

Addendum to the Black Rocks Site Report: Options for Mitigation of Two Cannons Discovered Offshore



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Preamble

During the process of a maritime survey by Zemi Cultural Heritage Services and SABARC of the affected area within the proposed Black Rocks Harbour development site, two ship cannons were found at a depth of approximately three to four meters. Both cannons measured 243cm long, and approximately 100cm in circumference around the base ring. There was no evidence of a shipwreck in the area or the entire survey zone, such as a pile of ballast stones, anchors, or clusters of artifacts. Therefore, particularly due to their crossed position, it appears that they were jettisoned from aboard a ship. This could be due to the need to shed weight quickly to lift a ship that struck bottom, or to prevent their capture into enemy hands. In the site report, three mitigation options were presented, including:

- 1) Recovering the cannons and beginning the process of conservation, with the goal of mounting them in the new harbour as display pieces. This option is not expensive, but it is time consuming as the process can take several years.
- 2) Moving the cannons to a nearby dive site as a means to add character and attract divers. While this option may be the fastest and most cost-effective,.
- 3) A blend of two previous options which involves partial conservation of the cannons as a means to determine their date, caliber, and place of manufacture, which will be used to create replicas. The originals would then be returned to a saltwater environment at a dive site, while the replicas would be mounted in the new harbour. Preferably, the replicas would be cast or at least plated with a saltwater resistant metal, such as marine-grade aluminum. This option is mid-range in terms of time and would be the most expensive.

Since then, a fourth option was found to be possible.

- 4) In-situ electrolysis of the cannons using sacrificial anodes. The cannons would be connected to a self-contained cathodic protection system, consisting of two zinc anodes placed on the muzzle and on the breech. This would be a similar approach to Option 1, however without the hassle of removing the cannons inland, or the need to periodically drain and replenish the baths.

Summary

The following actions for mitigating the cannons at Black Rocks each consist of an option package including elements of relocation, conservation, and public access.

- 1) Relocation
 - a. Nearby dive site
 - b. Inland
 - c. No relocation
- 2) Conservation
 - a. Full terrestrial electrolysis
 - b. Partial terrestrial electrolysis
 - c. In-situ electrolysis
 - d. No conservation
- 3) Public access
 - a. Display of original cannons after full terrestrial electrolysis
 - b. Display of replicas of original cannons
 - c. Promotion of new dive site with relocated cannons

Descriptions

First and Second Option

The first and second options would both involve the need to remove the cannons from the seafloor for relocation. In this scenario, an underwater drill, a hammer, and chisel would be required to separate the cannon from any encrustations binding it to surrounding rocks. The Saba Conservation Foundation (SCF) owns a Nemo underwater drill and underwater impact drill, so acquiring these would not be an additional expense. Once the cannons are either determined to be loose or are loosened from their concretions, lift bags would be attached to the cannons with straps in order to gently float them off the seafloor. Lift bags essentially function as a giant air bubble to provide flotation to whatever they are attached to. Once secured to an object, the bag is inflated with the secondary regulator from a scuba diver until flotation is achieved. Ideally, a nearby vessel with a crane would then hoist the cannons from just below the surface to onboard. If this is not possible, the cannons could be attached by rope to the Queen Beatrix II and gently ferried to Fort Bay (Options 1 and 3), where they could be hoisted to the harbour with a backhoe. In the case of Options 2 and 4, the cannons would be ferried either by or aboard the Queen Beatrix II to the nearby dive site.

Conserving iron objects such as cannons is a process that involves removing encrustations surrounding it, and also removing salt bound up within the iron as a result of its long-term immersion in salt water. Simply removing encrustations from the cannons without removing the salt would result in rapid oxidation and they would be soon destroyed. The process of electrolysis removes both encrustations and salt.

Electrolysis involves submersing the iron object into a bath of water outdoors that is subjected to a low-voltage electrical current supplied from a manually operated battery charger. The negative current is run to the bore and butt of the cannon (which serves as the cathode), while the positive current is attached to a steel (non-stainless) or iron plate that acts as a sacrificial anode. This process reverses the oxidation in the artifact (cathode) and gradually transfers it to the anode. The anode is replaced with another over time after it becomes too oxidized. It is important not to use stainless steel as an anode since the process of electrolysis would produce hexavalent chromium, which is highly carcinogenic. The process must also be conducted outdoors, not indoors, as it produces hydrogen gas as a byproduct.

Materials and infrastructure are low-budget, and include:

- Manual-setting 12-volt battery charger. An automatic charger will not work.
- Insulated copper wire.
- Set of non-stainless steel screws to act as connection points to the cannon and sacrificial anode.
- Steel (non-stainless), iron, or tin sheeting as a sacrificial anode. Discarded rebar from the Saba dump would serve this purpose very well.
- A large basin or old cistern to house the cannons. A large plastic basin would be preferable as they are portable and disposable.
- Access to a fresh water supply.
- 8% to 10% solution of soda ash (sodium carbonate) made from the fresh water.
- Sodium chloride test kit
- Rust inhibitor spray
- Acetone (optional)
- Paraloid NAD10 Resin (optional)

The set up and maintenance is quite simple and straightforward once materials have been acquired. Two screws will be drilled into the butt and bore of the cannons, respectively, to serve as terminals for the negative current. This will help prevent the need for repeatedly re-attaching the negative terminals once encrustations and corrosion begins to flake off the cannon from the oxidation-reversal process. As the cannons begin to de-oxidize, the iron will slowly regain its former integrity. The surface of the cannon will have to be gently brushed every few days to remove accumulated sludge and original encrustations that have detached. The water will have to be changed depending on the amount of accumulated sludge in the basin, likely weekly at the start of operations, and decreasing in frequency as time goes on, especially after most of the iron has regained its integrity and only salts remain to be removed from the cannon. The water for the basin will consist of a solution of 8% to 10% soda ash (sodium carbonate) that can be readily obtained from St. Maarten. It is commonly used

as a water softener for highly mineralized well water. It is relatively inexpensive to purchase in bulk. Once the integrity of the iron cannon has been restored, the process of removing sodium chloride (salt) via electrolysis may not be complete. The solution in the basin will have to be tested periodically until a negative test result for sodium chloride has been obtained. Once no sodium chloride can be detected in the bath, this phase of conservation is complete. The cannon will then have to be rinsed to remove the soda ash solution, then, ideally, immersed in a solution of acetone in order to remove any remaining water. It can be then treated with a rust inhibitor, then it should be impregnated with a waxy resin, such as Paraloid NAD10. This imparts a soft graphitized layer and helps to prevent oxidation and physical damage while on display. This process could take place immediately behind the Saba Heritage Center (SHC) building near the pump house. The sludge wastewater could be disposed of the SHC's cesspit, since it only accumulates a very low volume of water in any given week.

Once the cannons are fully restored after a period of several years, they can be put on display either at the new harbour or indoors within a large, prominent public place. Carriages would have to be built to support the cannons, ideally made by a professional that specializes in cannon replication. If they are displayed in outdoors close to sea spray or salty air, they will require maintenance to prevent corrosion, such as regular applications of oil or a salt-resistant lacquer.

Third Option

The third option consists of the recovery and initial conservation phases of Option 1 as a means to have exact replicas of the original cannons cast by a professional and mounted on carriages for display at the new Black Rocks harbour. The originals, with most of their salt still intact from their lifetime of immersion in the sea, would be relocated to a dive site near the harbour. While likely the most costly option, this approach produces new cannons that will not require the lengthy conservation process of Option 1, and will require less maintenance once they are put on public display. The cannons would be subject to short-term electrolysis, perhaps for no more than one or two weeks, primarily as a means to shed organic encrustations from the surface in order for the seals near the butt to become visible. Combined with better measurements of its dimensions, the cannons can be definitively identified and dated for replication. The cannons can then be returned to the sea to a dive site, or it is also possible to continue the conservation process fully as in Option 1.

After quite some time, a professional was found that could replicate cannons of this size. The Irons Brothers in Cornwall, UK, have extensive experience in replicating cannons for historic monuments and museums. They also manufacture period-specific wooden carriages for them as well. Their pieces have been displayed at the Bermuda Maritime Museum and in the Tower of London. While I wasn't able to obtain a specific cost for these cannons, as their caliber so far cannot be identified, a cast iron 9 pounder (which is similar length to these) costs approximately 4000 GBP, and the carriage would be 6000 GBP. The shipping costs would of course be extra. It may be worth inquiring to the Dutch Navy to see if they would want to deliver the cannons to Saba. It certainly relates to their *raison d'être* and provides them with an excellent means for public relations with the islands.

These replicas would be capable of being fired, providing an “official” means to open major public events such as Carnival and Saba Day while promoting Saba’s maritime cultural heritage.

Fourth Option

In-situ preservation of the cannons is possible with a self-contained, submersible electrolysis unit that uses sacrificial anodes in an identical way to the surface electrolysis set up described in Option 1. While this option is quite “hands-off” relative to conservation in a lab, the initial set up requires a series of field measurements such as the water temperature, salinity, dissolved oxygen levels, pH of the waters immediately surrounding the cannons, and a low-cost pre-treatment of a section of the cannon’s exposed surface to prepare them for attachment to the electrical contacts running to two sacrificial zinc or aluminum anodes attached to the muzzle and breech. After a few years of immersion in seawater, the pH of the waters immediately surrounding the cannon are more acidic than the outer waters due to the hydrolysis of iron ions. The results of these tests will determine the requirements of the ideal electrical current to be provided by the anodes.

This set up does not require a battery or other external power source, which is ideal; seawater surrounding metal acts as an electrode, and two metals connected while immersed in seawater will serve as an anode and cathode depending on the difference in the electrical charge of their ions. In this case, the zinc or aluminum will serve as the anode, and the cast iron cannon as the cathode. Sacrificial anodes are very common on marine craft to protect against corrosion, and this approach is now considered alongside terrestrial electrolysis as a standard conservation option for iron artifacts recovered from maritime environments since a first series of experiments by Ian MacLeod in 1996. A pair of sacrificial anodes can be purchased from a range of marine boating suppliers for less than \$200 USD. The anodes can be attached directly to the muzzle and breech by drilling into the cannon past the outer graphitization layer and attaching the wire via a zinc screw. The wire runs to the sacrificial anode which can be mounted to the exterior of the cannon with an insulated layer in between, such as tire rubber. A sample of this set up can be seen in Figure 1 below:



Figure 1: Sample set up of sacrificial zinc anodes to a cannon for in-situ electrolysis (Puoti 2016).

Electrolysis in this manner can be considered complete when the pH of the seawater immediately surrounding the cannon is close to or matches the pH of the outer waters. The cannons should then be removed from the sea and dewatered as described in Option 2. It is also possible to leave the cannons in a permanent state of in-situ electrolysis, if SABARC and the SCF are willing to ensure their long-term maintenance.

Discussion & Recommendations

From the potential avenues for conservation for the two cannons in the options described, it is the opinion of ZEMICHs that Option 4 be pursued as it is significantly less time consuming and requires less materials than terrestrial electrolysis. This option can be pursued even if the cannons are relocated to a nearby dive site. It is possible to continue the in-situ electrolysis process even after the cannons have reached a satisfactory state of restoration, since the ion exchange protects them from further corrosion. This allows for a wide timeframe for bringing them ashore for final conservation processes and display. Regardless of any decision to bring the originals ashore after in-situ electrolysis is complete, replicas of the cannons can still be made from details and measurements made when sufficient details of the cannons are visible, such as a date and coat of arms, after a certain period of electrolysis. The success of this project can be used to promote the use of in-situ electrolysis on some of the estimated 120+ anchors scattered within recreational dive limits across Saba's immediate offshore waters, both as a means to promote and preserve Saba's cultural heritage while improving the quality of existing dive sites.

References

Puoti, Flavia (2016).

In situ conservation of cannons in marine environment: cathodic protection, cleaning treatment and coverage with geotextiles. <https://honorfrostfoundation.org/2016/08/08/in-situ-conservation-of-cannons/>, last accessed 05 November, 2021.