The 'J Boat' Study

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Abstract

Six RAN submarines all of one class launched in 1916 were scuttled in Victorian waters of varying depth between 1922–1930. This provided a unique opportunity to study the parameters affecting shipwreck corrosion, while at the same time controlling for most other variables, such as date built, mode of construction and service histories. They also provide an excellent training bed for those seeking to examine the wreck of the iconic Australian submarine *AE2* in deep water near the Dardanelles in Turkey.

Introduction.

Between 1922–1930 six ex-RAN submarines all launched in 1916, with similar service histories and all scuttled in Victorian waters. These 'J Boats', as they are called, have the potential to provide a great deal to iron, steel and steamship archaeology. Lying in waters of varying depth and with different oceanographic configurations and seabed topography, the J Boats provide a unique opportunity to teach corrosion survey techniques, and to test corrosion theory. Not only are they at varying depth, but the metallurgical and temporal variables normally serving to complicate comparative research, are not present. This is fundamental to the progress of the science of understanding shipwreck corrosion. Issues such as the original source of iron ores and the effect on metal purity, metal composition, construction technique, date and place of construction are all factors that need to be acknowledged, for they all serve to skew potentially comparative data. It has long since been evident that some of these issues could be attended to by comparison of the degradation of identical vessels with similar service histories, especially where they had been lost within a few years of each other in the same body of water. This is what the 'J boats' represent to maritime archaeology and conservation science globally. As a result a suite of 'J boat studies' was flagged in the *Australian Institute for Maritime Archaeology Newsletter* (McCarthy 1999).

Early research at the 'J' Boats

An article by Gary Smith, entitled 'A brief history of the J-Class Submarines' in the *Bulletin of the Australian Institute for Maritime Archaeology* served to bring these vessels to the attention of the maritime archaeological community (1990). There Smith showed that the entire class were launched in Britain in 1916, that all bar one (which was sunk in World War One) were sent to service in Australian waters. All were refitted in Australia in 1920, and all were scuttled in Victorian waters during the period 1922–1930. Two of the J-boats (*J3* and *J7*) lie in shallow water within Port Phillip Bay, while the other four *(J1, J2, J4* and *J5*) lie in relatively deep water outside the Heads (at 36, 38, 27 and 36 metres, respectively).

Figure 1. *J2.* Latrobe (Picture Collection. State Library of Victoria).

In 1991, while working on behalf of Victoria Archaeological Survey (later Heritage Victoria), Western Australian maritime archaeologist Dena Garratt, conducted an inspection of *J3* located at Swan Island in Port Phillip Bay. This also included a corrosion analysis on six areas as part of a study designed to compare corrosion rates of ferrous metal totally immersed in the marine environment against those constantly exposed to the atmosphere and in the intertidal zone (Garratt, 1991). Two years later, Victorian maritime archaeologist, the late Terry Arnott produced a report entitled *Identification of J-Class Submarines in the Graveyard outside Port Phillip Heads* for the Maritime Archaeological Association of Victoria (MAAV). Though it was not a corrosion study, the report added further detail to G. Smith's account. In 1998 corrosion scientist Ian MacLeod also visited *J3* at Swan Island and in following Garratt's study, which he had supervised and facilitated, took corrosion measurements as part of an ongoing research project into the degradation of wrecks inside Port Phillip Bay.

When first mooted by this author in 1999, the modern 'J Boat' study was also considered as a potential test bed and underwater classroom for those gearing up to work on the then newly-found HMA submarine *AE2* (1915) lost during World War 1 in the Dardanelles. Leaders of the joint Australian-Turkish *AE2* project underway since the wreck was discovered in 1998 in the Sea of Marmara, responded accordingly and recognised the importance of the J Boats as a training tool (Smith, T., 2000). They were also able to provide a useful training ground for the deep water corrosion and hull thickness recording techniques required of the dive team in Turkey.

This program was to be effected first by theoretical lectures, followed by practical tutorials and then by progressing from the shallowest to the deeper sites once the measuring techniques were perfected. Under the study plan, a core working group was to be formed under the author's leadership comprising maritime archaeologists Shirley Strachan, (then Unit Head), Peter Harvey and Ross

Figure 2. The J Boats in Hobart (Latrobe Picture Collection. State Library of Victoria).

Anderson (all from the Maritime Heritage Unit, Heritage Victoria), David Nutley (then of the NSW Heritage Office, and the then President of the Australasian Institute for Maritime Archaeology), Tim Smith (NSW Heritage Office, Project *AE2* Archaeologist), Ian MacLeod (corrosion specialist and then Head of Materials Conservation, WA Museum), John Riley (illustrator, deep water diver, model-maker and noted iron and steam shipwreck specialist of the Maritime Archaeology Association of NSW), Patrick Baker (photographer, WA Maritime Museum), and Lyall Mills (Logistical co-ordinator of the Maritime Archaeology Association of Victoria). By this means the group would come to represent all Australian maritime archaeological and shipwreck conservation interests with provision for other specialists to join the project as the need arose (J-Boat Study file; McCarthy, 1999).

As the program developed it was envisaged that eventually each of the *J Boats* would be subject to an identical regime of 'pre-disturbance' observations and analyses. This was to include the measurement of parameters such as depth, salinity, turbidity, burial depth, tidal effects, dissolved oxygen content, extent of biological growth, etc. These were considered to be base data required of any comprehensive shipwreck analysis (McCarthy, 1982). Still and video photography and site plans would also be produced for site management and comparative purposes. Further each wreck was to have their corrosion status measured at identical points on the hull in both a metal thickness and corrosion parameter milieu. These results were then to be interpreted by appropriate specialists and a report produced. This in turn was to be utilised for other purposes, such as the continuing investigation of the *AE2* wreck site.

At the time it was proposed that a seminar conducted under the auspices of Heritage Victoria would be held in Victoria in the 1999/2000 financial year. Lectures and papers were to be presented and on-site techniques demonstrated, with a view to the further transference of knowledge. The resultant papers were to be published as the second volume of specific iron and steamship studies in the wake of the 1985 *Xantho* seminar. This was considered an essential step, for it was stated at the time that shipwreck corrosion studies

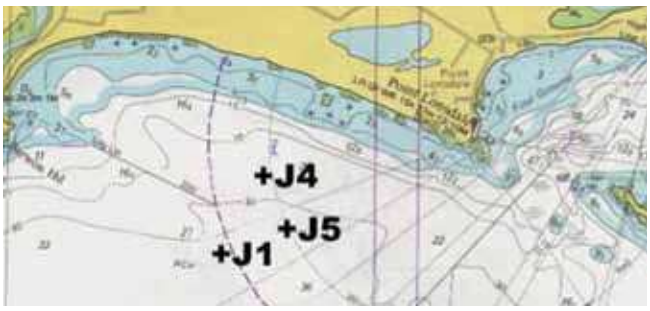

Figure 3. Location of the deep water J Boat wrecks (MAAV).

> …can only be considered to be in their infancy and the continuation of this stage long beyond the commencement of iron wreck corrosion studies in the mid 1980s must be a worry to those involved. Reproducibility of results and the validity of predictions made are issues yet to be adequately tested. Part of the reason for this extended gestation period in iron and steamship site formation studies is the very small number of experienced chemists and metallurgists (to name but two areas of specialty) who have taken the plunge and one aim at the proposed seminar will be to continue the necessary transference of knowledge and the broadening of the practitioner base in iron and steam shipwreck site formation processes (McCarthy, 1999).

It was also envisaged that the proposed *J Boat* seminar would logically follow on from the results and understandings then being gleaned at the wreck of the *City of Launceston* where corrosion studies were also in train (Anderson, this volume).

The J Boat program shelved

Despite the widespread interest, the study stalled and the project was shelved. Nonetheless the wrecks also provided other important scientific opportunities as evidenced by a report entitled *Applying PhotoModeler in Maritime Archaeology: A Photogrammetric Survey of the J3 Submarine Wreck* produced by Jochen Franke for Heritage Victoria (Franke, 1999). The sites were also popular diving attractions with *J2* being regularly accessed after 1974 and *J4* a decade later. As a result of the interest in them, a short video about the life of the J Class submarines and the history of their discovery and popularity as dive sites was produced in 2000 by MBH Productions (*Watchdogs of the Deep*, 2000). Finally, Chris Westwood from the Geomatics Department, University of Melbourne, used *J5* and *J7* as part of his research into virtual modelling using photogrammetry, multi-beam sonar and original plans (Westwood, 2004).

Thus interest in the importance of the group as educational, recreational, scientific and historic assets to the state and to the nation remained and it steadily grew. Further, the J Class submarines outside the Heads are now protected under the Commonwealth *Historic Shipwreck Act* 1976. *J7* which lies inside Port Phillip Bay and was the last vessel sunk, became historic in 2005 under the Victorian State *Heritage Act* 1995. *J3*, despite being inside the Bay, is technically in Commonwealth waters due to

Figure 4. Brad Duncan and the propeller shaft of *J3* (Heritage Victoria).

the Department of Defence owning Swan Island and the immediate waters around it.

A modern development: the J. Berenger-Pooley study

Recently, as part of a masters degree at Flinders University, J. Berenger-Pooley, produced a *Conservation Management Plan* for the entire suite of 'J Boat' wrecks, including a series of recommendations and a list of stakeholders (2005a). These two works served to summarise much of the research and fieldwork work conducted on the J Class submarines to that time. They also outlined existing legislative and protection regimes, and provided another history of the class, their construction, their wartime service, their transfer to Australia, the operations in Australia and their decommissioning. Site descriptions, statement of cultural heritage significance, and an assessment of threats to their historic fabric added further to the worth of the study.

Berenger-Pooley also conducted what he characterized as 'A Comparative Corrosion Analysis of J-Cla*s*s Submarines'. This was part-aimed at testing the theory that corrosion rates decrease in a primarily linear fashion with increasing water depth down to about 26 metres below which point the overall effect of increasing depth is no longer a major factor (MacLeod, 2002: 703).

Somewhat surprisingly, given that one would expect that water movement inside these vessels was less than that on the exterior, Berenger-Pooley found that the submarines were corroding faster inside than out. In attempting to understand this apparently anomalous phenomenon he noted that there is less marine growth on the inside of each submarine, where light levels were low in comparison to the outside where extensive marine growth is apparent, effectively providing a more efficient physical barrier to dissolved oxygen impingement when compared to the interior surfaces (Berenger-Pooley, 2005a; 2005b).

Berenger-Pooley also found that the relative depths of the submarines were not the governing factor in corrosion. With *J3* and *J7* lying in shallow water within Port Phillip Bay itself, and the other four outside the Heads (*J2* at 38 metres; *J1* at 36; *J5* at 36; and *J4* at 28), he had expected that *J2* would have shown the most stable corrosion profile of them all as it is the deepest site. *J2* is also popularly known as the 'broken sub' being split in two thereby providing more entrances for diver access and water flow. However it was found to be closer in corrosion rates to *J3* (at 3m), *J4* (at 28 m) and *J7* (at 3m). The most stable boat was *J1* which is the second deepest while the most corroding was *J3*. He also found that as *J1* and *J2* are located relatively close to one another in very similar environments, the differences were difficult to explain purely by environmental factors.

To J. Berenger-Pooley there was also another important factor leading *J2* to have such a high corrosion rate, i.e. its location directly outside of the Heads at the entrance to Port Phillip Bay, opposite the Rip, an area notorious for its currents and one thereby more likely to have increased water flow and more oxygen available to feed the corrosion. He also considered that one possible explanation for *J2*'s relatively high level of corrosion was the presence of more non-ferrous materials on board. These had been left as a result of incomplete salvage. While he considered that the small amounts remaining made this an unlikely possibility, the importance of this observation is that it highlights the difficulty in controlling for the many metallurgical variables even within this one class of near—identical vessels!

The effect of human activity on the submarines was also considered. *J1*, for example, has suffered from severe damage being situated in the middle of an anchorage. Anchors and chain serve to remove protective marine life that is slowing the corrosion process and also open up new areas of the vessel to direct contact with the ocean. This in turn accelerates existing corrosion and opens new parts of the vessel to the early stages of corrosion such as the edges of broken hull plates.

A second form of human interference was the use of 'shotlines' as site markers and for diving operations. Apart from the obvious damage caused by a fast moving weight falling onto the submarine, it was also evident that a rope wrapping around the hull of a submarine removes the layer of marine organisms and corrosion products in a similar, though less obvious, effect to anchor chain. In his study, Berenger-Pooley found that submarines are particularly vulnerable to this type of damage. Being rounded structures shotlines are able to wrap around more of the hull in contrast to a conventional wreck where the effect is far more localized. He also concluded that SCUBA divers may be affecting the rate of corrosion by their exhaled air (oxygen) becoming trapped in pockets inside the submarines accelerating corrosion. With many modern divers using Nitrox with its greater percentage of oxygen he also concluded that the situation is worsened, considering that a typical mix when diving on the deeper submarines is 29% Oxygen and 71% Nitrogen. In this fashion Berenger-Pooley concluded that the greater level of oxygen not only allows longer bottom times, but that the exhaled gas will contain more O_2 than if air was the breathing medium.

While these are all very useful insights, unfortunately, and as indicated by Berenger-Pooley himself, his corrosion study suffered from many technical and

logistical problems. It also does not appear to have been supervised and/or monitored by an experienced corrosion scientist, all leading to a perceived inability to accept the methodology and his conclusions uncritically. Nonetheless his was yet another important step forward in the J Boat program.

Future 'J boat' studies

Regardless of its procedural and analytical limitations, J. Berenger-Pooley's study further highlights the need for an expert corrosion analysis of this almost unique suite of near identical vessels in order to test the tenets and method of shipwreck corrosion studies. With growing interest in the *AE2* wreck, to that end the imminent use of the boats as a training ground for the *AE2* contingent using the expertise and equipment of expert practitioners like Ian MacLeod and Vicki Richards is a most welcome step forward.

Editor's note: As part of the lead-up to the 2007 examination of *AE2*, the 'J boats' did become the scene of lead up dives and gear trials.

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