

Development of Methods for Underwater Cultural Heritage Exploration: The Case of the Destroyer Warabi, Which Sank in the Mihonoseki Incident

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ABSTRACT

The topic of this abstract is most appropriate for this Session 1, as it deals with the preservation and use of underwater cultural heritage (UCH) in East Asia (Japan). The case study will be based on the discovery and digital recording of the warship destroyer Warabi, which sank in 1927 in the Sea of Japan and has since been lost. We use state of the art technology at depths between 95m and 180m. Resources available for the work include multibeam acoustic sounding and photography using ROVs, and 3D photogrammetry using PC software. The research questions are developed out of the identification and condition of UCH at great depths, as difficult and not well documented or conserved. The results will contribute significantly to the development of research methods in underwater archaeology.

INTRODUCTION

The topic of this paper fits best into this Session 1 because it is about the preservation and use of underwater cultural heritage (UCH) in East Asia (Japan). Although this study is about archiving underwater war sites, the methodology can be adapted to UCH generally.

CASE STUDIES

The research focuses on the case study of the Japanese destroyer *Warabi*, which sank in the Sea of Japan in 1927 and has been missing ever since. Using cutting-edge technology, the research team located and digitally recorded the wreck of the *Warabi* at a depth of 95 to 180 metres (m) on the seabed.

Warabi was a destroyer of the Imperial Japanese Navy, which was involved in a multiple collision later known as the Mihonoseki Incident, in which a total of 119 people were killed or missing. This accident was influenced by the Washington Naval Treaty. To compensate for the numerical disadvantage, the Imperial Japanese Navy conducted a night exercise at Mihonoseki on 24 August 1927. The ships sailed under cover of darkness with all lights out. They navigated at extremely close range. This created a very dangerous situation. In addition, a combination of factors led to collisions between the light cruiser *Jintsu* and the destroyer *Warabi*. Along with collisions between the light cruiser *Naka* and the destroyer *Ashi*. *Jintsu* and *Naka* suffered significant damage to their bow sections, while *Ashi* lost part of her stern but managed to avoid sinking. However, *Jintsu*'s oblique collision split *Warabi*'s hull in two and she sank. Immediately after the sinking, both the Navy and residents conducted search operations around the presumed location where *Warabi* sank, but only 22 people were rescued, and most of the crew remained missing and presumed dead.

Over 90 years have passed since the incident, and although there are some records of where the *Warabi* sank, its exact whereabouts remain unknown. Therefore, the aim of this research is to investigate the sinking of the *Warabi*.

RESOURCES

The resources available to carry out this research were bathymetry multibeam sonar, photogrammetry using ROV imagery and 3D photogrammetry using PC software.

There are several oral histories that report locations of the sinking of the *Warabi*, but after organizing the existing records and information from local fishermen, it was narrowed down to four locations. One of these four locations, although shallower than the recorded depths, was known to local fishermen as 'Gunkan (Warship)'. *Warabi* was used as a fishing reef. It was known there was an object on the seabed. In order to obtain accurate position measurements and understand its shape, a bathymetric survey using multibeam sonar was conducted in May 2020. The multibeam sonar Teledyne Reson Seabat T50P with a frequency range of 190-420 kilohertz (kHz) was used with a maximum swath angle of 165 degrees, and beam width of 0.5-1 degrees (using 400 kHz) at 512 beams. In addition, an SBG NvSight Apogee inertial navigation system and a Teledyne Reson SVP70 real-time sound velocity profiler were used. The survey area was approximately 1.5×1.5 kilometres around the fishing reef points.

The results of the multibeam survey showed a location with an elevation at a depth of approximately 96m on the seabed, with a length of approximately 54m, a height of 5.4m and a maximum width of 8.3m. The shape was similar to that of a ship, but asymmetrical at the front and back. A search was conducted within a radius of approximately 600m from this location, but no other seabed elevations were found.

In order to investigate the nature of the uplift, underwater filming was carried out in September 2020 using an ROV (CHASING M2) at the locations obtained from the multibeam survey. For this investigation, a filming device called MURAKUMO, which could be installed on the ROV, was developed and deployed.

Following the ROV survey, it was determined the mass at the survey site was the wreckage of an iron sunken ship. The shipwreck was covered in numerous fishing nets and most of the structures on the deck had collapsed, with the hull partially punctured. The shape of the bow was well preserved and had the characteristic "spoon bow", which is also a feature of the destroyer *Warabi*. The shape suggested that it was probably the forward part of *Warabi's* hull, although the aft part was not found in the vicinity.

The location where the sunken ship, believed to be the forward section of the *Warabi's* hull, was discovered was approximately 15km from the previously recorded sinking area, based on historical records. While the *Warabi* is believed to have sunk rapidly, it is now possible that the forward section did not sink at the collision point, but drifted and sank at its present location. To confirm the existence of the stern section of the *Warabi*, a new survey using multibeam sonar and ROV was conducted in July 2021 in an area known by some fishermen as 'Gunkan-ba' (warship area), where there were occasional sonar responses. The water depth in this area was 180m, twice as deep as the previous survey area.

Firstly, a multibeam sonar survey was carried out over an area of 2.5×2.5 km using the same equipment as the previous year (Seabat T50P). This identified detailed areas of significant uplift and showed that what was previously thought to be a single uplift consisted of three larger uplifts and several smaller ones.

The length of the *Warabi* bow was measured using multibeam data from the previous year and the length of the *Warabi* aft was estimated. Among several topographic rises. A rise that appeared to be close to the shape of *Warabi* was selected and surveyed by ROV. As the water depth in this area was 180 m and the ROV and filming accessories used in the previous year's survey could not be used

because they exceeded the pressure-resistant limit, an underwater drone, BlueROV2 manufactured by Blue Robotics, was used and a newly developed filming device, MURAKUMO, was mounted.

The ROV survey confirmed cylindrical structures similar to the third turret of the *Warabi*, portholes and torpedo launchers. In addition, as the hull was destroyed in the middle, leaving only the aft section, it was determined that it was most likely the destroyer *Warabi*.

Based on a large amount of photographic data taken by the MURAKUMO photographic device mounted on the ROV, photogrammetric 3D data of the front and aft parts of the *Warabi* hull were created. Analysis of this 3D data indicates the hull shape of the front and aft sections together closely resembles that of the destroyer *Warabi*. This is consistent with the fact the destroyer *Warabi* was broken up and sunk in a collision with the light cruiser *Jintsu*. The aft of *Warabi* immediately sank to the seabed and the bow drifted approximately 15 km below the sea surface to its present location.

Considering that the front section drifted 15 km, the presence of multiple potential sinking sites may indicate the wreckage of the destroyed ship is scattered and submerged in various areas.

FRAMEWORK

The aim of the research is to identify, evaluate and archive UCH at great depths. As water depth increases, visibility and the influence of currents become challenging factors. The use of ROVs requires their location and managing cables. In addition, reaching the target objects and performing photogrammetry in such environments is extremely challenging. In this survey, by successfully locating the *Warabi* and achieving its 3D reconstruction through photogrammetry, it has been possible to pinpoint the collision site, locate and record *Warabi*'s hull and identify other UCH.

RESULTS

The research methodology used in this study provides an efficient and highly accurate approach to the acquisition and documentation of detailed seafloor maps and the archiving of UCH. The use of 3D data allows for high-resolution and accurate representations, making a significant contribution to future research on UCH.

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