

Mauritius Maritime Heritage through GIS Mapping of Wrecks for Environmental Impact Assessment.

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ABSTRACT

Due to frequent naval battles and inclement weather conditions, Mauritius has been the site of an extensive number of shipwrecks. Research-based on historical and archival sources carried out over more than thirty years seeks to record this extraordinary heritage resource, the number of shipwrecks is estimated at over 1200, demonstrating the great potential of the island's maritime context. Starting from this impressive database, a new GIS project, "Mauritius_shipwrecks_GIS", is mapping all these shipwrecks. The aim is to create varied mechanisms to visualize the potential of maritime heritage for Mauritius, serving as a concrete example for future development in this region, and the wider Indian Ocean.

This endeavour is particularly relevant and timely, given that the Mauritian government has started promoting the development of an oceanic economy to make this sector one of the pillars of its economy. This initiative is replicated regionally. Therefore, the mapping of all wrecks in Mauritian waters, as a collaborative endeavour with the Department for Continental Shelf, Maritime Zones Administration and Exploration, had the potential to serve as a significant impetus for the formulation of a systematic approach that can guide the decision-making process not only for the protection of these wrecks but also to mitigate potential impacts on the environment as might occur through unsympathetic development.

Keywords: Geographic Information Systems (GIS), Maritime Archaeology, Historic Shipwrecks, Seascapes, Mauritius

INTRODUCTION

This paper presents a possible way to integrate the environmental impact assessment of fishing, tourism (especially the diving industry), and coastal use into Mauritius's GIS platform for the Underwater Cultural Heritage (UCH).

The study of maritime heritage involves knowing the interactions between man and water, whether in a river, lake, or sea (Westerdahl 2013, 754). The need to manage this immense heritage finds a powerful ally in the Geographic Information System (GIS) (Mather and Watts 1998). Although GIS has taken longer to enter the field of maritime archaeology than in land archaeology, its application nowadays is more than essential for the following four approaches: survey, site specific surveys, management of cultural resources, and predictive models and exploration data analysis (Mather and Watts 2002, 681). The number of shipwrecks discovered each year grows so rapidly that it requires a systematic way of storing and managing all this information. As Ford (2011, 5) recalls, the study of shipwrecks is only a component, and to understand better the maritime cultural landscape, we must take into account not only the sites but also includes a "wide range of interrelated and often ephemeral phenomena." In light of this statement, a noteworthy case study is the use of GIS in interpreting maritime cultural space in the coastal waters of South Australia, where this tool demonstrated a spatial correlation between shipwrecks, navigational lights, and shallow waters (Kimura 2006, 148).

Thus, this paper not only presents the usefulness of the GIS application in mapping wrecks to understand the maritime cultural landscape but also its benefit in environmental impact assessment. It will especially

present the importance of the macro scale in interpreting the seascape and the environmental impact of the activity around and on the wrecks. It is essential to highlight that maritime archaeology requires more careful management and conservation strategies because the underwater environment is potentially at risk due to the impact of natural and anthropogenic changes resulting from increasingly accelerated coastal development and recreational activities. Just to name a few, these human activities include fishing, commercial salvage operations, looting by treasure hunters, dredging operations, harbor developments, and oil spills from large bulk carriers. The latter case will be considered in this paper.

CASE STUDY

The case study under consideration is Mauritius and its islands. Mauritius was a pristine island before the arrival of the Europeans (Seetah et al. 2022), and it was only with the arrival of the Dutch that permanent settlements were established in 1638 ce (for the history of Mauritius, see: Allen 1999; Teelock 2009; Vaughan 2005). Since then, the island has been coveted by Dutch, French, and British to prevent other colonial powers from taking advantage of this strategic military and mercantile position (Carter 2006, 808).

For an island like Mauritius, historical maritime archaeology constituted a rich resource. Since the day it was placed on Western nautical maps, Mauritius has represented a nodal and vital stop-over for European navigation. Thus, Mauritian history and its maritime cultural heritage are intertwined with colonialism and European influence. Everything needed to constitute a colony, including the population, must be brought through the sea. In light of all these voyages, Mauritius waters and its islands conceal a wealth of maritime heritage of significant historical importance. Naval battles, adverse weather conditions, and navigation errors were the determining factors for the sinking of numerous vessels.

Maritime archaeology formally began in Mauritius in 1933 CE with an investigative exploration of the shipwreck *HMS Magicienne* (1781 CE) (von Arnim 2003). Following the introduction of scuba diving in the 1960s, archaeological studies were carried out intermittently over the ensuing six decades. Major archaeological investigations and excavations of shipwrecks include two Dutch East Indiamen, *Banda* (1606 CE) (Dumas 1981) and *Geunieerde Provinciën* (1603 CE); two British frigates, *HMS Magicienne* (1781 CE) and *HMS Sirius* (1797 CE) (von Arnim 1998); two French flutes *Diligente* (1809 CE) and *Ambulante* (1762 CE) (von Arnim 1998) and the French East Indiaman *Saint Geran* (1736 CE) (Blot 1979); the pirate ship *Speaker* (1699 CE) (Lizé 1984); the British bark *Maria* (1869 CE); and the illegal slave trader the *Coureur* (1818 CE) and the French slave trader the *Victoire* (1804 CE). Furthermore, many other underwater heritage sites have recently been identified and studied by local and international teams of divers mandated by the Mauritius Museums Council, the National Heritage Fund, the Mauritius Marine Conservation Society, the Mauritius Underwater Group, and the Mauritian Scuba Diving Association (von Arnim 2013).

FRAMEWORK AND RESOURCES

The GIS mapping project was initiated as part of a National Geographic Grant to render visible the valuable maritime heritage of Mauritius (Manfio and von Arnim 2020, 505). The project further developed a collaboration with the Department for Continental Shelf, Maritime Zones Administration & Exploration (CSMZAE), creating a working jointly under the MUCH project to map all information regarding the shipwrecks around the Republic of Mauritius and developing an E-platform for the inventory and dissemination of UCH (Mamode et al. 2022). The MUCH project emerged to respond to the mandate of the Mauritian government to promote the development of an Ocean Economy, which aims to make this sector one of the future pillars of its economy. With the increasing demand for marine space

for different purposes, particularly fishing, aquaculture, tourism, and leisure, it has become necessary to plan its use. In this context, using the GIS project, CSMZAE is developing a Marine Spatial Plan to ensure respect for international commitments as well as national policies and legislation, considering the preservation, protection, and improvement of the marine environment.

The information introduced into this mapping was gathered from over 30 years of archival research by local expert Dr. Yann von Arnim, who collected data on wrecks that have sunk around the coast of the Republic of Mauritius and beyond. This collection's considerable potential leads to a GIS project intending to map the shipwrecks and draft a plan for Managing Cultural Resources (MCR). This endeavor resulted in a systematic database containing valuable information - to name a few: location, name, date of construction, date of sinking, type of vessel, purpose, and primary and secondary source. The resources consulted were coming from numerous archives located in Mauritius and internationally from Dutch, British, and France libraries, but also historic newspapers and gazettes. The database consisted of over 800 wrecks recorded in archival resources, a number that increases to 1200 shipwrecks if we include its Exclusive Economic Zone (Manfio and von Arnim 2020, 497) (Figure 1).

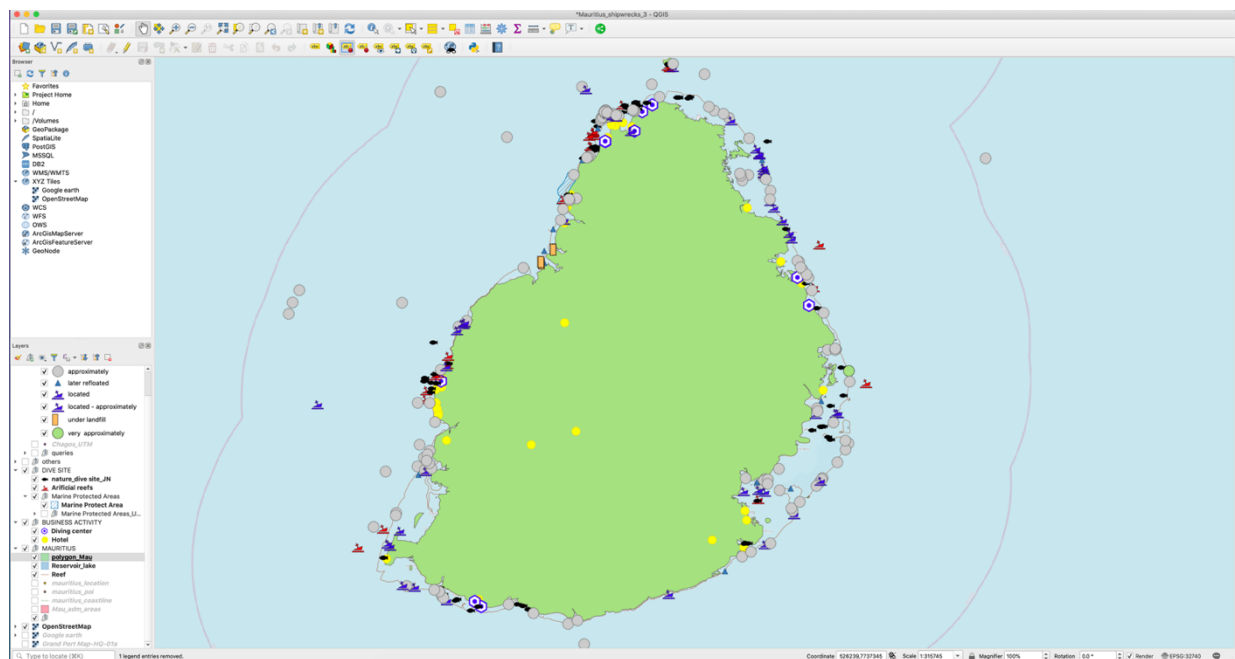


Figure 1 - Mauritius shipwrecks GIS project

To create the inter-site project entitled '*Mauritius_shipwrecks*' GIS project used the QGIS platform, an official program of the Open-Source Geospatial Foundation (OSGeo).

The most complex phase of the project was the positioning of the shipwreck point. Of the 800 wrecks recovered from archives, only 50 have been identified today. Hence, how to indicate these uncertain data in the GIS? From the archive research, it is possible to assume the navigation path that the ship was following and/or the indicative place of the shipwreck. Furthermore, numerous rocks and reefs in Mauritius have been named after the ship that crashed on them. Therefore, it was agreed to position the point indicatively in the area which is presumed where lie remnants of the ship. In the attribute table, under the wording 'site' and 'feature' is indicated how approximate the point is.

The location of any historical wreck is of fundamental importance in the evaluation phase of the archaeological potential of a specific maritime area.

The development of the coasts for tourist purposes or industrial use, for example, the expansion of docks and warehouses, leads to an irreversible modification. Without an archaeological assessment, this heritage could be lost. During the compilation of the GIS, it was noted that several wrecks sunk in Port Louis may now be lost or buried. In future developments, the buried wrecks could emerge during digging works; as a result, the GIS is turning out to be fundamental for the government to assess potential heritage underground.

The historical images collected from the archives showing the presence of wrecks do not contain spatial coordinates. Hence, using the well-known Georeferencing tool QGIS, it was possible to manually assign the coordinates (Kimura 2006, 88–92; Rumsey and Williams 2002). The superposition of these maps in the GIS allows us to study different aspects, including the modification of the coasts, the understanding of how the various ports of the island have developed, and the analysis of commercial routes. A particular case is the capital's port. Port Louis, where more than a hundred shipwrecks are registered'. For many shipwrecks, the causes of the sinking are unknown. Thanks to the overlapping of historical maps, the hypothesis that seems more plausible is that ships were sunk intentionally to create a solid basis for the expansion of the port.

Additionally, particularly prominent is the study of the lagoon and port mouths by combining satellite and historical nautical charts. The coral reef that makes this island attractive has certainly been a challenge for the sailors of the time. After the Dutch occupation, the French moved the main port on the west coast, where the entrance to the port was much easier. Navigating the waters inside the coral reef was certainly a challenging task. This is confirmed by the discovery of the wreck of the *Coureur* sunk because of a wrong maneuver while trying to escape from English ships commissioned to capture it. Thus, we have reason to believe this may not be an isolated case, thanks to the interpretation of the GIS, we can identify other archaeologically interesting areas.

In addition to the '*Shipwrecks*' groups, two other groups have been created: '*Dive site*' and '*Business activity*.' In the former, we have created two other layers containing: 1) GPS points of the naturalist dive sites, and 2) GPS points of the artificial shipwrecks that were sunk by scuttling (Devault, Beilvert, and Winterton 2017). In the latter group, we entered information about the hotels, resorts, and the locations of the diving centers. Implementing the GIS with other information not strictly related to historical wrecks. This will also allow us to understand the environment and tourism impact. An analysis that can be carried out is: What is the level of pressure that the historical wreck faces due to its proximity to frequented tourist sites?

RESULTS AND APPLICATIONS

Wakashio disaster and the HMS Sirius (1797) shipwreck

On the 25th of September 2020, while Mauritius and the world were already suffering from the pandemic outbreak, a large bulk carrier ran aground on a coral reef. In the following week, the *Wakashio* started to spill oil, and almost a month later, it broke up into two parts (Rajendran et al. 2022). Finally, during the cleaning operation, these two parts were pulled out and scuttled in the middle of the Indian Ocean.

This accident led to an estimated 1,000 tonnes of oil spilling into the ocean in what was called by some scientists the worst environmental disaster ever in Mauritius. Day after day, the *Wakashio* oil spill began to enter the Mauritian lagoon. The grounding happened in an area listed under the Ramsar Convention on wetlands of international importance and near the marine park of Blue Bay. Tourism plays a significant role in the economy of Mauritius and is centered around marine scenery and animals likely to be endangered by the oil spill.

A compelling study has demonstrated how GIS software made it possible to understand the magnitude of the oil spill, and it can be an essential tool to support management and decision-making regarding oil spill (Sunkur and Bokhoree 2021). The creation of these shapefiles then came in handy for our project as well to understand the impact on the UCH. Indeed, in that lagoon also resides one of the most famous and emblematic wrecks in Mauritian history, i.e HMS *Sirius* (1797 CE) shipwreck.

HMS *Sirius* is also a shipwreck of international importance. She was launched in April 1797 CE at Dudman's yard on the River Thames at Deptford (UK) and rated as a 5th-class frigate of the Royal Navy. In 1805 CE HMS *Sirius* was part of the British fleet commanded by Admiral Lord Nelson fighting against the Napoleonic Navy at Trafalgar. In the following years, the HMS *Sirius* was deployed in the Indian Ocean to keep the French operations under control. Indeed, France had launched several attacks on British India from Mauritius and used the island to supply their ships; the British capture of Indian Ocean bases would have been a severe blow to the French forces (Carter 2006, 808). Consequently, in 1810 CE, the British navy decided to attack the Île Bourbon (Réunion), capturing it in July and then advancing in August to the Isle de France (Mauritius). The Battle of Grand Port, which took place in Mauritius between 27 and 28 August 1810 CE, saw the complete defeat of the English fleet where two ships were scuttled (HMS *Sirius* and HMS *Magicienne*), two captured (HMS *Nereide* and HMS *Iphigenia*), and numerous prisoners and deaths (Taylor 2007). This battle was the only Napoleonic naval victory and was consequently commemorated in the Arc de Triomphe in Paris. Despite this victory, in December, the Isle de France passed under the British administration that renamed it Mauritius and ruled until 1968 CE, the year of independence.

The HMS *Sirius* shipwreck lies on a muddy bottom at a depth ranging from 20 to 79 feet (6 to 24m) near a small coral bank in the middle of a deep channel within the reef. Its discovery and excavation consecrated the interest in maritime archaeology in Mauritius. Although the early archaeology campaigns of 1965-68 CE were not methodologically accurate due to the use of explosives, valuable information was collected in subsequent campaigns (von Arnim 1998). To date, most of the remains and artifacts are on display at the National History Museum of Mahebourg, where an entire room is dedicated to the Battle of Grand Port and the HMS *Magicienne*, the other shipwreck scuttled during the conflict. Parts of the hull, numerous artifacts, and artillery pieces such as cannons still lie at the bottom of the sea today.

Once the more recent archaeological campaigns (2003-2005) were completed, guidelines were placed around the main part, and between the main part and the deeper aft section to pilot the diver throughout the wreck. Numbered floating labels have been placed on each cannon or other artifacts, some of which also provide information. Initially, a plate with text on the ship and site protection was placed in the center of the wreck. Given the importance of this battle and to commemorate the fallen sailors and the bicentenary of the Battle of Grand Port, the small plate was replaced by a large and heavy plaque in 2010. A guest book was placed in a basket next to a cannon for ten years, encouraging visitors to leave messages and their names. Furthermore, the diving centers were provided with brochures containing not only information on the ship, the wreck, and the underwater path but especially with rules to be respected in order to visit the site. The wreck of the HMS *Sirius* automatically became an unofficial maritime museum, where today, numerous diving centers bring tourists and locals to dive, offering a unique experience. The challenge was to balance the preservation and protection while simultaneously allowing the usability and development of tourism around the underwater site. The continuous monitoring carried out by volunteers and Yann von Arnim, who directed the latest excavation campaigns, showed no vandalism or looting.

The HMS *Sirius* site has been used as a training site in the past few years under the MUCH project to achieve capacity building directly on UCH in Mauritius, involving numerous local stakeholders (Mamode et al. 2022).

Therefore, this oil spill disaster had not only seriously impacted the environmental heritage of the lagoon “Grand Port” but also the UCH. Hence, studies and research have been launched to understand the post-oil spill effects on the UCH. For example, the government immediately implemented the “*ATBA - Recommended Areas To Be Avoided (ATBAs) around Mauritius - Merchant Shipping Notice Ref: 21 of 2020*”¹. A GIS shapefile has been created to outline the area merchant vessels should avoid when approaching Mauritius.

Understanding the environment and its potential risks to maritime cultural heritage is an important aspect that needs to be addressed. This assessment helps to make appropriate management and conservation decisions.

CONCLUSION

GIS has become one of archaeology’s most important technological innovations in the last twenty years (Ebert 2004, 320). Like all technologies, it constantly improves, promising features that could solve current constraints.

Accordingly, GIS is beneficial for Managing Cultural Resources (MCR). On the one hand, we can manage the massive amount of data obtained from collaboration with local experts, archival sources, and archaeological excavations. On the other hand, we can work on interpretations and create a plan to safeguard the underwater heritage of this island.

Another key component for further development of this project is the ethnographic aspect. The involvement of the local population, in particular fishermen and dive operators, who are repositories of important information, is helping to build and improve the database of maritime cultural heritage. Thus, not only is the aim of the GIS project to systematize and organize data for the analysis and study of the maritime heritage of the island but also to create a collaboration with local authorities and raise awareness of the population and tourists.

Although the ‘*Mauritius_shipwrecks*’ GIS is still under development, the expectations of this project are high. Once we have all data, the goal is to create an action plan that allows multidisciplinary collaborations, as follows.

- a. *Managing Cultural Resources (MCR) through collaborations with:*
 - *Government to build a Marine Spatial Planning with the main purpose of preserving and protecting the archaeological areas.*
 - *Diver operators to build the Blueprint project based on sustainable tourism.*
 - *Fishermen and fishing industry to develop models for ecosystem-based approaches to ocean exploitation.*
- b. *How heritage could fit into the Blue Economy mandate and contribute to resilience in Small Island Developing States (Small Island Developing States – UNESCO’s Action Plan).*
- c. *Heritage management designed by GIS programs that provide people with access to cultural heritage resources on the Internet.*
- d. *Collaborations with the Museums through the creation of interactive stations for learning maritime heritage.*

This is a substantial, but certainly not exhaustive, list of activities that can be achieved in Mauritius thanks to a Maritime Cultural Landscape GIS.

¹ https://gocoeanobservatory.govmu.org/layers/ocean_observatory_datastore:geonode:ATBA_LINE_20200929

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