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Managing Underwater Cultural Heritage: A Case Study of the SS *Yongala*

ABSTRACT

In June 1981 the SS *Yongala* was gazetted as an historic shipwreck under Section 5 of the Commonwealth *Historic Shipwrecks Act 1976*. The Queensland Museum, as state delegate to the *Act,* manages the *Yongala* site. Today, the *Yongala* is Australia's most popular protected historic shipwreck diving experience. Between 2002-2005 an average of 7774 divers per annum had been to the site. Associated with *Yongala's* high level of dive tourism, particularly during the years 1981-2001, damage occurred to the wreck's fabric, coral and concretions, primarily from charter boat anchors. Due to the site's cultural significance, a series of steps were taken to minimise human damage caused through activities such as penetration diving and anchoring near the site. This paper looks at the history of the *Yongala* site management, the current condition

of the wreck and the future options available to conserve the wreck and its associated material assemblage.

Keywords:

SS *Yongala*, site management, moorings, dive tourism, UNESCO

BIOGRAPHY

Viduka. Andrew. Employed at the Museum of Tropical Queensland (MTQ) as conservator, acting historic shipwrecks officer and site manager for the SS *Yongala.* In 1999 Andrew established MTQ's conservation laboratory and has since worked on material from HMS *Pandora,* HMAV *Bounty* and SS *Yongala*. Involved in archaeology since the mid 80's, he is currently undertaking postgraduate studies in maritime archaeology and has undergraduate degrees in history, materials conservation and a postgraduate qualification in management. Andrew has worked in Australia, Cyprus, Greece, England, Denmark, Saudi Arabia, Micronesia and Antarctica and was a recipient of a Churchill Fellowship in 2002 to study the conservation of wet organic archaeological artefacts.

INTRODUCTION AND SIGNIFICANCE

Built in 1903 by Armstrong, Whitworth and Co in Newcastle-on-Tyne, England, the SS *Yongala* (1911) was launched at Low Walker in Southampton on 29th April. The *Yongala* was 363 feet in length with a 45 feet beam and 27 feet depth of hold (111 m x 14 m x 8 m) (May 1985) (Figure 1). A luxury passenger vessel, classed as an A1 Screw Steamer, the *Yongala* was iron-hulled and powered by a large triple expansion engine from the Wallsend-Shipway Engineering Company Limited. The engine was supplied with steam from five large single-ended boilers, drove a single screw propeller. Supplementary to the engines the vessel was schooner rigged.

Figure 1 SS *Yongala* (Courtesy of the A.D. Edwards Collection in the State Library of South Australia)

In 1911 the *Yongala* foundered and sank in Cape Bowling Green Bay during a cyclonic event (Figure 2). Today the wreck is consistently rated by diving magazines and websites as one of the world's top 10 dive sites. Like an oasis in the desert, the *Yongala* has attracted an abundance of life rarely encountered in a single location by divers. The circumstances of the vessel's loss, its discovery 47 years later and its central role in the development of dive tourism in the Great Barrier Reef Marine Park are all facets of its history. The *Yongala's* significance has been assessed in accordance with the *Guidelines for the Management of*

Australia's Shipwrecks (Henderson 1994). 'The nature of the significance includes … historical, archaeological, social, scientific and interpretative values, and the degree of significance as being both representative and rare' (Moran 2001). The site is also a listed gravesite for the 122 passengers and crew who were lost when the vessel sank (Cumner 2006a, 2006b, 2006c).

LOCATION OF THE WRECK

The *Yongala* lies in open waters approximately 12 nautical miles from Cape Bowling Green and 45 nautical miles south of Townsville, Queensland, Australia in the central section of the Great Barrier Reef Marine Park ($S19^0$ 18.268'; E 147^0 37.337') (Figure 2). The site is adjacent to a major shipping channel with shipping traffic passing on both the east and west of the site. The site is clearly marked on all nautical charts as an historic shipwreck (Figure 3).

Figure 2 Location of SS *Yongala,* $S19^0$ 18.268'; E 147^0 37.337' (WGS 84, 7 satellites, accuracy +/- 5 metres).

Figure 3 Shipping traffic past *Yongala* wreck site (Image Courtesy of the Australian Maritime Safety Authority 2005)

SITE CONDITIONS

The seafloor surrounding the wreck is open and sandy and there are some local seagrass nursery grounds and complex estuaries in Bowling Green and Upstart Bays. A large current gyre occurs in the area and the wreck is subjected to

strong currents throughout the year (Malcolm *et al*. 1998). Currents on the *Yongala* have been reported by dive operators to reach velocities of up to 2 knots (Crocombe, *pers comm*., 2006; Batrick *pers comm*., 2006). The currents predominantly run along the length of the vessel in a north - south, south - north orientation.

The site is fully exposed to all weather condition. The trade winds start in March/April and are typically south easterlies ranging up to 25 -30 knots. Occasionally the south easterlies can reach gale force and develop a substantial swell with great destructive power, maintaining this strength for several days (Peter Gould, *pers. comm*., 2001, Townsville Metrological Office). In summer the prevailing winds swing to the north east.

The cyclone season generally extends from November to May, with a peak in January and March. The cyclonic direction in the Townsville region is north-west to south-east. The most intense cyclones (categories four and five with wind strength greater than 170 km/h) have been rare within this GBR region and Moran (2001) notes that Queensland has in the past generally experienced 'weak' cyclones of categories 1-3 (wind strength ranging from 65 -170 km/h, central pressure hPa 1000 -945) between 19^0 and 22^0 South. Notable exceptions to this rule were; Cyclone Althea (Category 4) which struck Townsville in 1971, and Cyclone Aivu (Category 4) which struck between Townsville and Ayr in 1989. Cyclone Aivu's landfall was similar to that of the cyclone in which the *Yongala* was lost in 1911.

In 2005 a category 5 Cyclone Ingrid crossed over one of the largest concentrations of shipwrecks in Queensland, around Raine Island, towards the far north coast. The cyclone diminished to a category 4 on crossing the coastline. In 2006, Cyclone Larry, another category 5 cyclone, crossed the Queensland coast at Innisfail. The intensity and rate of these two cyclonic events appear to be anomalous to the historic pattern.

Although cyclones do not affect water movements and currents, the effect on the water column (term for the water between the seafloor and the surface) can be significant. Although wave velocity diminishes with increasing depth, damage can occur to structures at depths greater than 16m below the surface, such as the *Yongala*. For example, the force of water movement during Cyclone Aivu in 1989 was great enough to dislodge the memorial plinth that had been cemented to the bow of the *Yongala* (at 19.6m) as well as scour a large area of the wreck. With the possible advent of increasingly strong cyclonic systems associated with global warming, the potential impact of cyclones on the *Yongala* and other submerged cultural heritage cannot be ignored. In 2006, after Cyclone Larry, *Yongala* dive operators reported areas of concretion loss on the stern and new holes in the remaining deck 'plate' (Crocombe, *pers comm*., 2006; Batrick *pers comm*., 2006).

WRECK DESCRIPTION

The wreck sits intact on the seabed, listing to starboard on an angle of 60-70^0 with the bow pointing in a northerly direction (347^0) (Riley 1993). The depth of

water to the sea floor is approximately 27-30m, with the upper sections of the wreck approximately 16 metres below the surface. Strong currents scour the area exposing or covering parts of the starboard side gunwale and decking. In 1973 Leon Zann did the first known drawing of the wreck. In 1986 and 1993 John Riley used the same perspective to show the sites condition and state of sand cover (Figure 4). Recent technological advances enable the site and the level of sand scouring/coverage to be documented using multibeam bathymetry which supplies a quantifiable reproducible baseline for comparative analysis (Figure 5). Zann's sketch appears to depict a large amount of sand in hull 2 and interpretations of the image have suggested that the site has been subjected to significant scouring in the subsequent years (Moran 2001). Communications with Zann (*pers comm*., 2007) have resulted in this artistic element being correctly attributed as shell build up on the wreck not sand. In Riley's images, he concentrated on accurately depicting sand (due to implications for his 'Waterline Theory'). In 2007, the vessel is scoured clear of sand under the bow and stern; only the starboard side gunwale associated with the citadel area (Figure 7) is covered. In general a significant amount of deck plate has corroded away and it is possible to swim the length of the vessel with views inside.

Figure 4 Sketches of the *Yongala* showing observations of deterioration of superstructure and sand coverage/scouring episodes.

Figure 5 *Image of the Yongala taken from Multibeam Imagery Data (Courtesy of Dr. Thomas Stieglitz, James Cook University)*

DIVE TOURISM ON THE *YONGALA*

The *Yongala* was first located by the SS *Rona* in 1941 and again in 1943 when they fouled their port paravane on an obstruction at a depth of 35 feet below water, 11 miles from Cape Bowling Green Light. The Master of SS *Rona*, J.A. Wallis, reported to the Deputy-Director of Navigation, 'the idea is that we have fouled the hull of the long lost S.S. *Yongala'***.** The confirmation of the wreck's existence in 1958 by Bill Kirkpatrick and members of the Queensland Underwater Research Group (Townsville Bulletin 1958) heralded the start of site access, periodic pilfering, and salvage. Initially site access was heavily restricted due to the difficulty of locating the site and the real effects of regular site visitation per se would not be felt until Doug Tarca and Ian Croll, but more significantly Mike Ball in 1981-1982, started running scheduled dive trips to the site (Mike Ball *pers comms*., 2007).

In 1976, Ben Cropp located the site and dived on it for 5 consecutive days recovering a large number of artefacts (Cropp 1980; Ben Cropp *pers comm*., 2007). Sometime after Cropp's visit and before 1980, the *Yongala's* propeller was salvaged.

During the 1980's the site's increasing reputation as a dive Mecca encouraged the exponential growth of dive tourism. Due to the exposed nature of the site, current and windage effects caused vessels to trawl their anchors and associated chain onto, or over, the wreck itself. This not only caused structural damage to the ships residual fabric but destroyed coral and knocked off concretions built up

on the wreck. In some circumstances vessels unintentionally dropped their anchors directly onto the wreck. Luis Sanches, a *Yongala* dive instructor in the 1980's, witnessed just such a moment: while kneeling before a number of students, an anchor crashed down behind him destroying a large coral on the wreck (Luis Sanches, *pers. comm*., 2005).

Another tourism related factor in causing damage to the *Yongala* was diver behaviour. Because dive tourism was based on training divers and giving them the opportunity to dive the *Yongala* as one of their first advanced dives, the majority of divers on site were inexperienced with little buoyancy control.. A combination of poor buoyancy control, lack of awareness of where their fins were, and grabbing onto the wreck to maintain position all contributed to the loss of coral and concretion over the site. Another detrimental diver activity was penetration diving (permissible up to 1994) and diving under the suspended bow and stern of the wreck. In these situations, air vented from the divers could become trapped in enclosed or overhanging spaces, potentially increasing the rate of corrosion in those specific locations by supplying more oxygen for the reaction to occur. The third type of detrimental behaviour was the occasional pilfering of artefacts from the site. Communication with local divers indicates that this was done mainly by dive instructors, passing vessels and locals, more so than dive tourists. This type of behaviour has been significantly reduced as the public has become increasingly aware, through popular media, of the importance of archaeology and its role, and the fact that any dive site is for the public generally and not just a few select individuals. Jewell (2002) used the *Yongala* as

a case study in her thesis on the value of interpretation affecting diver behaviour attitudes. Regular divers and permitted charter operators to the site are now the eyes and ears of the managing agency and assist in policing permitted diver behaviour.

In the 2002-2005 periods an average of 7774 divers per annum had been to the site (Great Barrier Reef Marine Park Authority - Environmental Management Charge data 2005). In the last two years these numbers have dropped off to an average of 4000-4500 divers per annum - due mainly to adverse weather conditions limiting diver access.

LEGISLATIVE PROTECTION

On the 5th June 1981 the *Yongala* wreck was protected by Section 5 of the Commonwealth *Historic Shipwrecks Act* 1976 (Gazettal No. S110) (hereafter called the *Act*). Responsibility for the day to day management of the wrecks in Queensland was delegated to the Queensland Museum under the *Act*. Two months after the site's declaration the wreck was inspected by Ron Coleman the Queensland Museum's Maritime Archaeologist (Coleman 1981). Coleman stated in his report that the reason for his inspection was that the form of the legislation, whilst declaring the site and objects protected, did not require divers to obtain a permit before accessing the site. 'As no methodic recording of the site had previously been undertaken it was deemed necessary to conduct a cursory examination of the wreck, its situation and its condition in order to monitor any future diver-inflicted deterioration' (Coleman 1981: 2). Coleman also stated that

another purpose for the investigation was ‘to raise any loose artefacts which might be souvenired by others’ (Coleman 1981:4). Coleman’s approach of intermittent monitoring and rescue archaeology set the tone for the Queensland Museum approach to the *Yongala* up until 2002-2004. After the installation of the moorings a more day to day management approach was introduced primarily to meet the significant increase in activities generated by the moorings management and to roll out recommendations from the 2001 Conservation Management Plan (Viduka 2006a, 2006b).

On 21 December 1983 the site was further protected under Section 7 of the *Act* with the establishment of a protection zone (Gazettal No. S8). As mentioned earlier, this increased legislative protection did not stop anchor damage to the site as the problem was specifically a physical issue to do with the difficulty of the conditions experienced around the site.

The *Yongala* was listed on the Register of the National Estate in 1982 and while this did not add any real physical protection to the site, the extent of anchor damage to date was directly mentioned as a major reason for the listing. It was included in the Central Zone of the Great Barrier Reef Marine Park in 1984.

Inclusion in the GBRMP Central Zone removed a serious threat to the wreck’s artificial reef eco-system. This zoning designation prohibits: fishing, aquaculture, bait netting, crabbing, harvest fishing, research without a permit, tourist programs without a permit, and shipping without a permit.

Today, access to the site is conditional on having an Historic Shipwreck permit and complying with its requirement, a minimum impact Code of Diving Practice that includes a ‘no penetration’ diving clause. Due to the site’s significance, a strategy to stop anchor damage on the wreck by installing moorings at the site was proposed and initiated in the MTQ’s 2001 SS *Yongala* Management and Conservation Plan (Moran 2001). In 2002, MTQ installed the first moorings system and vessels were subsequently prohibited from anchoring or tying off to the wreck site (Viduka 2006b) (Figure 6). The *Act* today prohibits any activities potentially detrimental to the *Yongala* wreck, artefacts and site, including anchoring within 500 metres of the wreck.

Figure 6 *Yongala* Moorings Layout

SITE MANAGEMENT ISSUES

(a) The Current Condition of the Wreck

As mentioned previously, the *Yongala* lies intact and on her side after 96 years of immersion in a location exposed to current, scouring and cyclonic conditions. Riley in 1983 proposed his ‘Waterline Theory’ based on his observation of the site formation processes of hundreds of wreck sites. According to Riley’s observations, the *Yongala* should have already lost its structural integrity and collapsed. Based on Riley’s observations, the site formation process will result in the port side hull collapsing once the internal beams and frames have corroded sufficiently. With the vessel lying on its side, the beams are acting like vertical

supports. Once these supports have sufficiently deteriorated, the unsupported bow and stern section will then accelerate the physical deterioration and separate from the residual structure.

Why the *Yongala* has not yet broken apart is mainly conjecture. However, a number of small micro-factors can be put forward as possible explanations: the number of internal bulkheads, the size of entry ways into the vessel, the reduced ability for water to move inside the vessel in its earlier stages of site formation, the positive effect of concretion limiting corrosion rates, and the orientation of the vessel to the current.

The *Yongala* was constructed primarily of steel, iron and timber and can be considered to have two components: superstructure (anything above the weather deck such as features on the raised poop, central citadel, winch and forecastle decks), and hull (Figure 7).

According to Lloyd's 1869 specifications for an A Class vessel, hull plates need to be 3/8" or approximately 9.5 mm (Macleod, *pers comm*., 2001). Utilising La Que's (1975) observation that the long term average corrosion rate of iron in open seawater is 0.1 mm/yr then 96 years of immersion x 0.1 mm = 9.6 mm of corrosion is possible. Therefore the hull and deck plating can mathematically be expected to be totally corroded by this time. Since this assumption is based on linear deterioration and does not take into account rate controlling effects such as concretion, La Que's observation is, at best, indicative of the condition of the metal.

Resulting from a recommendation in the 2001 Management Plan (Moran 2001) a corrosion survey was conducted between 2002-2007. Preliminary findings of that survey have been reported (Viduka 2007) and a paper will be forthcoming shortly. A corrosion survey includes measuring corrosion potential, pH, temperature and depth data amongst other qualitative and quantitative data.

From the corrosion survey it is possible to report that the deck and hull plating are extensively corroded. The extent of corrosion is variable and is related to depth, current and the extent of oxygen access to the surface. Hence, the shallowest portions of the wreck have corroded more extensively than the deeper portions.

Another major factor influencing corrosion patterns is concretion coverage. Underneath concretions an acidic and chloride-rich micro-environment develops near the remaining metal surface. The longer the concretion remains attached the more acidic the location becomes. MacLeod (1981, 2001) has demonstrated the correlation between increasing acidity and rate of corrosion. Viewing the gathered pH data spatially (Figure 9), the data indicate that there is greater and more durable concretion coverage midship (the middle of the ship) and aft to the stern area, than in the forecastle deck and port side bow end of the vessel where there is little concretion coverage currently. This level and distribution of concretion loss is due to environmental factors rather than diver behaviour and will be discussed below. The majority of the more acidic readings (pH<6) occur in the shallower portions of the wreck site and this concurs with MacLeod's

published corrosion phenomena, i.e. that depth has a significant effect on the rate of corrosion (a near linear decrease with depth up to 20 metres of water) and that shallow areas of a wreck are corroded preferentially to deeper portions of the wreck.

Figure 7 Terminology used in description of sampling locations

From the corrosion potential results gathered in May 2007 and compared to data collected in preceding years it appears that the bow of the vessel (which has lost its concretion coverage) is currently corroding at a generally higher rate than the remainder of the vessel (Figure 8). The substantial loss of concretion at the bow end of the vessel has made this area more anodic, when compared to the remaining portion of the vessel, and this will remain so until a concretion layer re-establishes itself and creates some resistance to the corrosion process. In April 2007, in strong south easterly wind conditions, the navigation marker moored near the *Yongala* site was lost. A metal ring, which was only inspected two months before hand, with a safety factor of 4 times the site specifications (category 4 cyclone), materially failed. After the strong south easterlies, dive operators reported losses to the metal hull and deck plate as well as the scouring of concretion at the bow (Crocombe, *pers comm*., 2006; Batrick *pers comm*., 2006). The May 2007 readings have picked up the results of this type of periodic site scouring event and an assumption of a general trend in the wrecks anodic/cathodic behaviour needs to be tempered by this event association.

Red (highest corrosion values)	Orange	Green	Blue	Indigo (lowest corrosion values)
-0.3445 to -0.3478	-0.3495 to -0.3525	-0.3528	-0.3535 to -0.3565	-0.3575 to -0.3615

Figure 8: Corrosion potential (Ecorr) data distributed over the site and colour coded. The mean point is coloured green. Locations coloured Blue and Indigo are more negative than locations coloured Orange and Red. Red sites have given corrosion potential readings indicating that those locations are corroding the fastest. The grouping of red sites at the bow end of the vessel indicates a 'uniform' higher rate of corrosion at the bow end of the vessel than compared to the remainder of the vessel. This would indicate the development of a large corrosion cell, with the mid ships and stern being more cathodic and potentially being protected by the bow (which would be the anode in the corrosion cell).

LEGEND			
Red	>pH 4 < pH 5	Black	> pH6 < pH 7
Yellow	> pH 5 < pH 6	Blue	> pH 7

Figure 9 pH distribution over the wreck site

The site's condition today can be summarised as being in an advanced state of corrosion with little metal remaining in hull or deck plating, particularly in the shallower portions of the wreck site. The results indicate a number of corrosion

cells have formed on the site and that the wreck is becoming electrically discontinuous due to the advanced state of deterioration.

(b) Moorings

A key feature in the management strategy to preserve the *Yongala* is the maintenance of moorings at the site originally installed in 2002. The moorings consist of 5 vessel mooring points, two diver access points and one mooring point with an isolated danger mark/navigation buoy (Viduka 2006b). Since their installation in 2002 only one report of anchor damage to the site has been lodged and that was from the commercial contractor caught in a squall whilst maintaining the moorings. The moorings have been a great success in stopping what Schiffer (1976) terms C-transforms or site changes caused through cultural activity.

Initially the moorings were installed using a capital only grant. A user reference body, the Society for Protection of Reef and Yongala (SPRAY), was also established to raise on-going funds for the moorings maintenance. Issues with this arrangement and the level of available funding became apparent over time and in 2005 a new strategy to place the moorings on a commercially sustainable footing were initiated. Consultation with charter operators and government regulatory authorities has subsequently guaranteed funding for the moorings via a user-pays system which the Queensland Museum administers (Viduka 2006a, 2006b).

(c) Diver Behaviour

Since the early 1990's, the Queensland Museum's site management focus has been on encouraging appropriate diver behaviour (Gesner 1992; Moran 2001). Conditions of diver permits are that divers act responsibly and try to avoid knocking off concretion by controlling their buoyancy and floating above the wreck. Prohibited actions include removing any artefact and penetration diving. Concerns about divers swimming under the bow and stern areas were voiced by Moran (2001) due to the possibility of exhaled air getting trapped in the concretion held on the underside of the vessel. Due to the popularity of the site for divers, issues with policing and the large amount of marine fauna that live in these locations, efforts to minimise this diver behaviour are periodically unsuccessful.

Currently there are five permitted dive charter operators to take divers to the *Yongala*. These operators act within the requirements of the *Act* and assist the Museum to protect the site and its eco-system by supplying dive briefings, as well as monitoring diver behaviour whilst on site. The education of operators in the importance of preserving the site has been successful.

Due to an operator's diligence, Queensland was the first state to successfully prosecute a diver for infringement of the minimum impact Code of Diver Behaviour conditions of permit. After supplying divers with a pre-dive briefing, a dive operator witnessed a diver entering the wreck. The diver was subsequently

fined $2,000 for making an illegal dive on the *Yongala*. With the operator's evidence, the prosecutor proved that the diver had 'ample opportunity to know the dive was a 'no penetration dive' and that the *Yongala* is designated not only as an "historic shipwreck, but as a grave site" (Townsville Bulletin 2003).

Another indication of a changing dive culture is the lack of reports to do with 'cleaning' the *Yongala* name on the vessel. Reports of 'wire brushing' incidents used to be regularly received with no identifiable culprit. Today these reports have stopped and this action, I believe, is directly related to a changing attitude in dive operators, instructors and in major part is being driven by a more 'aware' and socially responsible diving public.

(d) Threats

Unlike the 1958- 2002 period where C-transforms (cultural activity) were having a quantifiable effect, today the site's deterioration is almost exclusively N-transform (natural activity). Diver behaviour is generally good with most dives being escorted and divers being encouraged to swim off the wreck and look but not touch. The combination of the no penetration diving policy, dive briefings, escorted tours and established moorings have minimised C-transform processes of deterioration to the point of negligibility within the overall system.

As mentioned, the *Yongala* is today a highly deteriorated wreck in an advanced state of corrosion. Due to its orientation on the seabed it has internal stresses associated with its unsupported bow and stern areas. Extreme weather events in

or near the Townsville region will certainly put considerable stress on the residual structure of the vessel and its collapse is more likely to be associated with such an event, or severe gale, in the short term (0-20 years) rather than in the middle term (21-40).

FUTURE OPTIONS

With the extent of corrosion and distance from land, the practicality of in-situ conservation of the *Yongala* is non-existent. Therefore the imminent collapse of the *Yongala* is a significant management issue, not because it will negatively affect dive tourism, indeed a number of divers feel that it will make the site more interesting, but primarily because it will uncover a number of objects that have been buried in an anaerobic environment under sand, or shell, from within the vessel. This environment is conducive to the preservation of organic and inorganic artefacts.

On the *Yongala* and other Queensland historic shipwrecks, rescue archaeology has been employed on a case by case basis. In 1997, two artefacts were found near each other in a secondary deposition site off the starboard side of the wreck. These artefacts were found to be the ship's chronometer and clock. This has resulted in the Museum identifying the time of the sinking of the vessel (Viduka et al 2006).

Unlike the HMS *Pandora* which was partially excavated by the Queensland Museum, the *Yongala* has never been the subject of excavation using

archaeological method. This is in part due to its being an Edwardian period vessel where extensive documentary records for the vessel exist and in part because the material culture of the period is still available commercially or already within museum collections today. Consequently, the rationale and imperative for excavation has been reduced, particularly within the context of effectively using limited resources.

In the *Yongala's* case, the primary reason for recovery of artefacts would be to conserve the artefacts that flesh out our understanding of the society on board the vessel and the individuals caught up in the disaster. Other archaeological questions can be imposed 'on site', such as did the condition of the engines and other internal machinery have a role in the tragedy (Moran 2001).

As a mitigation strategy, communication with operators about the collapse process and its likely site outcomes will soon commence. The aim of *Yongala* management is to prepare operators mentally for the collapse scenario so that they can factor it into their business planning and also so that they can be made aware of the Museum's requirements of them to minimise any pilfering from the site at this time. In conjunction with this approach, the collapse of the *Yongala* opens new possibilities for the Queensland Museum to develop a public archaeology program. Rather than concentrating on policing and enforcement, the Museum will endeavour to harness the tourist diver as a resource to assist in the location of dispersed artefacts so that Museum divers can more simply and cost effectively investigate particular objects for their appropriateness for

recovery. The Museum for its part will now transparently develop a *Yongala* artefact collection policy, in consultation with stakeholders, to avoid any knee jerk popularist reactions that would overwhelm the Museum's resources.

Managing underwater cultural heritage is subject to the extremes of nature and fraught with difficulties such as: uncontrollable deterioration, isolation, weather dependency, limited site access and numerous interest and regulatory groups. Only through constant communication and transparent processes with corporate and regulatory support can anything effective be achieved. The *Yongala* is a site of national significance but beyond any practical or financial ability to save. The management foci of the site are to encourage diver participation and research in an appropriate manner and to remain sensitive to the fact that the wreck is the grave of 122 people.

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Mr, John Riley 2007, Technical Diver/ Avocational Nautical Maritime Archaeologist.

Mr, Luis Sanches 2005, ex Dive Instructor working the *Yongala*.

Dr, Leon Zann 2007, Retired Professor Marine Biology