FORSEADISCOVERY DATABASE

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ForSEAdiscovery is an interdisciplinary project which involves researchers from such different disciplines as underwater archaeology, history and wood sciences. The main research questions of the project address whether Iberian forest resources could sustain increasing demands for timber during the early modern era, the extent to which a scarcity of raw materials encouraged the technological changes that occurred in shipbuilding in 16th-century Iberia, and how demand for timber led to sustainable changes in forestry practice in the Iberian peninsula. The ForSEAdiscovery database is a tool that contributes to answering these questions.

The ForSEAdiscovery database compiles information from written sources and other databases (e.g. Associated Participant Nr, Filipe Castro, Miguel San Claudio). It collects data on wrecks documented from archival and bibliographical sources; known or suspected Iberian shipwrecks where substantial timber hull remains survive and could be subjected to survey; key construction features diagnostic of different shipbuilding traditions; dendrochronological sampling from shipwrecks, living trees and historical buildings; and dendro and geochemical information obtained from analysis. The database serves to search information and find patterns in early modern Iberian shipbuilding. Furthermore, it is the basis of a GIS platform, which can be used as a data integration engine and visualization tool for the analysis of different layers of information about the geographic location of shipwrecks and their main features.

The ForSEAdiscovery database is organized into tables, fields, and relationships between tables. A *table* is a collection of data pertaining to a subject, i.e. shipwrecks or timber samples. Each table contains several fields. A *field* is the basic unit of data in a record, which is to say it is contains a specific category of data. For instance, a table named "Shipwrecks" might contain fields such as "Built place," "Century of construction," and "Longitude" and "Latitude," among others that might hold information about the place and century – if known – in which the ship had been built, and the geographic coordinates of shipwreck's location. A *relationship* provides access

to data between tables. Relationships between tables are created through *match fields*. For instance, imagine that we have two tables, one with data of shipwrecks and another with data of timber samples taken from shipwrecks. In this case, we might need a relationship that allows us to identify, in a table of timber samples, the shipwreck from which the sample was taken; thus we require a match field, i.e. a field that holds an ID code, which must be both in the table of shipwrecks and in the table of timber samples to connect the two tables.

1. An overview of the ForSEAdiscovery database

The following image shows an overview of the ForSEAdiscovery database, including all tables and their relationships.



2. Main tables

The most important tables of the ForSEAdiscovery database are *Shipwrecks_History*, *Shipwrecks_Archaeology*, and *Analysis_Results*.

<u>A. Shipwrecks_History</u>. Registers of these tables collect historical data of shipwrecks. *Shipwrecks_History* holds information about the location, chronological data, name of officials, cause and circumstances of the wreck, sources, and bibliography. This table collects data of shipwrecks, but unlike the following table – *Shipwrecks_Archaeology*, which collects data taken from archaeological sites – *Shipwrecks_History* collects information from archives and other historical sources.

Shipwrecks_History are divided in three tables: "HShipwrecks", "Source" and "HShipw_source". The first table "HShipwrecks" contains basic identification data, location, chronological data, additional information, imagery and attached document

Fields of this table can be organized into 5 different types: (i) basic information (*ID_HShipwreck, Nameship, Alias, TypeVessel, Fleet, GeneralCaptain, Captain, Master*); (ii) location (*Latitude, Longitude, Place, Route*); (iii) chronological data (*Year, Month, Day*); (iv) additional information (*Incidence, Cause, DeathNumbers, Tonnage, Convoy*); and (v) others (*Web, Comment, Image*).

Name of field	Type of data	Description	
ID_HShipwreck	Text	This is the primary key, which is to say it is a	
		unique identifier that allows connecting this table	
		with others tables of the model. The	
		identification code is made by letter "S" and 4	
		digits (D) with an ascending order in the list (i.e.	
		SDDDD).	
Year	Number	Year of the wreck or loss of the ship. 4 digits.	
Month	Number	Month of the wreck or loss of the ship. 1 or 2	
		digits.	
Day	Number	Day of the wreck or loss of the ship. 1 or 2 digits.	
NameShip	Text	Name of the ship.	
Alias	Text	Nickname of the ship.	
TypeVessel	Text	Type of vessel, be it a <i>nao</i> , or a galleon, or	
		patache, etc.	
Fleet	Text	Name of the fleet, be it Tierra Firme, Nueva	
		<i>España</i> , etc.	
GeneralCaptain	Text	Name of the General Captain.	

Table HShipwrecks:

Captain	Text	Name of the Captain.	
Master	Text	Name of the Master.	
Convoy	Text	Position of the ship, in case it was part of a	
		convoy, i. e. Capitana, Almiranta, Gobierno or	
		null.	
Incidence	Text	Incidence that suffered the ship, i. e. whether it	
		wrecked, got lost or got captured.	
Cause	Text	Precise cause for the wreck or loss of the ship.	
DeathsNumber	Text	Number of victims.	
Tonnage	Number	Tons as expressed in sources.	
Longitude	Number	Geographic coordinates (longitude).	
Latitude	Number	Geographic coordinates (latitude).	
Place	Text	Location of the shipwreck.	
Route	Text	Route that covered the ship.	
Web	Hyperlink	Web according to Uniform Resource Locator	
		(URL).	
Comment	Text	Observations, additional information and details.	
Image1	OLE object	Image of the ship in bmp or jpg.	

The second table *"Source"* is referred to the documentary information, where we have referenced the primary sources and bibliography relate to shipwrecks (Table 2).

Table Source:

Id_Source	Numeric	This is the primary key, which is to say it is a
		unique identifier that allows connecting this table
		with others tables of the model.
Source	Text	Source of information. Each field from <i>Source 1</i>
		to Source 17 refers to a different document.
		Source 1 refers to a signature of documents from
		the Archivo General de Indias (AGI); Source 2 to
		Source 17 hold references to bibliography.

And the third table, "*HShipw_source*" relates the first table to the second table, through both primary keys, so by this way, we can know where a shipwreck is collected, i.e. it can be cited by different sources, or vice versa, what is the number of shipwrecks collected in a source.

Table *HShipw_source*:

Id_HShipw_source	Numeric	The primary key, which is to say it is a unique		
		identifier that allows connecting this table with		
		others tables of the model.		
Id_HShipwreck	Text	The foreign key (belong to the table		
-		"HShipwreck")		
Id_Source	Numeric	The foreign key (belong to the table "Source")		

Details	Text	Details corresponds the information of the
		Archives of General of Indies (Signature, i.e.
		book (<i>libro</i>), bundle (<i>legajo</i>), or number
		(numero) that you are seeking to locate the
		document.)

<u>B.</u> *Shipwrecks_Archaeology*. Registers of *Shipwrecks_Archaeology* hold archaeological data of shipwrecks and shipwreck sites, along with known bibliography if applicable. Fields of this table are the following.

Table Shipwrecks_Archaeology

Name of field	Type of	Description
	data	
Id_AShipwreck	Text	This is the primary key, which is to say it is a unique identifier that allows connecting this table with others tables of the model. The identification code is made by letter A (meaning <i>Archaeology</i>) plus three
		letters from the ship or the site's name plus a number of two digits, which distinguishes ships that have the same name (i.e., A- <i>LLLNN</i>).
Shipwreck_or_site	Text	Name of sunken ship or if it is unknown, name of the archaeological site.
Id_HShipwreck	Text	This match field holds the ID code of registers in the <i>Shipwrecks_History</i> table and allows connecting the <i>Shipwrecks_History</i> table and the <i>Shipwrecks_History</i> table and the <i>Shipwrecks_Archaeology</i> table. By connecting them, the searcher can identify shipwrecks documented both in written and archaeological sources. The identification code is made by letter "S" and 4 digits with an ascending order in the list (i.e., <i>SNNN</i>)
Century_construction	Text	Century of ship's construction.
Iberian_Construction	Text	Information about whether the ship was Iberian or not. Answers can be an exact place, a possible place or unknown.
Construction_terminus_post_quem	Text	Year after which the ship was constructed (<i>post quem</i>).
Construction_terminus_ante_quem	Text	Year before which the ship was

		constructed (ante quem).
Built_place	Text	Place where the ship was built, if
		known.
Wreck_terminus_post_quem	Text	Year after which wrecking event
		occurred (<i>post quem</i>).
Wreck_terminus_ante_quem	Text	Year before which wrecking event
		occurred (ante quem).
Dated	Text	Method through which a date was
		acquired.
Notes	Text	Useful info on the wreck.
Timber_remains	Text	Extent of timber remains and the
		part of the vessel they represent, if
		known.
Wood_sp	Text	Genus or species of tree from which
		ship timbers were converted, if
		known.
Status	Text	Status of archeological site, such as
		whether or not it is protected, or
		whether or not it has been the
		subject of archaeological survey or
		excavation.
Permitting_Agency	Text	Name of agency to provide
		permissions for archaeological work
		on the site.
Publications	Text	Records of whether publications are
		available on the site.
Bibliography	Text	Bibliographic references of any
		relevant publications.
History	Text	History of the site and/or wreck,
		including who and when it has been
		surveyed or excavated.
Longitude	Number	Geographic coordinates (longitude).
Latitude	Number	Geographic coordinates (latitude).
Route	Text	Maritime route, if known.
Lost_Country	Text	Country where the ship wrecked.
Lost_Place	Text	Geographical location where the
		ship wrecked
Depth_m	Text	Depth of site in metres.
Found	Text	Date and conditions under which the
		wreck was found.
Ballast_Pile	Text	Remaining ballast.
Туре	Text	Type of ship.
Tonnage	Text	Estimated tonnage

As outlined below, the *Shipwrecks_Archaeology* table has a one-to-many relationship with the tables *Type*, *Architectural_Information*, *Dimensions* and

Additional_Information, which collect information about the main features of each shipwreck.

<u>C. Analysis_results</u>. Registers of this table collect data of the analysis on wood and timber samples. The table holds information about dendro analysis, isotope analysis, organic analysis, DNA analysis, FTIR analysis, Py-GC/MS analysis, and anatomical markers analysis.

Table *Analysis_results*

Name of field	Type of data	Description

3. Secondary tables and relationships

Secondary tables depend on - i.e. they are connected through a one-to-many relationship with - main tables.

<u>A. Secondary tables connected to Shipwrecks Archaeology table</u>. Secondary tables dependent on the Shipwrecks_Archaeology table are, on the one hand, tables that hold information about features of shipwrecks – Type, Architectural_information, Dimensions and Additional_information –, and, on the other, tables with data produced as a result of archeological work – Dive_log and Visual_registers.

A1. Tables on the features of shipwrecks.

<u>A1.1. *Type*</u>. This table collects more detailed information about the shipwreck that help conclude its type. Fields of this table are the following.

Table *Type*

Name of field	Type of	Description
	data	_
Id_Type	AutoNumber	This is the primary key, which is to say it is the unique identifier of each register. The identification code is an autonumber.
Id_AShipwreck	Text	This is the identification (ID) code of the shipwreck. Thus, this is the match field that connects the <i>Type</i> table to the <i>Shipwrecks_Archaeology</i> table. The ID code is made by letter A (meaning <i>Archaeology</i>) plus three letters from the ship or the site's name plus a number of two digits, which distinguishes ships that have the same name (i.e., <i>A-LLLNN</i>).
No_Decks	Text	Number of shipwreck's decks.
No_Masts	Text	Number of shipwreck's masts.
Length_overall_m	Text	Overall length of the shipwreck in meters.
Keel_length_m	Text	Keel length of the shipwreck in meters.
Length_on_deck_m	Text	Length of shipwreck's deck in meters.
Max_Beam_m	Text	
Flat_floor_m	Text	

<u>A1.2. Architectural_information</u>. This table collects information about the main architectural features of the shipwreck. Several fields in the table refer to scantlings, or measurements of ship timbers, which if known, contribute to defining trends in ship construction that could be used in the identification or characterization of the shipwreck. Fields of this table are the following.

Table Architectural_information

Name of field	Type of data	Description
Id_Architectural	AutoNumber	This is the primary key, which is to say it is the

		unique identifier of each register. The identification code is made by an autonumber.
Id_AShipwreck	Text	This is the identification code of the shipwreck. Thus, this is the match field that connects the <i>Architectural_information</i> table to the <i>Shipwrecks_Archaeology</i> table. The ID code is made by letter A (meaning <i>Archaeology</i>) plus three letters from the ship or the site's name plus a number of two digits, which distinguishes ships that have the same name (i.e., <i>A-LLLNN</i>).
Keel_scarves	Text	Type of carpentry join between keel sections.
Stern_Knee_TO	Text	Description of stern knees.
Stern_deadwood_knee_TO	Text	Description of deadwood at stern knees.
Bow_Knee_TO	Text	Description of bow knees.
Floors_scarved_to_futtocks	Text	Method of joining floor timbers to futtocks.
Planking	Text	Type of planking (carvel or clinker/lapstrake).
Fastening	Text	Type and material of fastenings used (e.g., iron bolts, copper pins, treenails).
Keelson	Text	Description of keelson (TO)
Maststep	Text	Description of maststep (expanded keelson / sister keelsons) (TO)
Maststep_butresses_and_bottom_stringers	Text	Description of maststep butresses and bottom stringers (TO)

<u>A1.3. *Dimensions*</u>. This table collects information about shipwreck timbers' dimensions. Fields in the table refer to scantlings, or measurements of ship timbers, which if known, contribute to defining trends in ship construction that could be used in

the identification or characterization of the shipwreck. Fields of this table are the following.

Table Dimensions

Name of field	Type of data	Description
Id Dimensions	AutoNumber	This is the primary key,
		which is to say it is the
		unique identifier of each
		register. The identification
		code is an autonumber.
Id AShipwreck	Text	This is the identification
_ 1		code of the shipwreck.
		Thus, this is the match field
		that connects the
		Dimensions table to the
		Shipwrecks_Archaeology
		table. The ID code is made
		by letter A (meaning
		Archaeology) plus three
		letters from the ship or the
		site's name plus a number
		of two digits, which
		distinguishes ships that
		have the same name (i.e.,
		A-LLLNN).
Keel_Sided_mm	Text	Side to side thickness of the
		keel.
Keel_molded_mm	Text	Varying thickness of the
		keel.
Keelson_Sided_mm	Text	Side to side thickness of the
		keelson.
Keelson_molded_mm	Text	Varying thickness of the
		keelson.
Maststep	Text	Dimensions of the
		maststep.
Sternpost_m	Text	Height of the sternpost.
Sternpost_Sided_mm	Text	Side to side thickness of the
		sternpost.
Sternpost_molded_mm	Text	Varying thickness of the
		sternpost.
Stem_Post	Text	Height of the stem post.
Stem_post_sided_mm	Text	Side to side thickness of the
		stem post.
Stem_post_molded_mm	Text	Varying thickness of the
		stem post.
No_Frames	Text	Number of frames.
Floors_sided_mm	Text	Side to side thickness of the

		floor timbers.
Floors_molded_mm	Text	Varying thickness of the
		floor timbers.
Room_and_Space_mm	Text	Distance between
		corresponding ribs on
		starboard and port sides.
1st_Futtocks_sided_mm	Text	Side to side thickness of
		first futtocks.
1st_Futtocks_molded_mm	Text	Varying thickness of first
		futtocks.
Y-Frames_mm	Text	Length of the y-frames.
Planking_width_mm	Text	Width of planks.
Stringers_width_mm	Text	Width of stringers.
Wales_width_mm	Text	Width of wales.
Ceiling_width_mm	Text	Width of ceiling planks.
Stanchions_width_mm	Text	Width or diameter of
		stanchions.
Beams_width_mm	Text	Width of beams.
Scarves	Text	Type of scarves or joins.
Tool_marks	Text	Any tool marks seen on
		timbers.
Caulking_or_Sheathing	Text	Type of caulking or
		sheathing used.

<u>A1.4. Additional_information</u>. This table collects information about shipwrecks' dimensions. Fields of this table are the following.

Table Additional_information.

Name of field	Type of	Description
	data	_
Id_Additional	AutoNumber	This is the primary key,
		which is to say it is the
		unique identifier of each
		register. The identification
		code is made by an
		autonumber.
Id_AShipwreck	Text	This is the identification
		code of the shipwreck.
		Thus, this is the match field
		that connects the
		Additional_information
		table to the
		Shipwrecks_Archaeology
		table. The ID code is made
		by letter A (meaning
		Archaeology) plus three
		letters from the ship or the

		site's name plus a number of two digits, which distinguishes ships that have the same name (i.e., A-LLLNN).
Rudder	Text	Remains of the rudder and
		type.
Artillery	Text	Remains of artillery and
		types.
Anchors	Text	Remains of the anchors and
		types.
Rigging	Text	Remains of rigging.
Artifacts	Text	Remains of other artifacts.

A2. Tables on data produced as a result of archeological work.

<u>A2.1. *Dive_log*</u>. This table collects information about each underwater dive carried out in ForSEADiscovery's archaeological campaigns (2014-2018). Fields of this table are the following.

Table Dive_	log
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Name of field	Type of	Description
	data	
Id_Dive	Text	This is the primary key. The
		identification code is made
		by the id code of the
		shipwreck plus date of dive
		plus number of dive on that
		day (i.e. A-LLLNN-DD-M-
		YYYY-N).
Id_AShipwreck	Text	This is the identification
		code of the shipwreck.
		Thus, this is the match field
		that connects the <i>Dive_log</i>
		table to the
		Shipwrecks_Archaeology
		table. The ID code is made
		by letter A (meaning
		Archaeology) plus three
		letters from the ship or the
		site's name plus a number
		of two digits, which
		distinguishes ships that
		have the same name (i.e.,
		A-LLLNN).

Date_Dive	Date	Date of dive
		(DD/MM/YYYY).
Diver_name	Text	Name of divers
Support_vessel	Text	Name of the vessel used to
		transport divers to and from
		the site.
Deco_tables	Text	The decompression tables
		used to plan the dive.
Breathing_mixture	Text	Mixture of gasses used
		during the dive.
Left_surface	Number	Time in which divers left
		surface. Four digits – the
		two first digits indicate the
		hour, and the two second
		digits indicate the minute.
Left_bottom	Number	Time in which divers left
		bottom. Four digits – the
		two first digits indicate the
		hour, and the two second
		digits indicate the minute.
Arrived_surface	Number	Time in which divers
		arrived at surface. Four
		digits – the two first digits
		indicate the hour, and the
		two second digits indicate
		the minute.
Bottom_time	Number	Time which divers spent
		diving in minutes – one or
		two digits.
Max_depth	Number	Maximum depth in meters –
*		one or two digits.
Visuals	Text	Whether divers took visuals
		or not.
Samples_taken	Text	Whether divers took
		samples or not.
Work_description	Text	Description of work.
Problems Description	Text	Any problems encountered
_ 1		that may have hindered the
		progression of work.

<u>A2.2. Visual_registers</u>. This table hold data on the visuals, be they plans/maps, photography, videos or drawings, made in ForSEADiscovery's archaeological campaigns (2014-2018). Fields of this table are the following.

Table Visual_registers.

Name of field	Type of	Description
	data	
Id_Visual	Text	This is the primary key. The identification code is made by the id code of the shipwreck plus date in which the visual was taken or made plus initials of person in charge plus initial of visual's type (i.e. A- <i>LLLNN-DD-M-YYYY-LL-L</i>)
Туре	Text	Type of visual – plan/map, photograph, video or drawing.
Id_AShipwreck	Text	This is the identification code of the shipwreck. Thus, this is the match field that connects the <i>Visuals_registers</i> table to the <i>Shipwrecks_Archaeology</i> table. The ID code is made by letter A (meaning <i>Archaeology</i>) plus three letters from the ship or the site's name plus a number of two digits, which distinguishes ships that have the same name (i.e., <i>A-LLLNN</i>).
Id_Sample	Text	Identification code of sample/samples. The identification code is made by the ID code of the shipwreck plus number of tree digits plus first letter of material (W for wood, C for ceramics, M for metals, and so forth) plus number of artefact's sample (i.e. A- <i>LLLNN-NNNL-NNNS</i>). (see <i>Id_Sample</i> in table <i>Samples_Shipwrecks</i>

		below).
Date	Date	Date (<i>DD/MM/YYYY</i>).
Made_by	Text	Name of registrar (surname plus name).
Description	Text	Description of visual.

<u>B. Secondary tables connected to Analysis results table</u>. Secondary tables dependent on the Analysis_results table are Samples_Trees, Samples_Shipwrecks and Samples_Buildings. Analysis_results_has a one-to-many relationship with these thee tables.

<u>B1. Samples Trees</u>. This table collects data of each sample taken from living trees.

Table Samples_Trees

Name of field	Type of data	Description

<u>B2. Samples Shipwrecks</u>. This table collects data of timber samples taken from shipwrecks, so that it is connected both to *Analysis_results* and *Shipwrecks_Archaeology*.

Table Samples_Shipwrecks

Name of field	Type of data	Description
Id_Sample	Text	This is the primary key, which identifies the sample. The identification code is made by the ID code of the shipwreck plus number of tree digits plus first letter of material (W

		for wood, C for ceramics,
		M for metals, and so forth)
		plus number in three digits
		of artefact's sample (i.e. A-
		LLLNN-NNNL-NNNS).
Id_AShipwreck	Text	This is de identification
		code of the shipwreck.
		Thus, this is the match field
		that connects the
		Samples_Shipwrecks table
		to the
		Shipwrecks Archaeology
		table. The ID code is made
		by letter A (meaning
		Archaeology) plus three
		letters from the ship or the
		site's name plus a number
		of two digits which
		distinguishes shins that
		have the same name (i.e.
		Λ <i>LLLNN</i>
I.I. A while at	Tout	A-LLLIVIV).
Ia_Artijact	Text	This code identifies the
		artifact from which samples
		are taken. It is made by the
		ID code of the shipwreck
		plus the three-digit number
		and the first letter of
		material (W for wood, C
		for ceramics, M for metals,
		and so forth) (i.e. A-
		LLLNN-NNNL)
Id_Sampler	Text	This field identifies the
		person who took the
		sample.
Id_Registrar	Text	This field identifies the
		registrar.
Id_Dive	Text	This field identifies the
_		dive during which the
		sample was taken. It is
		made by the ID code of the
		shipwreck plus date of dive
		plus number of dive on that
		day (i.e. A-LLLNN-DD-M-
		YYYY-N). Thus, this is the
		match field that connects
		the Sample Shipwreeks
		table to the Dive log table
Id Viewal	Tayt	This field identifies the
ia_visuai	Text	rins field identifies the
		visuais, de it plan/map,
		photograph, video, or

		drawing, of the sample. The identification code is made by the ID code of the shipwreck plus date in which the visual was taken or made plus the initials of person who created the visual, plus a letter identifying visual's type (M for map or plan, P for photograph, V for visual, D for drawing) (i.e. A- <i>LLLNN-DD-M-YYYY-LL-</i> <i>L</i>). Thus, this is the match field that connects the <i>Sample_Shipwrecks</i> table to the <i>Visual_registers</i> table
Location_Current	Text	Current location of the sample.
Description	Memo	Brief description of the sample and the artifact from which it came.
Condition	Memo	Condition of the sample.
Type_element	Text	Type or part of the wreck from which the sample was taken – frame, plank, stanchion, beam, stringer, etc.
Conversion	Text	How the parent timber, or artifact, was converted from the original stem or branch of the tree.
Dimensions_length_cm	Number	Length of the sample in centimeters.
Dimensions_width_cm	Number	Width of the sample in centimeters.
Dimensions_depth_cm	Number	Depth of the sample in centimeters.
Storage	Text	Conditions of the sample in storage.
Dendro_analysis	Yes/No	This field identifies whether the sample has been subjected to a dendro analysis.
Isotope_analysis	Yes/No	This field identifies whether the sample has been subjected to an isotope analysis.
Organic_analysis	Yes/No	This field identifies

		whether the sample has
		been subjected to an
		organic analysis.
DNA_analysis	Yes/No	This field identifies
		whether the sample has
		been subjected to a DNA
		analysis.
FTIR_Analysis	Yes/No	This field identifies
		whether the sample has
		been subjected to a FTIR
		analysis.
Py-GC/MS_Analysis	Yes/No	This field identifies
		whether the sample has
		been subjected to a Py-
		GC/MS analysis.
Anatomical_Markers_analysis	Yes/No	This field identifies
		whether the sample has
		been subjected to
		anatomical markers
		analysis.

<u>B3. Samples_Buildings</u>. This table collects data of timber samples taken from historical buildings.

Table Samples_Buildings.

Name of field	Type of data	Description