Chapter 4
Iberian Ships of the Early Modern Period

Filipe Castro, Marijo Gauthier-Bérubé, and Miguel Martins

Abstract At the cultural convergence of three different worlds, the Atlantic, the Baltic, and the Mediterranean, Spain, and Portugal played an important role in the Renaissance technical revolution. Both countries developed new types of watercraft during this period and adopted new navigation techniques that allowed them to venture further away from the Iberian Peninsula. Thousands of books have been written about the Renaissance and the European expansion, but the ships that made the European voyages possible are still largely unknown to us. This short chapter is a contribution to a better understanding of the origins of Iberian shipbuilding traditions.

1 Introduction

As explained by Marcel Pujol in Chap. 6 of this book, ship shapes and sizes varied with their uses and their maritime environments. Their development happened in a cultural setting that was both progressive in its attitudes and traditional in its business structures. Technological innovation shaped new ships, mixing traditions to produce a continuous stream of ideas and construction practices (Oliveira 1995).

The world of the fifteenth and sixteenth centuries changed drastically, and at a fast pace. The post-medieval world was volatile. Its power superstructures were affected by the development of rural capitalism, urbanism, industry, commerce, banking, diplomacy, intelligence agencies, and war machines and theories. Both middle and upper urban classes understood the value of knowledge and like everything else in Europe, ship conception and construction changed from parochial to cosmopolitan paradigms.

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F. Castro (✉) · M. Martins
Universidade Nova de Lisboa (UNLA), Lisbon, Portugal
e-mail: fcastro@fcsh.unl.pt

M. Gauthier-Bérubé
Texas A&M University (TAMU), College Station, USA

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The study of the complex relations between tradition and innovation is exciting because they are difficult to map and understand in such a dynamic and porous context.

The ships of the Portuguese age of discoveries can be considered hybrids, as they can be described as Mediterranean ships with Atlantic reinforcements. But ships are also the result of the shipwright's taste and knowledge, the availability of building materials, and the ship owner's perceptions of quality.

The study of Iberian ships requires a definition of these ships and a comparison with their contemporary European types and models. Preceding the in-depth study presented in Chap. 6 we want to quickly address the probable origins and influences on Portuguese shipbuilding since the first millennium BCE and up to the fifteenth and sixteenth centuries and suggest a theoretical approach to improve our understanding of shipbuilding cultural evolution.

2 Origins of Portuguese Ship Construction for the Atlantic

Phoenicians, Greeks, Carthaginians, Romans, Suevi, Visigoths, Vandals, and Arabs, among other visitors and settlers, all left their influences in the Iberian Peninsula's architecture, language, agriculture, religious beliefs, and many other cultural and technological aspects, including its shipbuilding traditions. Phoenician merchants visited the Iberian Peninsula in the first millennium BCE and probably brought writing, the potter's wheel, and iron technology to this end of the known world (Arruda 1999). They probably arrived on shell-based built vessels, likely built with large pegged mortises and tenon joints, similar to the ones found on the 1300 BCE Uluburun shipwreck (Pulak 2002). They were followed by Greek sailors and settlers, probably traveling on boats with their planks sewn together (Polzer 2010). Carthaginians and Romans also sailed into the Iberian Peninsula, probably on ships built by joining the planks together with small-pegged mortise-and-tenon joints. The archaeological record in Portugal is scarce. There are news of a Roman shipwreck looted and they destroyed by dredges at the mouth of the Arade River (Castro 2006), and ceramic finds suggest the existence of another two shipwrecks from the Roman period in Peniche (Blot and Bombico 2013) and Esposende (Morais et al. 2013).

In the first decades of the first century CE, the Greek geographer Strabo mentioned rafts, skin craft, and dugout canoes in the Iberian Peninsula. We know that the latter were extensively used at least from the end of the first millennium BC until the modern age, being documented on the Bay of Santander as late as the sixteenth century (Casado Soto 1995). Five dugouts were found on the margins of Lima River, in the north of Portugal, between 1985 and 2003. Their dates span from second or first centuries BCE to tenth or eleventh centuries CE (Alves 1986; Belo 2003; Alves and Rieth 2007).

The ships of the peoples that lived in the Iberian Peninsula in the five centuries that followed the sack of Rome, in the early fifth century, are not known to us. Visigoths, Byzantines, Arabs, Franks, and northern migrants successively occupied the Peninsula and traded, waged war, and transported people and goods on a variety of watercraft. We have only a few written references to watercraft from this period (Pico 1963), and perhaps even less surviving iconography.

The Arab occupation probably kept most of the habits and structures intact. Arabs were shipbuilders and fishermen and must have built and used vessels to sail along the coasts and into the Atlantic. They sailed their galleys to Galicia, as mentioned in the *Cronica Compostellana* (Filgueiras 1989).

Portugal was carved out of the Iberian Peninsula from the twelfth century onwards through complex historical reasons and its territory does not encompass a single cultural horizon. The north perhaps has obvious cultural and geographic affinities with Galicia, the centre with Castilla, and the south with Andalucía. Traditional watercraft illustrates the cultural divisions of the Portuguese territory. The north – as already mentioned by Pujol in the previous chapter – seems to have been in more intense contact with the Cantabrian region, the south with the Mediterranean, and the centre seems to have formed during the late middle age as a melting pot of European invaders' ideas and Arab residents' practices and gestures.

3 The Germanic Influence in the Fifth Century

Galicia has a clear northern connection. For instance, today's *dornas* are lapstrakes, built under a clear northern influence (Alonso Romero 1991), and so are the bottom based *barcos rabelos* from the Douro River, built with flush laid planks on the bottom and lapstrake sides, in the manner of the Hanseatic League cogs (Filgueiras 1992).

Octavio Lixa Filgueiras suggested that some of the craft that could be found north of the Douro River region was built with northern influence, perhaps from the Germanic Suevi people, which invaded the Iberian Peninsula between CE 407 and 409, together with other Germanic tribes, the Vandals and Alans (Filgueiras 1979). The Portuguese coast is difficult, however, with few good bays or natural harbours, and it is possible to guess southern cultural influences in the *saveiros* from the Aveiro delta, which seem to be evolved plank canoes and present incredible similarities the Middle Eastern model from Ur, dated to the late third millennium BCE, as famously suggested by Octavio Lixa Filgueiras (1980).

Lapstrake construction may have been utilized in the late middle ages along the coast south of Aveiro, although the only evidence is a small frame found on the now silted bay of Alfeizerão (Alves et al. 2005), already mentioned by Pujol, and a larger frame, dated to the late sixteenth or 17th centuries, found at the mouth of the Arade River and possibly belonging to a lapstrake exposed by dredging works in the 1970s (Castro 2006).

4 North African Influence in the Eighth Century

The Muslim chieftains that composed most of southern Iberia in the seventh century brought visitors from the north of Europe as part of the ongoing movement of the crusades (Le Goff 2000). Arabs have also been great shipbuilders and may have used frame-based vessels since perhaps as early as the eighth century. The

hypothesis that they were the developers of this shipbuilding tradition cannot, at this time, be excluded.

In the late eighth century, Al-Jahiz, the author of the *Book of the Animals*, mentions an Umayyad governor of Iraq named al-Haggag, who died in CE 714, and is reputed to have built the first vessels "nailed and caulked". Other Arab documents, from the tenth century onwards, mention the construction of vessels built with planks nailed to the frames as opposed to the Indian Ocean and Red Sea vessels, in which the planks were sewn together (Darmoul 1985; Harpster 2005). Muslims were an important naval power in the Mediterranean; it is logical to assume that the Arab world was another important source of influence on Iberian shipbuilders. Arab warships had helped the Arab conquest in the eighth century and later, their galleys fought Viking invaders, and sacked coastal villages regularly since the Christian leaders had started the northern push against Muslim rule we call the *Reconquista* (Filgueiras 1989).

A number of shipwrecks found on the coast of present-day Israel, namely the Dor D, Dor 2001/01, and Tantura A (all dated to the sixth century), Tantura B (ninth century), and Tantura F (tenth century), are the earliest known examples of this skeleton-based tradition (Wachsmann and Kahanov 1997; Royal and Kahonov 2000; Kahanov and Royal 2001; Barkai and Kahanov 2007). Unfortunately, not all these shipwrecks have yet been fully recovered, disassembled, and analysed, and it is therefore impossible to state with certainty whether they were constructed in a purely skeleton-first way, or whether there are any edge fastenings in the planking of the lower hull. Be it as it may, all the evidence mentioned above seem to suggest a Middle Eastern or Arab origin for the skeleton-based shipbuilding tradition, perhaps as the result for the lack of proper timber, or for the lack of labour trained in mortise-and-tenon joints construction.

Another group of shipwrecks found on the southern coast of France, namely the Agay A, Agay B, Batéguier, and Estéou shipwrecks (all dated to the tenth century), also suggests that Arab ships of this period were built by the frame-based method (Ximenes 1976; Jézégou et al. 1997). The *Reconquista* lasted more than ten generations, from the twelfth to the fifteenth century, and encompassed periods of peace and cooperation as well as alliances and substantial sharing of ideas and cultural traits. Moreover, after the conquest of the Peninsula by Christian kings, a part of the Arab population was absorbed and converted into Christianity.

Christianized Arabs – or *moçarabes*, as they were known – almost certainly went on building boats and ships under the new Christian rulers. Being absorbed into a bigger population group does not mean total annihilation of previous knowledge; Christianized Arabs did not stop using their ways of building ships, blending their skills to newcomers. As an example, the Christians that settled in the south of the Iberian Peninsula adopted Arab values, practices, and vocabulary. For instance, the Portuguese word for tail frame, *almogama*, literally translates as "meeting point" in Arabic. The fact that Portuguese shipwrights adopted an Arab word suggests the existence of two closely integrated cultures within the shipbuilding profession. This is further substantiated by the writings of Father Fernando Oliveira. Oliveira wrote about his visits to harbours and shipyards of Spain, France, Italy, England, and

"some in the lands of the Moors". He wrote about how he "practiced with their [the Moors] carpenters, and learning their styles, and carpentry customs, and construction traditions". Known for his candour, Oliveira mentioned the Maghreb harbours and shipyards together with the Italian and the Spanish counterparts without expressing any particular criticism. It is very likely that shipbuilding in the Maghreb was as good and sophisticated as in any other major seafaring country of the time (Oliveira 1995).

5 Mediterranean Influence: The Genoese between the 12th and 16th Centuries

A Mediterranean influence on Iberian shipbuilding is documented as early as the twelfth century, when bishop Gelmirez of Santiago de Compostela hired Italian shipwrights from Pisa to build and operate a fleet of galleys for the protection of the Galician coast, often attacked by Arab parties (Filgueiras 1989). During the thirteenth century Genoese ships began visiting the coast of the Bay of Biscay and setting up intermediate trading posts for their commercial enterprise in the north Atlantic. Already trading with Muslim Seville, the Genoese established a permanent presence in the city soon after it was conquered by King Alfonso X, in 1248. By the second half of the fifteenth century the Genoese community in Seville had grown quite large (Pike 1966).

Perhaps more importantly, the presence of Italian merchants and bankers in Spanish and Portuguese courts and in prominent cities is well documented in the fifteenth and sixteenth centuries (Coelho and Battelli 1934; Lowe 2000). More than one century of scholarship attests this presence, as well as the intense cultural interchange between Portugal, Castile, and Rome, Florence, Venice, Pisa, Genoa, among other Italian cities and regions. Another major player in the Iberian expansion into the Atlantic was the kingdom of Aragon, which was part of the Mediterranean cultural world.

The contact between the Iberian crowns and merchants, and Italian cities is clearly illustrated in the roles of individuals such as Lanzaroto Malocello, Niccoloso da Recco, Angiolilo del Tegghia de' Corbizzi, Cristoforo Colombo, or Amerigo Vespucci. In the first part of the fifteenth century Portugal's Prince D. Henrique contracted the services of Italians such as Antoniotto Usodimare and Alvise Cadamosto to sail his caravels down the coast of Africa (de Albuquerque 1994). Colombo himself, allegedly came to Lisbon to join his brother in the 1470s, married a Portuguese lady, and sailed both Portuguese and Castilian ships before engaging in his attempt to cross the Atlantic Ocean.

Contacts with Italian navigators and shipwrights are relatively well studied and continued into the fifteenth and sixteenth centuries and may have intensified under the Habsburg rule. In February 1513, Pantaleone Queirolo, a shipwright from the small village of Varazze, appears to have left his homeland in Italy for Portugal with

a group of shipwrights contracted to construct and operate galleys for the king of Portugal (Viterbo 1988; Ciciliot 2000).

It looks like Spanish and Portuguese shipwrights started building ships in the Mediterranean way, by using moulds and ribbands to obtain the shape of the hull, and then pre-designing the frames based on a midship frame mould and a system of reduction scales that progressively narrowed and raised the turn of the bilge points on each pre-designed frame.

We know from late sixteenth century shipbuilding treatises and archaeological excavations that both Portuguese and Spanish ships were built in this way, at least since the late fifteenth century, but probably considerably earlier. The Aveiro A, Cais do Sodré, Highbourne Cay, and Molasses Reef shipwrecks seem to share a certain number of characteristics – Eric Rieth's architectural signatures – that seem to be common to the Peninsula Atlantic ships, from the Basque country to the Strait of Gibraltar. In the second half of the sixteenth century, some shipbuilding treatises explain how to obtain, beforehand, a good and functional turn of the bilge line, using one of a small number of geometric algorithms to generate the curves of the vertical and horizontal projection of the turn of the bilge line (Anderson 1925; Bellabarba 1993, 1996; Rieth 1996; Bondioli 2003). This method prevailed in the Mediterranean until the twentieth century, perhaps because it presented two major advantages: firstly, because it was non-graphic and could be applied to each one of the pre-designed frames to mount over the ship's keel; and secondly because it was simple and could be applied with success even if the shipwright did not understand its geometric foundations (Castro 2007).

Moreover, circumstantial evidence, such as the units of measure and the geometric algorithms used in the shaping of the ship's hulls, indicate a close relationship between Iberian and Italian shipwrights. By the sixteenth century Portuguese shipwrights used the *goa* (77 cm) and the *palmo de goa* (25.67 cm) as units of length in their shipyards. Both these units have a parallel in Genoese units of measure (Barker 1998; Ciciliot 1998).

5.1 A Second Wave of Northern Influence in the Fourteenth Century

At the dawn of the Renaissance the Italian influence in Portuguese shipbuilding must have been rather important, but by no means unique. The Portuguese and some of the Spanish crowns traded with the Baltic Sea at least from the fourteenth century, exchanging cereals, metals, and textiles for salt, cork, olive oil, wine, and wool. In 1430 permanent commercial relations were established between Lisbon and Danzig, and there is evidence that Portuguese merchants bought vessels in the north, from Galician, Basque or British origins (de Albuquerque 1994).

Several shipwrecks from this period – for instance Highbourne Cay, *San Juan*, Newport, Western Ledge Reef Shipwreck – have mast steps that show a northern

influence when compared with the Mediterranean mast steps of similar vessels (Rieth 1998). Similarly, the angular timbers possibly used to fasten the keel to the stem and sternposts in Portuguese ships, known as *couces* (*de proa* and *de popa*), have a parallel in the northern construction, in the *hooks* of the cogs and cog-like vessels. A third interesting feature may be typical of the Iberian Peninsula: rectangular or dovetail joints in the connections between floor timbers and first futtocks have been recorded in several Iberian vessels (Oertling 1989, 2001, 2004). These scarfs differ from the traditional Mediterranean hooked scarfs recorded in shipwrecks within the region, such as the early fourteenth century *Culip VI*, the sixteenth century Ottoman shipwreck of *Yassıada* or the late seventeenth century shipwreck *Sardinaux* (Rieth 1998). However, dovetail joints between floor timbers and first futtocks have been recorded in a growing number of northern shipwrecks, such as the Cattewater, B&W 7, or the Princes Channel shipwrecks (Redknap 1984; Lemée 2006; Auer and Firth 2007).

6 Conclusion

Positioned between the Mediterranean and the North Atlantic and Baltic maritime worlds, the Iberian Peninsula developed a rich and diverse collection of watercraft, each type suited for its intended purpose, resulting from the local natural resources and shipbuilding traditions, the availability of imported materials, and the influence of external contacts. During the Middle Ages hundreds of types of ships and boats were referred in documents. In the nineteenth century Admiral Quirino da Fonseca has listed 167 types in Portugal alone (da Fonseca 1915). This effervescence of types is rooted into this interminglement of different influences from northern Europe to the Arabic peninsula. The development of Portugal shipbuilding industry, or any shipbuilding tradition for that matter, should not be understood as an isolated event.

If a profound and determinant Italian influence in Portuguese shipbuilding is beyond discussion in the late Middle Ages, the identification and description of non-Italian traits in Portuguese watercraft remains a difficult task, given the scarcity of archaeological evidence. Diffusionism does not seem to be a good enough model to explain how new solutions were adopted and adapted in new paces. A lot of traits found on watercraft structures seem to result from a mix of new and old ideas, and when we consider the use of geometric algorithms to obtain repeatable hull shapes it becomes evident that these methods have travelled throughout the Mediterranean as practical recipes, rather than as well-understood geometric solutions.

Most archaeologists accept therefore, even if they seldom admit it in these terms, a Darwinian-like evolutionary model to explain change in the way ships and boats were conceived and built through time: good recipes adapted to new challenges and survived. Together with this slow and largely random evolution (based on taste, knowledge transfer processes, and availability of materials), a certain amount of radical innovation, driven by new intellectual trends, is commonly accepted, namely

during the consolidation of the modern state, in the fifteenth century, with the development of royal shipyards.

For this reason, perhaps, a better evolutionary model to explain the development of new watercraft during Medieval and Renaissance would be Niles Eldredge and Stephan J. Gould's idea (1972) of punctuated equilibrium. This model, applicated to shipbuilding, postulates a slow and random evolution of ship shapes and rigging arrangements, punctuated with radical modifications established by law in the royal shipyards. In other words, to the constant diversification of ship types of the medieval period, each model surviving and adapting to the needs of its socio-economic environment, the development of a state sponsored shipbuilding industry added a stream of new ideas and inventions, often imposed by scholars a world outside the shipwright's own. All ships are an answer to a particular set of questions, considered all the restrictions of the time and place. The final result is a combination of skill, knowledge, and taste of the shipwright, and cost and availability of the necessary materials.

Following this line of reasoning, the amazing diversity of solutions that this process generates can be tentatively organized in taxonomic groups, according to common traits found in geographical areas and time periods. A certain amount of convergence, however, must be considered, mostly after the consolidation of the modern state, with the (re)appearance of highly organized naval shipyards such as the Venetian or the Portuguese ones. After the fifteenth century European oceangoing shipbuilding, as well as war craft shipbuilding, saw a continuous convergent trend towards standardization, driven by the central political powers at play. Convergence became the norm between all maritime powers, through adoption of traits perceived as functional, and of each vessel model – galleys, short sea trading vessels, long sea merchantmen, and even certain types of small craft such as caravels – looked increasingly like its neighbours throughout the late fifteenth and the sixteenth centuries.

For this reason, perhaps an even better model to explain shipbuilding evolution can be Richard Dawkins' *memetics* (1976), as his *meme* theory is sometimes referred to. The *meme* concept, loosely defined by Dawkins as a unit of cultural transmission, allows us to imagine a finer and more complex system in which certain ideas, concepts, or solutions can be considered cultural units susceptible of being created and passed along (replicated), either intact or transformed. In this particular case, *memes* can be singularly helpful to frame the process by which we hypothesize how characteristics observed in Portuguese ships were imported from the Mediterranean, from the north of Europe, or sometimes developed in-house. These *memes* are the same thing that Ole Crumlin-Pedersen and Eric Rieth have called respectively 'fingerprints' and 'architectural signatures' (Crumlin-Pedersen 1991; Rieth 1998). As mentioned above, Oertling was the first to point out these *memes* (Oertling 1989, 2001, 2004).

A growing number of shipwrecks excavated and published in the last two decades has allowed a better understanding of Oertling's original list of *memes*, and the definition of potential areas of use of these. His 2001 table is presented below. It was modified in 2004 (Oertling 2004), and reduced to eleven traits, since the

Table 4.1 Thomas Oertling 2001 list of architectural signatures

Preassembled Central Frames	A given number of central frames, assembled before they were set up on the keel, whose futtocks are joined to the floor with a dovetail mortise and tenon, and transverse treenails and nails.
Planking nails and treenails	The carvel planking is fastened with a combination of nails and treenails joining plank and frame. The nails are at the plank edge on the frame centerline and the treenails alternate across the centerline of the frame.
Sternpost scarfed to keel knee	The aft end of the keel is a naturally grown knee whose upper arm is scarfed to the sternpost.
Stern deadwood knee	A single piece deadwood knee timber sits on top of the keel knee. This timber reinforces the juncture of the sternpost and keel, provides a surface for fastening the lower hull planks and is the base for the aftermost Y-shaped frames
Y-timbers tabbed to deadwood	The stern Y-timbers are tabbed into the deadwood knee (the tabs supported the timbers until the planking was added).
Keelson notched over floors	The keelson is notched over the tops of the floor timbers.
Maststep is expanded keelson	The mast step is an expanded portion of the keelson, part of which is cut away to seat the ship's pump.
Butresses and stringers	The mast step is supported by buttresses and bilge stringers.
Ceiling / filler planks	Ceiling planking extends just above the ends of the floor timbers where the last ceiling plank is notched to accept the short transverse filler planks.
Rigging chain assemblies	The ships have as part of their standing rigging a teardrop-shaped iron strop to accept a heart block or deadeye which is attached to 2–3 lengths of chain and the last link through an eyebolt.
Flat transom	Flat transoms widening the deck abaft and pushing the midship frame forward.
Carved garboard	The garboard is carved from an extra thick plank.

archaeological record did not suggest that the garboards carved from a single plank were typical in the Iberian shipbuilding traditions (Table 4.1).

We have revisited Oertling's seminal work and reanalysed the traits he assigned to the Iberian shipbuilding tradition. The following are the results of our analysis.

6.1 Flush Laid Planking

This seems to be the rule in the Iberian Peninsula, at least from the beginning of the fifteenth century, except for the Basque country, where lapstrake was probably common during the early to mid-fifteenth century, as shown in the Barceloneta 1 (c. 1425) and Urbieta (c. 1450) shipwrecks, for example.

6.2 Preassembled Central Frames

This trait seems to be common in Iberian ships, although neither dovetail scarfs and treenails and iron nails are always associated with dovetail scarfs. As described in sixteenth-century technical texts, placing a certain number of pre-designed frames on the keel seems to have been the canonical way of building ships, not only in the Iberian Peninsula. After laying the keel and posts, shipwrights assembled a certain number of central frames, and fastened them to the keel. The bow and stern shapes were often obtained with ribbands. In some archaeological examples, such as the Culip 6 (c. 1350), Aveiro A (c. 1475), Cais do Sodré (c. 1500), and Pepper Wreck (lost 1606), the frames are numbered and have construction marks that suggest a particular non-graphic way of pre-designing them (Rieth 1996).

6.3 Dovetail Scarfs

Dovetail scarfs were found on shipwrecks from the Mediterranean, Iberian Peninsula, and North Atlantic. There is a prevalence of the use of trapezoidal (dovetail) scarfs on Iberian ships, such as the Aveiro A (c.1475), Cais do Sodré (c. 1500), Molasses Reef and Highbourne Cay (c. 1525), Emanuel Point 1 (lost 1559), Belinho 1 (c. 1550), *San Juan* (lost 1565), Western Ledge (c. 1575), Angra F (c. 1600), *San Diego* (lost 1600), and Green Cabin (lost 1618), to cite just a few examples, and shipwrecks like the Pepper Wreck (lost 1606) or *N. S. de Atocha* (lost 1622) – and perhaps *Santa Margarita* (lost 1622) – had square shaped scarfs. There are, however, dovetail scarfs in ships built in the north, like the Princes Channel (c. 1575) and B&W7 (c. 1600) shipwrecks, and this type of scarfs are also mentioned in Mediterranean shipwrecks, such as Calvi 1 (c. 1575) and *Lomellina* (lost 1516).

6.4 Floor/Futtock Fasteners

The fasteners used in the Iberian Peninsula seem to follow a pattern, with treenails or a combination of nails and treenails on the north coast, and iron nails with square shanks on the west and southern coasts.

6.5 Planking Nails and Treenails

Again, the use of nails and treenails seems to be only valid on the northern coast of the Iberian Peninsula. Ships built on the western and southern coasts seem to have been assembled exclusively with square shanked iron nails.

6.6 Sternpost Scarfed to Stern Knee

This seems to have been a common practice in the Iberian Peninsula. It was observed in most shipwrecks where this portion of the hull was preserved or recorded. It was found on the Corpo Santo (c. 1400), Aveiro F (c. 1425), Aveiro A (c. 1475), Studland Bay (c. 1525), Belinho 1 (c. 1550), *San Esteban* (lost 1554), *San Juan* (lost 1565), Western Ledge (c. 1575), Esposende 1 (c. 1600), Angra B1 and Angra D (c. 1600), *San Diego* (lost 1600), and Fuxa (c. 1610). In the Mediterranean, *Lomellina* (lost 1516) and Calvi 1 (c. 1575) seem to have keels ending with a natural curve and overlaying knee timbers.

6.7 Stern Deadwood Knee

Knee timbers overlaying the upwards stern knee seem to have been a common practice in the Iberian Peninsula. In the north of Europe these deadwood knees are relatively common, connecting the keel or keel planks to the sternposts. The Iberian stern knees, in Portuguese *corais da popa*, appear in the Corpo Santo (c. 1400), Aveiro A (c. 1475), possibly in the Studland Bay (c. 1525) and *San Esteban* (lost 1554), *San Juan* (lost 1565), as well as Esposende 1 and Angra D (c. 1600). In the Mediterranean similar timbers seem to be part of the stern arrangements of *Lomellina* (lost 1516) and Calvi 1 (c. 1575), although erosion of the upper portion of *Lomellina*'s overlaying timber does not allow a definitive statement.

6.8 Y-Timbers Tabbed to Deadwood

This feature is found in many European ships of this period and cannot be assigned only to the Iberian Peninsula building traditions of the early modern period.

6.9 Keelson Notched over Floors

This feature is also found in many European ships of this period and cannot be assigned only to the Iberian Peninsula building traditions of the early modern period.

6.10 Maststep Is Expanded Keelson

This type of maststep seems to be common practice in northern Europe and in the Iberian Peninsula, but not in the Mediterranean.

6.11 Buttresses and Stringers

This feature is also found in many European ships of this period and cannot be assigned only to the Iberian Peninsula building traditions of the early modern period. The Mediterranean vessels from Boccalama, a galley and a *rascona*, both have buttresses granting lateral support to the maststeps, and the same is true for the Contarina 1 vessel.

6.12 Ceiling/Filler Planks

These small planks covering the spaces between the frames were found on the Cavalaire-sur-Mer Basque shipwreck (c. 1475), and in the Highbourne Cay (c. 1525) shipwreck, as well as in the Basque ship *San Juan* (1565), the French-built vessel Arade 1 (c. 1580), and the Mediterranean vessel of Calvi 1 (c. 1580).

6.13 Rigging Chain Assemblies

This feature is also found in many European ships of this period and cannot be assigned only to the Iberian Peninsula building traditions of the early modern period. Iconography suggests that deadeyes were tear shaped in most European ships of the sixteenth century.

6.14 Flat Transom

This seems to be a feature common in the sixteenth century, and not exclusive to the Iberian Peninsula. Flat transoms are almost generalized after 1500, in Mediterranean, Iberian, and North European vessels.

6.15 Carved Garboard

This feature is also found in many European ships of this period and cannot be assigned only to the Iberian Peninsula building traditions of the early modern period.

Perhaps one of the most interesting elements of this study is the fact that during the fifteenth century most northern European maritime powers adopted the Mediterranean skeleton-based shipbuilding method, and the Mediterranean merchantman model, with three or four masts and well-integrated fore and stern castles,

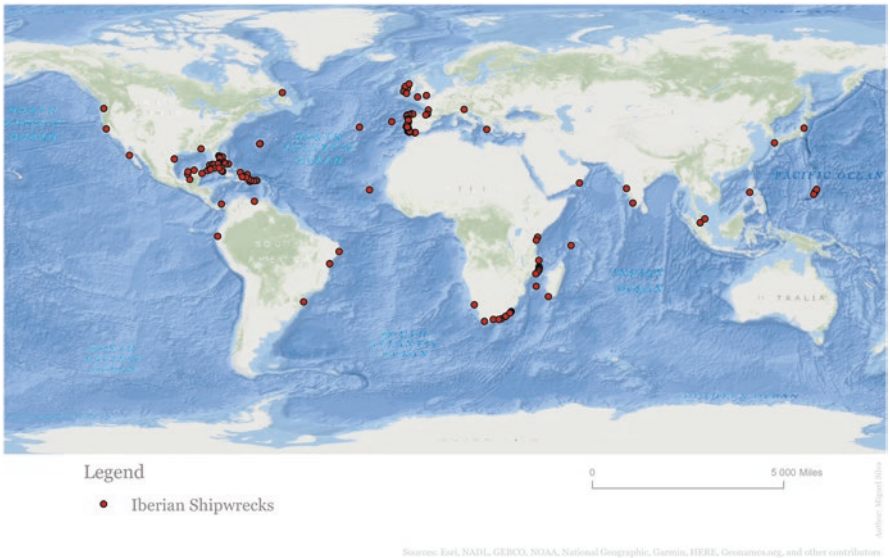

Fig. 4.1 World map with a distribution of possible Iberian shipwrecks (Miguel Silva)

making it even more difficult to pinpoint the Mediterranean (mostly Italian) shipbuilding *memes* adopted directly from Italy into Portuguese and Spanish shipbuilding methods, and those that arrived in the Iberian Peninsula via the north of Europe.

An important factor to compound at this point is the difficulty to identify the country of origin of a ship or boat. Ships were bought, seized, rented, and repaired, and without good dendrochronology data it is not possible to know for sure where a ship was built. Ships were sometimes also built with imported timber. It is, therefore, difficult to know for sure where some of the architectural signatures started or how they eventually spread into different cultural landscapes.

Nevertheless, the construction of history is an iterative process. Scholars propose narratives and test them against new or overlooked data. In Fig. 4.1 we present a map with the shipwrecks that we believe could have been built on the Atlantic coasts of Portugal or Spain. This is a tentative and provisory map and, as mentioned above, only dendrochronology studies will allow us a better understanding of these ship's technological roots.

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