TEXAS A&M UNIVERSITY

CMAC

Center for Maritime Archaeology & Conservation

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Contents

On the cover: Archaeologists work on a galley, one of over 30 Medieval-era shipwrecks discovered during excavations of the Theodosian harbor at Yenikapı, Turkey.

The Center for Maritime Archaeology and Conservation (CMAC) is based at Texas A&M University in College Station, Texas. Working in partnership with the Anthropology Department's Nautical Archaeology Program, the non-profit Institute for Nautical Archaeology, and other research institutions, CMAC strives to be in the forefront of maritime archaeological research around the world. The opinions expressed in CMAC News & Reports are those of the authors and do not necessarily reflect the views of the Center, or Texas A&M University.

Editor: Megan H. Smith

From the Director

CMAC:
The Center for Maritime Archaeology and Conservation at Texas A&M University

Welcome to our introductory issue of the Center for Maritime Archaeology and Conservation's CMAC News and Reports. The following pages highlight the Center's research goals, its faculty, staff, students, and the laboratory facilities that play such a vital role in achieving its mission. We'll also briefly look at just a few of the archaeological projects that have been undertaken by CMAC-sponsored teams in Turkey, North America, Europe, the Caribbean, and in many other places around the world.

The mission of the Center for Maritime Archaeology and Conservation (CMAC) is to support the research of the Nautical Archaeology Program (NAP) by studying ships and shipwrecks in the context of the seafaring cultures that created them. A variety of projects are conducted in partnership with the Institute of Nautical Archaeology (INA), also based at Texas A&M University (TAMU). And there is so much to be discovered! We live on a planet that is nearly three-quarters covered by saltwater seas, oceans that have been vital to the development of the human species. Long ago our ancestors learned that with the right technology – rafts, boats, and later ships – they could turn oceans, lakes, and rivers from barriers into a means of traveling great distances, efficiently carrying heavy loads, or harvesting marine resources.

Evidence suggests that seafaring began tens of thousands of years ago, and was one of the first complex technological activities attempted by early humans. Boats and ships have been – and still are – the largest moving structures created by people, and their assembly, outfitting, and use has always been a labor- and resource-intensive activity. Even today most of the world's trade relies on ships to carry goods to their destinations. Despite the importance of our seafaring past, much of it was never recorded in any written records. Fortunately, we have a way to recover the story of seafaring, and that is to seek out the material evidence, the shipwrecks, port facilities, and other archaeological sites that lie beneath land and water.

Maritime or nautical archaeology is a relatively new field of scholarship. The Nautical Archaeology Program of the Anthropology Department at Texas A&M University, founded by Dr. George F. Bass in 1976, is the earliest such graduate program and one of the largest of its type (in terms of the number of faculty, students, and ongoing projects) to be found anywhere in the world. It specializes in training graduate students in the archaeology and history of ships and seafaring. Courses in the program focus principally on the ships and maritime activities of the ancient, medieval, and early modern eras; additional classes cover artifact conservation, historical archaeology, and deep water research. The seven faculty members of the program are united in their scientific approach and share common interests in the

history of wooden ship construction and related technology, shipboard life, the development of maritime trade and economic systems, naval warfare, the role of seafaring in exploration and contact between cultures, and the importance of artifact conservation in archaeological research. Students enrolled in NAP work in the field as well as in the classroom and are encouraged to pursue individual projects that will help define nautical archaeology's future.

Founded in 2005, the Center for Maritime Archaeology and Conservation is headquartered in the Anthropology building at Texas A&M University, along with the Nautical Archaeology Program of the Anthropology Department and the Institute of Nautical Archaeology. The center supports and coordinates faculty and student field research projects around the world including many in Mediterranean countries, Africa, eastern Asia, northern Europe and the Americas. CMAC maintains eight laboratories at the university that further its goal of researching, analyzing, and publishing archaeological finds. Five of the laboratories focus on discoveries from shipwreck sites, including the Steffy Ship Reconstruction Laboratory, the Ship Model Laboratory, the New World Laboratory, the Old World Laboratory, and the Wilder Imaging Laboratory. In these laboratories excavated ships are reconstructed on paper or computers, and comprehensive analyses are carried out on artifacts, as well as faunal and botanical remains.

CMAC has three laboratories devoted to the conservation of archaeological materials from marine environments, including the Conservation Research Laboratory (CRL) with an on-campus teaching facility and a large-projects facility at TAMU's Riverside Campus, the Archaeological Preservation Research Laboratory, and the Archaeo–Genomics Laboratory. Through the CRL, CMAC maintains an active contract program that conserves finds from terrestrial and underwater archaeological sites, and provides stabilization treatment of artifacts held in museum and historic site collections. The contract program provides outside institutions with reasonably-priced, high-quality conservation services. Over the years the CRL has generated research and employment opportunities for graduate students, and allowed them to obtain on-the-job technical training and, for many, a certificate in conservation.

Throughout much of human history, boats and ships have carried people, ideas, technology, and trade around the world. Through its study of shipwrecks CMAC is uniquely qualified to interpret important social, technological, and economic transitions that have occurred within or between cultures, and over a vast expanse of time. The research mission of CMAC is inherently interdisciplinary, involving anthropology, oceanography, geography, engineering, all the natural sciences, history, languages, and architecture. And, because oceans connect the world's land masses and cultures, the work of CMAC is necessarily international in scope, involving scholars and research institutions from North and South America, Europe, Africa, Asia, and Australia. CMAC faculty have studied sites as ancient as the 13th-century B.C. Ulu Burun wreck in Turkey and as recent as the 1830s-era Mississippi River steamboat *Heroine* in Oklahoma, USA.

- Kevin J. Crisman

Conservation Research Laboratory

Donny L. Hamilton, Ph.D., Director

The Conservation Research Laboratory (CRL), established in 1978 at Texas A&M University, is one of the oldest continuously operating conservation laboratories in the United States and deals primarily with material from shipwrecks and other underwater sites. CRL plays a leading role in CMAC and the Nautical Archaeology Program at Texas A&M; it also works closely with all of the excavation projects of the TAMU-affiliated Institute of Nautical Archaeology (INA).

The Conservation Research Laboratory is directed by Dr. Donny Hamilton and has a permanent staff of four people and a variable number of graduate assistants on annual appointments. H. James (Jim) Jobling serves as the projects manager and sees that everything runs smoothly. Dr. Helen Dewolf is the chief conservator who provides oversight on all of the conservation work being performed. John Hamilton supervises the student workers, and Peter Fix is in charge of various contract projects that CRL undertakes. In addition, anywhere from eight to twelve graduate students work on the different projects.

CRL's teaching, research, and archaeological contract projects continue year-round and are based in two laboratory facilities. The first, located in the Anthropology building on the university's main campus, is used primarily to teach conservation courses for students in the Nautical Archaeology Program at TAMU.

Figure 1: Student conservator Andrew Roberts cleaning a gun from the *Alabama.*

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All students are required to take the introductory class, Conservation of Cultural Resources I, so that they will be familiar with the basic techniques to treat artifacts and materials recovered from underwater sites. Graduate students may elect to take twelve hours of conservation classes which allows them to be awarded a conservation certificate in addition to their graduate degree. Graduate students from the Anthropology Department and from other majors also find conservation to be an important part of their training at Texas A&M University.

The on-campus teaching laboratory is equipped to conserve a wide range of small inorganic and organic artifacts, but it is at CRL's second laboratory, the CRL Projects Facility at the university's Riverside campus, where large-scale conservation projects are undertaken. Here, cannons, anchors, steamboat machinery and other weighty and complex objects are cleaned and treated.

Another aspect of the CRL Projects Facility is the contract conservation program, in which artifacts from a range of underwater and terrestrial sites are conserved for federal, state and private organizations that do not have their own conservation facilities.

Any artifact found in any archaeological site, submerged or terrestrial, can be treated at CRL. The lab handles artifacts ranging from those made of iron, copper, brass, silver, pewter or gold to those of bone, wood, leather, glass or ceramic.

Figure 2: Re-construction of *La Belle* hull before treatment, mounted on a lifting platform.

Figure 3: Drs. Dewolf and Hamilton researching an array of conserved artifacts from Port Royal.

The CRL staff is currently conserving an extensive collection of material recovered from the 17th -century sunken city of Port Royal, Jamaica. The laboratory has also contracted with the Texas Historical Commission to treat all the cargo, equipment, and hull of a 17th- century French ship, *La Belle*, which wrecked in Matagorda Bay in 1686. The Oklahoma Historical Society has engaged the CRL to conserve artifacts from the 1838 steamboat *Heroine*. Most recently, the CRL has undertaken the conservation and study of objects recovered from the Mardi Gras wreck, a deep water site in the Gulf of Mexico. The project was conducted in conjunction with Texas A&M's Department of Oceanography and the U.S. Government's Mineral Management Service.

In addition to these large projects, CRL conserves artifacts from small historical and archaeological collections and sites; artifacts recovered from terrestrial sites are also treated, along with artifacts from museum collections damaged by storms, floods and hurricanes.

In the past, the lab has treated artifacts such as a wooden chest of tools from the wreck of the *Brother Jonathan* for the State of California, metal artifacts from Fort Griffin for the Texas Historical Commission, a time capsule from Goliad, and American Revolutionary period artifacts from the Battle of King's Mountain, South Carolina, for the National Park Service.

The CRL welcomes the opportunity to take on outside conservation projects. Any person or organization interested in properly conserving a single artifact or an entire collection is encouraged to contact CMAC. Artifacts are conserved only for legitimate archaeological projects (no commercially salvaged collections are accepted).

More information on the CRL can be found at:

http://nautarch.tamu.edu/napcrl.htm

Archaeological Preservation Research Laboratory

C. Wayne Smith, Ph.D., Director

The Archaeological Preservation Research Laboratory (APRL) developed out of and works closely with the Conservation Research Laboratory. It differs in that it is primarily a research facility dedicated to the refinement of existing conservation protocols and development of new conservation strategies for preservation of archaeological material. It is directed by C. Wayne Smith. Since its founding in 1997, APRL has worked with conservators from many countries, contributing scientific methodologies for use in numerous archaeological projects in Europe, Australia and the United States.

From its conception, APRL has been a 'what if' laboratory, focused on answering questions that arise while developing conservation methods for waterlogged organic artifacts. Often, these artifacts do not respond well to traditional conservation methods and materials, necessitating the development of innovative new treatments. APRL facilities include equipment for conducting digital microscopy as well as super-cold conductive and polymer research. Interdisciplinary research and development projects are part of the APRL mandate.

Research with the Texas A&M Nuclear Science Center is a case in point. With the aid of nuclear science researchers, APRL staff members have conducted a number of studies on radiation-aided "flash polymerization" processes that provide fast, reliable stabilization of fragile objects.

Figure 1: Nautical student Megan Smith examining slides in the APRL facility.

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To date, the work of Drs Wayne Smith, D.L. Hamilton and Jerome Klosowski (Dow Corning Corporation) has resulted in the award of five major patents with additional patents pending. This research focuses on the development of chemical processes for targeted applications. The resulting treatments can be applied both to archaeological preservation and numerous industrial situations. For example, one process can be used to treat waterlogged wood, leather, or rope from an archaeological site, or to treat a cadaver for medical research.

APRL has been in the forefront of developing and applying silicone oil processes for conserving artifacts. These techniques have shown great promise for long-term stabilization of organic materials. Using accelerated weathering and computer modeling, APRL has determined that the half life expectancy for treated artifacts is at least 250 years. Best of all, silicone oil treated artifacts can be easily re-treated if or when retreatment is necessary.

Graduate students from many departments at TAMU have successfully completed classes in archaeological conservation. Through the Nautical Archaeology Program at TAMU, students and even international colleagues can attend classes in conservation to fulfill requirements for our Conservation Training Certificate without seeking an M.A. or Ph.D. degree.

Information on the Conservation Certificate can be found at:

http://nautarch.tamu.edu/academic/cert.htm

Like the CRL, APRL takes on conservation contract work; for more information, visit:

http://nautarch.tamu.edu/aprl/

Figure 2: Disassembled pulley – consisting of a block, sheave and pin – from *La Belle,* after silicone oil treatment.

J. Richard Steffy Ship Reconstruction Laboratory

Filipe Vieira de Castro, Ph.D., Director

The Ship Reconstruction Laboratory, generally referred to as the Ship Lab, was created by J. Richard Steffy in 1976 and today is one of the laboratories of the Center for Maritime Archaeology and Conservation at Texas A&M University. Following Mr. Steffy's retirement, Dr. Frederick M. Hocker, now at the *Vasa* Museum, became the lab director. The lab is currently directed by Filipe Vieira de Castro, and its mission is to acquire and disseminate knowledge about wooden shipbuilding through time. The Ship Lab, by design, serves as a classroom, a research laboratory, and an outreach institution.

The primary function of this laboratory is to provide classroom space for ship construction and documentation courses. It is here that Nautical Archaeology Program students learn how to draw ship's lines and reconstruct ship's hulls, fittings, and rigging from archaeological remains. As a classroom its main objective is to provide an effective learning environment. With a collection of research models, twelve drafting stations, and three computers, the Ship Lab is a well-equipped drafting room where students at various stages of their graduate training can have a quiet working space with all the materials and facilities required to further their research.

The laboratory's research objectives are to assist archaeological investigations, seek public and private research funds, and recruit and retain quality students for its projects. The Ship Lab research focus lies in the nexus between nautical archaeology and naval architecture. Currently its main project is the reconstruction of a Portuguese India *nau* in its technological, historical, and cultural contexts.

Working in partnership with several institutions, including the Center for the Study of Digital Libraries at Texas A&M University and the Centre for Marine Technology and Engineering at Instituto Superior Técnico, Technical University of Lisbon, Portugal, the Ship Lab is advancing the knowledge of early modern European shipbuilding on several fronts.

A virtual model of a Portuguese India *nau* was developed by graduate student Audrey Wells at the Texas A&M University Department of Visualization Sciences, under the direction of Dr. Frederic Parke. The virtual model serves as a research tool to investigate how cargo was stowed in the hold, and has permitted the study of how the space on the ship was managed and appropriated. This led to an inventory and ranking of research questions pertaining to the ship's structural performance and intact stability.

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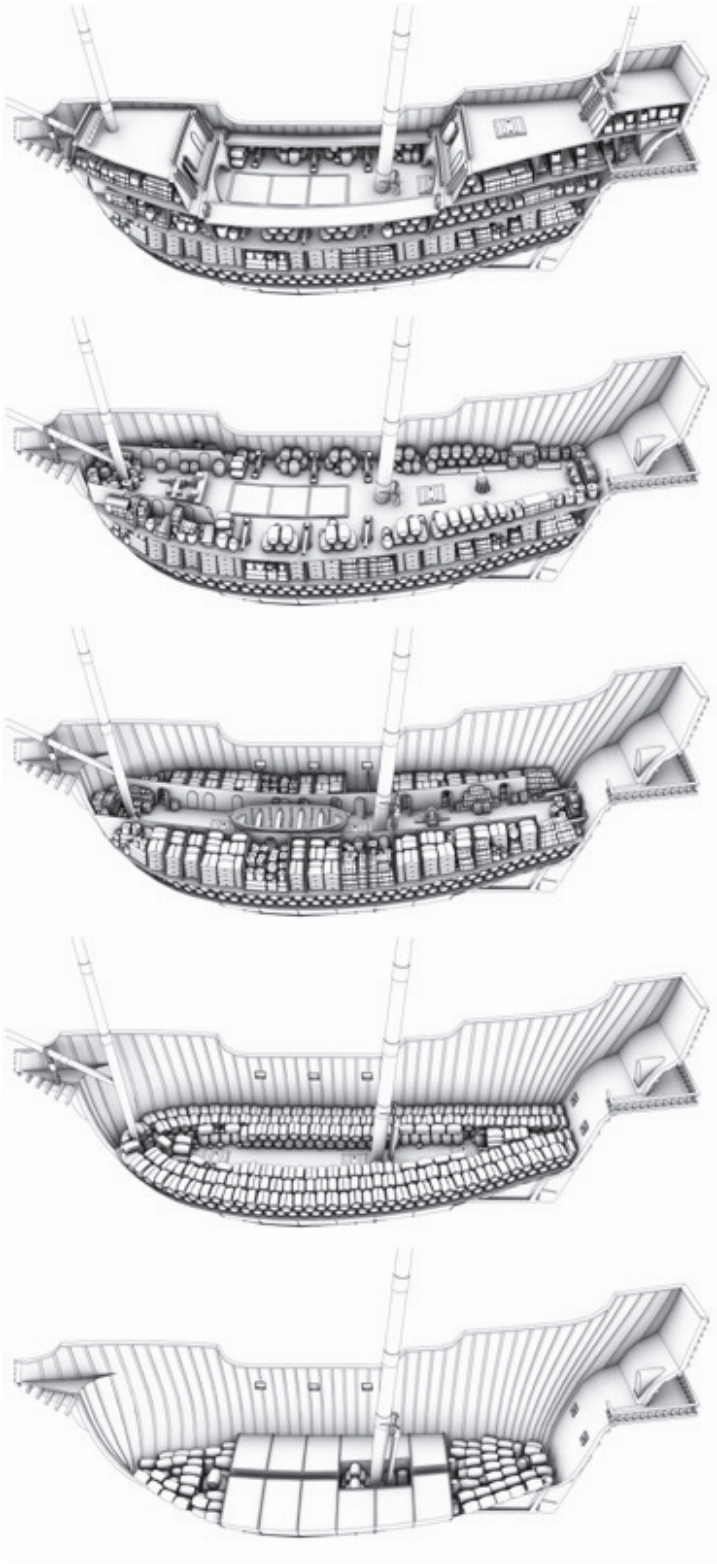

Figure 1: Audrey Wells' virtual model of the reconstructed pepper wreck.

Figure 3: Test model of a Portuguese *Nau* created by the Centre for Marine Technology and Engineering of Instituto Superior Técnico', in Lisbon, Portugal.

The engineering input for studying the construction of 16th- and 17th- century Portuguese India *Naus* has been provided by Dr. Nuno Fonseca at the Centre for Marine Technology and Engineering of Instituto Superior Técnico, and his team: Dr. Tiago Santos and Ph.D. students Tomás Vacas and Carla Carvalho. In parallel with multiple other aspects, such as the study and reconstruction of Portuguese Indiamen from contemporary shipbuilding treatises, Dr. Fonseca's team has built a scale model and is carrying out a number of tow tank tests that will allow a better understanding of many aspects of the sailing performance of these vessels. Wind tunnel studies of the ship's reconstructed rigging are scheduled for next year, and the final results should be known in two years.

To understand the Indiaman in its historical context entails a study of the equivalent watercraft of other European seafaring nations. That work is being developed in cooperation with a number of international scholars, centered on the Centro de História of the University of Lisbon, under the direction of Dr. Francisco Contente Domingues, and the Projecto Ciência e Descobrimentos, under the direction of Dr. Rui Loureiro. Several of his students are working on the historical sources pertaining to this period and type of ship. One of the most interesting projects entails the creation of a carefully researched wooden model by Dr. Domingues' graduate student Carlos Montalvão. Scale wooden models are a very useful tool to understand a plethora of technical issues pertaining to the structural details of a ship. Models also contribute to the analysis of the vessel's construction sequence, and to the understanding of spatial divisions on board.

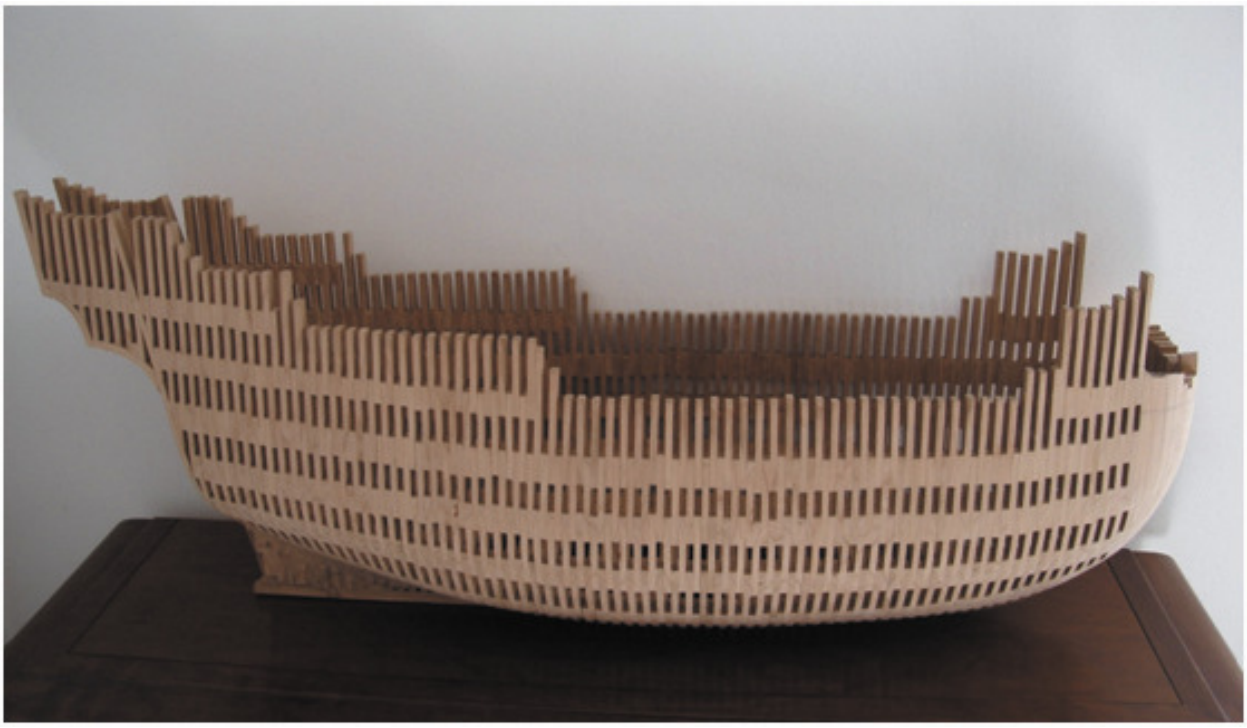

Figure 4: Carlos Montalvão's model.

Another Ship Lab project is the Nautical Archaeology Digital Library, being developed with the Texas A&M Center for the Study of Digital Libraries, under the direction of Dr. Richard Furuta, of the Department of Computer Science. It is based on the Pepper Wreck project, an early 17th-Century Portuguese Indiaman excavated at the mouth of the Tagus River in Portugal. This project aims at creating an on-line system that makes available all notes from archaeological excavations, together with supporting data such as treatises on shipbuilding, drawings, glossaries, and archaeological parallels for many kinds of ship types. It is supported by the Portuguese Navy, through its Academia de Marinha, the Portuguese National Library and the Library of the University of Coimbra, as well as Lisbon Universidade Autónoma, the City of Lagos, and the prestigious Centro de História of the University of Lisbon.

The rationale behind the digital library endeavor is that nautical archaeologists are all too often do not have their primary data available for scrutiny; this project aims to alleviate the problem.
Funding for Ship Lab research is provided by several grants, of which the most important come from the National Science Foundation, the Portuguese Fundação para a Ciência e Tecnologia, and a memorial gift from Dr. and Mrs. Peter Amaral, Texas A&M Alumni and active supporters of the university's Nautical Archaeology Program.

Other projects presently ongoing at the Ship Lab pertain to Italian shipbuilding in the Renaissance and early modern periods. In cooperation with the renowned specialist Mauro Bondioli, nautical archaeology student Lilia Campana is studying early shipbuilding treatises in Italian contexts. Also in cooperation with the Centre for Marine Technology and Engineering at Instituto Superior Técnico and historian Furio Ciciliot of the Societá Savonese di Storia Patria, we are trying to develop a framework for the analysis of the evolution of lateen rigged merchant ships in the Mediterranean World. Another research question we will address is the development of the 16th-Century three -masted ship.

Field work is an important part of the Ship Lab's activity, and a project to study Puerto Rico's maritime history has been ongoing since 2007, in cooperation with the Puerto Rican Instituto de Investigaciones Costaneras and the Texas A&M Department of Geology and Geophysics. So far, sixteen underwater sites have been inspected and categorized, and some may undergo further study in the wider contexts of the island's maritime landscape and geomorphology.

As an outreach institution the Ship Lab aims at providing information, education, and guidance about the discipline of nautical archaeology and the importance of the world's submerged cultural heritage, perhaps more than ever threatened by treasure hunting and uncontrolled excavations.

Through frequent public speaking and popular publications, the Ship Lab has been active in the promotion of archaeology against the destructive activity of treasure hunters, emphasizing the importance of public education and promotion of good archaeological projects that serve as examples of successful public protection of the world's submerged cultural heritage.

More information on the J. Richard Steffy Ship Reconstruction Laboratory can be found at:

http://nautarch.tamu.edu/shiplab

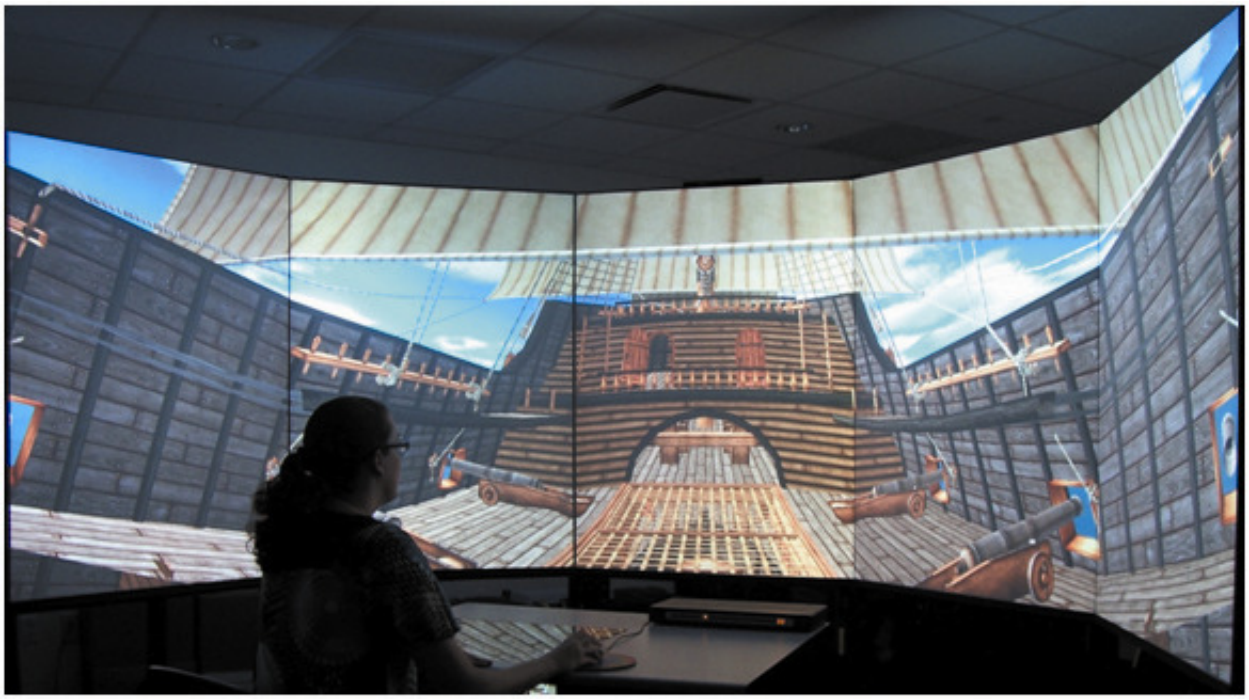

Figure 5: Department of Visualization Sciences 'Cave', developed by Dr. Frederic Parke, where Audrey Wells' virtual model of a Portuguese Indiaman of c. 1600 can be explored.

Ship Model Laboratory

Glenn P. Grieco, Director

The Center for Maritime Archaeology and Conservation's Ship Model Laboratory is a fully equipped woodworking and machine shop which developed out of the Steffy Ship Reconstruction Laboratory in 2005. The model lab produces a wide variety of museum quality ship models and artifact replicas. It continues to work closely with the Steffy Ship Reconstruction Laboratory and the archaeological projects of the other CMAC laboratories.

The goal of the Ship Model Lab is to provide a better understanding of the original appearance and construction of artifacts excavated from marine sites by creating 3-D reconstructions. Whenever possible, original construction techniques and materials are utilized, and in the case of scale models, special attention is given to using materials that approximate the mechanical properties of the original material in scale. The resulting models provide an accurate picture of what could have been done at full scale and are used as visual aids in Nautical Archaeology Program courses.

In addition to research and teaching models, the laboratory also contracts to build display models for museums. This is an effective way to present the results of different research projects to the general public.

This past year saw the completion of four models commissioned by the Oklahoma Historical Society for their newly-constructed Museum of History in Oklahoma City. The western river steamboat Heroine was built in 1832 and ran onto a snag in the Red River in 1838. Excavated under the direction of Dr. Kevin Crisman, it is the most complete Mississippi River-type steamboat excavated from this period, providing a unique look at the early evolution of this class of vessel.

Figure 1: A 1:20 scale model of the wreck of the *Heroine* in situ.

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The *Heroine* model collection includes detailed 1:10 scale models of the reconstructed stern of the vessel, a representative cross-section, and a working reconstruction of the steam-powered engine, flywheels, and paddlewheels. The act of excavating a site and removing artifacts permanently alters the archaeological remains; therefore, the Oklahoma Historical Society also commissioned a 1:20 scale model to illustrate the stern of the wreck prior to the removal of the propulsion machinery.

The process of modeling the machinery of the steamboat required disassembling and analyzing the surviving engine parts. This analysis has provided many new insights into not only how the vessel and its equipment were constructed, but also how the steamboat was operated and maintained.

To aid in the reconstruction and fabrication of the machinery, computer design and manufacturing programs such as AutoCAD™ and BobCAD™ were used. These programs allowed the field data and drawings to be quickly converted to 3-D computer models, and the models were made into solid parts using a three-axis computer-aided mill. The computer programs also enabled the reconstruction of damaged and missing parts. Information on the weight and balance of each part derived from the AutoCAD™ drawings also assisted in the recovery of the massive iron castings from the river using a helicopter.

The research and reconstruction of the steam machinery aboard the *Heroine* is still ongoing. As conservation of the artifacts continues, new features and discoveries are coming to light, providing a wealth of information on these poorly-documented marine engines. Although only a handful of artifacts from the boilers have been recovered, a 3-D computer reconstruction of the boiler assembly is currently underway with the possibility of a scale model and publications in the near future.

Figure 2: Glenn Grieco working on the 1:36 model of *Jefferson*, a U.S. Navy brig from the War of 1812.

Figure 3: Scale model of *La Belle*.

Past models that have been constructed in the lab include two 1:6 scale models of *La Belle*, a small ship employed by the French explorer René-Robert Cavelier, Sieur de La Salle, which was lost off Matagorda Bay, Texas in 1686. Although small in size, the vessel contributed greatly to our knowledge of French shipbuilding in the late 17th century.

One of the *La Belle* models is on display at the Texas Maritime Museum in Rockport, Texas and the second, pictured above, is on permanent display in the Anthropology Building on the Texas A&M University campus. An ongoing project is a 1:36 scale model of the U.S. Brig *Jefferson*. Built on Lake Ontario in 1814 to counter British forces during the War of 1812, the brig's remains were excavated in the 1980s under the direction of Dr. Kevin Crisman. The resulting data provided a wealth of information on innovative shipbuilding practices of the day.

By combining primary research, computer-aided design, and hands-on construction, the Ship Model Laboratory provides the Center for Maritime Archaeology and Conservation a tool for visualizing archaeological discoveries in a manner that is accessible to both scholars and the general public.

More information on the Ship Model Laboratory can be found at:

http://nautarch.tamu.edu/model/

New World Laboratory

Kevin J. Crisman, Ph.D., Director

The Center for Maritime Archaeology and Conservation's (CMAC) New World Laboratory, directed by Kevin Crisman, may be of modest dimensions (it consists of a medium-sized room with an attached office), but the research taking place within its walls has always been ambitious in scope. Located in Texas A&M University's Anthropology Building, this lab is a focal point for archaeological studies of ships and seafarers in the early modern era (the period between the late 15th and early 20th centuries). The research subjects are eclectic, involving everything from sailing warships, to mule-towed canal boats, to early steamships, to a two-horse-powered paddle boat, but the central theme is wooden vessels of medium to large size, along with their contents, the mariners who sailed aboard them, and the role of ships in world history.

The lab's title might suggest that only ocean-going ships are of interest to its research, but a broader interpretation of 'seafaring' is employed here, since many of the wrecks studied in the lab spent their careers on the rivers and lakes of North America. The lab opened in 1991 when Texas A&M University's Anthropology Department moved into the old Aerospace Engineering building, and since then it has hosted a considerable amount of thesis, dissertation, and other scholarly research.

Figure 1: A painting by Peter Rindlisbacher, showing the U.S. Navy 20 gun brig *Eagle* under sail in September of 1814.

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The lab's equipment is basic, consisting of the tools needed for analysis of shipwrecks and preparation of reports: computers, drafting tables, a light table, and tables for laying out artifacts and drawings. The room also contains storage drawers and shelves for the numerous plans, charts, and files generated by all of the archaeological field work.

From its beginning the New World Lab has had a strong "Shipwrecks of the War of 1812" component running through it. The U.S. Navy 20-guns brigs *Eagle* and *Jefferson*, vessels built in 1814 for service on Lakes Champlain and Ontario, were the subjects of Crisman's M.A. and Ph.D. research. The data and plans generated from the two wrecks are now archived in the lab, and *Jefferson's* plans have recently been used by CMAC master craftsman Glenn Grieco to create a spectacular 1:36 scale, fully rigged model of the brig (scheduled to go on display in the lab in the near future). Other 1812-era wreck studies completed by Texas A&M students include the U.S. gunboat *Allen* (Eric Emery, Ph.D. 2003), the British brig *Linnet* (Erika Washburn, M.A. 1998), the British transport schooner *Nancy* (Chris Sabick, M.A. 2004), and the Royal Navy frigate *Princess Charlotte* (Daniel Walker, M.A. 2006); M.A. candidate LeeAnne Gordon just completed her thesis on the British Navy's lake schooners *Newash* and *Tecumseth*. And to wrap all of this 1812-related research up in one package, a contributed-chapter book featuring sixteen warships is scheduled for completion and publication in the near future.

Lake Champlain shipwrecks and related sites have also been a major part of the work undertaken in the New World Lab. This lake, a vital interior waterway between the U.S. and Canada, has yielded the wrecks of merchant schooners, canal boats, French and Indian War-period naval vessels (the 1759 British sloop *Boscawen* has been the subject of four Texas A&M master's theses on weaponry, tools, personal effects, and rigging finds), sailing canal boats (Joseph Cozzi, Ph.D. 2000), and a sunken bridge from the Revolutionary War (Scott McLaughlin, M.A., 2000). The lake also yielded a rare example of a horse-powered ferry boat, the subject of a book written by Kevin Crisman and Arthur Cohn and titled *When Horses Walked on Water* (Smithsonian Institution Press, 1998).

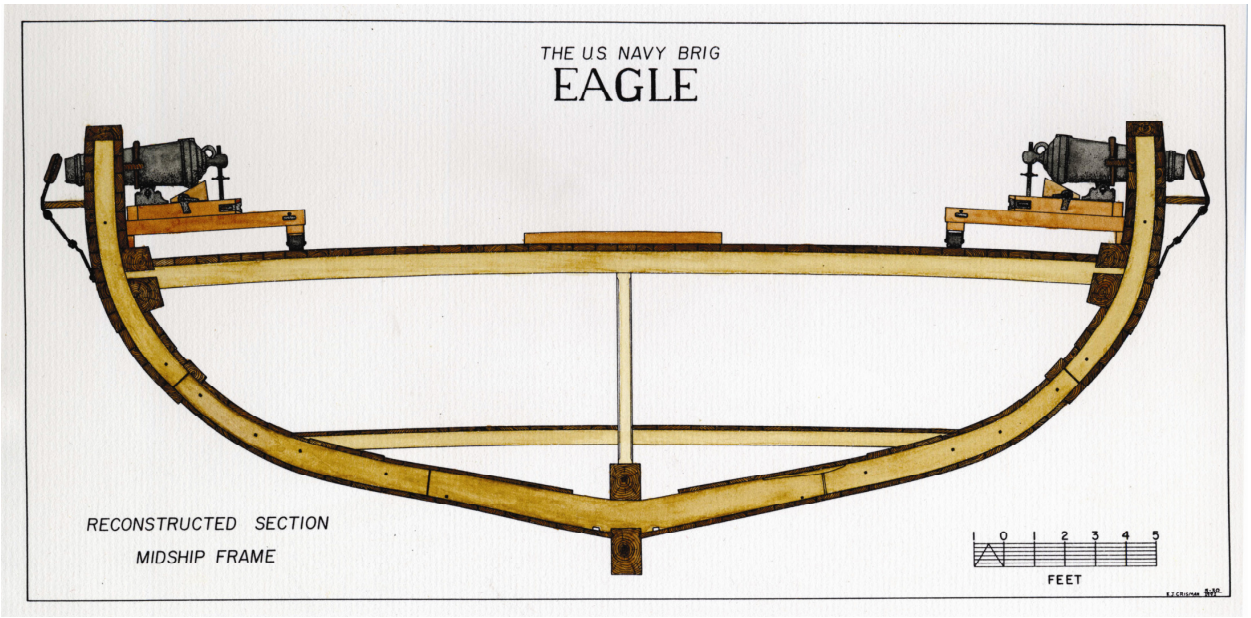

Figure 2: A reconstructed section of the brig *Eagle* at the midship frame, showing the extreme shallow draft of this lake-bound warship.

Figure 3: A helicopter prepares to airlift the remains of *Heroine*'s machinery from the Red River.

Figure 4: Nautical student Will Moser drawing a bottle from the *Heroine*.

The dominant theme in the lab at the present time is steamboats, specifically a boat called *Heroine* that navigated the Mississippi River and its tributaries during the 1830s. Discovered in the Red River in 1999 and jointly investigated by the Oklahoma Historical Society, Texas A&M and the Institute of Nautical Archaeology between 2002 and 2008, *Heroine* is the earliest "western river" steamer to be archaeologically studied. It has greatly expanded our understanding of steamboat development and use on America's inland waters. The wreck yielded hundreds of artifacts, ranging from cargo barrels and boxes, to steam engine parts, to the personal possessions of the crew, all of which have been conserved by CMAC's Conservation Research Laboratory. As these artifacts complete their preservation treatment, they are brought to the New World Lab for drawing, photography, and analysis. Visitors to the lab have been amazed by the range and excellent condition of *Heroine*'s finds, and by the stories each of the objects has to tell about steamboat technology and river life in the era when steamboats ruled the waterways.

While *Heroine* artifacts and files presently fill the lab, it is not the only steamboat wreck undergoing study by Texas A&M researchers. M.A. student Brad Krueger is currently co-directing the study of the Lake Erie steamboat *Anthony Wayne*, while Ph.D. student George Schwartz has recently commenced dissertation research on Lake Champlain's *Phoenix* (1815-1819), the oldest known steamboat wreck in North America. This work, and future investigations of inland and ocean-going shipwrecks, will undoubtedly keep the New World Seafaring Lab busy with activity and crowded with data and plan files for the foreseeable future. All theses and dissertations produced by Nautical Archaeology Program students can be accessed at:

http://anthropology.tamu.edu/theses

Additional information on the New World Laboratory and its projects can be found at:

http://nautarch.tamu.edu/newworld.htm

Figure 5: The excavation team with the portside wheel of the *Heroine* after its recovery from the Red River..

Old World Laboratory

Cemal M. Pulak, Ph.D., Director

The Center for Maritime Archaeology and Conservation's Old World Laboratory is a focal point for Texas A&M University (TAMU)-based investigations of ships and shipwrecks of the ancient and medieval Mediterranean. The laboratory's work space and equipment are shared by ongoing projects directed by Dr. Cemal Pulak, Dr. Shelley Wachsmann, and Dr. Deborah Carlson.

While the actual conservation and cataloguing of artifacts and hull timbers recovered from shipwrecks takes place in the Institute of Nautical Archaeology's (INA's) Research and Conservation Center in Bodrum, Turkey (or in other Mediterranean-region countries), field and artifact data from these sites are brought back to the Old World Laboratory for analysis and report preparation. Consequently, the laboratory sees a great deal of research, drafting, and writing activity throughout the year.

Perhaps the most significant and renowned shipwreck under study in the Old World Seafaring Laboratory is the Late Bronze Age shipwreck excavated by Dr. Pulak at Uluburun, Turkey between 1984 and 1994 and dated to the last quarter of the 14th century B.C. This is the oldest intact shipwreck to be studied by archaeologists; its load of copper, tin, and glass ingots, ebony, ivory, gold jewelry, bronze weapons and tools, and ceramic containers filled with resin and other goods makes it one of the richest sites in terms of the knowledge that has been gained from its cargo and equipment.

Figure 1: An archaeologist examines timbers from the Uluburun Shipwreck.

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In November 2008, New York's Metropolitan Museum of Art opened an exhibit on the Middle and Late Bronze Age Near East featuring many of the finds from the Uluburun wreck (described in an exhibit catalogue of the artifacts prepared by Dr. Pulak).

The laboratory is also the scene of ongoing research on a variety of other wooden vessels that have been excavated or documented by Dr. Pulak. These include the *Kadırga*, a late 16th- or early 17th-century Ottoman imperial galley-type barge that is one of Turkey's great national treasures. Housed in the Naval Museum in Istanbul, *Kadırga* represents an era when Ottoman cultural and military influence dominated the Mediterranean; it is also the oldest continuously-maintained wooden hull in the world and the only example with an outrigger for rowing. The galley had never undergone intensive technical and historical study until a multi-year program of recording and archival research was undertaken to trace its use and refurbishment over the centuries.

Another ongoing project is the reconstruction, by drafting and three-dimensional modeling, of a late 16th-century A.D. wreck found off Yassıada reef on the Turkish coast (this is also known as the Ottoman Wreck), and excavated by Dr. Pulak in the early 1980s. Despite its fragmentary condition the hull has yielded insights into an era of Mediterranean ship design and building practices that had previously received scant attention from scholars.

Figure 2: Two man submersible used on the DANAOS Project.

Figure 3: Using a lift balloon to move a column drum from the Kizilburun Shipwreck.

Most recently Dr. Pulak and a team of INA and TAMU researchers have collaborated with Istanbul Archaeological Museums to excavate shipwrecks in the Medieval-era (Byzantine) Theodosian harbor of Constantinople (modern-day Istanbul, Turkey). Discovered in Yenikapı, Turkey during the construction of a new underground railroad station, many of the more than 30 wrecks recovered during the archaeological excavations at the site were thought to have sunk in the harbor as a result of a massive storm. With the support of CMAC, a total of eight of these wrecks were documented and recovered by Dr. Pulak's group, and four of the wrecks will soon be undergoing full documentation and conservation at INA's Research and Conservation Center in Bodrum. The wrecks excavated by Pulak's group represent a range of merchant vessel types and at two galleys—the oldest galleys found in the Mediterranean; most of the wrecks date to the late 10th century A.D., although one appears to date to the 7th century. Intensive study and reconstruction of several of these wrecks will be undertaken as M.A. and Ph.D. projects over the next few years.

CMAC's Old World Laboratory also hosts the ongoing surveys and shipwreck excavation projects of Drs. Wachsmann and Carlson. Since 2007, Dr. Wachsmann has been conducting the DANAOS Project involving a series of deep-water surveys south of Crete, an area that saw considerable ship traffic since the earliest phases of seafaring in the Mediterranean. Thus far, the surveys have yielded scattered ancient amphoras, indicative of the disposal or loss of ceramics by vessels that passed over this section of the Mediterranean.

Dr. Carlson is currently engaged in two major archaeological studies of ancient shipwrecks excavated off the coast of Turkey. The first of these is the analysis and publication of finds from the Classical Greek shipwreck at Tektaş Burnu, a small amphora carrier lost in the third quarter of the 5th century B.C., and excavated between 1999 and 2001. The second of Dr. Carlson's projects is the ongoing excavation of the Kızılburun Wreck, a 1st-century B.C. vessel lost while carrying eight massive marble drums for a complete (though unfinished) Doric-style column and other newly-quarried marble objects, including nearly a dozen grave stones and two large basins with separate pedestal bases. Isotopic data indicate that Proconnesos Island in the Sea of Marmara was the source of the marble and metrological research points to the Temple of Apollo at Claros in western Turkey as the intended destination. The Kızılburun excavation, which is still underway, provides a unique snapshot of quarrying processes, long-distance transport by sea, and monumental construction in marble in Late Hellenistic Asia Minor.

In November of 2007, the Old World Laboratory commemorated earlier work by nautical archaeologists at INA and TAMU when CMAC faculty and students hosted a two-day symposium that included 29 scholars from 10 different countries. Among the speakers were historians, archaeologists, numismatists, and ceramicists specializing in medieval trade, Byzantine ships, and Mediterranean ports. Timed to coincide with the 25th anniversary of the publication of the 7th-century A.D. Yassıada Wreck by Drs. George F. Bass and Frederick H. van Doorninck, the symposium honored these pioneers in the field of nautical archaeology by drawing attention to the legacy of their work.

For archaeologists, surveys and excavations are merely a starting point for discovering the technology, economics, politics and daily lives of seafarers and maritime communities of earlier eras. The Old World Laboratory serves as a repository for data collected from dozens of annual shipwreck surveys conducted along the Turkish coast, as well as an archive for the publication of various shipwreck excavations, such as the three volumes dedicated to the 11th-century A.D. Serçe Limanı 'Glass' Wreck published under the directorship of Drs. George F. Bass and Fred H. van Doorninck. The Serçe Limanı ship and its cargo are now on display in the Museum of Underwater Archaeology in Bodrum, Turkey. In short, the Old World Seafaring Laboratory provides a locus for the concentrated scholarly research that allows for the interpretation of archaeological finds, and their transformation into the reports and publications in order to disseminate our discoveries and research among other scholars and the general public alike.

More information can be found at:

http://nautarch.tamu.edu/cmac/oldWorld/oldWorld.htm

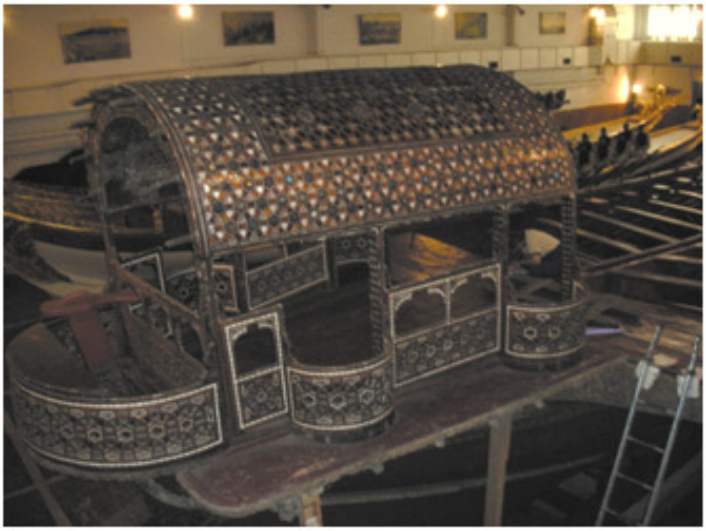

Figure 4: The Ottoman sultan's galley *Kadirga*.

Wilder Digital Imaging Laboratory

C. Wayne Smith, Ph.D., Director

The Wilder Digital Imaging Laboratory, directed by C. Wayne Smith, was established in 2006 within the Center for Maritime Archaeology and Conservation at Texas A&M University. The lab was designed to meet the expanding role of digital imaging in archaeology. This technology plays a role in documenting sites, recording artifacts, reconstruction and reproduction of artifacts, and site reconstruction using computer assisted design (CAD) based technology.

In the Wilder Lab, a Konica Minolta non-contact scanner and precision turntable are used to scan, analyze and reconstruct artifacts. This gives us the ability to replicate delicate artifacts in the process of developing conservation strategies.

Figure 1: Nautical student Ryan Lee scanning a replica skull for use with computer modeling software.

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Figure 2: Scale replicas of anchors produced with Z-Corp 310 printer.

Using our Z-Corp 310 printer we routinely make molds of artifacts, and in many cases we can print scaled replicas of artifacts for comparative collections research and for museum and classroom use. Through the Wilder digital imaging lab, students work with Rhinoceros Nonuniform rational B-spline (RHINO NURBS™) software and other CAD programs to replicate and analyze archaeological site formation.

Using state-of-the art digital SLR cameras, students learn the art of taking diagnostic black & white and color images. Working with photo editing tools, students practice image management and all stages of image processing, from the initial photography to publication. Strata Foto-3D is used to create 3-dimensional objects from sequenced, registered photographs. Using Photomodeler, students create 3-D view archaeological models.

Through a research arrangement with the St. Joseph Regional Medical Center in Bryan, Texas, we are able to conduct advanced analysis of artifacts using MRI and CT imaging. Using these techniques we can interface with tools in the Wilder Lab and the Ship Model Laboratory to better analyze, conserve and preserve archaeological data.

In the Wilder Lab, digital technologies interact in a range of ways to allow creation of new tools for archaeology and fine art conservation. The lab gives students the opportunity to combine photographic skills with site mapping and 3-dimensional replication of archaeological data.

More information on the Wilder Lab is at:

http://nautarch.tamu.edu/WilderLab/

Archaeo-Genomics Laboratory

Peter D. Fix, Director

The Archaeo-Genomics Laboratory (AGL) is directed by Peter Fix. He is assisted by Catherine M. Sincich, a Ph.D. student in the Nautical Archaeology Program. The laboratory was founded in 2007 as part of CMAC's Flying in New Directions Program. The goal of the lab is to gain a better insight into the complex microbial communities involved in aqueous corrosion, in particular as the corrosion issue relates to the decay of submerged historic aircraft. The oceans of the world contain a myriad of micro-organisms capable of causing or influencing the deterioration of metal alloys. Known by the acronym MIC, for microbially influenced corrosion, this decay mechanism was once considered to contribute very little to the corrosion of submerged archaeological metals. Over the past several decades, however, a better awareness of the fundamental role that bacteria may play in aqueous corrosion has generated new preservation challenges for archaeological conservators and cultural resources managers. Yet, with these challenges there is an abundance of new opportunities for research and discovery.

The mission of CMAC-AGL is to investigate MIC of submerged metallic objects and structures in order to understand how microbial communities positively or negatively affect these materials, and to better define what role MIC plays in the biocorrosion process.

Texas A&M University archaeologists and researchers annually travel to excavations around the world, which when combined with a growing list of collaborating institutions and interested parties, provides access to massive quantities of provenienced data.

Figure 1: A TBD-1 Devastator aircraft, used in World War II, rests on the bottom of a South Pacific Lagoon. It is covered by a thick growth of marine organisms and bacteria that may increase the deterioration rate of the structure. Photo courtesy of TIGHAR.

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The establishment of a MIC database is a cumulative, long-term goal for CMAC-AGL. From multiple sites and over a period of years, corrosion samples for microbial DNA analysis, along with water quality parameters, depth, artifact history, and an estimation of corrosion rates associated with the a wreck can be inexpensively collected with little effort or burden on the field team. Once the corrosion or water sample arrives at the lab, a small portion is selected and processed for DNA extraction. The next step is to amplify fragments of ribosomal DNA con-served sequence (16S rDNA) by a polymerase chain reaction (PCR). If sufficient material is present on the amplified gel plate, the DNA is run through a sequencer in a profiling technique called terminal-restriction fragment length polymorphism (T-RFLP) fingerprinting of a microbial community by analyzing the sequence differences of a particular gene. The graph product of the T-RFLP can then be subjected to fragment analysis using software programs that establish the identity of the microbial community.

We theorize that by querying the collated information, directed research questions will become apparent. For example, if a particular microbial community was found to be associated with all heavily degraded metallic materials, but not with minimally degraded materials, what research design could be developed to scientifically establish the deleterious influence of that microbe? Secondly, could it be established that one or more of the supplementary sampled parameters helped to promote microbial propagation? This information could be crucial to a cultural resources manager debating whether or not to apply limited funds to the costs associated with recovering, conserving, and curating an artifact, or if the artifact may be safely preserved in situ. Granted, corrosion issues connected with a submerged archaeological site are far more complex than simply a question of the presence or absence of microorganisms, but these new lines of scientific inquiry will provide a deeper understanding of conservation or long-term preservation issues surrounding shipwrecks, aircraft wrecks and other types of submerged sites.

Figure 2: Microbiologist Todd Plaia and Nautical student Catherine Sincich gather corrosion samples for microbial DNA analysis.

The AGL is currently in a formative period of its development and sharing space as a guest of Dr. Wayne Smith in the Archaeological Preservation Research Laboratory. One of the early goals of AGL is to establish sampling procedures that meet a number of requirements. Ideal procedures are relatively easy to use in the field, require small amounts of material in order to preserve the cultural item, and can be performed by both scientists and amateurs alike in order to augment the total number of sampling sites. The AGL also aspires to develop laboratory research protocols that are both user and environmentally safe (i.e. no generation of hazardous wastes and non-radioactive).

These goals and others yet to be determined will influence the research undertaken by the lab as it develops exciting new insights into the effects of microbes on archaeological material, both for CMAC projects and for projects conducted by other archaeologists or conservators.

More information about the Archaeo-Genomics Laboratory can be found at:

http://nautarch.tamu.edu/cmac/labs.shtml

Figure 3: Front view of the TBD-1 Devastator. Photo courtesy of TIGHAR.

Staff and Faculty

Deborah N. Carlson

Dr. Carlson specializes in ships and seafaring of the Classical Mediterranean; she teaches courses in Classical Greek and Roman archaeology as well as university-wide courses in the Greek and Latin languages. She is currently directing the excavation of an ancient ship that was transporting a monumental marble column when it sank off the coast of Turkey in the first century B.C..

Filipe Veira de Castro

Dr. Castro is the director of CMAC's J. Richard Steffy Ship Reconstruction Laboratory, where he instructs graduate students in the techniques of analyzing and rebuilding wooden hulls. He specializes in ships and seafaring of the late Medieval and early modern eras, as well as early texts on ship design and construction. He was the director of the early 17th-century Portuguese "Pepper Wreck" excavation near Lisbon, Portugal, and has recently undertaken shipwreck surveys in Puerto Rico.

Kevin J. Crisman

Dr. Crisman is the director of CMAC, as well as the director of the Center's New World Laboratory. He specializes in ships and seafaring of the early modern era and has worked on numerous inland water craft. He is completing a book on naval wrecks of the War of 1812 and is currently directing the analysis of the Mississippi River steamboat *Heroine*, lost in Oklahoma's Red River in 1838.

Helen C. Dewolf

Dr. Dewolf is the Chief Conservator at the Conservation Research Laboratory Projects Facility (CRL-PF). She specializes in the conservation of archaeological artifacts, particularly organics and complex composite artifacts, from inundated sites. She also oversees the hands-on training of students in the art and science of archaeological conservation for the projects conducted at CRL-PF.

Peter D. Fix

Mr. Fix provides project support for the Conservation Research Laboratory and Center for Maritime Archaeology and Conservation. His areas of concentration include the reassembly and materials conservation of ships, boats, and aircraft recovered from the marine environment; *in situ* preservation of architectural and archaeological metals in coastal marine environments; and underwater aviation archaeology. In addition to working closely with the CRL and on the conservation of the hull of La Salle's ship, *La Belle*, he has directed projects in Irian Jaya, Indonesia, the Caribbean, and is the founding director of CMAC's Archeo-Genomics Laboratory

Glenn Grieco

Mr. Grieco is the director of CMAC's Ship Model Laboratory, where he builds research and museum display models of vessels excavated and reconstructed by the faculty and staff of CMAC and working models to be used as training aids in classes within the Department of Anthropology. Models he has completed include two 1/12th scale models of the 17th century vessel *La Belle*, the war of 1812 brig *Jefferson*, and several detail models of the Western River Steamboat *Heroine* and its paddle machinery.

Donny L. Hamilton

Dr. Hamilton specializes in historical archaeology, submerged port sites, and the conservation of artifacts recovered from marine environments. He is the founding director of CMAC and the Conservation Research Laboratory. Dr. Hamilton directed the excavation of the sunken city of Port Royal, Jamaica (1692), was a past president of the Institute of Nautical Archaeology, and is currently the head of the Anthropology Department.

John P. Hamilton

Mr. Hamilton is the Metals Conservation Specialist in the Conservation Research Lab Projects Facility. His expertise also encompasses the art of concretion excavation and casting. In addition, he is involved in the technical training of undergraduate and graduate students at the Conservation Research Laboratory Projects Facility on Riverside campus.

H. James Jobling

Mr. Jobling is the lab manager at the Conservation Research Laboratory Projects Facility on the Riverside campus of Texas A&M University. He organizes the day to day operations needed to successfully operate a large, contract-oriented conservation facility. He is the Dive Safety Officer for CMAC and the Institute of Nautical Archaeology. Mr. Jobling also teaches DAN (Diver Alert Network) dive safety courses to divers involved in many underwater archaeology projects.

Cemal M. Pulak

Dr. Pulak is the director of CMAC's Old World Laboratory and a specialist in ships and seafaring of the pre-classical, classical, and medieval-era Mediterranean. He teaches courses in nautical archaeology, Bronze Age trade, and on the history of wooden ship building. He is the director of the late 13th-century B.C. Uluburun shipwreck study and most recently directed the excavation of eight medieval-era wrecks at the ancient Byzantine harbor at Yenikapı in Istanbul, Turkey.

C. Wayne Smith

Dr. Smith specializes in artifact conservation and archaeological photography, and is the director of CMAC's Archaeological Preservation Research Laboratory and the Wilder Imaging Laboratory. He teaches courses on conservation treatments, advanced photography, and computer imaging.

Shelley Wachsmann

Dr. Wachsmann teaches courses in biblical archaeology, seafaring in the ancient Mediterranean, and deepwater archaeology. Dr. Wachsmann excavated the first century A.D. Sea of Galilee Boat, a collection of classical- and medieval-era wrecks at Tantura Lagoon, Israel, and he is currently directing the DANAOS Project's search for ships in very deep water between Crete and Egypt.

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