Nautical Dendrochronology: An Assessment of the Whaler Charles W. Morgan

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The American-built whaler Charles W. Morgan, constructed in 1841 and now berthed at the Henry B. duPont Preservation Shipyard, Mystic Seaport, Connecticut, is currently undergoing major restoration. Its timbers provide a wide range of possible dendrochronological investigations. In late 2010, the ship was evaluated for its potential to contribute to a methodological framework in nautical dendrochronology (which is, itself, defined). This paper discusses the collection, rationale, and initial findings, and concludes that, while extremely promising, more samples from the ship are needed for analysis.

Introduction

The 113-foot Charles W. Morgan (Figure 1), built in 1841 in New Bedford, Massachusetts, is the last remaining wooden whaleship of a bygone American age. At the apex of the Morgan’s nearly 80-year operational career, approximately 850 similar whaleships were likewise plying the seas, but only this one survives as a functional vessel (Davis, Gallman and Gleieret 1997). After nearly 100 years in service, the Charles W. Morgan arrived at its present berth, Mystic Seaport, Connecticut, in 1941. Culver and Grant (1938), Stackpole (1967), Schultz (1967), Leavitt (1973), and especially Mystic Seaport (2012) provide detailed histories of the Morgan, its construction, voyages, and various other aspects of its working life. In recognition of its endurance and as a representative of its primary industry, which once was crucial to the American and world economies, the Morgan was designated as a National Historic Landmark in 1966, the same year that the National Historic Preservation Act (1966) was passed. The lessons learned from approximately 75 years of intensive preservation efforts at Mystic Seaport have contributed significantly to the development of the Standards for Historic Vessel Preservation Projects, as published by the National Park Service’s National Maritime Initiative (Delgado 1987, 1991, 1992).

Since 1941, the Mystic Seaport teams have undertaken multiple campaigns of repair, with the intention of keeping the ship seaworthy. Regular inspections of the integrity of the hull, which was initially placed in a sand berth, revealed the need for a series of major refittings (MacArthur 1973). The most recent effort, “Restoration Voyage,” began in 2008 and is scheduled for completion in 2013. The fundamental goal of this campaign is to prepare the ship to sail again. To make the Morgan seaworthy, tons of old and structurally unstable timber needed replacement. It is this endeavor that has provided the opportunity for an initial dendrochronological evaluation of the ship’s timbers.

With renovations soundly underway, Chris Taylor of the Henry B. duPont Preservation Shipyard contacted the Laboratory of Tree-Ring Research (LTRR) at the University of Arizona in mid-2010. He informed LTRR that a large volume of wood that was potentially useful for dendrochronology could be made available for study and that Mystic Seaport hoped to learn as much as possible regarding the ship. In October, Christopher Baisan (LTRR) and the author traveled to Mystic to review and collect specimens from various stocks of timber available at Mystic Seaport: Charles W Morgan; selections from the Preservation Shipyard’s raw timber supply; and historic unfinished timber from Charlestown Navy Yard in Boston, donated to Mystic for use in the Morgan’s refitting. The thirty-two specimens acquired from original
Maritime or Nautical Dendrochronology?

When tree rings and timber from ships are analyzed, the work is, at present, interchangeably referred to as “maritime” or “nautical” dendrochronology. Research with ship timbers is more appropriately termed “nautical dendrochronology” than other variations, while work with timbers related to maritime endeavors but not derived from ships (for example, harbors) is more accurately referred to by the broader term “maritime dendrochronology”. These differences mirror the subtle distinction between the fields of maritime archaeology and nautical archaeology, and are stated here for clarification. The diverse aspects of nautical dendrochronology are discussed in greater detail below.

Nautical Dendrochronology

In all ages, timber has been an important commodity, exploited and manipulated especially for use in ships (Lane 1975; Meiggs 1982; Borza 1987; Perlin 1989; Corvol and Amat 1999; van Duivenvoorde 2009). Nautical dendrochronology can provide far more than dates—as items of material culture, ship timbers themselves are individual artifacts that can reveal chronological, environmental, and behavioral information (Robinson 1967; Dean 1996; Daly 2007; Creasman 2010a). Yet, in most cases, ship timbers are only evaluated for their dating or sourcing potential, neglecting most of the “human” questions that define the field of archaeology. Many analytical benefits of applying dendrochronology to ship timbers in pursuit of information beyond dates have been described elsewhere (Loewen 2007; Creasman 2008, 2010b), including specific advantages for increasing the understanding of historic vessels, environments, economies, and the people who built them (Stahle and Wolfman 1985; Loewen 2000; Creasman 2010c).

A properly studied wooden ship, or the surviving portions thereof, offers a potentially significant glimpse of the past (Bass 1972; Steffy 1994). Yet, even under the best cases of archaeological recovery, recording, and analysis, much of the information unrelated to a ship’s final voyage or construction remains a mystery. For ancient ships, particularly, which tend to lack contemporary documentation, dendrochronology can reveal crucial data (Creasman 2010b). Ships from the historical period often have written records available, but it is these very records that have likely contributed to lower rates of application of dendrochronology. Tree-ring dating might seem irrelevant to some if a construction contract, insurance claim, or media record of a ship’s launch or loss exists, but these dates, while important, do not relate the entire story. Much typically remains unknown about the life and origin of any given vessel and the people who built it. A more thorough examination and analysis of a ship’s timbers can expose portions of these mysteries.

The longstanding archaeological practices of focusing study on ship construction—evaluating ships as facilitators or markers of an economy, or as technological achievements and trends—have overshadowed an understanding of ship timbers as individual artifacts and cultural indicators (Basch 1972; Bass 2005). Similarly, the longstanding dendrochronological practice of seeking foremost a construction date or timber source for ships has overshadowed a variety of other possibilities (Farrell and Baillie 1976; Guibal 1992; Wazny 2002). A holistic dendrochronological and archaeological analysis of ship timber—the synthesis of these two fields is referred to as “nautical dendrochronology”—addresses the much broader and deeper question: what can the wood from ships reveal about the people and cultures that built them, their environment, and interactions between the two?

Since humans first took to the rivers and seas, they have acquired a substantial volume of wood from the natural environment to put to use in watercraft. In some cases, thousands of mature trees have reportedly been harvested for a single vessel: 3,906 for the English king Henry V’s Grace Dieu (Friel 1993), approximately 3,000 mature oak trees for each ship of the French king Louis XIV’s fleet (Ballu 2003), and more than 6,000 trees for Admiral Horatio Nelson’s flagship HMS Victory (Albion 1926). Nonetheless, seemingly fundamental inquiries, such as how many trees went into the construction of a particular ship, are rarely addressed. With the volume of timber employed in ships, nautical dendrochronology has great potential. If only a small percentage of the timber remains, as is the case for many shipwrecks, such research should prove extremely valuable, provided that tree-ring sampling methodology (cores or sections) can be balanced with preservation and display preferences. The necessary number, and type, of samples vary based on several factors, including research question(s), age, species, number of rings, quality of preservation, and other considerations. At present, ship timber is a virtually unharvested trove of behavioral and environmental...
Where Does the Charles W. Morgan Fit In?

The investigation of the Charles W. Morgan provides an array of pertinent opportunities to advance nautical dendrochronology. Of critical importance, the vessel is currently undergoing major restoration. Hundreds of original structural floors and futtocks are being removed and replaced (Figure 2). The comparatively recent construction of the ship (1841) should render moot many of the complications associated with older or less complete ships, such as long chronology building or the lack of relevant written records. Fewer complicating factors make these timbers ideal for developing new methods of analysis and honing a methodology for collection.

Elsewhere, the author has proposed a method for the dendroarchaeological interpretation of ship timbers (Creasman 2010b). The Morgan provides an opportunity to evaluate and improve this methodology. It is rare to archaeologically recover complete wooden vessels, much less have the opportunity to sample, cut, and otherwise dissect such a ship. As the Morgan is undergoing an organized and extensive renovation, replacing old timbers with new, dendrochronological sampling on the old timbers is largely free from conventional archaeological limitations (for example, display or seaworthiness). Such freedom will aid progress in evaluating the interpretive methodology.

With the volume of timber in a large wooden ship, it is critical to develop an understanding of the relationship between sampling method and a specific research question. For example, which timbers on a ship should be sampled to obtain a construction date, to estimate a lifespan, or to build a chronology? If a methodology can be established and replicated reliably, it could be more readily applied to wooden watercraft around the world, allowing time – and resource-intensive excavations to derive further knowledge from their material.

It is significant that the Morgan’s life, including repair, has been thoroughly documented. These records can provide a baseline to which archaeological and dendrochronological interpretations can be compared. Perhaps the only critical record missing for this ship is the original construction contract (K. Borden, pers. comm., 14 October 2010), which presents an opportunity. Dendrochronological analysis can recover much of this information (for example, the original source of the timber or nature of the repairs), supplementing the history of the ship, its builders, and the environment. In addition, the Morgan’s timbers have great potential to extend existing mid-western and eastern U.S. chronologies, including New England oaks (Quercus sp.), hackmatack (Larix laricina), and possibly southern yellow pines (Pinus sp.). All things considered, the Charles W. Morgan is an ideal candidate to support timely and quality gains in the field of nautical dendrochronology.

Field and Laboratory Work

On October 12th, 2010, the LTRR team arrived in Mystic, Connecticut. After a warm welcome at the Henry B. duPont Preservation Shipyard, the team set to work sampling the timbers extracted from the Morgan (Figure 3). Timbers removed from the Morgan had been inventoried, labeled with their internal location, and stockpiled on pallets. As this was an exploratory study, cross sections were considered ideal samples rather than cores. Cores are more typical for archaeological structures but are also more limiting in their analysis, due to the relatively smaller size of a core. Only 32 representative

![Figure 2. Refitting of the Morgan, facing bow (photo by author, October 2010).](image)
specimens were collected (generally, one sample per timber, but in some cases two), as some basic questions must be addressed prior to methodological development and the testing of more complicated analyses. The wood used must first be evaluated for its dendrochronological potential: that is, is this specific set of timber suitable for chronological tree-ring analyses (Stokes and Smiley 1968)?

After collection, the wood was shipped by Mystic Seaport to the LTTR for preparation and analysis. Over the following months, the specimens were prepared and evaluated by standard dendrochronological techniques. Twenty-eight samples were analyzed, including eighteen white oak sections and nine southern pine sections (Figure 4). The initial intention was to date them and identify their provenance. If these two standard analyses could be completed, it should also be possible to derive the interpretation of other related cultural and environmental information. Therefore, the immediate goal was to establish cutting dates and timber origins.

**Analysis and Discussion**

Two dominant genera of wood were used for the sampled structural components of the Morgan from which the team took samples: oaks (*Quercus* sp.), primarily white oak (*Quercus alba*) and related species, and southern yellow pines (*Pinus* sp.). The oaks from the Morgan were compared with numerous existing chronologies of known locations from the International Tree-Ring Data Bank (2012), along with some additional tree ring data generously provided by E.R. Cook, Columbia University, and H.D. Grissino-Mayer, University of Tennessee. While no definitive matches were found some suggestive correlations were noted between the oak timbers and chronologies from New York State, Pennsylvania, and Massachusetts. More data is needed to confirm a precise location. The oak samples from the Morgan’s futtocks have different growth characteristics, suggesting that they likely came from several stands, perhaps from two or three areas. Additionally, several specimens stand out as “different” from the bulk. One of these may be a different species of oak (field number CMW 13); driven through it is an oak treenail that, unlike the locust (*Robinia* sp.; likely *Robinia pseudoacacia*) treenails that are more typical for the Morgan, is not stained black with age. Perhaps this one oak treenail and timber represent a repair.

Using the same comparative method, the southern pines from the Morgan were compared to extant chronologies resulting in a possible match between several of the pines and a chronology in South Carolina. Again, to judge from their growth characteristics, these specimens probably come from two or more stands of trees. Several of the pine samples exhibited periods of growth suppression and locally absent rings suggestive of injury, perhaps by fire. Ecological fire studies alone are extremely informative and may help narrow the time or source. Unsurprisingly, the pine keelson—being a long, relatively straight timber—likely came from a different area than did the curved pieces used as floors or futtocks. If the timbers indeed prove to be from different stands with different growth characteristics, this would seem to indicate that the timber suppliers or shipwrights saw a clear relationship between tree form and timber function.

At present, only a suggested cutting date can be provided for the Morgan timbers. In good practice, such “tentative” dates are not published, as they are inevitably misunderstood or interpreted as fixed dendrochronological results. As has been noted by others, the reputation of the entire field is at stake when dendrochronological dates are published; therefore, no specific date will be provided here (Grissino-Mayer 2009:8). Sampling of additional timbers would bolster the chances of establishing tree-ring dates.
Evidence of age clusters in ship timbers can be used to infer forestry practices or the status of supplies and is not strictly dependent on having fixed cutting dates for the timber. Here, relative ages of the timber are all that is required. Brad Loewen’s observations regarding the very close ages of structural timbers from the Cavalaire-sur-Mer shipwreck is the primary case study (Loewen and Delhaye 2006). Nearly three-quarters of the frames in the Cavalaire-sur-Mer find were 65 years old when harvested, ±5 years. While the Morgan sample size is not large enough to make reliable conclusions and was biased in sampling towards specimens with more rings, there appears to be a similar trend, although the oak timbers averaged closer to 125 years old when harvested and ranged from approximately 90 to 200 years in age (there were not a sufficient number of pine specimens to evaluate this point, even preliminarily). If the trend holds on further investigation, it may suggest managed forest reserves or timber supplies, as explained by Loewen (2007; Loewen and Delhaye 2006).

Timber size, shape, and quality also underwent preliminary analysis. In this case, it is important to consider that choice plays an important role in ship construction and timber selection, as timber size and shape can be revealing of resource, economic, or environmental stresses. That is, if adequate timber was not available at a cost-effective price, one might expect to see smaller, lower quality, and younger timbers employed in construction. There are no obvious signs of such stresses in the timber for the Morgan’s construction. Most of the Morgan’s framing timbers sampled were cut to closely match the shape of the original tree or branch, which might seem a byproduct of conservation efforts but instead suggests two practices that are not congruent with timber conservation. First, shipbuilders, and indeed anyone who regularly works with wood, quickly discover that certain cutting patterns yield certain results and they should tend to use methods that optimize costs and benefits in a manner best suited to their situation (McGrail 1997; Creasman 2010b). The experienced shipbuilders in New Bedford ca. 1840 fit this mold and likely did their best to take advantage of the natural curvature and dimensions of a timber, to avoid unnecessary investment of labor trimming wood. Second, all of the sampled structural oak timbers were cut from or near the center of a tree or branch and most retained sapwood. If timber conservation was the goal, halving slightly larger timbers would have been a better investment. The only timbers that show any possible evidence of timber conservation are the southern pines, which are cut significantly offset from center, but this can probably be better explained by the tendency of these trees to grow faster and straighter than oaks; they thus require more shaping to fit the curved location low in the hull, near the turn of the bilge, where these floors and futtocks were located. Several pine timbers were sampled at multiple locations along their length and confirm the suspected growth trend.

Conversely, wasteful production methods would suggest either an abundance of resources, whether the timber itself or another capital used to acquire timber, or sufficient need to override usual economies, perhaps a “special” purpose or client. However, there is no apparent evidence of wastefulness in the timbers sampled, either. Thus, the brief analysis of timber conversion for the Morgan would seem to confirm the historical record: the ship was not a special build but simply a whaling ship constructed in a well-established yard by experienced hands.

**Conclusions**

After initial investigation and vetting, the Charles W. Morgan remains an ideal source of data for the development of a holistic methodology for nautical dendrochronology. The timbers retain the appropriate fundamental characteristics for successful tree-ring dating, from which much information can be derived. With only a fraction of structural timbers sampled, it is already possible to extract
more than merely a date and origin for the wood (although both of these aspects need further refinement). The only conclusions that can be drawn at this point are that more samples are required and that continuing dendroarchaeological analysis on the Charles W. Morgan’s timbers will be worthwhile.

More details regarding the science behind the above analyses can be found in Creasman and Baisan (under review) and a catalog of the specimens is available in Creasman, et al. (2012), from which portions of this manuscript were derived.

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