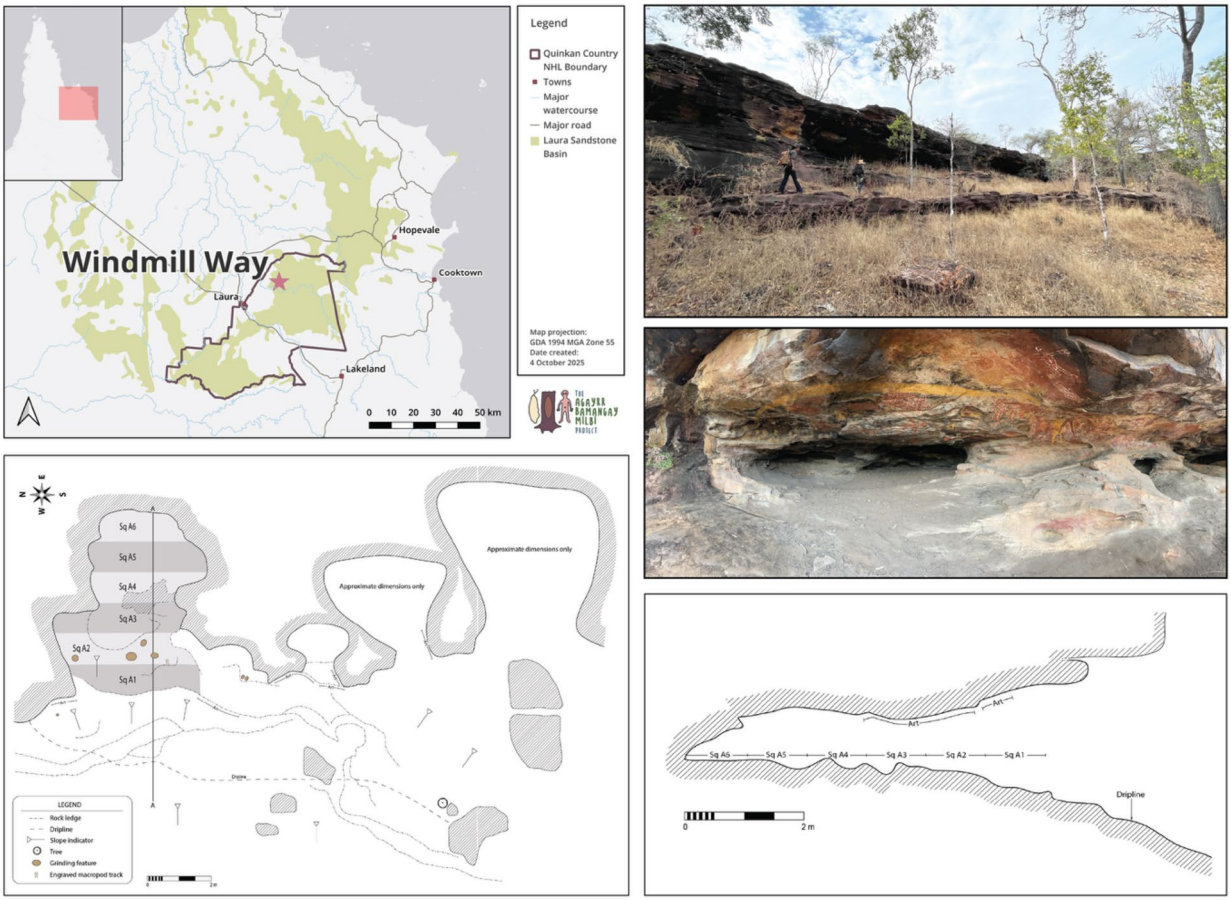


**Figure 2.** Location and views of the study site: (upper left) location of Windmill Way; (lower left) site plan; (upper right) view looking southeast up to site (photo by Lynley Wallis); (centre right) panoramic view of the northern alcove and rock art, prior to excavation (photo by Lynley Wallis); and (lower right) profile.

uneven, slightly sloping bedrock floor, and the maximum ceiling height is 3.1 m at the dripline. This decreases markedly towards the rear, limiting suitable living space and making comfort variable depending on where in the shelter one is situated. The northernmost alcove, from which the assemblage discussed here was recovered, measured approximately 3 m in width and 2.5 m in length, and had a maximum ceiling height <1 m.

Average annual rainfall is about 950 mm, often associated with thunderstorms and occasional tropical cyclones from mid-December to May, with rain almost non-existent from June to September (BoM 2025). Temperatures range from an average daily minimum of 16.1 °C and maximum of 28.3 °C in July to between 22.5 °C and 34.1 °C in December.

The Laura Basin encompasses a variety of regional ecosystems supporting a suite of different plant species (Neldner et al. 2023). Botanical surveys around Windmill Way undertaken in the 2024 dry season (not the ideal time to capture the full range of floristic diversity) by staff from the Queensland Herbarium identified three vegetation communities on the flat tops of the local escarpment: *Melaleuca viridiflora* low woodland, *M. stenostachya* woodland, and *Corymbia stockeri* and *Eucalyptus tetrodonta* woodland. Immediately at the base of the escarpment are areas of *E. leptophleba* woodland (associated with drainage lines) and *E. tetrodonta* woodland. The sandstone forms a fire refuge, allowing the establishment of a narrow band of deciduous notophyll/microphyll vine thicket along the escarpment edge.

Before the nineteenth century, the region around Windmill Way was occupied by patrilineal, patrilocal clans of 25–50 people (Sutton and Rigsby 1982). Neighbouring clans shared customs and spoke dialects of the same language. The size of clan lands varied with local biodiversity, thus, groups occupying the drier, sparsely vegetated interior of the Laura Sandstone Basin had relatively large estates (Morwood 1995:33). Although isolated maritime contacts on the west and east coast of CYP had taken place as early as the seventeenth century (Collingridge 1906; Mutch 1942; Robert 1973), and Edward Kennedy's party passed west of Laura in 1848 (Logan Jack 1921), Europeans had no persistent presence around Windmill Way until 1874, when gold discoveries were announced on the Palmer River (Hann 1873). After this date tens of thousands of non-Indigenous people flooded into southeast CYP, causing

widespread and devastating changes. Despite these upheavals, extensive social networks for ceremony, trade, warfare and intermarriage were documented across the region in the late 1890s by the first Northern Protector, Walter Roth, indicating both the resilience and resourcefulness of local *Bama*. The last family groups remained living on Country until the 1920s and 1930s, when they finally agreed to 'come in' to fringe camps (Cole 2010:18; Trezise 1968, 1971:25).

## The ethnohistory of fibre production in southeast Cape York Peninsula

A major source of information on fibrecraft in SE CYP derives from the work of Walter Roth, although it is not clear that he ever visited Laura specifically. He certainly collected objects from the Frome and Musgrave Native Mounted Police (NMP) camps and met *Bama* from the region in 1898 (Khan 1993, 2004; Roth 1898b, 1898c, 1898d), as well as writing detailed descriptions of people and material culture northwest of Laura in the hinterland of Princess Charlotte Bay (Roth 1898a), and south around the middle Palmer River (Roth 1899). Accordingly, it seems reasonable to assume that many of his observations about fibrecraft are at least relevant to the Laura region, if not derived directly therefrom. Unfortunately, although Roth's observations captured key aspects of production processes and techniques, his interest failed to extend to many nuances of detail, such as when materials were harvested and by whom, whether plants were valued for attributes other than strength or colour or the significance, if any, of bicolour striping employed in some dillybags.

In CYP string was made from both animal (human-, possum- and macropod-hair and macropod-tail tendons) and plant products (Roth 1901). Generally, the bark of young trees would be soaked in salt or brackish water, sun dried, split into the desired length and thickness, and then rolled. Sometimes the bark was chewed to soften it. As shown in Figure 3, the process generally involved the operator rolling the prepared fibre (Figure 3.1) 'forwards upon the outer side of the thigh … [to produce] a slight tension', thereby creating a 'strand' (Figure 3.2). The strand was then folded in two (Figure 3.3), with the 'bend' being held between the thumb and forefinger of the left hand, and the remainder rolled under pressure 'once comparatively slowly forwards and, without removing the pressure, once somewhat-sharply backwards' (Figures 3.4 and 3.5). The forward movement caused the strand to form into a single uniform twist (Figure 3.6), and the 'results of the combined forwards-and-backwards movement is to roll the strand into two twists of an

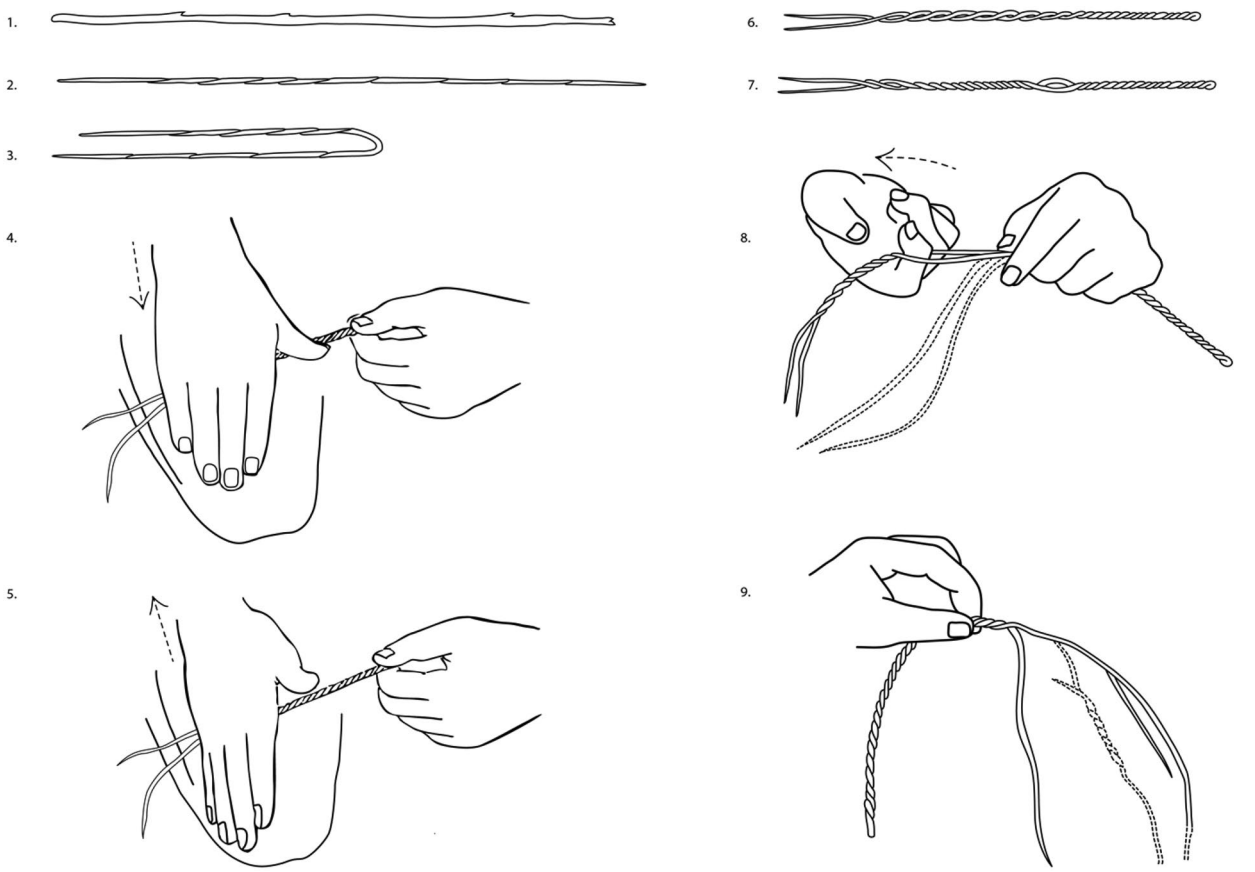


**Figure 3.** Illustrations by Roth (1901:Plate II) demonstrating the process of fibre string production in north Queensland.

opposite direction with a 'break' in between' (Figure 3.7). The 'break' was removed by,

> … holding the portion just above it between the left thumb and forefinger (to prevent the twine already manufactured from becoming untwisted) and inserting in it [Figure 3.8] the right forefinger, which is pulled firmly but carefully outwards, thus as the same time freeing the two extremities of strand. While the left hand retains its present position, the two extremities of strand are again rolled once forward, and once backwards, the 'break' removed as before, the process thus repeated again and again. All fibre-twines are thus made of two plies … the presence of the 'break' prevents the twine already manufactured from becoming untwisted each time the left hand shifts its position onwards. As soon as one of the extremities of strand under consideration has been reached, another strand is fixed to it [Figure 3.9] by a simple rolling-forwards: this composite is then rolled into the other as before. (Roth 1901:10)

Roth (1901) described various ways to preserve the continuity of twine, included super-positioning, splicing, looping, knotting, splitting and the use of beeswax. Fibres could then be used for plaiting, chain work, over-knotting, fringing, winding, lacing, top-stitching, over-casting, basketry, woven bag-work and net-work. While 'staining' was sometimes added to colour fibres, natural plant colours included cream, brown, red, green and white. Later observations on the manufacture of plant fibre string from cabbage tree palm leaf cortex at Edward River and Aurukun by West (1980, 1999) in 1978 revised and updated Roth's (1901) descriptions without altering the basic process.

Hale and Tindale (1934:137), in describing fibrecraft practice at Princess Charlotte Bay, noted that '… the mesh of the nets obtained is mostly the hour-glass or double-loop pattern, although the knotted netting stitch pattern is rather common'. *Livistona* fibre and *Acacia* bast fibres were preferentially used for dillybag production, and sometimes other barks 'in the preparation of thicker string, such as that used for large fishing nets and for the mooring ropes of canoes' (Hale and Tindale 1934:137; see also Thomson 1934:229–231).

More recently, Laura Elders Nancy Musgrave and Laura George (both now deceased, and relatives of authors CM, RG and N Coleman) gathered and prepared cabbage tree palm frond cortex for string production and weaving in 1975, captured (albeit imperfectly) by Andrée Rosenfeld in a series of rare photographs shared with family members and Noelene Cole (Figure 4). *Lama Lama* Elders similarly noted the use of cabbage tree palm cortex, along with native fig bast, for making string, and pandanus leaves for weaving baskets (Bassani et al. 2006). *Kuku Thaypan* Elder George Musgrave (now deceased) led a weaving workshop at Laura in the late 1990s attended by several of our authors (CM, RG, N Coleman and N Cole), demonstrating how pandanus string was used for weaving bags, and how string could be coloured using the red dye from *Haemodorumi* sp. bloodroots. Such sources demonstrate a wealth of ongoing knowledge and skills amongst Laura Elders, with both women and men being skilled in fibrecraft and retaining knowledge about the specific plants from which fibres could be produced.

Together, these sources indicated that plant materials were used for a range of purposes in SE CYP during the nineteenth and twentieth centuries, including food and shelter, technologies, ornamentation, games, and medicine (Table 2).

## Field and analytical methods

### Excavation

At the outset, signs of repeated macropod, pig and dingo visitation made it clear that the site integrity of Windmill Way was highly compromised. However, in 2021 the identification of charcoal and pieces of string in the northernmost alcove indicated that excavation might be worthwhile. Windmill Way was excavated the following year (2022). The presence of large amounts of roof fall restricted excavation to the northernmost alcove, which was divided into six 1 m-wide strips (labelled 'Squares' A1–A6), each spanning the width of the alcove, and all of which were excavated to bedrock (Figure 2 lower left and Figure 5).

All deposit was passed through nested 7 and 3 mm sieves. Initially, a 1 mm sieve was also used in the hope of retrieving beads and fish bones, but sorting of a sub-sample of the residues yielded no such remains and this time-consuming process was discontinued. All cultural material from the larger sieve residue was preliminarily sorted in the field and returned to Griffith University, Brisbane, where it was separated into raw material types. The 3 mm sieve residue was fully retained and sorted in the laboratory after washing and drying.

Apart from the fibre artefacts discussed here, other artefactual material recovered included bone and wooden artefacts, flaked and ground stone artefacts, mussel shell, macrobotanical remains and ochre (ABM Project unpub. data), study of which is ongoing.

### Radiocarbon dating

Six in situ charcoal samples were submitted for dating to the Waikato Radiocarbon Dating Laboratory


**Figure 4.** Laura Elders demonstrating weaving in c.1975: (a) Nancy Musgrave and Laura George collecting cabbage tree palm fronds at Dowling Yards; (b) Nancy Musgrave stripping the frond cortex; and (c) (d) and (e) the dillybag beginning to take shape (photos by Andrée Rosenfeld, reproduced courtesy of Christine Musgrave, Roseanne George, Nancy Coleman and Noelene Cole).

(Table 3): two from charcoal concentrations sitting immediately atop the bedrock (~15 cm below surface), the largest of which was 45 cm across x 5 cm deep, while the other four comprised large fragments collected during excavation. Twelve fragments of processed plant fibre were subject to AMS radiocarbon dating at the Waikato Radiocarbon Dating laboratory, ANSTO and the Chronos Radiocarbon Laboratory (Table 3). At Chronos, sample preparation involved teasing apart the individual fibres, followed by an Acid-Base-Acid pre-treatment protocol (equivalent to pre-treatment code CP in Turney et al. [2021]). At ANSTO sample pre-treatment involved cleaning in de-ionised water using an ultrasonic bath, an Acid-Base-Acid treatment followed by a bleach treatment using $NaClO_2$/HCl solution, washing thoroughly and freeze drying prior to combustion and graphitisation using an IonPlus AGE3 system. The Southern Hemisphere Calibration Curve (SHCal20; Hogg et al. 2020) was used for the calibration of age determinations using OxCal 4.4 (Bronk Ramsey 2009).

### *Fibre analysis*

Fibre fragments were catalogued and photographed, and their details entered into the ABM Project database with the prefix 'FIBRE', followed by a unique five-digit number. Variables recorded included raw material (i.e. leaf, bast), dimensions, weight, form (categorised according to the degree of processing as either unprocessed, string, netted, looped, woven or twined), ply, presence/absence of a ply fold, twist, knot presence and form (overhand, double, half hitch, clove hitch, sheet bend or carrick bend, Figure 6), direction of ply, presence of ochre/feathers/resin, fabric type, mesh size and interpreted object form. Length was determined in mm, and inflexible fragments and sections of fabric were measured to their maximum dimensions in their current shape. Twist was recorded by determining the direction of the initial twist of the strands, and the direction of spin used to combine them. In a clockwise twist the fibres slant from the upper left to lower right, similar to the shape of the letter S, while an anticlockwise twist resembles a Z. Thus, a 2-ply string with the strands

**Table 2.** Forms, uses and techniques of string fibre artefacts in Cape York Peninsula based on ethnographic and ethnohistorical accounts.

| Form/use | Observations | Species | Common name | Location | Source |
|---|---|---|---|---|---|
| String or rope generally | Used for a variety of general tasks, including hafting of woomeras, axes and spears, and/or for production of other items below. | *Melaleuca leucadendron* and other species | ti-tree | 'everywhere' (very common) | Roth (1901:8) |
| | | *Acacia leptocarpa* | slender fruited wattle | middle Palmer River | Roth (1901:8, 1904:28) |
| | | *Acacia lysiphloea* | turpentine | middle Palmer River | Roth (1901:9, 1904:28) |
| | | *Cochlospermum gillivraei* | kapok bush | middle Palmer River | Roth (1901:9) |
| | | *Hibiscus panduriformis* | yellow hibiscus | Mitchell River | Roth (1901:9) |
| | | *Hibiscus tiliaceus* | cotton tree | Pennefather River | Roth (1901:9, 1904:32); West (1980:20–25) |
| | | | | Cooktown | |
| | | *Panicum trachyrachis* | panicum | Mitchell River | Roth (1901:9) |
| | | *Sterculia quadrifida* | kurrajong; peanut tree | Cape Bedford | Roth (1904:32) |
| Dillybags | Simple-loop, loop and single-twist, loop and double-twist, hourglass, and fish-net patterns. *Acacia* sometimes alternated with *Malaisia* or *Sterculia* to produce stripes. Made exclusively by women and were used for ordinary family objects and food, but if used by men the bag and contents were regarded as sacred (Khan 1993:106). | *Acacia* spp. | | Bloomfield River | Roth (1898a:27, 1899:25) |
| | | | | middle Palmer River | |
| | | *Acacia flavescens* | toothed wattle | Cape Bedford | Roth (1901:8, 1904:28) |
| | | | | Cooktown | |
| | | *Acacia latifolia* | wattle | Cape Bedford | McConnel (1953:12); Roth (1899:24, 1901:8, |
| | | | | Cooktown | 1904:28) |
| | | | | Archer River | |
| | | | | middle Palmer River | |
| | | *Haemodorum coccineum* | scarlet bloodroot | Musgrave | Roth (1901:8, 9) |
| | | *Barringtonia racemosa* | freshwater mangrove | Musgrave River | Roth (1901:9) |
| | | | | Cooktown | |
| | | *Dillenia alata* | red beech | Lockhart River | West (1980:Appendix C) |
| | | *Hibiscus panduriformis* | yellow hibiscus | Mitchell River | Roth (1901:9) |
| | | *Ficus benjamina* | weeping fig | Batavia River | Roth (1901:9, 1904:7, 27) |
| | | | | Embley River | |
| | | | | Pennefather River | |
| | | *Ficus fasciculata* (now *F. congesta)* | red leafed fig | Moorehead River | Roth (1901:9; 1904:7, 28) |
| | | | | Starcke River | |
| | | | | Princess Charlotte Bay | |
| | | *Ficus opposita* | sandpaper fig | Aurukun | Roth (1901:9, 11); West (1980:Appendix C) |
| | | | | Batavia River | |
| | | | | Embley River | |
| | | | | Pennefather River | |
| | | *Ficus platypoda* | rock fig | | Roth (1901:9) |
| | | *Hardenbergia retusa* (now *Vandasina retusa*) | | Cape Bedford | Roth (1901:9; 1904:28) |
| | | *Heleocharis sphacelata* (now *Eleocharis spacelata*) | tall spike rush | Pennefather River | Roth (1901:9) |
| | | *Imperata arundinacea* (now *I. cylindrica*) | blady grass | Cape Bedford | Roth (1901:9, 1904:28) |
| | | *Livistona australis* | cabbage tree palm | Princess Charlotte Bay and north generally | Roth (1899:25, 1901:9, 1904:28); West (1980) |
| | | | | middle Palmer River | |
| | | *Macaranga tanarius* | macaranga | Musgrave River | Roth (1901:9, 1904:28) |
| | | *Malaisia tortuosa* (now *M. scandens*) | crow ash or burney vine | | Roth (1904:28) |
| | | *Sterculia caudata* (now *Brachychiton diversifolius)* | kurrajong | middle Palmer River | Roth (1899:24, 1901:10, 1904:28) |
| | | *Sterculia diversifolia* (now *Brachychiton populneus*) | kurrajong | middle Palmer River | Roth (1901:10, 1904:28) |
| | | *Brahcychiton garrawayae* | | Aurukun | West (1980:Appendix C) |
| | | *Xerotes longifolia* (now *Lomandra longifolia)* and *X. multiflora* (now *L. multiflora)* | | Starcke and Bloomfield Rivers | Roth (1901:10, 1904:28) |

(*Continued*)

**Table 2.** Continued.

| Form/use | Observations | Species | Common name | Location | Source |
|---|---|---|---|---|---|
| Fishing nets | Similar form to dillybags. Oversized, looped bags with an oval of cane threaded through the upper rows of looping, and joins lashed together. | *Malaisia tortuosa* (now *M. scandens*) | crow ash or burney vine | Pennefather River<br>Princess Charlotte Bay & hinterland<br>Moorehead River | Roth (1898a:27, 36–38, 1901:9); West (1980:Appendix C) |
| | | *Sterculia caudata* (now *Brachychiton diversifolius)* | kurrajong | Princess Charlotte Bay & hinterland<br>Moorehead River | Roth (1898a:27, 1901:10) |
| | Coastal fishing nets had a folding frame, hinged at either side to form a 'purse' shape; these purse-nets were traded to unspecified locations inland. | *Livistona australis* | cabbage tree palm | Princess Charlotte Bay and north generally<br>Moorehead River<br>Laura | Roth (1898a:36–38, 1901:8, 9); McConnel (1953:12); West (1980:Appendix C) |
| | | *Acacia* spp. | | | Roth (1898a:36–38) |
| | | *Acacia leptocarpa* | north coast wattle | middle Palmer River | Roth (1902) |
| | | *Acacia latifolia* | wattle | Musgrave River<br>Moorehead River | Roth (1901:8); West (1980:Appendix C) |
| | | *Calamus* spp. | lawyer cane | Princess Charlotte Bay & hinterland<br>Moorehead River | Roth (1898a:36–38) |
| Sieve bags | Used for washing yams or other poisonous plants that required leaching in water to render them safe for consumption. | *Drymophloeus normanbyi* (now *Normanbya normanbyi)* | black palm | Bloomfield River | Roth (1901:8, 1904:28) |
| | | *Spinifex hirsutis* | hairy spinifex | middle Palmer River | Roth (1901:8, 1904:28) |
| | | *Triodia* spp. | spinifex | | Roth (1899:24, 1901:10) |
| | | *Haemodorum coccineum* | Scarlet bloodroot | Musgrave NMP camp<br>middle Palmer River | Roth (1898a:36, 1899:24, 1901:9, 1904:28) |
| | | *Pandanus* spp. | | middle Palmer River | Roth (1899:24, 1901:9) |
| Corpse ties | Used for binding bodies during mortuary rituals. | *Careya australis* (now *Planchonia careya)* | cocky apple | middle Palmer River | Roth (1901:9, 11–12); West (1980) |
| Mourning strings | Worn by men and women around the waist, neck, or chest. Described as chainwork formed in a series of links made from loops of string or a single core string of plant or hair, overcast with a plant-fibre string. | | | | |
| Tasselled apron belts | Worn around the waist. | *Careya australis* (now *Planchonia careya)* | cocky apple | middle Palmer River | Roth (1901:9, 11–12); West (1980) |
| | | *Barringtonia racemosa* | freshwater mangrove | Musgrave | Roth (1901:9) |
| | | *Acacia leptocarpa* | slender fruited wattle | middle Palmer River | As cited in West (1980:Appendix C) |
| | | *Ficus virens* | white fig | Archer River<br>Batavia River<br>Embley River<br>Pennefather River | McConnel (1953:12);<br>Roth (1901:9, 11) |
| | | *Malaisia tortuosa* (now *M. scandens*) | crow ash or burney vine | | Roth (1901:9); West (1980) |
| Games | String games known to Europeans as 'cat's cradle'. | | | | Roth (1901:10–11) |
| Necklaces/ Personal strung ornaments | 2-ply plant-fibre strings, might also be made from human and animal hair. Worn by men and women. | | | | Roth (1901:7–8); Wallis and Burke (2024) |

(*Continued*)

**Table 2.** Continued.

| Form/use | Observations | Species | Common name | Location | Source |
|---|---|---|---|---|---|
| Medicine strings | Two forms: ligatures or sucking strings. Ligatures were tied around the afflicted part of the body or a proxy body part, such as ankles or wrists, during pain or sickness. Sucking strings were used by a female relative to 'suck' the bad blood from the afflicted person. The string was applied around the afflicted body part and the end across the user's lower lip until it bled. This 'bad' blood was discarded. | *Acacia leptocarpa; A. lysiphloia; Sterculia diversifolia* (now *B. populneus*) | | Palmer River | Roth (1904:37, 38) |
| Mops | | *Malaisia tortuosa* (now *M. scandens*) | crow ash or burney vine | | Roth (1901:9) |

initially twisted clockwise then plied together anti-clockwise was recorded as 'ssZ', with the number of lower-case letters correlating to the number of ply (Emery 1995:11). 'Fabric' comprised 'cloth' or other materials produced by looping, weaving, knotting or knitting fibres together, with loops classified as single, double/hourglass (Figure 6), or 'netting' (i.e. knotted). Fragments of netting were recorded twice: once in the category of netting and once in the category of sheet bend knots. Single examples of sheet bend knots were identified as netting because sheet bends have not been recorded in any context other than netting in Australia (Davidson 1933:257–259; Roth 1901:13). The total number of knots in a fragment of netting was not captured, as this would have skewed the data with the false appearance of more knotted objects than were actually present. Instead, the dimensions of the mesh were recorded to assess its gauge. No identification of fibre artefacts to plant species was undertaken as part of the initial study, but is currently underway using an array of microscopic and chemical analytical techniques.

Further analysis was undertaken of a piece of cotton cloth, one of only two post-contact artefacts to be recovered (Figure 7). A solvent-based extraction of this material was performed using two solvents (acetonitrile and methanol) to extract the dye and/or associated materials. The extraction process involved soaking a small fragment of the cotton in the solvent for 30 minutes. Extracts were then filtered through a 0.22 micron filter and prepared for liquid chromatography and mass spectrometry using a Orbitrap 200 series. Data were processed using Compound Discoverer v3.2 software and compared against existing databases of dyes.

## Comparative museum object analysis

A collection of 39 objects held by the QM, made wholly or in part with plant fibre and collected from the Laura region in the twentieth century, were examined to identify potential objects from which the Windmill Way fibre fragments may have derived. These objects were chosen by QM staff based on the presence of fibre in their internal catalogue description and the robusticity of the objects. Accordingly, a single firestick sheath, 23 dillybags, four woomeras, three nets and eight shell necklaces were examined, all of which are attributed to Daniel Joseph Fitzgibbon ($n=38$) and Percy Trezise ($n=1$). Fitzgibbon was a constable with the Qld Police Force, stationed at Laura between 1904 and 1913, who took a keen interest in Indigenous lifeways (Burke and Wallis 2019). Rock art researcher Trezise collected a well-preserved dillybag cached in a rockshelter near Laura in 1975, eventually depositing it in the QM collection (item number S549.1) (McLay 2023; McLay

**Figure 5.** Windmill Way, Square A4 (between the two horizontally positioned mini-rods) after excavation, with Square A3 in the foreground, and Squares A5 and A6 (awaiting excavation) at rear. Note the uneven nature of the underlying bedrock (photo by Heather Burke).

et al. 2024). For these objects the same range of variables were recorded as for the archaeological samples, with the addition of the QM identifying number, collector and/or donor, and object type. The gauge of a bag was calculated by leaving the bag relaxed and, from the middle of a thread, measuring the length and width of ten loops and then averaging the results.

## Results

### *Radiocarbon dating*

Six charcoal samples collected during excavation returned a minimum age of 178 ± 19 BP and a maximum age of 2,112 ± 20 BP. Results of the AMS dating of 12 pieces of processed plant fibre ranged from essentially modern through to 1,700–1,589 cal BP (FIBRE00096) (Table 3).

### *The fibre assemblage*

A total of 535 fragments of plant bast fibre were examined, ranging in weight from 0.001–2.780 g, with a mean of 0.07 g, and a cumulative weight of 40.47 g; no human or animal hair was present. The bast fibres were composed of unprocessed or partially processed material ($n = 31$), as well as processed fibre in the form of string ($n = 464$), sometimes with knots or formed into netted ($n = 9$) or looped fabric ($n = 29$). The quantity of fibre fragments increased towards the rear of the alcove where there was generally a greater depth of deposit, with 152 fragments recovered from Square A5 and 132 from Square A6 (Table 4). String fragments ranged in length from 5 to 500 mm, with an average of 32.35 mm, a mean of 21 mm and a mode of 15 mm.

### *Unprocessed fibre*

Unprocessed fibre makes up 6% of the fibre assemblage, although macrobotanical material recovered from the 7 mm sieve is still being catalogued, so this is not the final amount. The unprocessed material consisted of strips of bast fibre that, while they may have undergone some refinement, had not yet been processed into string (Figure 8). The most heavily refined pieces had been shredded, scraped, chewed or otherwise teased to remove extraneous plant cells and separate the individual fibres. Six of the unprocessed items comprised strips of bast that had been knotted (6 x overhand, 1 x carrick bend).

**Table 3.** Radiocarbon dates for plant materials (charcoal and fibres) from Windmill Way.

| Laboratory Code | Context (Sq) | Material (Artefact Code) | C14 Age BP | Calibrated Age (68.3% probability) cal BP* | Calibrated Age (95.4% probability) cal BP* |
|---|---|---|---|---|---|
| Wk-55266 | A4 feature A | Charcoal | 178 ± 19 | 290–260 (12.8%)<br>220–140 (43.7%)<br>20–… (11.8%) | 290–250 (19.1%)<br>230–140 (56.3%)<br>40–… (20.0%) |
| Wk-55264 | A4 feature A | Charcoal | 192 ± 19 | 290–270 (19.6%)<br>210–150 (48.7%) | 290–260 (21.8%)<br>220–140 (59.8%)<br>30–… (13.9%) |
| Wk-55265 | A4 feature B | Charcoal | 365 ± 20 | 480–430 (40.5%)<br>360–330 (27.8%) | 500–420 (53.2%)<br>400–310 (42.2%) |
| Wk-55267 | A5 | Charcoal | 376 ± 19 | 500–450 (50.7%)<br>360–330 (17.6%) | 500–420 (64.6%)<br>380–320 (30.9%) |
| Wk-55263 | A3 | Charcoal | 1,516 ± 21 | 1,410–1,360 | 1,470–1,450 (1.0%)<br>1,420–1,340 (94.5%) |
| Wk-55268 | A6 | Charcoal | 2,112 ± 20 | 2,120–2,040 (62.2%)<br>2,020–2,000 (6.1%) | 2,150–1,990 |
| UNSW-4054 | A6 | Plant fibre string (FIBRE00088) | 132 ± 14 | 240–232 (6.4%)<br>137–114 (20.5%)<br>94–84 (5.8%)<br>69–25 (35.6) | 252–227 (13.5%)<br>140–80 (36.6%)<br>75–… (45.3%) |
| OZCA07 | A6 | Plant fibre string (FIBRE00089) | 160 ± 25 | 258–223 (18.6%)<br>142–136 (2.8%)<br>116–61 (31.8%)<br>26–… (15.1%) | 271–217 (26.4%)<br>148–… (69.0%) |
| UNSW-4056 | A6 | Plant fibre string (FIBRE00104) | 364 ± 20 | 446–432 (11.0%)<br>414–356 (48.2%)<br>334–322 (9.1% | 461–314 (95.4%) |
| UNSW-4037 | A3 | Plant fibre string (FIBRE00044) | 367 ± 20 | 448–434 (10.4%)<br>410–354 (47.7%)<br>336–323 (10.1%) | 465–316 (95.4%) |
| Wk-53952 | A3 surface | Plant fibre string (no code) | 390 ± 18 | 486–480 (4.8%)<br>469–441 (26.2%)<br>366–328 (37.4%) | 510–440 (79.1%)<br>360–330 (16.4%) |
| UNSW-4057 | A6 | Plant fibre string (FIBRE00105) | 399 ± 19 | 488–478 (9.7%)<br>472–444 (30.0%)<br>358–332 (28.6%) | 494–437 (49.5%)<br>404–326 (46.0%) |
| UNSW-4038 | A3 | Plant fibre string (FIBRE00083) | 401 ± 14 | 486–480 (8.0%)<br>469–447 (31.3%)<br>356–334 (29.0%) | 494–440 (55.4%)<br>401–391 (1.9%)<br>371–327 (38.2%) |
| OZCA10 | A6 | Plant fibre string (FIBRE00087) | 410 ± 25 | 491–448 (47.8%)<br>355–336 (20.5%) | 498–438 (55.9%)<br>404–326 (39.5%) |
| UNSW-4039 | A3 | Plant fibre string (FIBRE00084) | 487 ± 14 | 509–496 (68.3%) | 516–492 (95.4%) |
| OZCA06 | A5 | Plant fibre string (FIBRE00492) | 490 ± 25 | 514–494 (68.3%) | 534–486 (93.0%)<br>480–469 (2.5%) |
| UNSW-4036 | A2 | Plant fibre string (FIBRE00018) | 1,213 ± 20 | 1,176–1,166 (12.4%)<br>1,152–1,140 (8.1%)<br>1,076–1,055 (27.1%)<br>1,016–992 (20.7%) | 1,179–1,132 (29.2%)<br>1,110–1,051 (40.0%)<br>1,026–984 (26.3%) |
| UNSW-4043 | A4 | Plant fibre string (FIBRE00137) | 1,293 ± 20 | 1,262–1,212 (45.2%)<br>1,135–1,110 (23.1%) | 1,265–1,207 (48.1%)<br>1,182–1,173 (3.0%)<br>1,165–1,080 (44.4%) |
| UNSW-4055 | A6 | Plant fibre string (FIBRE00096) | 1,777 ± 16 | 1,698–1,650 (53.2%)<br>1,626–1,610 (15.1%) | 1,700–1,607 (88.2%);<br>1,600–1,589 (7.3%) |

*SHCal20 (Hogg et al. 2020) was used for the calibration of age determinations using OxCal 4.4 (Bronk Ramsey 2009).

### *Processed fibre*

The bulk of the assemblage (94%) was processed fibre. With a single exception (FIBRE00492; Figure 9e), it was dominated by 2-ply, with 10 pieces of 1-ply, five of which had crimping along their lengths, indicating they had unravelled from an original piece of 2-ply string. Almost half of the smaller fragments ($n = 155$, 47%) were set in curved shapes resembling the curves and twists of double looping (Figure 10). Many smaller fragments ($n = 349$, 69.9%) lacked secondary attributes, such as knots, that could have indicated their final form or use, and thus their identification was limited to 'string' without further attribution to an object.

Diagnostic elements of the remaining, longer string fragments ($n = 180$) included looping, overcast string, and several types of knots. Overhand knots were the most common ($n = 28$), followed by sheet bend ($n = 9$), clove hitch ($n = 6$), carrick bend ($n = 2$), double ($n = 1$), and half hitch ($n = 1$).

None of the fibres exhibited evidence of dye, with colour variations resulting from the incorporation of different plants rather than deliberate colouration.

### *Overcast string*

The assemblage contained three fragments of overcast string, i.e. a string wound around one or more base strings (Figure 9a, 9b and 9c). FIBRE00087

comprised 20 loops of 2-ply string wound around 16 2-ply core strings, FIBRE00117 had four core 2-ply strings with five loops of binding 2-ply string and FIBRE00482 comprised a single 2-ply string with a second 2-ply binding string looped around it four times and secured with a half hitch knot.

### *Base strings with clove hitch loops*

Three fragments comprised a single base string supporting clove hitches, all of which were recovered from Square A5 (Figure 9d, 9e and 9f). One possessed a single clove hitch (FIBRE00484), while a second supported four clove hitches (FIBRE00499). The third fragment was a 3-ply sssZ string supporting 25 loops of 2-ply string (FIBRE00492; Figure 9e); as the loops do not exhibit a spiral around the base string they are not overcast. Two of the loops on FIBRE00492 comprise two definite clove hitches, and the 'tails' of the hitches on another two have broken away; the other 21 loops are too fragmentary to be certain of their mode of knotting, but it seems likely they were also tied in clove hitches.

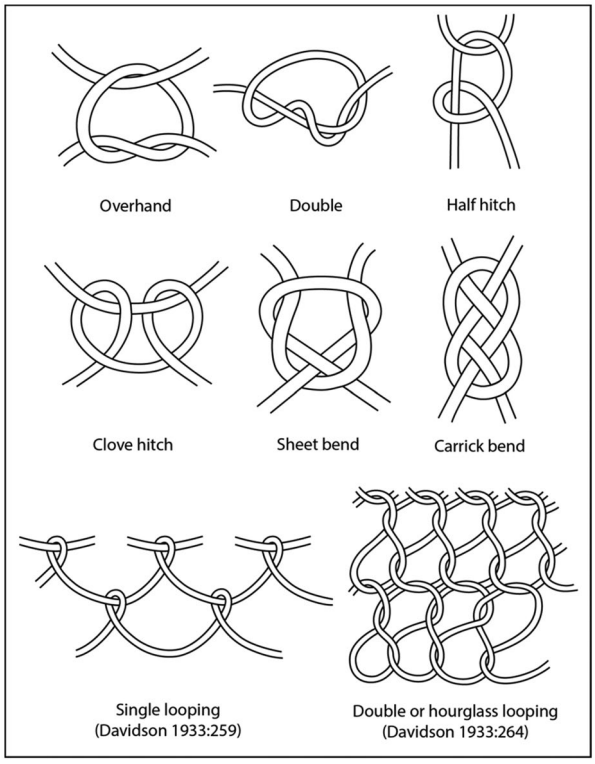


**Figure 6.** Knot and looping types.

### *Looped and netted fabric*

Twenty-nine fragments of looped fabric and eight fragments of netted fabric were identified (Figure 11). All looped fabric was identified as double looping, with the many small fragments of string set in curved shapes closely matching the double loop pattern. FIBRE00088 and FIBRE00089 were double looped fragments similar in both colour and string diameter, and their looping was consistent in size and tension, suggesting they derive from the same object. FIBRE00088 had two short fragments of a lighter coloured string drawn through the looping, one of which terminated in two overhand knots.

All netted fabric was square mesh constructed with sheet bends, with small gauges ranging between 7 and 15 mm. One of the largest pieces, FIBRE00085 (Figure 11 upper left) had a 10 mm gauge and 72 sheet bend knots. FIBRE00137 (Figure 11 upper right) measured 80 mm long, with a gauge of approximately 15 mm and six intact sheet bend knots.

### *Cotton twill*

A single strip of faded red, 10% cotton–90% hemp fibre blend fabric, measuring 300×22 mm, was also recovered

**Figure 7.** Red cotton-hemp twill fabric from Windmill Way (photo by Cheeryll Fhariza).

**Table 4.** Attributes of the processed fibre, sorted by context. Note that the 'square' of the surface finds (collected in 2021) is unknown, though they likely came from A2 or A3. PF = Number of processed fibres recovered from each context; TF = total number of fibres (processed plus unprocessed) recovered from each context. ^Three fragments had clove hitch knots on a base string. *A second carrick bend knot was recorded in a piece of unprocessed fibre from this context.

| | | Context | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Surface<br>PF: 3<br>TF: 3 | Sq A1<br>PF: 3<br>TF: 3 | Sq A2<br>PF: 17<br>TF: 23 | Sq A3<br>PF: 97<br>TF: 109 | Sq A4<br>PF: 110<br>TF: 113 | Sq A5<br>PF: 144<br>TF: 152 | Sq A6<br>PF: 128<br>TF: 132 |
| Attributes | | | | | | | | |
| Ply fold | | – | – | – | 5 | 2 | 3 | 3 |
| Ply | 1 | | | 1 | 1 | 1 | 2 | 5 |
| | 2 | 3 | 3 | 18 | 97 | 109 | 141 | 127 |
| Looping | | | | 1 | 4 | 7 | 3 | 13 |
| Netting | | | | | 3 | 1 | 4 | |
| Wound string | | | | | | | 1 | 2 |
| Knot type | Sheet bend | 1 | | | 3 | 1 | 4 | |
| | Overhand | 1 | | | 5 | 4 | 11 | 8 |
| | Clove hitch | | | | | 1 | 5^ | |
| | Double | | | | | 1 | | |
| | Half hitch | | | | | | 1 | |
| | Carrick bend | | | | | | 1* | |

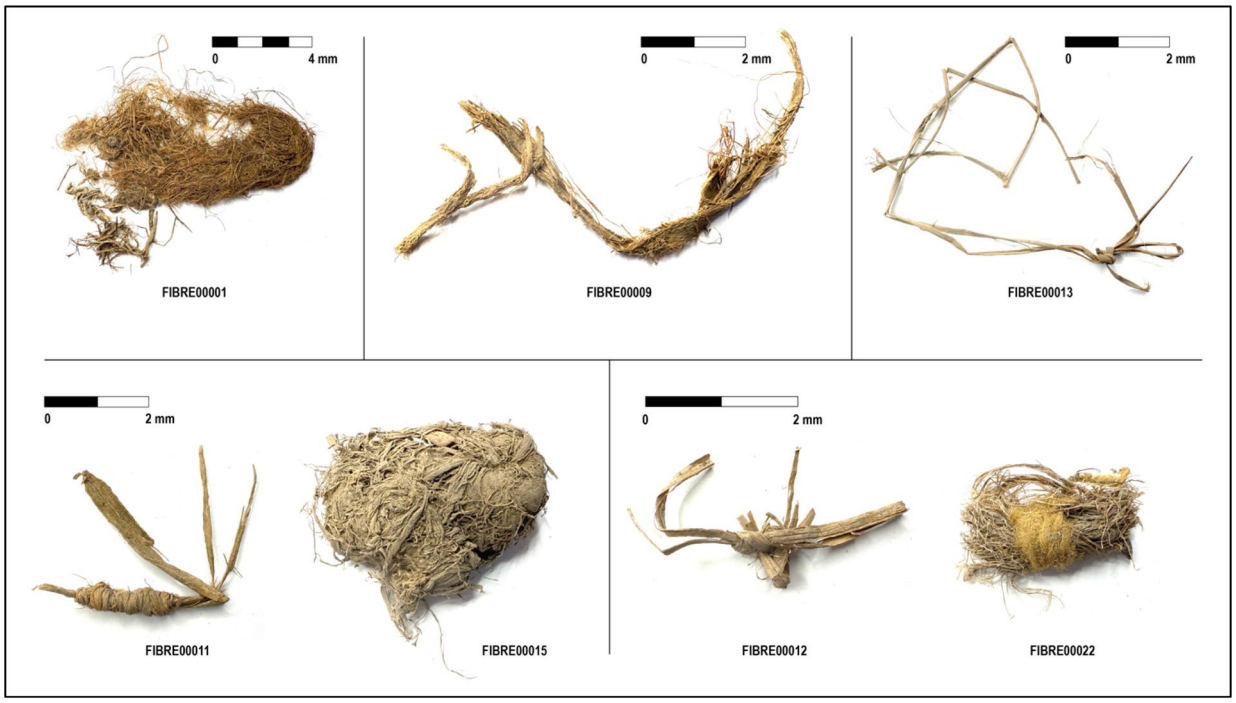


**Figure 8.** Examples of unprocessed fibre from Windmill Way. Note particularly the knots present in FIBRE00012, FIBRE0013, the partially processed bast fibre wound around the end of a short, folded piece of unprocessed bast/bark in FIBRE00011, and the bundle of brown bast fibres bound with a length of yellow, single-ply s-twist bast fibres in FIBRE00022 (photos by Lynley Wallis).

(Figure 7). It is a machine-manufactured, warp-faced 2/1 twill weave with a Z twist: this is the simplest of twill patterns, where the weft thread weaves under one warp thread and over two, resulting in a pattern that replicates every third weft strand (Wingate 1979:636). Liquid chromatography and mass spectrometry revealed the colour to be the result of an anthraquinone-based dye widely used in the late nineteenth and early twentieth centuries in colonial contexts (Ferreira et al. 2004; Shahid et al. 2019).

### *Indirect evidence: personal adornment and rock art motifs*

Several items of personal adornment, in the form of macropod incisors with balls of resin at their proximal ends and a broken baler shell, were also recovered from Windmill Way (ABM Project unpub. data). The incisors—probably strung as necklaces or headbands—and the baler shell—almost certainly used in the handle of a woomera secured in part with plant fibre string—provide indirect evidence for string use at the site.

Another form of indirect evidence for fibre is several of the rock art motifs, including dillybags ($n = 3$) and female anthropomorphs wearing tassel skirt belts ($n = 2$), mourning strings strung across the chest ($n = 1$) and a headband ($n = 1$) (Figure 12). These motifs are painted in the typical Quinkan style (Cole 1995), having solid infill with overlying linear or dot infill and white outline.

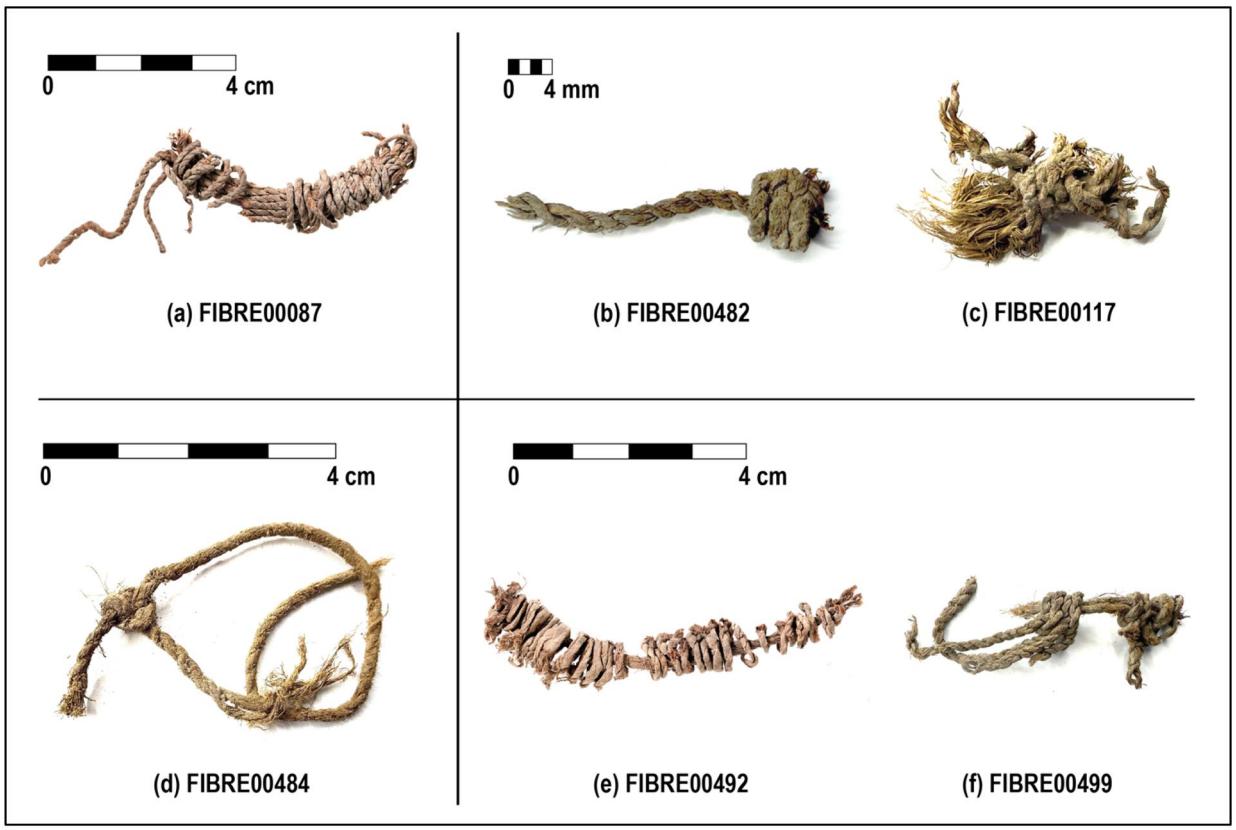


**Figure 9.** Overcast string and base string with clove hitches from Windmill Way: (a) FIBRE00087 is a bundle of 16 2-ply bast fibre strings with ssZ twist, bound by further 2-ply bast fibre with ssZ twist, wound around the bundle 20 times; this is possibly a dillybag handle (photo by Cheeryll Fhariza); (b) FIBRE000482 is a fragment of 2ply ssZ string, with a second string looped around three times and secured with a half hitch knot (photo by Lynley Wallis); (c) FIBRE00117 is a bundle of 2-ply bast fibre strings with ssZ twist, bound with the same sort of string and is another possible dillybag handle fragment (photo by Lynley Wallis); (d) FIBRE00484 is a segment of 2-ply ssZ string with a clove hitch (photo by Lynley Wallis); (e) FIBRE00492 is a single fragment of 3-ply sssZ string around which is looped 25 additional fragments of 2-ply string. Two complete clove hitches visible, and the other loops likely also featured clove hitches but now have 'tails' broken off (photo by Cheeryll Fhariza); and (f) FIBRE00499 comprises 2-ply ssZ strings, with a foundation string featuring a further four fragments of string attached with clove hitch knots (photo by Lynley Wallis).

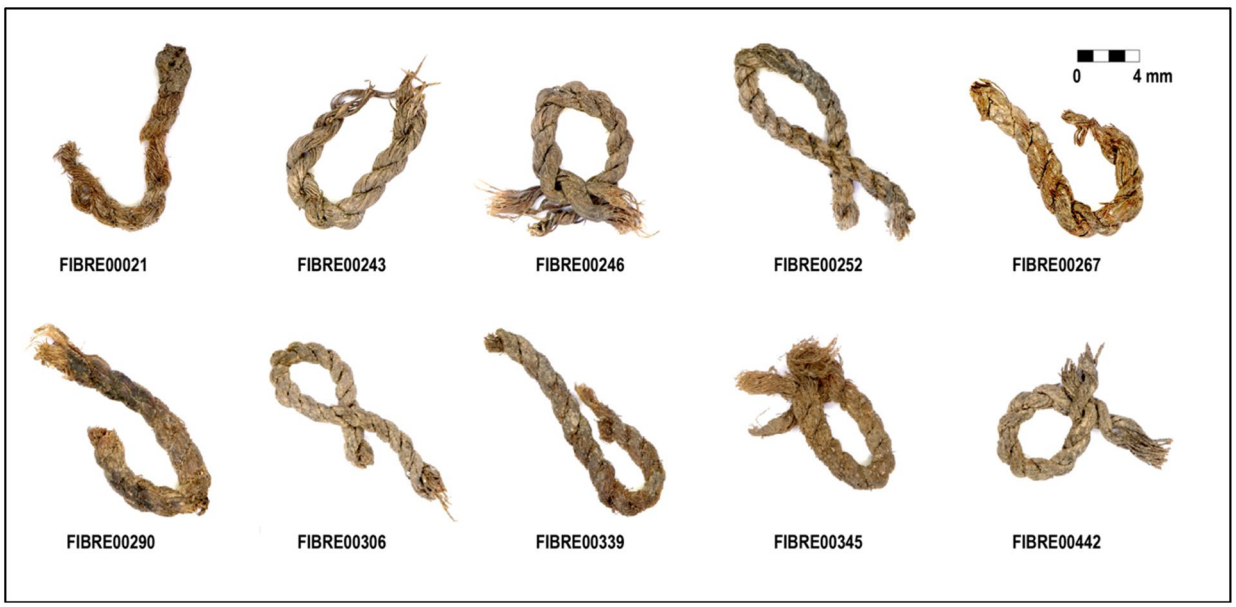


**Figure 10.** Examples of fragments of string set in curved loops from Windmill Way (photos by Alexandra Snep).

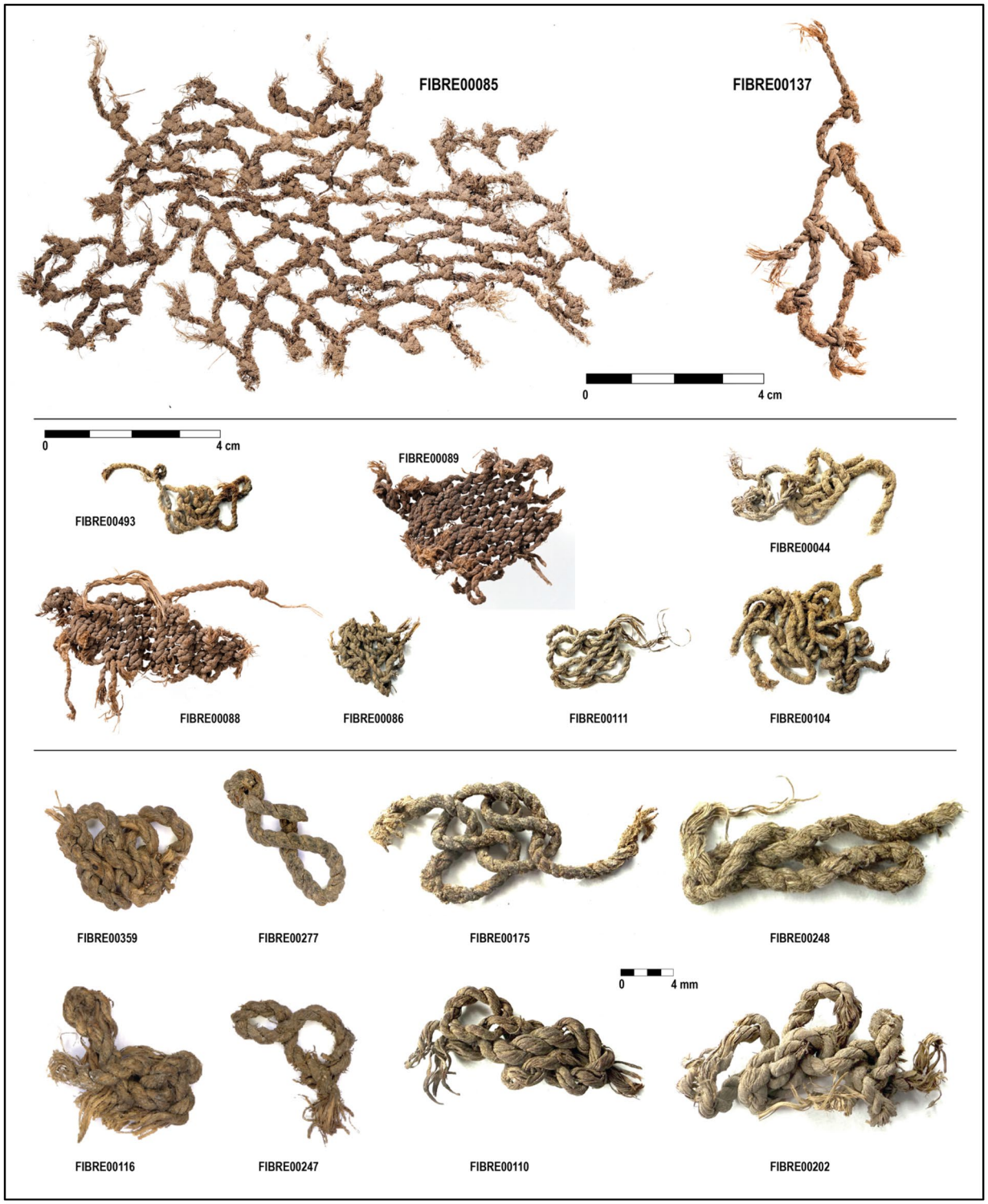


**Figure 11.** Netted (top row) and looped fabric from Windmill Way (photos by Cheeryll Fhariza [top row, FIBRE00088, FIBRE00089, FIBRE00116, FIBRE00247, FIBRE00277, FIBRE00359] and Lynley Wallis [all others]).

### *Queensland Museum objects*

Figure 13 shows a sample of the material cultural objects from the QM examined for comparative purposes and Table 5 provides details of the dillybags and their attributes.

### *Firestick sheath*

The firestick sheath comprises reeds secured with resin and bound with undyed string, with additional resin applied over the top (Figure 13a). The string is a 2-ply bast fibre with many small white feathers incorporated into the twist. No knots or ply folds are visible, though the resin coating obscured most of the string.

### *Dillybags*

The 23 dillybags examined were uniformly constructed from 2-ply ssZ bast fibre string, except for

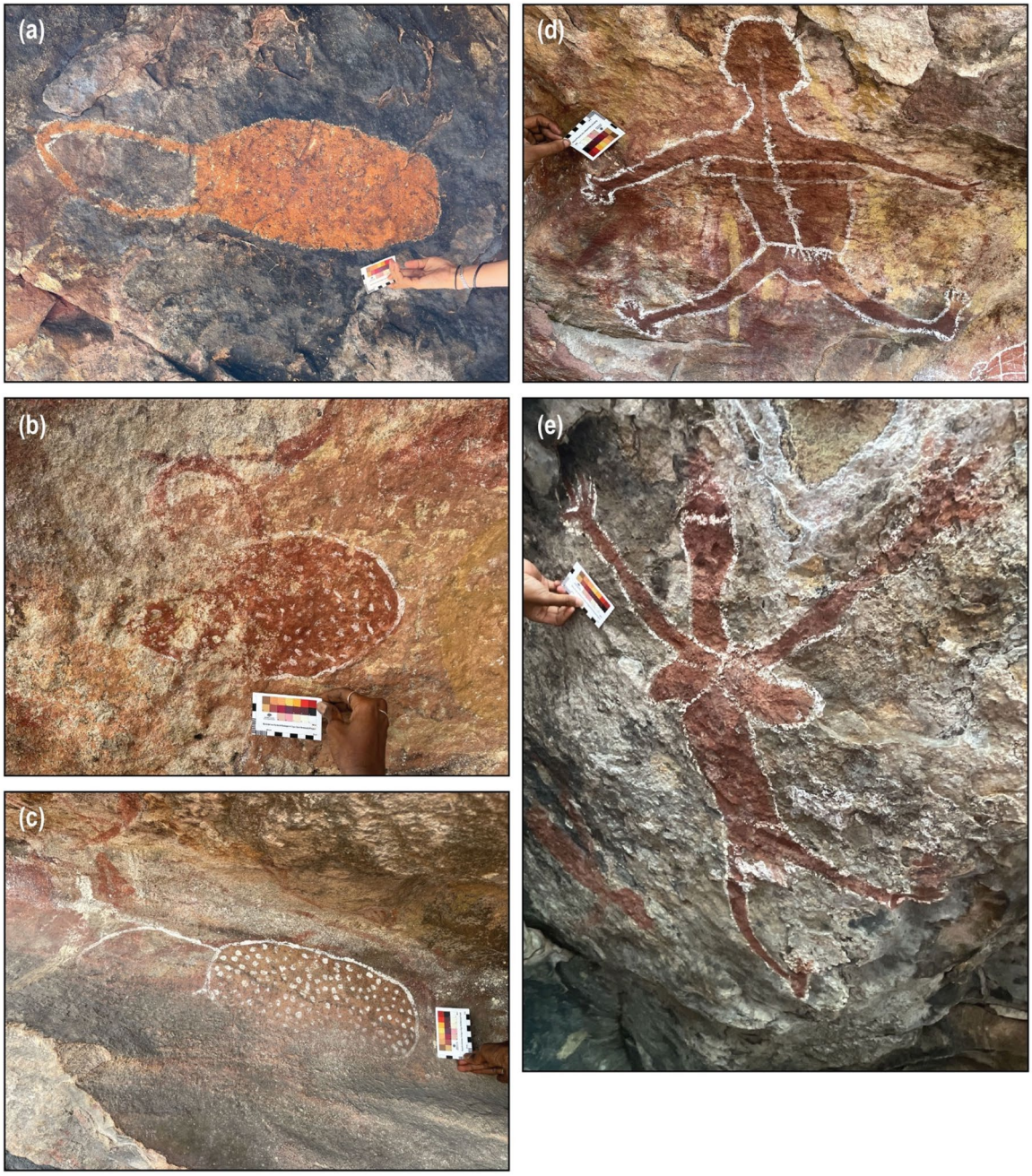


**Figure 12.** Indirect evidence of fibrecraft in the form of rock art motifs at Windmill Way: (a) dillybag (Panel 2, Motif 4); (b) dillybag (Panel 9, Motif 5); (c) dillybag (Panel 12, Motif 107); (d) female anthropomorph with tassel skirt belt (Panel 1, Motif 87b); and (e) female anthropomorph with tassel skirt belt, headband and mourning strings (Panel 20, Motif 159) (photos by Lynley Wallis).

one which was constructed in zzS twist (i.e. with the initial fibres spun separately anti-clockwise then combined using a clockwise twist) (Table 4; Figure 13f–j). All were fabricated with a double-looping pattern, and several had unfinished rims, usually with a simple drawstring threaded through the uppermost loops; they often lacked handles. Bags varied in size from 200–575 mm (length) and 150–415 mm (width), with handles (where present) measuring from 430–780 mm long. There is considerable variability in the bag gauges, but the average minimum and maximum lengths of loops are 8.8 and 14 mm, with average width ranging from 2.5–3.5 mm.

The most 'finished' bags ($n = 9$) had handles comprised of four strings that were resin or wax-coated then wrapped with strips of European cotton cloth in varying colours (red = 7, brown = 1, and red/brown = 1). In all instances the cloth appeared uniformly well-worn, almost threadbare, suggesting it had reached the end of its useable lifespan as clothing when it was repurposed.

Overhand knots were present in all bags, while double knots were noted in two, and a clove hitch and a half hitch in two others. In four bags, knots were noted in the rim bindings, four bags had knots in the drawstrings, two had knots in the handle, and

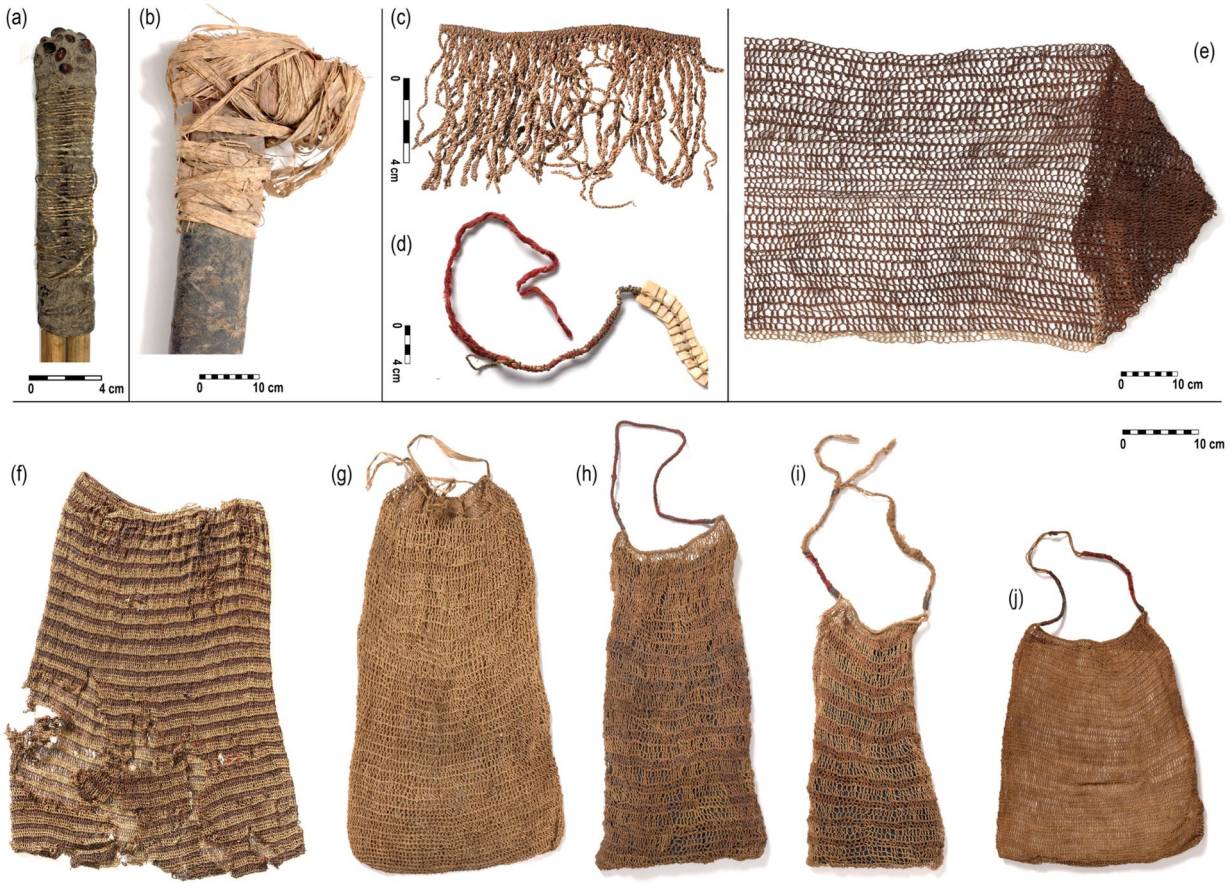


**Figure 13.** Sample of material culture items from the QM collection with string components: (a) firestick (QE10860, photo by Lynley Wallis); (b) binding on woomera (QE10859); (c) tassel string belt (S594/2, photo by Cheeryll Fhariza); (d) shell necklace (QE1084); (e) one end of a fishing net (QE10837); (f) dillybag (S594/1); (g) dillybag (QE10832); (h) dillybag (QE10836); (i) dillybag (QE10830); and (j) dillybag (QE11288) (unless otherwise noted, all photos by Lee Wilkes).

three had knots in the less substantial hanging strings. Eleven bags had knots in more than one of these locations. All bags had knots in the looping that formed the body of the bag, except QE10824.

Colour variation was created by alternating fibres from different plant species. Six bags seemingly used fibres from up to four different plant species to create striping, and a further four (QE10830, QE10833, QE11290, S549.1) included small sections of red or green European-derived fibre spliced into the bast fibre string.

### *Woomeras*

The four examined woomeras had fibre lashings, usually bast but sometimes 2-ply string (Figure 13b). In most instances the fibre was obscured by a thick coating of resin, two specimens had loose strings threaded through a hole drilled in the handle, and on a third small sections of string were visible in places where the resin had been chipped. Visible strings were made with 2-ply ssZ and zzS twist, and one specimen was a 3-ply sssZ twist string. No knots or ply folds were visible.

### *Necklaces*

Eight necklaces were examined, each made of several types of fibre with various objects (predominantly shells) strung thereon. The shell necklaces were uniform in appearance, with 20–65 rectangular shell beads per necklace, twined with two matching strings. QE10846 had dual bead strands joined in the same way to form a single necklace. The twining strings were then tied to one or more different strings, with the join overcast, or bound, with a third string and tied with a simple twist or rolling hitch. The string that secured the shells was the same, being worn or broken, and in one instance had all but disintegrated (QE10848). Importantly, all string used in the necklaces was of a much looser twist and of less refined appearance than that used in other objects, suggesting it was of a European origin, with the exception of QE10840 (Figure 13d), which incorporated a length of hand-made plant fibre string similar to that used in the dillybags.

Two necklaces had black or red European-made cloth tied onto the bead strings. QE10847 had lost these added strings, but the remaining fibre showed crimping, demonstrating where the additions had been attached, and the ends of the bead strings were stained a deep pink hue, probably through contact with red cloth. QE10848 was a collection of 67 beads with wisps of fibre caught in the bead holes, four

**Table 5.** Attributes of dillybags in the QM collection.

| QM ID Number | Length (mm) | Width (mm) | Depth (mm) | Ply | Ply Fold Presence | Twist | Rigidity | Looping Type | Knots Present | Handle presence | Cloth presence | Striping | European spliced fibres | Resin presence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| QE10822 | 490 | 270 | 60 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10823 | 340 | 180 | 430 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10824 | 330 | 180 | 360 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10825 | 350 | 190 | NA | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10826 | 320 | 240 | NA | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10827 | 350 | 210 | 450 | 2 | CND | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10828 | 520 | 290 | 500 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10829 | 515 | 220 | 780 | 2 | CND | ssZ | Flexible | Double–hourglass | Double overhand; half hitch | | | | | |
| QE10830 | 3350 | 180 | NA | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10831 | 350 | 1850 | 460 | 2 | | zzS | Flexible | Double–hourglass | Overhand | | | | | |
| QE10832 | 510 | 290 | NA | 2 | CND | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10833 | 270 | 185 | NA | 2 | CND | ssZ | Flexible | Double–hourglass | Overhand; clove hitch | | | | | |
| QE10834 | 200 | 160 | 480 | 2 | CND | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE10835 | 400 | 150 | NA | 2 | | ssZ | Flexible | Double–hourglass | Overhand; double overhand | | | | | |
| QE10836 | 470 | 190 | 430 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE11284 | 450 | 330 | 0 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE11285 | 575 | 415 | | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE11286 | 495 | 330 | 0 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE11287 | 380 | 410 | 0 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE11288 | 310 | 270 | 385 | 2 | | ssZ | Flexible | Double–hourglass | Overhand; double | | | | | |
| QE11289 | 540 | 350 | 0 | 2 | | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| QE11290 | 380 | 345 | 0 | 2 | No | ssZ | Flexible | Double–hourglass | Overhand | | | | | |
| S549.1 | 535 | 394 | | 2 | CND | ssZ | Flexible | Double–hourglass | Overhand | | | | | |

CND: could not determine; Grey filled: present; blank: absent.

small fragments of separated single ply, and one overhand knot of 2-ply ssZ string.

### *Nets*

The three nets examined were 'bag nets', constructed of double looping in an enlarged version of the dillybags described above. All three appeared unfinished, with no rim binding, drawstring, or other finish to the top edge of the looping. All were shallow (0.28–0.91 m) compared to their width (1.6–2.7 m). The final row of looping in one (QE10837; Figure 13e) was a light brown fibre spliced into the deep red fibre of the rest of the net, with an overhand knot securing the splice. After looping a row more than halfway around the bag, the string was left with a short, unsecured tail. Object QE10839 had several short, broken strings, possibly of European origin (based on their loose ply and highly processed fibres), tied at each side of the opening: these strings appear to be associated with subsequent display of the objects, rather than part of their original design. All nets had holes, some of which had been repaired by rejoining broken strands with overhand bend knots.

## Discussion

### *The Windmill Way assemblage*

Although animal and human hair fibre string is known from the region (McLay 2023; McLay et al. 2024; see also Roth 1901), the archaeological fibres from Windmill Way are all derived from plants, specifically bast fibre, with at least six different types apparent. Bast requires more time-consuming, multi-stage processing to prepare it for use, but it is longer-lasting and more versatile than other forms of plant fibres, such as those produced from entire stems or leaves (Johnny Ross, pers. comm. August 2025).

Plant string production rarely requires the use of secondary artefacts, such as spindle whorls, though unmodified sticks might be used to anchor base strings for production of some forms (e.g. Hale and Tindale 1934:Figure 193; Thomson 1939:Plate XXI; cf. Figure 4c, 4d, and 4e in which chair legs are used to anchor the strings). However, Roth (1904:27) referred to wooden 'netting-needles' on the west coast of CYP being used in the production of fish-nets and dillybags, and in 1928 Donald Thomson photographed a woman at the Edward River using such a needle in the production of a dillybag (West 1980:Plate 7a). Roth (1904) also noted bone needles could be used for removing the outer layers of cabbage palm leaves before making twine. Given there are more than 50 bone points in the Windmill Way assemblage, it is possible some of these, particularly the larger unipoints, were used as needles or picks, though others were clearly too small to have served such purposes; here it is worth noting that Laura Elders Nancy Musgrave and Laura George were adept at using just their fingernails to split fronds (Roseanne George, pers. comm. 2024).

The widely varying morphological characteristics of the fragments and the varying age estimates suggest the Windmill Way assemblage derives from more than a single object. At least some specimens (e.g. FIBRE00088 and FIBRE00089) potentially come from a single decayed object, a not unexpected finding given the large size of the assemblage, the long time span involved, and the disturbed nature of the deposit. Unfortunately, the highly fragmented nature of the fibres renders definitive identification of individual objects difficult in most instances. Nevertheless, several observations can be made.

Double looping, rather than knotting, was the preferred means of construction, the former creating a 'fabric' with considerable give, while the latter is securely arranged to prevent slippage (Davidson 1933:270). While it is not possible to reduce all instances of double looping to a specific object form (i.e. dillybag or net, such as apparent in the QM collection), specific indicators of dillybags include:

- two fragments of double looping (FIBRE00044 and FIBRE00104) made from visually different fibre-types looped together; these are similar to QM bag QE10827 that contained four different fibre types woven together to create a patterned appearance; and,
- FIBRE00087 and FIBRE00117, both of which are overcast fragments of string very similar to the dillybag handles observed in QE10829, which consisted of four core strings wound with fibre or cloth.

The eight fragments of square mesh knotted fabric use sheet bend knots in a gauge ranging between 7 and 15 mm. Although square mesh was reportedly used for bag manufacture by Koko Warra and Koko Minni peoples (Roth 1899:24), only the Koko Lama Lama of Princess Charlotte Bay were recorded as using this mesh to make fish-nets. None of the QM dillybags from Laura, however, are made from knotted square mesh, although it is possible that looping, as a faster technique, was preferentially adopted in the colonial period, especially if an object was being made for a collector. While the square mesh fabric at Windmill Way could derive from fish-net, all three dated samples (FIBRE00083, 00084 and 00137) were made prior to European invasion and could just as easily derive from dillybags.

Rarer fragments consist of a series of loops secured with clove hitches to a top string, each loop rolled to form a tassel. FIBRE00492 is a 65 mm length of 3-ply sssZ string that supports 25 loops of string with a total weight of 0.91 g (Figure 9e). Two of the loops are complete clove hitches, with the remainder appearing to be clove hitches with their 'tails' broken off. FIBRE00499 (Figure 9f) similarly consists of a foundation 2-ply ssZ string to which a further four fragments of 2-ply string are attached with clove hitches. The use of so many clove hitches on a single core string accords with examples of pubic tassel string belts/aprons recorded by Roth (1901:12), as well as specimens of tassel belts held in the QM (Figure 13c). These items were commonly worn by women across Qld, though also as necklaces by men (Roth 1901:39–40).

Another possible interpretation for some string fragments is mourning strings. Across SE CYP these were formed from a series of links (chainwork) made from loops that were similar to, but substantially longer than, those used in pubic string belts. Mourning strings were worn by men and women around the waist, neck, or neck and under one armpit (Roth 1901:11–12) and Roth donated two such items from Cape Bedford and Maytown to the Australian Museum in 1905 (Khan 1996:53). George Musgrave previously advised author N Cole that the crossed strings across the chest of one painting of a woman at the Giant Horse site near Laura represent such an object; these are similar to the crossed lines shown on the chest of the female motif at Windmill Way (Figure 12e).

### Contact and after

Dillybags, with their overcast string handles—a process in which two or three strings are threaded through an upper row of looping, and then bound by another string to stabilise the looped body of the bag and strengthen the opening (Roth 1901)—were commonly carried by 'slip[ping] the handle string over the forehead, the bag hanging behind, between the shoulders' (Roth 1898a:27). The addition of cloth binding to the handles would have increased the comfort of carrying them in this way, as suggested by the QM dillybags. The shape and fabric of the cloth strip recovered from Windmill Way appears superficially similar to that observed on the bag handles of QM objects, and it seems plausible it might have been intended for similar use, though no string was found inside it when untwisted. The colour is 'turkey red', an inexpensive, colour-fast dye discovered in 1785 that was commonly applied to mass-produced cotton calico (plain-weave) and twill in Europe (Lowengard 2022). Large quantities were exported to colonial Australia for clothing production (e.g. *Queenslander* 1876), but pieces of turkey red were commonly used as gifts, payment, or in trade with *Bama*, alongside glass beads, tobacco and tomahawks (e.g. Gore 1911; Spencer and Gillen 1928:4). For

example, Roth issued 'a hundred Government-issued red shirts, a hundred turkey-red dresses' and other goods to *Bama* who assisted in the aftermath of Cyclone Mahina at Bathurst Bay in 1899 (McDougall 2015:48). Members of the Qld Police made similar distributions, such as Sergeant James Whiteford (1897) of the Musgrave NMP (north of Laura), who distributed '12 tomahawks, 12yds of turkey red, 12 fishing lines, 1 box of fishhooks and 6 lbs of tobacco' to *Bama* at 18 Mile Lagoon.

The rarity of introduced European materials at Windmill Way is especially interesting, given that some family groups continued living on Country until the 1930s (Cole 2010:18; McLay et al. 2024; Trezise 1968, 1971:25). There are three possibilities to account for this lack of material. The first is that introduced materials were regarded as too useful to part with, as indicated by the care that was taken in caching the glass beads and silver-plated spoon at the Dillybag site (McLay 2023; McLay et al. 2024). However, the Dillybag site is a rare instance of caching. Alternatively, the opposite may also have been true: European materials may have been regarded as too unimportant or inappropriate to incorporate into everyday *Bama* practices. Given the sheer number of Europeans who arrived from 1874 onwards, it is unlikely that the occupants of Windmill Way could have remained isolated from their material goods, which would have been available in abundance from camps, and discarded along travel routes; oral testimony from now deceased Laura Elders indicate common travel routes passed by not far from Windmill Way. The ABM Project has recorded 613 sites to date in the Laura area, yet, excluding European sites, only four of these incorporate European materials (chiefly glass in very small quantities) (ABM Project unpub. data). This suggests that decisions to adopt European materials were not simply a function of proximity, although little more can be said at this point without further, more robust, analysis of contact traces more broadly. The final, and most likely explanation, is that people ceased to use the site once Europeans invaded the region in 1874, being either unable or unwilling to return to it. The essentially modern date for the youngest Windmill Way plant fibre string (FIBRE00088) supports this argument and forced abandonment is perhaps not surprising given the density of conflict known to have occurred in the Cook pastoral district, including around Laura (Burke and Wallis 2019; Cole 2004, 2010).

## Conclusion

For possibly as much as 2,100 years, and certainly for the last 1,700, *Bama* in the Laura region, as elsewhere, were adept fibrecraft workers, exploiting locally available species for a wide variety of plant-based technologies. One of the most obvious features of the Windmill Way assemblage is its uniformity across this timespan. The string was mostly 2-ply ssZ twist and the knots of six known types. The square mesh knots and gauge were uniform, although varying between fragments, and the looping fragments all conformed to the same pattern. This demonstrates a refined and stable fibrecraft practice, with regular patterns and techniques used for specific purposes and passed down intergenerationally over at least 1,700 years. New raw materials were incorporated selectively into such practices.

That these objects survived in a rockshelter not particularly suited to human occupation, that was taphonomically compromised and in a geological context known for limited organic preservation, says much about the exceptions that would otherwise be overlooked in general archaeological practice. Australian archaeologists often concern themselves with chronology, declining to excavate sites that do not afford the promise of great depth or time. The Windmill Way site, representing as it does a shallow and highly disturbed palimpsest rather than a deep, stratified deposit, would usually have been dismissed as having minimal archaeological potential. Yet, the presence of well-preserved organic material culture objects on the surface afforded a rare opportunity to explore such items from an archaeological context, generating what now constitutes the largest known assemblage of archaeological fibres in Australia.

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