From the Instructor

Andrea Foster was a pre-med student who participated in my WR 150 class, "Piracy of the Atlantic! History, Archaeology, and Pop Culture." In this course, we examined the golden age of piracy (1500s–1750s) in the Atlantic from both a historical and a fictional perspective. Through a variety of readings, our class looked at contemporary, eighteenth-century accounts of marauders, reports of excavated shipwrecks and pirate "lairs," and modern, pop-cultural representations of pirates. Although the course was unrelated to her major, Andrea was very engaged with every aspect of it and was especially excited about writing this paper.

The assignment asked the class to design and propose a new research project around an ongoing and controversial excavation of a pirate shipwreck off the coast of Cape Cod. Specifically, they had to identify a research question that had yet to be answered and argue how their proposed project would provide a solution. The goal of the paper was to give students practice finding research questions as well as to show them that writing a research proposal requires the same strategies as writing an academic argument. Andrea chose to propose a forensic study of the bones from the shipwreck and argued that such a project could reveal a wealth of information about pirate health and healthcare. She went above and beyond in her research for this paper, addressing counter arguments that I had never thought of (like her discussion of the Native American Graves Protection and Repatriation Act) and finding creative solutions to a complicated project. Her enthusiasm for the topic and the paper was apparent throughout the writing and editing process, and I think it is obvious in the final result. She clearly loved both the topic and the research and produced an exceptional paper.

— Kathryn Ness

WR 150: Pirates of the Atlantic: History, Archaeology, and Pop Culture

From the Writer

I wrote "Crossbones: Forensic Osteology of the *Whydah* Pirates" in response to a request for a research proposal in Kate Ness's WR 150 course. This particular course focused on the history and rumor of historic Atlantic pirates from a variety of sources, including literature, film, and the sole confirmed pirate wreck, the *Whydah*. Prompted by my interest in biomedical sciences, I developed the project to help expose the typical pirate's socioeconomic background before, during, and after engaging in piracy by utilizing modern forensic techniques on human bones found on site at the *Whydah*.

— Andrea Foster

Andrea Foster

Prize Essay Winner

Crossbones: Forensic Osteology of the *Whydah* Pirates

1.0 Introduction

For nearly 300 years, the *Whydah* wreckage was lost along the ever-changing New England coastline, until treasure hunter Barry Clifford located her remains off Cape Cod. Clifford's confirmation of the discovery of the *Whydah* in 1985[1] and his subsequent salvage techniques have led to such controversy that research on the only known pirate remains ever discovered[2] has been halted. However, analysis of the human remains would be invaluable to archaeologist and bio-archaeologists today. While scholars know that pirates had a historic form of health insurance,[3] very little is known about the quality of health care aboard a pirate ship due to the lack of confirmed pirate remains and bio-archaeological research. Since quality medical care requires education and training, the lack of quality medical care and the prevalence of childhood diseases, as determined by skeletal implications, would indicate poor socioeconomic standing of people who would later become pirates. Conversely, quality medical care and lack of childhood diseases could also shed light on the pre-pirate life of these people. I propose that human remains be excavated from the *Whydah* so that the bones may be used to analyze the general health and quality of medical care aboard a pirate ship. A team of highly skilled scientists will work in conjunction with bio-archaeologists to examine bones for implications of Rickets, osteoarthritis, and fracture remodeling.

2.0 The Team and Standard Operating Procedure

Our expert team will consist of a forensic anthropologist, a forensic osteologist, and a bio-archaeologist. The forensic anthropologist and osteologist will work as a closely-knit team to form a detailed understanding of the human remains, and together will possess expert skill in hard tissue marks of age, sex, ancestry, stature, dental anatomy and variation, osseous and dental pathology, hard tissue indicators, and recognition of ante-, peri-, and postmortem injury.[4] Additionally, the forensic osteologist will be very experienced in determining Native American remains purely by visual analysis in order to be compliant with the Native American Graves Protection and Repatriation Act. The bio-archaeologist will not only possess expert skill in osteometry, microscopy, and analysis,[5] but will also be skilled in ground search methods, excavation methods, artifact collection and preservation, and site recording.[6] All three of our experts will work in conjunction to determine the ante- and peri-mortem health of the deceased. Specifically, we will primarily examine skeletal remains for three health-related concerns: rickets, osteoarthritis, and set fractures. Rickets is indicative of childhood (pre-pirate) health,[7] osteoarthritis is indicative of adult (pirate) health,[8] and evidence of set bone fractures is indicative of quality medical care.

Our methodology will not only be compliant with any and all regulations regarding the exhumation of human remains, but it will also adhere to a strict Standard Operating Procedure (SOP) designed with the expert advice from our bio-archaeologist. Extremely detailed and clear reports will be fundamental to our SOP, and will largely account for the chain of custody of physical evidence, storage, and records of procedure. Detailed record keeping will also play a key role in sound bio-archaeology methods for tissue selection and skeletal autopsy procedures.

3.0 Ethics – Conservation and Native American Bones

Boston University associate professor of archaeology Ricardo J. Elia describes three major components involved in ethical archaeology: conservation, rejection of commerciality, and permanent curation. While we must legally comply with all permitting requirements and restrictions involving human remains, we must consider our methodology in the light of ethical considerations as well. As stated by Elia, "compliance archaeology is not necessarily good archaeology."[9] We aim to address Elia's primary ethical

concerns and concerns relating to the Native American Graves Protection and Repatriation Act (NAGPRA) in the following section.

While removing the bones is necessary for research, the context in which they are found can be preserved through meticulous use of photographic evidence and three-dimensional renderings. Furthermore, the nature of biological research, even with human remains, generally preserves a very large portion of the specimen. Our research will primarily involve observation and will not require decimation of the bones in any way. Following the conclusion of our research, the bones will be permanently curated in an appropriate facility.

Since one of the two survivors of the Whydah was Native American,[10] we have reason to believe that other Native Americans may have been on board. To combat this complication, we will begin by examining all documentation of all known records of the ship's personnel. Even in the event that no records indicate the presence of Native Americans, all further research with suspected Native American remains will be done in compliance with NAGPRA and a specialist will be consulted.

Lastly, Elia believes that the original salvage activities have threatened or even ruined any archaeological data to be obtained.[11] While it is true that the prop-washing technique used by Clifford has destroyed much of the contextual evidence, it did not destroy any of the bio-archaeological evidence. Even if prop-washing or other techniques damaged any of the bones, it is easy to separate these injuries from injuries obtained during life and it will not affect any of the other skeletal implications.

4.0 Bio-Archaeological Methods

We will exhume as many human remains as possible and preserve them for continual scientific research. Increasing the sample size by increasing the number of exhumed bodies will also increase our overall understanding of the pre-pirate health, pirate health, and health care of the deceased by increasing the statistical significance of our findings. Following the conclusion of our research, the skeletal remains will be placed in permanent curation at a qualified facility.

4.1 Evidence of Quality Pre-Pirate Health – Rickets

Rickets has been identified in many populations of skeletal remains[12] and was historically a common ailment for impoverished children as late as the 20th century.[13] The bones of a rickets-affected person are smaller and weaker, and mechanical forces can deform the skeletal elements.[14] People who were affected by rickets in childhood are therefore also short in stature, as well as possibly deformed.[15] Since rickets is primarily a childhood disease,[16] we expect any indication of rickets is only an indication of pre-pirate health and socioeconomic standing.

Vitamin D deficiency causes rickets[17] and was especially prevalent in impoverished children. Calcium cannot be properly absorbed into the body without vitamin D, and, as such, rickets causes insufficient mineralization of newly-formed bone.[18] Unlike most vitamins, only an insignificant portion of vitamin D is consumed through food; it is instead synthesized in the body as a response to ultra-violet rays in sunlight that act on a chemical precursor in the skin.[19] Therefore, rickets is a better indicator of childhood socioeconomic standing, and possibly childhood indoor labor, than of diet. Pirates who had been affected by rickets as children will show bending deformation of the long bones (femur, tibia, etc) and will have flattening and bone porosity near the epicondyles (the knuckle of the bone).[20]

4.2 Evidence of Pirate Health –Osteoarthritis

Osteoarthritis (OA) has already been identified in the skeletal remains of several archaeological populations.[21] Additionally, specific movements and activities can be correlated to the location and severity of OA. For example, the skeletal remains of the Alaskan Inuit population show a much higher and much more severe expression of OA in the elbow as a result of hunting activities.[22] While these conclusions are only generalized hypotheses drawn from good correlations, they provide valuable insight to the physical activities and diets of pirate life. Diets poor in calcium lead to quicker progression into OA and poor health. Bones riddled with OA also become much more likely to fracture, leading to additional health problems.

Osteoarthritis is a degenerative bone disease[23] and is directly linked to calcium intake.[24] Pirates who have been affected by osteoarthritis will have osteophytes (bone spurs), boney protrusions around the joint, the transformation of mature soft tissue into boney tissue, and an altered shape at the bone heads.[25]

4.3 Evidence of Pirate Health Care – Fracture Remodeling

Evidence of properly treated injuries is indicative of good health care by educated individuals. While it will be impossible to study soft tissue injuries, as the soft tissue will no longer exist, studying skeletal injuries will help determine whether pirates had the knowledge and skill to properly set a bone, perform an amputation, etc. It is imperative that skeletal evidence of trauma be separated into categories of ante-, peri-, and postmortem injuries. Peri- and postmortem injuries are irrelevant to a study of the pirates' health care and education. Bone remodeling is a reliable indication of antemortem injuries[26] and will be used to determine the quality of post-injury care.

Remodeling begins to occur after only a few days and is distinguishable from perimortem or postmortem injuries by the presence of a fibrous matrix that provides structural framework for the initial boney callus deposits.[27] Recent antemortem injuries, such as those attained when the *Whydah* was first captured only a few days before she capsized, are even distinguishable from older antemortem injuries by the lack of a lamellar bone remodeling.[28] Thus, injuries attained during pirate life can be distinguished from those occurring before and those attained when the ship capsized.

4.4 Complications Associated with Marine Bio-Archaeology

Decomposition of human remains in salt water is highly variable[29] and poorly researched since most marine taphonomy research has been done as a byproduct of forensic casework.[30] Marine taphonomy research is further complicated since discovery of terrestrial and human remains at sea is very rare.[31] While our research will also contribute a wealth of knowledge to the field of marine taphonomy, what is already known indicates

that it is likely possible for skeletonized remains in sea water to be examined for forensic evidence.

Cold sea water decelerates decomposition,[32] and bodies that are trapped between decks would not only be protected from rapid decomposition but also from marine scavenging. It is likely that some cancellous bone, the porous inner bone, will be exposed, and it is still possible to determine ante-, peri-, and postmortem changes to the bone.[33] While no research has been done on remains trapped below water during the entire decomposition process,[34] at least one documented case describes intact bones found off the coast of Maine thirty-two years postmortem.[35] These remains have also demonstrated that bones incased in shoes and boots survive erosion for far greater periods of time than previously thought.[36] Given this evidence, we believe that it is possible to examine bones submerged in cold sea water, and possibly protected from scavengers, nearly three hundred years postmortem.

5.0 Overview

Bio-archaeological research of confirmed pirate skeletons would provide invaluable insight to a pirate's pre-pirate health, education, and socioeconomic standing as well as the effectiveness of their health care during pirate life. Since many pirates were former sailors, it is not unlikely that some were educated in dietary needs and/or care for injuries; however, it is also not unlikely that there was little health knowledge aboard a pirate ship, since many pirates had impoverished backgrounds. Forensic research of pirate bones will generate more insight on the socioeconomic background of those aboard a pirate ship, and, ideally, more pirate remains will be identified so that similar forensic research can be used to create significant research. Bones know all the answers and they never lie, but they must be examined before their truth can be heard.

Notes

1. Christopher E. Hamilton, "From The Pirate Ship Whydah," in *X Marks the Spot: The Archaeology of Piracy*, eds. Russell K. Skowronek and Charles R. Ewen (Tallahasse: Florida A&M University, 2006), 134.

2. D. Webster, "Pirates of the *Whydah*," *National Geographic* 195, no. 5 (1999): 66.

3. M. Rediker, "Life under the Jolly Rodger," *The Wilson Quarterly* 12, no. 3 (1988): 160.

4. M. Skinner, D. Alempijevic, and M. Djuric-Srejic, "Guidelines for International Forensic Bio-archaeology Monitors of Mass Grave Exhumations," *Forensic Science International* 134, no. 2–3 (2003): 82.

5. Ibid., 84.

6. Ibid., 83.

7. S. Mays, M. Brickley, and R. Ives, "Growth and Vitamin D Deficiency in a Population from 19th Centry Birmingham, England," *International Journal of Osteoarchaeology* 19, no. 3 (2009): 407.

8. H. Spencer et al., "Influences of Dietary Calcium Intake on Ca47 Absorption in Man," *The American Journal of Medicine* 46, no. 2 (1969): 203.

9. R. J. Elia, "The Ethics of Collaboration: Archaeologists and the *Whydah* Project," *Historical Archaeology* 26, no. 4 (1992): 109.

10. "The Pirate Code," The National Geographic Channel, The National Geographic Society, accessed February 22, 2014, http://channel.nationalgeographic.com/channel/videos/the-pirate-code/

11. Elia, *Historical Archaeology*, 108.

12. Mays, Brickley, and Ives, *International Journal of Osteoarchaeology*, 407.

13. Ibid., 407.

14. D. J. Ortner and S. Mays, "Dry-bone Manifestations of Rickets in Infancy and Early Childhood," *International Journal of Osteoarchaeology* 8, no. 1 (1998): 46.

15. Ibid., 46.

16. Mays, Brickley, and Ives, *International Journal of Osteoarchaeology*, 407.

17. Ortner and Mays, *International Journal of Osteoarchaeology*, 46.

18. Ibid., 46.

19. H. L. Henry and A.W. Norman, "From *Metabolism of Vitamin D*," in *Disorders of Bone and Mineral Metabolism*, ed. Fredric Lawrence Coe (New York: Raven Press, 1992): 150.

20. Mays, Brickley, and Ives, *International Journal of Osteoarchaeology*, 406 and 412.

21. R. D. Jurmain and L. Kilgore, "Skeletal Evidence of Osteoarthritis: a Palaeopathological Perspective," *Annal of the Rheumatic Diseases* 54 (1995): 447.

22. Ibid., 447.

23. Ibid., 443.

24. Spencer et al., *Journal of Medicine*, 203.

25. J. H. Kellgren and J.S. Lawrence, "Radiological Assessment of Osteo-Arthrosis," *Annals of the Rheumatic Diseases* 16, no. 4 (1957): 494.

26. Norman J. Sauer, "From *The Timing of Injuries and manner of Death: Distinguishing among Antemortem, Perimortem and Postmortem Trauma*," in *Forensic Osteology*, ed. K. J. Reichs (Springfield: Charles C. Thomas, 1998), 322.

27. Ibid., 322.

28. Ibid., 322.

29. Marcella H. Sorg et al., "From *Forensic Taphonomy in Marine Contexts*," in *Forensic Taphonomy: The Postmortem Fate of Human Remains*, ed. William D. Haglund and Marcella H. Sorg (Boca Raton: CRC Press, 1997), 568.

30. Ibid., 597.

31. Ibid., 597.

32. Ibid., 568.

33. Ibid., 594.

34. Ibid., 588

35. Ibid., 588 and 595.

36. Ibid., 596 and 598.

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