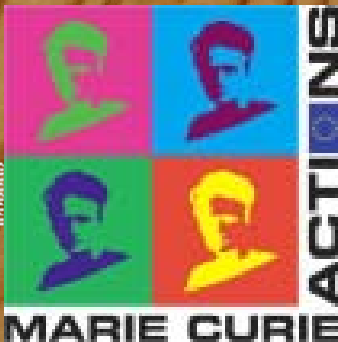


# ForSEAdiscovery

FOREST RESOURCES FOR IBERIAN EMPIRES:  
ECOLOGY AND GLOBALIZATION IN THE AGE OF DISCOVERY

- The Portuguese Forest and its Association with Shipbuilding, along the 16th Century. Revisiting the “Cais do Sodré” wreck. History, Underwater Archaeology and Dendrochronology

António Rocha Santos,  
Early Stage Researcher (ESR7),  
Work Package 2,  
ForSEAdiscovery project  
(PITN 2013 GA 607545),  
IAP/FCSH-UNL



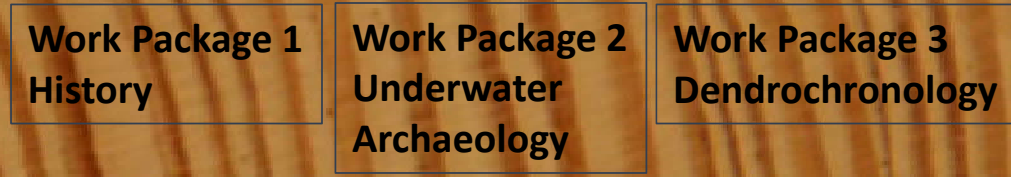


# Brief Overview of ESR7 Framework

- Project for SEAdiscovery PITN 2013 GA 607545 directed by Professor Ana Crespo Solana, entitled “Forest resources and Ships for Iberian Empires: ecology and globalization in the Age of Discovery”, divided in 3 work packages: history, underwater archaeology and dendrochronology;
- Work Package 2 (WP2), dedicated to underwater archaeology, coordinated by Professor Nigel Nayling and divided between different early stage researchers;
- Early Stage Researcher (ESR7 -“16th century shipbuilding in Portuguese dockyards: a historical and archaeological perspective”), António Rocha Santos, PHD research proposal entitled “The Portuguese Forest and its Association with Shipbuilding, along the 16th Century”;



Dr. Ana Crespo Solana, Director of ForSEAdiscovery Project



Dr. Nigel Nayling, Work Package 2 Coordinator



Koldo Trapaga, António Santos, Benat Miranda and Adolfo Martins, Early Stage Researchers in Work Package 2

# Thesis Structure

- Introduction
- Chapter 1 – The Portuguese Forested Areas and Wooden Species Applied on Shipbuilding Industry During the 16<sup>th</sup> century
  - 1.1 Forest Areas. From Early Ages until the 16<sup>th</sup> Century. Antecedents and Future Influences;
  - 1.2 The 16<sup>th</sup> Century Portuguese Territory: Forest Areas;
  - 1.3 Wooden Species Applied on Shipbuilding Industry;
  - 1.4 Timber Routes Supply between the Forest and the Shipyard;
  - 1.5 Domestic and Imported Timbers Applied on Shipbuilding Industry;
- Chapter 2 – The Royal Administration: Crown, Forest and Shipyard
  - 2.1 Kingdom of *D. Manuel I* (1495-1521);
  - 2.2 Kingdom of *D. João III* (1521-1557);
  - 2.3 Kingdom of *D. Sebastião* (1557-1578);
  - 2.4 Kingdom of *D. Filipe II* of Spain, *I* of Portugal (1581-1598);

## Chapter 3 – The 16<sup>th</sup> Century Shipbuilding in Portugal: Treatises, Timbers and Vessels

- 3.1 The Treatise of Priest Fernando Oliveira from 1580 – *Liuro da Fábrica das Naus*;
- 3.2 The Treatise of João Baptista Lavanha from 1610 – *Livro Primeiro da Architectura Naval*;
- 3.3 The appropriate species, according with F. Oliveira and J. B. Lavanha versus the applied species;
- 3.4 Merchant Ship and Warship: Differences and Similarities during the Shipbuilding Process, Adapted to Different Realities;
- 3.5 Transition from Small and Medium Scale Local Shipbuilding to a Centralized and Monopolist Shipbuilding in Great Scale. Tradition versus Imperialism;
- 3.6 Portuguese Shipbuilding in India;

## Chapter 4 – Case Study: Analysis of Timber Remains Identified as ‘*Cais do Sodré*’ Wreck

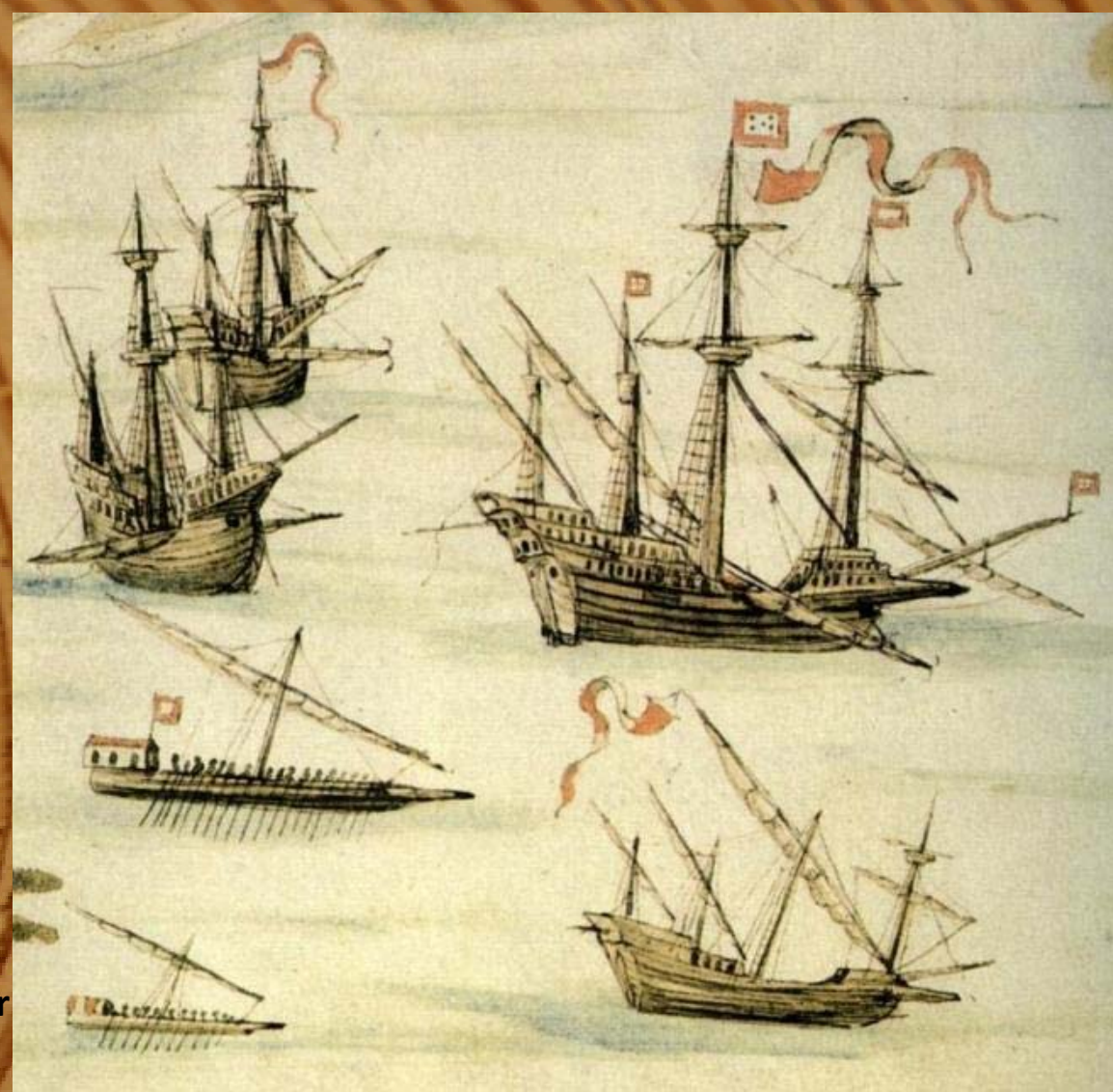
- 4.1 Ethics and Legislation regarding underwater sites and underwater practise;
- 4.2 The archaeological excavation;
- 4.3 Preservation Conditions post-excavation;
- 4.4 Graphic List Description of Timber Remains;
- 4.5 Timber from Monuments;
- 4.6 Comparative Analysis of other 16<sup>th</sup> Century Portuguese Wrecks

## Chapter 5 – Conclusions



# Research Questions

- Were the Portuguese forests capable of answering the constant need for timber in the Portuguese dockyards?
- Was the legislation and regulation issued during this century successful in assuring those demands?
- Was the Baltic timber imported into Portugal essential for the shipbuilding process or just complementary according with certain key components (for example mast and spars involving trees for masts)?
- During the 16<sup>th</sup> century, Portugal starts producing ships in India. Was this production supplementary to the shipbuilding taking place in Portugal, or was India already producing more ships than the national shipyards?
- It is recognized that the importation of Baltic timber formed part of the timber supply for Portuguese shipbuilding at this time. Did this system of Baltic timber supply have a reciprocal relationship with the exportation of Portuguese salt?
- Early shipbuilding treatises (such as *Fernando Oliveira* and *Francisco Lavanha*) promote particular standards of timber usage in shipbuilding. Are these reflected in broadly contemporary ship timber assemblages?
- What do we identify as a Portuguese/Iberian Ship?



In Domingues, F. C. (2004). "Os Navios do Mar Oceano. Teoria e empiria na arquitectura naval portuguesa dos séculos XVI e XVII"

# PHD and ForSEAdiscovery activities timetable

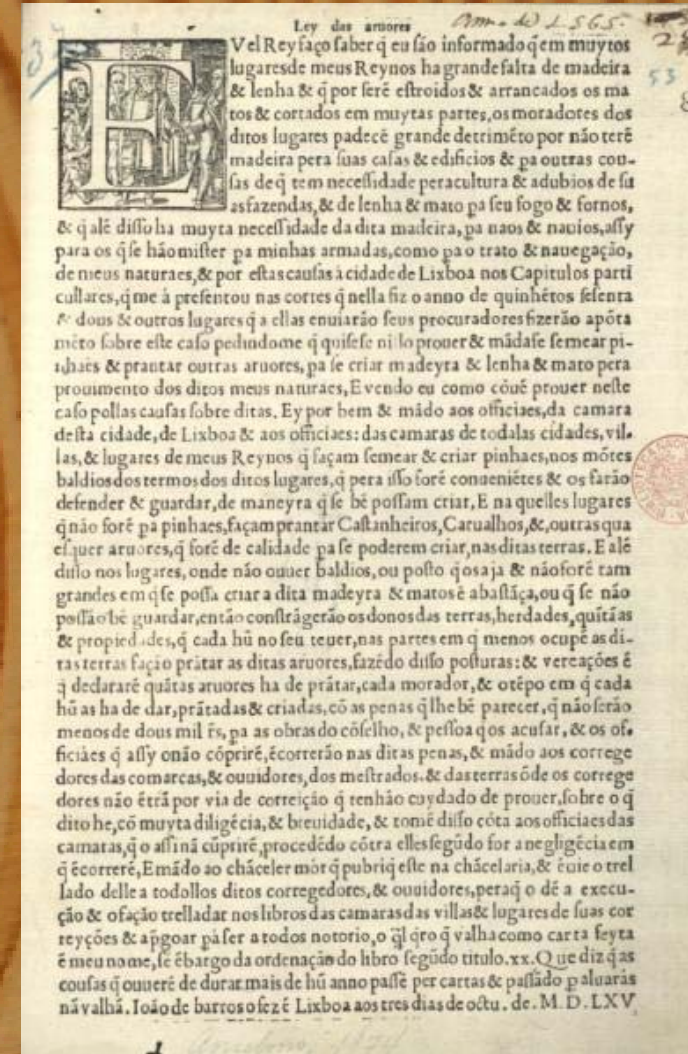
(last updated 19/05/2016)

	2014			2015												2016									2017								
	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September									
Gathering of archive documentation		Arquivo Histórico Ultramarino		Biblioteca Nacional Lisboa		Arquivo Distrital do Porto		Torre do Tombo				Torre do Tombo e Tribunal de Contas de Lisboa	Arquivo Histórico da Biblioteca de Obras Publicas																				
Gathering of written documentation	Yes	Yes	Yes					Yes		Yes																							
Conferences, meetings and workshops	IKUWA Cartagena	Network Meeting Lisbon		Workshop on shipbuilding Madrid	Marie Curie Porto	DEGUWA Nuremberg		Workshop on archive research Groningen				ISBSA Gdansk	Workshop on GIS and Rhino Madrid	Lisbon PHD Proposal	Lampeter for the Glossary, Workshop Wagnigen, Network Meeting Madrid																		
HSE Diving course						Yes	Yes																										
Archaeological Interventions									Galicia		Esposende																						
Written documents for evaluation	Essay of Metodologia & Problemática	Essay of Metodologia & Problemática	Essay of Metodologia & Problemática	Publition D.Manuel I	Publition D.Manuel I	Essay Floresta e Construção Naval		Essay Floresta e Construção Naval		PHD Proposal Projecto Final de Curso & Publication Safety at Work		PHD Proposal Projecto Final de Curso	Summary ForSEAdiscovery dissemination	Nuremberg Publication Article	Career Development Plan & Network Meeting Presentation																		
Research conducted on case study "Cals do Sodré"										Yes	Yes		Yes	Yes																			
Glossary										Yes	Yes	Yes	Yes	Yes																			
Thesis																																	
	2016												2017																				
	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September												
Gathering of archive documentation	Torre do Tombo																																
Gathering of written documentation	Yes																																
Conferences, meetings and workshops																																	
Secondment in Wales				from 01 of April	til 31 de May																												
Archaeological Interventions				Yarmouth Roads	Yarmouth Roads																												
Written documents for evaluation																																	
Research conducted on case study "Cals do Sodré"		With Prof. Nigel Nayling	Without Prof. Nigel Nayling						? To decide	? To decide	? To decide	? To decide																					
Chronology						Yes	Yes	Yes																									
Thesis	Alinea 2 of Chapter 1		Alinea 1 of Chapter 1						Chapter 1	Chapter 1	Chapter 2	Chapter 2	Chapter 3	Chapter 3	Chapter 4	Chapter 4	Chapter 5	Chapter 5	Final Corrections	Final Corrections	Submit Thesis												



# Archives and References Research on Forest Management

- Research already conducted on: *Arquivo Histórico Ultramarino, Arquivo Distrital do Porto, Tribunal de Contas em Lisboa and Arquivo Histórico da Biblioteca de Obras Públicas;*
- Research being conducted on *Arquivo Nacional Torre do Tombo and Biblioteca Nacional de Lisboa;*
- Main published references consist on the research conducted by Nicole Devi-Vareta, Amândio Barros, Amélia Polónia, Leonor Freire Costa and Francisco Contente Domingues;



1565 - "Lei das Árvores" (Tree Law) from the kingdom of D. Sebastião

# Some examples of Forest Administration along the 16th century

- D. Manuel I - From this moment onwards (1517) the landlords of *Viana do Castelo* were mandated to plant trees (4 per year) with priority for oaks, chestnuts, walnuts and willow trees;
- D. João III - Forbidden (in 1552) any business assets that depended on great amounts of timber, on an area of 10 leagues (40 km) around Lisbon;



King D. Manuel I  
(1495-1521)



King D. João III  
(1521-1557)



# Some examples of Forest Administration along the 16th century

- D. Sebastião – (in 1565) '*lei das árvores*' - '*que se plantem arvores para madeira. Pinus, Quercus e Castanea*';
- D. Filipe II of Spain, I of Portugal - The over explored and degraded pine forest of *Leiria* is replanted and expanded in 1587;



King D. Sebastião  
(1557-1578)



King Filipe II of Spain,  
I of Portugal (1581-1598)



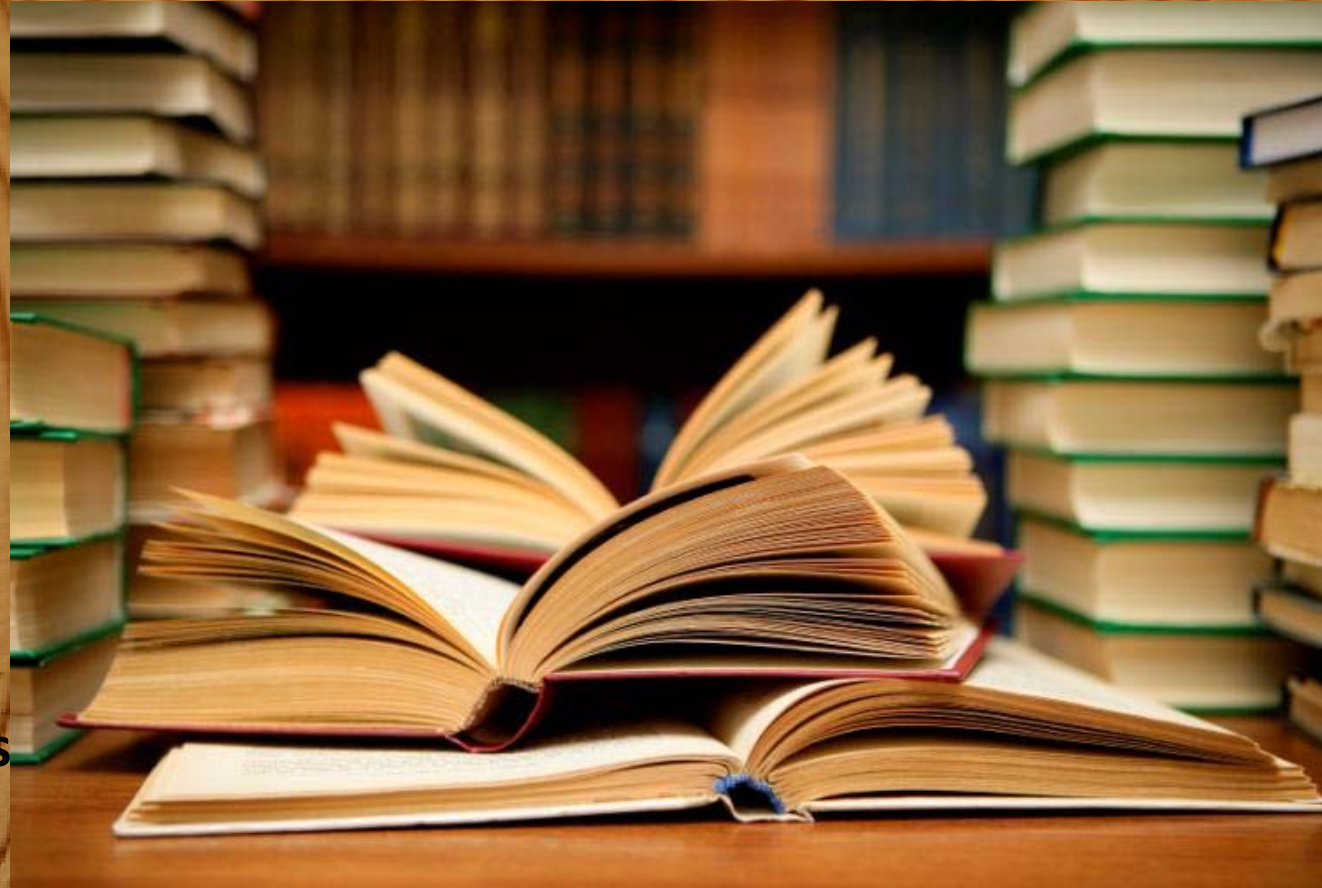
# Shipbuilding Treatises

- Two unique sources of information belonging to our period of study;
- Rich on shipbuilding details, such as measurements and shapes of different ship parts;
- Also important by the reference to different tree species according with the required ship component;



# Written sources: main authors consulted

- Dr. Nicole Devy-Vareta
- Dr. Amândio Morais Barros
- Dr. Leonor Freire Costa
- Dr. Amélia Polónia
- Dr. Filipe Vieira Castro
- Dr. Francisco Contente Domingues
- Dr. Paulo Jorge Rodrigues





# Activities within ForSEAdiscovery Project

- Workshops;
- Network meetings;
- Participation/attendance on conferences;



CARTAGENA 2014  
IKUWA V



ISBSA  
14 International  
Symposium on Boat  
and Ship Archaeology



Baltic and beyond

Change and continuity in shipbuilding  
National Maritime Museum in Gdańsk  
21-25/09/2015



# Activities within ForSEAdiscovery Project



- HSE Diving Course
- Timber sample recovery through diving campaigns;
- Timber sampling on land
- Timber recording;





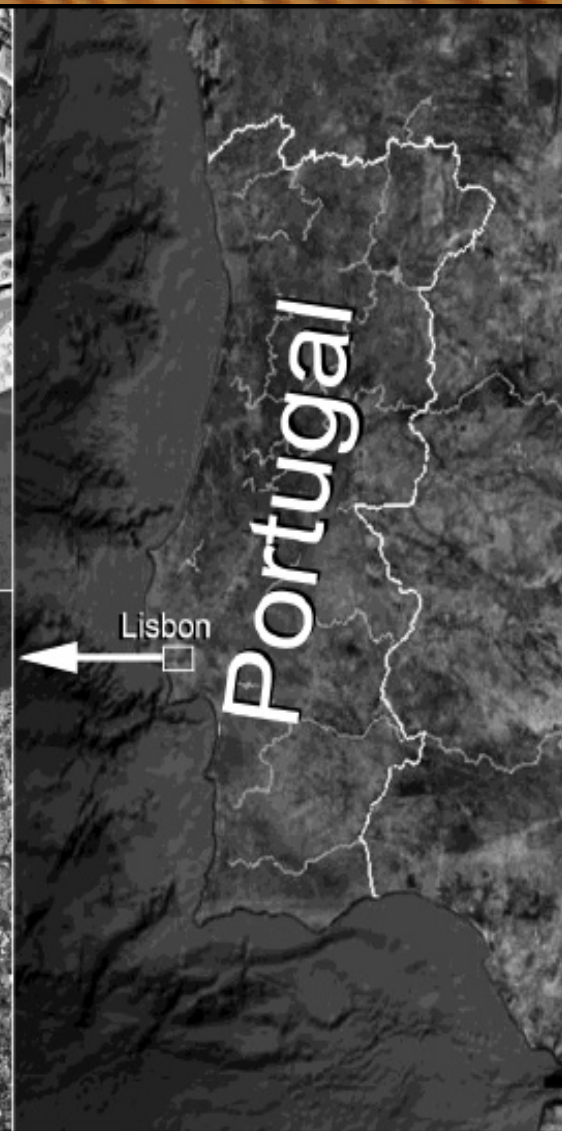
# Case Study: The “*Cais do Sodré*” Wreck



Photography taken during excavation. Image obtained during documental research conducted on MARL warehouse from DGPC, Loures, Lisboa

# Brief overview of Wreck and Site Location

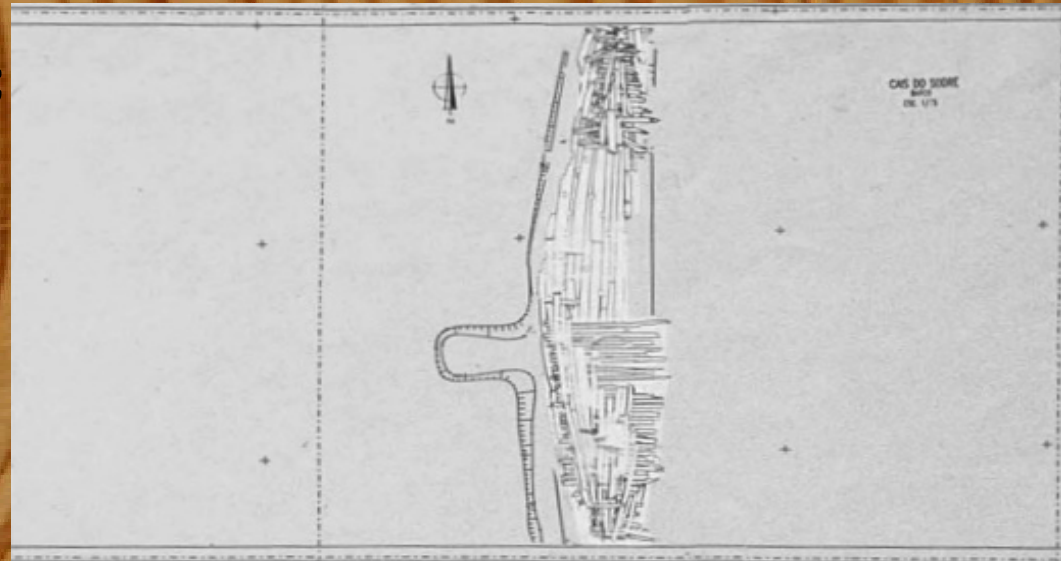
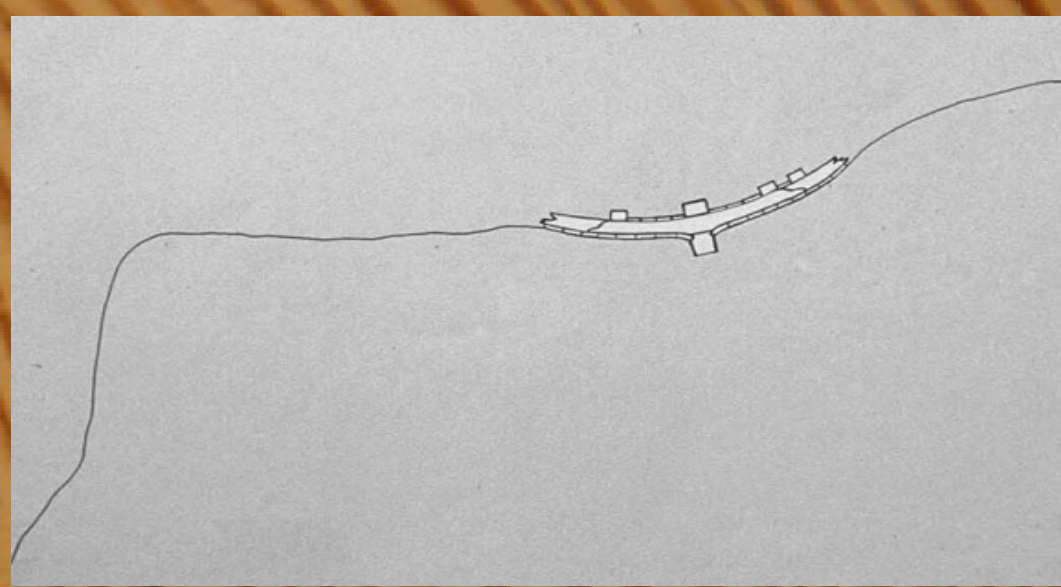
- Wreck found in 1995, during the construction of a new metro station;
- Practically devoid of artifacts;
- Presents few traces of usage on the outer surface of keel and hull planking;
- Ship remains found at a depth of -6,5m below the water level;





# Brief overview of Wreck and Site Location

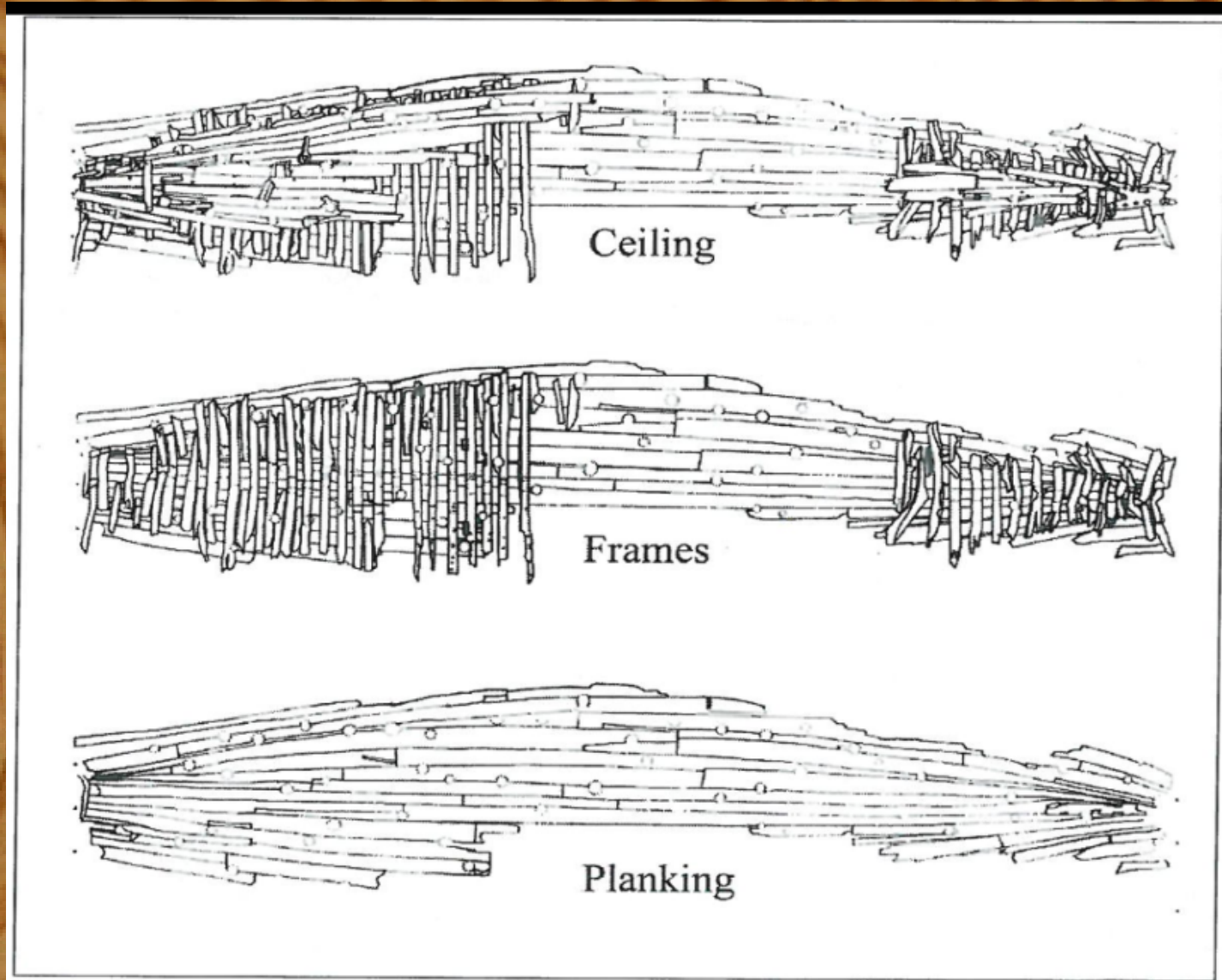
- Wreck location presumed to be an ancient riverbed;
- 120m offshore from Lisbon`s waterfront;
- Likely to have sunk around 1500;
- 24m long by 5m wide;



Wreck stand as found during 1995 excavation. Images obtained during documental research conducted on MARL warehouse from DGPC, Loures, Lisboa

# The Excavation

- Both the bow (north side) and stern areas (south side) were affected by concrete walls;
- Wreck damaged along its starboard side during the excavation by a backhoe loader damaging both planking, frames and ceiling structures;
- Wreck also pierced several times by the concrete piles;





# Post Excavation and Preservation Conditions

- Between the 1995 excavation and 1996 the wreck was disassembled and placed in water tanks;
- After 1996 the timbers were abandoned in a warehouse deprived of any water, consequently drying out and warping;
- These timbers irreversibly lost most of its academic potential due to political negligence;



Preservation conditions between the excavation and Spring 1996. Images obtained during documental research conducted on MARL warehouse from DGPC, Loures, Lisboa



# Current storage of “Cais do Sodré” timber remains

- We won't extend our comments on this slide due to... shame, sorrow and revulsion.
- Plus, how to justify an equivalent scenario inside or outside of Portugal... during the 90`s?

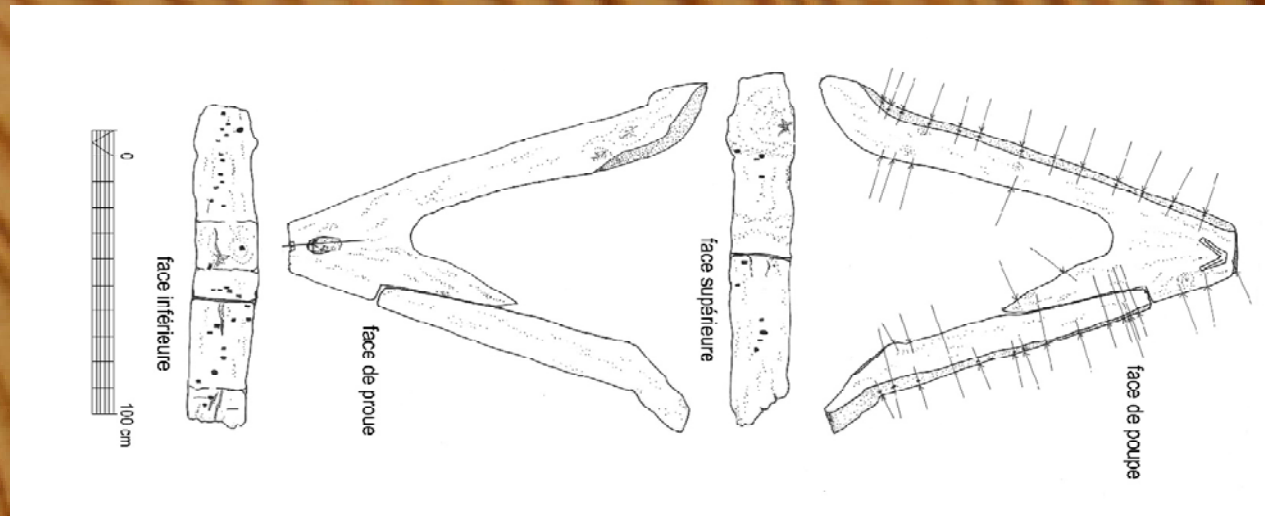


Actual display of timber remains. This photography is a courtesy of Filipe Castro (2015), Loures, Lisboa



# Research conducted between the 90`s and 00`s

- Research mainly focused on the wreck`s framing, not as focused on the planking and ceiling timbers;
- 37 manual drawings of all remaining frames;



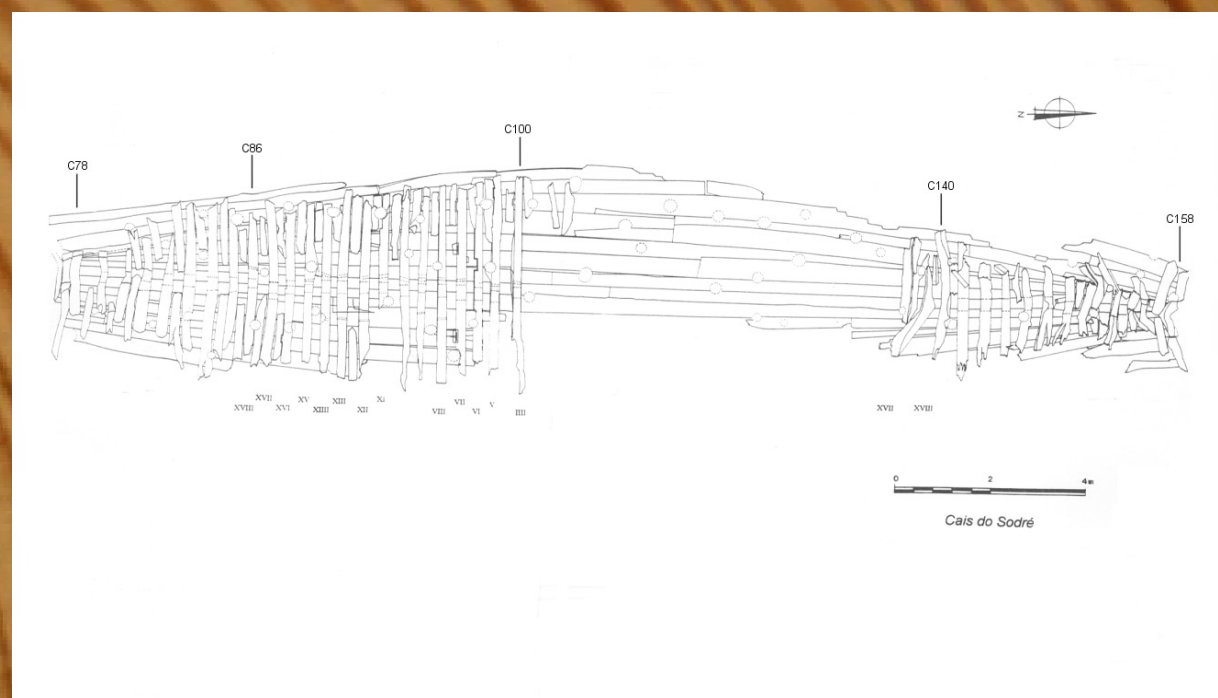
Drawing of frame 78, in Rodrigues, P. J. (2002) *“Comentários ao cavername dos destroços do navio do Cais do Sodré da 2ª metade do século XV/inícios do século XV”*, 2º volume;



Tri-dimensional model of ship`s frames, in Castro, F., Yamafune, K., Eginton, C. & Derryberry, T. (2011). *“The Cais do Sodré Shipwreck Lisbon, Portugal”*. Centre for Maritime Archaeology and Conservation, Department of Anthropology, Texas A & M University, College Station. *The international Journal of Nautical Archaeology*,40:2:, p. 343

# Research conducted between the 90`s and 00`s

- Pre-designed frames are identified with marks and Roman numerals;
- The marks can be Sub-divided in “*Traços de Astilhas*” (where the frame meets the keel), “*Traço Horizontal*” (responsible for the rising and narrowing of frame) and “*Traço Vertical*” (possibly related with the angle of futtock).  
The Roman numerals confirm the position of each frame on the keel;



Drawing of pre-designed frames marked with Roman numbering. Image obtained during documental research conducted on MARL warehouse from DGPC, Loures, Lisboa



Roman numbering on pre-designed frame. . Image obtained during documental research conducted on MARL warehouse from DGPC, Loures, Lisboa

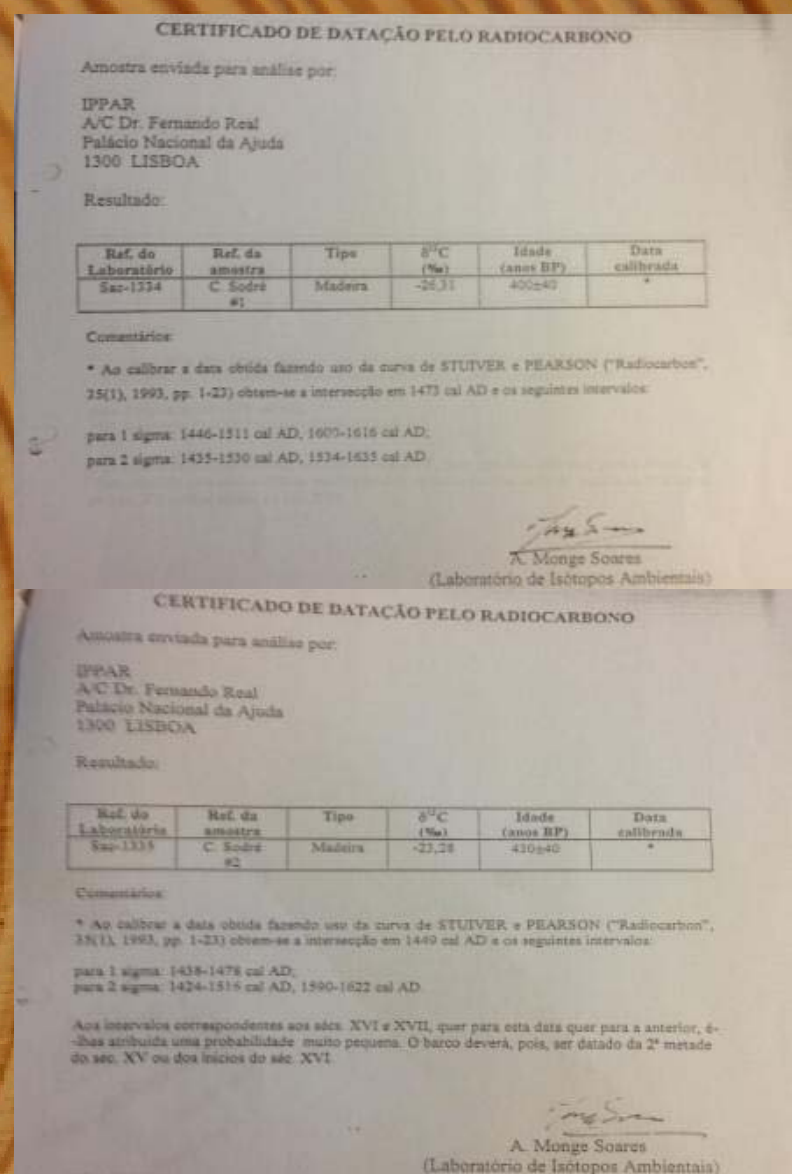


# Previous radiocarbon dating

- The radiocarbon dating from 1996 was conducted on 2 timber samples;
- The first sample was obtained from a frame. The second sample was extracted from the hull planking;
- According with the obtained results, the “Cais do Sodré” wreck was dated between the 2nd half of 15th century and early 17th;

Radiocarbon dating conducted by the Nuclear and Technologic Institute from the Ministry of Culture.

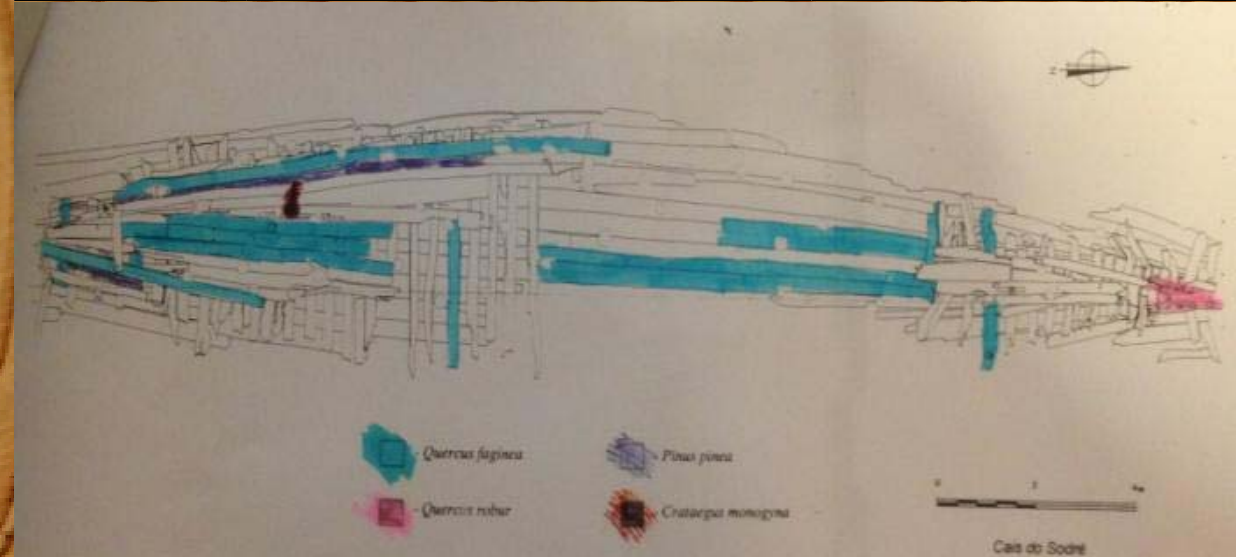
Image obtained during documental research conducted on MARL warehouse from DGPC, Loures, Lisboa



# Identification of tree species

- From the 20 samples analyzed by the Paleoecology Laboratory, 16 were identified as *Quercus faginea*, one as *Quercus robur*, one as *Pinus pinea*, one as *Pinus sylvestris* and lastly, one as *Crataegus monogyna*;
- The species identification can be observed on the wreck shown on the 2nd image;
- We have doubts regarding that identification of species;

Sample code	Ring Width	Timber Identification
Barco 79	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Braço 88	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Braço 140	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Contraquilha Sul	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Contraforte	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
C78	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
C81	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
C96	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
C143	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Escoa 1/EB/Sul	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Escoa 2/BB/Sul	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Forro Interior	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Pé de Carneiro	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Quilha	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Tabua de Casco 4BB	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Tabua de Resbordo	Growth rings very large (up untill 5mm)	Carvalho alvarinho ( <i>Quercus faginea</i> )
Buçarda	Growth rings very distinct (up untill 1,7mm)	Carvalho roble ( <i>Quercus robur</i> )
Forro Interior EB5	Growth rings very large and distinct (1,6mm)	Pinheiro manso ( <i>Pinus pinea</i> )
Forro Interior BB4	Growth rings very narrow and distinct (0,6mm)	Pinheiro silvestre ( <i>Pinus sylvestris</i> )
Pinção	Growth rings indistinct	Pilriteiro ( <i>Crataegus monogyna</i> )



Identification of trees species from some timber remains. Excel produced from the Paleoecology Laboratory results from 1999. Image obtained during documental research conducted on MARL warehouse from DGPC, Loures, Lisboa



# Research undertaken by ForSEAdiscovery (February/March 2016)

- Contribute to a better understanding regarding the origin and species of timbers applied on the 16<sup>th</sup> century shipbuilding tradition in Portugal;
- A total of 19 timber fragments were recorded from sections 1.4, 1.5, 2.4 and 2.5;



Actual display of timber remains. This photography is a courtesy of Filipe Castro (2015), Loures, Lisboa

# Research undertaken by ForSEAdiscovery (February/March 2016)

- Our first step consisted of selecting a suitable number of ship timbers to observe “through the perspective of a dendrochronologist”;
- This consisted of observing the grain pattern, looking at the growing shape of timbers, analysing the tree rings, observing bifurcations in the process of tree growth, considering the fast or slow development of trees and attempting to identify its species;



The 19 record sheets produced by Professor Nigel Nayling and ESRr07 António Santos, February 2016, Loures, Lisboa



Timber fragment identified as “Bastarda”, photo code A-CDS01-17-02-16-NN-AS-P-BASTARDA(1)



# Research undertaken by ForSEAdiscovery (February/March 2016)

- Regarding the timber tags, we underline two timbers (record number 12 and 13) which were unable to be identified, due to lost or unreadable labels (the paper labels placed on each timber in 1995 were still the same ones we found during the research conducted in February 2016);
- We attempted to correlate all fragments through the original site photos taken during the ship`s discovery. However, those pictures were taken in a dark environment using flash photography, brightening the label and rendering its code unreadable for a great majority of the pictures;



Timber fragment identified as “plank fragment”, photo code A-CDS01-12-02-16-NN-AS-P-PF(1)



Timber fragment identified as “unlabeled plank fragment”, photo code A-CDS01-12-02-16-NN-AS-P-UPF(1)

# Research undertaken by ForSEAdiscovery (February/March 2016)

- In terms of type of cut, we concluded that twelve fragments – record number 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 19 – were tangential cuts, five remains were whole pieces – record number 1, 2, 16, 17 and 18 – and two were quartered – record number 5 and 6;
- Then, we proceeded through the identification of which ship part (component) each timber was. 10 of those were successfully identified – record number 1, 2, 3, 5, 6, 9, 14, 15, 16, 17, 18 and 19 while nine timber remains are still doubtful – record number 4, 7, 8, 10, 11, 12 and 13.



Timber fragment identified as “F1/01/S?”, photo code A-CDS01-10-02-16-NN-AS-P-F101S(1)



Timber fragment identified as “F1/04/I?”, photo code A-CDS01-12-02-16-NN-AS-P-F104I(1)



# Research undertaken by ForSEAdiscovery (February/March 2016)

- It was possible to calculate the ARW (average ring width) of ten remains – record number 1, 2, 7, 9, 10, 12, 13, 15, 16 and 17;
- One remain – record number 6 – was considered as uncountable;
- Concerning the timber species of analysed artefacts, we identified 16 samples as hardwood (*Quercus*) – record number 1, 2, 3, 4, 5, 6, 7, 8, 12, 13, 14, 15, 16, 17, 18 and 19 - and three, as softwoods (*Pinus?* species) – record number 9, 10 and 11;



Timber fragment identified as “F1/E3/S? B N”, photo code A-CDS01-12-02-16-NN-AS-P-F1E3SBN(1)



Timber fragment identified as “TC/07”, photo code A-CDS01-12-02-16-NN-AS-P-TC07(1)

# Research undertaken by ForSEAdiscovery (February/March 2016)

- Five timber remains were considered suitable for sampling – record number 7, 9, 10, 16 and 19;
- Twelve were discharged from sampling – record number 1, 2, 3, 4, 5, 6, 8, 12, 13, 14, 15 and 17;
- While two remain questionable – record number 11 and 18;
- One fragment – record number 16 – might be suitable for more than one sample, on the top right corner of this slide;



Timber fragment identified as “BREASTHOOK”, photo code A-CDS01-17-02-16-NN-AS-P-BUÇARDA-BREASTHOOK(1)



Timber fragment identified as “BC 78”, photo code A-CDS01-17-02-16-NN-AS-P-C78(1)



# Research undertaken by ForSEAdiscovery (February/March 2016)

Number of Record	Site Code	Date of Record	Timber Tag (Possible Identification)	Ship Component	Timber Species	Photography	Suitable for Sampling	Length	Width	Thickness	ARW (Average Ring Width)	Comments	Type of conversion
1	CDS 01	10/02/2016	K 3	Keel	Quercus	No	No		180 mm	225 mm	145/27 = 5,27mm		Whole
2	CDS 01	10/02/2016	BT 1	Buttress	Quercus	No	No		190 mm	190 mm	130/35 = 3,7 mm		Whole
3	CDS 01	10/02/2016	TC/05	Hull Plank	Quercus	No	No	1167 mm	210 mm	75 mm		Rings unclear, knotty	Tangential
4	CDS 01	10/02/2016	TC/05/Z/6	Hull Plank?	Quercus	No	No	250 mm	90 mm	55 mm		Fast grown	Tangential
5	CDS 01	10/02/2016	C 145/0	Floor	Quercus	No	No					Fast grown H then slower sapwood and possible Be	Quartered
6	CDS 01	10/02/2016	P 102/0	Framing Timber	Quercus	No	No				Uncountable	H uncountable +10s+Be	Quartered
7	CDS 01	10/02/2016	F1/01/Z N"	Ceiling?	Quercus	No	Yes	1300 mm	230 mm	55 mm	55/40 = 1,4 mm	knotty	Tangential
8	CDS 01	10/02/2016	F1/01/S?	Ceiling?	Quercus	Yes (4)	No	2255 mm	280 mm	45 mm		Medium growth rate	Tangential
9	CDS 01	10/02/2016	F1/05/0?	Ceiling Plank	Softwood	No	Yes	1320 mm	155 mm	20 mm	65/50 = 1,3 mm		Tangential
10	CDS 01	12/02/2016	F1/E5	Ceiling?	Softwood	No	Yes	1570 mm	145 +	20 mm	100/48 = 2,22 mm		Tangential
11	CDS 01	12/02/2016	F1/04/1?	Ceiling?	Softwood	Yes (2)	?	810 mm	135 mm	30 mm			Tangential
12	CDS 01	12/02/2016	Unlabeled Plank Fragment with heel?	Ceiling?	Quercus	Yes (6)	No	2010 mm	305 mm	50 mm	110/25 = 4,3 mm	25H +H/S? Sapwood lost	Tangential
13	CDS 01	12/02/2016	Plank Fragment with charred face	Hull Plank fragment?	Quercus	Yes (2)	No	400 mm	145 +	80 mm	145/25 = 5,8 mm		Tangential
14	CDS 01	12/02/2016	TC/07	Hull Plank	Quercus	Yes (5)	No	1230 mm	260 mm	70 mm		Rings unclear, knotty	Tangential
15	CDS 01	12/02/2016	F1/E3/S? B N	Ceiling Plank?	Quercus	Yes (5)	No	2340 mm	205 mm	35 mm	35/5 = 7 mm		Tangential
16	CDS 01	17/02/2016	Buçarda	Breast Hook	Quercus	Yes (4)	Yes (in 3 different areas)	1,7 m	0,45 m	0,23 m	C 40H +H/S	Slow grown, sapwood lost?	Whole
17	CDS 01	17/02/2016	Bastarda	Stanchion?	Quercus	Yes (3)	No	1020 mm	160 mm	170 mm	48/11 = 4,3 mm	Sapwood lost	Whole
18	CDS 01	17/02/2016	C 78	Floor	Quercus	Yes (3)	?					Med-fast growth rate. H/S over much of inboard face. Sapwood and B lost	Whole
19	CDS 01		TC/06/B (B)	Hull Plank	Quercus	No	Yes	2330 mm	270 mm	80 mm		Slow grown with >20 sapwood rings	Tangential

More to come...

# What does this mean?

- We faced some difficulties and challenges looking at old material that clearly lacked the proper care, degraded by time and environmental conditions, access very limited as the keel timbers located on the top shelf, facility very distant from Lisbon (30 min by car) with no public transportation to its location...;
- Which timbers are which, comparing old pictures and old paper tags with the new coded timber drawings on Paulo Jorge Rodrigues thesis;
- Questionable identification of *Quercus* species, specially the *faginea*, as stated on the 2011 IJNA article. Yes there is oak, but which species?
- So far, most of the frames are made of relatively fast grown young oak trees;
- Many of the framing timbers originally had a considerable amount of sapwood and bark edge, now lost due to the adopted preservation conditions;
- Most of frame drawings do not include a cross section perspective showing the conversion which often retains sapwood and bark edge;
- According with the timber identification report, we are not observing the adequate species mentioned in the shipbuilding treatises. Do the framing timbers fulfill the shipbuilding standards since we evidence traces of sapwood and bark edge on several timbers applied on this ship?
- According with the treatises, does the usage of other species and presence of sapwood with bark edge suggest a conflict between the capacity of supply and demand of timber?



# Where do we go from here?

- To selectively sample some of the already observed timber fragments;
- To observe other timber remains and decide if they are worth sampling as well;
- Potentially display the “*Cais do Sodré*” remains as suggested by the curators?
  - Would this offer us an opportunity during the shifting of timbers to continue the recording process and sampling selection?
- Would it be worth to develop a similar programme of timber assessment regarding other ship remains located in this warehouse (MARL, Loures) also dated as 16th century or early 17th (Pepperwreck, Aveiro A, ...)?

Thank You for your attention.  
Feel free to raise any questions.

