Conservation and photogrammetry of subfossil Quaternary walrus (*Odobenus rosmarus*) from the Bay of Fundy, Canada

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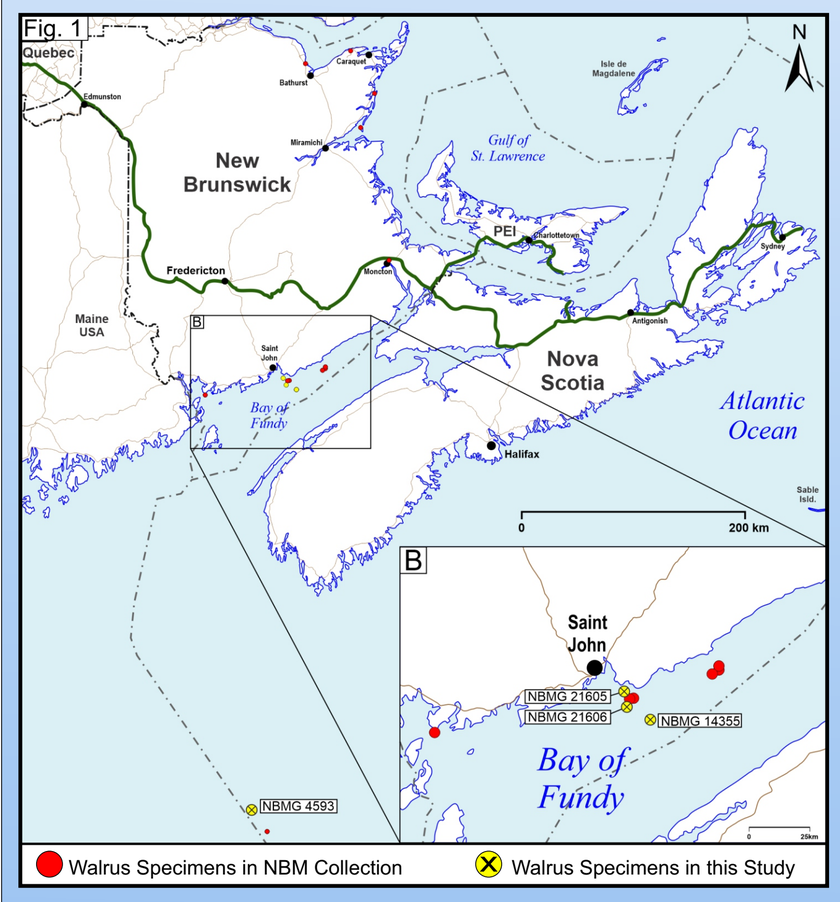
Introduction

As ice retreated from southeastern Canada 12,700 years BP, walrus (*Odobenus rosmarus*) occupied the emerging shoreline until hunted to extirpation in the 18th century. Their remains are occasionally dredged from the seafloor of the Bay of Fundy (Fig. 1), or washed from Quaternary marine sediments that outcrop along shorelines due to erosion. Subfossil walrus remains, particularly tusks, quickly deteriorate if untreated. We describe a simple approach to the conservation of these remains dredged from salt water that maintains integrity for research and exhibition.

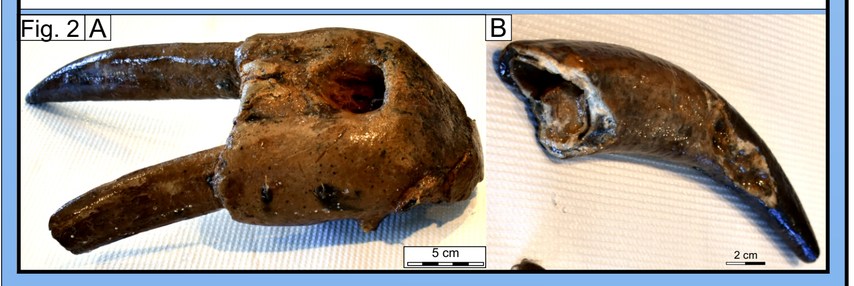
Fig. 1



Specimen description

A partial cranium with tusks and molars (NBMG 21605, Fig. 2A) and a single tusk from a second individual (NBMG 21606, Fig. 2B) were recovered from 73 m depth, 9 km offshore in early spring 2019 by scallop fishermen (Fig. 1). Because the specimens were discovered within days of each other, and communication between the fishermen and the New Brunswick Museum ensured neither specimen was permitted to dry out, they were treated simultaneously and share a conservation record.

Fig. 2 A B



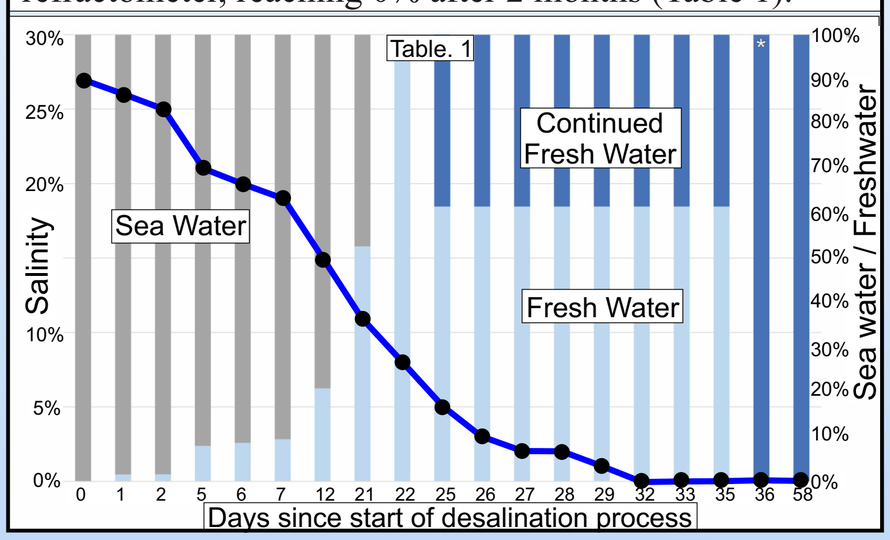
Deterioration of Quaternary tusk and bone from marine environment: defining the problem

The objective of conservation is to balance a specimen's aesthetics for exhibition purposes with preserving its potential for scientific research, such as radiometric dating, biochemistry, or osteological studies. Subfossil walrus tusks quickly deteriorate upon removal from the marine environment due to their anatomical structure, and treatment approaches such as solvent-drying and consolidation can be problematic for both (Fig 3). We therefore needed an approach that was less interventive and produced specimens useful for both research and exhibition.

Fig. 3 A B

Desalination

The specimens were immersed in seawater upon retrieval, and desalinated by gradual replacement of sea water with tap water over a period of 60 days. Salinity was monitored throughout, using a VEE-GEE handheld refractometer, reaching 0% after 2 months (Table 1).

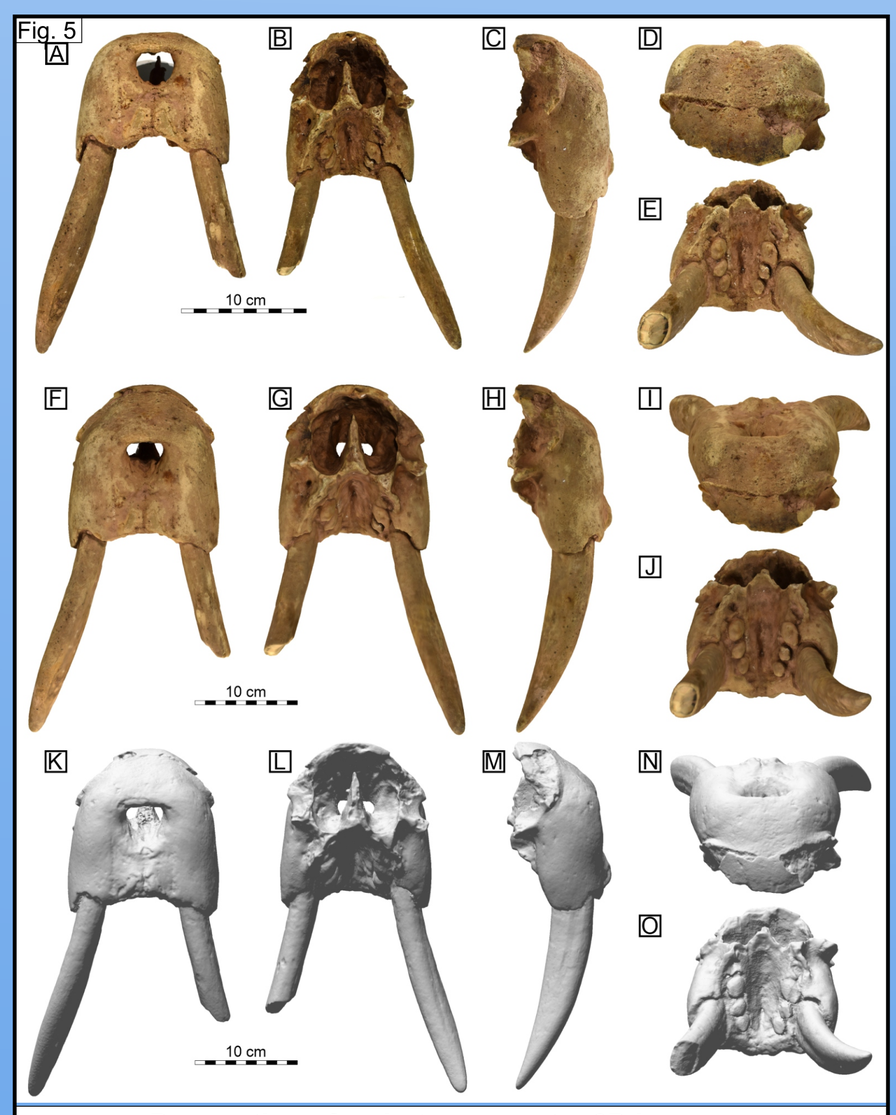


Controlled slow drying

A simple humidification tent was set up from materials on hand for controlled slow drying (Fig. 4). Changes in relative humidity and mass were recorded at intervals, and drying was deemed complete when the cranium and tusk weights stabilized after 532 days.

Fig. 4

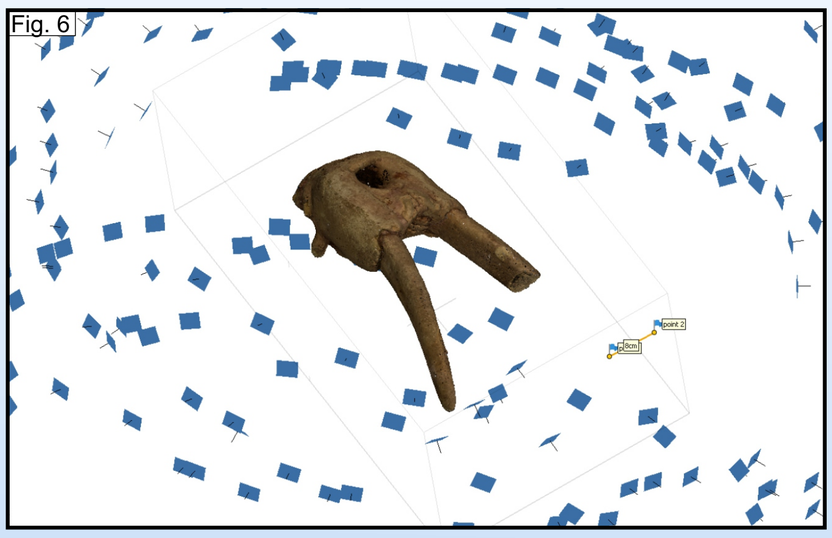
Fig. 5



Preparation of a photogrammetry 3D image

Photogrammetry is an inexpensive, non-destructive method that uses photos of an object to generate a digital 3D model. This model digitally preserves details of morphology, colour, and texture, allowing study and reproduction without direct handling (Fig.5). Agisoft PhotoScan/Metashape software was used to combine 160 overlapping photographs into a dense point cloud (~4 million points; Fig. 6) with a mesh surface (2 million polygons) to generate an orthographic photogrammetry digital rendering of the walrus skull.

Fig. 6



Consolidation

Ivory began spalling on both specimens at 10 months, after an HVAC malfunction (Fig. 7). Photos for photogrammetry were quickly collected and a decision was made to proceed with surface consolidation with a dilute solution of Jade 403 polyvinylacetate. Spalled pieces were reattached wherever possible using Jade 403, dried under light weights and a low fan, and specimens returned to the slow drying chamber. Unconsolidated samples (Fig. 7B) were retained for future analytical testing (Fig. 7). Upon completion of treatment, a custom acid free storage mount and box were made to help protect the specimens from vibration, dust, and environmental fluctuations in museum storage (Fig. 8).

Fig. 7 A

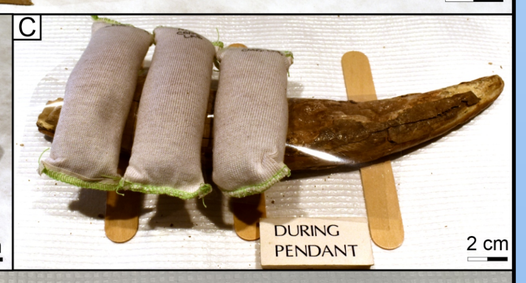
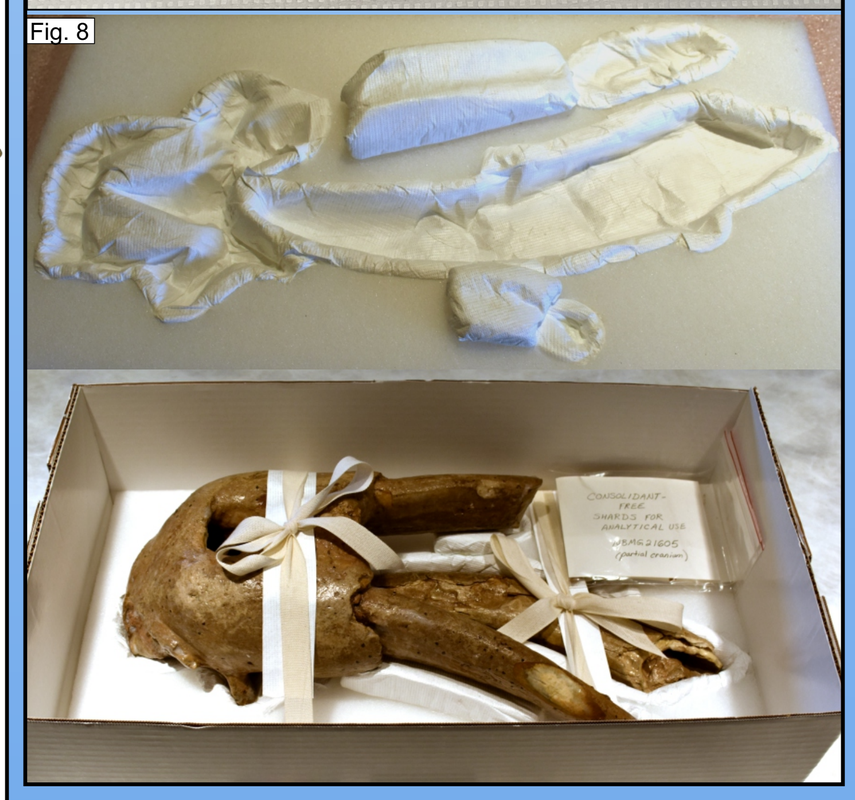


Fig. 8



Conclusion

It is critical that subfossils retrieved from marine waters not be permitted to dry out prior to desalination. Many museums contend with inadequate climate-control challenges. We were able to avoid an overly invasive and irreversible consolidation and maintain specimen integrity with a simple, inexpensive method. The Jade 403 consolidant penetrated the walrus crania by only millimeters, leaving the core uncompromised for future analysis. Photogrammetry generated 3D images minimize the need for future handling of the fragile specimens while still enabling research and exhibition.

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