2008 Diver Investigations of the Suspected *Serapis* Site Ambodifototra, Isle Ste Marie, Madagascar

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Presented by:

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SERAPIS PROJECT

Institute of Civilizations
Museum of Art and Archeology
University of Antananarivo

INSTITUTE FOR NEW HAMPSHIRE STUDIES

University of West Florida

SOUTHEASTERN ARCHAEOLOGICAL RESEARCH, INC.

ACKNOWLEDGEMENTS

A project of this scope could not have taken place without the cooperation and hard work of numerous dedicated individuals and institutions. First and foremost are Dr. David Switzer of the Institute of New Hampshire Studies, Plymouth State University and Mrs. Amy Swete Pruett (daughter of Mr. Dick Swete). These two individuals have kept the project on a steady keel. Dr. Chantal Radimilahy of the Institute of Civilizations/Museum of Art and Archaeology of the University of Antananarivo and Prof. Jean-Aime Rakotoarisoa who have been involved with the project since 1999 are also thanked for their support.

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The Malagasy students who participated in the project were Mr. Eric Randrianantenaina (a veteran of earlier field seasons), from Antananarivo Mr. Richard Andrianavalomahefa, Ms. Annita Ramankierana, and Ms. Seraphin Herifanomezanjo from Tamatave.

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ABSTRACT

During November 2008, the Serapis Project, in association with the Institute for New Hampshire Studies, Plymouth State University and the Institute of Civilizations/Museum of Art and Archaeology of the University of Antananarivo, Madagascar conducted an underwater archaeological field season in the harbor of Ambodifototra, Isle Ste Marie, Madagascar. This field season included two phases. The first phase included dive training and certification of local Malagasy students interested in their maritime heritage and protecting their nation's submerged cultural resources. The second phase included the investigation of the suspected hull remains of the HMS *Serapis*, a 44-gun, fifth-rate ship that was captured by John Paul Jones and the crew of the *Bonhomme Richard* off Flamborough Head, England in 1779. Acting on a tip from a local diver, team members with the Serapis Project directed their attention to a shipwreck site in the harbor of Ambodifototra, Isle Ste Marie, Madagascar. The shipwreck measures approximately 130-140 feet in length, 40 feet in width, and is exposed approximately 6 to 7 feet off the harbor floor. Located in approximately 75 feet of water, dive times were limited to approximately 30-35 minutes per-dive, per-day.

A number of objectives were achieved during the 2008 field season. First, a total of four Malagasy students successfully completed their dive training and were certified by an international SCUBA certifying agency. It is hoped these students will continue with their dive training to help protect the submerged cultural resources of Madagascar. Secondly, information obtained during the investigation of the suspected HMS *Serapis* will allow for the development of excavation plans for future field seasons. In addition, the current investigation indicates that the site is historic and warrants protection. Lastly, the creation of a maritime museum (in conjunction with the University of Antananarivo) dedicated to the maritime history and culture of Madagascar with a display of material from the suspected *Serapis* wreck site may be feasible.

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PREFACE

The following is a brief project update and a preliminary site report for the 2008 Serapis Project field season. Archaeology, to be done properly, requires time for adequate research and in-depth analysis of findings during the post-field work phases. Good archaeology calls for the dissemination of findings throughout the archaeological community and to the associated institutions and supporters of the project in a timely fashion.

Therefore, it should be understood that some of the initial statements or interpretations presented herein may be incomplete or in need of additional analysis or revision. It also should be recognized that, albeit preliminary, this report will serve as the foundation for subsequent research at the suspected *Serapis* site.

INTRODUCTION

The Serapis Project has been an ongoing effort to locate and identify the remains of the HMS *Serapis* which sank in the harbor of Ambodifototra, Isle Ste Marie, Madagascar in 1781. Beginning as an oral agreement between Mr. Richard “Dick” Swete, project founder, and Prof. Jean-Aime Rakotoarisoa of the University of Antananarivo, the first scientific underwater archaeological investigation in Malagasy waters was initiated in 1999. The *Serapis*, under the French flag, had stopped at Isle Ste Marie in 1781 (while in route to India) and sank in the harbor due to an onboard fire. This project, which began over a decade ago, remains strong and today the historic and archaeological research continues with the full participation of the Serapis Project and the Institute of Civilizations/Museum of Art and Archaeology of Madagascar’s University of Antananarivo. Field investigations to date have been conducted at Isle Ste Marie in 1999, 2000, 2004, and most recently in 2008. The purpose of this report will be to highlight all work on this project to date, primarily focusing on the results of the 2008 field season.

During November 2008, the Serapis Project conducted student diver training as well as underwater archaeological field investigations in the harbor of Ambodifototra, Isle Ste Marie, Madagascar. The initial phase of the 2008 project included certifying four Malagasy students who completed a week of dive training. The intention of certifying these students was to provide each with the basic training to assist in the future stewardship of Madagascar’s submerged cultural resources. Each student subsequently received a National Association of Underwater Instructors (NAUI) SCUBA certification. It is hopeful these students will continue their dive activities to promote and protect Madagascar’s underwater heritage.

The second phase of the 2008 field season was to conduct an initial site recordation of the suspected remains of HMS *Serapis*. Acting on a tip from a local diver, project archaeologists investigated a shipwreck site located in the harbor of Ambodifototra. The site included a significant amount of lower hull remains that measured approximately 130-140 feet long, 40 feet in width and extended approximately 6-7 feet above the harbor floor. While the majority of the lower hull is either buried under sediment or protected by a sizeable ballast mound, the presence of copper sheathing (on the outer hull of the vessel) indicates the vessel dates to the last quarter of the eighteenth century. An anchor, ten cannon, brick, cobble ballast, ceramics, glassware, rigging elements, and other cultural materials were observed associated with these hull remains. Analysis of material culture also indicates that the site dates to the late-eighteenth century and represents a sizeable armed vessel. Located in approximately 75 feet (23 meters) of water, dive times were limited to approximately 30-35 minutes per-diver per-day. Pre-disturbance recordation of the shipwreck site *in situ* was conducted during the current investigation including sketch mapping, still, and video photography.

The historic shipwreck remains documented during the 2008 field season may open a new chapter in the late-eighteenth century maritime activities in the Indian Ocean. More importantly, if the remains prove to be those of the HMS *Serapis*, an important footnote can be added to American naval history. As such the remains need to be studied, recorded and preserved for future generations. Protection of the site for scientific and educational purposes is another goal of the Serapis Project.

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SERAPIS PROJECT BACKGROUND

Project Area Environment

Madagascar is an island nation and the fourth largest island in the world, located off the southeast coast of Africa (Figure 1). African, Asian, and European influences are evident throughout the country. Different regions of the country exhibit varying degrees of these influences. The location of the 2008 field investigation took place on Isle Ste Marie, an island approximately 5 to 15 miles off the northeast coast of Madagascar in the Indian Ocean (Figure 2). Isle Ste Marie is a long thin low–lying island approximately 30 miles in length (north-south) and about 1-3 miles wide. The main town and port is Ambodifototra situated along the southwest coast of the island.

Project Background

The Serapis Project was founded by Mr. Richard "Dick" Swete, a historian and archaeologist who recognized the historic importance of John Paul Jones. Considered by many to be the "Father of the American Navy," Jones commanded numerous vessels while in the service of the navy of the United Colonies. Today Jones' remains rest in the crypt below the chapel at the United States Naval Academy (Figure 3).

While the final dispositions of many of the ships under Jones' command are known today the remains of the *Bonhomme Richard* and HMS *Serapis* remain undiscovered. To date many groups have searched the North Sea (off England) for the *Bonhomme Richard*; but no one has tried to follow the trail of *Serapis*.

Having amassed a large collection of historic documents and spending a life time studying history, Swete was well versed with the story of John Paul Jones and the famous battle off Flamborough Head between the *Bonhomme Richard* and the HMS *Serapis*. Researching the records of the battle, Swete knew the final disposition of the vessels, the *Bonhomme Richard* sank on September 25th in the North Sea shortly after the encounter and the HMS *Serapis* ended up in French service. Archival materials indicate that in 1781, the *Serapis* was lost in the harbor of Ambodifototra, Isle Ste Marie, Madagascar.

1999: The Project Begins

Richard Swete traveled to Madagascar in early 1999 and made contact with Professor Jean-Aime Rakotoarisoa, the director of the Institute of Civilizations/Museum of Art and Archaeology at the University of Antananarivo. Conversations with Professor Rakotoarisoa and historic research by Swete confirmed the harbor of Ambodifototra, Isle Ste Marie had never been investigated relative to historic shipwreck sites in general or the *Serapis* in particular. During his initial trip to Isle Ste Marie, Swete found that that there was also no local knowledge of the loss of the *Serapis*.

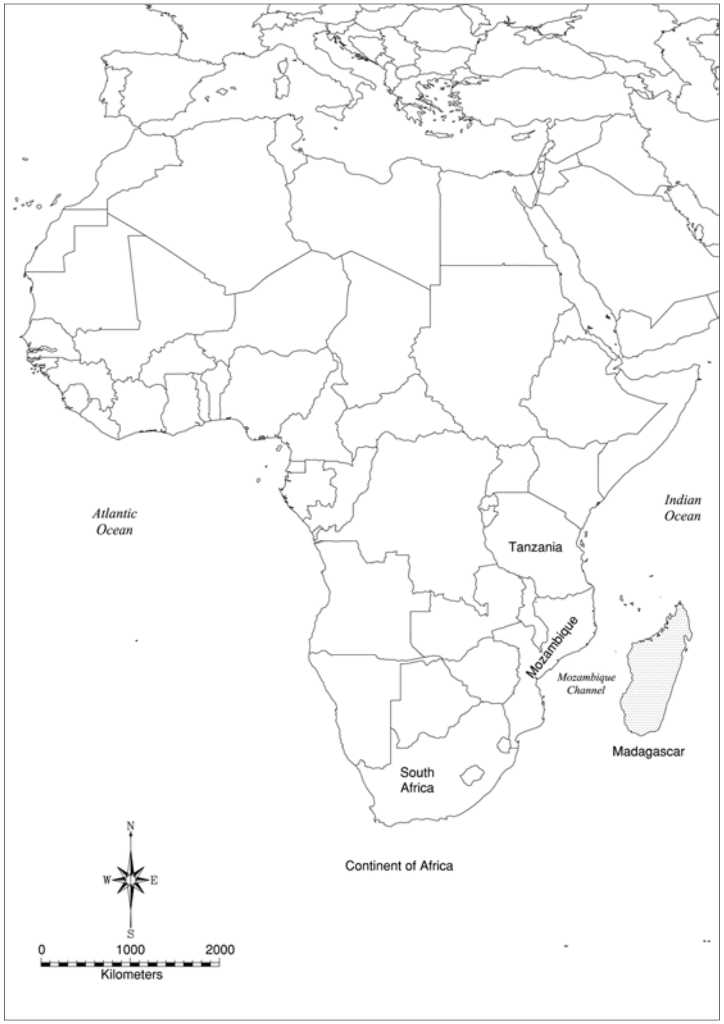

Figure 1. Map showing location of Madagascar off of the south east coast of Africa (Map courtesy of Lee McKenzie, University of West Florida).

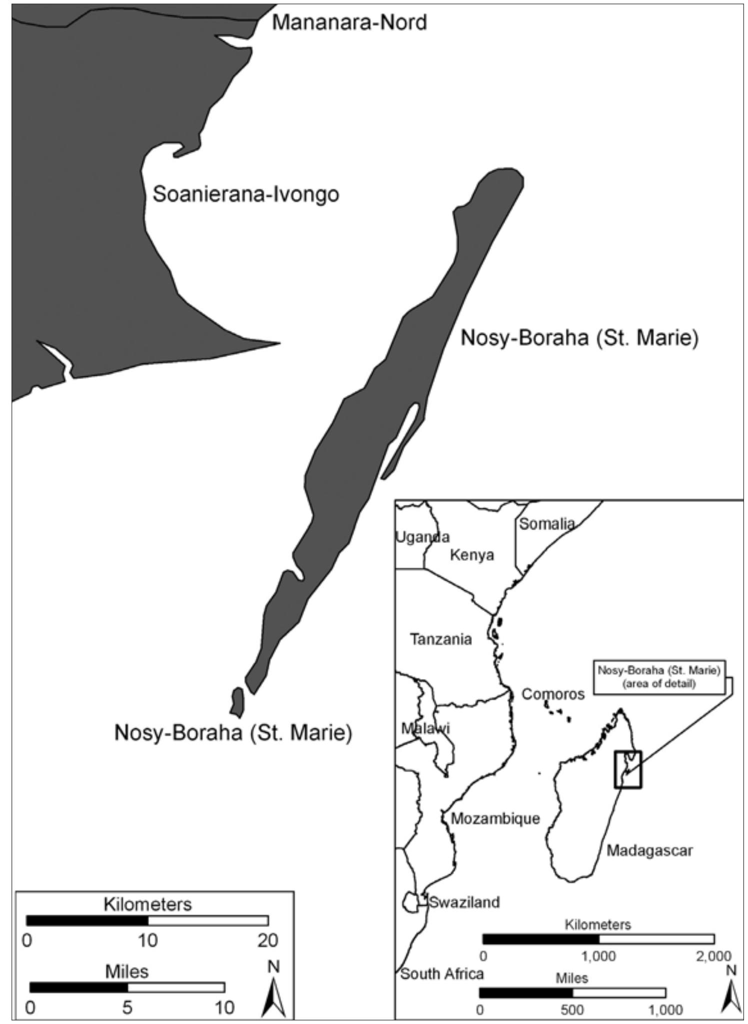

Figure 2. Map of Isle Ste Marie (Map courtesy of Debra Wells, Southeastern Archaeological Research).

Figure 3. Crypt of John Paul Jones beneath the chapel at the United States Naval Academy.

Swete and Rakotoarisoa agreed that the Serapis Project and the Institute should collaborate to locate and identify the wreck site. If a historic shipwreck site was located the proper government agencies would be informed, via the university, in an effort to protect the site. It was also decided that all field research would be conducted in association with the Museum and that Malagasy students would have the opportunity to be involved in the project. It was hoped this would encourage an indigenous base of maritime historians and archaeologists.

In November of 1999 Swete directed an international group of American, French, and Malagasy archaeologists, divers and students, in a remote sensing survey and diver investigation of portions of the harbor off Ambodifototra. The goal was to locate vessel remains that could be linked to *Serapis*. Remote sensing equipment was utilized, including a magnetometer linked to a Global Positioning System (GPS) donated by Panamerican Consultants, Inc. (Panamerican), of Memphis Tennessee. The equipment was deployed off a vessel provided by a local group, Bungalows de Vohilava. Diving operations on high probability targets were conducted with standard Self Contained Underwater Breathing Apparatus (SCUBA) gear.

The remote sensing survey identified three potential targets within the area of the harbor surveyed. The first target examined was identified as a long shot of anchor chain. The second target represented a scatter of ballast stones, copper sheathing, and other cultural material in approximately 45 feet of water. This target area was subsequently labeled the "Copper Site". Copper sheathing was considered a very important indicator of the *Serapis* as it was a recent innovation in maritime technology during the late eighteenth century. The *Serapis* was sheathed in copper and historic research indicates no other copper sheathed vessels in the harbor of Ambodifototra. The third target was a naturally occurring bottom feature.

A limited number of artifacts were recovered from the "Copper Site" in addition to the piece of copper bottom sheathing there was a copper container, a bullet, and an encrusted key. The items, including the copper sheathing and container, stayed in the possession of the University of Antananarivo and was cleaned and conserved by Mr. Pierre van den Boogaerde (Figures 4, 5). The copper sheathing was positively identified as sheathing used to protect a lower hull from bottom fouling and damage from ship worms (*Teredo navalis*). Ideas as to what was held in the copper container ranged from edible oils to gun powder. The other two items recovered including the bullet and the key were brought to the United States and sent to the conservation laboratory at Ships of Discovery in Corpus Christi, Texas for treatment. The objects have since been returned to the University of Antananarivo (Appendix A). The key and bullet appear to post date the sinking of *Serapis* and are considered to be intrusive material, not uncommon in an active harbor environment.

During the 1999 field season no hull remains were identified that could be linked to the *Serapis*. However, the discovery of the "Copper Site" (including copper sheathing, ballast cobble, and cultural debris) provided an indication that a late-eighteenth or early-nineteenth century shipwreck could be nearby. With information gathered from the survey and diver investigations, future search and excavation plans were developed for the next field effort. A

Figure 4. Copper container found in 1999 and conserved by Mr. Pierre van den Boogaerde.

Figure 5. Copper bottom sheathing conserved by the Institute of Civilizations/Museum of Art and Archaeology at the University of Antananarivo.

field report of the 1999 season's activities and results was produced and disseminated to the archaeological community and to project participants (Tuttle and Swete 2000).

2000: Plymouth State University Involvement

Having located cultural material indicating that a late-eighteenth century ship had sunk in the immediate area, Mr. Swete began to assemble an archaeological team, collect excavation materials, and create a plan for the next phase of the project which was to include the excavation of the "Copper Site". As the project developed it became obvious that some form of administrative organization was necessary to provide the project with fiscal credibility. Renowned nautical archaeologist Dr. David Switzer of the Institute for New Hampshire Studies (INHS) at Plymouth State University suggested that the INHS (a non-profit organization) would act as the American academic base and as the fiscal agent for the Serapis Project.

2000: Preliminary Site Investigations

Swete, joined by Maritime Archaeologist Michael C. Tuttle traveled back to Madagascar in the fall of 2000 to handle logistical concerns and prepare for the archaeological investigation of the "Copper Site". A hookah (surface supplied) diving system and underwater pump were procured and tested for the investigation. A work platform was leased from the owners of the Bungalows de Vohilava while docking space was secured on Ilot Madame for the nightly storage of project materials. Initial dives were made at the "Copper Site" to set a buoy and conduct additional equipment testing prior to the arrival of the remainder of the project team.

After the first day of dive operations the program was called to a halt due to confusion among the local authorities relative to the project. Another team of divers, looking for another shipwreck site (allegedly Captain Kidd's *Adventure Galley*), was also working in Ambodifototra Harbor. In an effort to determine the legitimacy of both teams, the Serapis Project crew desisted from all archaeological activity to honor the wishes of local authorities and the University of Antananarivo. As time progressed, Serapis Project volunteer crew members ultimately returned to their homes in the United States, Australia, and Madagascar as they were only available for a short period of time.

As the director of the project, Swete stayed on to determine the reason for the confusion, clear up any problems, and to ensure future field efforts would not encounter similar difficulties. Unfortunately during his stay Swete fell victim to a virulent strain of malaria on Isle Ste Marie and died on November 4, 2000 while awaiting a medical evacuation flight off the island.

2001: Serapis Project Resurrection

In 2001, family members of Mr. Richard Swete, Dr. David Switzer, and various members of the Serapis Project decided that letting the project lapse would be a disservice to Swete's memory and all the time and effort he had put into the project. In addition, allowing the project to lapse could hinder the protection of Madagascar's submerged cultural resources. Mr. Michael C. Tuttle, who had assisted Swete with the previous field seasons, was asked to continue the project as director of the Serapis Project. Tuttle, Dr. David Switzer, and Amy Swete Pruett (Swete's daughter), began to rebuild the project by raising funds and developing plans for a return to Isle Ste Marie.

2004: Return to Isle Ste Marie

In 2003, a generous donation from author Clive Cussler, an advocate of maritime archaeology, permitted a return to Madagascar in May of 2004 by the team members of the Serapis Project. Due to budget constraints no Malagasy students were involved in the 2004 field season.

Using notes from Mr. Swete and materials from the past field seasons the team successfully relocated the "Copper Site". The goal of the 2004 field investigation was to produce a pre-disturbance site plan of the area located in 1999. The site, located at geographical coordinates 16° --. ---' South, 49° --. ---' East, lies in approximately 45 feet of water.

A visual inspection of the site quickly identified two cultural features including stone ballast and copper sheathing. These features typically indicate the presence of a shipwreck, or that a shipwreck may be located nearby, or may be buried beneath harbor floor. No exposed hull structure was observed in the area. A small scattering of other cultural material such as ceramics, glass bottles, and metal concretions were observed in the area. The coincidence of the ballast stones and copper sheathing were considered a very strong indicator that the *Serapis* could be located nearby.

Ballast stones are a very recognizable cultural feature on the sea floor. The shape of river cobbles/beach shingles (rounded and worn) appeared out of place on the harbor floor of Ambodifototra and were obviously introduced to the environment. While these stones could have been deposited at this location as a ballast dump (as has been found in other harbor anchorage contexts), it is generally not customary to dump ballast in an active anchorage but at a location where the material can be reused. Ballast dumps have been reported in shallow water areas such as the foreshore where they would also be rinsed by the action of the tide and still been accessible (Tuttle 1998).

The presence of copper sheathing was also a very good indicator that the *Serapis* might be located near the area under investigation. However, it should be noted that Isle Ste Marie was a French East India Company station and French naval vessels would not have been a rare site in the harbor (evidenced by *Serapis* stopping on the island before transiting to another destination). While it is plausible that one of these vessels may have lost bottom sheathing for any number of reasons the coincidence of both the ballast and sheathing located in proximity to one another begged further investigation.

Diver investigations were conducted for seven days. The team recorded all bottom features, including a sizeable scatter of isolated artifacts, ballast stones, and copper sheathing (Figure 6). No excavation of the site was undertaken during the 2004 field season. Although ballast stones and copper sheathing were recorded across the harbor floor, no ship timbers or hull structure were located (Figures 7, 8). Additional artifacts in the area included ceramics,

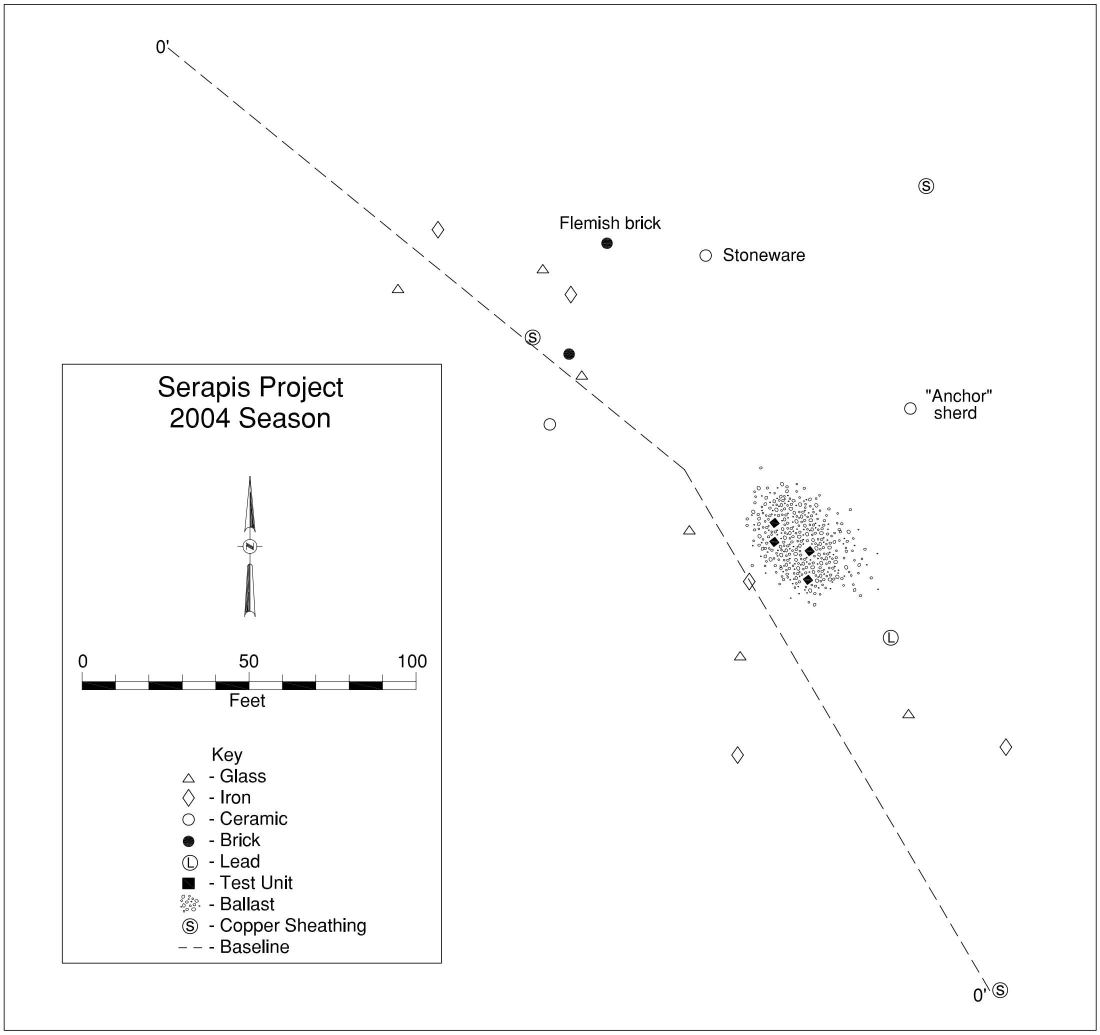

Figure 6. 2004 site plan of the “Copper Site” (Illustrated by Mr. Greg Cook, University of West Florida, digital image by Lee McKenzie).

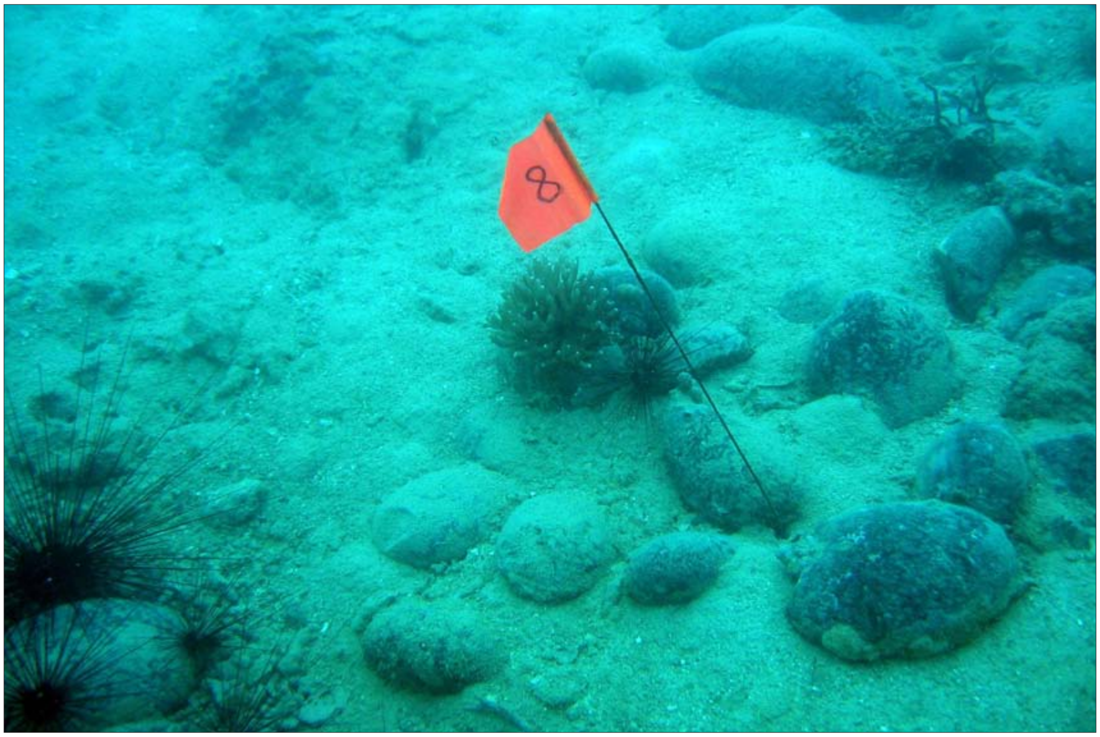

Figure 7. Ballast stones on the sea floor in harbor of Ambodifototra

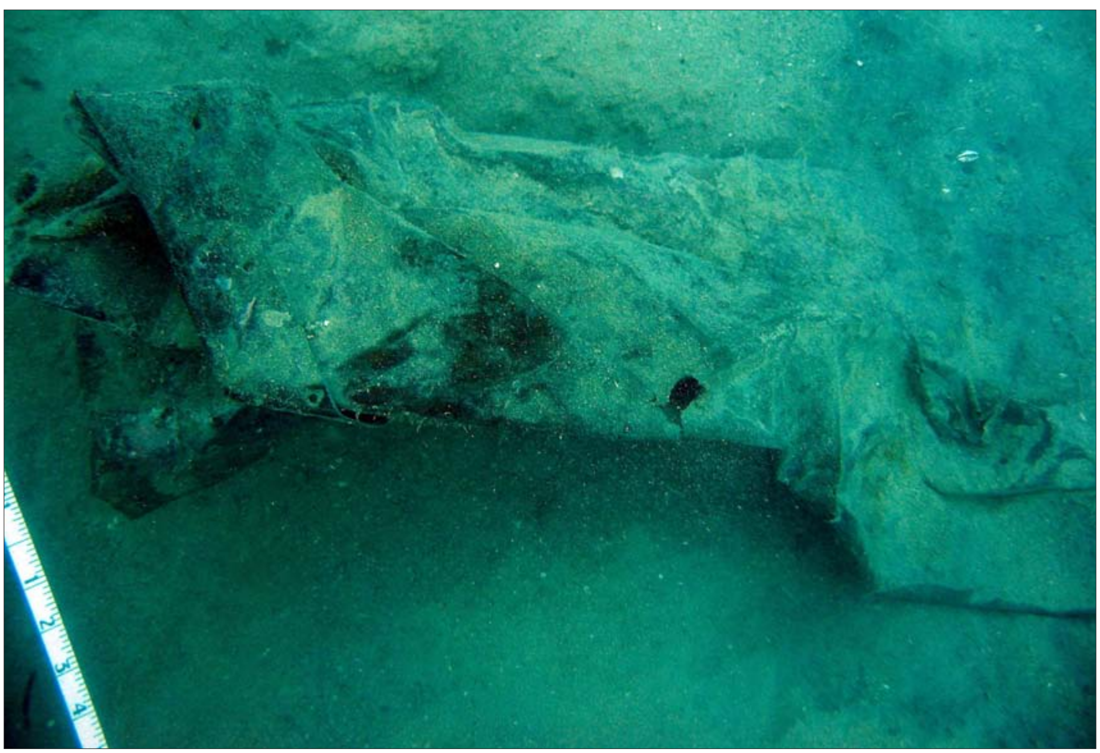

Figure 8. Copper hull sheathing protruding from the seabed.

glassware, and miscellaneous concretions. In addition, the presence of modern debris across the site indicates the harbor has acted as a receptacle for both historic and modern debris for hundreds of years.

Many ideas were posited to explain the lack of hull structure at the “Copper Site”. It was surmised that the hull remains were either buried, destroyed by biologic, chemical and/or physical processes, or were simply not located in the area being investigated by the Serapis Project.

At the close of the 2004 field season, plans for future investigations were developed to focus on locating hull remains associated with *Serapis*. This would entail excavating test trenches beneath the ballast stones and copper sheathing. If hull remains were located, wood samples would be taken to identify the species of wood which might aid in determining where the vessel was constructed.

2008: Current Investigation

In 2008 sufficient funding was secured for another field effort thanks to the generosity and archaeological interests of Ms. Beth Gdowik. In addition to allowing the Serapis Project team to return to Madagascar, enough funding was secured to certify four Malagasy university students to dive. Considered one of the primary goals of the project, this training was intended to provide local Malagasy students with certifications to continue their interests in underwater archaeological and heritage preservation projects throughout Madagascar.

HISTORY OF THE *SERAPIS*

The HMS *Serapis*

His majesty's ship-of-war (HMS) *Serapis* was launched into the River Thames by shipbuilders Randall and Co., Rotherhithe, England on March 4, 1779. She was one of the Thomas Slade-designed, two-decked, 44-gun warships of the Roebuck class that were constructed from the 1770s through the early 1780s (Lyon 1993:79-80). Classified a fifth-rate, by the English classification system, these vessel types generally functioned as frigates. Frigates were too small to be considered line-of-battle ships in the great age of sail. Generally quicker than anything larger and more powerful than anything smaller, frigates were perfect for convoy, communication, scouting or ranging the seas alone or in small groups (Callo 2006:63).

Based on the lines of the *Roebuck*, the HMS *Serapis* was commissioned to be 140-feet long on the lower deck, with a keel of 115 feet, 9-inches length, a beam of 37-feet, 9½-inches with a measured tonnage of 876-26/94 (Figure 9). During the late-eighteenth century ship designs and dimensions could not be exactly replicated, in part due to the different builders, and the materials available. However the ship's builders did an excellent job in the design specifications of the HMS *Serapis*. The length of the lower deck measured 140-feet 2-inches, the keel was 115-feet 7 5/8-inches long, the extreme breadth of the vessel was 38-feet, and the tonnage measurement was rounded out to 888-16/94. The ship drew 10 feet of water forward and 14 feet 2 inches aft when launched. After fitting and rigging the HMS *Serapis* drew over 16-feet (PRO ADM 95/77, Lyon 1993:79). As built, the HMS *Serapis* conformed closely to the overall design of the class.

The two-decked, 44-gun vessel design was considered an interesting naval development. Small and compact, the ships were designed to carry an impressive armament load. The battery on the lower deck was intended for twenty 18-pounder cannon while the main deck included twenty-two 9-pounders as well as two 6-pounders. The "broadside weight" (the amount of shot expended during the firing of a single broadside) of this vessel type equaled 285 pounds of metal. The potential throw-weight of this vessel class, as designed, would have been fearsome to any enemy ship that would have come into contact with this class of vessel.

Another innovation incorporated into many vessels of this class was copper-hull sheathing. Tested in the 1760s, copper sheathing was a new advancement of the British Navy. While the cooler waters of Northern Europe were not conducive to marine wood borers, specifically *Teredo navalis*, as wooden ships began exploring the world's warmer seas they encountered new problems with various forms of marine bore-worms. These organisms eat into the wooden hull of vessels (below the waterline) and over time decrease the ship's structural integrity. Many methods were attempted to prevent this danger from occurring. Careening, the process of beaching a vessel in order to clean the bottom of growth was a common practice. Also many forms of bottom treatments were used to prevent damage from wood

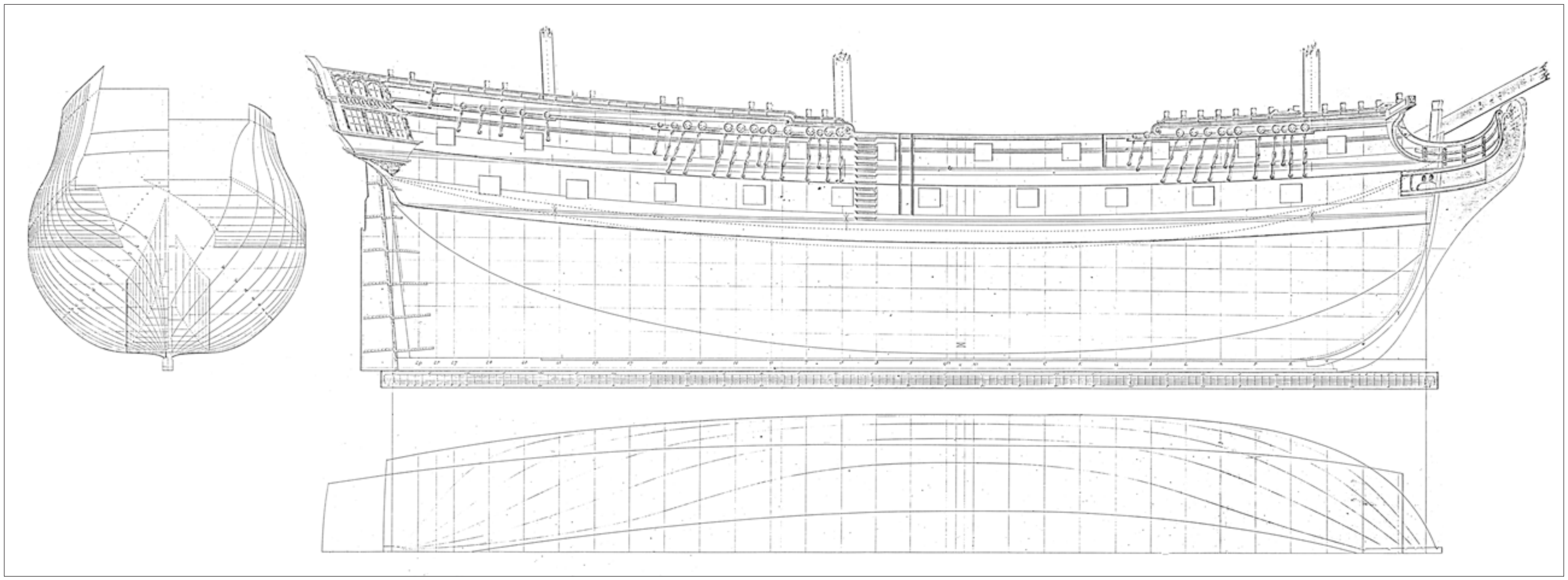

Figure 9. Lines from HMS Roebuck class (from the papers of Dick Swete, reference unknown). The HMS *Serapis* was one of twenty such vessels built.

borers, such as concoctions of pitch, horse hair, and sulfur. One of the most common practices was to place a thin layer of wood over the submerged portions of a hull. Separated by a layer of pitch, horse hair, or some other material this layer was commonly referred to as "sacrificial planking" or "furring." Depending on the amount of time spent in warm tropical waters and biologic activity, vessels had to be routinely careened and the worm-eaten sheathing replaced.

Prior to the 1760s many forms of anti-fouling, anti-boring methods were attempted with varying degrees of success. After numerous experiments coppering the keels (the main structural element of a ship) of several vessels, the British Admiralty believed that copper sheathing was an acceptable deterrent to such a problem. In response the navy conducted a full-scale experiment on the frigate *Alarm* in 1761 by sheathing all the submerged portions of the hull with a thin layer of copper. When *Alarm* returned from two years in the Caribbean her hull was surveyed and found to be virtually free from the effects of any marine-boring organisms. The experiment was considered a success.

In 1763, the *Alarm* and another coppered-hull vessel, the *Tartar*, were sent to the Caribbean for further tests. In addition, a number of other British war ships were sheathed with copper. While there were some problems identified with coppering the lower hull of vessels, the cost benefits outweighed any such problems. By the American Revolution many vessels were coppered and in 1779 the Admiralty decided that the entire naval fleet should be coppered (Cock 2001:450-456).

As copper was an expensive resource and the application labor intensive, only British naval vessels were coppered at first. In addition to the British, the French soon took up the practice of coppering the lower hull of their vessels. As technology increased, merchant vessels began to incorporate the use of copper sheathing as a means of protecting hulls from damage. As metallurgical technology advanced various alloys of copper were developed that could perform the same task at a lesser cost. Copper subsequently fell out of use and was replaced by Muntz-metal and other copper-alloy based sheathing in the 1830s. Therefore, the use of copper, not alloys, can be dated to a relatively distinct date range from circa 1760 to the early nineteenth century. The HMS *Serapis* is known to have been coppered when she sank in 1781.

The first and only journey of the HMS *Serapis* under the British flag was as a guardian to a convoy of merchant vessels transiting to and from the Baltic Sea. The American Revolution was well underway and the HMS *Serapis* was well armed due to privateering activity of the Americans in the North Sea. Due to the heightened risk of attack the HMS *Serapis* carried additional cannon so that instead of her rated 44 guns, she carried a complement of 50 cannon. This increased her broadside-throw-weight to 300 pounds of iron shot. Departing Elsinore, Denmark on what appeared to be a routine mission on September 1st, 1779 the HMS *Serapis*, under the command of Captain Pearson, unknowingly sailed into what would become the most fierce ship-to-ship combat of the American Revolution (Morison 1959:226)

John Paul Jones

John Paul Jones was born "John Paul" at Arbigland, Scotland on July 6, 1747, the son of a gardener. His early upbringing gave no inkling to the maritime prowess that he would later exhibit. He attended school to the age of thirteen and was then apprenticed to the sea on a merchant vessel for seven years. Sailing the Atlantic Ocean as a boy he learned his trade well and became a ship's master by circumstance. On a trip from Jamaica to Scotland in 1768, the vessel's captain died and Jones navigated the vessel safely home. He was then appointed master of the vessel by its owners. Jones' career as a shipmaster was interrupted when he killed a mutinous sailor in Tobago in 1773. As a result, John Paul moved to the American colonies and in 1774 was living in Fredericksburg, Virginia, the home of his brother and his earliest continental contacts. It was during this time that Paul subsequently changed his name to John Paul Jones.

With a new name and a new country Jones offered his services to the Continental Navy and was commissioned a lieutenant in 1775. Although Jones ran up the Grand Union flag on the *Alfred* in 1775, his first command was the sloop *Providence* in May of 1776. During this time Jones was very successful in commerce raiding off Canada. During November 1777, Jones (in command of the *Ranger*), received the first salute in recognition of the American flag by a European power on his way to France. Jones displayed his martial prowess by preying on English shipping in British waters. Relieved of command by a superior officer, Jones used his influence with Benjamin Franklin to obtain an old East Indiaman the *Duc du Duras* which Jones renamed *Bonhomme Richard* in honor of Franklin. It was on the *Bonhomme Richard* that Jones met and defeated the HMS *Serapis*. Jones would then go on to command the *Alliance* (to which he transferred his flag from the *Serapis*), then the *Ariel*, and finally at the end of the war, the *America*.

The apex of Jones' career was while he was in command of the *Bonhomme Richard* (Figure 10). Commanding a Franco-American squadron that circumnavigated the British Isles, Jones caused consternation and fear throughout the islands, in effect creating a diversion so the French could conduct operations in the English Channel. The Americans had successfully brought the war to British waters as they had never experienced it before. During the afternoon of September 23, 1779, while off the east coast of England, sails were seen to the north by Jones and his crew. The sails were from a fleet of merchant ships returning from the Baltic with needed naval supplies. Protecting this convoy was Captain Richard Pearson in the HMS *Serapis* and another smaller vessel the HMS *Countess of Scarborough* commanded by Captain Thomas Piercy. As the convoy headed towards England to fall under the protection of the fort at Scarborough Castle, Jones and his squadron headed north in pursuit of the *Serapis* and *Countess of Scarborough*.

The HMS *Serapis* and *Bonhomme Richard* paired off to battle each other in what resulted in the fiercest ship-to-ship naval battle of the American Revolution. The ships began a contest that lasted approximately three and a half hours. The battle opened with the HMS *Serapis* getting off the first broadside. The ships sailed, fired, and sailed again a number of times. Then, at close quarters, both vessels became entangled and the fighting became more fierce

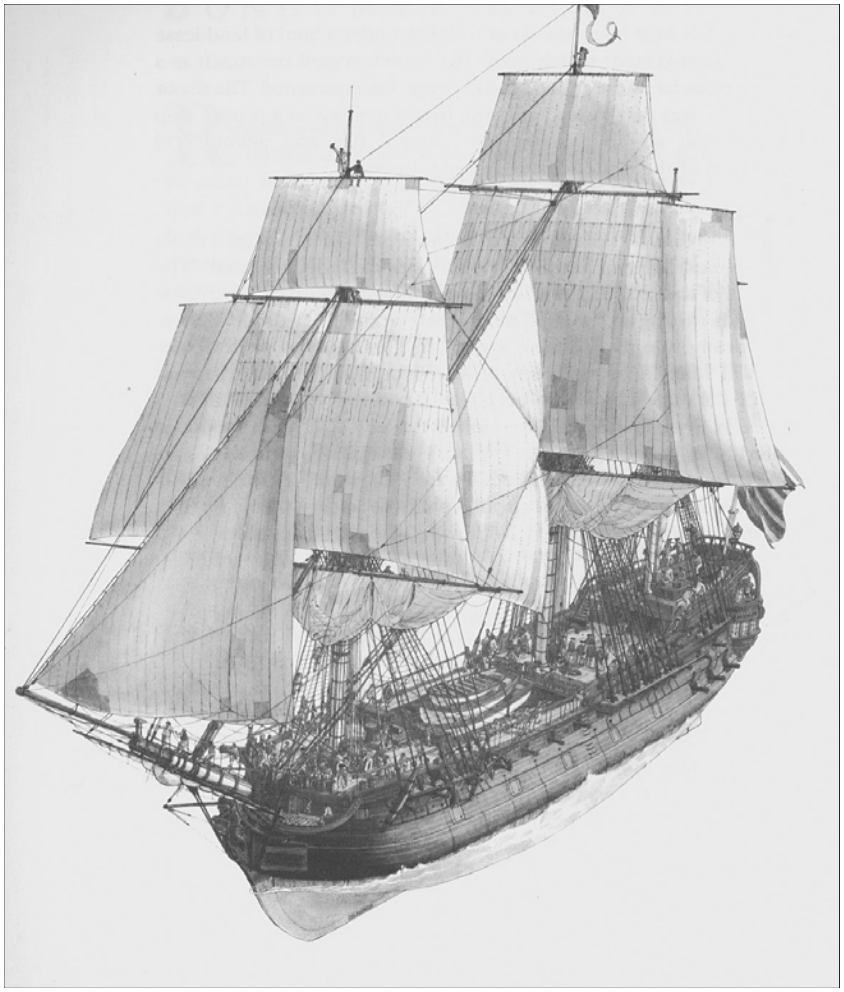

Figure 10. The *Bonhomme Richard* (Image courtesy of William Gilkerson).

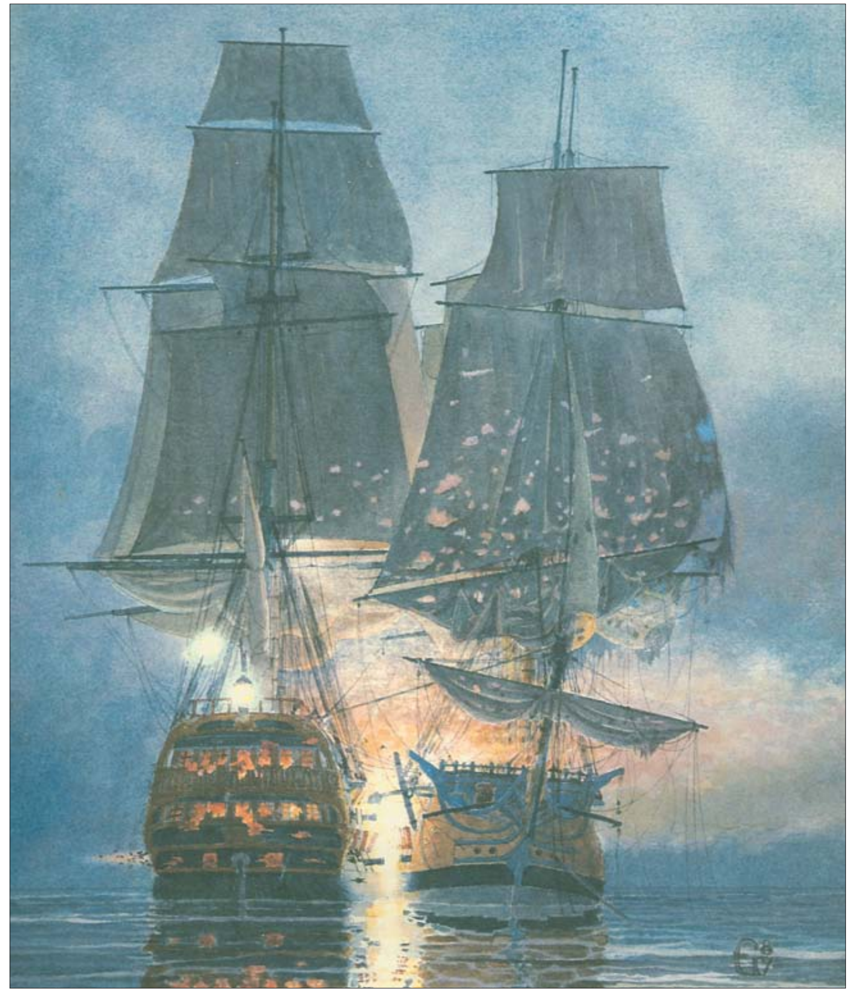

Figure 11. The battle between the *Bonhomme Richard* and the HMS *Serapis* (Image courtesy of William Gilkerson).

and bloody. At one point the men on both ships ceased firing on each other, fought fires on board each of their respective vessels, and then resumed the contest (Figure 11).

During the battle two junior officers on the *Bonhomme Richard* erroneously assumed that their senior officers were killed and therefore thought that that they were in command and called for quarters from the British. Jones hearing this was angered and hurled his pistols at them and quickly reestablished his authority. Pearson on hearing 'Quarters,' asked if the *Bonhomme Richard* was ready strike its colors, thereby giving up. What exactly Jones said has been lost to time, but the immortal words, "I have not yet begun to fight," are what was popularly reported and have become lore.

Pearson seeing that the convoy was safe under the guns of the Scarborough Castle, and recognizing that he did his duty saw no sense in continuing the battle. Around 10:30 PM, Pearson struck his colors and the battle came to an end. Almost half of both crews were killed or wounded (approximately 300 men) and both ships were extensively damaged.

The American strategy had been to disable the HMS *Serapis* by firing into her rigging and clearing the decks with small arms fire. Because of this, *Serapis* was dismasted. On the other side of the battle the English strategy concentrated on firing on the hull of the aged *Bonhomme Richard*. The English strategy also worked, as the day after the battle the *Bonhomme Richard* (the victor of the fight) sank into the North Sea (Figure 12). Jones transferred his flag to the *Serapis* and sailed to the Netherlands, as per French orders.

The victory over the British was met with wild enthusiasm in America as the war had not been going well for the Continentals. The British had taken Georgia in the south and the Penobscot expedition was a huge failure in the north. In addition, the French plan to attack England's southern shore was aborted earlier in the year. Thus the action of Jones and his squadron circumnavigating the British Isles and taking a British frigate was seen as a major success and was trumpeted as such. While Jones was seen as a hero to both the Americans and French, Jones represented a problem for the neutral Dutch. Due to various political machinations Jones transferred his flag to the *Alliance* in November and before the New Year sailed out of the Netherlands.

Command of *Serapis* transferred to the commander of the *Pallas*, Commandant Cottineau who sailed her to L'Orient, France. The battle-damaged *Serapis* was repaired by razeeing (the removal of the upper deck), re-armed, and coppered in the French shipyard. After refitting she was put under the command of Lieutenant de Vaisseau Roche and sent to the Indian Ocean in support of Admiral Suffern whose fleet was protecting French interests from the British.

Reaching the Cape of Good Hope Roche landed some of his ill mariners and then proceeded to the Indian Ocean stopping at Isle Ste Marie, Madagascar. While the captain was ashore attending to ship's business in July 1781, a junior officer was cutting the crews' brandy ration and a lantern (held by another mariner) started a fire in the spirit room that rapidly spread and lead to the loss of *Serapis*. There was a minor attempt to salvage cannon and other important pieces of the wreck, but the site was eventually abandoned.

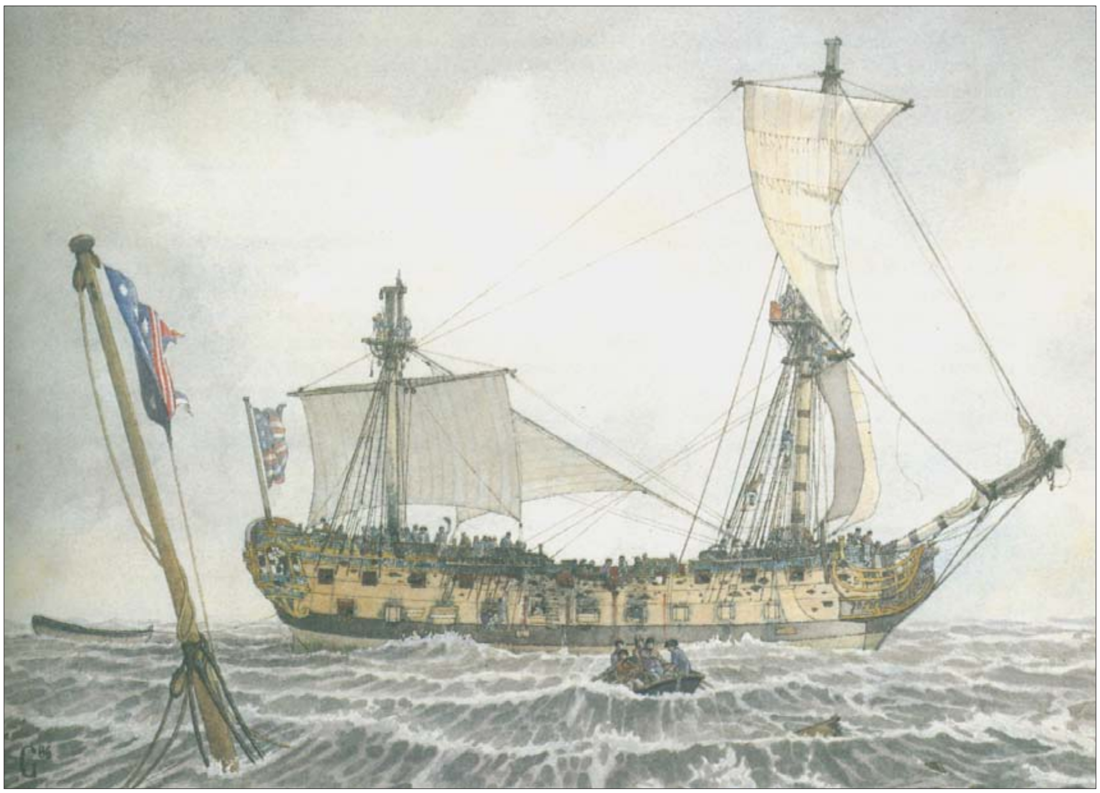

Figure 12. Last view of the *Bonhomme Richard* from the HMS *Serapis* (Image courtesy of William Gilkerson).

INVESTIGATIVE METHODS

Research Design

Fieldwork for the 2008 season consisted of two components. The first component provided dive training for four Malagasy students and the second consisted of an initial recordation of the "Copper Site" located in 1999. The methods involved with training the Malagasy students consisted of both classroom time as well as in-water instruction. All work with the students was conducted on Isle Ste Marie.

Initial plans to return to the "Copper Site" consisted of locating and identifying any remaining hull structure potentially associated with the *Serapis*. Since the site had already been located in 1999, a Global Positioning System (GPS) was required to return to the site. However, prior to returning to Isle Ste Marie, the Serapis Project was informed of a previously unknown shipwreck located due west of the "Copper Site". The wreck had been located by a Malagasy diver who subsequently reported the find to Henry Bellon de Chassy (Proprietor, Bungalows de Vohilava) and local dive operator Max Felici.

An initial dive on the site by Felici identified several visible features including an anchor, several cannon, miscellaneous artifacts, and a substantial ballast mound consistent with a late-eighteenth shipwreck site. Considered worthy of investigation by professional maritime archaeologists associated with the Serapis Project, the focus of the 2008 field season shifted to investigate this wreck site prior to any additional work at the "Copper Site".

Environmental Conditions

In November 2008 conditions off Isle Ste Marie were ideal for diving during the investigation. The Port of Ambodifototra on the leeward/west side of Isle Ste Marie (where the suspected wreck site is located) protects the site from the brunt of easterly winds and waves which typically develop across the full reach of the Indian Ocean. As the winds were generally from the east there was no difficulty with the sea state during dive operations (Figure 13).

Atmospheric conditions were generally sunny with temperatures ranging from 70°F (21.1°C) to 80°F (26.6°C) and boat work was comfortable due to a consistent offshore breeze. Occasional periods of rain and cloud cover protected the crew from sun exposure. The crew maintained a constant intake of fluids for proper hydration during all dive operations. The surface water temperature was approximately 80° F (27° C).

The wreck site is located in 75 feet (23 meters) of water making bottom times for divers limited. Light penetration was excellent and visibility on site ranged from 10-30 feet (3-10 meters). Water clarity and light conditions within the harbor were excellent allowing for digital still and video imaging of the site. There was some tidally-induced current over the site which did degrade visibility occasionally. The sea floor around the site generally consists of small disarticulated corals covered by a layer of sterile silt/sand. The wreck site itself acts as an artificial reef to a variety of life forms including corals and fish. This included long-spined sea urchins and lion fish which were avoided during all dive operations.

Figure 13. The dive site looking east-south-east toward Ilot Madame.

While sharks have been observed in the area, none were observed during the current investigation.

Madagascar (including Isle Ste Marie) regularly receives annual storms during the cyclone season (typically December through April). Preceding both the 2004 and 2008 field investigations Isle Ste Marie was hit by tropical cyclones. In February of 2008, the eye of Cyclone Ivan passed directly over Isle Ste Marie. Media reports indicated that large portions of the Isle Ste Marie's infrastructure were destroyed. The shipwreck remains investigated during the current field season are located in approximately 75 feet of water and apparently have not been affected by any cyclonic event (including increased wave action, surge, or tidal activity). This is evidenced by the overall integrity of the site.

Commercial traffic into and out of the harbor was moderate during the 2008 field season. The Port of Ambodifototra is the main harbor for Isle Ste Marie and there has been a steady rise in tourism and tourist infrastructure since the initial investigations in 1999. Daily ferries, dive charters, local fishing craft, and a number of other vessels transit the harbor daily. On one afternoon the passenger cruise ship *Hanseatic* anchored approximately 200 yards from the site and numerous motor launches transiting passengers to shore passed the site during dive operations.

Personnel

Two phases of the current investigation included fulfilling an agreement with the Museum to provide dive training to local university students and archaeological investigation/recordation of the suspected *Serapis* site by maritime archaeologists associated with the Serapis Project. Four students were selected by Dr. Chantal Radimilahy of the Institute of Civilizations/Museum of Art and Archaeology at the University of Antananarivo for dive training based on their interest in Madagascar's underwater heritage (Figure 14). They included Eric Randrianantenaina (who had assisted the project during the initial remote sensing phase in 1999), Richard Andrianavalomahefa a student at the National Institute of Tourism and Hotel Business (INTH) in Antananarivo (who is preparing for his Sustainable Tourism Development degree), Annita Ramanankierana, a student of archaeology in the Civilizations Department at the University of Antananarivo, and Seraphin Herifanomezanjo, a student of history from the University of Tamatave.

Initial logistics and dive training were conducted by Serapis Project Director Michael Tuttle and Justin McNesky, a certified National Association of Underwater Instructors (NAUI) instructor. Classroom sections of the class were conducted at the Bungalows de Vohilava, located along the southwest coast of Isle Ste Marie. All in-water training was conducted within the protected reef system at the Princess Bora Hotel, also located along the southwest coast of Isle Ste Marie. Mr. Max Felici of the Il Balenottero Dive Center provided SCUBA equipment, the dive boat, and support for all the open water dives. Water depths in the protected anchorage off the Princess Bora Hotel averaged 15 feet (5 meters), perfect for beginner dive training exercises. The management of both hotels welcomed the student training at their facilities in support of the conservation and preservation of Madagascar's submerged cultural resources.

Figure 14. The dive instructors and student divers (from l. to r.) NAUI Instructor Justin McNesky, Annita Ramanankierana, Eric Randrianantenaina, Seraphin Herifanomezanjo, Richard Andrianavalomahefa and NAUI Instructor Max Fellini.

Figure 15. 2008 Serapis Project dive crew holding the flag flown by John Paul Jones during the battle of Flamborough Head (from l. to r.) Kelly Bumpass, Norine Carroll, Michael Tuttle, Michael Krivor, Jason Burns, and Justin McNesky.

After the student dive training was successfully completed the next phase of the project kicked off under the direction of Project Director Mr. Michael Tuttle and Dr. Radimilahy. The 2008 field crew consisted of Mr. Michael Krivor and Mr. Jason Burns, maritime archaeologists from Southeastern Archaeological Research Inc. (SEARCH), Ms. Norine Carroll, collections manager at the University of West Florida (UWF), and Mr. Kelly Bumpass, graduate student from East Carolina University (ECU). In addition, Mr. Justin McNesky, a NAUI Instructor, also provided dive support during a portion of the field investigation.

The 2008 participants are trained maritime archaeologists familiar with all phases of the submerged cultural resource archaeological investigations (Figure 15). Mr. Max Felici of Il Balenottero Dive Center (conveniently located at the Port of Ambodifototra) again provided his services as boat captain and diver. All logistical support, including housing and transportation, was provided by Mr. Henry Bellon de Chassy, the proprietor of the Bungalows de Vohilava.

Dive Operations

All dive operations were conducted utilizing Self Contained Underwater Breathing Apparatus (SCUBA). Due the depth of the wreck site investigated (75 feet/23 meters) and safety concerns (including the potential for decompression sickness (DCS), repetitive dives, and lack of a local decompression chamber), dive times were limited to no decompression limits. Standard U.S. Navy dive tables were utilized during each dive. Additionally, a 3 minute safety stop at 15 feet (5 meters) was incorporated into every dive plan. With such safety measures in place each two-member dive team had approximately 30-35 minutes of bottom time to complete their daily assigned tasks. A total of 49 dives were made on site during the 10-day field season.

Reluctantly, it was decided not to include the newly-trained Malagasy students due to their lack of dive experience, the depth of the wreck site (75 feet/23 meters), and paucity of emergency facilities (primarily a recompression chamber) on Isle Ste Marie.

Archaeological Methods

The goals of the archaeological investigation of the unidentified shipwreck located in the harbor of Ambodifototra included a pre-disturbance site plan, visually investigating the site to determine whether or not it may represent the remains of the *Serapis*, and to collect sufficient data to develop an efficient excavation plan for future investigations of the site.

To produce the pre-disturbance site plan a baseline was established on the north side of the wreck site. This baseline was oriented parallel to the wreck site. It is important to establish a baseline, as archaeology can be a disruptive and destructive process. Therefore any pre-disturbance data collected prior to any subsequent excavations is essential. Botma and Maarleveld observed while working underwater, “Accurate maps hardly ever exist, working conditions often impede the use of certain techniques and bottom-time efficiency must be maximized” (Botma and Maarleveld, 1987:87).

An off-set method of data recovery (off the baseline) was utilized as it is one of the quickest and most basic methods to create a two-dimensional representation of the site in plan view. The baseline was approximately 155 feet long with both ends of the baseline extended past the exposed material on the harbor floor. Both ends of the base line were geo-referenced using a GPS and surface floats tied to each end of the baseline. Site features were measured in with fiberglass tapes running perpendicular from the established baseline. Measurements included the extreme length and width of the exposed wreck site, as well as the location of diagnostic features such as cannon, anchor, brick concentrations, and ballast. Although not as accurate as tri-lateration (measuring a single point relative to multiple known points), depth and time constraints dictated the methods utilized in the field.

All measurements taken underwater were recorded in feet and inches. The *Serapis* was constructed in an English shipyard where the base measurements were in feet and inches. Therefore measurements of ship structure should conform to this standard. Additionally, *Serapis*, when taken into the French service, was refitted and any improvements or additions would have conformed to French standards (which were somewhat larger). Both systems were slightly different and this variation in scales was noted for post field work analysis. For example in comparing French to English measurements; 1 pounce is equivalent to 1-1/16 inches, 1 pied is equivalent to 12-3/4 inches and 1 livre is equivalent to 1.08 pounds (Bryce 1984:8). Finally, all small artifacts recorded were measured in both inches and centimeters.

In addition to the development of the pre-disturbance site plan, both still and video images were collected over the wreck site. These images were collected to obtain additional and more accurate data to improve the interpretation of the site. To assist in the recordation of the site a Canon PowerShot SD870 IS digital camera in conjunction with a Canon WP-DC17 underwater housing. Rated to a depth of 130 feet (40 meters) the housing is constructed of a polycarbonate and has positive buoyancy. The WP-DC17 also has a flash diffuser which is helpful in an underwater environment. The camera has 8.0 megapixels of resolution, an Optical Image Stabilizer and 3.8x optical zooming feature. The camera has a large, high-quality 3.0-inch PureColor LCD screen with wide angle viewing which is useful in an underwater environment. The focal length of the Canon PowerShot SD870 IS is 4.6-17.3mm f/2.8-5.8 (35mm film equivalent: 28-105mm).

The Canon was used to digitally record all exposed features of the wreck site, as well as to assist in creating a photomosaic. By combining numerous single images a composite representation of the site can be produced. A photo mosaic can produce a near photographic representation of the site, but there are also errors introduced by optical shifts due to the position of the camera while taking images of overlapping areas from different points.

Video recordation of the site was also undertaken. A small, light-weight Sony Super Steady Shot Mini Digital Video (DV) camera was used for video imaging the site. This camera was housed in a Gates Underwater Products, Sony PC7/PC10 underwater housing. A red filter was also engaged to improve color quality and clarity of images. To collect overlapping footage of the entire wreck site a diver would swim over the wreck at a predetermined depth. (15 feet off the seafloor). Due to limited bottom times it was decided that swimming parallel to the baseline (east/west) was more advantageous than collecting video perpendicular to the baseline. Several prominent site features, such as the anchor and various cannon, were recorded from multiple angles. Additionally, some video measurements were attempted across the wreck site. Due to somewhat limited visibility and the substantial size of the overall wreck site, one complete video image of the entire wreck site could not be obtained.

The data collected via the pre-disturbance site map, still photographs, and underwater video helped to generate an initial assessment of the site. This data can be useful in observing site characteristics and assist in developing future research and excavation plans. Finally, all three forms of data can be used to help understand the processes that have acted on (or are continue to act on) the shipwreck remains, and act as a baseline to any future recordation of the site.

Recordation of individual components of the site was undertaken using standard measuring tapes. This included all cannon visible onsite, the anchor, the unidentified "box" located amidships, as well as other small diagnostic artifacts. Measurements of these individual objects are useful for determining scale and accuracy to the pre-disturbance site map. In addition these measurements can be used alone to determine the approximate size or weight of a cannon and/or anchor.

During the 2008 investigation no excavation of the site or collection of artifacts was undertaken. The primary reason for not collecting any artifacts was that no facilities for conservation had been established prior to the investigation. However, a limited number of diagnostic artifacts (exposed on the wreck site) were recovered, measured, photographed, and re-deposited on site. These items were considered diagnostic and may assist in determining a temporal or cultural affiliation of the wreck site. Additionally, a small number of artifacts recovered from the purported *Serapis* by local divers (prior to the initiation of the current project) were recorded and photographed. These artifacts were desalinated to stabilize them from further deterioration. While the provenience of these artifacts can not be accurately established (as they were removed without archaeological control), they may assist in providing insight into the identity of the shipwreck in question.

The methods used to conduct the 2008 preliminary recordation of the shipwreck in Ambodifototra Harbor were conducted in an effort to identify the site as that of the *Serapis*. This includes the development of a pre-disturbance site plan, a photo mosaic (using still photographs), and the collection of video imagery. In addition, a number of artifacts were recorded and analyzed to assist in providing a temporal analysis of the site. These findings can then ultimately be compared to the *Serapis* in preparation for future research questions and excavation plans.

RESULTS

Dive Training

The initial phase of the 2008 field season was to provide dive training and certifications to four Malagasy students. During the 1999 and 2000 field efforts Malagasy students were involved with the Serapis Project and received "on the job" training for diving. While this process allowed students to familiarize themselves with the theory and techniques of diving they did not receive an internationally recognized dive certification (such as NAUI) that would allow them to dive outside of Madagascar if the opportunity arose. During the 2004 field season no students were involved with the project due to time and monetary constraints. It was agreed that providing a new group of students with dive training from a qualified dive instructor should be a project goal in 2008 (Figure 16).

All of the students satisfied their classroom and open water requirements and received international NAUI dive certifications. While it was hoped the students would be able to assist in the investigation of the purported *Serapis*, the depth of the wreck to be investigated (75 feet), relative lack of emergency services (i.e., a recompression chamber), and lack of dive experience counteracted their participation.

Archaeological Investigations

Prior to the initiation of the 2008 field season it was brought to the attention of the Serapis Project that a local diver had recently located a shipwreck site approximately 300 yards west of the "Copper Site". This site became the object of the 2008 field effort and emphasizes the importance of utilizing local knowledge for archaeological investigations. The wreck site, in 75 feet of water, is located at approximately 16° --. ---' South, 49° --. ---' East.

On November 20, 2008 archaeologists with the Serapis Project (with the guidance of local dive shop owner Mr. Max Felici) made an initial inspection of the unidentified shipwreck located in the harbor of Ambodifototra. Descending to the wreck site divers quickly noted the presence of a large, nineteenth century folding stock anchor sitting upright on the harbor floor, approximately 50 feet north of the unidentified wreck (Figure 17). Although the anchor (which post dates *Serapis*) is not associated with the investigated wreckage, it does represent evidence of continual harbor use.

Proceeding south from the folding stock anchor divers quickly observed the remains of a sizeable shipwreck, including an eighteenth century anchor, intact ballast mound, numerous iron cannon, a large metal box (approximately 5 feet square), and a variety of exposed artifacts. The ballast mound rises off the seafloor approximately 8 feet in some areas and is heavily encrusted in coral and other marine growth. Proceeding to the west end of the wreck divers observed a number of lead ingots. These ingots are approximately 3 feet in length with a width of 6 to 8 inches. A small hole was observed near the end of a number of the ingots. This hole was likely used to assist in transporting the ingots on and off the ship or for moving them whilst on the ship (via a rope that was strung through the hole).

Figure 16. Malagasy students in the harbor of Ambodifototra completing their open water dive.

Figure 17. Diver swimming past a nineteenth century anchor north of the suspected *Serapis* site.

After the initial dive on the wreck site Serapis Project team members determined that the site warranted additional investigation in the form of a pre-disturbance site map, still and video documentation, and the recordation of prominent features of the site including cannon, anchor, and a variety of other exposed artifacts.

The first step of the investigation included establishing a temporary mooring onsite. It was decided that the mooring line would be tied to the large iron anchor located amidships and a small float would be established just below the water surface for easy relocation each day. This would allow divers to proceed directly to the wreck site without wasting valuable bottom time searching for the wreck site. The float was tied just below the surface of the water so as not to attract the attention of locals who may have an interest in looting the site or making off with the float. Once the mooring was established the location of the float was obtained using a GPS so that it could be easily retrieved each day prior to dive operations.

After the mooring was successfully established a baseline (using a fiberglass measuring tape) was positioned north of the site, parallel to the wreck site. Oriented approximately east/west this baseline extended past both exposed ends of the wreck site allowing for the exposed portions of the wreck to be mapped in using offset measurements. Six-foot sections of iron rebar were driven into the harbor floor to secure each end of the baseline.

Due to the large number of exposed cannon strewn across the site it was decided to individually tag each cannon with numbered flagging tape. Tagging the cannon assisted in orientation of the site during site recordation. A total of ten exposed cannon were tagged prior to the mapping of the site.

Once the baseline was established divers began recording the exposed portions of the wreck site. This was conducted by pulling additional measuring tapes (perpendicular to the baseline) across the wreck site and recording all exposed features. This was done in 5-foot intervals (off the baseline) until the entire wreck site was recorded. After each day of diving the notes/sketches from each dive were transferred to a master site plan (Figure 18).

Due to adequate visibility on site, still photographs were taken in hopes of producing a photo mosaic of the wreck site. Utilizing a digital camera in an underwater housing the diver proceeded from the baseline across the wreck site taking pictures 15 feet above the wreck. Working at 5-foot intervals (along the established baseline) the diver took enough pictures along each transect to ensure each photograph overlapped. Each transect from 0 feet (west end of the wreck) to 150 feet (east end of the wreck site) was successfully photographed with the digital camera. A total of thirty transects were completed over the wreck site. While a number of transects have been successfully stitched together (Figure 19), the photo mosaic is still being produced and will be available at a later date.

In addition to still photographs, a substantial amount of video footage was also obtained from the wreck site. This included using a diver to swim over the wreck numerous times to record all exposed features of the wreck site. The diver completed this video recordation of the site by swimming transects parallel to the baseline approximately 15 feet above the wreck site until the entire wreck site was documented. Additional video footage of diagnostic artifacts

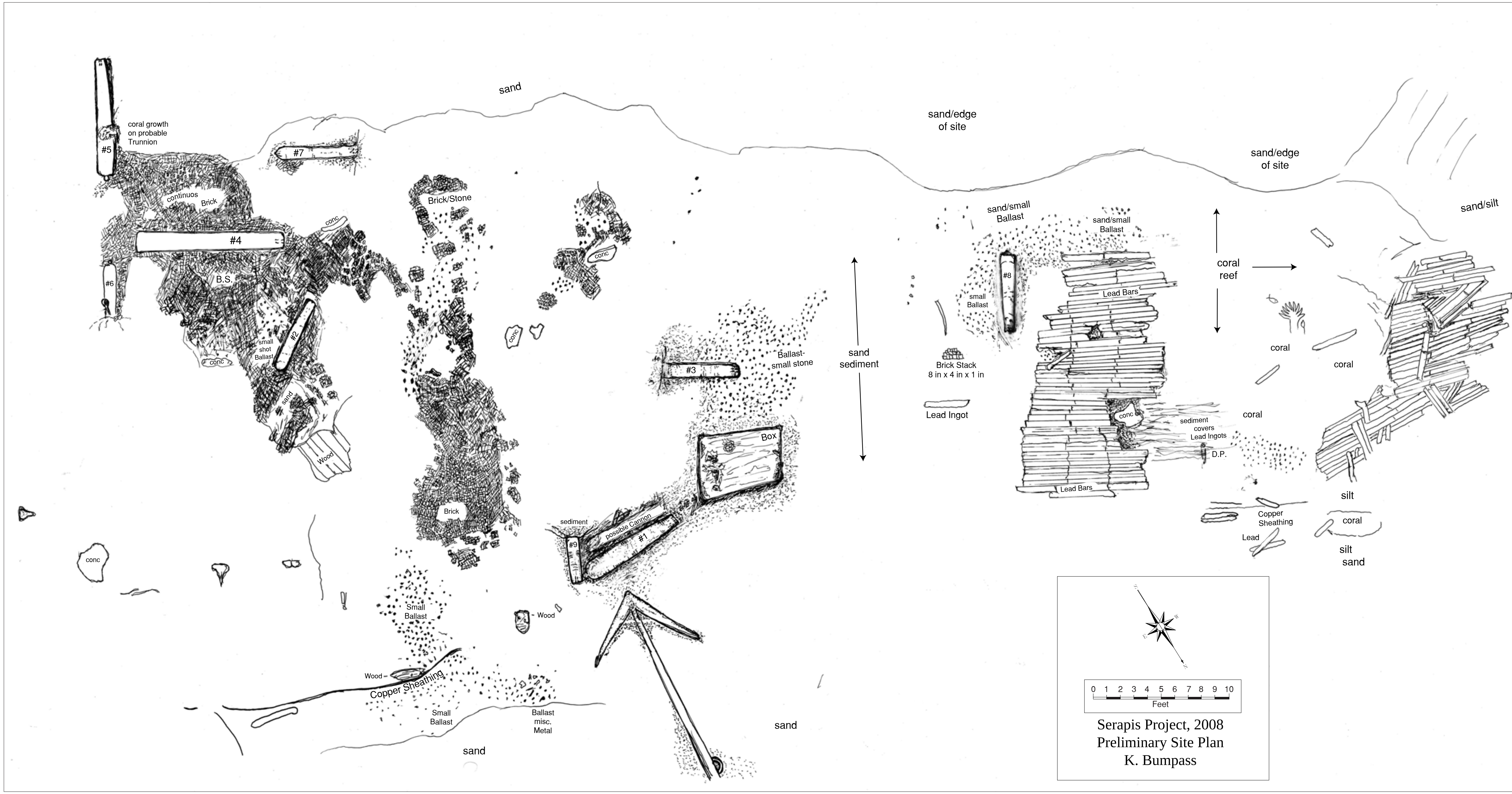

Figure 18. Preliminary site map of the remains investigated in 2008 (Illustrated by Mr. Richard Kelly Bumpass, East Carolina University, digital imaging courtesy of Lee McKenzie, University of West Florida).

Figure 19. One transect of photographs stitched together will help produce a complete photo mosaic of the wreck site.

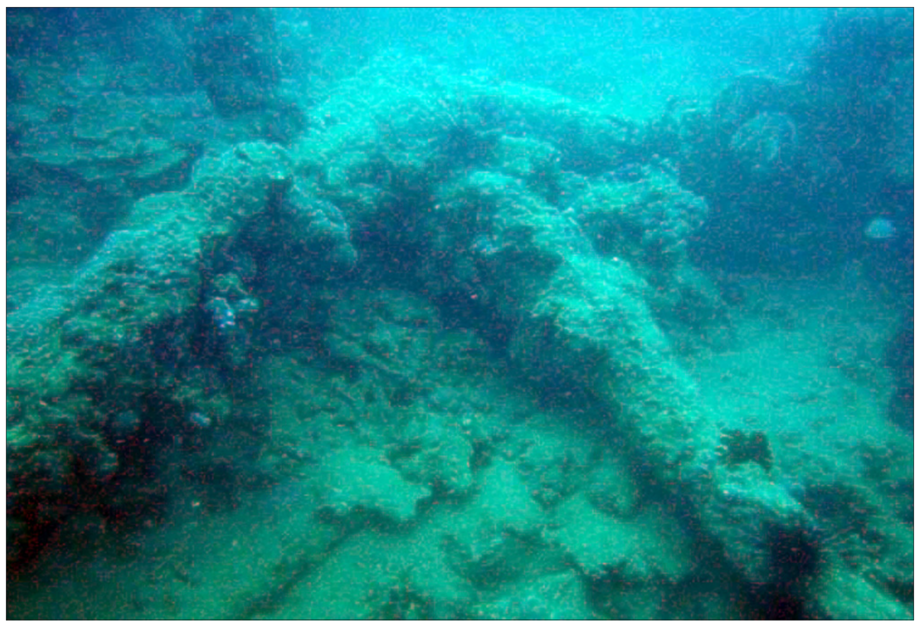

Figure 20. A large iron anchor located amidships along the north side of the wreck.

such as the anchor, cannon, ballast, and other exposed features was obtained.

Once data for the pre-disturbance site plan was gathered, archaeologists began recording individual components and artifacts associated with the wreck site. This included the anchor, all exposed cannon, lead ingots, ballast, brick, and the large box located amidships. The following is a brief analysis of these various features and artifacts investigated during the 2008 field investigation.

Anchor

One of the most distinct features of the wreck site investigated in 2008 is the presence of a sizeable iron anchor situated along the north side of the exposed wreck. Located approximately amidships this anchor sits on the side of exposed wreck with the crown of the anchor facing south (Figure 20). The measurements taken from the anchor are as follows. The shank length of the anchor is 12’ 11”; length of arm from crown to bill is 6’ 6”; the palm length was 9” and its width was 10”. The anchor has a distinct ‘pointed’ crown and a ‘nut’ at the opposite end of the shank where the wooden stock would have been attached. Both of these features are common to eighteenth century Admiralty style anchors and generally disappear by the nineteenth century.

Many anchors do have a maker’s mark on the crown. Both French and English anchors of the late-eighteenth century are known to have these identifying characteristics, especially if they were government property used in national service. Attempts to remove the concretion on the crown of the anchor to see if there was a mark for identification purposes were unsuccessful. The concretion was too hard to be removed with a chisel and sledge hammer. Information potentially contained on the crown underneath the concretion will be crucial on identifying the nationality of the anchor.

Another common feature of eighteenth century anchors is a large ring for the anchor cable. A large diameter ring was necessary so that the cable (typically a large diameter piece of natural fiber rope), could be attached. The ring on this anchor had a diameter of approximately 15 inches.

Anchors are a very important part of a ship’s hardware. They were used to keep a ship safe in a tranquil harbor or safe during a raging storm. A ship the size of the *Serapis* (circa 888 tons) would have had several anchors for various purposes. “The Established Sizes and Weights of Anchors for the Royal Navy, c1763” indicates that a 44-gun ship should have six anchors; four bowers, one stream and one kedge, published values for 1809 and 1825 are also the same. A bower was considered to be the main anchor for a vessel and one would be prepared for immediate use in case of an emergency. A stream anchor was a smaller anchor and usually carried in the aft portion of a vessel and utilized while at anchor to keep the vessel from swinging. The smallest anchor, a kedge, was used to move a vessel by dropping the kedge anchor from a ship’s boat a cable length ahead and then hauling the ship up via the capstan (Steffy 1994:266-267).

Serapis should have been outfitted with a minimum of six anchors, at least one of which was lost during the battle. When Jones transferred his flag from *Serapis* to the *Alliance* on

November 21, he ordered that supplies be removed to his new ship. No anchor was enumerated on the inventory of that day. Later, on February 17, Jones ordered one anchor (3,200 lbs.), retrieved that was left by *Serapis* (Barnes 1911: 41, 69). For purposes of this of this discussion, Royal Navy anchor information will be used for comparative analysis. Additionally, four anchors, bower and sheet, were located at the *Endymion* site, a sister-ship to the *Serapis* (Keith 1998:213).

The recorded dimensions of this anchor do not match those reported for a 44-gun ship. The length of shank for a bower should be 15' 10", stream 10' 2", and kedge 8' 3". The 12' 11" measurement falls between the two larger recommended models. An estimated weight for the anchor based on its measurements and tables in Curryer is approximately 19 cwt (2,128 lb) (1999:56). This is approximately ½ the weight of a bower and double the weight of a stream for a 44-gun ship. The weights of anchors for a 44-gun ship are reported to be 40 cwt (4,480 lb) for a bower, 10 cwt (1,120 lb) for a stream and 5 cwt (560 lb) for a kedge.

This anchor may be considered to be the proper size of a bower for a 400-ton vessel (approximately). This raises the question of the tonnage of *Serapis* after being razeed by the French. Also, if the "Established Size and Weight," table was only a recommendation rather than being an absolute the differences from the observed and reported information can be explained. Further research into the specific equipment provided to the *Serapis* when it was fitted out by the French may provide a reason for the apparent difference. Morison reports that when Jones transferred his flag from the *Serapis* to the *Alliance*, he also "…transferred a certain amount of equipment…" (Morison 1909:41). Lastly, when the French razeed the *Serapis* (creating a lighter displacement measurement for the ship), the vessel would not have required anchors as large as originally recommended. More archival research is required to explain the apparent historic and archaeological discrepancies.

The anchor found on site conforms to the eighteenth century wooden stocked Admiralty anchor design (Figure 21). However, its dimensions do not accord exactly with information in the referenced tables. Curryer notes that even if dimensions are taken from an establishment table, "… that anchors frequently vary considerably from them…" (Curryer 1999: 56, 59-60, 75). One might make the case that there was greater uniformity in industrial production methods of the nineteenth century than during the production of similar objects during earlier periods of the Industrial Revolution. Therefore, one may expect to find more variability in earlier products and not be surprised by differences between 'established' rates and those found on site.

Ballast

Two types of ballast, consisting of stone, river cobble (also referred to as "shingle") and metal bar ballast, were observed within the remains of the extant hull. Lavery indicates that ships carried both types of ballast (typically four times as much stone ballast to iron, although proportions did vary) (Lavery 1987: 186-187). While stone ballast had a tendency to foul in wet bilge environments, it provided a malleable foundation for the stowage of casks and stores. Stone ballast was typically placed on top of any associated metal ballast, which would be located in the lowest portions of the vessel, and easily stowed in awkward places (Lavery 1987:186-187). Recordation of the site indicated that stone ballast was prevalent

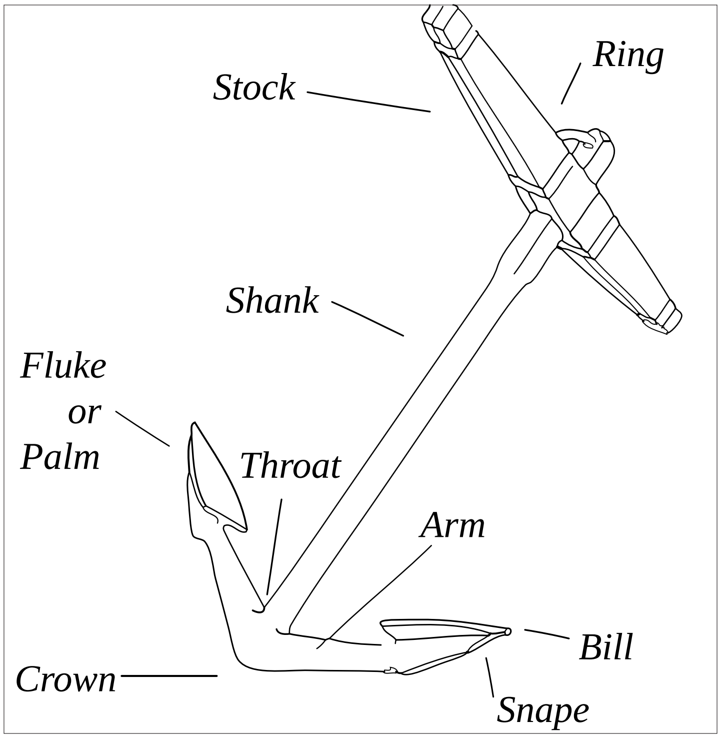

Figure 21. Representation of an eighteenth century wooden stocked anchor (Curryer 1999:7).

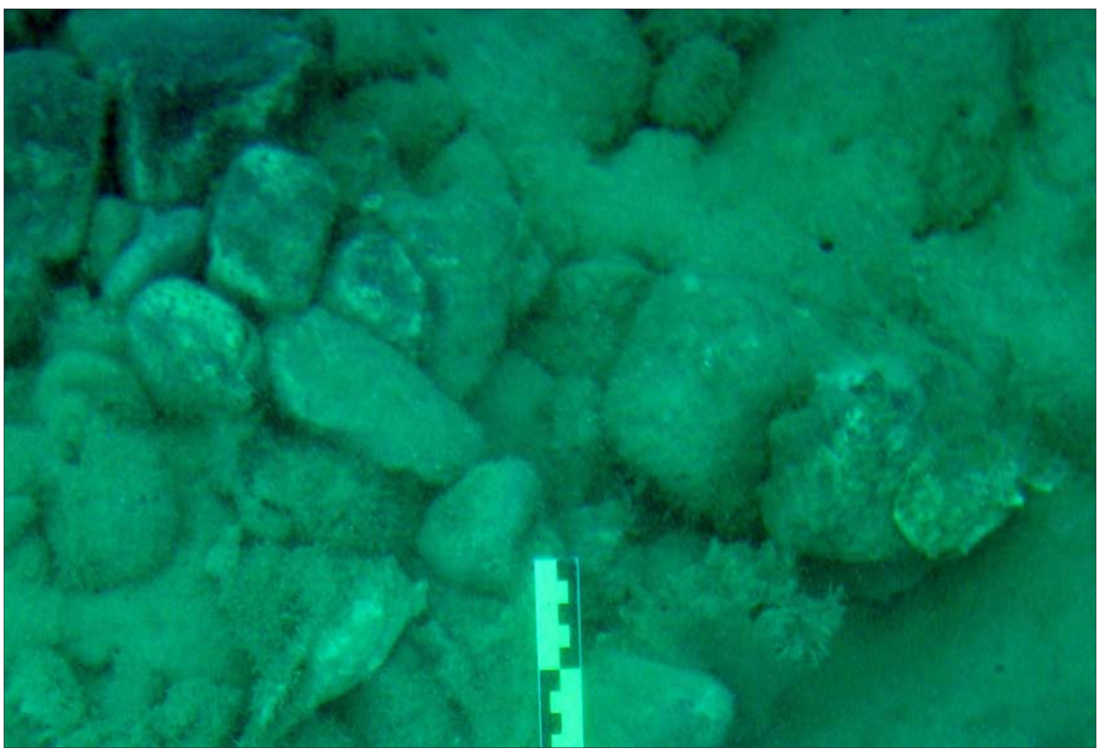

Figure 22. Stone ballast from the suspected *Serapis* site.

from the midships area toward the east and the metal ballast bars were prevalent from the midships area extending to the west.

The stone ballast observed on site were primarily small, fist-sized stones and were rounded or "river worn". The color of these ballast stones (under limited light conditions), was a grey/black. No stone ballast were recovered during the present investigation but were photographed and videoed *in situ* (Figure 22). Future analysis of the density and chemical composition of these stones may assist in identifying the source of the cobble.

The metal ballast, also referred to as bars, blocks, bricks, kentledge or pig(g)s, were also a distinct feature of the site. Both iron and lead ballast was used throughout the eighteenth and nineteenth century in sailing vessels. The density of metal ballast lowered the metacenter of a vessel causing it to sail 'stiffer,' that is, in a more upright aspect relative to the winds. Blaise Ollivier, a French Shipwright, who visited English shipyards investigating technical advances, reported *circa* 1737, that the English used iron pigs "about 36 inches long and 6 inches square, and with these dimensions they must weigh 350 pounds" (Roberts 1992: 55). Records indicate there is some variability in the weight of English iron ballast ranging from approximately 320 lbs at mid-eighteenth century to one or two hundredweight (ctw) into the nineteenth century. However, the dimensions appear to closely conform to the 6" x 6" square and were either 18" or 36" in length.

The use of metal ballast on vessels has been well documented on other English warships investigated archaeologically. Investigations of the HMS *Fowey* which sank off Florida indicated that 320 pound, 36" x 6" x 6" iron ballast blocks, marked with the English broad-arrow were associated with the site (Skowronek et al. 1987:317). The HMS *Charon*, sunk in the York River, Virginia was investigated in 1980 by a team from Texas A& M University (including Dick Swete). The investigation recorded ballast in the form of both rounded, black river cobble as well as 36" x 6" x 6" iron bars (Steffy et al. 1983:172). Archaeologists examining the HMS *Endymion*, lost off the Turks and Caicos Islands, identified iron ballast bars that also appeared to be the standard 36" x 6" x 6" dimensions (Keith 2001:213). After the launching of HMS *Janus* in May 1778, it is reported that 296 "Piggs of flatledge" averaging one cwt (hundred weight) approximately 112 lbs, were brought on board between June 3rd and 4th. The dimension of these ballast blocks was approximately 18 inches long by 6 inches square. Additionally in mid-July another 100-tons of ballast, most likely loose shingle were added to trim the vessel (Goodwin 2002:88). Finally, another English warship, the HMS *Pomone*, lost off the Needles (southwest England) in 1811, had 37 ballast blocks of 2 ctw, (approximately 225 pounds) (Tomalin et al. 2000:3-42). As they appear to be double the weight of the *Janus'* bars, their dimensions could easily be 36" by 6" by 6", the apparent standard size. The HMS *Charon* (loss 1781), HMS *Endymion* (loss 1790) and HMS *Janus* (loss 1800) were sister ships of the HMS *Serapis*.

It is interesting to note that the ballast bars found on the suspected *Serapis* site represent a unique find compared to the other vessels mentioned above. A magnet taken to the wreck site was placed on the ballast bars to determine whether they were made of iron or another metal. The magnet did not stick to any of the bars suggesting the bars are not made of iron but likely lead. The concretion on the ballast bars was a noticeably different color than the concretion on other iron artifacts (i.e., cannon, anchor) associated with the wreck site. The concretion on the iron objects appeared to be a yellowish-beige color whereas the concretion on the ballast bars appeared to be more of a blue-grey. The length of each ballast bar was 39 inches in length and both sides were approximately 7 inches square (Figure 23). The total number of ballast bricks (mostly located near the west end of the exposed wreck site) on site was not ascertained. The dimensions of the ballast bars are close to those reported for HMS *Charon*, *Endymion* and *Pomone* and an approximate weight of 2 cwt each would be anticipated if both materials were the same density.

Numerous lead bars were recovered from the wreck of the *Adelaar* (loss 1728) and were approximately a meter in length. However their shape is quite different from those found on the *Serapis* site. The *Adelaar's* ballast bars were flat on one side and curved ("C" or "U" shaped) on the other. Lead was considered to be "paying ballast" (i.e., cargo) and not specifically integral ballast. However, it very well may have acted as ballast during this voyage (Stephen Lisco, personal communication, 2008).

The ballast from the *Adelaar* did not exhibit much growth in the form of concretion; in fact the ballast bars were essentially clean. In comparison the surface of the ballast bars from the *Serapis* were somewhat rough and bubbly in texture. It is plausible the difference in corrosion may be caused by a difference in ambient conditions between these two wreck sites. The *Adelaar* wrecked off the east coast of Scotland in a dynamic surge environment whereas the vessel in Madagascar is located in the relatively calm harbor at Ambodifototra. The warmer water temperatures in Madagascar may also help explain the concretion on the ballast bars versus the lack of concretion found on the ballast bars off Scotland.

Future analysis of these ballast bars is recommended. This may include weighing individual bars and conducting a compositional analysis to determine the elemental constituents of these bars. Additionally, maker's marks and weight stamps may become visible after the cleaning and conservation of some of the ballast bars.

A couple a research questions may be answered after a closer examination of these ballast bars. When the French were razeeing and refitting *Serapis*, would they have exchanged iron for lead? Or were the lead bars used as "paying ballast" to be removed and used at the ships final destination? Further archival research may hold the answer to some of these questions.

Cannon

Ten cannon, associated with the hull remains, were visible during the 2008 field season. All were exposed to some degree and several were heavily encrusted into the marine growth that covers much of the site (Figure 24). Measurements, taken of each individual cannon (when obtainable), indicate various-sized cannon on site. Prior to recordation each cannon was individually tagged and numbered with flagging tape to keep track of each cannon and its location on site.

The largest cannon (labeled #004) was over 11 feet in length, and one of the smaller cannon (labeled #002) measured approximately 6 feet in length. Lavery indicates that there were seven different lengths for 6-pound cannon in the late-eighteenth century (Lavery 1987:102).

Figure 23. Possible lead ballast bar identified onsite.

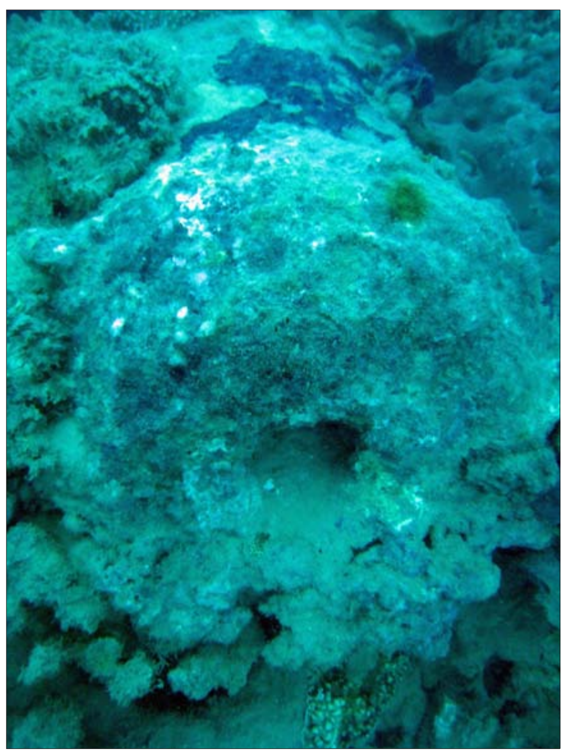

Figure 24. The muzzle of a cannon protruding from the wreck assemblage, note concretion in and around muzzle area.

This infers that the length of a cannon may not be the best indicator in determining the particular size of a cannon. Bore diameter (the size of the orifice at the muzzle end of a cannon) however, is more useful in determining the actual size/rating of a cannon. However, accurate bore diameter dimensions were difficult (if not impossible) to obtain due to the heavily encrusted condition of the cannon on site.

The cannon are generally dispersed across the exposed hull remains. However, there is a concentration of four cannon situated amidships in close association to the anchor. Due to the deteriorated hull remains it is unclear whether the cannon were being used on one of the decks before the vessel sank or whether they were stowed as ballast for the voyage to the Indian Ocean.

All cannon observed on the site were made of iron. No brass cannon were observed. Brass cannon were much more expensive to produce but not uncommon. By the mid-eighteenth century brass was going out of style and after 1782 all British naval guns were iron (Lavery 1987: 87). Iron cannon can typically be identified by various markings and decoration. If the guns are English, King George III's (r.1760-1820) monogram might be inscribed on them. If the French replaced the guns after taking possession of the *Serapis* with cannons of their own manufacture a monogram of King Louis XV (r.1715-1774 or Louis XVI (r.1774-1792) might be found. Maker's marks and weights were also common inscriptions found on cannon. Due to the heavy concretion covering the cannon on site no identifying inscriptions were observed.

The *Serapis*, when she sailed under the British flag, carried 50 cannon; 20 eighteen pounders on the lower deck, 20 nine pounders on the upper deck, and 10 six pounders on the quarter deck (Morison 1959: 226). Lavery indicates that an eighteenth century 18-pounders ranged in length between 9' and 9' 6" and late-eighteenth century 9-pounders ranged in length from 7' to 9' 6" (Lavery 1987:101). It is unknown how many cannon were lost or removed during and after the battle between *Bonhomme Richard* and *Serapis*. However, after being razeed by the French the *Serapis* would not have been able to carry as many cannon and her complement of armament was likely adjusted to carry a smaller number. The total number and size cannon on the site investigated by the Serpais Project has yet to be determined as only those cannon exposed on site were recorded. Additional fieldwork, excavation, and archival research may assist in determining the origin of the cannon and whether or not they are associated with the *Serapis*.

Ceramics

No ceramics were recovered by Serapis Project team members during the 2008 field season. However, a few ceramic pieces were presented to the team (purportedly recovered from the site prior to the 2008 field season) by local divers. These artifacts, although recovered without archaeological control, were recorded and photographed by members of the Serapis Project for analysis purposes. All ceramics were mechanically cleaned using various small hand tools to remove surface concretions. They were then placed into a freshwater bath for desalination. The freshwater was changed out twice daily for a period of 12 days, and the artifacts were then slowly air dried. While the materials had already been previously air dried (after removal from the wreck site), it was decided that desalination would help to arrest any further deterioration of the ceramics.

The ceramic types recorded include one blue and white porcelain bowl base (Massimo-0006), a complete tin-glazed earthenware mug (Massimo-0007), a tin-glazed earthenware bowl base (Massimo-0011), and a complete earthenware jar/decanter (Massimo-0008). A complete description of each item is provided below.

<u>Porcelain Bowl</u>
The porcelain bowl has an opaque glaze with hand painted underglaze blue motifs on the exterior (Figure 25). The bowl contains two rough, slightly blurred marks, one on the interior bottom of the bowl, and one on the exterior base. Further research is needed in order to identify the meaning of the marks. It is possible they are maker's marks or the mark of the ceramics production center.

Hand painted motifs (in this case thought to represent ocean waves or clouds) on blue and white porcelain are usually indicative of ceramics of Chinese manufacture. Most European blue and white porcelains were most often transfer printed as opposed to painted free hand. The base and size of the bowl indicate that it was possibly a rice bowl. This ceramic would likely date to circa 1840-1880, post dating the first Opium War (1839-1842) which forced China to open up trade with to a broader worldwide market (Eric West, personal communication, December 2008).

This bowl was also identified as possibly Canton Ware, which usually consists of a white, or greyish white, glass-like vitreous paste (Debra Wells, personal communication, February 25, 2009). Glaze on Canton ware is generally of a poorer quality than on other porcelain types, and tends to have occasional pinholes and an imperfect texture. The background color is typically grayish white. Design execution is usually simple, using bold brush strokes and various shades of blue ranging from watery grayish-blue to cobalt. It was often referred to as "Ballast ware" due to the high number of wares often shipped and sometimes used as actual ships ballast (Deegan 2009). Mean dates for Canton Ware are typically 1790-1835.

Both suggested dates for the blue and white bowl base are late or post-date the suspected *Serapis* shipwreck. As stated earlier, due to the location of the wreck site and the dynamics of the harbor it is quite possible that the ceramic piece is intrusive. However, blue and white export ceramics have been located on the 1760 *Machault* shipwreck in Chaleur Bay (Sullivan 1986:66, 68-73). The widespread distribution of these ceramic types at French-colonial sites suggests it is not unlikely that blue and white wares would be found aboard *Serapis*. "Oriental-style ceramics" have also been found on the HMS *Swift*, lost 1770. The collection from the *Swift* include porcelains, red stoneware, fine earthenware and coarse earthenware, some with apparent makers marks (Elkin 2006), marking a further indication that these types of finds are not uncommon on wreck sites of the era.

Figure 25. Porcelain bowl with opaque glaze and hand painted blue motifs.

Figure 26. Image of tin glazed earthenware mug base, note indentations.

Tin Glazed Earthenwares

During the eighteenth century tin glazed earthenwares were produced throughout Spain, Portugal, Italy (Majolica), Holland (Delft), and France (Faience). It is often difficult to determine counrty of origin for tin glazed earthenwares that lack distinguishing decorations.

A mug (Massimo-0007) reported to have been recovered from the wreck site in Ambodifototra Harbor has a deep red coarse earthenware body paste, bluish hue and thickness of glaze, and a thick handle all of which suggest the possibility of a French manufacture. An additional distinguishing factor suggesting French manufacture is the presence of two crossed marks on the exterior base of the mug (Figure 26). Mr. Greg Waselkov communicated that these marks are usually indicative of sticks that were placed under vessels during the firing process to keep the glaze from pooling, a technique often utilized by French ceramicist (Greg Waselkov, personal communication, 2009). No comparable forms for the mug have been located as of yet, and more research is necessary to locate identical forms in the archaeological or art history literature.

A second tin glazed earthenware artifact consists of a bowl base (Massimo-0011) with a reddish body paste and thick white glaze on both the interior and exterior of the vessel (Fig. 27). The form of this vessel is indicative of other French vessel bowl forms that can be seen in several North American French colonial sites from regions such as the St. Lawrence Valley, Northwest Louisiana, and in and around Mobile, Alabama. A similar style of bowl (CgEo-2-4U7-3) that is known to have been imported from France was located at Rocher de lax Chapelle, Ile-aux-Oies, a 17th -18th century French farming settlement located on the St. Lawrence River in Quebec (Avery 2007:155).

If manufactured in France, both of these vessels would possibly have been created in the Rouen region, and be classified as faience blanche, or Normandy plain. Normandy plain refers to all undecorated faience blanche forms, produced and were produced between the 1640’s into the early 19th century (Waselkov and Walhall 2002:65). Rouen faience is often characterized by an interior tin glaze that varies from pale blue to white to tinted pink at the edges, and a purpulish-brown lead glaze that covers the back of the generally coarse red body (Hume 1960:559). This style was indicative to Rouen, but Rouen potters were also known to have produced utilitarian faience blanche materials, especially during the latter part of the eighteenth century, when the French faience industry was in decline.

Coarse Earthenwares

One unglazed roughly-made grit tempered earthenware jar/decanter (Massimo-0008) was reportedly recovered from the site (Figure 28). The vessel was obviously hand formed, with one side slightly flattened. This was likely due to the maker holding that area as he/she formed the vessel or the vessel was lying on that side in the kiln. There are visible tool markings on the exterior. The paste is a brownish/red color, with small amounts of visible stones in the paste. No exact match for this form has been located as of yet; however, Waselkov noted that he has seen this form before in a French context, but could not recall within which context (Greg Waselkov, personal communication, 2009). Other vessels resembling this object can be seen within North American French colonial collections from

Figure 27. Image of tin glazed bowl base.

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Figure 28. Unglazed earthenware jar/decanter.

the Mobile, Alabama region, namely the "Tunica Treasure," excavations at Old Mobile, and vessels from the Intendants palace in Quebec City, Canada. Namely the rim style and base of this decanter is similar to other French-made vessels. However, no determination that this is a French vessel can be made at the present stage of research. The analysis of the ceramics is still ongoing. Further research using comparative collections and typologies will be necessary to make more accurate determinations as to country of manufacture. Information relative to French Colonial materials in North America is somewhat limited, and European resources and collections have yet to be explored in depth. Having two complete vessels associated with the site provides a unique opportunity to locate comparable vessel forms by utilizing archaeological records, museum collections, and art history resources.

Glassware

Glassware can be a very diagnostic artifact. Numerous studies and chronological typologies have been created and are very useful in dating glassware. The only glass artifacts recovered from the site by archaeologists were two glass bottle bases, (Massimo-0001 & Massimo-0002). These artifacts were not excavated from the wreck site but were retrieved from the wreckage during a surface collection of artifacts. Once on the surface, the bottle bases were cleaned, measured, drawn, and photographed (Figure 29, 30). After this information was collected, the artifacts were re-deposited on site. Since glass (contemporary with the wreck site) reacts poorly when removed from a marine context if it is not properly conserved, it was prudent to redeposit the material on site where it would be in stasis with the environment in which it has rested for centuries.

Measurements of both glass bottle bases match representative glass wine and liquor bottle type dating to the latter part of the 18th century (Hume 1969: 68). Each base has a diameter approximately 3 ½", and a push up or "kick" height of approximately 2". It has been inferred that pontils were often made deliberately deep in green glass bottles so the bottles would appear to be larger than they actually were. High push ups can be a helpful feature in dating glass bases, as this type of height and shape have been associated to late 18th century wine bottles (Jones 1971:70).

It is not uncommon to see bottles dating from earlier time periods in later archaeological contexts as the reuse of English wine/liquor bottles in the 18th century was commonplace. Credits were often given to merchants for returned bottles. The commercial use of bottles for shipping began in the mid 17th century in England, and by the late 17th century bottled beers, wines, and other liquors were being shipped as far as India (Jones 1986:18).

More analysis and research relative to these glass bottle bases is necessary. References and research comparing 18th French wine and liquor bottles to English 18th century bottles is limited. Typologies for English vessels have been created and are considered reliable, but no complete typologies of French vessels written in English have been located. Both bottle bases being fragmentary and containing no shoulder, string rim, or lip areas, furthers the difficulty since using these diagnostic elements were not present.

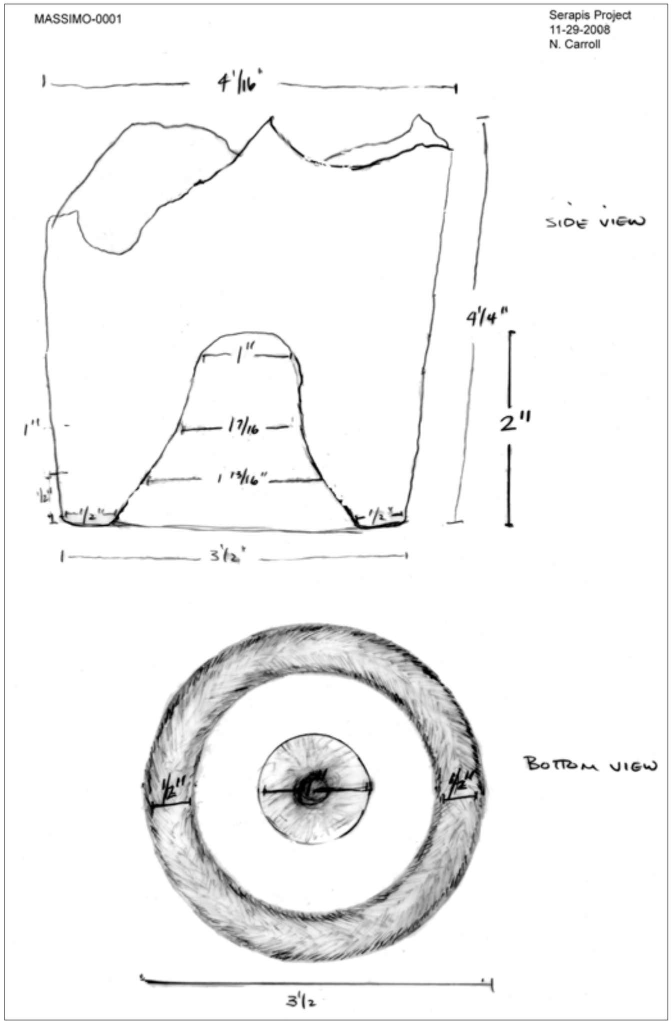

Figure 29. Field drawing of olive green glass bottle base from the site.

Figure 30. Image of olive green glass bottle base.

Copper Sheathing

Investigation of the hull remains identified an exposed run of copper hull sheathing along the exposed northeast side of the wreck site (near the 98-foot mark on the baseline). The run of copper sheathing, located at the base of the ballast mound, is associated with lower hull timbers and extends under the ballast mound. As no excavation of the site was permitted, no sheathing was recovered during the present investigation. Only a brief examination, including photographs, was undertaken with regards to the *in situ* copper sheathing (Figure 31).

A small piece of copper sheathing and a copper fastener were recovered from the wreck site prior to the arrival of the Serapis Project team members. This copper sheathing and fastener was provided to members of the Serapis Project for elemental analysis (Appendix C). The copper sheet had no distinguishing marks and was badly deteriorated. The copper sheathing tack however was in better condition for analysis. It is approximately 3.8 cm in length with a square shank diminishing to a point, and the flattened circular head has a diameter of 2 cm (Figure 32).

With the consent of the Museum, Ms. Norine Carroll of the Archaeology Institute at University of West Florida had the copper analyzed in December of 2008. The sample was analyzed using a Fisher Scientific handheld Niton XL3t (a non-destructive x-ray florescence or XRF) by Archaeometry specialist Julia Kleyman of Fisher Scientific. An area (free from surface concretion) was chosen and was mechanically cleaned to expose the patina-free copper surface. The XL3t sampled the copper for a duration of 60 seconds. Results revealed the sample consisted of 96.57% Copper (Cu) (+/-0.161), 2.05% Lead (Pb) (+/- 0.098), with under 1% of Zirconium (Zr), Bismuth (Bi), Nickel (Ni), Iron (Fe), Vandium (V), and Thallium (Ti). Complete results of the analysis are presented in Appendix C**.** The results are consistent with earlier forms of copper sheathing that were made of pure copper as opposed to copper alloy (approx. 60:40 copper-zinc composition) such as Muntz metal which was patented in 1832 (McCarthy 2005:167).

Copper sheathing nails, similar to the one recovered from the wreck site in Madagascar, have been documented from archaeological sites. Copper sheathing nails from the *Serapis'* own sister-ship the *Charon* (excavated by a team of students from Texas A&M University) were recovered in the early 1980s (Figure 33). The similarities between the suspected *Serapis* and *Charon's* tacks are uncanny. Unfortunately, no measurements are available at this time for the sheathing tacks from the *Charon*. Additonal research may locate a report that contains such measurements.

A more in-depth analysis of the copper sheathing may assist in identifying the vessel. Additional analysis may include determining the size of each individual copper sheet associated with the wreck site. Copper sheathing was produced/rolled by the English in a standard size, typically 14-inches by 48-inches. Copper sheathing was also stamped with either government or makers marks which may assist in identifying the vessel in question (Bingeman et al. 2000:218-229). Additionally, copper sheathing produced in England was a standard weight whereas the French did not manufacture their sheathing to a regulated size. However, it should be noted that the French did complete repairs and did apparently copper

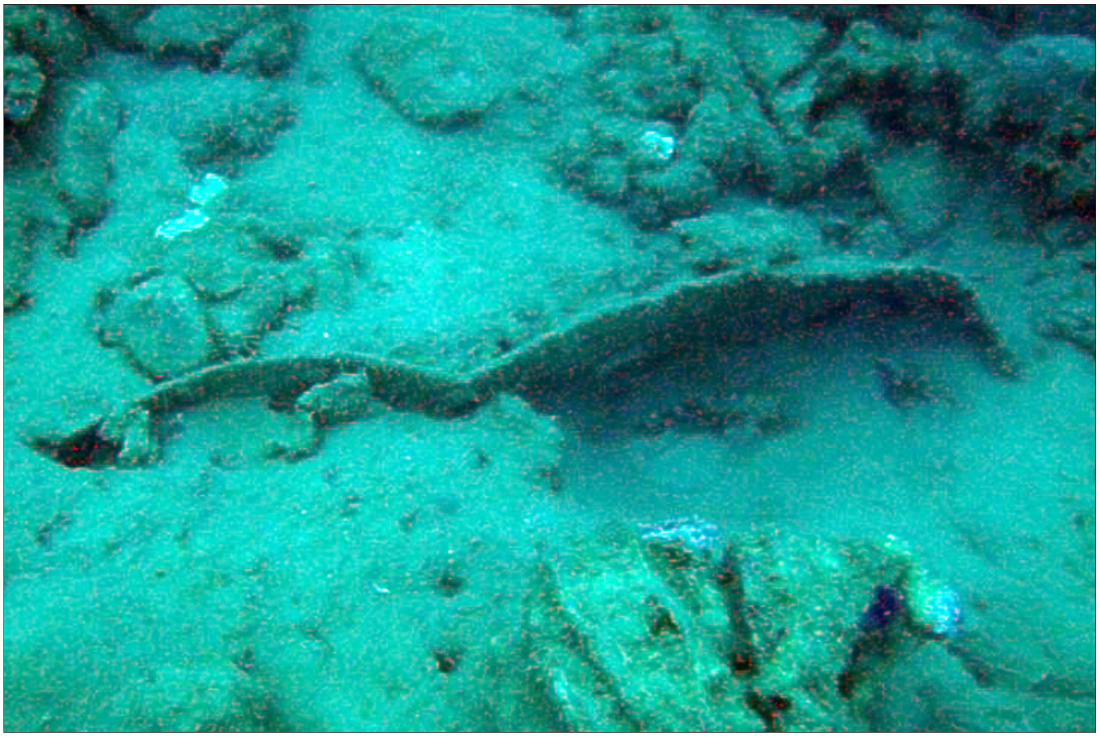

Figure 31. Copper hull sheathing *in situ*.

Figure 32. Copper fastener.

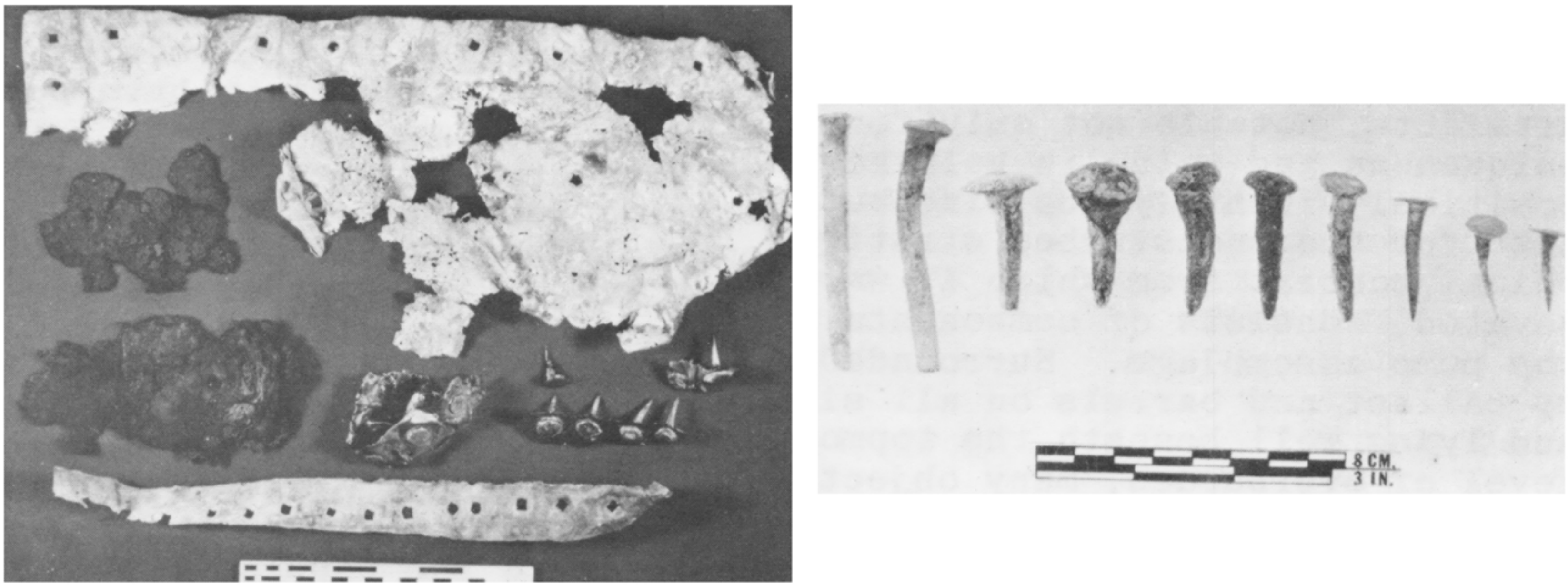

Figure 33. Copper sheathing and fasteners from the HMS *Charon*, sister-ship to the *Serapis*, from Texas A&M excavations (Steffy, et al., 1981: 12).

the *Serapis* before sending her on her voyage to the Indian Ocean. Therefore, a close examination of the copper sheathing should be undertaken during subsequent field seasons.

The piece of copper that was recovered from the "Copper Site" in 1999 is not a full rectangular sheet. It appears to be a goring, fillet, or stealer piece (a sheet trimmed at an angle to fill in gaps on the bottom surface of the vessel between rectangular pieces) and its dimensions therefore would not necessarily conform to standard British sizing (14 inches by 48 inches). No identifying stamp or mark has been observed on the piece. Therefore it is possible that this could be an early specimen as later were usually marked in some fashion. The galvanic reaction between copper sheathing and iron framing bolts was known but not well understood during the American Revolution as copper sheathing was still a new technology. Iron (acting as a sacrificial anode) deteriorated at a rapid rate when in contact with copper due to ionic differences at the elemental level. This caused rapid and serious degradation of iron bolts and drift pins, leading to the weakening of the fasteners between the ships framing and hull timbers. Ship surveys after the Revolution indicated the problem was serious enough to reconsider the coppering program. It was only after 1783 (when a process to harden copper-zinc alloy framing bolts was discovered and perfected) that copper bottom sheathing's future was assured.

The *Serapis* was constructed, launched, and coppered before the discovery of these copper-zinc alloy framing bolts. Therefore, the framing bolts on the *Serapis* would have been made of iron. During excavations of the *Charon*, lost 1781, it was noted that iron bolts were not found in the keel/keelson assemblage, but concretions were located that "attest to their presence" (Steffy et al. 1981:126). No brass or copper alloy keel bolts were reported indicating that the iron bolts had corroded away, leaving only concretions. Conversely, investigations of the wreck site of the *Endymion* indicated that rows of "yard long brass bolts" believed to be keel bolts were observed (Keith 2001:215). The *Endymion* was lost after the hardening process of copper-zinc alloys had been perfected. The fasteners located in the keel/keelson assemblage of the suspected *Serapis* should be made of iron, and their identification will be a goal of future investigations.

Brick/Tile

Two brick/tile fragments (Massimo-0009, Massimo-0010) were recovered from the wreck site by sport divers and were documented by members of the Serapis Project (Figure 34, Figure 35). Both bricks have a reddish yellow body (Munsell 7.5yr 6/6: reddish yellow) with a fairly smooth paste. These bricks were probably formed by hand in a wooden or iron-clad mold, a common practice used until the 19th century.

One of the fragments (Massimo-0009) contains two indentations running horizontally across the face that range in width from .8 cm to 1.2 cm. Due to their inconsistent width, these indentations appear to have been made by the brick maker. It is possible these are what could be considered "frogs" or the depressions found in some bricks from the 17th century onward, the purpose of which was to provide a key for mortar. Artifact # Massimo-0010 does not appear to have these striations or "frogs". Both specimens exhibit evidence of charring. These bricks may have been part of a kiln or oven associated with the kitchen area of the vessel or they may also have been used as ballast on the ship. The idea of the bricks

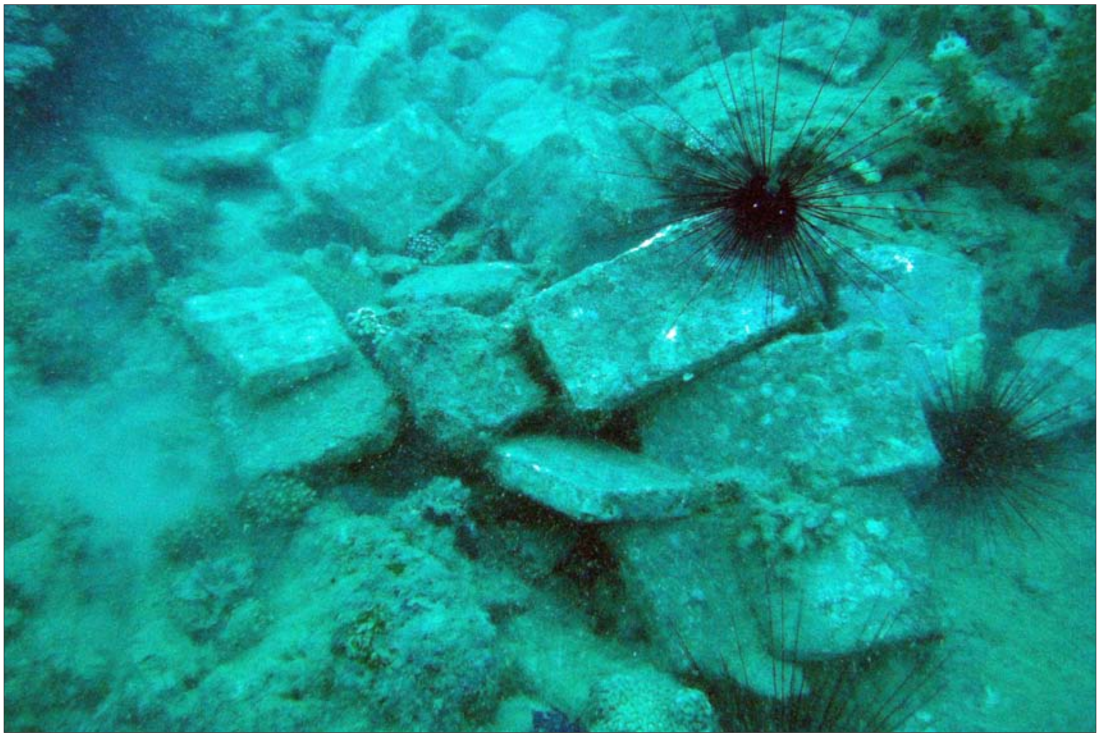

Figure 34. Brick assemblage located on the suspected *Serapis* site.

Figure 35. Image of recovered brick.

being used as ballast seems unlikely due to the shingle and ballast bars observed on site.

It is possible these bricks may be considered tiles rather than bricks as they are relatively thin (1.8 cm to 2.5 cm). Thin bricks such as these would have been referred to as "split bricks" (Gurke 1987:15,112,121). More research is necessary to determine standards in brick versus tile dimensions from both British and French contexts. One fragment (Massimo-0009) was permitted to be temporarily brought back to the United States for further analysis and study.

Metal box

An intriguing artifact observed on the site was a large metal box located at approximately the 80-foot mark on the baseline (or approx. amidships). The box measures approximately 79 inches by 67 inches and tapers in depth from 24 inches down to approximately 9 inches. Initial investigations of the box indicate it is empty. The purpose of the box is still unknown at this time and it is unclear whether the box is made of lead or iron. It is possible it might be a lead storage container for gun powder or possibly an iron cooking stove. An iron cooking stove was found on the HMS *Swift*, loss 1770 (Elkin et al. 2006:8). Iron cooking stoves were first proposed in the English Navy in 1728, as they were lighter than heavy brick stoves. By mid-century iron stoves were common on war ships. Cook stoves for a 44-gun ship were approximately 5 feet by 5 feet square and would have various openings for fuel, the flue, cook pans, or kettles (Lavery 1987:197-199). While cook stoves were generally located in the forward section of a vessel it is plausible the stove may have slid to its resting place during the sinking process, or may have fallen into its current location as the decks later collapsed.

Archaeologists employed a magnet to determine if the box was lead or iron. The box failed the magnet test indicating it is likely made of lead. Additional examination of this artifact is recommended during future investigations to determine what it is constructed of and what its purpose may have been.

Organics

Environmental conditions at the wreck site are not conducive for the preservation of organic material, such as hull timbers. Warm waters encourage biologic activity and there is little to no sedimentation on site to help preserve such materials. Visual examination of the site indicates there may be a significant amount of lower hull remains located beneath the ballast pile. The ballast has in effect provided a protective layer over the lower hull since the vessel sank.

Faunal

One bone fragment, recovered from the site by sport divers, was documented by archaeologists with the Serapis Project. It has been tentatively identified as a pig bone due to its size and surface features. This bone may be evidence of the ships food supplies, salt pork. Further analysis may provide additional information relative to this bone.

Rigging Elements

Three types of rigging elements (including coaks, an I-bolt, and blocks) were observed on the site. Three coaks (an internal bearing associated with either a sheave or block) were recorded by the Serapis Project. Two of the coaks were recovered from the wreck site by sport divers prior to the archaeological investigation. The third coak was recovered during the current investigation and was subsequently returned to the site after it was recorded and photographed. The coak recovered from the site during the current investigation still had some wood attached (Figure 36). This coak has dimensions very close to one recorded on the wreck of *Le Machault* (Table 1). Other rigging elements were observed on site, but a lack of time prohibited in depth investigations or detailed recording. They include an I-bolt and a relatively large block (Figure 37).

Table 1: Comparative Measurements of Copper Alloy Coaks from the Suspected Site of the *Serapis* and *Le Machault*

	Suspected Serapis	***Le Machault***
Overall Length	9.8 cm	11.6 cm
Overall Width	5.7 cm	6.6 cm
Overall Thickness	4.0 cm	5.7 cm
Diameter of sheave pin hole	3.8 cm	4.2 cm
Diameter of bolt holes	1.0 cm	.8 cm

Data from *Le Machault* (Bradley 1981)

Alternate Sources For The Wreck Material

The remains observed appear to be the comparable to what would be expected if it was verified as being *Serapis*. However, because research indicates that there are in fact a number of wrecks in the harbor at Ambodifototra, a positive identification of the site must be achieved before any scientifically backed announcement can be proclaimed. The harbor has been an active port for European maritime activity since the seventeenth century. Just prior to the end of the eighteenth century both the *Adventure Galley*, the privateering vessel of the infamous Captain William Kidd, as well as the English East Indiaman cum pirate *Mocha Frigate* were reported scuttled in the harbor. Numerous other vessels from this era of piracy on Isle Ste Marie also met similar fates as it was reported in 1699, “In this harbour lie various wrecks of pirate ships and of the Moorish prizes captured by them” (Earl 2003:118-119, 122). However, ships from this period were often salvaged in a near shore context, and none would have been coppered at that early date.

Figure 36. Copper alloy coak from the suspected *Serapis* site.

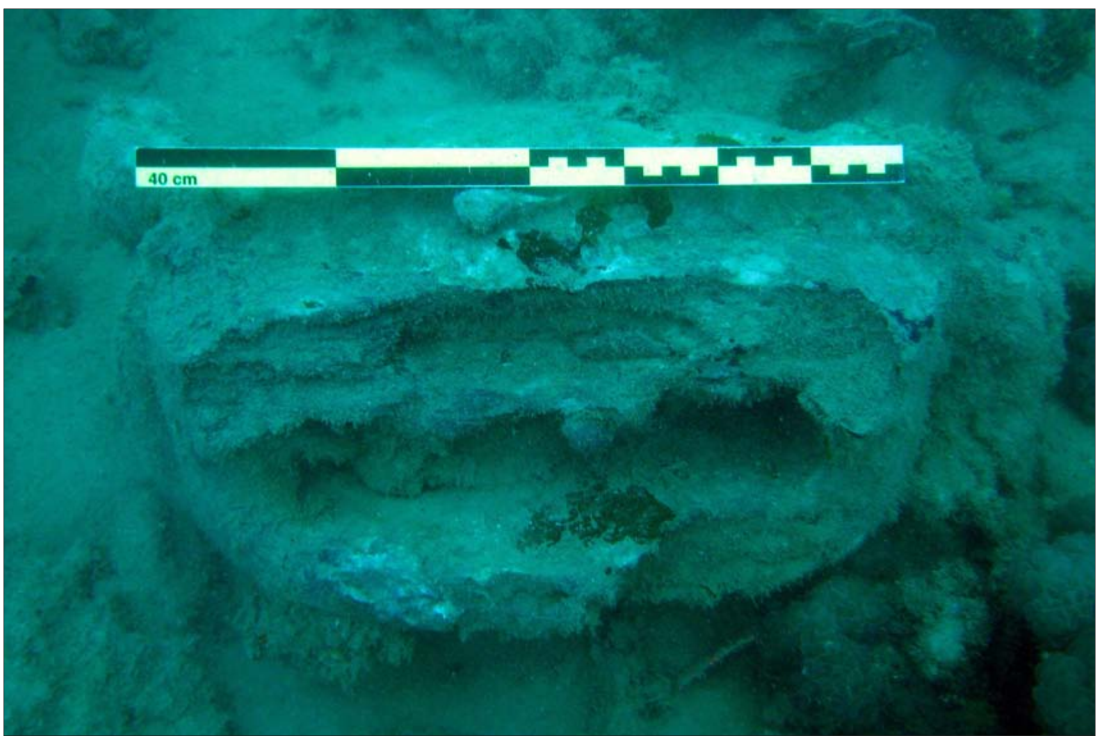

Figure 37. A block *in situ*.

Eighteenth century vessels are reported lost in the harbor as well. The French merchant vessel *Glorieux* was condemned on Isle Ste Marie in 1755, and *Phelypeaux*, foundered at anchor in 1757 during a storm (van den Boogaerde, 2009:139). The material culture of the crews aboard these sites, should approximate the materials of a wreck dating 24 years later. However, merchant vessels of the 1750s, would not have certain features incorporated on the hull such as copper bottom sheathing. Therefore the copper clad site examined cannot be considered to be the remains of the *Glorieux* or *Phelypeaux* unless new evidence of coppering turns up that indicates an earlier date than the generally accepted date of the 1761-1763 *Alarm* Experiment.

Intrusive Material

The wreck site examined lies in an active water way in which numerous vessels are known to have been lost. Additionally, the area is an historic anchorage as evidenced by ground tackle noted during investigations. During the 1999 investigation an approximately 30-yard shot of chain was discovered (Tuttle and Swete 1999:15). During the present investigation a nineteenth century anchor was located north of the shipwreck remains. Modern plastic materials and other intrusive material were also found around the wreck site. Additionally, the remains act as an artificial reef, and fishing equipment from nets, hooks and various forms of sinkers are found distributed throughout the site. It is not inconceivable to imagine a fisherman throwing a bottle or some other refuse over the side of his vessel while fishing in the area. This brief exhibit of objects indicates that there is the possibility of contamination with materials not related to the wrecking event, and therefore caution must be used when attempting to date artifacts that come from the site.

Conclusion

The remains and associated materials observed at the suspected *Serapis* site represent an opportunity to research many historical, archaeological and other scientific questions. Any investigations should be used to answer the research questions that have been presented in conjunction with the data recovered. Finally, the remains are part of the historic and cultural heritage of the Malagasy underwater landscape which should be preserved for future generations.

CONCLUSIONS AND RECOMMENDATIONS

The 2008 Serapis Project field season was highly successful. Two primary goals were achieved including providing diver certifications for four Malagasy students and the preliminary investigation (including the production of a pre-disturbance site map) of the suspected *Serapis* shipwreck site. The processes of scientific study and site protection can now be more confidently developed and executed.

The shipwreck remains on the floor of the harbor at Ambodifototra, Isle Ste Marie, Madagascar clearly represent a historically significant site. While it is too early to positively identify the wreck as that of *Serapis*, preliminary archaeological investigations confirm that the wreck dates to the late-eighteenth century. Although the site is located in an active harbor, the site still remains relatively untouched. An intact ballast pile and presence of multiple cannon indicates the site has not been disturbed by looting or salvage. While there is evidence of post-depositional cultural material on and around the site (including a nineteenth century anchor, modern fishing nets/gear, and other modern debris), the site remains relatively protected. The site currently serves as an artificial reef system providing a home to numerous sea creatures.

The wreck itself consists of lower hull remains covering an area approximately 140 feet in length (east/west) by 40 feet in width (north/south). While the majority of lower hull is protected by a sizeable ballast mound a number of wood frames, hull planking, and copper sheathing were observed during the current investigation. The ballast mound extends approximately 6 feet above the seabed in some areas. Cultural material associated with the site include an 18th century anchor, 10 cannon, brick, non-ferrous ballast bars, ballast stones, rigging elements, and a variety of ceramics and glassware.

The cultural remains recorded clearly indicate a vessel of a late-eighteenth century ship, possibly the *Serapis*. While there is evidence of other vessels being lost or abandoned in the harbor, none were apparently sheathed in copper with the exception of the *Serapis*. Additional archaeological research and scientific analysis will be necessary to confirm the identity of the site.

Wreck Formation Processes

Both the 1999 and 2004 field seasons located and recorded a debris field, approximately 300 yards to the east of the present wreck site, containing pieces of copper sheathing and ballast stones. It is suggested that the "Copper Site" is related to the suspected *Serapis* site and may be an indicator of the wreck formation process. Historic records point out the wreck of the *Serapis* was fairly violent and it is possible that portions of the hull may have been torn away causing both sheathing and ballast to be scattered across the harbor floor. It is likely that the *Serapis* did not sink immediately, but drifted, while burning, with the tide and/or wind before finally filling with water. This hypothesis could explain the existence of two separate sites containing copper sheathing and ballast. Future comparative analysis of the copper and ballast from both areas may shed light on this question. After the wreck event, court martial records indicate that the *Serapis* was also salvaged and eventually abandoned. Therefore, a number of processes have impacted the wreck site including fire, explosion, impact with the sea floor, and salvage. Other impacts continuing to affect the site today include both biological and chemical processes.

Current Site Conditions

Biological
The wreck serves as an artificial reef on a relatively sterile harbor floor. Numerous species of fish use the wreck as a habitat. They are attracted by the hard surfaces which promote growths of corals, sponges, and other potential food sources. Long-spine urchins as well as hard/soft corals and sponges are also attracted to the hard surfaces of the wreck site. Biologic degradation at a less visible level is also continuing to take place as well. The warm tropical waters are a host to destructive marine organisms such as shipworms, (*teredo navalis)*, that consume wood. It is likely that much of the hull of the vessel (not protected by ballast) has been consumed by such organisms.

Chemical
The most obvious chemical process observed on site includes the degradation of iron associated with the wreck site. There is a substantial amount of iron on the site including an anchor, numerous cannon, and iron fasteners. The formation of concretions (a calcareous shell that forms on iron objects when exposed to seawater) on iron artifacts can slowly degrade these objects over time. In addition salt from the seawater can migrate into ceramics and glass that have been submerged for centuries. This chemical activity can both bind and break down cultural materials over time. A proper conservation facility will have to be established prior to the removal of any cultural material from the wreck site to ensure their protection once removed from the saltwater environment.

Recommendations

The site investigated in 2008 clearly represents a late-eighteenth century shipwreck that should be considered historically significant. There is a strong possibility that the site represents the remains of HMS *Serapis*. The historic significance of the *Serapis* is consoderable to the history of the United States, being the prize captured during the fiercest ship-to-ship naval battle of the American Revolution as well as its association with the 'Father of the American Navy' John Paul Jones. If the vessel is indeed the *Serapis* it may also be considered significant due to its British design (Thomas Slade). The vessel also represents an important link to the French naval and colonial heritage of the late-eighteenth century. The vessel is also part of the Malagasy underwater cultural landscape and illustrates the varied underwater heritage of the country. The remains should be afforded some level of protection from salvage or other destructive processes, such as the removal of artifacts by sport divers.

The Serapis Project and the University of Antananarivo's Institute of Civilizations/Museum of Art and Archaeology are working together to both historically and archaeologically document the remains of the vessel in an effort to positively identify the vessel as the

Serapis. In addition, both groups are working to develop some form of preservation framework to protect the shipwreck site. The Serapis Project and the Museum are also working in conjunction to recover, conserve, and display in an open and educational venue this portion of Madagascar's maritime history.

In the future, both the Serapis Project and the Museum would like to continue working together to create the best possible institution or agency to accomplish the project objectives. It is expected prior to the next field effort some form of document will be drafted that will express these ideals.

Shipwreck Protection in Madagascar

Since the sixteenth century vessels of numerous European nations made their way around the southern tip of Africa on their way to the trading emporiums of the Far East. The island nation of Madagascar stood at the western gates of this route to and from the Indian Ocean. Europeans were desirous of the rare spices, gems, porcelains, silks and other treasures the Far East had to offer. As a result of this important trade route, European maritime powers such as the Portuguese, Dutch, English, and French all lost trading ships along the coast of Madagascar. In addition, Madagascar was inhabited by pirates from western nations at the end of the great age of piracy during the late-seventeenth and early-eighteenth centuries. Based primarily on Isle Ste Marie, the pirates were known to have brought captured prizes to Madagascar. Later, the British and French also lost military vessels in the waters of Madagascar during the eighteenth and nineteenth centuries. Vessels from various nations have continued to wreck in Madagascar through today. Thus, with long and varied maritime traditions, Madagascar has come to posses a vast wealth of important underwater cultural sites that span the centuries and multiple nations.

Unfortunately, the rich underwater cultural heritage that resides off Madagascar has been the focus of looters and salvers looking to make a profit off shipwreck sites. The crucial question is, "What can be done to protect the underwater cultural heritage of Madagascar?" In 2008, concerned citizens of Madagascar, including government officials, academics, and others came together to start an association (ARCHEOMADAMAR), to protect the maritime cultural heritage of Madagascar. Recognized by and registered with the Government of Madagascar ARCHEOMADAMAR has several goals including training an indigenous base of underwater archaeologists and conservators. Another objective is to develop a laboratory/research center to conserve and analyze artifacts as well as accommodate any underwater research that will take place in local waters. Additionally, the association hopes to conduct surveys and excavations in Malagasy waters with the object of site protection. A final goal of the organization is to create a maritime institute/museum that will promote the underwater cultural heritage of Madagascar as well as display artifacts from archaeologically investigated underwater sites. ARCHEOMADAMAR is positioning itself to become the premier underwater archaeological group in Madagascar.

As the University of Antananarivo's Museum of Art and Archaeology and the Serapis Project have a long history of cooperation, student involvement, and engagement in underwater archaeological investigation both institutions wish to aid ARCHEOMADAMAR in its objectives. Having trained student archaeologists to dive, collected and conserved maritime artifacts and promoting the protection of the underwater cultural heritage of Madagascar, the Serapis Project's objectives merge well with those of ARCHAEOMADAMAR. The Serapis Project intends to use its expertise and connections in the underwater archaeological world, both universities and cultural resource management firms, to work with and support the activities of ARCHEOMADAMAR.

Future Investigations

The suspected site of *Serapis* offers a potential wealth of historic and scientific information. The hull remains and artifacts contained therein provide a valuable glimpse into the lives of the men that made the vessel their home. In addition there were many technological innovations that appeared in the late-eighteenth century ship construction that may be elucidated. Additionally as a biological oasis on the harbor bed the site is the home to many sea creatures, an unintentional artificial reef that can be studied or utilized for positive development. The potential for research and investigation at this site cuts across multiple disciplines, methods and motivations. It is hoped that the wreck site can be used to develop both scientific and cultural interest and a greater awareness of submerged cultural resources on Isle Ste Marie in particular and Madagascar in general.

Research Topics

Copper Sheathing and Fasteners
One of the most important identifying features of the wreck site may be the copper bottom sheathing. Some valuable information has been gathered on copper sheathing since fragments were found on the harbor floor in 1999. Although it was known that copper could protect a wooden hull from the destructive actions of the 'shipworm' (*teredo navalis*) and bottom fouling, there were unforeseen problems. The main problem was electrolysis, which is when two dissimilar metals (in this case iron and copper) chemically react with each other resulting in the rapid corrosion of one or the other. Iron drift pins, bolts, and fasteners connected the keel, frames and planks of a vessel together. Unfortunately, covering and fastening the lower hull with copper caused rapid and destructive corrosion of the iron that went unnoticed.

At the time of *Serapis'* construction the corrosive effects were known but the seriousness was not entirely understood or appreciated. It is safe to assume, in light of any evidence to the contrary, that *Serapis* was constructed with typical building methods of the day, iron drift pins in the keel, stem and stern post as well as other portions of the hull. Numerous British vessels suffered from the effects of this corrosion during the American Revolution and it was debated whether coppering should continue. However by the late 1780s the technological problem of electrolysis was resolved by using copper based bolts and fasteners on the underwater portions of vessels (Bingeman et al. 2000:222). If the remains are *Serapis*, launched in 1779, they should incorporate iron fasteners that were then in use at all underwater locations, except the copper nails and tacks used to attach the copper bottom sheathing. The iron fasteners may only exist as corrosion products. Also there should be no copper based fasteners in the hull structure. Either of these observations would aid in an identification of the site.

During the next phase of the project a test excavation will be one of the techniques used to locate, clarify, and confirm construction details of the hull construction, the keel, the rudder, and types of fastenings. If the latter are iron, then a tighter date range for the site will be established; circa 1763 to 1785. This date range again includes the building, launching, use life and loss of *Serapis*. It also raises the question of whether the corrosion caused by galvanic reaction contributed to the loss of the *Serapis* by weakening her bottom. When the fire broke out, and the powder magazine exploded the hull would have been weakened by years of the damaging chemical process. Thus a larger than normal hole could have been created in the ships hull resulting in a quicker sinking event. This may explain the source of the ‘Copper Site’ 300 yards to the east of the main wreck site.

Some time after its initial use, copper sheathing began being stamped by manufacturers with identifying marks. The British Admiralty’s Naval Board established three weights of copper sheets for use; 32, 28 and 22 ounce per square foot, and their standard size was 14 x 48 inches. It is thought that the French may not have use the 14 x 48 standard for their copper sheathing as well. To add to the potential confusion of copper sheathing, it is reported from archaeological investigations that sheathing from the HMS *Charon*, sister ship to the *Serapis*, measured “5 feet long and 1 ½ feet wide” (Steffy et al. 1981). If a full sheet of copper could be successfully removed from the hull remains intact useful information could be noted, makers’ marks, weight stamps, etcetera. Examination for any manufacturer or government stamps or any stamp indicating sheet weight would be considered a priority. Further research into sheathing practices is considered a priority.

Vessel Orientation

There are other methods to determine the orientation of the vessel remains as well. At present it is theorized that the bow of this vessel lies toward the east and the stern is to the west. This is based upon the observations of materials made on site. Brick assumed to belong to the galley are found to the east. And although not recovered by the archaeologists, several of the ceramic materials recovered by local divers were reported to come from this area as well. A ship’s cooking area, the galley, was generally located in the bow. Lead or other non-ferrous material used as ballast blocks, pigs or bars are found to the western area of the remains. It is theorized that these items were in the stern of the vessel for trimming purposes. The areas were narrow and constricted; thus ballast bars might more easily maneuvered than shingle or cobble.

Knowledge of the manner of application of copper sheathing to the ship’s hull may provide an incontrovertible answer to the orientation question. Sheathing sheets were applied in an overlapping pattern from bow to stern and from the keel to the waterline. The simple mechanical process of sailing indicates this process. If the sheets were overlapped from stern to bow, the force of water and wave action in the process of moving forward would gradually peel them backward negating their efficacy. Observations of the direction of the overlapping seams will confirm the orientation of the vessel. This knowledge will aid in generation any future archaeological excavation strategy.

Ballast
Further analysis of the ballast may provide valuable insight into the origin and nationality of the vessel. Determining the chemical composition of ballast stones may indicate the source of the ballast. In addition the ballast can be compared to other shipwreck sites. While the ballast from the "Copper Site" and the suspected *Serapis* site look similar in size, color, and texture a chemical analysis of stones from both sites will aid in the theory of the wreck formation process if they are found to be chemically similar.

The metal/lead ballast may also be an important indicator of the vessel's origin. Several of *Serapis'* sister-ships, including HMS *Charon*, HMS *Janus* and HMS *Endymion*, can all be used as comparative examples. Comparisons can be made with materials reported or found on these vessels to indicate if there was a standard size and weight of metal ballast bars employed on these vessels. This comparative analysis may challenge the veracity of the historic documents that suggests standards for ballast were in place, when in fact they were not. It is recommended that a sample ballast bar be recovered for further analysis. This analysis will confirm the composition of the bars and determine if there are any maker's marks associated with the ballast.

Wood
At present no wood samples have been recovered from the site for analysis. The 2008 scope of work did not include any provisions for excavation or acquiring organic samples from the site. Wood samples can often assist in determining where a vessel may have been built and can offer information relative to any vessel repairs that may have taken place in foreign ports. While oaks and pines would suggest a European or North American origin, teak and other tropical woods would indicate vessel construction or possibly repairs in a warm water port.

It is anticipated that a significant portion of lower hull remains preserved under the ballast mound. The next phase of the project should include plans for a test excavation to expose a portion of the lower hull, to map the extant framing pattern, and to acquire wood samples for analysis. The information gathered from this analysis can be compared to historic documents and other late eighteenth century shipwrecks.

Cannon
The iron cannon may also provide valuable information relative to the identity of the vessel in question. However, all 10 cannon documented on site are covered with a very hard concretion. It is suspected that markings identifying the cannon may be located beneath these concretions (possibly on the trunnions, base ring, or first reinforcement). Removal of concretions in these specific areas, where known ciphers or other markings are located, may assist in placing the cannon in a temporal and national context. The recovery of cannon for analysis and as a museum display is a consideration. However, the stabilization and conservation of cannon will require significant amounts of funding and a laboratory capable of completing such conservation.

The suspected *Serapis* site offers many avenues for continued archaeological and historical research in addition to providing future educational and cultural development on Isle Ste Marie. The answers to some research questions that have been raised will require an excavation plan that can be efficiently and effectively carried out during future investigations of the site. Continued cooperation between the Serapis Project and the University Museum will be paramount in the development of plans for future archaeological excavations, the conservation of artifacts, and the display of artifacts recovered from the site. Funding sources will have to be identified and funds secured to continue investigations of the site. Protection of the site must be maintained to ensure the integrity of the site for future investigations. While a cooperative agreement is currently in place future discussions will be necessary to move the project forward to the next field effort and subsequent publications.

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(Tuttle)
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(Carroll)
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E-mail communication Dec. 23, 2008, Eric West.

Personal communication, Dec 1, 2008, Henry Bellon De Chassy.

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Web Resources:

Deegan, Kathy. *Historic Period Archaeological Ceramics (1492-1850)* Florida Museum of Natural History. Digital Type Collections: http://www.flmnh.ufl.edu/histarch/gallery_types/, accessed April 7, 2009.

Appendix A

Letter of Acknowledgement from the University of Antananarivo
For the Return of Serapis Project Artifacts Recovered in 1999

UNIVERSITE D'ANTANANARIVO

INSTITUT DE CIVILISATIONS
MUSEE D'ART ET D'ARCHEOLOGIE

Directeur

2008,ICMAA-176/MCR/Ma.-

ATTESTATION DE REMISE

Je soussignée, RADIMILAHY Chantal, Directeur de l'Institut de Civilisations Musée d'Art et d'Archéologie, atteste par la présente que M. Michael TUTTLE, Institute of New Hampshire Studies, Department of Social Science, Plymouth State College a rapatrié les échantillons archéologiques suivants aprés analyse :

- Morceaux de balles
- 1 (une) clé

Les résultats feront l'objet de publication commune par les deux Institutions.

Cette attestation est délivrée pour servir et valoir ce que de droit

RADIMILAHY Chantal
Directeur

APPENDIX B

Letter of Acknowledgement From The University of Antananarivo For the Removal of Artifacts from Madagascar for Analysis in 2008

UNIVERSITE D'ANTANANARIVO

INSTITUT DE CIVILISATIONS
MUSEE D'ART ET D'ARCHEOLOGIE

Directeur

2008,ICMAA-175/MCR/Ma.-

ATTESTATION

Je soussignée, RADIMILAHY Chantal, Directeur de l'Institut de Civilisations – Musée d'Art et d'Archéologie, atteste par la présente que dans le cadre des échanges scientifiques entre notre Institut et l'Institute of New Hampshire Studies, Department of Social Science, Plymouth State College, M. Michael TUTTLE Archéologue Maritime est autorisé à exporter les échantillons archéologiques suivants pour analyses scientifiques et datation en laboratoire :

- 1 (Un) morceau de brique
- 1 (Un) fragment de cuivre
- 1 (Un) clou en cuivre

M. Michael TUTTLE s'engage à rapatrier à Madagascar les échantillons après leur analyse.

Les résultats de ces analyses feront l'objet de publications communes par les deux Institutions.

Cette attestation est délivrée pour servir et valoir ce que de droit.

Antananarivo, le 05 décembre 2008

RADIMILAHY Chantal
Directeur

17, rue Dr Villette – Isoraka, Antananarivo 101 - ☎ : 020 24 221 65, E.mail : vohitra@refer.mg

Appendix C

Report of Serapis Project Copper Sheathing XRF Analysis Results

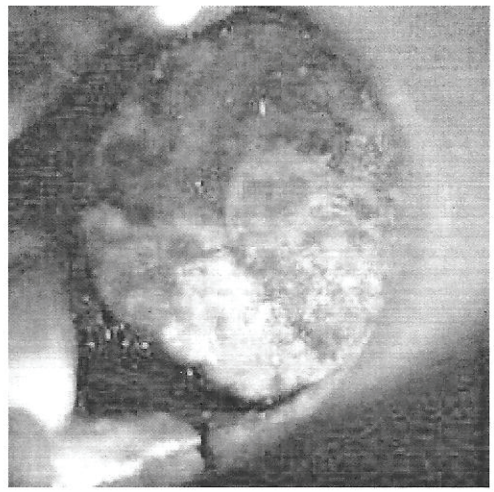
Thermo
SCIENTIFIC

Thermo Fisher Scientific
900 Middlesex Turnpike
Billerica, MA 01821

Certificate of Verification

XL3t-31895

Reading No	822
Mode	ALLOY
Time	2008-12-11 13:36
Duration	60.00
Sequence	Final
Alloy1	No Match : *5.01
Alloy2	No Match : *5.01
Flags	8mm
SAMPLE	MAD COPPER
HEAT	
LOT	
BATCH	
MISC	
NOTE	



	%	±	Error
Mo	< LOD	:	0.012
Zr	0.056	±	0.009
Pb	2.046	±	0.098
Se	< LOD	:	0.021
Zn	< LOD	:	0.140
W	< LOD	:	0.070
Cu	96.577	±	0.161
Ni	0.099	±	0.033
Co	< LOD	:	0.029
Fe	0.328	±	0.032
Mn	< LOD	:	0.036
Cr	< LOD	:	0.024
V	0.108	±	0.013
Ti	0.091	±	0.012
Sb	< LOD	:	0.126
Sn	< LOD	:	0.089
Ag	< LOD	:	0.550
Pd	< LOD	:	0.036
Nb	< LOD	:	0.010
Bi	0.108	±	0.035
Al	< LOD	:	80.000
Ru	< LOD	:	0.019

Appendix D

Serapis Project Artifacts from Massimo Site (Suspected *Serapis* Site)
2008 Field Season

Artifact Number	**Description**	**Material Type**
Massimo-0001	Bottle Base	Blown Glass; Olive Green
Massimo-0002	Bottle Base	Blown Glass; Olive Green
Massimo-0003	Coak	Copper Alloy
Massimo-0004	Coak	Copper Alloy
Massimo-0005	Coak	Copper Alloy
Massimo-0006	Bowl Base Fragment	Blue and White Chinese Export Porcelain
Massimo-0007	Mug	Tin Glazed Coarse Earthenware
Massimo-0008	Jar/Decanter	Earthenware
Massimo-0009	Brick Fragment	Earthenware
Massimo-0010	Brick Fragment	Earthenware
Massimo-0011	Bowl Base Fragment	Tin Glazed Earthenware
Massimo-0012	Tack	Copper
Massimo-0013	Sheathing Fragment	Copper
Massimo-0014	Sheathing Fragment	Lead
Massimo-0015	Concretion	Iron
Massimo-0016	Bone	Possible Pig

Artifact Descriptions and Measurements

<u>Massimo-001</u>
Blown olive glass green bottle base with markings on exterior with rough push up on exterior base.
Diameter of bottle base: 3 ½
Height of bottle fragment: 4 ½”
Diameter at top of bottle fragment: 4 ½”
Height of push up: 2”
Width of push up on interior of bottle: 1”

<u>Massimo-002</u>
Blown olive green glass bottle base with rough push up on exterior base.
Diameter of bottle base: 3 $^{1/8}$”
Height of bottle fragment:6 ¼”
Diameter at top of bottle fragment: 3 ¼”
Height of push up: 2”
Width of push up on interior of bottle: 13/16”

Massimo-003
Copper alloy coak with small fragments of wood attached
Height: 4.0 cm
Overall length: 9.8 cm
Overall width 5.7 cm
Diameter of sheave pin hole: 3.8 cm
Diameter of bolt hole: 1 cm

Massimo-0004
Copper alloy coak
Overall length: 12.0 cm
Overall width: 6.0 cm
Diameter of sheave pin hole: 3.0 cm
Diameter of bolt hole: 1.0 cm

Massimo-0005
Copper Alloy coak
Overall length: 12.0 cm
Overall width: 6.0 cm
Diameter of sheave pin hole: 3.0 cm
Diameter of bolt hole: 1.0 cm

Massimo-0006
Blue and white porcelain bowl base fragment
Under glaze hand painted cobalt blue designs. Blurred marks on exterior base and interior bottom of bowl.
Maximum width: 10.2 cm
Maximum height: 3.0 cm
Base diameter: 7.5 cm,

Massimo-0007
Coarse tin glazed earthenware mug
Thick glazed utilitarian ware. Glaze missing or worn off base of vessel. Two cross hatched markings located on exterior base of mug. Object was located near brick scatter on site (Bellon De Chassy, personal communication, Dec. 8, 2008).
Maximum height: 8.2 cm
Diameter at base: 6.5 cm
Maximum diameter: 8.2 cm

Massimo-0008
Coarse earthenware decanter/jar
Reddish brown paste color. Vessel very uneven and roughly crafted. Tool marks evident on exterior of vessel. One side of exterior is slightly flattened, suggesting makers hand print while forming vessel. Object was located near brick scatter on site (Bellon De Chassy, personal communication, Dec 1, 2008).
Maximum height: 11.5 cm

Diameter at base: 4.8 cm
Diameter at lip: 2.5 cm
Maximum diameter: 7.8 cm

Massimo-0009
Brick/tile fragment.
Munsell color 7.5YR 6/6: reddish yellow. Evidence of burning on lower one third.
Maximum length: 13 cm
Maximum width: 10.4 cm
Maximum height: 2.5 cm

Massimo-0010
Brick/tile fragment.
Reddish yellow color. Munsell color unavailable.
Evidence of burning on 1/3
Maximum length: 14.2 cm
Maximum width: 10.4 cm
Maximum height: 2.5 cm

Massimo-0011
Tin glazed earthenware bowl fragment
Salmon paste color and greyish/white glaze
Maximum diameter: 12.0 cm
Maximum height: 4.4 cm
Base diameter: 10.8 cm

Massimo-0012
Copper sheathing tack with beveled head
Maximum length: 6.4 cm (2 ½”)
Maximum diameter of tack head: 1.9 cm (3/4”)
Maximum length of shaft: 3.6 cm (1 ¼”)

Massimo-0013
Copper sheathing fragment, folded and bent with 5 fastner holes
Maximum length: 31 cm (12.2”)
Maximum width: 16.5 cm (6.5”)
Length of fastner hole: 0.7cm (3/16”)
Width of fastner hole: .0.5 cm (1/8”)
Distance between fastner holes: 0.8 cm (3.1”)

Massimo-0014
Lead sheeting fragment with three fastner holes
Maximum length: 6 ¼”
Maximum width: 3 7/8”
Approx diameter of fastners: 0.5 cm (3/16”)

Massimo-0015
Iron concretion. Iron completely corroded, only shell of concretion remaining.
Measurements not recorded.

Massimo-0016
Bone
Possible pig
Measurements not recorded.