Shipwrecks and Provenance

in-situ timber sampling protocols

with a focus on wrecks of the Iberian shipbuilding tradition

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Chapter 1
The Uniquely Problematic Shipwrecks of the Equally Problematic 'Age of Discovery'

Two of the questions most frequently asked by archaeologists of sites and the objects that populate them are 'How old are you?' and 'Where are you from?' These questions can often be answered through **archaeometric** dating and provenance analyses. As both archaeological sites and objects, shipwrecks pose a special problem in archaeometric dating and provenance because when they sailed, they often accumulated new construction material as timbers were repaired and replaced. Additionally, during periods of globalization, such as the so-called Age of Discovery, the provenance of construction materials may not reflect where the ship was built due to long-distance timber trade networks and the global nature of these ships' sailing routes. Accepting these special challenges, **nautical archaeologists** must piece together the nuanced relationship between the ship, its timbers, and the shipwreck, and to do so, wood samples must be removed from the assemblage. Besides the provenance of the vessel's wooden components, selective removal and analysis of timber samples can also provide researchers with unique insights relating to **environmental history**. For this period, wood samples could help produce information on the emergent global economy; networks of timber trade; forestry and carpentry practices; climate patterns and anomalies; forest reconstruction; repairs made to ships and when, why, and where those occurred; and much more.

This book is a set of protocols to establish the need for wood samples from shipwrecks and to guide archaeologists in the removal of samples for a suite of **archaeometric** techniques currently available to provenance the timbers used to construct wooden ships and boats. While these protocols will prove helpful to archaeologists working on shipwreck assemblages from any time period and in any place, this book uses Iberian ships of the 16th to 18th centuries as its case studies because their global mobility poses additional challenges to the problem at hand (see below 1.3 and 2). At the same time, their prolificacy and ubiquity make the wreckage of these ships a uniquely global phenomenon.

Beginning with a brief historical overview of these vessels' place in Early Modern history, this guide also highlights some characteristics that are thought to be unique to ships of the Iberian-Atlantic shipbuilding tradition during this period, and which could make these vessels easier to identify *in situ*. However, the primary aim is to provide archaeological researchers with a set of protocols as to when and why *in-situ* timber sampling may be called for, how to go about it, and what to do with the samples afterward (for sampling *ex situ*, see Orton 2000, 191-209). A disclaimer should be stated, though, that perusing this guide will not qualify the reader as a specialist in either nautical archaeology or wood science; instead, specialist assistance should always be sought while conducting fieldwork, and ideally, before excavation even begins (Nayling in Coles & Goodburn 1991). In its educational capacity, this set of protocols is meant to complement and supplement existing guidelines on shipwreck excavation (Bowens 2009; Historic England 2015d [2010b]), dendrochronological sampling (Domínguez-Delmás et al. in prep, b; Brewer & Jansma 2016; Historic England 2015a [1998]), and handling waterlogged wooden artefacts (Historic England 2015c [2010a]).

1.1. Historical Background

Contemporary nautical construction is such a continuous, global occurrence that rarely if ever do we consider where container ships, oil tankers, or cruise ships were constructed; not even the construction of naval vessels can be taken for granted to have occurred in the nation they represent (Gordon 2015). In an era of unprecedented globalization, it is sometimes difficult to imagine our world

without interconnections that circumnavigate the planet. Being a highly mobile species, the roots of complex trade networks and global colonization are nearly as old as are humans, but the foundations of consistently global mobility were established in the Age of Discovery, during the 16th to 18th centuries (Giraldez 2015; Crespo Solana 2012; Polónia & Barros 2012).

Also, and arguably more accurately, called the Age of Exploration, Age of Sail, Age of Empire, and Age of Trade, this period was characterized by a rapidly changing and complex political landscape; new perspectives on land, sea, and people, along with the ownership thereof; and a gradual awareness that the landmasses of the earth are little more than vast islands sharing a single body of water. Even at the beginning of the colonial race, Spanish and Portuguese sailing vessels were already plying the earth's waterways to establish empires that spanned multiple hemispheres, eastern and western, northern and southern.

These unprecedented imperial ventures contributed to the movement of ideas and ideologies (religions, languages, technologies, politics), animals, plants and pathogens; and people both free and enslaved. The desire to develop and dominate transoceanic pathways was fueled by trade in spices and slaves, but these quests also had a strong religious component. Between the Reconquista (1492) and the Ottoman defeat at the Battle of Lepanto (1571), anti-Islamic religious sentiment in Iberia mandated that Christian forces reach East Asia before the great Islamic empires – Ottoman, Safavid and Mughal – beat them to it (Hamdani 1997; Noonan 2007; Matar 1999; Kelsey 2016; Casale 2010). So in the same spirit of the Crusades or the Reconquista, the Christian crowns of Spain and Portugal conquered, converted, and controlled territory dispersed across five different continents: North and South America, Europe, Africa, and Asia.

Iberian maritime expansion and the parallel development of a naval industry also had a global impact due to the widespread and rapid transfer of technical and technological knowledge. Changes to traditional ship construction to better facilitate oceanic voyages were necessitated by the exploitation of trade winds that opened up the Atlantic, linking Iberia with the Canaries and Azores, and then with the Lesser Antilles, and finally, the whole of the Caribbean Sea and Gulf of Mexico (Figure 1; Crespo Solana 2014). Soon afterward, Africa, Asia, and the rest of the Americas were irreversibly inducted into the greater Atlantic social environment.

Almost immediately after Columbus made landfall in Hispaniola and returned to Castile, Spain and Portugal realized that they were each other's primary competition. The competing monarchies compromised and signed treaties that redistributed newly 'discovered' (albeit already inhabited) lands between them. The Treaty of Tordesillas (1494) set a line of demarcation in the Atlantic dictating that what lay to the west (most of the Americas) belonged to Spain and what lay to the east (including Brazil, the Azores, and Africa) belonged to Portugal (Waisberg 2017; Coben 2015). When disputes began in the South Pacific, the Treaty of Zaragoza (1529) added another demarcating line that gave the East Indies to Portugal and the Pacific Ocean to Spain, although by 1565, Spain would breach that meridian to claim the Philippines for itself (Hayes 2001; Giraldez 2015; Kelsey 2016). The efficacy of these treaties and the demarcations they intimated were often disputed, and the Church frequently intervened. However, the Protestant explorers to the north, namely English and Dutch, like the Muslim Ottomans to the east, disregarded the border allocations altogether, as the Pope had no legitimate control over their seafaring endeavors. As such, much of the European land race was conducted over water. This fact lead to ambitious shipbuilding regimes, swapping of trade secrets, and rapid changes to traditional ship architecture. Inevitably, it also means that the wreckage of ships of European and especially Iberian-Atlantic shipbuilding traditions are found in waterways the world over (Castro 2005, Appendix B; Isorena 2015; Giraldez 2015; Kelsey 2016).

Populating the length of the *Carrera de las Indias* between Spain and the Americas, the *Carreira da Índia* between Lisbon (Portugal) and Goa (India), and the Manila Galleon trade route between Manila (Philippines) and Acapulco (Mexico) are hundreds of Iberian shipwrecks known and unknown, whose

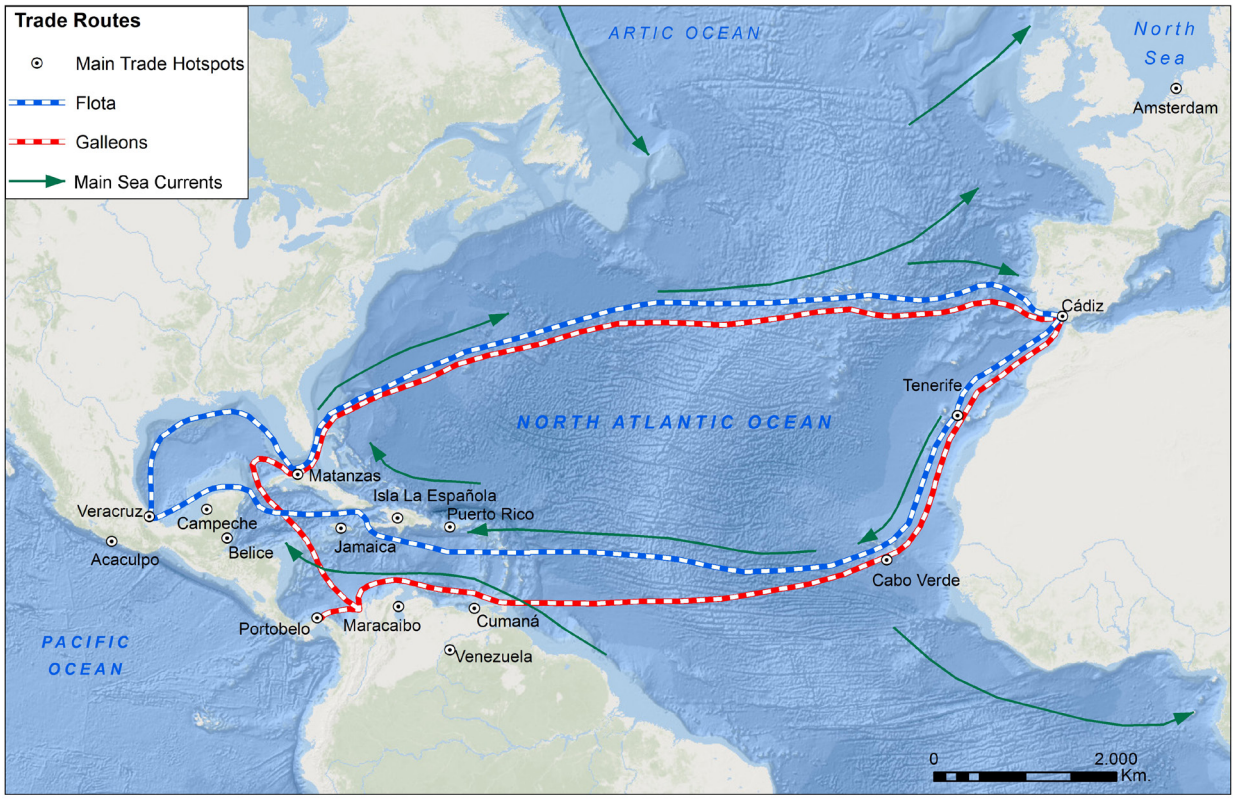

Figure 1. Map of main North Atlantic ocean currents, corresponding with trade winds and Iberian trans-Atlantic sailing routes from the late 15th century. Map prepared by María José García Rodríguez with data from Ana Crespo Solana, © ForSEAdiscovery Project, 2016.

trade ambitions connected Iberia to areas far beyond its direct control (Figure 2; Crespo Solana 2011). Their individual and collective stories narrate the history and origins of the modern world, and yet we still know relatively little about them (Gordon 2015).

1.2. Emergent oceangoing ship types

The origins of Renaissance-period ship design are still under debate by nautical archaeologists and maritime historians. There are three main lines of thought: 1) Mediterranean carvel-built ships spread into the Atlantic in the 15th century, 2) Spanish and Portuguese shipwrights were more influenced by English and Nordic traditions even before the advent of carvel planking, or 3) the geographical location of the Iberian peninsula made it a confluence of ship design and construction practices hailing from both the Mediterranean and the North Seas, along with Arab influences (Steffy 2001; Loewen 1998; Phillips 1986; Martin 2000; Castro 2005; Castro 2008; Agius 2008; Loureiro 2012; Casabán 2017).

There are three main types of oceangoing ship in use during this period in Iberia, each with its own set of functions and qualities, although these could and did often overlap. These ships are all hybrid forms, and at the time of writing, the form best attested in the archaeological record is the galleon (Vivas Pinedas 1998; Phillips 1986). Only one *nau*, the Portuguese Indiaman known as the Pepper Wreck, has been identified and excavated (Castro 2005). Other carracks and caravels *may* be attested at various sites around the world (Figure 2; see Castro 2005, Appendix B; the early sixteenth-century date and proportions of the Highbourne Cay wreck (Bahamas) suggests that it may be one of these two ship

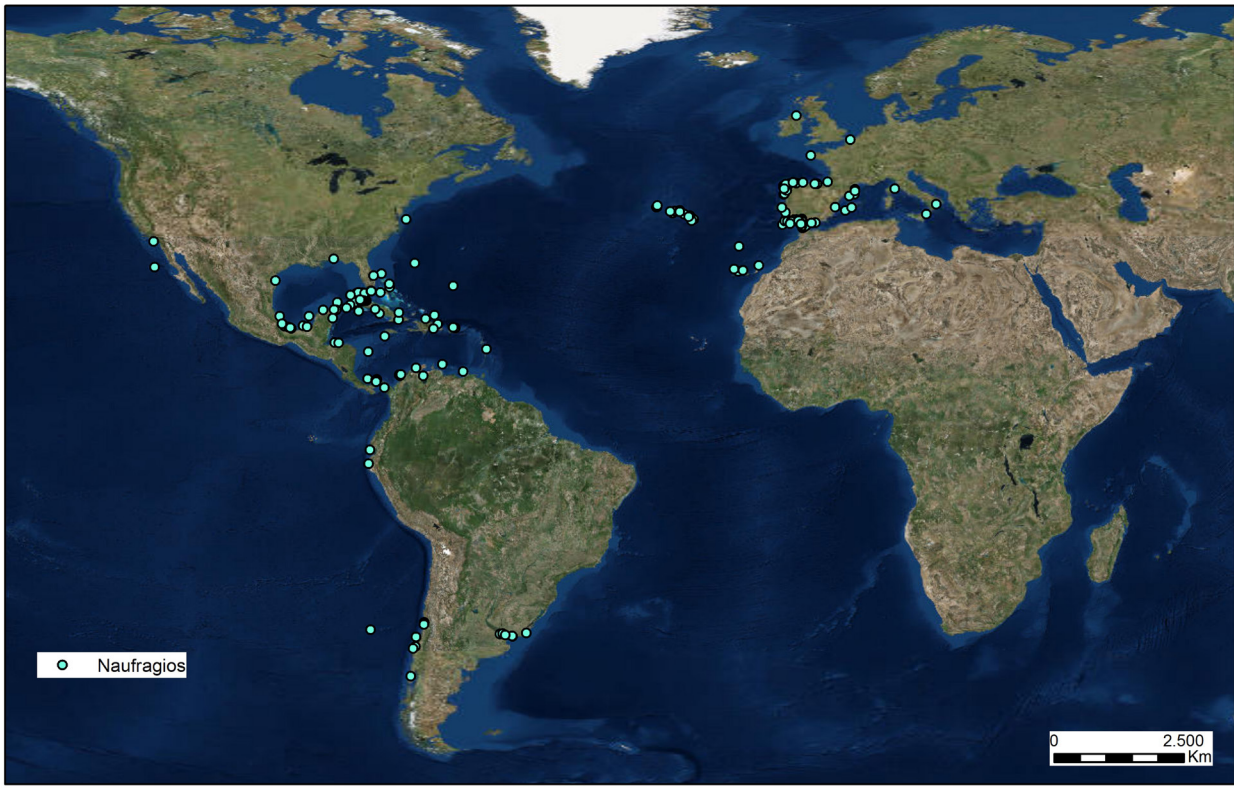

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Figure 2. Distribution map of known sixteenth to eighteenth-century Iberian shipwrecks in the Atlantic Ocean and the Pacific coast of the Americas. Of these, 698 are known from historical records and 216 from archaeological investigations. The western Pacific and Indian Oceans surely harbor comparable numbers of vessels, although fewer have been identified and investigated as of yet. The Global Shipwrecks Database, from which this map was produced, seeks to continually build upon its existing dataset and incorporate other databases of Iberian shipwreck sites around the world. Map prepared by María José García Rodríguez with data from Ana Crespo Solana, © ForSEAdiscovery Project, 2016.

types: Smith et al. 1985; Oertling 1989), but the caravel is at this time only attested in iconographical and historical archives. Furthermore, it seems that at times, the Iberian term *nao* or *nau* was synonymous with the pan-European forms of the carrack and even caravel (Castro 2008; Flatman 2009; Phillips 1986). As state-sponsored experiments with hybrid forms continued, the galleon and the carrack also merged into a single unit capable of both war and trade; indeed even those two opposing aspects of cross-cultural contact were little more than two sides of the same Piece of Eight (Gordon 2015; Phillips 1986).

1.2.1. Galleon

The main function of galleons was in battle; however they also had commercial functions as they carried valuable cargoes and protected the rest of the merchant fleet. They feature two or three decks; a low-set fore and a higher aft castle; three or four masts and a bowsprit using both square (fore, main, and bowsprit) and lateen (mizzen and fourth mast, or 'bonaventure') sails (Martin 2000; Castro 2005; Casabán 2017; Phillips 1986). Probably developing out of Mediterranean galleys, galleons were longer than carracks and *naos*, with an average length to breadth proportion of 4:1, which decreased water resistance and increased maneuverability. They featured a square stern which supported the higher aft castle and allowed for more deck space and mounted cannons, which were evenly distributed around the hull (Phillips 1986).

1.2.2. Nao*,* nau*, carrack*

Nao (in Spanish) and *nau* (in Portuguese) are generic words for 'ship' but, along with 'carrack' (from Italian *caracca*), they typically refer to a vessel with between two and four decks; well integrated fore and aft castles; and three or four masts, of which the mizzenmast and bonaventure bore lateen sails, with the other one or two bearing square sails (Castro 2005; Phillips 1986). From iconography, the stern of a carrack can be square or round, and its proportions are typical of Mediterranean round ships at 3:1 length to breadth. These vessels could be enormous in size and had an alleged carrying capacity of 500 to 600 tons, which facilitated long voyages to India or the Americas. Their average burden though was around 100 metric tons, doubling from the 16th to 17th century. Although their primary function was as merchantmen, sixteenth-century commentators said that a capacity of 400 tons would allow the vessel to be effective both in commerce and war. Fleets of merchantmen were always armed and were requisitioned by the navy when needed (Phillips 1986).

1.2.3. Caravel

The caravel developed out of an older Mediterranean prototype (compare *carabus* in Latin, καραβος [karavos] in Greek, and قارب [qaarib] in Arabic) and was adapted in sixteenth-century Iberia to suit the needs of the *armada*. It typically featured four masts with all but the foremast supporting lateen sails. With a length to breadth ratio of 3.5:1, they were lightweight (about 50 tons compared to the 100 tons of a carrack), fast, and readily maneuverable (Castro 2005; Phillips 1986). Because they were adapted to different sailing circumstances on the Mediterranean and Atlantic coasts, and because of the ship type's antiquity and regional evolution, its telltale characteristics, even its favoring of lateen sails, change from place to place and time to time, rendering it perhaps more difficult to identify in the archaeological record than the other two ship types. From the iconographical record, by the 16th century, caravels may have morphed into a something similar to galleons in shape and silhouette (Castro 2005; Casabán 2017; Phillips 1986). However sparse the evidence in the archaeological record, the caravel is noted in historical sources as the ship of choice from the 15th to 17th centuries, after which its design and function apparently merged into either the carrack for commercial pursuits or the galleon for combat (Phillips 1986).

1.3. What it means to be 'Iberian'

The idea of an Iberian shipbuilding tradition is a modern descriptor constructed to categorize the origins of wrecked vessels. Those involved in the design and construction of ships during this period would likely not have thought of themselves as Iberian or Atlantic, or their methods as falling into these categories either. However, there are three different ways in which a ship or shipwreck might receive the qualifier 'Iberian': 1) it was built within the confines of an Iberian empire; 2) it was constructed with timber from within the Iberian Peninsula; or 3) it conforms to Iberian ship architecture. Contemporaneous historical and iconographical accounts assert that oceangoing vessels hailing from the Iberian peninsula shared a few common features: they were built empirically without architectural plans (at least until the mid-16th century); their designs were based on proportion and scale; and they were skeleton-first (frame-based), carvel-built with planks fixed flush to the frames (Castro 2005; Apestegui 1998). Recently, several archaeologists have compiled more detailed lists of characteristics that are common to the hulls of ships built along the Iberian coast, or elsewhere complying with what can be considered the same architectural tradition (compiled from Loewen 1998; Castro 2008; Oertling 2001; Loureiro 2012; see also Phillips 1986).

1. Deciduous oak (*Quercus* subg. *quercus* L.) dominates the structural timbers (frames, ceiling, decks, keel, etc.) as well as the treenails, although pine (*Pinus* spp. L.) may be used in the hull planking. Repaired or replaced timbers have been documented as chestnut (*Castanea sativa* Mill.), and other broadleaf woods have been noted in small quantities. The wood may be of inferior quality.

2. Oak **treenails** (25mm diameter) and iron fastenings (10-12mm square section) are both used in the hull, and at each join of a frame and a plank, two of each are used. Treenails may be composed of wood from roots.
3. Timber measures, or **scantlings**, are uniform, even between large and small ships:
   - floor timbers = 19-20cm square section
   - futtock square sections decrease from 19-20cm to 14cm at the upper deck
   - hull planks = 33-38cm wide, 4.5-6cm thick, and max. 10-11m long
   - deck and wall planks = 17-19cm wide, 3-3.5cm thick, and max. 10-11m long
4. Some first futtocks and floors are assembled laterally with dovetail mortise and tenon joints, forming pre-erected design frames. These alternate with 'floating futtocks' that are only fastened to the hull planks.
5. The notched keelson swells in size at the main mast step and is buttressed on each side against the bilge clamps (or footwale), and on one or both sides of the keelson, there is a semi-circular cavity in the wood that held the pump.
6. The outermost stringers, called *albaolas,* are crenelated and feature small inserted 'filler' planks, which seal the bilges.
7. Central frames are predesigned and preassembled.
8. Curved timbers (*couces*) connect the stem and sternpost. These are supported by a curved knee, over which is a y-shaped frame (*pica*) connected to the *couce* by deadwood (*coral*).
9. The transom is flat with a tall, more-or-less vertical sternpost.

While any one of these characteristics could be seen in a vessel of a different origin, when taken together, they are assumed to be diagnostic of pan-Iberian shipbuilding traditions from the 16th to 18th centuries. This method of identification is not without its problems: namely, that the sample of shipwrecks confirming these traits may have been engaged in Iberian trade, but it cannot be confirmed that all of them were built in Iberia, or by Iberians, or even necessarily for Iberians. Furthermore, there are many regional variations that may reflect outside influences (as in labor force or other technology transference mechanisms) or local specializations (construction of oceangoing versus estuarine vessels, or galleons versus caravels, e.g.) (Loureiro 2012). These ambiguities help make the case for why advancing the methods and analytical potentials of wood provenance is so important. If a broad sample of structural timbers could be dated and provenanced, it would elucidate the continuum – temporal and spatial – of the historical 'place' of the ship and all that went into making it and sailing it.

1.4. Treasure and archaeology

All shipwrecks are treasure troves of information, but few contain actual treasure. With romantic ideas of sunken hordes of gold doubloons and treasure chests of jewels guarded by one-eyed pirate skeletons, Spanish and Portuguese shipwrecks are especially vulnerable to the efforts of those who seek to profit financially, not culturally, from 'excavating' shipwrecks (e.g., Smith et al., 1985; Keith & Simmons III 1985). The practices of modern-day treasure hunters (who variously refer to themselves as salvors, explorers, or even commercial archaeologists) destroy heritage sites just to get to 'the rich stuff' (a phrase made famous in Steven Spielberg's 1985 film, *The Goonies*). The shipwreck assemblage is rarely if ever recorded, and excavations are less than systematic, let alone scientific. Neither are treasure hunters concerned with the socio-historical context of the gold and silver from which they hope to profit; namely, that it was mined by enslaved indigenous people whose torture was legitimized by the colonialist concepts of biological, cultural, and religious superiority (Beuchot 1997). Instead, artefacts 'salvaged' from such sites are sold to private collectors for profit, where, far more often than not, they disappear once again from public access and from the infinite lessons history has to teach us.

Archaeologists, in strict opposition to treasure hunters or 'salvage' teams, operate by way of a professional deontological code, or duty-based ethics (Brodie et al., 2006; Brodie & Tubb 2002; Castro, n.d.). **Deontology**, as it relates to cultural heritage, champions the production of knowledge over the production of profit because only the production of knowledge leads to the formulation of truths (see also Chapter 5). Those few archaeologists who are willing to collaborate with treasure hunters compromise their professional ethical code because even well-intended collaborations do not result in some idealized win-win situation. Instead, there will always be a conflict of interest (Juvelier 2017; Dromgoole 2002). All too often, shipwreck sites are excavated without being guided by research questions; they are inadequately mapped and documented; and any results (including the presence of decontextualized finds) are disseminated exclusively through popular media channels, eschewing scientific peer-reviewed publication altogether (e.g., Pope 2007; Butterfields 2000; Mathewson 1986; but see: Lu and Zhou 2016; Flecker 2002). Just as dangerously, the archaeological record becomes biased toward shipwrecks that have the potential to turn the most profit. It should be clear that all of these factors hinder the production of knowledge and truth. Legitimate archaeological organizations around the world have developed ethical codes of conduct, and financial gain from stolen and/or decontextualized tangible heritage is unanimously rejected (e.g., CifA 2014; see also http://worldarch.org/code-of-ethics/). The 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage (UCH) Article 2.7 states explicitly: 'Underwater cultural heritage shall not be commercially exploited' (full text available at www.unesco.org).

Not surprisingly, ship timbers do not usually promise a great deal of profit for treasure hunters, so they are forcefully removed or otherwise ruined in the search for more valuable artefacts. That being said, a large timber was recently found as flotsam on the coast of one of the Hebrides (Scotland), and in 2015, it was posted for sale on the online auction site Ebay with a starting bid of 750 GBP (Figure 3). The seller

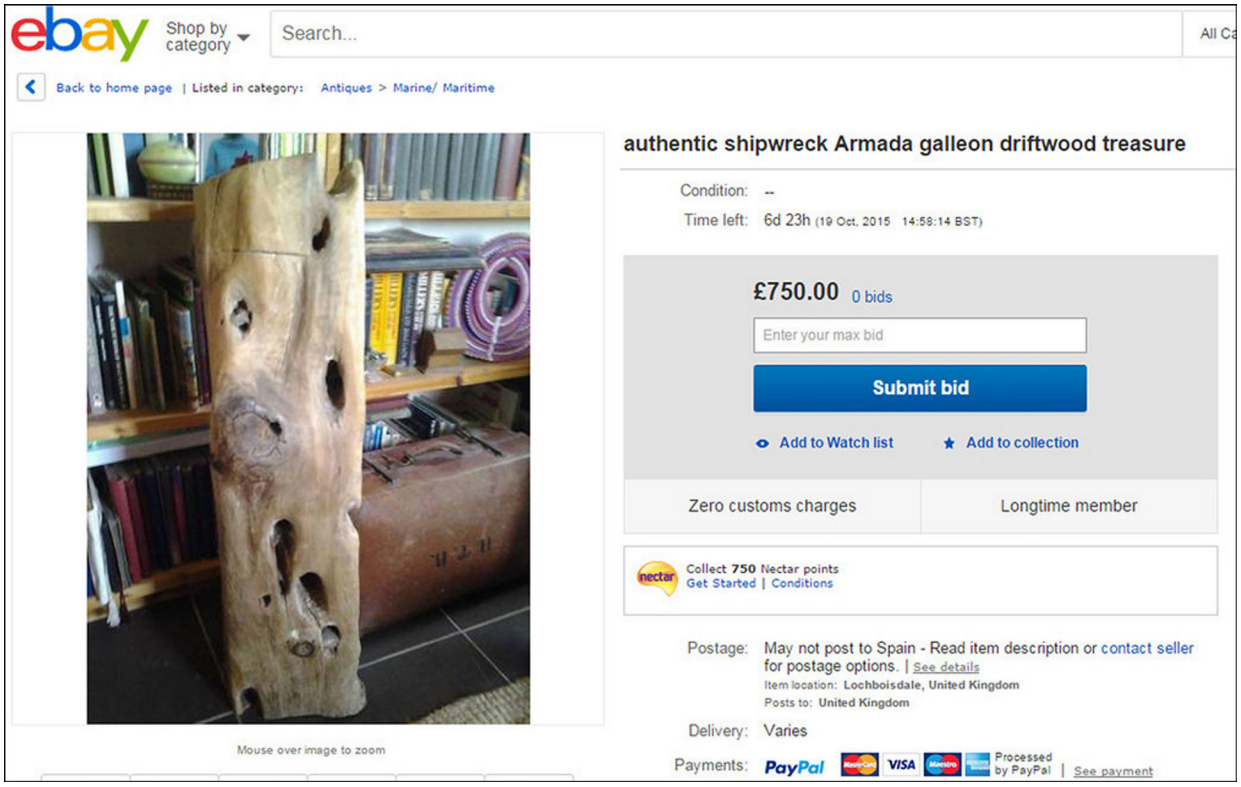

Figure 3. Supposed shipwreck timber from a galleon of the 1986 Spanish *armada* that appeared on the online auction site Ebay in 2015 after having washed up on the Scottish coast as flotsam.

described it as coming from one of Philip II's *armada* galleons wrecked in the storm of 1588 (Birch & McElvogue 1999; Martin 2000; Casabán 2017). Without context though, this claim cannot be validated, and it is unlikely that any archaeological project or wood science lab would be in a position (financially or ethically) to purchase the timber in order to confirm a date or origin (Huysecom et al. 2017). Whether a timber is destroyed or sold, either way, its scientific potential and historical relevance are irreversibly compromised in exchange for profit.

Online auction houses like Ebay are perfect vehicles for the global illicit trade in tangible cultural heritage, some of which supports the work of international terrorist organizations. While undoubtedly a global phenomenon, developing countries and areas experiencing armed conflict or regime change are most highly susceptible to looting and antiquities trafficking (Huysecom et al. 2017; Brodie et al. 2006; Flecker 2002). At the same time, collectors buying these stolen antiquities are most often found in the wealthiest and most politically stable countries, specifically the United States and the United Kingdom, where cultural artefacts devoid of their original context are demoted further to prestige badges and conversation pieces. This all too common scenario only serves to uphold colonialist conventions of the disempowered Other, as well as that of a present that is unnecessarily disarticulated from the past (Brodie et al. 2006; Lucas 2001, 2012).

Countries that have ratified the 2001 UNESCO convention on UCH may prosecute treasure hunters (O'Keefe 2013; Guérin & Egger 2010; Dromgoole 2002; for more on the UNESCO convention, see 5.1); however, in countries that have not yet ratified the convention, these individuals and companies may be paid handsomely for their crimes (often because they are not actually defined as such). It is worth emphasizing, however, that the profit is one-sided; in many cases, the costs of judicial proceedings and litigation resulting from contested activities or rights is publicly funded: that is, by the same taxpayers who will no longer have access to heritage items sold into private collections (Throckmorton 1998).