Bibliographical research as part of the Technical Studies for Offshore Energy Potential (project PRR RP-C21-i07.01).

Report on work carried out in May and June 2024

Study requested by IPMA, I.P. as part of the Technical Studies for Offshore Energy Potential (project PRR RP-C21-i07.01)

Bibliographical research as part of the Technical Studies for Offshore Energy Potential (project PRR RP-C21-i07.01).

Report on work carried out in May and June 2024

José Bettencourt and Francisco Mendes

Version 2: July 2024 - delivered to ERA Arqueologia S.A. and IPMA – Instituto Português do Mar e da Atmosfera

Technical information

Scientific director: José Bettencourt (CHAM/FCSH)

Title: Bibliographical research as part of the Technical Studies for Offshore Energy Potential (project PRR RP-C21-i07.01).

Geographical and administrative location: Viana do Castelo, Leixões and Figueira da Foz, impacting waters off the districts of Coimbra, Aveiro, Porto, Braga and Viana do Castelo.

Framing entity: ERA Arqueologia S.A.

Contracting entity: IPMA.

Execution: NOVA Faculty of Social Sciences and Humanities / CHAM - Humanities Centre.

Archaeological team: José Bettencourt and Francisco Mendes.

Summary

This report shows the results of the historical and archaeological research carried out by CHAM - Centro de Humanidades (Humanities Centre) of the Faculty of Social Sciences and Humanities as part of the Technical Studies for Offshore Energy Potential (project PRR RP-C21-i07.01) off the coast of northern mainland Portugal.

To characterise the project's area of intervention and determine the zone's historical/archaeological potential and the consequent impact of the works to install the planned structures, we consulted a bibliography on the maritime history of each region and, in addition, compiled the occurrences inventoried by various entities in databases.

There are no known archaeological sites in the areas under study; however, the available data shows at least 220 events or obstacles with a potential archaeological record – 82 in the Viana do Castelo area, 60 in the Leixões area and 78 in the Figueira da Foz area. We recommend that geophysical studies in the project's areas of implementation and the characterisation and assessment of each target detected, including documented illustrations (photographs and/or drawings), precede any direct prospecting or installation operation.

Index

Index of figures

Index of tables

1. Introduction

This report shows the results of the bibliographical research undertaken as part of the project to install wind energy generation infrastructure off the Portuguese mainland coast. Included in the Technical Studies for Offshore Energy Potential (project PRR RP-C21-i07.01) requested by Instituto Português do Mar e da Atmosfera (Portuguese Institute for the Sea and Atmosphere) (IPMA), the work aims to identify potential archaeological sites and assess the possibility of their existence in the areas of the project's implementation off Viana do Castelo, Leixões and Figueira da Foz.

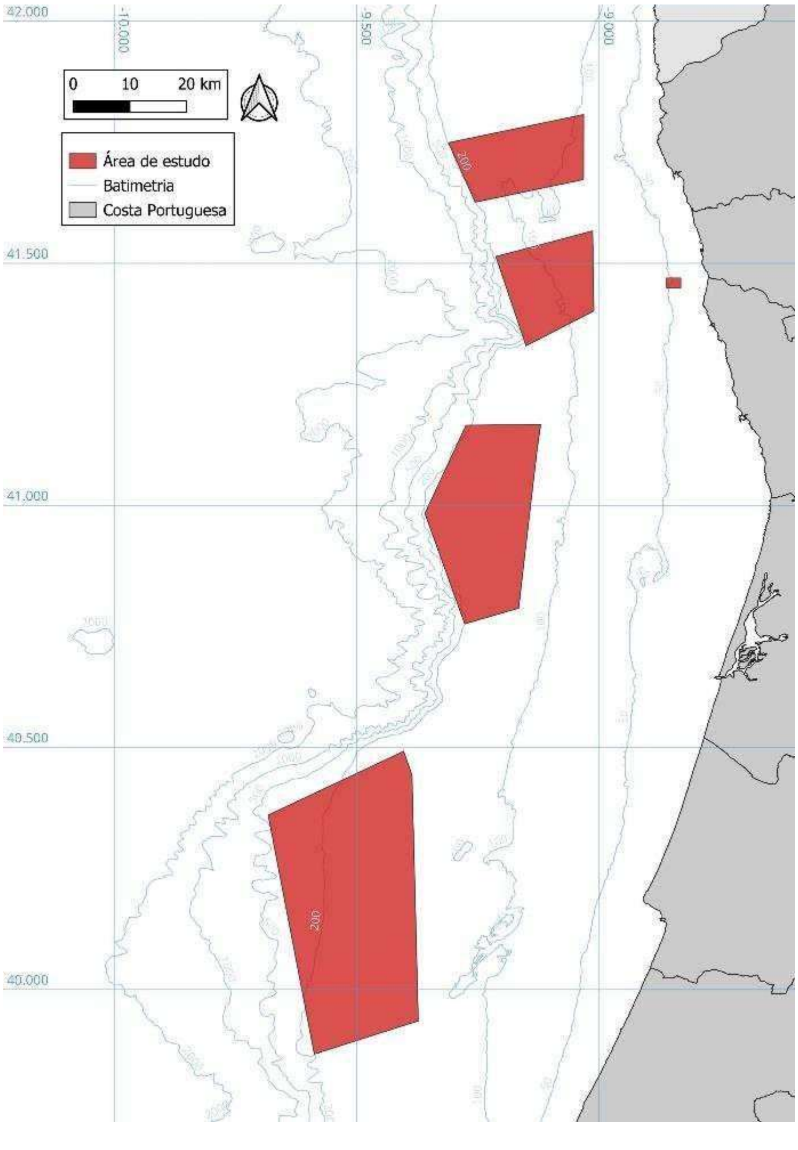

Figure 1 - Location of the three project areas, from north to south: Viana do Castelo North, Viana do Castelo South, Leixões and Figueira da Foz.

2. Objectives

This study seeks to identify the character, extent, quality and probable value of known or potential archaeological resources in the project area. It comprises a documentary assessment of written, graphic, photographic and electronic information. The aim is to gather the available information on the history and archaeological heritage that may exist, defining measures to advance knowledge and manage this heritage. Thus, we set out the following tasks:

- Historical and documentary survey of cultural heritage and characterisation of historic shipping routes in the project area;
- Characterising the reference situation and classifying the degree of impact of the project on the heritage;
- Defining minimisation measures;
- Producing a technical report.

3. Background

This work integrates a project by IPMA concerning the possible installation of renewable energy production centres off the Portuguese coast. The goal is to characterise the areas that could be directly affected by offshore wind energy generation infrastructures. These areas correspond to three distinct zones off the coasts of Viana do Castelo, Leixões, and Figueira da Foz, with a total area of 2575 km2. The study does not include corridors connecting to land, only potential areas for installing equipment off the Portuguese coast.

The study area off the coast of Viana do Castelo covers 606 km2 and, according to information from IPMA and based on EMODNET data, extends from depths of 73.0 to 560.1 metres. The study area off Leixões comprises 644 km2 and reaches depths between 120.0 and 324.4 metres. The southernmost study area, off Figueira de Foz, is the largest, with 1,325 km2 and ranging in depth from 124.4 to 530.4 metres.

4. Study methods

4.1 Objectives and tasks

The study of the underwater cultural heritage (UCH) aims to characterise the marine use of the project area and the occurrence of maritime accidents, allowing us to define their archaeological potential. The strategy to be adopted included the following tasks:

a) Defining the reference situation

The definition of the reference situation drew from a review of existing historical and archaeological data on the study area, partly from the files stored by Centro Nacional de Arqueologia Náutica e Subaquática (National Centre for Nautical and Underwater Archaeology) (CNANS), which oversees the UCH in Portugal. Since the project's affectation area is at a considerable distance from the coast and the vast majority of the documentation held by CNANS corresponds to a closer zone, and at depths where detecting remains occurs through diving, it was also necessary to compile information from the following alternative sources:

- The UK Admiralty database, which contains a shapefile named "Wrecks and Obstructions Shapefiles". Frequently updated, it is available online at the Marine Data Portal[1]. The information therein comes from various sources, including the nautical charts of the Portuguese Hydrographic Institute and the Lloyd's Register Foundation's annual inventory of accidents at sea.

- The Wrecksite.eu database, available online[2]. Currently the largest shipwreck database in the world, it contains information from the Hydrographic Institute's nautical charts and data provided by the seafaring community that contributes to its development.

- The national archaeological database Endovélico, which is available at Portal do Arqueólogo[3]. Sites or references to shipwrecks known to the supervisory authority are labelled with Código Nacional de Sítio (National Site Code) (CNS).

---

[1] Available at https://datahub.admiralty.co.uk/portal/apps/sites/?_gl=1*1s555x4*_ga*MTg3MjY1MDY3Mi4xNzE1MDc4MjYy*_ga_8PTW8GJL1R*MTcxODYzMjc0Ni4yLjAuMTcxODYzMjc0Ny4wLjAuMA..#/m arine-data-portal/items?tags=GlobalWrecks, consulted on 17 June 2024.
[2] Available at https://www.wrecksite.eu/, consulted on 17 June 2024.
[3] Available at https://arqueologia.patrimoniocultural.pt/, consulted on 21 June 2024.

- Plano de Situação do Ordenamento do Espaço Marítimo (Maritime Spatial Planning Situation Plan) (PSOEM) for Portugal's continental space and the extended continental plate.

- Data from the oral collection of information from active fishing vessel masters by Ana Catarina Bizarro Guerreiro in 2020 for her master's thesis (Guerreiro, 2020).

We also complemented this information by consulting Planos Diretores Municipais (Municipal Master Plans) (PDM) of all the municipalities in front of the project’s affectation areas, which revealed a total lack of submerged heritage management instruments of interest to this study. Bibliographical research was also carried out, mainly in history and archaeology works.

b) Assessment of archaeological potential

The data collected served as a basis for identifying and characterising possible archaeological sites and assessing the archaeological potential of the project area. Given the inherent imprecision of the data, all occurrences detected within 10 km of the project's direct impact areas were included (Figure 2). Also added were all occurrences from the Portuguese government's database (Endovélico/Portal do Arqueólogo) for which we have no coordinates but which are known to be off the coast directly adjacent to the affectation areas.

To best illustrate the archaeological potential of the study areas, we also compiled all the occurrences in the waters immediately adjacent to the project zones and in the corridor separating them from the land. These will be included in the final graphic outputs to give an idea of the density of obstructions throughout the region; however, given the work's objectives, they were not considered in the final study.

All the information gathered was systematised in a database with the fields described in Table 1 for each detected occurrence.

ID	The sequential number used for each occurrence and only for this study;
Zone	Location of the occurrence within the three affectation areas (Viana do Castelo, Leixões and Figueira da Foz)
Type	Type of occurrence (Shipwreck, Finding, Aircraft crash)
CNS	Código Nacional de Sítio (National Site Code) assigned by the relevant authority
Chronology	The period to which the detected remains correspond / the year of the occurrence
Latitude	WGS84 geographical coordinates, decimal degrees
Longitude	WGS84 geographical coordinates, decimal degrees
Designation	Name given to an archaeological site or name indicated by sources for known shipwrecks
Origin	Ship flag for shipwrecks and aircraft crashes
Hull material	Wood; Iron/Steel
Cargo	Material on board at the time of shipwreck
Max. dimensions (m)	The largest known size of the wreck
Heritage asset value	High; Medium; Low
Explosives	Probable presence of explosives – Yes or No
Notes	Details considered important for characterising a given occurrence
Source	Source of information

Table 1 – Descriptive fields of the occurrences inventoried during the study.

The value ‘Undetermined’ was inserted for all fields that were impossible to fill in, either because they did not apply to a particular occurrence or because there was no information.

This data accompanies the report as two tables in .txt format:

- areas_ocorrencias: all the data with a geographical position.

- endovelico_ocorrencias: historical information on shipwrecks without any geographical position.

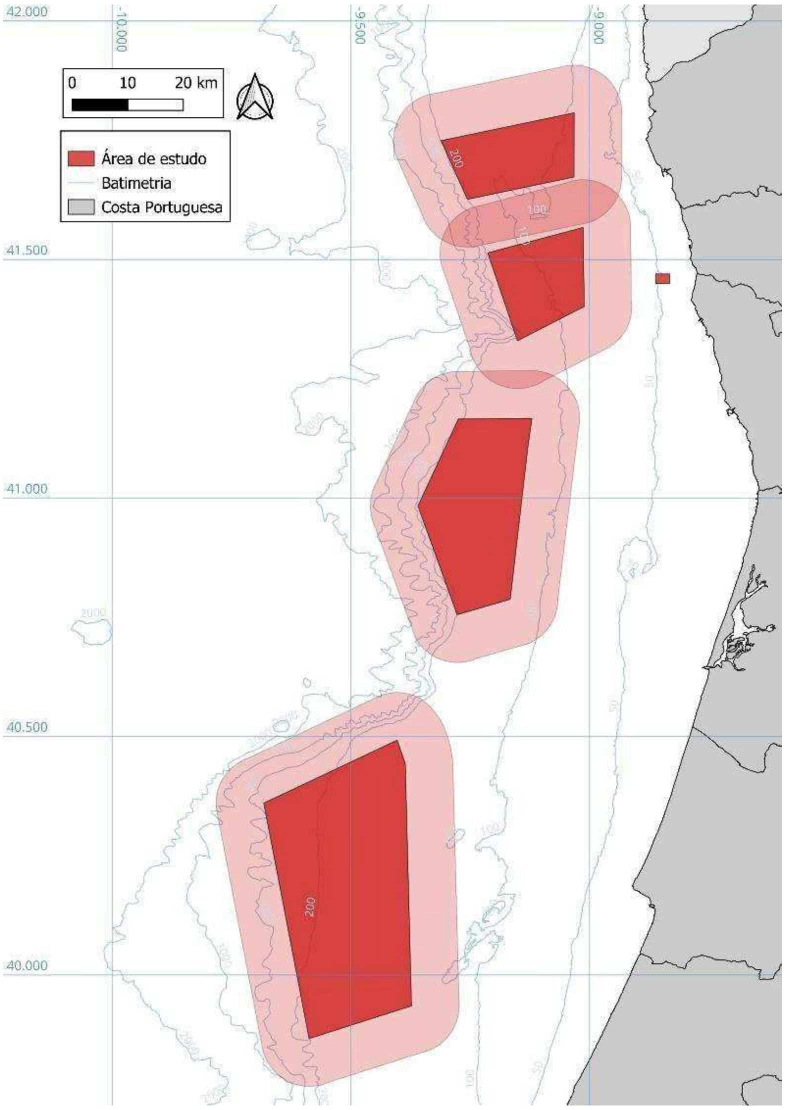

Figure 2 - Graphic representation of the study areas, extended with a 10-km buffer.

c) Impact assessment

The assessment of the project's potential impact on the archaeological heritage and the recommendations for mitigating it drew from the data obtained in defining the reference situation and evaluating the historical and archaeological potential.

At this stage of the work, we cannot concretely characterise the project's direct impact on the region's underwater cultural heritage. Therefore, for the moment, the assessment is limited to analysing the probability of finding particular occurrences within the affectation area.

For the same reasons, the heritage value attributed to each occurrence is merely a prediction in most cases, based for now on criteria such as the chronology of each wreck.

In addition, we considered the possibility of the presence of explosive material for one occurrence.

4.2 Team

Two people were responsible for collecting historical and archaeological data, systematising the data and producing the final report (Table 2). José Bettencourt, an archaeologist specialising in maritime archaeology with extensive experience in project management in Atlantic archaeological contexts, was in charge of the work.

Name	**Position**	**Function**	**Training/experience**
José Bettencourt	Archaeologist	Scientific Director, data processing and report elaboration	PhD in History, specialising in Archaeology. Researcher in charge of maritime archaeology projects at the Humanities Centre (CHAM).
Francisco Mendes	Archaeologist	data processing and report elaboration	Master's student in Archaeology and Researcher in Maritime Archaeology at the Humanities Centre (CHAM)

Table 2 - Team.

5. Results

5.1. Historical context of the project area

The study area susceptible to direct impacts by this project corresponds to 2575 km2 subdivided into three large zones (Viana do Castelo, Leixões and Figueira da Foz). Although located off the Portuguese mainland coast, their nearest point being 18 km away (roughly off Esposende), it is crucial to understand the port infrastructure in this territory to characterise the traffic that occurred there throughout history and understand the type of heritage generated by these maritime flows.

Thus, we will characterise the main port complexes along the coastline of c. 200 km, between the municipalities of Caminha and Pombal, through which many of the vessels that may be the source of existing cultural heritage circulated. For this analysis, we will consider the complexes directly in front of the project's affectation areas, from north to south.

5.1.1. Viana do Castelo North and Viana do Castelo South areas - Caminha, Viana do Castelo, Esposende and Vila do Conde harbour complexes

The first area of interest for this study – subdivided into two sectors, Viana do Castelo North and Viana do Castelo South – corresponds to a coastline of around 55 kilometres, where we highlight four port complexes that greatly influenced maritime flows in that region over time (Figure 3). The complexes described below formed an extended network around the port of Viana do Castelo, while the main ports of the maritime-fluvial networks that communicated with the interior were in Caminha, Esposende, and Vila do Conde (Blot, 2003).

The first complex includes the estuarine harbours of Caminha and Tuy, around the mouth of the River Minho, which then connected with an indeterminate number of river ports along both banks of the River Minho. This watercourse and the River Coura, a few kilometres upstream, made this region significant as a commercial and cultural hub since at least Protohistoric times (Blot, 2003). The various settlements at the mouth of the Minho show a sequence of occupation from the Late Bronze Age to the Modern Period, attested by the presence of artefacts from the south of the peninsula and the Mediterranean world, as well as salt pans dating back to the Iron Age (Lemos, 1982). In the Middle Ages, these harbours maintained links with other Portuguese harbours and others in Biscay and northern Europe (Barros, 2016). The gradual silting up of the estuary and the bed of the River Minho itself led to a decline of the Caminha port between the 16th and 18th centuries; it considerably lost its importance as a connection to the interior

(Blot, 2003), despite references to the river transport of materials such as salt and stone until the 1940s (Iglesias Almeida, 1988).

Another port complex in the region relevant to analysing maritime flows in the affectation area is Viana do Castelo. Located at the mouth of the River Lima, the port of Viana do Castelo served a series of smaller harbours along that watercourse, which was navigable as far as Ponte de Lima, where it connected with a significant Roman road (Blot, 2003). The River Lima was part of vast trade networks since (at least) Roman times, with amphorae from the 1st century and ceramic containers from the 16th century found side by side in the same contexts, attesting to its continued use (Blot, 2003). As in Caminha, salt production also dates back to the Late Iron Age, which, together with mining, were the principal goods transported by river in ancient times (Blot, 2003). During the Middle Ages, this port was a stopover for pilgrims who chose the sea route to St. James of Compostela (Marques, 1993).

The Viana do Castelo port came to the fore during the 16th century when it maintained trade relations with ports from Corsica to Flanders, to which goods such as salt, wine, and dried fish were exported and from which a wide variety of goods were imported, such as raw materials for shipbuilding, an essential industry for the region until the 20th century (Moreira, 1995).

The third maritime complex in this region forms around the Cávado River, especially in Esposende. As in other prominent harbours in Minho, its occupation dates back to the Late Bronze Age, with evidence of salt-making activity. During the Iron Age, archaeology in the region's settlements attests to maritime contacts with Mediterranean regions (Almeida, 1996). Commercial contacts with the outside world continued during the Roman period, when it was a central point for supplying relevant settlements upstream, such as Bracara Augusta (Alarcão, 1990[2]). In the Modern Period, and especially from the 16th century onwards, shipbuilding was decisive for developing the urban centre of Esposende, which mainly maintained links with Northern Europe. However, the rapid silting up of the bar from the first quarter of the 17th century and the development of the city of Porto would take away its prominence in the regional context (Blot, 2003).

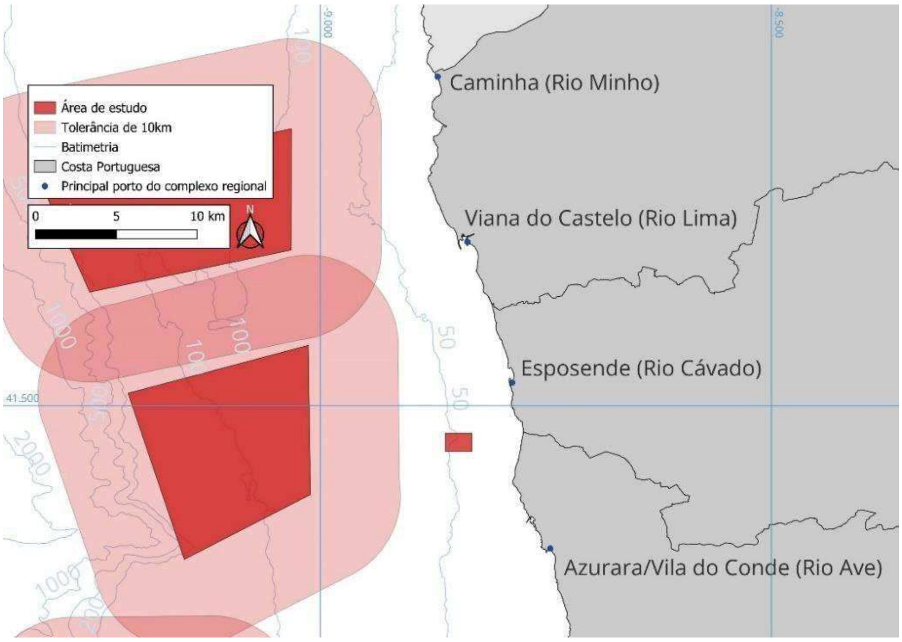

Figure 3 - Location of the main harbours in the region affected by the project off Viana do Castelo.

Finally, further south, we have the River Ave port complex, consisting of the Azurara and Vila do Conde settlements. During Antiquity, this was probably an alternative supply port for inland settlements, such as Bracara Augusta, since there are multiple navigable watercourses in the surrounding areas (Rio Este, Rio do Esteiro, Ribeira da Barranha, Rio Alto, etc.) as well as good connections to road networks. The region's pre-Roman settlements followed the same model as those along the north coast, taking advantage of maritime and river resources and choosing high-altitude areas to control the landscape (Blot, 2003). Throughout the Middle Ages, the economic activity consisted mainly of fishing and salt production; from the reign of King Ferdinand onwards, it evolved into a hub for the Kingdom's shipbuilding industry, partly due to the proximity of quality raw materials (Polónia, 1999). Shipbuilding became one of this complex's most emblematic industries, lasting on a large scale until the 19th century (Blot, 2003). Due to silting up, the harbour gradually lost its capacity to accommodate tall ships, something it became incapable of in the 18th century (Freitas, 1988).

5.1.2. Leixões Area - Porto port complex

Despite the coastal strip that corresponds to the second project area being similar in length to the one discussed above (c. 50km), its coastline is more challenging to navigate, with no coastal indentation serving as a shelter between Ria de Aveiro and the mouth of the River Douro (Ribeiro, 2021) (Figure 4). Like the other harbour complexes further north, the first settlements in the Porto area date from the Late Bronze Age. Set high up, these settlements had the advantages of defensibility conferred by the terrain and easy access to the coast. Evidence of contact with the Mediterranean region from the 5th century BC confirms this connection with the sea (Silva, 1995). In Roman times, there is continued occupation and urban settlement in the same spaces, with the urban centre expanding to the riverside area in the Late Roman period (Silva, 2000). On the left bank of the river, the situation is similar to the one in the north since the Iron Age. In Roman times, we see infrastructure for the production of fish preparations in the Matosinhos area, highlighting the importance of both banks of this complex for receiving and transporting goods (Silva, 2000).

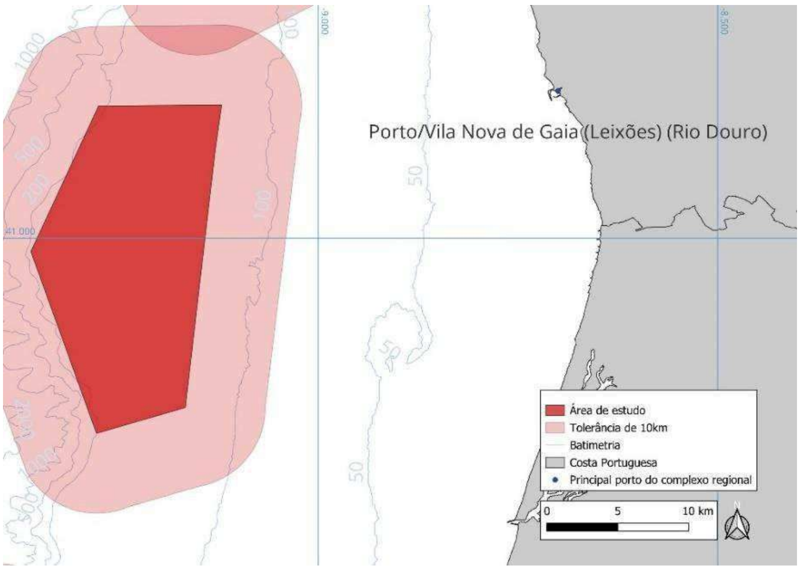

Figure 4 - Location of the main ports in the region that will be affected by the project off Leixões.

Some authors dispute the role of this complex as a seaport. The same regarding the level of articulation between the two shores during Antiquity; however, this became an undeniable reality from the Middle Ages onwards, with the Vila Nova de Gaia and Porto shores being equal sides of the same port (Blot, 2003). In the 13th century, salt production in the region took on significant proportions, and shipbuilding subsequently developed. In the 14th century, we already had docks providing river boats and, later on, infrastructures for supplying large ships. In addition, secondary docks appeared on the Vila Nova de Gaia side (Pereira, 1994). At this time, the secondary docks of this large complex had little docking infrastructure; nevertheless, they operated as ports all year round (Blot, 2003).

During the Modern Period, from the end of the 16th century onwards, Porto became a prominent commercial port and shipbuilding centre, with connections in both Europe and across the Atlantic (Barros, 2004).

5.1.3. Figueira da Foz area - Figueira da Foz port complex

The third zone, stretching along approximately 65km of coastline, includes a prominent port complex at the mouth of the River Mondego, today around the town of Figueira da Foz (Figure 5). The project's affectation area does not extend far enough south for us to add complexes such as those of the former Alfeizerão and Pederneira lagoons to our list.

Similar to what we see to the north, the first known settlements on the Mondego occupy positions overlooking the river and show vast contact networks as far as the Mediterranean. However, evidence of settlements here only dates back to the Iron Age (Matos, 1996). Of particular note is the fortified settlement of Santa Olaia (18th-17th century BC), where traces of Phoenician influence were associated with a possible prehistoric harbour structure (Wachsamnn et al., 2009). The loss of connection with the remote Mediterranean around the 4th century BC caused the decay of this and other settlements of Phoenician-Punic origin or influence along the Portuguese coast. However, during Antiquity, the Santa Olaia palaeoestuary was probably a Roman port, a theory put forward partly due to the lack of material evidence of port activity from this period in Figueira da Foz and Buarcos. These locations would later replace the Santa Olaia complex (Alarcão, 1990), which was probably the main port complex in the region until the Lower Middle Ages (Fernandes, 1987).

The substantial geomorphological changes that made Santa Olaia inoperable as a maritime port explain the transfer of this activity to Buarcos and later to Figueira da Foz. There, the existence of docks (Pereira, 1994) and a fortress built at the mouth of the River Mondego led to the considerable growth of the town centre until the 18th century. The frequent incursions by pirates meant that all the harbour activity occurred in this space, which was less vulnerable than alternatives such as Buarcos (Blot, 2003).

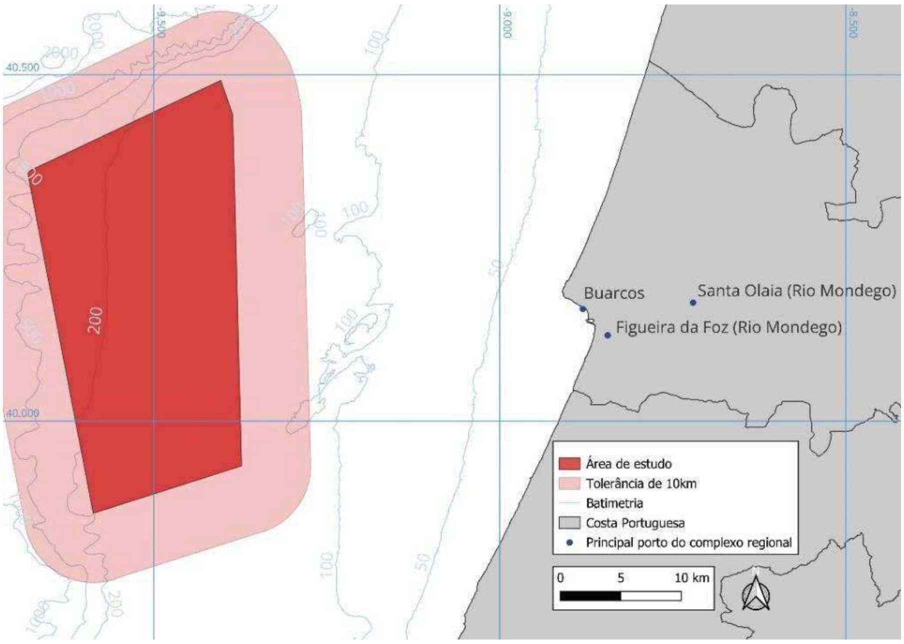

Figure 5 - Location of the main harbours in the region that will be affected by the project off Figueira da Foz.

5.2 Historical and archaeological data

There are no known archaeological sites in the project areas. However, considering the 10-km buffer, 220 detected occurrences may correspond to underwater cultural heritage. In addition, the implementation area is likely to impact places with potential submerged prehistoric occupations, a result of significant environmental changes that, in Portugal, 18,000 years ago, pushed the coastline approximately 120 to 140 metres below the current sea level (Dias et al., 1997). We are yet to find traces of these occupations in Portugal; in contrast, research carried out in the North Sea over the last few decades has shown very distinct evidence, including submerged settlements, artefacts, human and faunal remains, and palaeo-landscapes, which one should consider when implementing minimisation measures (Gaffney et al., 2024).

The available data also allowed the detection of 465 occurrences in front of the coast between Caminha and Figueira da Foz; nevertheless, once located beyond the established 10-kilometre buffer, we assume they are outside the impact zone.

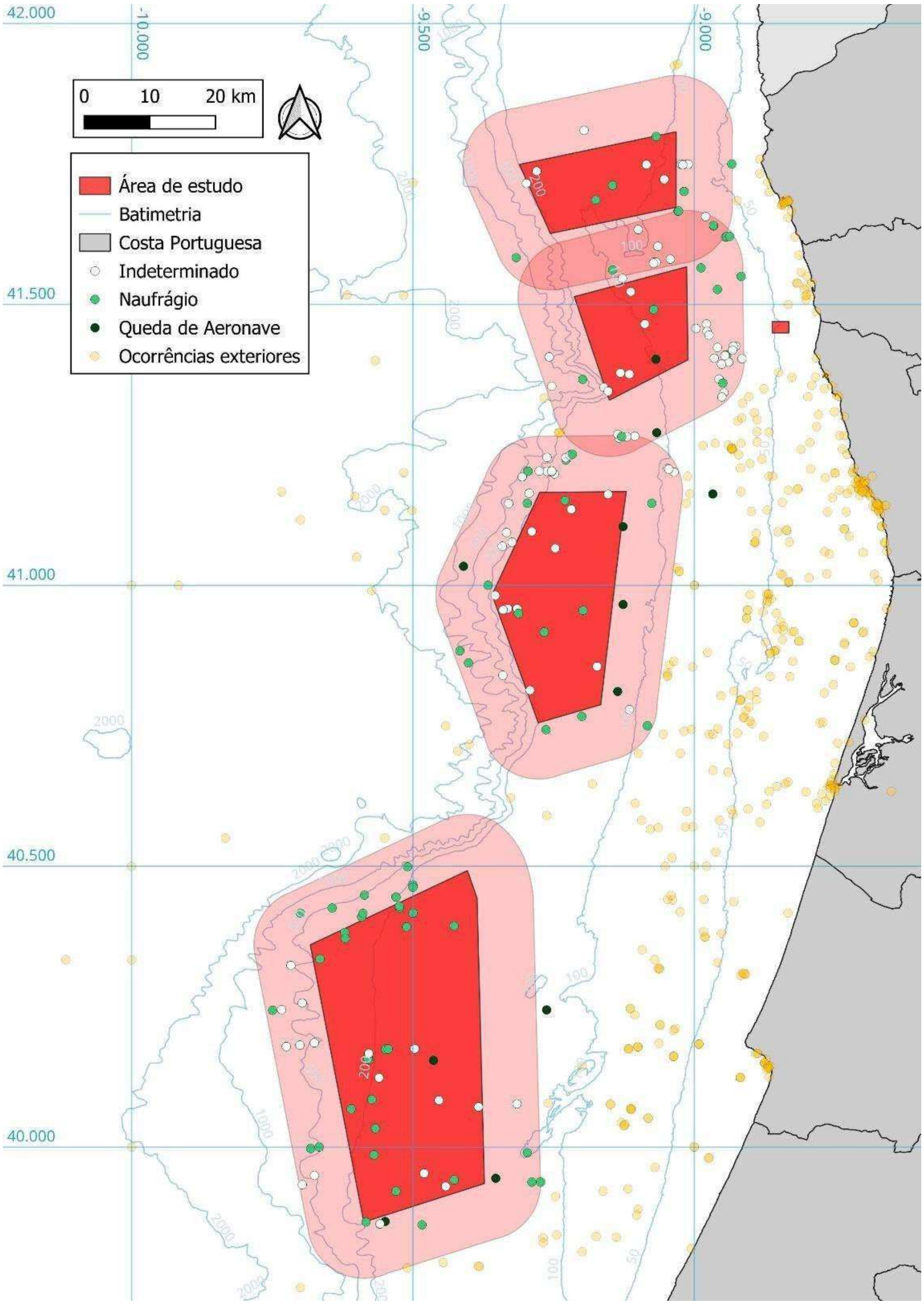

Figure 6 - Location of the occurrences identified during this study.

5.2.1. Viana do Castelo

The first affectation area, off the coast of Viana do Castelo, subdivided into Viana do Castelo North and Viana do Castelo South, covers around 312 and 294 km2, respectively, a total of c. 606 km2 (Figure 7). Considering the 10-km buffer, we detected 82 occurrences corresponding to potential archaeological sites within this zone.

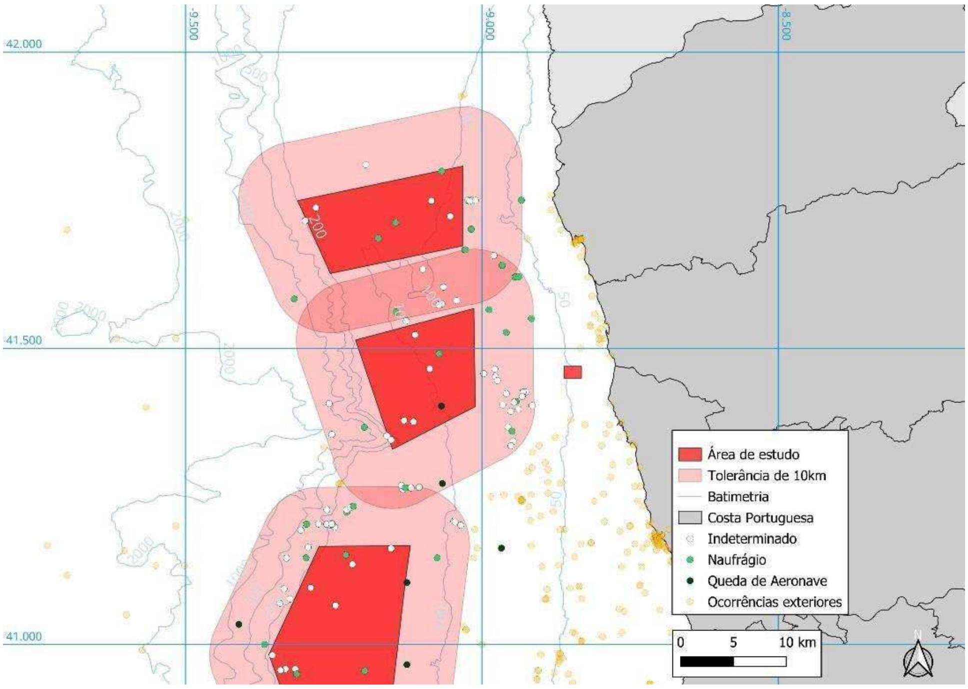

Figure 7 - Location of the occurrences detected within Viana do Castelo's allocation areas.

Of these 82 occurrences, one corresponds to an aircraft crash at sea (Ferreira, 2012), 24 correspond to shipwrecks recorded between 1911 and 2009, and the remaining 57 are undetermined but could equate to shipwrecks. There are also potentially 50 occurrences with CNS listed in the Endovélico national database, but we have no coordinates for them.

Most of the occurrences detected in the national database correspond to bibliographical references to shipwrecks off the coast, 17 of which are chance finds. Presumably, these references to shipwrecks are all, or at least the vast majority of them, closer to the shore than the project area. Nevertheless, they are a valuable source of information for characterising any shipwrecks not mentioned in the other sources.

With no known archaeological sites in the study area, we highlight occurrence ID 196: a wooden image of Jesus Christ. Recovered on the high seas in the nets of a fishing boat, it is possibly evidence of a shipwreck from the Modern Period. The other chance finds that may amount to evidence of shipwrecks are unlikely to be found in the project's affectation area since, in these cases, the artefacts washed ashore.

The 33 bibliographical references to shipwrecks for this area in the Endovélico national database are very dissimilar cases. The older ones refer to two ships wrecked in 1692, one known to have been flying the French flag (ID 262) and the other to have washed ashore after combat with a privateer (ID 263). In 1693, a single event washed 15 ships ashore (ID 264), and on a single night in 1788, for example, four reported ships (ID 251, 252, 253 and 270) sank laden with salt and soap and almost the entirety of their crews.

At the beginning of the following century, in the context of the French invasions, three notable occurrences amount to the sinking of c. 27 vessels in combat. These episodes took place in February 1809 and correspond to the sinking of two French boats by the artillery of the Ínsua and Areia forts in the early hours of the 15th to 16th (ID 273 and 274), followed by the sinking of around 25 boats and more than 600 French soldiers (ID 275). Once again, any evidence is presumed to be very close to the coast, but this is a direct testimony to the conflict in these waters.

More recently, there is a reference to a vessel identified only as a ship 'from the Great War' or possibly the Second World War. This occurrence (ID 205) has been given the name Apúlia 4 in the Endovélico database; however, we could not ascertain its location, the cause of its sinking or if it directly or indirectly associates with any of these conflicts.

Two occurrences within the project area undeniably relate to one of the world conflicts: the cargo ship Lilly (ID 330) and the schooner Ligeiro (ID 331), both sunk by German submarines during the Great War (Brandão, 2015). We know little about the latter except that it was a wooden vessel.

The information on the SS Lilly is more relevant. Owned by Danes at the time of its loss, this 69.9m-long vessel powered by a triple expansion steam engine was built in 1890 in Germany with a capacity of 1150 tonnes (Figure 8). On 9 June 1917, while on its way to Aarhus in Denmark, carrying peanuts from the Gambia River, it was sunk by the crew of the German submarine UC-53 captained by Albrecht Kurt using explosive charges[4].

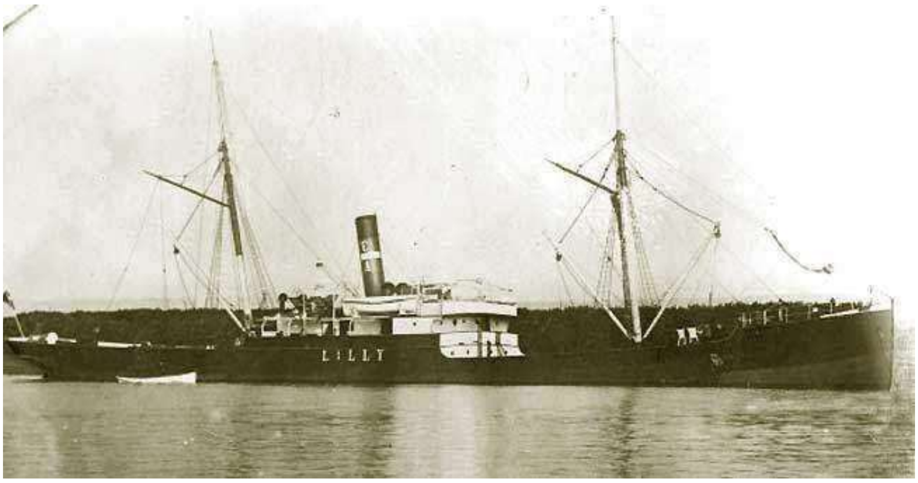

Figure 8 - Period photograph of the freighter SS Lilly, date unknown (Wrecksite).

As for aircraft crashes in these waters, one notable occurrence could be within the project area. ID169 corresponds to a British Vickers Wellington bomber lost during the Second World War. In 1941, witnesses saw the aircraft crashing in flames, with no survivors among the six crew members (Ferreira, 2012). This type of bomber, mainly used in night bombing operations, was equipped with 8 British .303 calibre machine guns and had a capacity of up to c. 2000 kg of bombs[5] (Figure 9). The weaponry on board at the time of the crash is unknown.

[4] Available at https://wrecksite.eu/wreck.aspx?177088, consulted on 17 June 24.
[5] Available at https://www.canada.ca/en/air-force/services/aircraft/vickers-wellington.html, consulted on 20 June 24.

Figure 9 - Photograph of a Vickers Wellington bomber, 1943 (Royal Air Force).

5.2.2. Leixões

The second area, off the coast of Leixões, covers around 644 km2. Within this sector, 60 inventoried occurrences could correspond to potential archaeological sites. Of these 60, 5 amount to aircraft crashes (Ferreira, 2012), 17 are shipwrecks, and the remaining 38 are undetermined (Figure 10).

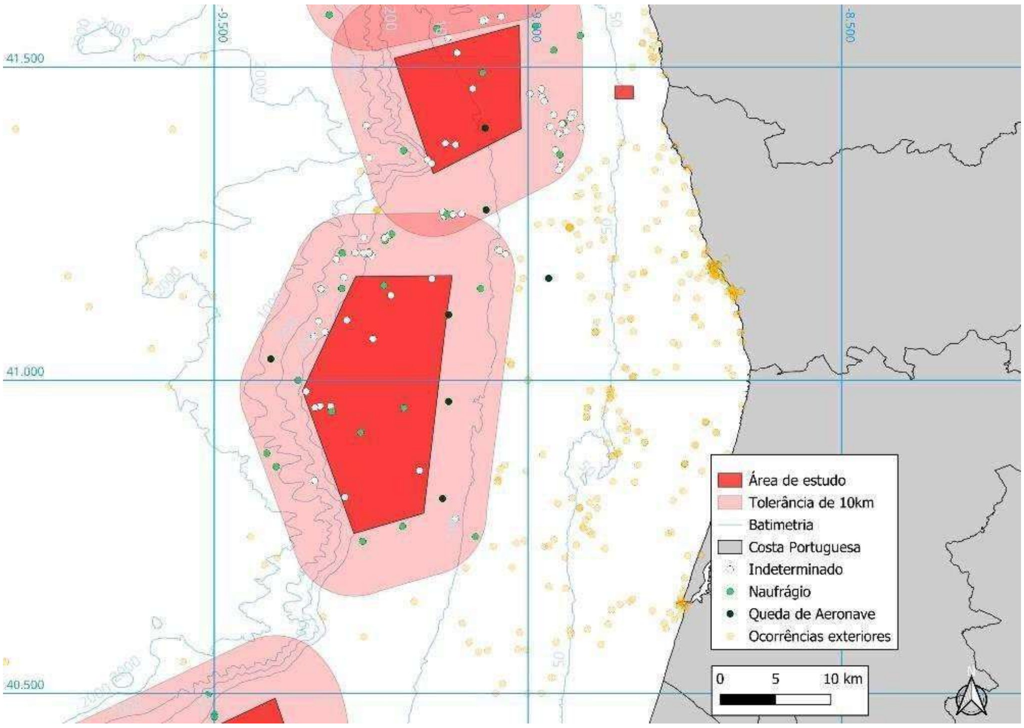

Figure 10 - Location of all occurrences detected off Leixões.

Regarding this region, we also have 24 occurrences with CNS in the Endovélico national database. As with the Viana do Castelo area, the majority are references to shipwrecks, and 11 cases are chance finds. Never ruling out the possibility of these being evidence of shipwrecks, only one appears to have come from the high seas, recovered during trawl phishing: an iron anchor with a wooden stump (ID 181), probably from the Modern Period. Nevertheless, it may not be direct evidence of a shipwreck as there are various reasons for a ship to lose an anchor. The remaining isolated finds come from river environments or have washed ashore; therefore, even in the case of shipwrecks in the surroundings, the project will presumably not impact them.

The earliest bibliographical reference to a shipwreck on this coast dates back to 1691, corresponding to a ship from Brazil loaded 'with a thousand chests of sugar' (ID 260). In the centuries that followed, there are fewer references to accidents along this shore than in the area further north. One of the most notables is the sinking of the ship *São José e Nossa Senhora das Mercês* in 1793, c. 15 leagues from Ovar, with almost all of its crew and cargo, on its way back from Spain, where it had been on a military mission.

For more recent periods, we highlight the activity of German submarines during the First and Second World Wars. At least two of these submarines rest in these waters, the U-566 (ID 326) and the U-1277 (ID 189), both sunk by their crews in 1943 and 1945, respectively. The location of the former, sunk off the coast of Vila do Conde, is still unknown, but according to the available data, it is unlikely to be in the affectation area. We do not know what weaponry was on board at the time of the sinking, just that a VIIC class submarine such as the U-566 had a maximum capacity of 14 torpedoes, complemented by an 8.8 cm artillery piece and its ammunition and one or two 20 mm calibre anti-aircraft machine guns[6] (Figure 11). The U-1277 is closer to the coast, 2.5 miles off Cabo do Mundo, and its position is known. Labelled with a CNS, it is regularly visited for recreational diving[7] and is outside the affectation area.

---

[6] Available at https://www.wrecksite.eu/wreck.aspx?14268, consulted on July 21 2024.

[7] Information about diving on this site is available at https://www.portugaldive.com/best-dives/spot/u1277-29.html, consulted on July 21 2024.

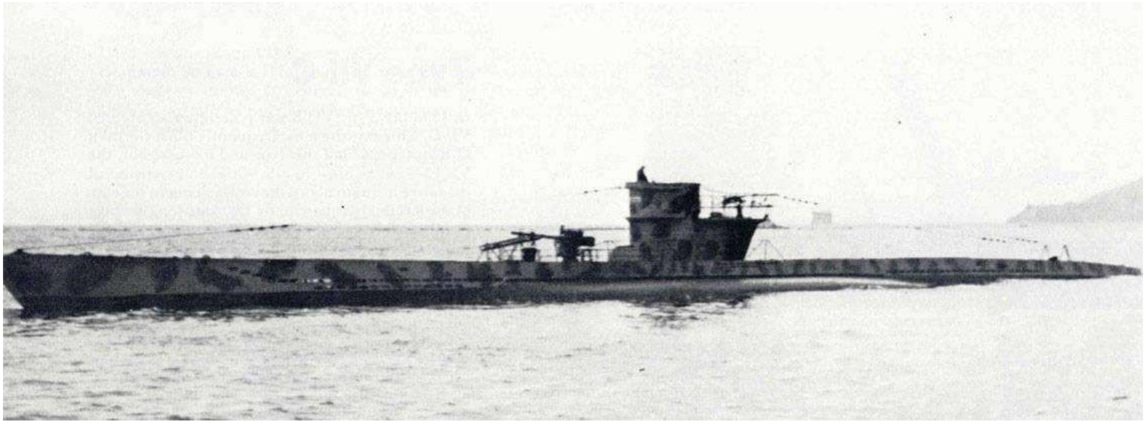

Figure 11 - Photograph of a VIIC class submarine, same model as the U-566, date unknown (Wrecksite).

War activity in recent times has led to a considerable loss of vessels in these waters, especially during the First World War, in which Portugal took an active part. This study includes all shipwrecks recorded during this conflict. In the project area off the coast of Leixões, we found records of two cargo ships that went down as a result of the German submarine war: the SS Britannic (ID 318) and the Giralda (ID 316) (Brandão, 2015).

The SS Britannic, built in the UK in 1888 and owned by Norwegians at the time of the sinking, was 88.4 metres long and had a capacity of 2289 tonnes (Figure 12). It was travelling to Barrow from Almeria loaded with iron ore when it was sunk in 1917 by Captain Otto Launburg's German submarine UC-37. It is unclear whether it was due to a torpedo or explosive charges[8].

Also built in the UK in 1889, the SS Giralda was a similar ship, measuring 83.1m in length with a capacity of 2194 tonnes (Figure 13). In 1918, it was flying the Spanish flag en route from Huelva to Pasajes carrying iron pyrites when Constantin Kolbe's U-1529 sunk it[9].

[8] Available at https://wrecksite.eu/wreck.aspx?59727, consulted on 17 June 2024.
[9] Available at https://wrecksite.eu/wreck.aspx?143112, consulted on 17 June 2024.

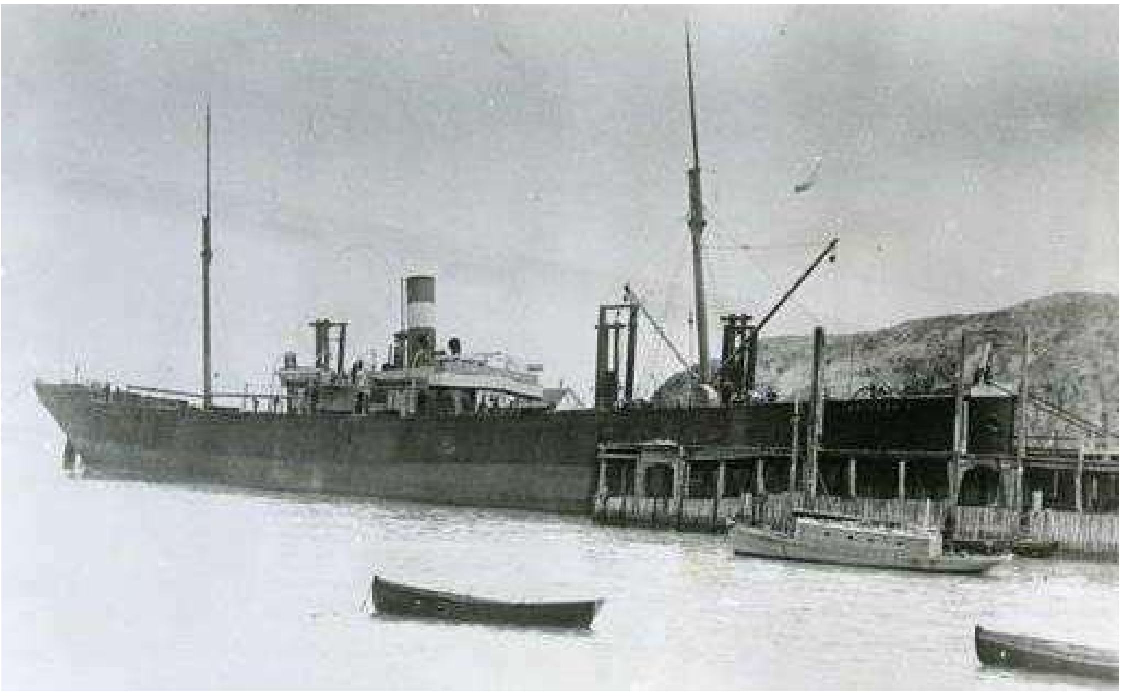

Figure 12 - Photograph of the SS Britannic, date unknown (Wrecksite).

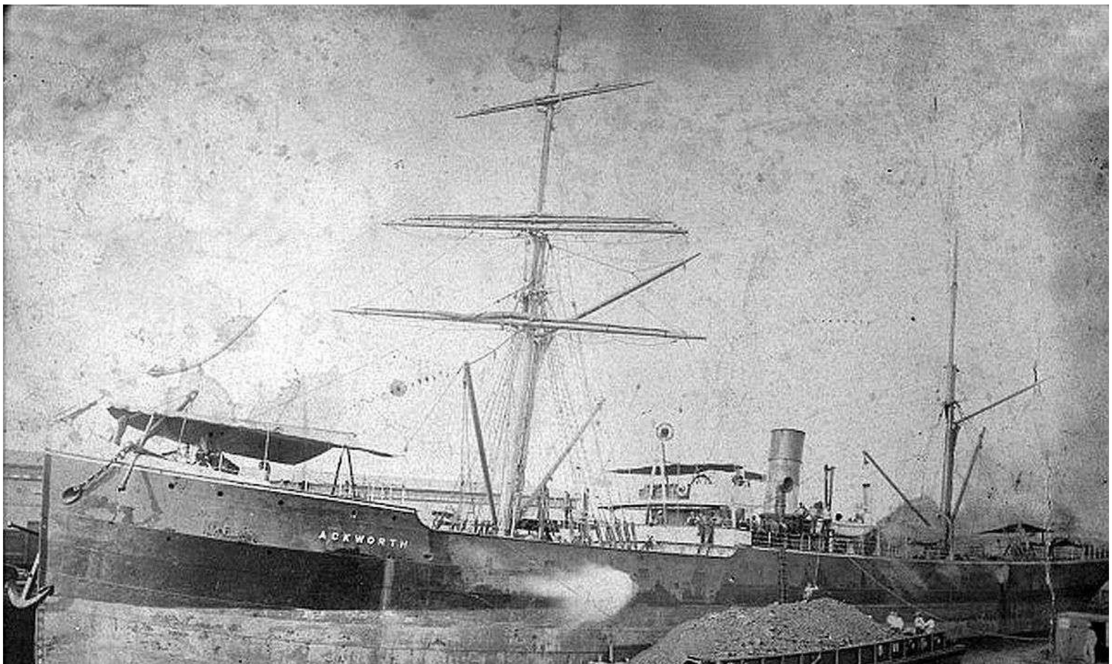

Figure 13 - Photograph of the SS Giralda still bearing its first name, SS Ackworth, date unknown (Wrecksite).

The loss of the SS River Tyne in October 1916 is coeval (Figure 14). Also of British construction, dating back to 1894, it was a similar ship to the Giralda and the Britannic. Weighing 1,450 tonnes and 83.8m long, it sank when the iron ore it carried shifted in the hold[10].

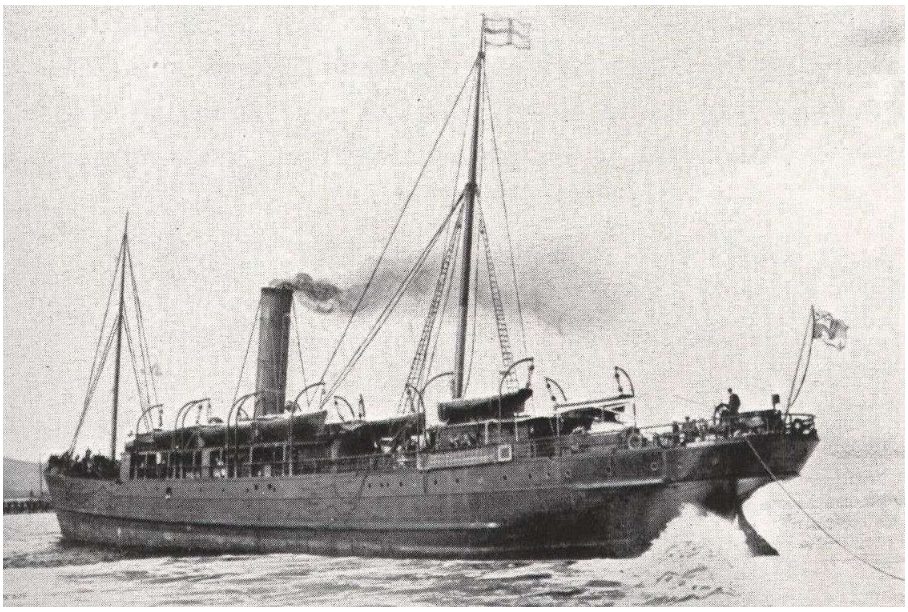

Figure 14 - Photograph of the SS River Tyne, still under its first name, SS Lady Wolseley (Wrecksite).

Several aircraft crashed here during the Second World War. All five occurrences for this area are British bombers that collapsed in 1943, two off the coast of Porto, after malfunctioning: a Short Sutherland and a Bristol Blenheim (ID 173 and 174, respectively) (Ferreira, 2012). The former was a seaplane known mainly for its capabilities against submarines[11], although we can't say for sure what its configuration and armament were at the time of the accident.

Two other bombers, a Vickers Wellington and a Bristol Blenheim, are thought to have moored off Vila do Conde (ID 170) and Póvoa de Varzim (ID 171), the latter possibly having washed ashore later (Ferreira, 2012). These aircraft are distinctive for being light bombers with a crew of just two and a lower bomb load capacity of around 500kg[12]; however, the configuration and armament for this specific aircraft are unknown.

---

[10] Available at https://wrecksite.eu/wreck.aspx?136919, consulted on 17 June 2024.

[11] Available at https://uboat.net/allies/aircraft/sunderland.htm, consulted on 17 June 2024.

[12] Available at http://www.211squadron.org/bristol_blenheim_i.html, consulted on 21 June 2024.

One last Vickers Wellington (ID 175) crashed off Cortegaça after reports of combat with a German Junkers JU88 aircraft. Once again, the weaponry on board the plane when it went down is unknown (Ferreira, 2012).

5.2.3. Figueira da Foz

The third and final area studied is off the coast of Figueira da Foz. It is the largest, with around 1,325 km2, comprising 78 recorded occurrences within the project area (Figure 15).

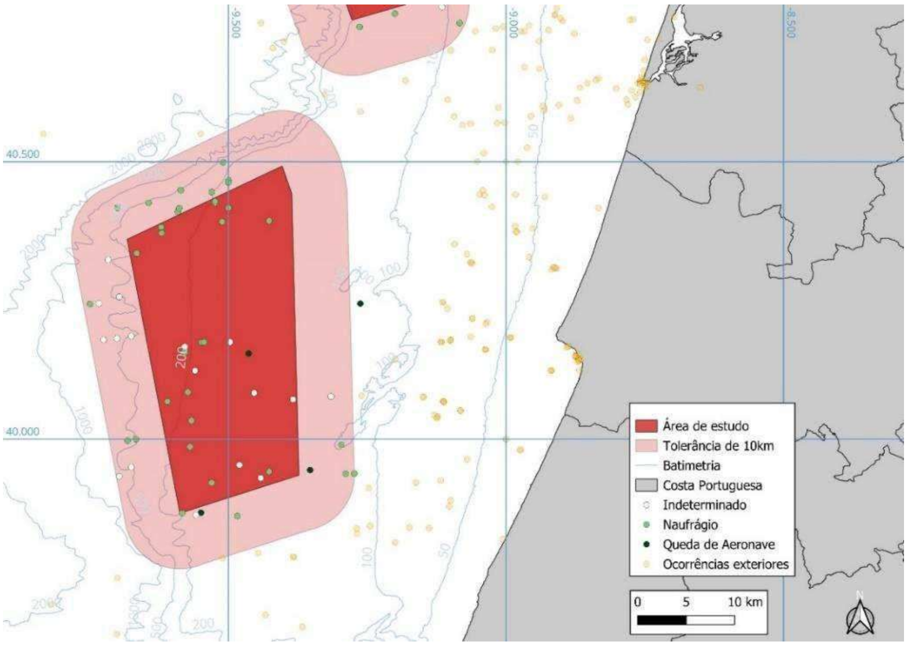

Figure 15 - Location of all the occurrences detected within the area off Figueira da Foz.

Of these occurrences, 34 are confirmed shipwrecks between 1917 (ID 1052 and 1053) and 2009 (ID 721), four correspond to aeroplanes that crashed into the sea (Ferreira, 2012), and the remaining 40 are undetermined.

There are also 35 occurrences with CNS adjacent to the project's impact zone. Nine correspond to fortuitous artefact finds, notably amphorae (ID 225) and lead anchor stumps (ID 210). These bear witness to the passage of Roman vessels and may indicate the presence of shipwrecks from this period in the waters off Figueira da Foz, not least because, in both cases, the recovery of the artefacts resulted from fishing.

The first reference to a shipwreck regards a ship that sank off Casal da Marinha in 1552 (ID 258). A few years later, coming from Puerto Rico, the Spanish ship La Piedad disappeared (ID 190). Most conspicuously, in 1804, a storm caused the loss of more than 20 English ships travelling in convoy to Jamaica, the better part of them washing ashore.

In 1908, the Dutch ship SS Santduo reportedly sank within the project area (Figure 16); with 2009 tonnes and 82.3m long, it was on its way from Algiers to Middlesbrough, loaded with iron ore[13].

Figure 16 - The Dutch ship SS Santduo, an oil painting by an unknown artist (Wrecksite).

[13] Available at https://wrecksite.eu/wreck.aspx?169236, consulted on 17 June 2024.

Like the two previous areas, the world wars also left their mark on the Figueira da Foz coast. Two occurrences originated in the First World War: German submarines sunk the fishing trawlers Germano and Serra do Gerês (ID 317 and ID 322) (Brandão, 2015).

In 1933, the SS Magyar, a 3079-tonne and 96.9-long ship (Figure 17), crashed into a submerged object. The crew abandoned it before it went down with its load of coal. Made in the UK, this ship dates back to 1907[14].

Figure 17 - Photograph of the SS Magyar (Wrecksite).

There are also occurrences resulting from the Second World War, again in 1943: the crash of a British Bristol Beaufighter fighter (Figure 18) off Cape Mondego, in which one of the two crew members died (ID 177), and that of an American B26 Marauder bomber (Figure 19), likely after combat with a German submarine – in this case, the entire crew was lost, their bodies later washing ashore (Ferreira, 2012).

[14] Available at https://wrecksite.eu/wreck.aspx?58324, consulted on 17 June 2024.

Figure 18 - Photograph of a British Bristol Beaufighter, date unknown (Royal Air Force).

Figure 19 - Martin B26 Marauder, 1944 (United States Army Air Force).

The Bristol Beaufighter is an aircraft dedicated to night combat armed with at least four 20 mm machine guns[15]. The B26 Marauder is a bomber capable of carrying up to 1300 kg of bombs and between four and 12 .30 or .50 calibre machine guns for air defence[16]. We can't estimate the exact configuration and armament on board both aircraft at the time of their loss.

---

15 Available at https://aeronauticsmagazine.com/wwii-aviation/bristol-beaufighter, consulted on June 20 2024.

16 Available at http://www.aviation-history.com/martin/b26.html, consulted on June 20 2024.

The remaining two aircraft crashes in these waters resulted from accidents involving the same model: F86F Sabre. These jets crashed in 1963 (ID 180) and 1977 (ID 179), and both disappeared along with their pilots (Ferreira, 2012). The exact configuration of their weaponry at the time of crashing is also unknown; however, these aircraft usually featured four 50-calibre machine guns with 265 rounds per gun, complemented by 900kg of bombs or up to 16 .5 calibre missiles[17] (Figure 20).

Figure 20 - F86F Sabre of the United States Air Force, 2016 (United States Air Force).

6. Assessment and minimisation measures

As noted in the contextualisation of the regional port network, the communities in the coastline directly in front of the project's affectation area have a long connection to the sea, with traces that go back (at least) as far as the Late Bronze Age. The exploitation of maritime resources developed into the creation of communication routes, with early exchanges with ports in the Mediterranean and later the North Atlantic, among others, up to the present day. The areas envisaged in the project were also the stage for various military clashes that led to the losses of ships and aircraft, especially during the two world conflicts. In addition, the project implementation will likely impact zones with possible submerged prehistoric occupations that may preserve evidence of settlements, artefacts, human and faunal remains, and palaeo-landscapes, which one should consider when implementing minimisation measures.

[17] Available at http://www.aviation-history.com/north-american/f86.html, consulted on July 20 2024.

Thus, despite the absence of known archaeological remains in the project areas, the large flow of boats over time and the possible existence of prehistoric remains increases the likelihood of discovering underwater cultural heritage of high scientific interest. The frequent presence of obstructions of unknown origin on the seabed also suggests this.

Therefore, systematic underwater prospecting with geophysical methods in the affectation areas, plus the characterisation and assessment of each target detected, including documented illustrations (photographs and/or drawings), must precede any infrastructure implementation on the seabed. Geophysics should include at least magnetic gradiometry, side-scan sonar and multibeam sonar and go along with an assessment of the targets identified within the areas to be affected by infrastructures.

Lisbon, June 20 2024,

JBettencourt

José Bettencourt

(Scientific director)

Bibliography

Alarcão, J. de. (1990). A produção e a circulação dos produtos. In J. Serrão & A. de Oliveira Marques (Eds.), *Nova História de Portugal* (Vol. 1, pp. 409-441). Lisboa: Editorial Presença.

Alarcão, J. de. (1990). O Estado e o governo local. In J. Serrão & A. de Oliveira Marques (Eds.), *Nova História de Portugal* (Vol. 1, pp. 383-394). Lisboa: Editorial Presença.

Almeida, C. A. B. de. (1996). *Povoamento romano do litoral minhoto entre o Cávado e o Minho* (Tese de Doutoramento). Porto: Faculdade de Letras da Universidade do Porto.

Barros, A. J. M. (2004). *Porto: A construção de um espaço marítimo nos alvores dos tempos modernos* (Tese de Doutoramento). Porto: Faculdade de Letras da Universidade do Porto.

Barros, A. J. M. (2016). Um Atlântico de Açúcares. Os portos do Norte de Portugal e o Novo Mundo. *Nuevo Mundo, Mundos Nuevos*. https://doi.org/10.4000/nuevomundo.69940.

Blot, M. L. (2003). *Os portos na origem dos centros urbanos: Contributo para a arqueologia das cidades marítimas e flúvio-marítimas em Portugal* (Trabalhos de Arqueologia, 28). Lisboa: Instituto Português de Arqueologia.

Brandão, M. C. (2015). *(Con)Viver com o Inimigo – A Atividade Submarina Alemã Durante a Primeira Guerra Mundial (1914-1918) – Interações na Costa de Esposende* (Dissertação de Mestrado). Porto: Faculdade de Letras da Universidade do Porto.

Dias, J. M. A., Rodrigues, A., Magalhães, F. (1997) - Evolução da Linha de Costa, em Portugal, Desde o Último Máximo Glaciário até à Actualidade: Síntese dos Conhecimentos. *Estudos do Quaternário (1)*. Lisboa: APEQ, pp. 53-66.

Fernandes, J. M. (1987). O lugar da cidade portuguesa. *Povos e Culturas*, 2, 79-112. Lisboa: Centro de Estudos dos Povos e Culturas de Expressão Portuguesa.

Ferreira, J. R. (2012). *A defesa do património cultural subaquático e a criação de mecanismos para a construção da carta arqueológica subaquática aeronáutica* (Trabalho de Investigação Individual do CPOS/FA 2011/2012). Lisboa: Instituto de Estudos Superiores Militares.

Freitas, E. da C. (1988). Vila do Conde. Memórias Paroquiais de 1758. *Vila do Conde. Boletim Cultural*, Nova Série, 2, 54-67. Vila do Conde: Câmara Municipal.

Vincent, G., V., Harding, R., Fitch, S., Walker, J., Boothby, V., & Fraser, A. I. (2024). Winds of Change: Urgent Challenges and Emerging Opportunities in Submerged Prehistory, a Perspective from the North Sea. *Heritage, 7*, (4): 1947-1968. https://doi.org/10.3390/heritage7040093.

Guerreiro, A. C. B. (2020). *Contributos para a carta arqueológica subaquática nacional.* (Dissertação de Mestrado) Alfeite: Escola Naval.

Iglesias Almeida, E. (1988). *Notas Historicas del Bajo Miño. Puertos, barcas, pesqueras.* Tui: Imprensa Juvia.

Lemos, F. S. (1982). O Sítio Arqueológico da Gelfa. Notícia Preliminar. *Cadernos de Arqueologia* (Estudos do Quaternário do Litoral Minhoto), 2, 21-48. Braga: [s.n.].

Marques, A. H. de O. (1993). *Hansa e Portugal na Idade Média*. Lisboa: Editorial Presença.

Matos, J. L. de. (1996). A Romanização inicial, os mares e os rios. In *Miscellanea em Homenagem ao Professor Bairrão Oleiro* (pp. 331-338). Lisboa: Colibri.

Moreira, M. A. F. (1995). *Os Mareantes de Viana e a Construção da Atlantidade*. Viana do Castelo: Câmara Municipal.

Pereira, J. A. R. (1994). Tercenas. In L. de Albuquerque (Ed.), *Dicionário de História dos Descobrimentos Portugueses* (Vol. II, pp. 1023-1026). Lisboa: Editorial Caminho.

Polónia, A. (1999). *Vila do Conde. Um porto nortenho na expansão ultramarina quinhentista* (Tese de Doutoramento). Porto: Faculdade de Letras da Universidade do Porto.

Ribeiro, O. (2021). *O Mediterrâneo e o Atlântico* (2nd ed.). Lisboa: Letra Livre.

Silva, A. C. da. (1995). Origens do Porto. In A. de O. Ramos (Ed.), *História do Porto* (pp. 44-117). Porto: Porto Editora.

Wachsmann, S., Dunn, R. K., Hale, J. R., Hohlfelder, R. L., Conyers, L. B., Ernenwein, E. G., & Davis, D. (2009). The Palaeo-Environmental Contexts of Three Possible Phoenician Anchorages in Portugal. *International Journal of Nautical Archaeology, 38*(2), 221–253. https://doi.org/10.1111/j.1095-9270.2009.00224.x.