History of Collecting, Preparing and Degreasing Whale Skeletons at the Smithsonian Institution

Historique de la collecte, de la préparation et du dégraissage des squelettes de baleines à la Smithsonian Institution

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Abstract: Whale skeletons were first collected and prepared at the Smithsonian in the 1850's under the direction of Spencer Baird, assistant secretary and later second secretary of the Smithsonian Institution. In 1903, Frederic A. Lucas, chief osteologist and head of exhibits oversaw preparation of the first cast of a blue whale for exhibit. Such luminaries as Frederick W. True, Leonhard Stejneger, A. Remington Kellogg, Clayton E. Ray and James G. Mead expanded the scope of the science and collections over the next century. In 2008 the National Museum of Natural History opened the new Sant Ocean Hall, which features a life-sized model of Phoenix, a North Atlantic right whale, as well as mounts of a Basilosaurus skeleton, and the skulls of a minke whale and a bowhead whale. The osteological preparation facility moved from place to place within the institution and employed a variety of techniques to clean and degrease whales, including dermestid cleaning, beach burial and maceration. Under the guidance of current marine mammals collection manager Charles W. Potter, a new osteopreparation lab was completed in Suitland, Maryland in 1994, which continues to prepare new cetacean specimens, primarily from the marine mammal stranding network, for the collection, now the largest in the world at around 6500 cetacean specimens. At the lab we have experimented with composting, maceration, peroxide and fly cleaning as methods to clean and degrease whale skeletons.

Résumé : Les squelettes de baleines ont été collectés et préparés pour la première fois pendant les années 1850 sous la direction de Spencer Baird, l'assistant-directeur, et plus tard le directeur de la Smithsonian Institution. En 1903, Frederic A. Lucas, chef ostéologue et chef des expositions a dirigé le premier moulage d'une baleine bleue pour exposition. Des scientifiques célèbres tel que Frederick W. True, Leonhard Stejneger, A. Remington Kellogg, Clayton E. Ray, and James G. Mead ont élargi le champ de la science et aussi les collections pendant le siècle suivant. En 2008 le Muséum National d'Histoire Naturelle inaugure la nouvelle salle Sant Ocean qui expose une maquette de grandeur nature nommé Phoenix, d'une espèce du genre Eubalaena de la mer Atlantique du Nord. On y trouve également un squelette de Basilosaurus, les crânes d'une baleine de Minke et d'une baleine boréale. Le laboratoire de préparation ostéologique s'est déplacé plusieurs fois dans l'institution. Il employait plusieurs techniques afin de nettoyer et dégraisser les baleines, dont le nettoyage aux dermestes, l'enfouissement dans les sables et la macération. Sous la direction du responsable des mammifères marins Charles W. Potter, un nouveau laboratoire a été établi à Suitland (Maryland) en 1994. Ce laboratoire poursuit la préparation de nouveaux spécimens cétacés, surtout ceux issus d'échouages. La collection comprend actuellement 6 500 spécimens, la plus vaste collection de mammifères marins du monde. Au laboratoire, nous avons expérimenté plusieurs méthodes de nettoyage et dégraissage des squelettes de baleines. A titre d'exemple, le compostage, la macération, le peroxyde, et les mouches.

1. Introduction

The Smithsonian Marine Mammal Program has a long history of collecting and preparing specimens and houses the world's largest collection of marine mammals. This collection has had a major impact on the study of marine mammals. We are continually seeking new and better methods to prepare and degrease our specimens.

2. History of Smithsonian Marine Mammal Program

Spencer F. Baird, second Secretary of the Smithsonian Institution and the first commissioner of the United States Commission of Fish and Fisheries (more commonly referred to as the U.S. Fish Commission), began what would become the world's largest cetacean collection with the addition of whale skeletons from the U.S. Exploration Expedition of 1838-1842, as well as from collecting strandings (Rivinus & Youssef, 1992). As director of the U.S. Fish Commission in 1871, he began to build the foundation for fisheries science at Woods Hole, Massachusetts, with the Northeast Fisheries Science Center. In 1883 he was honored by the naming of Baird's beaked whale, *Berardius bairdii* by Leonhard Stejneger. Plans for a specimen preparation lab were not implemented and he had to carry on the work in the basement of the Smithsonian Castle. William H. Dall was hired by Baird to explore and collect in Alaska, an expedition which proved instrumental in the purchase of that territory by the U.S. government. Dall's porpoise, *Phoecenoides dalli*, was named in his honor by True in 1885.

Other notables followed. Frederick True became the Smithsonian's first curator of marine mammals in 1883 (True, 1892). He convinced a network of lighthouse keepers to collect strandings for him during their daily beach walks searching for shipwrecks. He revised the Delphinidae and is noted for extensive work on beaked whales. True's beaked whale, *Mesoplodon mirus*, was named after him. Leonhard Stejneger, who began work at the Smithsonian in 1881 and eventually became head curator and a noted authority on fur seals, described and named Stejneger's beaked whale, *Mesoplodon stejnegeri*.

Construction of the Smithsonian's first whale exhibits began in 1886 with the mounting of a humpback whale skeleton, the left side of which was covered with a plaster "skin" (Fig 1).

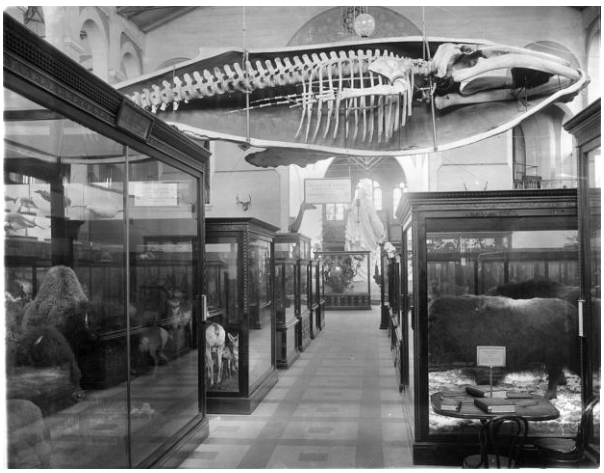

Figure 1: Smithsonian humpback whale exhibit 1886. Smithsonian archives.

Frederic Lucas, preparator, osteologist and curator, oversaw the building of a blue model in 1903 for the Smithsonian exhibit at the St. Louis World's Fair. The initial work was carried out at a Newfoundland whaling station shown in a classic series of photographs from the Smithsonian archives (Fig 2).

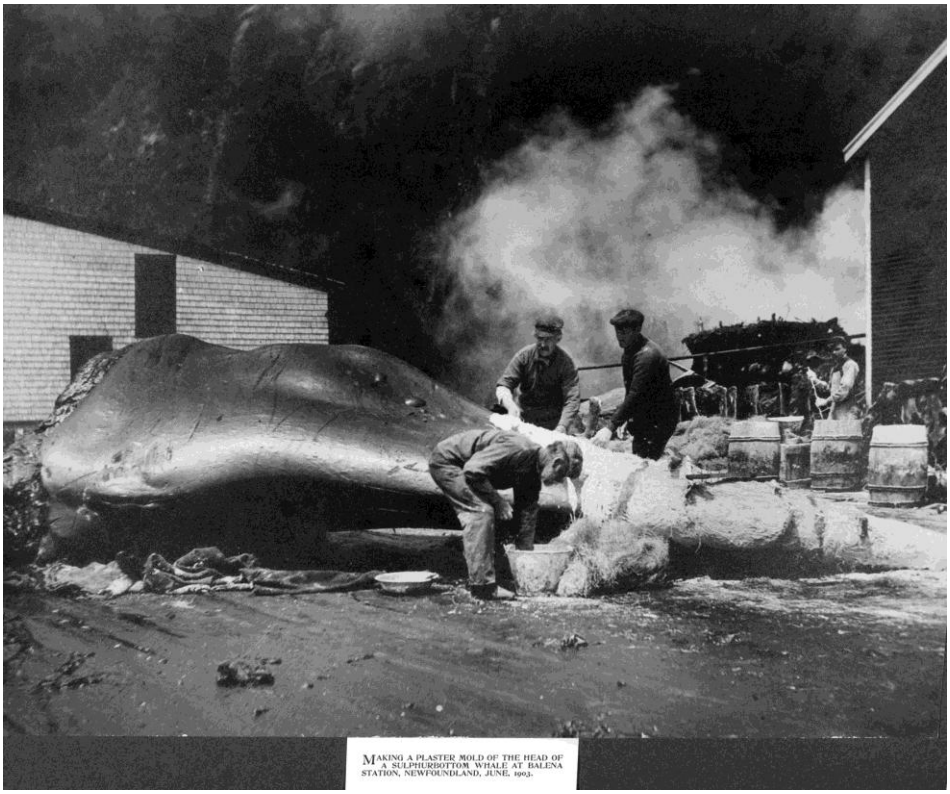

Figure 2: The making of a blue whale plaster cast at a Newfoundland whaling station 1903. Smithsonian archives.

Later, Remington Kellogg came to the Smithsonian as assistant curator and later curator of marine mammals in 1928 (Whitmore, 1975). He was instrumental in the creation of the International Whaling Commission in 1949. Blue whales were being slaughtered in huge numbers mainly to support the whale oil margarine industry. Kellogg's conservation efforts helped bring an end to the mindless killing of many cetacean species which were on the brink of extinction.

The next large Smithsonian whale exhibit featured a cast of blue whale in 1963. The cranium of this animal was also hung from the ceiling of the whale hall. At the time the Smithsonian whale skeleton collection was kept in various places including the west attic of the natural history museum and in hangars at the offsite facility in Suitland, Maryland.

The most recent curator of marine mammals was James Mead who began work in 1972 on cetacean taxonomy and anatomy, especially of beaked whales. Also starting that year was a new marine mammals collections manager, Charley Potter. The team of Mead and Potter quickly

developed an interest in collecting strandings, driving up and down the beaches of the U.S. east coast in a land rover, picking up the specimens and processing them in the lab in the west basement of the Smithsonian National Museum of Natural History. Cetacean strandings are of great scientific value. They can be used to monitor changes in the health and structure of populations, as well as studies in anatomy, zoogeography, distribution and systematics. New and rediscovered species have been picked up from beaches, and it is a relatively cost-effective way to collect specimens. The efforts of the Smithsonian marine mammal team caught the attention of others, including research associate William Perrin, who made use of strandings and fisheries bi-catch to revise cetacean taxonomy and describe new species. Perrin's beaked whale, *Mesoplodon perrini*, was named in his honor by Dalebout and Mead in 2002. John Heyning at the Los Angeles County Museum also collaborated with the Smithsonian team, and used strandings on the U.S. west coast to help create the world's second largest collection of whale skeletons. Stranding operations have now spread worldwide.

Continuing a Smithsonian tradition dating to the late 1800's of showcasing whales in exhibits, the Sant Ocean Hall opened in 2008 with Phoenix, a 45-foot full-scale model of an Atlantic right whale hanging prominently in the center. The hall highlights threats to this endangered species, which include ship strikes and entanglements. The hall also features a mount of a Basilosaurus skeleton, as well as the skulls of a minke whale and a bowhead whale (Fig 3).

Figure 3: Smithsonian Sant Ocean Hall 2011. Photo: John Ososky

In 1994, Charley Potter helped oversee the building of a new osteopreparation lab at Suitland, Maryland, which quickly became a center for the preparation and study of cetacean specimens. Researchers from around the world have come to this lab to dissect and study the anatomy of such diverse species as beaked whales, pygmy sperm whales, bottlenose whales, harbor porpoises and many species of dolphin. Of special interest to James Mead has been the study of the melons of beaked whales. He has dissected them in sections to study how muscles attached to the melon distort its shape and alter the direction of echolocation clicks coming through it.

Another research associate, Martin Nweeia, has partnered with Inuits in Canada to collect narwhal heads from their hunt. They are transported to the lab where the tusk is removed and cut lengthwise with a band saw to reveal its fine structure. The rest of the head is also dissected and studied for its unusual anatomy. Computed Tomography scans are employed to reveal more of its fine structure.

Other techniques and technologies, such as x-rays, magnetic resonance imaging and three dimensional laser imaging are used to maximize the amount of scientific information from a specimen. Collection specimens are also increasingly used by fine artists to create contemporary works.

The marine mammal skeleton collection was formerly housed in the west basement of the natural history building, an area prone to flooding and mold. In 2005 two new modern buildings were erected on the Institution's Suitland campus to house the whale and dolphin collection. At approximately 6500 specimens the Smithsonian houses the largest cetacean collection in the world. The collection contains many specimens with highly unusual anatomy, such as the strap-toothed beaked whale, whose single tooth on each side wraps around the rostrum and restricts its gape. We also have many mounted specimens, relics of exhibits past, but still useful for study. Roads south of Washington, DC were temporarily closed so that the blue whale cranium, formerly on exhibit, could be brought by crane to its new home in the collections, where it resides now close to its post-cranial elements. We also have substantial collections of gray whales, right whales, bowhead whales and other large whales.

3. Techniques for Cleaning and Degreasing Whale Skeletons

The most prevalent bone cleaning technique used to produce this collection has been cleaning by dermestid beetles (True, 1892) (Fig 4). The beetle is a voracious scavenger and will often clean skeletons quickly in the warm humid conditions found in the labs "bug chambers". When the specimen is cleaned it is removed from the chamber and soaked in a weak ammonia solution (3%) and dried. In most cases this will adequately degrease the specimen for our research collection.

Figure 4: Scanning electron microscope image of dermestid beetle.
Image: Chip Clark

In the 1980's and 1990's the Smithsonian used a hot water maceration tank to clean and degrease whale skeletons (Fig 5). While this technique proved to be effective for cleaning and degreasing the specimens, the processing required large time and energy commitments. Another effect was the accumulation of coagulated lipids, also called adipocere, on the bone surface which were sometimes difficult to clean off.

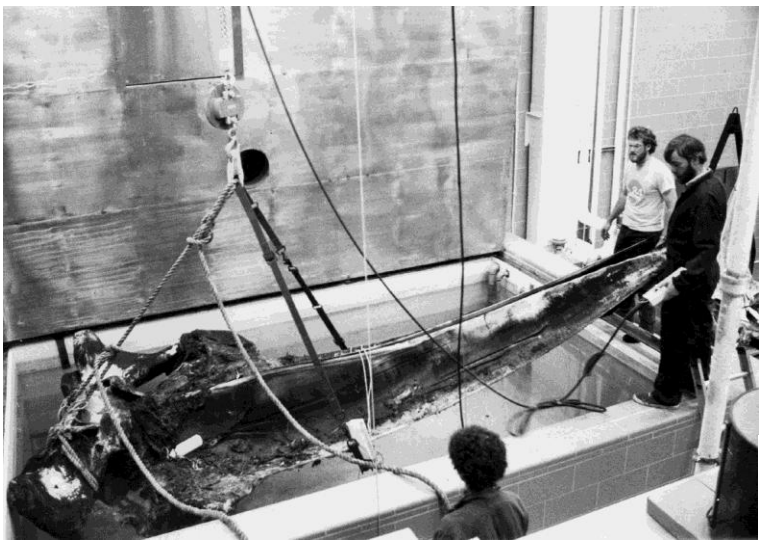

Fig. 5: Smithsonian hot water maceration tank for whale skulls. Smithsonian Division of Mammals archives.

As an alternative we began to prepare whale skeletons in compost for both cleaning and degreasing. This has often proved to be both quick and effective for us. In my example a ship-struck sei whale was brought into Baltimore harbor stuck to the bow. It was brought to a nearby landfill where it was necropsied and the post-cranials disposed of. The skull was returned to the lab for cleaning and incorporation into the collection. We collected a large truck load of hay and manure mixture from the elephant house of the Smithsonian National Zoological Park. One meter of this material was laid down as a bed. The skull was placed on top and then surrounded on all sides by another meter of compost medium. In less than three weeks the specimen was cleaned and very well degreased. It was washed off, dried and installed in the collection.

This technique also proved to be effective for specimens that our dermestid beetle colonies stubbornly refused to clean. I give the example of a greasy Burmese python. After a year of trying and failing to get dermestids to clean it, the specimen was laid out on a compost bed in a transport case and covered with fresh compost medium. The specimen cleaned up quickly and we were able to carefully extract the vertebral column and string it together. Later, a second python was also successfully prepared this way.

We then tried the technique on a highly unusual variant of Bryde's whale. After two weeks of composting the skull came out very well cleaned and degreased.

We then tried the technique on an ancient Minke whale skull from the collection. Oils had leached from the specimen over time and turned to rancid tar on its surface. The specimen was left in a hot compost pile for one month. The pile was opened up, recharged with marine mammal tissue and closed back up at two points. At these points the pile lost some heat but then heated up again beyond the previous maximum. At the end of the period 70°C was achieved. The results are mixed. Much of the tarry coating on the specimen was cleaned up and a substantial amount of grease was extracted, although a significant amount of staining remained.

Maceration is another technique we have tried with success on oily whale specimens after failing to degrease with standard ammonia treatment. In my example, a cleaned but very oily beaked whale cranium showed little improvement after a weak ammonia solution soak. We placed it in barrel of water in the heat of summer and let it sit for two months, occasionally changing the water. At that point it was again soaked in a weak ammonia solution and dried. The specimen was very well degreased. We think that water changes are important to keep adipocere from forming on the surface.

We have just started to experiment with another technique, cleaning and degreasing using fly maggots. We have reports that fly cleaning is effective and degreases well. In my example I placed a loggerhead turtle in large solid container which flies could access. The specimen became amassed in flies and was coming clean. Unfortunately it was started late in the year and cold weather brought a temporary end to the experiment, although we plan to continue.

We have on occasion used hydrogen peroxide to degrease oily specimens for exhibit or outreach. While it is very effective we hesitate to recommend it as the substance is highly corrosive and can damage specimens.

4. Conclusion

A number of techniques, especially composting, show some success for degreasing specimens, but none is perfect and we continue to search for better solutions.

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