



Wrecked All Over the Place: The Identification of Disarticulated Context-Free Ship Remains from the Gold Coast in Queensland, Australia

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Abstract This article shows that it is possible to identify a vessel from disarticulated ship remains missing their original depositional context. By studying a dispersed collection of timbers, fasteners, and hull sheathing from a previously unidentified shipwreck on the Gold Coast, Australia, the authors were able to identify the remains as most likely from the colonial schooner *Heroine*. In this instance there were several possible identifications for the disarticulated ship remains, so historical research, detailed artifact recording, and timber and metal analyses were used to study the ship elements. The results showed a range of timbers preferred by New South Wales shipwrights

and copper sheathing of a datable metal composition, generating new knowledge of the material selection and techniques used in Australian colonial shipbuilding in general. While disarticulated or context-free shipwreck remains are often only able to provide a generic cultural or type affiliation, this study shows that through detailed analysis it is possible to ascribe a ship's name to the dispersed structural elements.

Resumen Este artículo muestra que es posible identificar una embarcación a partir de restos de barcos desarticulados que carecen de su contexto deposicional original. Al estudiar una colección dispersa de maderas, sujetadores y revestimientos del casco de un naufragio previamente no identificado en Costa Dorada, Australia, los autores pudieron identificar los restos como probablemente de la goleta colonial *Heroine*. En este caso, hubo varias identificaciones posibles para los restos del barco desarticulado, por lo que se utilizaron investigaciones históricas, registros detallados de artefactos y análisis de madera y metal para estudiar los elementos del barco. Los resultados mostraron una variedad de maderas preferidas por los armadores de barcos de Nueva Gales del Sur y revestimientos de cobre de una composición metálica fechable, lo que generó nuevos conocimientos sobre la selección de materiales y las técnicas utilizadas en la construcción naval colonial australiana en general. Si bien los restos de naufragios desarticulados o libres de contexto a menudo solo pueden proporcionar una afiliación cultural o de tipo genérica, este estudio muestra que

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a través de un análisis detallado es posible atribuir el número de un barco a los elementos estructurales dispersos.

Résumé Cet article démontre qu'il est possible d'identifier un vaisseau à partir des vestiges désarticulés d'une embarcation privés de leur contexte dépositionnel d'origine. Grâce à l'étude d'une collection de bois, de vis et du revêtement de la coque d'une épave auparavant non identifiée sur la Côte d'Or en Australie, les auteurs ont été en mesure d'identifier les vestiges comme étant très vraisemblablement ceux de la goélette coloniale *Heroine*. Il existait dans ce cas plusieurs identifications possibles pour les vestiges désarticulés du vaisseau. Ainsi, la recherche historique, les archives détaillées d'artefacts et les analyses de bois et de métal ont été utilisées pour l'étude des éléments du bateau. Les résultats ont mis en évidence une série de bois qui avaient la préférence des charpentiers de marine des Nouvelles Galles du Sud et d'un revêtement en cuivre d'une composition métallique susceptible d'être datée. Ceci a généré des connaissances nouvelles quant au choix du matériau et des techniques utilisées de manière générale pour la construction de bateaux dans l'Australie coloniale. Si les vestiges désarticulés ou sans contexte de vaisseau sont souvent uniquement capables de fournir un affiliation type ou culturelle générique, cette étude démontre que le recours à une analyse détaillée rend possible d'attribuer un nom de bateau aux éléments structurels dispersés.

Keywords shipwreck identification · colonial shipbuilding · *Coolangatta* · *Heroine* · Australia

Introduction

While shipwrecks typically remain at their original wreck site, relocation of wreckage is possible as well. Natural events and human activities can result in the exposure and movement of shipwreck remains. The dismantling and removal of a wrecked vessel—or elements thereof—by members of the public unfamiliar with archaeological practices, for example, results in disarticulated ship fragments missing the in situ details and context that can aid in their investigation. The identification of dispersed ship remains, therefore, poses different challenges to the investigation of

shipwrecks for which the initial site information and associations are available. This article presents the results of an archaeological investigation of disconnected and context-free hull remains and sundry ship elements from the Gold Coast, in Queensland, Australia, and the investigative processes that aided in the identification of the source shipwreck.

The exposure of wooden hull remains in 1974, designated Shipwreck X, on North Kirra Beach led to their removal by the Gold Coast City Council (GCCC). Sections of the shipwreck were subsequently included in sculptures, memorials, and trophies exhibited around the city, and some of the remains were presented to visiting public figures as gifts. Authorities deposited other sections at the GCCC storage depot in Tugun. Since the wooden hull fragments were stored outside in the elements and received no proper conservation treatment, their study was subjected to the methodological constraints that highly degraded materials place on available research methods. The results of this study also contribute to knowledge of Australian shipbuilding, in particular that of the state of New South Wales. This study also provides details about the techniques employed and the use made of (and familiarity) that shipwrights had with local materials. The significance of this study is indicated by its rarity, in that of the “2,786 colonial-built vessels wrecked in Australian waters, [at least] 271 have been relocated” (Nash 2004:95; Bullers 2018:3). To date, 18 of these have been surveyed or excavated archaeologically and 15 have had such results published (Jeffery 1987; Nash 2004; Bullers 2006, 2018; O'Reilly 2007; Bullers and Shefi 2009; Clayton 2012; Staniforth and Shefi 2014; Coroneos et al. 2022). This investigation of Shipwreck X, therefore, adds to a small sample set of studies of locally built ships.

Site Formation Considerations

The factors that influence the dispersal of shipwreck remains include the natural redistributive functions of the dynamic near-shore environment—the environmental formation processes—as well as the anthropogenic impacts of salvage, souveniring, reclamation, and reuse—the cultural formation processes (Stewart 1999; Martin 2012; Gibbs and Duncan 2016). The impacts of these processes are sometimes clear on

sites that retain structural or contextual integrity, but the more a site is dispersed or separated, and consequently mixed with other cultural material, the more difficult it becomes to identify the original context. Muckelroy (1975:173) refers to the difficulties of excavating a “scattered” shipwreck site, by which he meant “one on which no coherent ship’s structure has survived,” but he was primarily concerned with the distribution of artifacts on the seabed. O’Shea (2002) instead considered “scattered” wrecks in the near-shore region and sought to identify elements of the processes that distributed the vessels’ remains. Natural processes that distributed wreckage or allowed it to collect in “debris traps” were further compounded by “salvaging, scavenging, and intentional or unintentional scattering” (O’Shea 2002:220–221). In efforts by nautical archaeologists to identify the remains of such scattered wrecks, O’Shea (2002:225–226) saw advantage in “the planned structure of the vessel itself” and in “the very complexity and redundancy of vessel construction.” Elements of a distributed shipwreck may be scattered all over the place, but they each served an original function within the ship for which signatures may survive in individual timbers and artifacts. In this way, disarticulated context-free ship remains are still able to yield valid archaeological information, and it is on this premise that this study is built.

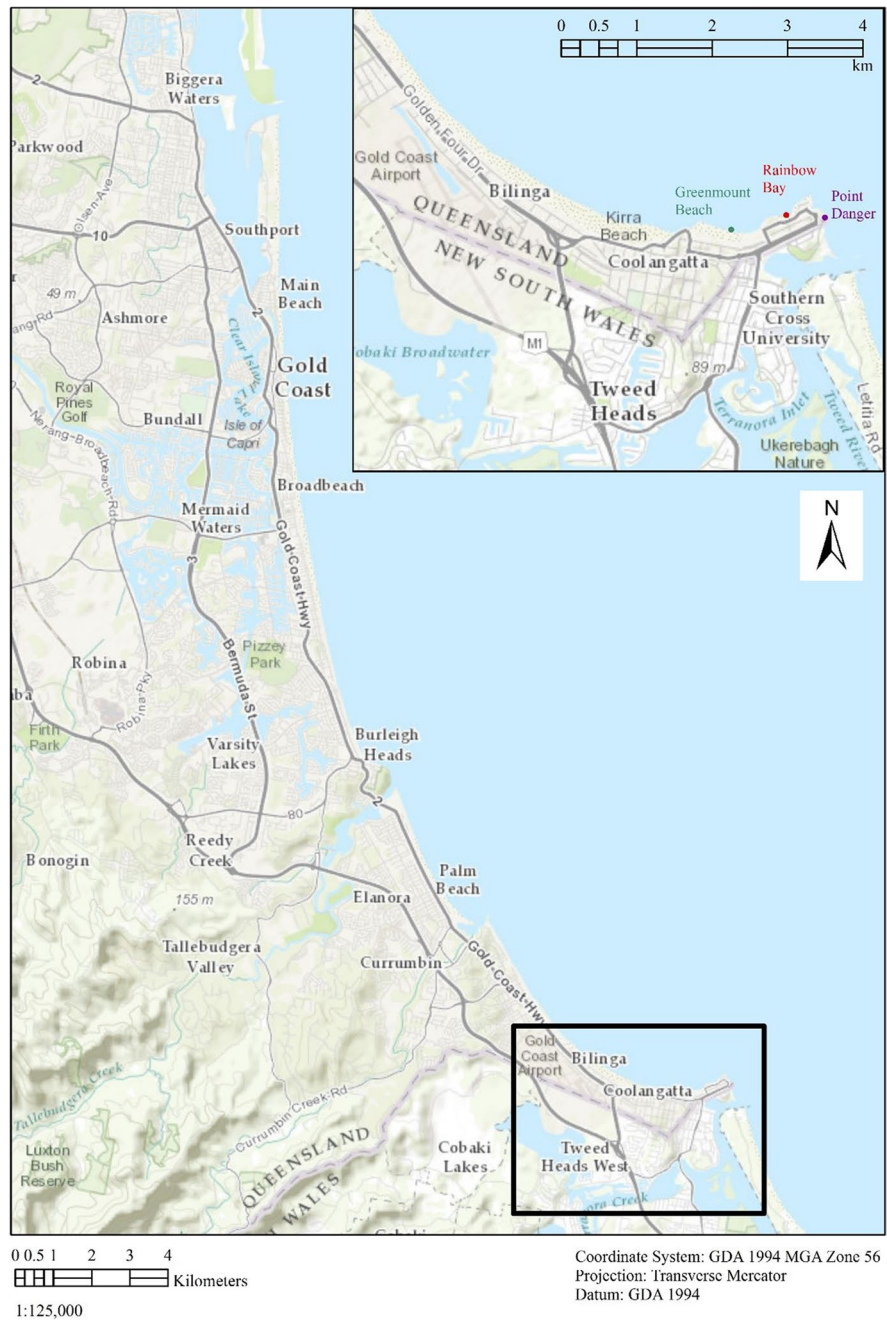
The Location of the Shipwreck Site

The Gold Coast is located at the extreme south of Queensland’s Pacific coast and its suburb of Coolangatta, situated near the mouth of the Tweed River, is its southernmost point. The region was part of New South Wales from the first arrival of Europeans until 1859 when the colony of Queensland was established. Maritime trade and transport were essential to the development of the region, and local shipping centered on the Tweed River, as it was the only means of communicating with the interior to receive supplies or export goods. The Tweed empties into the southern Coral Sea on the south side of the Point Danger headland, which was an important navigational landmark for local shipping. To the north is Danger Bay, the southern shore of which encompasses present-day Rainbow, Greenmount, and Kirra Beaches (Fig. 1). Though broad, the bay

did afford vessels good anchorage and shelter from inclement southeasterly weather (Keats 1999:23). Despite its importance, the Tweed River itself posed a problem, as it was subject to frequent silting to where it became hazardous for vessel traffic. The first ship recorded entering the Tweed was the schooner *Letitia*, in 1840. There have been 61 documented shipwrecks in the area since then, 56 of which occurred at the river bar or close to the river’s entrance (Longhurst 1996:14; Arthur 1998:3–4). In 1974, Shipwreck X was exposed on North Kirra Beach near Coolangatta Creek (Fig. 2), but the Tweed mouth, just to the other side of Point Danger, was the vessel’s likely intended destination (*Sydney Morning Herald* 1846a, 1897).

Periodically since the 1920s, visible wooden hull remains from a shipwreck have been reported on Kirra/Bilinga Beach, accompanied by a debate over the identity of the vessel. In August 1925, wave action eroded the beach and uncovered a wooden shipwreck measuring 12.2 m (40 ft.) in length (*Brisbane Courier* 1925). Following heavy seas in 1936, a 9.1 m (30 ft.) section of timber hull with heavy crosspieces and protruding bolts was revealed on the beach between Bilinga and Currumbin (*Courier Mail* 1936). Rutilite miners working with a tractor on the beach near Coolangatta Creek in 1954 salvaged planks from a hull measuring some 9.1 m (30 ft.) in length, with the remains then identified as *Coolangatta* (*Courier Mail* 1954). In 1973, erosion uncovered the remains of a shipwreck at Kirra Beach. The Department of Harbours and Marine soon dynamited the remains, thereby destroying the exposed frames of the vessel, after members of the public had sustained injuries from the shipwreck’s remains while swimming and surfing (*Courier Mail* 1973; Shoalhaven Historical Society 1977; Department of Environment 2018). Other ship timbers remained buried in the sand. After storm activity exposed Shipwreck X in 1974, a good deal of local souveniring took place until the GCCC removed the remains and deposited them at their depot in Tugun (*Telegraph* 1978). The hull timbers subsequently were separated and dispersed further, with pieces being incorporated into memorials, trophies, art installations, and gifts for visiting dignitaries (*Australian Women’s Weekly* 1978; *Gold Coast Bulletin* 1980; Diamond 1983). These dispersed remains form the basis of this study.

Fig. 1 Location map showing the southern Gold Coast region. (Map by Lauren Davison, 2022.)



Previous Efforts to Identify the Shipwreck

The identity of Shipwreck X has been debated since its removal from the beach, but it is almost certainly a colonial-built vessel. The European settlement of Australia was completely dependent on maritime transport, with ships providing regional, national, and international connections. Initially, the

British restricted local shipbuilding to prevent competition with the East India Company and their trading monopoly in the Indian Ocean, and because of the fear that it would offer convict inhabitants a means of escape (Jeans 1974:160; Bach 1976:70). Geographical factors, such as Australia’s great distance from England and its unknown and hazardous coasts, contributed to an adverse economic situation that, British

Fig. 2 Shipwreck on North Kirra Beach. (Photo by unknown photographer [possibly B. Stafford], 1970s, courtesy of the Tweed Regional Museum, TH192-11T.)



legislation notwithstanding, soon convinced colonial authorities of the need for local solutions (Bach 1976). Prohibitions on local shipbuilding were lifted in 1813, and a thriving shipbuilding industry quickly developed. Investigations into local shipbuilding have taken a variety of forms, from archival studies to archaeological research involving fieldwork. The former has tended to focus on ship construction in particular regions, often including information about individual shipwrights; for example, Kerr (1987), Dundon (1997), Dickson (1998), Evans (2004), and Robin (2011). The shipbuilding industry in New South Wales has been the subject of limited historical and archaeological studies. Jeans (1974) used shipping registers to examine 19th-century boatbuilding in the Sydney area, while Dundon (1997) researched the shipwrights and dockyards of Brisbane Waters, on New South Wales's central coast. To date, archaeological investigations of one boat and four shipwrecks have contributed knowledge relating to the construction of New South Wales colonial-built vessels, i.e., the Barangaroo boat (1830s), *Clarence* (1841–1850), *Alert* (1846–1854), *Mary Wadley* (1874–1901), and *Mary Ellis* (1897–1907) (Lester 1984; Harvey 1987; Nash 2004; Bullers 2006; Bullers and Shefi 2009; Staniforth and Shefi 2014; Veth et al. 2016; Sydney Metro 2018; Coroneos et al. 2022). The most recent discovery and excavation of the Barangaroo boat in Sydney harbor by Casey and Lowe and Cosmos

Archaeology has provided an important addition to the corpus of colonial-built vessels from New South Wales (Sydney Metro 2018; Coroneos et al. 2022). The Barangaroo archaeological boat remains represent a small double-hulled clinker-built vessel that was abandoned in the 1830s. It was raised in its entirety in 2018 and is currently undergoing conservation treatment. The Barangaroo boat provides an opportunity to undertake a long-term, comprehensive ship study in Australia for the first time since the excavation of the 1629 *Batavia* shipwreck in the 1970s (van Duivenvoorde 2015a; Green and Paterson 2020).

Attempts to identify Shipwreck X have been limited to mostly historical studies (for example, Nutley [2014]). The two most likely candidates are the colonial-built schooners *Coolangatta* and *Heroine* wrecked in 1846 and 1897, respectively, under similar circumstances—the vessels were the only ones blown ashore on the beaches north of Point Danger (Fig. 3) (Smith 1980; Carling-Rodgers 1981; Dwyer 1984; Noffke 2008:1,5, 2009:7; Potts 2014). The vessels were built in New South Wales, *Coolangatta* in 1843 and *Heroine* in 1894 (*Sydney Morning Herald* 1847; Australian Register of British Shipping for Port of Sydney 1844, 1894; Lloyd's Register of Shipping 1896). *Coolangatta* had loaded cedar from the Tweed River and *Heroine* was transporting a cargo of coal for the Colonial Sugar Company mill at Condong



Fig. 3 *Heroine* beached on Sunday, 25 July 1897. (Photo by F. J. Davey, 1897; courtesy of the Tweed Regional Museum, TH10-40.)

(*Sydney Morning Herald* 1847; *Evening News* 1897). On each occasion, the vessel was anchored in Danger Bay when gale winds blew it ashore dragging its anchor (*Sydney Morning Herald* 1846b, 1847; *Evening News* 1897). The present research includes the first archaeological investigation based on systematic recording of the surviving hull remains that may serve to differentiate these two candidates. While the timbers that survive are scattered and highly degraded fragments, having received no conservation since their recovery nearly 50 years ago, they provide the best means available to determine how the vessel was built and operated and to identify the shipwreck.

Approaches to Watercraft Identification from Physical Remains

One of the most common approaches to shipwreck studies is attempting to ascribe a name to an

otherwise anonymous site or assemblage based on concordance between archaeological evidence and historical records. Such studies are idiographic and historically particular, and “interpret archaeological assemblages within a narrative and context previously created by sources beyond the archaeological sphere” (Harpster 2013:589). Harpster (2013:593) codes studies that seek to ascribe an affiliation or name to an archaeological site as Type B investigations (as opposed to Type A where the identity of the ship is known but the site is yet to be identified). An underlying presumption inferred in Harpster’s description is that the site is discovered in situ and includes both associated artifacts (cargo, fittings, equipment, personal possessions, etc.) and vessel remains. Indeed, such artifacts, in association with the remains of the ship itself, typically provide the necessary data to date and provenience the entire shipwreck assemblage. Such relationships often are missing when investigating disarticulated ex situ shipwrecks where provenience cannot be determined.

Conclusive identification of a shipwreck is linked typically to a diagnostic piece of evidence, often a particular item such as a ship’s bell (McCarthy 2004:60–61, 2009:11,22; Van Duivenvoorde, Stedman et al. 2012:156; Wilson 2012:22). When conclusive diagnostic artifacts do not exist, identifying a shipwreck is then usually based on more than a single piece of evidence. In 2011 Wilson (2012:81–84) investigated an unidentified shipwreck off Phillip Island, Victoria. He analyzed timber samples, vessel dimensions, and artifacts and compared the results to historical accounts. This evidence-based investigation resulted in the shipwreck being identified as *Levan Lass* (Wilson 2012:88). In 1986 a winter storm uncovered vessel remains on a beach in Port MacDonnell, South Australia. Public souveniring ensued at the scoured site before the council removed the vessel (Fowler and McKinnon 2012:45). Initially, the remains were transported to the local council depot, and then subsequently moved to their current location at the Port MacDonnell Maritime Museum. In 2011 Fowler investigated 17 timber elements, including frames, hull planking, keel, keelson, and stringers (Fowler 2011:50). The investigation involved a survey to record the vessel and identification of timber samples. Close attention to detail allowed the results to be compared to historical evidence and previous research that had tentatively identified the

wreck as *Miame*, which was blown ashore during a gale in 1861. The 2011 research concluded that *Miame* is indeed the most likely identification for the remains (Fowler and McKinnon 2012:45,53). This study uses a similar evidence-based approach to identify the origins of the disarticulated timber assemblage associated with Shipwreck X.

The Framework for Investigation

The framework for the investigation of the disarticulated ship remains associated with Shipwreck X was developed from a combination of methods used in previous studies. Sound historical research into archival and documentary material of all possible shipwreck events in the region of the Tweed River was the initial step. This historical research aimed to identify potential in situ and ex situ locations of interest, as well as establish a timeline of events that contributed to the formation of the disarticulated shipwreck site. Fieldwork to locate and record the remains of Shipwreck X in identified ex situ sites, and remote-sensing surveys to locate any in situ material, followed. Timber and metal remains were then recorded and sampled for later analysis.

Historical Research

Archival research of the construction and shipwrecking events of *Coolangatta* and *Heroine* provided historical data for comparison to the archaeological record (Smith 1980; Carling-Rodgers 1981; Dwyer 1984; Noffke 2008:1,5, 2009:7; Potts 2014). The Australian National Library database “Trove” allowed access to newspaper accounts from the 19th and early 20th centuries. Keyword searches using “Coolangatta,” “Heroine,” “shipwreck,” “Tweed River,” and “Gold Coast,” or combinations thereof, yielded useful results. *Evening News*, *Gold Coast Bulletin*, the *Brisbane Courier*, the *Courier Mail*, the *Moreton Bay Courier*, and the *Sydney Morning Herald* newspapers all contained relevant articles. The Tweed Heads Historical Society Museum archives provided newspaper articles from the 1970s and 1980s relating to the 1974 exposure of the vessel remains at North Kirra Beach and the related souveniring and council removal of timbers.

Gold Coast Fieldwork

The fieldwork for this investigation took place in southern Gold Coast and assessed shipwreck remains located across three sites: (1) the GCCC’s depot at 71–77 Boyd Street, Tugun; (2) the Gold Coast and Hinterland Historical Society (GCHHS) at 8 Elliot Street, Surfers Paradise; and (3) Queen Elizabeth Park (QEP) on Marine Parade in Coolangatta. During the fieldwork, archaeologists from Flinders University recorded the timber remains stored or displayed at the GCCC Tugun depot, the GCHHS, and QEP (Figs. 4, 5).

Ship-Timber Recording

The surviving hull remnants from Shipwreck X, comprising small intact sections and individual elements, were recorded at the Tugun storage depot and the GCHHS. Investigators recorded dimensional data and information relating to joinery, fastenings, condition, and other observable features using timber recording forms. Digital photographs were taken of each section or component, as well as of any observable diagnostic features. Scaled drawings completed from baseline offset surveys provided 1:5 or 1:10 representations of the intact sections and frames. Offset distances to individual features were recorded at 90° from baselines established at the edge of the element under investigation using a setsquare with attached level (Fig. 6) (Bowens 2009:120–121; Burke et al. 2017:185–187). Full-size tracings on stretched polyester film provided an accurate representation of the hull planking. Plank edges, fastenings, and holes were recorded to illustrate the details of GCHHS Plank 1 (P1) and QEP P2 and P3. Standardized symbols were used for consistency.

Two individual frames and an intact section containing frames, outer planking, ceiling, and a caprail were recorded at the Tugun depot. A small intact section of hull, with frames, planking, and a wale, was recorded at QEP (Figs. 5, 6). A sculpture at the GCHHS, relocated from Coolangatta airport when the runway was extended (Department of Environment and Science, Queensland 2014, pers. comm.), included 10 timber elements—planking and frames—from Shipwreck X (Figs. 7, 8). The recording team first photographed the artwork in detail before disassembling it, which allowed them to access the ship

Fig. 4 Map of fieldwork locations, Gold Coast, Queensland. (Map by Lauren Davison, 2022.)

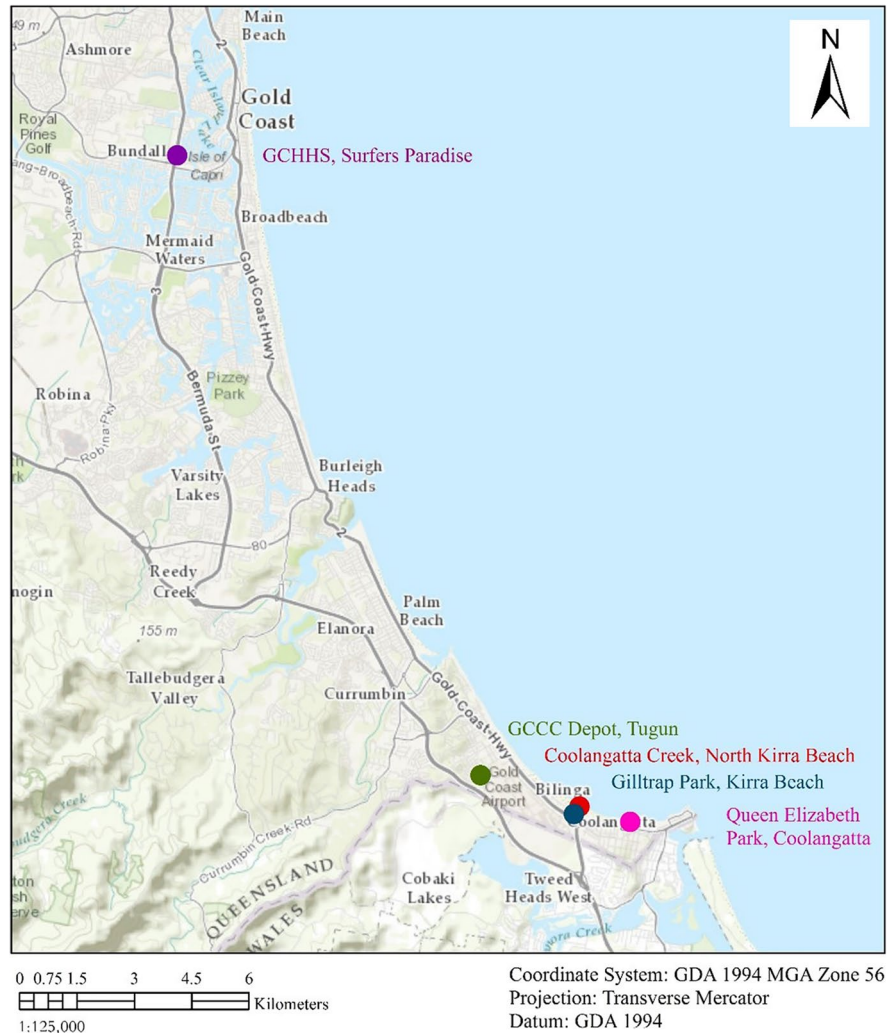


Fig. 5 Hull remains displayed at QEP on Marine Parade in Coolangatta (display is upside down). (Photo by Lauren Davison, 2014.)



Fig. 6 Lauren Davison and Peta Fray recording hull remains at QEP using baseline-offset measurements. (Photo by Mark Polzer, 2014.)



Fig. 7 Sculpture made of loose ship timbers and sheathing from Shipwreck X, GCHHS, Surfers Paradise. (Photo by Wendy van Duivenvoorde, 2014.)



Fig. 8 Timbers from the sculpture ready for recording, GCHHS, Surfers Paradise. (Photo by Kate Greenwood, 2014.)

components for recording and then reassemble the installation to its initial form.

Sampling for Wood Species Identification

Investigators collected 14 timber samples, measuring no more than 5×5 cm, using handsaws, chisels, and hammers. Each sample fragment was placed in an individual ziplock bag labeled with collection details, including site, feature, collector, and date. Accessibility and timber condition determined sample location, with the aim being to retrieve samples from areas with good preservation. Jugo Ilic, of Know Your Wood laboratory, Victoria, conducted species identification of all the timber samples (Table 1).

Recording and Analyzing Copper-Alloy Sheathing and Tacks

Fragments of copper alloy remained on the exterior surface of the hull planking, and nail holes were present where sheathing was absent. While moving the intact section at the GCCC depot the team detected two pieces of sheathing fastened to the hull planks while a third fragment remained on the ground. At the GCHHS, six examples of sheathing remained, three still connected to planks and three loose sheets, one of which forms a flag at the top of the sculpture. Five pieces survive at QEP, including one intact sheet. The same recording techniques used on the timber elements were applied to the copper-alloy sheets—scale drawings, photographs, 1:1 tracing, and recording forms. The collection of nine samples from the loose sections of metal underneath sheets still attached to the timber provided examples for the elemental analysis to determine the composition of the metal. Nine samples, three from each location, underwent semi-quantitative analysis to determine their composition using x-ray detection with an SDD EDS detector in a FEI Quanta 450 FEG environmental scanning electron microscope (ESEM).

The authors embedded a small fragment of each sample in Struers MultiFast phenolic hot-mounting resin for general use. The resin mounts were set in a Struers CitoPress-10 hot-mounting machine, and then polished using a Struers TegraPol-11 diamond polisher to expose the samples and allow the authors to access relatively clean, uncorroded surfaces for analysis.

Table 1 Species identification

No.	Location	Description	Scientific Name	Common Name	Geographic Region
1	GCHHS	Hull plank No. 1	<i>Eucalyptus? pilularis</i>	Blackbutt	Bega, New South Wales to Maryborough, Queensland (Baker 1919:207–209; Boland et al. 2006:528; Bootle 2010:252)
2	GCHHS	Frame No. 2	<i>Eucalyptus? pilularis</i>	Blackbutt	Bega, New South Wales to Maryborough, Queensland (Baker 1919:207–209; Boland et al. 2006:528; Bootle 2010:252)
3	GCHHS	Frame No. 4	<i>Corymbia gummifera</i>	Red bloodwood	Coastal areas from eastern corner of Victoria through New South Wales to southeast Queensland (Boland et al. 2006:528; Bootle 2010:252)
4	GCHHS	Hull plank No. 6	<i>Eucalyptus? pilularis</i>	Blackbutt	Bega, New South Wales to Maryborough, Queensland (Baker 1919:207–209; Boland et al. 2006:528; Bootle 2010:252)
5	GCHHS	Hull plank No. 9	<i>Eucalyptus? pilularis</i>	Blackbutt	Bega, New South Wales to Maryborough, Queensland (Baker 1919:207–209; Boland et al. 2006:528; Bootle 2010:252)
6	QEP	Plank No. 3	<i>Eucalyptus? microcorys</i>	Tallowwood	Newcastle, New South Wales to Maryborough, Queensland (Baker 1919:189; Boland et al. 2006:506; Bootle 2010:350)
7	QEP	Plank No. 2	<i>Eucalyptus? microcorys</i>	Tallowwood	Newcastle, New South Wales to Maryborough, Queensland (Baker 1919:187–189; Boland et al. 2006:506; Bootle 2010:350)
8	QEP	Wale	<i>Eucalyptus? paniculata</i>	Grey ironbark	Bega, New South Wales to Coffs Harbour, New South Wales, mainly 80 km of the coast (Baker 1919:279–280; Boland et al. 2006:496; Bootle 2010:287)
9	QEP	Frame No. 4	<i>Eucalyptus? microcorys</i>	Tallowwood	Newcastle, New South Wales to Maryborough, Queensland (Baker 1919:187–189; Boland et al. 2006:506; Bootle 2010:350)
10	QEP	Frame No. 3	<i>Eucalyptus? microcorys</i>	Tallowwood	Newcastle, New South Wales to Maryborough, Queensland (Baker 1919:187–189; Boland et al. 2006:506; Bootle 2010:350)
11	QEP	Plank No. 1	<i>Eucalyptus? microcorys</i>	Tallowwood	Newcastle, New South Wales to Maryborough, Queensland (Baker 1919:187–189; Boland et al. 2006:506; Bootle 2010:350)
12	QEP	Frame No. 4	<i>Eucalyptus? microcorys</i>	Tallowwood	Newcastle, New South Wales to Maryborough, Queensland (Baker 1919:187–189; Boland et al. 2006:506; Bootle 2010:350)
13	GCCC	Frame No. 2	<i>Eucalyptus? salinga</i>	Sydney blue gum	Batemans Bay, New South Wales to southern Queensland, mostly 120 km of coast (Baker 1919:243–245; Boland et al. 2006:294; Bootle 2010:278)
14	GCCC	Caprail	<i>Eucalyptus? fibrosa</i>	Red ironbark	Moruya, New South Wales to northwest of Rockhampton, Queensland (Boland et al. 2006:476; Bootle 2010:287–288)

The application of the FEI Quanta 450 with SDD EDS detector provides a semiquantitative analytical method of elemental composition by area or spot testing. The area or spot sizes analyzed for the samples prepared in this study measured approximately 300 × 300 μm to 3 × 3 mm (Figs. 9, 10, 11). This

method of sample analysis is thus a localized testing method, which may not necessarily be representative of the elemental composition of an entire artifact. For the ship sheathing, preferably three areas per sample are tested to confirm as much as possible that they are characteristic, whereas the exposed areas of the

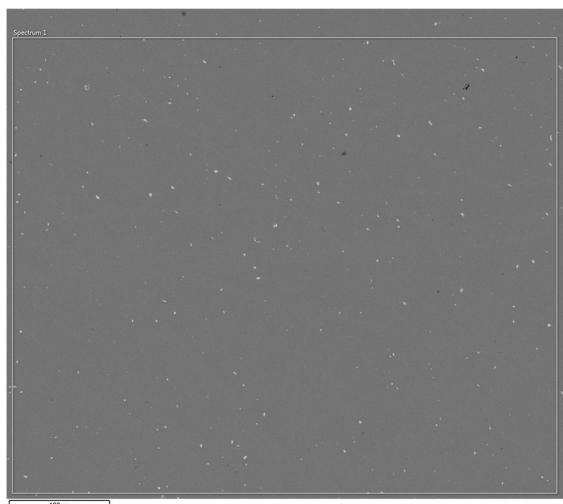


Fig. 9 Micrograph showing sheathing area analyzed (with the white-lined box labeled Spectrum 1) (Sample 3). White specs in micrographs are lead inclusions. (Micrograph by Wendy van Duivenvoorde, 2021.)

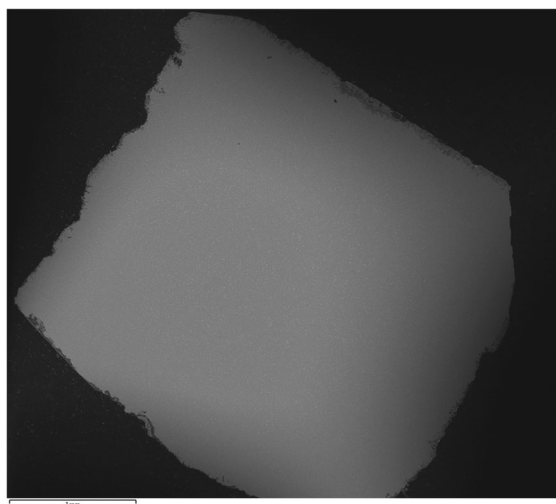


Fig. 11 Micrograph showing cross section of tack shaft (Sample 2). (Micrograph by Wendy van Duivenvoorde, 2021.)

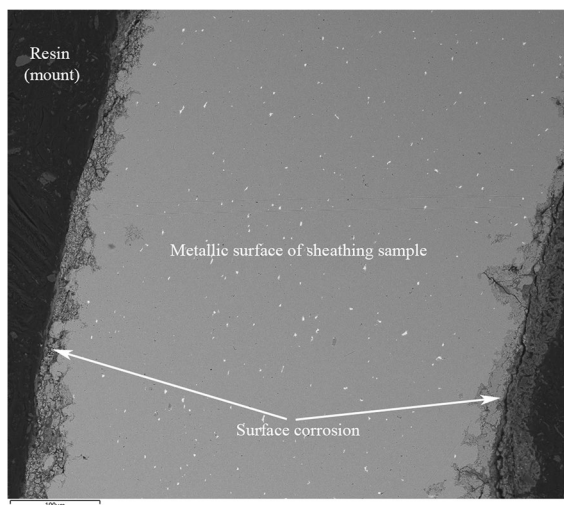


Fig. 10 Micrograph showing cross section of sheathing fragment (Sample 7), showing surface corrosion on the edges and metallic surface of the sample. (Micrograph by Wendy van Duivenvoorde, 2021.)

sheathing tacks were analyzed in their entirety. Such fasteners, when embedded in resin, display the entire cross-sectional surface of their shafts (in this case these sections measure ca. 3×3 mm) (Fig. 11), and it is possible to capture this entire area for elemental determination—the areas chosen for analyses display solid metal and are relatively free of any surface

corrosion (Fig. 9). The time of analysis per sample was automated—the Quanta 450 takes about 10 sec. to get a reliable elemental composition.

Patent marks found on the edges of the sheathing material were photographed in the field from different angles. One example from GCHHS was sampled for closer inspection. Photographs of this patent stamp taken with a Nikon D3100 digital camera and a Tamron 272ENII macro lens in controlled settings with Microlight 150 fiberoptic lightguides highlighted the engraved features. To record further details, rubbings of the patent marks using different types of paper and pencils were made at QEP.

Results

This section presents the archaeological results of this investigation in three sections: the first considers the historical research, the second details the study of the timber remains at the three locations, and the third describes the metal sheathing observed on the hull planking.

Historical Research

Archival research provided information on the construction and life of the two vessels suggesting useful evidence to search for during the archaeological

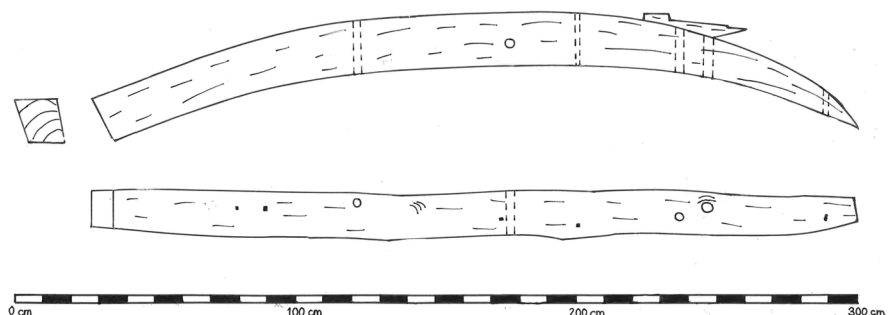
fieldwork that would aid in identification. Examination of the Lloyd's Shipping Register (Lloyd's Register of Shipping 1896: order No. 552) and the Sydney Shipping Register (Australian Register of British Shipping for Port of Sydney 1894) revealed details about the size and registration of *Coolangatta* and *Heroine*. A photographic collection compiled from Tweed Heads Historical Society, the GCHHS, and Picture Gold Coast—the Gold Coast Local Studies Library database—provided visual representations of the shipwreck on the beach and the original art installation from Coolangatta airport. The available images provided a comparison between the surviving remains and the 1974 vessel.

No records pertaining to the removal of the remains from the beach were found, leaving the poorly preserved shipwreck sections as the only physical evidence available to identify the vessel. The photographs, newspapers, reports, registers, and other secondary sources consulted during the historical research were used for comparison to the fieldwork results aiding in the identification of Shipwreck X.



Fig. 12 Ship timbers at GCCC depot. (Photo by Lauren Davison, 2014.)

Fig. 13 Schematic drawing of GCCC F2. (Drawing by Lauren Davison and Wendy van Duivenvoorde, 2022.)



Ship Timber

A total of 30 individual timber fragments from Shipwreck X, including 18 frames, 9 hull planks, 1 wale, 1 ceiling plank, and 1 cap rail, survive in a condition to provide recordable data. At the GCCC depot, two frames and one intact section—recorded as a single feature containing six frames, two hull planks, 1 ceiling plank, and a caprail rail—provided information. The remaining timber pieces at the depot are extremely deteriorated and unable to offer relevant data (Fig. 12). The GCHHS contains four plank and six frame fragments as part of the sculpture. An intact section comprising three hull planks, one wale, and four frames forms a memorial in QEP. The measurements and descriptions of each timber feature are listed below.

Frames

Frame 2 located at the GCCC depot (GCCC F2) is the only surviving curved frame and measures 264 cm in length (Fig. 13). The remaining 17 frames are much smaller, straight and rectangular in shape, and measure from 27.3 cm (QEP F2) to 141.1 cm (GCCC F3) in length. Their molded dimensions vary from 12.7 to 18 cm and their sided from 12.3 to 18.5 cm (Table 2).

Frames from the intact sections at the GCCC depot and QEP provide details about the construction methods. Double frames are present with three pairs of frames still attached to the intact section at the GCCC depot and one set at QEP (F3 and F4). Discoloration on the interior surface of the hull planking indicates the previous presence of a double frame next to QEP F2. Frames in the intact section at GCCC depot are spaced 30–34 cm apart and sit in rectangular recesses 31.5–37.5 cm long, 18–21 cm wide, and cut 6–7 cm deep into the caprail (Fig. 14).

Table 2 Frame dimensions

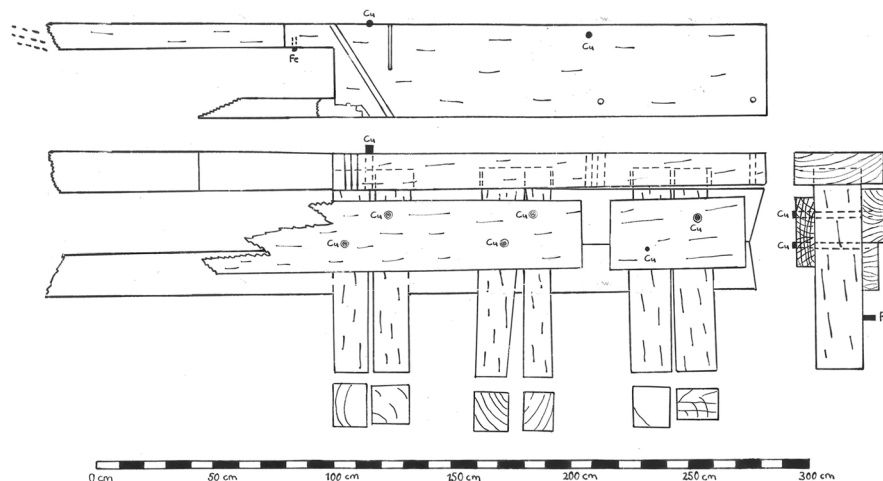
Location	Feature	Number/Name	Length (cm)	Molded (cm)	Sided (cm)
GCCC	Frame	2	264.0	18.0	16.0
GCCC	Frame	3	141.1	18.0	—
GCCC	Frame	4	77.0	13.8	18.5
GCCC	Frame	5	77.0	13.8	16.9
GCCC	Frame	6	80.0	13.8	15.4
GCCC	Frame	7	80.0	12.3	16.9
GCCC	Frame	8	77.0	17.8	16.9
GCCC	Frame	9	77.0	16.9	12.3
GCHHS	Frame	2	94.0	17.5	14.5
GCHHS	Frame	3	87.0	16.5	18.0
GCHHS	Frame	4	91.2	14.5	15.5
GCHHS	Frame	7	91.0	17.0	15.5
GCHHS	Frame	8	88.0	16.5	13.2
GCHHS	Frame	10	89.5	16.0	13.0
QEP	Frame	1	28.1	13.4	—
QEP	Frame	2	27.3	13.8	—
QEP	Frame	3	98.9	15.5	16.9
QEP	Frame	4	104.0	12.7	17.0

Iron fasteners attach the planking to the frames. GCCC F3 contains the remains of 10 iron bolts with two lines of five fasteners spaced 20 cm apart, protruding 5–6 cm above the timber surface in a zig-zag pattern. The GCHHS provided samples of two iron fasteners. The bolts measure 14.2 cm long, their hexagonal shafts are 1.5 cm wide, their circular flat heads each have a diameter of 1.9 cm, and all have flat ends. Frames at all three sites contained the same type of iron fasteners and fastening holes

measuring 1.6–2.2 cm in diameter, which indicate the location of bolts that have either completely corroded away or been salvaged.

The six frames at the GCHHS are all individual elements in the sculpture and measure between 87 and 94 cm long. They are possibly cut to a specific length for the purpose of the art installation. All contain the remnants of between three and six iron fasteners on the exterior surface, either the bolts themselves or the holes left behind.

Fig. 14 Schematic drawing of intact section with double framing, two hull planks, one ceiling plank, and caprail at GCCC depot. (Drawing by Lauren Davison, Brad Guadagnin, and Wendy van Duivenvoorde, 2022.)



Planking

The best-preserved intact portion of the ship’s hull at QEP contains the highest proportion of planking still connected. This includes three hull planks and a wale (Figs. 5, 15). Planks range in length from 99.5 (GCHHS P9) to 348.9 cm (GCCC P1) and from 17.5 to 31.5 cm wide (Table 3). Thickness varies from 5.9 to 6.5 cm in the hull planking while the wale is 10.1 cm thick. The planking is still fastened to frames and the planks themselves are separated by small spaces. This may be due to the deterioration of the timber.

The ceiling plank is 230 cm long by 29.2 cm wide by 7.7 cm thick and attached to the frames using copper alloy bolts approximately 3 cm in diameter with circular washers ranging between 4.5 and 4.8 cm in diameter. A rectangular section, 10.1 cm wide, is missing from the ceiling plank above a fastener hole in the caprail. This may indicate the local souveniring of metal fastenings mentioned in newspaper accounts

of the shipwreck’s appearance in 1974 (*Telegraph 1974*).

Caprail

The intact section at the GCCC depot has a caprail attached to the frames and hull planking. It is rectangular, measuring 221.5 cm long, 36.9 cm wide, and 15.4 cm thick, and has three recesses to accommodate the top ends of the double frames (Fig. 14).

Wood Species Identification

Six different types of Australian trees were identified from 14 timber samples: blackbutt (*Eucalyptus pilularis*), grey ironbark (*E. paniculata*), red bloodwood (*Corymbia gummifera*), red ironbark (*E. fibrosa*), Sydney blue gum (*E. saligna*), and tallowwood (*E. microcorys*). The identification of each sample is outlined in Table 1.

Fig. 15 Illustration of intact Muntz-metal sheet on ship’s remains on display at QEP in Coolangatta. (Drawing by Mark Polzer, Dana Gilmore, and Wendy van Duivenvoorde, 2022.)

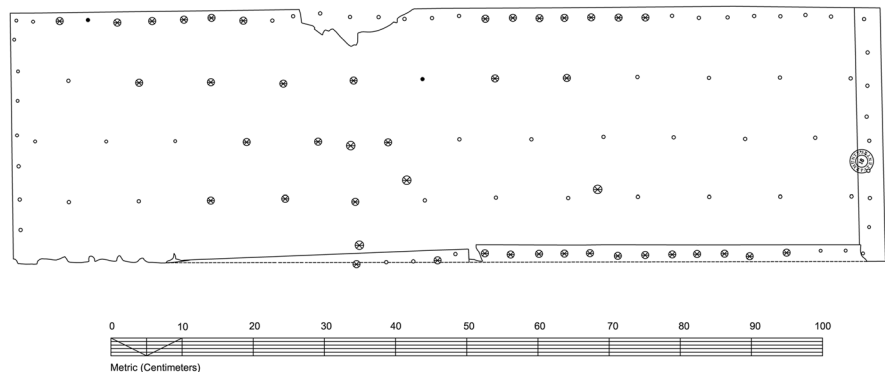


Table 3 Planking dimensions

Location	Feature	Number/Name	Length (cm)	Molded (cm)	Sided (cm)
GCCC	Planking	1	348.9	26.7	6.7
GCCC	Planking	2	285.5	22.2	4.4
GCCC	Planking	Ceiling	230.0	29.2	7.7
GCHHS	Planking	1	158.5	28.0	6.0
GCHHS	Planking	5	225.5	31.5	6.0
GCHHS	Planking	6	259.0	23.5	6.5
GCHHS	Planking	9	99.5	23.0	6.0
QEP	Planking	3	224.0	24.5	6.0
QEP	Planking	1	265.5	17.5	6.0
QEP	Planking	2	180.3	24.7	5.9
QEP	Planking	Wale	323.0	26.8	10.1

The hull remains at each of the three sites contain two different timber species (Table 1). The ship timbers at the GCCC depot are Sydney blue gum and red ironbark, while those at the GCHHS are blackbutt and red bloodwood. The QEP memorial includes grey ironbark and tallowwood. The surviving frames from Shipwreck X are constructed from four timber species, and at least two different species were used for its planking.

Five of the six wood species identified here have been found previously in archaeological investigations of Australian-built ships. The hull of *Alma Doepel*, an historical vessel built in 1903 on Bellinger River in northern New South Wales (only 19–20 km north of the Nambucca), contained blackbutt, red bloodwood, red ironbark, and possibly Sydney blue gum (or flooded gum) (Clayton 2012:64). Shipwrights used tallowwood and Sydney blue gum in the hull of *Clarence*, Sydney blue gum in *Alert*, and blackbutt in *Mary Ellis*, all three ships having been built in New South Wales during the 19th century (Clayton 2012:64).

Copper-Alloy Sheathing

Fourteen complete or fragmentary sheets of Muntz's metal patented sheathing survive on the remains of Shipwreck X. The remnants of three sheets were observed at the GCCC depot, two still attached to the hull planking (Fig. 16). The third piece was found detached below the ship remains and was fragmented into three segments when moved. The GCHHS contained three sections of sheathing still attached to the timbers, two loose sheets, and a flag constructed from a third fragment (Figs. 7, 8, 17). QEP has five sheets attached to the hull planking—one complete sheet and four fragments (Figs. 5, 15). The complete sheet of Muntz-metal sheathing (QEP S1) is 122 cm (48 in.) long and 35 cm (14 in.) wide. The sheathing fragments measure between 26.7 and 127.2 cm in length and they vary in width from 6 to 35.5 cm. Their thicknesses range from 0.05 to 0.2 cm.

Muntz Sheets: Placement and Hole Patterns

The complete sheet of Muntz-metal from Shipwreck X has the standard British dimensions of 48 × 14 in. typically seen in colonial-built vessels in the Americas and Australia (Ronnberg 1980:128;



Fig. 16 Detail of intact section showing double framing, two hull planks, and preserved Muntz-metal sheets at GCCC depot (remains are photographed upside down; the caprail is attached to the bottom of this assembly and not visible in photo). (Photo by Lauren Davison, 2014.)



Fig. 17 Muntz-metal sheet turned into a flag on the sculpture from Shipwreck X, GCHHS, Surfers Paradise. (Photo by Kate Greenwood, 2014.)

Villalobos 2020:95). The sheet was mechanically punched with three rows of nails in a diagonal pattern at 60°, requiring 36 tacks, each row was spaced 8.5 cm apart, and holes were spaced 10 cm from center to center. The other fragments of sheathing from Shipwreck X also have three rows of mechanically punched holes for the sheathing tacks,

with similar spacing between the rows and holes. It is worth noting that this is consistent with late 19th-century plate punching technology (Ronberg 1980:134; Villalobos 2020:97–101; Bennett, this issue).

Generally, the attachment of the yellow metal sheets was done from top to bottom and from stern to bow (Ronberg 1980:130; Staniforth 1985:28). The small fragmentary sheet of Muntz-metal directly below the caprail on the intact section recorded at the GCCC depot overlaps the next sheet, which indicates that Shipwreck X was sheathed from the keel up and from stern to bow (Fig. 16). Ronberg notes that the lapping of top and bottom margins of the sheets in merchant vessels shows that both methods were applied, whereas “the forward edge of any plate [was] covered by the aft edge of the plate forward of it” (Ronberg 1980:130). This also confirms that the intact section of Shipwreck X at QEP is displayed upside down (Figs. 5, 15). The yellow metal sheets of Shipwreck X overlapped by 3.6–4 cm and were attached with tacks hammered into hand-punched holes (Ronberg 1980:135). Their spacing is not uniform, i.e., not in a straight line, and they have irregular intervals at roughly 4 cm apart (Fig. 15). The tacks along the top and bottom margins are about 8.5 cm from the closest row of the mechanically punched tack holes in the center of the sheets. The plates were first fastened to the hull with tacks via the mechanically punched holes in their centers, after which shipwrights fastened the overlapping edges of each sheet (Villalobos 2020:99–101).

Sheathing Tacks

The sheathing tacks used in the construction of Shipwreck X measured 3 cm in length and their shafts were roughly 0.42 cm in diameter. The shafts were cylindrical in cross section from the heads down, but they became square in section at their tapered ends. Their heads are round and flat, and measured 1 cm in diameter. Their manufacturing process was similar to that of the tacks used to fasten the Muntz-metal sheets to the hull of *Edwin Fox*, where the process of tack making had become more mechanized and the tack heads were machine made (Villalobos 2020:97; Bennett, this issue).

Evidence of Remetaling

The hull remains of Shipwreck X demonstrate it was remetaled as there are many more tack holes in the hull planks than in its Muntz-metal sheets, and it also shows the margins of the vessel’s old sheathing tacks on the exterior of its planks, which are inconsistent with the margins of its new sheathing. On the intact section at QEP some four heads of tacks from the ship’s old yellow sheathing were left in place and they are situated below its new sheathing (see complete sheet in Figure 15); their heads are also slightly larger and measure 1.2 cm in diameter. This clearly confirms that Shipwreck X was remetaled during its lifetime.

Analysis with a Quanta 450 ESEM with SDD EDS Detector

The analysis conducted on seven sheathing samples and two fastenings from Shipwreck X provided semi-quantitative results revealing the elements present in each sample. The main elements of the sheathing are copper and zinc, and all sheathing samples had similar spectral signatures. The copper-alloy fastenings contained the same elements as the Muntz-metal sheets, with the addition of a small quantity of tin.

The ESEM SDD EDS x-ray detection of the metal samples provided results for semiquantitative, i.e., area, analysis, indicating the elements present. The sheathing samples analyzed returned similar spectrum results, but the fasteners differed. Copper and zinc are the major elements present in both the sheathing and tacks. Elements such as arsenic (As), silver (Ag), bismuth (Bi), iron (Fe), lead (Pb), nickel (Ni), antimony (Sb), and tin (Sn) were added manually to all the spectra, as they are known trace elements in copper (compare MacLeod [1987]). They are presented in red in all spectra, as for example shown in Fig. 18, which indicates that they are too low in intensity to be anything other than trace elements.

The Muntz-metal sheathing from Shipwreck X is an alloy of approximately 62–63 wt% copper, 37–38 wt% zinc (Table 4). The tacks that fastened the sheathing to the hull contain a slightly different alloy. The concentration of copper in the tacks is significantly higher at 81–83 wt%, there is much less zinc at only 15–16 wt%, and there is 3 wt% tin

Fig. 18 Spectrum 1 of Shipwreck X, Sample 1 including all trace elements. (Graph by Wendy van Duivenvoorde, 2021.)

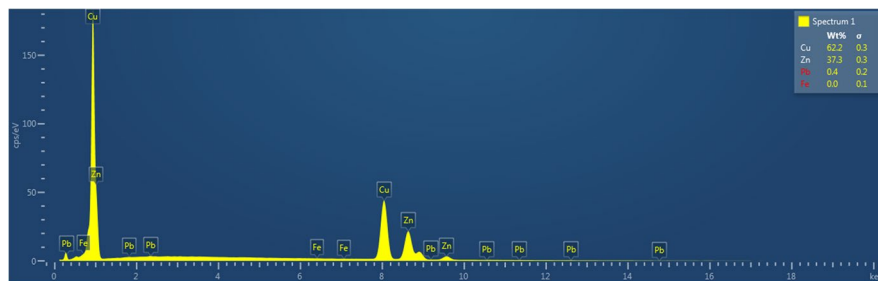


Table 4 Copper-to-zinc ratio of sheathing samples

Description	Wt%			Atomic%		
	Cu	Zn	Total	Cu	Zn	Total
Sample 1: Spectrum 1	63	37	100	63	37	100
Sample 1: Spectrum 2	62	38	100	62	38	100
Sample 1: Spectrum 3	62	38	100	63	37	100
Sample 3: Spectrum 1	62	38	100	63	37	100
Sample 3: Spectrum 2	62	38	100	63	37	100
Sample 3: Spectrum 3	62	38	100	63	37	100
Sample 4: Spectrum 1	62	38	100	63	37	100
Sample 4: Spectrum 2	62	38	100	63	37	100
Sample 4: Spectrum 3	63	38	100	63	37	100
Sample 6: Spectrum 1	62	38	100	63	37	100
Sample 6: Spectrum 2	62	38	100	63	37	100
Sample 6: Spectrum 3	62	38	100	63	37	100
Sample 7: Spectrum 1	62	38	100	63	37	100
Sample 7: Spectrum 2	63	37	100	63	37	100
Sample 7: Spectrum 3	63	37	100	63	37	100
Sample 8: Spectrum 1	63	37	100	64	36	100
Sample 8: Spectrum 2	63	37	100	64	36	100
Sample 8: Spectrum 3	63	37	100	63	37	100
Sample 9: Spectrum 1	63	37	100	63	37	100
Sample 9: Spectrum 2	63	37	100	64	36	100
Sample 9: Spectrum 3	62	38	100	63	37	100

Table 5 Elemental composition of sheathing tack samples

Description	Wt%				Atomic %			
	Cu	Zn	Sn	Total	Cu	Zn	Sn	Total
Sample 2: tack	81.34	16.17	2.50	100	82.67	15.97	1.36	100
Sample 5: tack	82.53	14.58	2.89	100	84.00	14.43	1.57	100

(Table 5). The tack alloy with higher levels of tin makes for a harder metal, which is to be expected, as fastenings are required to be stronger than the sheathing they hold in place.

Muntz’s Metal Patent Stamps

Investigators observed five Muntz’s patent stamps on the sheathing, two at QEP and three at the GCHHS. All are located near the edges of the sheathing and

have double circular designs: the outer ring being 3.3 cm in diameter and the inner ring 1.7 cm (Fig. 19). The words “MUNTZ’S” and “PATENT” survive to varying degrees around the edges of the stamps between the rings, and the number “18” is centered within the inner ring. The best-preserved example, from GCHHS P5, is three-quarters complete (Fig. 19, left). The letters “MUNTZ’S PATE” are visible and measure 0.35 cm high, while the number “18” is intact and is 0.47 cm high. In addition, the stamp includes a smaller number “47,” measuring 0.28 cm high, imprinted horizontally at the left and right between the words “MUNTZ’S” (above) and “PATE[NT]” (below).

Discussion: The Schooner *Heroine* Emerges

The study of Shipwreck X allowed this research project to assess how investigative archaeological methods aid in the identification of ex situ and disarticulated shipwrecks. A ship can be associated with a style of construction, culture, or location (Type D), while a name is only one possible affiliation (Type B) (Harpster 2013). An assessment of the archaeological and historical data suggests an identity, which provides a context for comparison to other vessels and research. For example, Shipwreck X provides new knowledge about disarticulated vessels and Australian colonial shipbuilding. This investigation also provides a comparison to other shipwreck identification approaches. The highly degraded nature of Shipwreck X allows for an assessment of the constraints placed on the available methods due to the physical condition of the remains.

Ship Timbers

Establishing a date is an important step in the assessment of shipwrecks, increasing the confidence in the identification (Ahlström 1997:37). Dating ship’s timber elements, however, can be problematic for identifying vessels and to ascertain construction dates (van Duivenvoorde 2014; Petchey et al. 2015). Dating specific artifacts, such as bottles, associated with the vessel applies a potential timeframe, which creates or narrows a list of possible ships (Wilson 2012:22). The only way to establish a date for Shipwreck X and other ex situ remains missing contextual information that links diagnostic artifacts to the vessel is through the hull itself. The historical record contains little information regarding the construction of *Coolangatta* and *Heroine*. The timber species and Muntz-metal sheathing provide a possible construction locality and earliest date.

The wood species used in the construction of *Coolangatta* are unknown from the historical record, but the timber most likely came from the Shoalhaven area of New South Wales (Nutley 2014:15). *Heroine* was constructed with northern New South Wales hardwoods, but the exact species remain absent in the historical sources (*Sydney Morning Herald* 1894). The 6 different species identified from 14 archaeological samples from Shipwreck X all came from coastal New South Wales. The geographic range of five of the timbers includes both Shoalhaven and Nambucca areas. The sixth species, tallowwood, found between Newcastle, New South Wales, and Maryborough, Queensland, encompasses the Nambucca River but starts 230 km north of Shoalhaven. Two different wood species, blackbutt and tallowwood, were used for Shipwreck X’s frames and planking. Shipbuilders

Fig. 19 Muntz’s patent stamps on ship’s hull sheets from QEP (left) and hull plank at GCHHS (P5), Surfers Paradise (right). Scale is in centimeters. (Photos and drawing by Lauren Davison [left] and Wendy van Duivenvoorde [middle, right].)



did use imported timbers to construct vessels, but New South Wales shipwrights favored local timbers (Bullers 2006:17; Clayton 2012:55). Blackbutt, a known shipbuilding material, grows around the Shoalhaven region. It would be unusual for a shipwright to import just one species, such as tallowwood, from the same state for an element for which suitable local woods are available.

Five vessels constructed in New South Wales between 1830 and 1903 have been part of archaeological or historical investigations with timber species identification. The 1830s Barangaroo boat was constructed from spotted gum, stringybark, and Sydney blue gum, as well as banksia—all sourced in the Sydney basin (Sydney Metro 2018; Coroneos et al. 2022). *Alert* and *Alma Doepel*, built at the Bellinger River, approximately 20 km north of the Nambucca, contained species also found on Shipwreck X. *Alma Doepel* (1903) was constructed using blackbutt, red bloodwood, red ironbark, and possibly Sydney blue gum (Clayton 2012:64). *Alert* (1846) had frames, hull planking, and a keel timber made from Sydney blue gum (Nash 2004:94). *Clarence* (1841), constructed at Williams River, contains Sydney blue gum and tallowwood (Clayton 2012:64), while *Mary Ellis* (1897), built at Kincumber, has blackbutt ceiling planking (Bullers and Shefi 2009:68). The range of species from Shipwreck X closely resembles that found in the vessels constructed in other areas. Each of the three Gold Coast locations contain ship remains made with different wood species. It is therefore possible that the shipwreck sections at the GCCC depot, the GCHHS, and QEP are actually different vessels. Nevertheless, this is unlikely when considered in relation to other evidence, in particular the sheathing, which is the same across all three locations. The Muntz-metal composition is the same, as are the patent stamps across all three sites. It is true that Muntz-metal sheets would have been imported or manufactured in batches and were distributed to shipyards from the same consignment, and it is most likely that vessels constructed at regionally and temporally adjacent yards used sheathing from the same source lot. It is, however, very unlikely that two ships built 51 years apart in New South Wales would have Muntz-metal of the same gauge with the exact same patent stamps. It is more likely that there was variation of wood species within the ship's hull; some could even represent repairs made throughout the vessel's life.

It is known that New South Wales shipbuilders preferred local woods when constructing vessels (Bullers 2006:17; Clayton 2012:55); all the timbers from this study grow along the New South Wales coast, confirming this practice (Table 1). Tallowwood and grey ironbark provided the two narrowest species distributions. Tallowwood's geographic range is northern New South Wales, starting at Newcastle, approximately halfway between Shoalhaven and Nambucca River, and farther north. Grey ironbark's northern extent is at Coffs Harbour (Baker 1919:189,279–280; Bootle 2010:287,350; Boland et al. 2006:496,506). The timber species identification of Shipwreck X revealed a vessel most likely constructed in northern New South Wales, a region in which the Nambucca River is located.

Colonial-built vessels generally contain oversized scantlings with undersized hull planking (Bullers 2006). According to the standards formula in Marquardt (2003:134), *Coolangatta* should contain frames 10.97 cm thick and *Heroine* 15.6 cm to be considered proportionate, which is a quarter of a vessel's extreme breadth. Sided measurements from Shipwreck X are between 12.3 and 18.5 cm. This is more consistent with what is expected for *Heroine*'s scantling than for *Coolangatta*'s and is consistent with the oversized frames recorded in the majority of Australian-built vessels investigated to date (Bullers 2006).

Recording of the frame spacing is less common than the siding dimensions, with only six examples from Shipwreck X available for comparison. According to Marquardt (2003:134), there should be 30.5–45.7 cm between pairs of double frames. The frames in the GCCC depot intact section are proportionately positioned and separated by 30–34 cm. There is more variation in the spacing than the siding measurements. Three examples of proportionate spacing survive: Shipwreck X, *Alert* (New South Wales, 1846–1854) and *Zephyr* (1851–1852). Also surviving are one with closely positioned frames, *Alert* (Tasmania, 1872–1959); one with variable distances between pairs (*Annie Watt*, 1870–1970); and one vessel with larger than recommended spaces between the frames (*Victoria*, 1888–post-1918) (Bullers 2006:55).

There are no specific rules regarding the dimensions of hull planks, with their widths and thicknesses differing depending on their position in the vessel (Bullers 2006:9). Marquardt (2003:136) provides one

example of planking dimensions for a vessel 29.26 m in length and 7.32 m in breadth. Of similar size to Shipwreck X, these measurements provide a good comparison for the planking dimensions. The hull planks on the Gold Coast remains measure 17.5–31.5 cm in width and 5.9–6.5 cm in thickness. In comparison to other Australian-built vessels, Shipwreck X had wider and thicker planking—yet its planking dimensions were similar in thickness to those of *Dianella* (1872–1909) and *Alert* (New South Wales, 1846–1854) (Bullers 2006:56). This would be consistent with a ship of larger size such as *Heroine*.

The evidence from historical context and ship timbers suggests that the most likely candidate for Shipwreck X is *Heroine*. The schooner was constructed on the Nambucca River, which falls within the northern geographic region suggested by the timber species. Built in 1894, remodeled in 1895, and wrecked in 1897, the vessel also dates to within the range suggested by the Muntz-metal sheathing.

Muntz’s Metal Patent and Sheathing

Shipwrights applied various measures throughout history in attempts to protect wooden ships from detrimental marine organisms such as *Teredo navalis* (shipworm), including antifouling compounds, sacrificial planking, filling nails, and metal sheathing (lead, copper, and alloyed metal) (Bingeman et al. 2000:218–220). Copper had problems as a protective material because galvanic action between copper and iron corroded iron fastenings and the sheathing itself was soft and subject to erosion (Jones 2004:94,97; van Duivenvoorde 2015b:8). Furthermore, driving copper nails into the ship timbers resulted in bending, breaking, or distortion at the head of the fastener (McCarthy 2005:104). The need for harder materials led to the introduction of mixed metal sheathing and fastenings.

Muntz-metal provided great protection for wooden hulls, corroding less than pure copper; the addition of zinc reduced the manufacturing costs (Flick 1975:74). In 1832 George Fredrick Muntz developed yellow metal, a “60 percent copper and 40 percent zinc” alloy (Franklin Institute 1833; Flick 1975:74). He obtained a 14-year patent to manufacture and distribute the material, which was an important stage in the development of protective sheathing (Franklin Institute 1833; Flick 1975:76). In 1846, when the

original patent expired, Muntz changed the composition to include lead; yellow metal now consisted of 56% copper, 40.75% zinc, and 3.25% lead (Franklin Institute 1847; Patent Office 1861:145). The closest archaeological example of the 1846 Muntz patent may be the hull sheathing of an unidentified shipwreck in Koombana Bay, Western Australia, which measured 59.47 wt% copper, 36.99 wt% zinc, and 3.54 wt% lead (McAllister 2012:39–41, tables 1,2). Metallurgy changes continued with further alterations between 1847 and 1863, working toward a more corrosion resistant product (Franklin Institute 1833, 1847; O’Guiness Carlson et al. 2010:113).

Sheathing was produced in different weights (16–32 gauge) measured in gauge or ounces per square foot. Copper sheathing of 22, 24, 26, and 28 gauge was the most common, while the British Navy standard was 28 oz./sq. ft. (8.5 kg/m²) (Staniforth 1985:28). The weight of the sheathing is stamped in the middle of the patent mark, and all examples found on Shipwreck X are 18 gauge. Applied from keel up and from stern to bow, sheathing overlapped on the rear and top edges so as to have the joints in a position that reduced the possibility of the water lifting sheets from the hull (Staniforth 1985:28; Jones 2004:110). Typically, higher-gauge sheathing was placed at the bow with sheets reducing in weight toward the stern (Ronnberg 1980:145; Jones 2004:108). Eighteen gauge is at the lower end of the scale and would most likely be located toward the stern of the vessel. The meaning of the small “47” observed on the edge of the patent stamps from Shipwreck X is unknown. A suggestion, however, is that they may represent an internal company code (O’Guiness Carlson et al. 2010:108), possibly linking to a supplier (Brad Duncan 2014, pers. comm.), a year date, or a contracted manufacturer. As for the latter, it is known that Muntz had “insufficient factory capacity to meet demand for his sheathing, so under his licence other companies were contracted both at home and abroad” (Bingeman 2018:466).

Muntz’s original ratio of “60:40% copper-zinc mix was superseded by a 63:37% composition that could be cold rolled to thinner gauges than the original, which was limited to being ductile only during hot rolling” (Bingeman 2018:466). This 63:37% composition is similar to the Muntz-metal sheathing of Shipwreck X with its 62–63% copper, 37–38% zinc (Table 4) (no added lead, nor iron [Fig. 18]).

It is also consistent with the composition of the Muntz-metal from *Barbara* (1841–1852), *Petrel* (1847–1853), *Snow Squall* (1851–1864), *Edwin Fox* (1853–present) and *Violet* (1877–1896) (O’Guiness Carlson et al. 2010; Department of Environment 2018:*Violet*; van Duivenvoorde 2018, 2020; Van Duivenvoorde, Taylor et al. [2023]; Bennett, this issue). *Barbara* was a 16-ton schooner constructed on Joseph Hind’s property in Exeter on the Tamar River, Tasmania, in 1841 (Taylor 2017:41; Heritage Council of Victoria 2022). *Barbara* was purchased by George Ward Cole, a Melbourne businessman who, due to the lack of public infrastructure, seized the opportunity to repair and build private wharfs within Port Phillip and charged a levy for their use (Botham 2017:29). Cole owned *Barbara* from 1848 until its sinking on 6 August 1852 (Taylor 2017:41; Heritage Council of Victoria 2022), and it is possible that the vessel was sheathed with Muntz-metal by his shipwrights (Van Duivenvoorde, Taylor et al. [2023]). *Petrel* was a 195-ton barque also constructed in Tasmania, while *Violet* was a Queensland-built ketch of 37 tons that was found more recently at Sandy Point, south of Corio Bay (north of Yeppoon) in Queensland (O’Guiness Carlson et al. 2010; Department of Environment 2018:*Violet*; van Duivenvoorde 2018). Muntz’s patent stamps were not observed on the ship remains of *Barbara* or *Violet*, and that of *Petrel* was published in O’Guiness Carlson et al. (2010:108). *Snow Squall* was a 742-ton clipper ship built in Maine in the United States in 1851 (Knott 2008:22; O’Guiness Carlson et al. 2010:107), while *Edwin Fox*, now sitting in dry dock in Picton, New Zealand, was constructed in 1853 near Calcutta (Kolkata), India (Bennett 2021, this issue).

The Muntz patent stamps found on Shipwreck X’s sheathing are closest in appearance to the one found on *Edwin Fox*. The only difference is the small unidentified number on its side, which reads “45” for *Edwin Fox* and “47” for Shipwreck X (Bennett, this issue). The sheathing found on *Edwin Fox* today could date to 1869 when the ship was remetaled “from its wales down” during repairs in London, or to 1885 when its yellow metal sheathing was repaired and the vessel converted to a meat freezer in Dunedin, New Zealand (Costley 2014:97,148; Bennett 2021:274).

Muntz or yellow metal was known to last for three years (Ronnberg 1980:147) but it is uncertain

and perhaps unlikely that merchant vessels were resheathed, or remetaled, strictly to this interval. If they were even made at all, historical records on the overhauling, resheathing and repairs of ships may no longer be available, and the reapplication of yellow metal every three years would have been too costly for some merchant fleet owners.

Historical newspapers mention that *Heroine* was remetaled one year after it was launched in June 1895 (*Evening News* 1896; *Sydney Morning Herald* 1896). It is unknown if this was related to the damage that the ship sustained in November 1894 when it had run aground near Hokitika in New Zealand (*Evening News* 1894a, 1894b). It had lost its foremast, foretopmast, and rudder, and it sustained “other” damage in rough weather (*Evening News* 1894a). *Heroine* was repaired in Greymouth, New Zealand, in late 1894 and was loading with a cargo of timber for Melbourne at the end of January 1895 (*Evening News* 1894b; *Daily Telegraph* 1895). The vessel was thus remetaled in an Australian shipyard, six months after it had undergone repairs in New Zealand.

Muntz patent sheathing was first advertised for sale in Australia in 1839 (*Hobart Town Courier* 1839) and would have been available in 1843, thus, it is possible that *Coolangatta* had metal sheathing. Of all 168 advertisements for Muntz’s patent metal in Australian newspapers in the 1840s, 153 were published in the period from 1845 to 1849 (Trove Newspaper Database search: Muntz’s metal, 1840–1849). It must therefore not have been readily available on regional colonial shipyards in the early 1840s. There is no reference in historical records that *Coolangatta* was sheathed with Muntz-metal, nor that the ship was ever docked for extensive repairs or remetaling. The only known reference that has been misinterpreted as a “refit” comes from a local newspaper stating “*Coolangatta* is discharging and refitting in the river [Moreton Bay]; she leaves the day after to-morrow for the Tweed” (*Sydney Morning Herald* 1846a; Nutley 2014:6). This “refit” clearly refers to a general preparation to make the vessel ready for its next voyage while it remained in the water. It is therefore unlikely *Coolangatta*’s hull was ever sheathed with yellow metal. *Heroine*, as aforementioned, was remetaled in 1895 and was certainly sheathed with Muntz-metal when it beached in 1897.

Ship Identification

Disarticulated vessels removed from their original exposure location represent a different kind of site to investigate, devoid of contextual information. This leaves the investigator unable to determine the relationships between the hull and associated artifacts or even the different ship elements. The subject study of this article demonstrates that valid identifications of such *ex situ* ship remains are still possible. Most methods relating to shipwreck identification focus on historical era vessels, with the aim to affiliate the site with a specific ship; for example, Ahlström (1997), O’Shea (2004), and VanZandt (2009). Harpster (2013) brings attention to the fact that a name is only one form of identity. While many shipwreck investigations attempt to apply a Type B affiliation, disarticulated vessels are often Type D associations. Type D has an affiliation with a modern construct, either functional or geographical, for which historical accounts are unavailable.

The classification of a shipwreck is frequently tied to artifacts or some diagnostic piece of evidence, which provides a suggestion of the date or name of the vessel. In the case of *ex situ* sites, the lack of provenance means that the hull itself provides the only data for identification. This often results in applying a broader association, rather than a specific name, particularly as details of smaller, locally used vessels are often absent in the documentary record. Successfully linked to the historical records, *Miame* and Shipwreck X, both Type B investigations, are larger trading vessels that wrecked in areas with strong connections to their maritime heritage. For these investigations, timber and sheathing samples provided the strongest links between the physical remains and documents to identify the vessel as a specific ship.

Additionally, the shipbuilding information provided through the archaeological research is comparable to previously studied Australian colonial-built vessels. Timber species commonly identified in vessels constructed in New South Wales also were found on Shipwreck X. Examples built on Bellinger River contain a similar range of wood types. Previous investigations into the colonial industry have revealed that New South Wales shipbuilders preferred to use local species. The builders of Shipwreck X obviously were aware of the differing properties of various local timbers and their suitability for boatbuilding, and

used multiple species for fashioning vessel elements. Frames, for example, were made from tallowwood, blackbutt, red bloodwood, and Sydney blue gum.

Considerations

The hull remains of Shipwreck X, having received no conservation since recovery, are highly degraded. Their poor physical condition makes it difficult to handle the material and to observe recognizable features. At the GCCC depot, although a large amount of timber survives, only about 10%–20% of it is preserved well enough to provide usable data. The effects of weathering, rot, and termites make the positive identification of ship elements problematic.

When studying highly degraded remains, an initial visual inspection allows for the identification of the best-preserved and recognizable elements. Aiding in the project management, this process allows the recording of such pieces and leaves sections that are unrecognizable. For example, the wood fragments in Figure 12 cannot be accurately identified as ship timbers and so are irrelevant to the investigation, other than in acknowledging the amount of unidentifiable timber. After the initial observation, photographs provide a record of the original condition of the remains. Disarticulated *ex situ* vessels can be moved easily to gain access for optimum recording. In most instances they are already separated into small manageable sections, accidentally or purposely, during the recovery process. To prevent damage to the better-preserved elements, moving the extremely deteriorated remains improves access. As observed at the GCCC depot, the wood often disintegrated further during handling. Identifying which elements are relevant to the investigation allowed for the movement of the surrounding unrecognizable highly degraded pieces. This provided further access to the targeted sections without causing more damage to these features.

Timber species identification is a valuable technique for archaeological investigations, providing a possible construction locality and information about the shipwright’s knowledge of suitable materials. To collect samples, the timber needs to be in a reasonable condition to identify the wood from its microstructure. Selection of sample location is, therefore, even more important when attempting to identify highly degraded remains. Along with requiring preservation

for species identification, the timber must be strong enough to handle the physical stress from the collection process. For example, the fragile condition of the intact section at QEP required several people to stabilize the memorial during sample collection. To conduct effective sampling for species identification it is essential to retrieve specimens from areas with better preservation.

Conclusions: Reconstructing Identity from Dispersed Remains

An ex situ shipwreck missing the contextual information from the original exposure site is still a valuable resource. The lack of provenance between the different features and artifacts, however, means that the hull itself is the only evidence available to provide a date or locational information. Site plans are unnecessary when remains have been removed from their original contexts. Unlike in situ investigations, a site plan is unlikely to provide relevant data; therefore, research should focus on the individual elements. The physical condition of the timber determines the methods employed to record highly degraded remains. If remains are highly degraded, an initial visual inspection allows for the identification of ship features. It also targets the recording process toward these pieces. The same recording techniques used for in situ shipwrecks are suitable for ex situ remains. Completing the timber record forms compiles information regarding the preservation, overall dimensions, and construction methods. Techniques such as photographs, scale drawings, and 1:1 tracings capture a visual representation of the elements. Separated during the removal processes—whether purposely such as Shipwreck X or accidentally—ex situ shipwrecks are often in manageable sizes. Due to this, full-sized tracings are practical and smaller scales are acceptable for individual feature drawings. Disarticulated vessels are frequently recorded in 1:5 scales as seen in this investigation of Shipwreck X. These smaller sizes provide a detailed record of individual features where aspects such as fastening patterns or tool marks become clear. Separation into individual elements allows access to all surfaces of a fragment during data collection, and the ability to reposition pieces optimizes the recording process. Sampling small pieces of the remains

for timber species identification provides indications of the timbers that were familiar to the shipwrights and possibly a construction locality. This data helped determine a Type B identification in two of the disarticulated shipwrecks, the Port MacDonnell Maritime Museum vessel (*Miame*) and Shipwreck X.

Recording remains across the Gold Coast as part of the first archaeological investigation into Shipwreck X contributed to the identification debate. Timber species identification, scantling dimensions, evidence of remetalting, and Muntz-metal analysis provide evidence toward the assessment of Shipwreck X, including a possible construction locality, and place the vessel in the late 19th century. Using this information, the most likely candidate for the remains is *Heroine* constructed in 1894 on the Nambucca River. A comparison between Shipwreck X and other Australian-built vessels contributes to knowledge of the colonial shipbuilding industry. The results from the Shipwreck X investigation supports Buller's (2006) conclusion that shipwrights in Australia constructed ships with oversized scantlings. Research into disarticulated ex situ vessels shows that they are a valuable resource and identification of such ships is possible.

The identification of disarticulated ex situ vessels is made possible through the archaeological recording of the remains. Identification is usually achieved through the relationship between the shipwreck and associated artifacts indicating a potential date or specific vessel. Disarticulated context-free sites require evidence to come from the hull itself as artifacts lack provenance. Most shipwreck investigations are what Harpster (2013) terms Type B identifications that apply a specific name. This research, however, has indicated that for disarticulated vessels, a Type D association with a modern concept is more easily achieved. The archaeological recording of the hull provides details about the construction of the vessels that can determine a ship type. Type B affiliations are nevertheless possible for ex situ remains, as this investigation shows.

This archaeological study successfully recorded a disarticulated vessel's remains and contributed to identifying Shipwreck X. The investigation provides additional data on the Australian colonial shipbuilding industry, in particular relating to New South Wales shipwrights and the use of metal sheathing on locally built vessels. More generally, this study shows how it

is possible to identify a “scattered” shipwreck based on disarticulated and context-free remains that have been subjected to severe cultural formation processes. The elements that survive have been related to their original functional or structural context in the vessel where possible, but also subjected to analyses that enable the contending identities to be discounted. Furthermore, this study assessed the constraints that highly degraded material places on attempts to identify its original context, and it has established the preferred approaches for disarticulated ex situ shipwrecks.

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Declarations

Conflict of Interest On behalf of all the authors, the corresponding author states that there is no conflict of interest.

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