

Assessing Potentially Polluting Wrecks in US Waters

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ABSTRACT

The topic of this abstract fits within this session on threats to underwater cultural heritage (UCH) because of the environmental risk posed by shipwrecks with petroleum cargoes. While many shipwrecks from the World Wars are important parts of our cultural heritage, they also pose a significant threat to the marine and coastal environment as the steel hulls containing their cargoes continue to corrode. A vital limiting factor in addressing such pollution risks is that many of these wrecks lie in deep water and have yet to be located. Surveys to find these wrecks, followed by assessment and management are required to prevent or minimize the adverse impacts to our ocean heritage. Recent work using satellite detection of oil slicks has assisted in locating certain oil tanker shipwrecks in deep water.

KEYWORDS Potentially Polluting Wrecks, World War II, oil spills, shipwrecks

INTRODUCTION

This paper studies the wrecks identified by the United States National Oceanic and Atmospheric Administration (NOAA) as “Potentially Polluting Wrecks” (PPW), which are those that pose the greatest risk of leaking or spilling their petroleum cargoes or bunker fuel and causing an environmental hazard (NOAA 2013a). This fits within this session, “Major Threats to Underwater Cultural Heritage” because most are considered historic under the US National Historic Preservation Act (NHPA). More than half of the wrecks identified as PPWs are merchant ships from World War II, which is a significant theme of national importance reflected in the programs for recognizing and encouraging the historic preservation efforts in the United States. The risk of threats to conservation of our heritage also refers to both natural and cultural resources under the World Heritage Convention. Historic and archaeologically significant shipwreck sites that are also potentially polluting therefore pose a risk to natural ocean heritage while being cultural sites also at risk themselves of collapsing. In these instances, when a wreck suffers a loss of structural integrity due to corrosion in the marine environment, the result is not only a loss of archaeological integrity as a historic site, but as a catastrophic pollution event as the cargo that had been retained in the hull is released. Under U.S. law, removing oil to prevent potential release from historic wrecks needs to consider and attempt to avoid or mitigate any loss of the historic property.

CASE STUDIES

A handful of significant shipwrecks have undergone site assessment and pollution risk mitigation through oil removal operations in the last few decades, but have typically been responsive to oil leaks rather than proactive. The wrecks that still retain their bunker fuel and petroleum cargoes will leak them into the ocean, and it is a matter of when rather than if. A major factor, therefore, is how much cargo or fuel remains, which is determined by the amount of damage to the hull, what level of structural integrity remains, the rate of corrosion, and how the wreck is situated on the seabed.

Several case studies speak to these efforts, here I discuss three: SS *Jacob Luckenbach*, USS *Mississinewa*, and SS *Bloody Marsh*. Remediations of polluting wrecks have typically been conducted as reactionary spill response rather than proactive remediation of retained petroleum cargoes. However, the approaches and methodologies employed on these early remediations have assisted in developing our understanding of removal efforts and how to assess sites. The lessons learned from these

remediations have informed later work and guided the various studies that have begun to standardize approaches to pollution mitigation from shipwreck sites.

SS Jacob Luckenbach

In 1953, the 164-m C-3 freighter *SS Jacob Luckenbach* collided with its sister ship in the fog offshore San Francisco when departing for Korea with full bunkers. All crew members were rescued as the vessel sank to a depth of 53 meters (m) in less than 30 minutes. A series of mystery oil spills were observed in the 1990s, and possibly going back as far back as the 1980s, and a group consisting of the US Coast Guard, California's Office of Spill Prevention and Response together with NOAA's Office of National Marine Sanctuaries (ONMS) searched for the source of these spills in 2001 (Symons and Parker-Hall 2003). NOAA's involvement as a trustee for ocean resources included the ONMS because the wreck lies within the Greater Farallones National Marine Sanctuary protecting significant natural and cultural resources. Leading up to this, thousands of oiled birds had washed up along California beaches (Michel et al. 2005). Samples of the oil were chemically fingerprinted to the bunker fuel carried on *Jacob Luckenbach*. A salvage operation was undertaken in May 2002 to determine the amount of oil remaining on the wreck and remove as much as possible. Many of the fuel tanks were found to have badly corroded piping and vents, which caused the oil to leak into cargo tanks; the assessment identified numerous spaces on the wreck that were estimated to contain 540 tons of heavy fuel oil (Michel et al. 2005). After 123 days on site, the operation removed 350 tons of oil from the wreck.

The pollution remediation of the *Luckenbach* wreck was the first major one performed by the United States. Its location in a sanctuary further complicated the effort due to environmental impact concerns and mitigation. Approximately 85,000 gallons of oil were removed leaving an estimated 29,000 gallons of the oil within the wreck likely in small overhead spaces within the structure. The project was also viewed as a restoration action that addressed the immediate threats to the marine life and environment (Symons and Parker-Hall 2003).

USS Mississinewa

USS Mississinewa (AO-59) was a 553-ft T3-S2-A1 type auxiliary oiler launched in the spring of 1944. The oiler carried a cargo of 146,000 barrels of aviation fuel and Navy Special fuel oil (Gilbert et al. 2003). While at anchor at Ulithi in the Federated States of Micronesia in November, the tanker was struck by a *kaiten*, a Japanese human-piloted torpedo, which caused a large explosion that sprayed fuel across the ship that set it ablaze. The aviation fuel caused a second explosion, followed by a final one when the flames reached the ammunition magazine. The ship capsized and sank, extinguishing most of the fires. Sixty-three sailors died in the attack. It was the first known successful use of a *kaiten* (Mair 2008).

A team of adventure divers located the wreck in 2001 in the Ulithi lagoon at a depth of 38 m. Soon after, a typhoon hit and caused the surrounding beaches to be "fouled by heavy oil leaking from the vessel" (Gilbert et al. 2003, 175). The oil continued to leak for months causing the Governor of Yap State to declare a state of emergency. U.S. Navy divers patched leaks in 2001, and then conducted a more extensive oil removal operation in 2003. The bow of the tanker had been blown off during the attack and lies at 90 degrees on its port side while the rest of the wreck is fully capsized on the seabed, which presented the removal team access to the cargo tanks (Naval Sea Systems Command 2003). Approximately 6,000 tons of oil was removed from the wreck and pumped onto a barge. Oil remains on the site, but is only residual oil in the piping, likely less than 50 tons (Michel et al. 2005). The removal operation was more straightforward than at the *Luckenbach* wreck due to the inverted position of the wreck and the warmer waters, which made moving the heavy fuel oil easier and better visibility for divers.

A similar oil removal operation was conducted by the U.S. Navy on the wreck of the German heavy cruiser, *Prinz Eugen* in 2018. The vessel had been a target ship at Bikini for Operation Crossroads

following its capture by the US at the end of the war. After the nuclear tests, the ship was towed to Kwajalein Atoll, where it capsized and sank in shallow water against the reef. The removal operations recovered nearly 230,000 gallons of oil from the wreck, which had been leaking into the waters of the atoll (Naval Sea Systems Command 2019).

SS Bloody Marsh

Recent ocean exploration efforts located the wreck of *SS Bloody Marsh* in deep water off the coast of South Carolina in 2021. The T2-SE-A1 tanker was sunk with two torpedoes by U-66 on its maiden voyage from Texas to New York with a cargo of more than 100,000 barrels of heavy fuel oil (NOAA 2013b). After an initial attempt to find with wreck by NOAA ship *Okeanos Explorer* in 2019, we were provided satellite data from colleagues in the UK who had found a series of oil slicks in the area of the tanker's reported sinking that had been repeating since the 1990s. A second mission with *Okeanos* conducted additional multibeam mapping in the area and located a target, which when dived on with the ship's ROVs, was identified as the wreck of *Bloody Marsh*. The stern and area of the engine room was severely damaged from the first torpedo strike, and the forward 100-feet or so of the tanker were missing and this bow section is ostensibly somewhere nearby. The main part of the wreck is the completely inverted hull, identified through its welded joinery and overall dimensions. The welded seams and hull plates are fairly intact in this main section, and the leaking oil is likely stemming from ruptured tanks near the areas of torpedo damage rather than corroding plate seams. The wreck, however, due to its intact and inverted state, is expected to likely contains a large amount of the oil cargo it carried.

RESOURCES

The resources available to conduct pollution risk assessments of potentially hazardous shipwrecks typically start with desktop and historical research, followed by site inspection and then remediation, when warranted. However, often, remediations are reactive rather than proactive and sometimes must start with patching leaks and move to direct remediation and oil removal, as was the case with *Mississinewa*. Studies like the RULET work, NOAA's PPW study, and the International Oil Spill Conference work by Michel and colleagues have done much to lay the groundwork for standardized approaches to stepped assessments and informed remediations. Estimates of 20,000 PPWs convinced Congress to appropriate \$1 million for NOAA to identify and prioritize the most ecologically and economically significant PPWs in U.S. waters for inclusion into USCG regional and area contingency plans resulting in NOAA's 2013 PPW study.

NOAA's PPW study began with an assessment of nearly 20,000 historic era shipwrecks that had the potential to pollute that lay within the territorial waters of the US Exclusive Economic Zone (EEZ). Through systematic assessment and detailed historical research, as well as assessing available archaeological data, the list was ultimately reduced to 87 shipwrecks that had the greatest potential to pollute. However, fewer than half of the 87 wrecks identified as highest priority in the PPW study have been found, in a large part because they were sunk away from the coast and lie in deep water. While desktop assessments of historical accounts of petroleum cargoes and the sinking events are essential, those only go so far. Locating and assessing the shipwreck sites themselves is imperative, especially now that wrecks from World War II are now passing their 80th year in the marine environment undergoing corrosion. Expanded efforts for targeted ocean exploration to find potentially polluting wrecks is necessary to understand the scope of the pollution threat posed by these wrecks.

Since its 2013 study of PPWs, NOAA's ONMS Maritime Heritage Program, and Ocean Exploration assessed two of the 87 wrecks: *MV Fernstream*, wrecked in 1952, lies in shallow waters inside San Francisco Bay, and *SS Coast Trader*, a World War 2 (1942) combat loss in the Straits of Juan de Fuca, between the state of Washington and Canada's Province of British Columbia. These assessments determined that all the oil had been released when *Fernstream* sank, and approximately half of the oil had been released when *Coast Trader* sank, but that the other half remained in the

intact, and essentially non-corroded forward hull of the wreck. *Bloody Marsh* was the third such assessment, this time undertaken by NOAA Ocean Exploration collaborating with the author. While the wreck of *Bloody Marsh* was thankfully relatively intact and indicative of a stable hull, we also learned that the hull was inverted and containing a substantial percentage of its cargo. It is not a matter of if that will spill out, but when, and at what rate, either slow leaks or catastrophic.

FRAMEWORK

The research questions regarding addressing pollution concerns from shipwrecks include standardized steps to be taken among stakeholders to best mitigate their pollution risks. While there is no consensus on a single comprehensive approach for pollution remediation between nations who have dealt with the issue, approach typically taken is incident specific and requires evaluation of the wreck, environmental conditions, risk reduction, and potential for catastrophic pollutant release (Landquist et al. 2013, 91; Etkin et al. 2009). The determination of a shipwreck as potentially polluting does not, however, negate its significance as a historic site. While the pollution risk from wrecks can pose a threat to ocean heritage, the potential hazard also poses a risk to the archaeological integrity of the historic sites. NOAA's Remediation of Underwater Legacy Environmental Threats (RULET) project was designed to assist "in prioritizing potential threats to ecological and socio-economic resources while at the same time assessing the historical and cultural significance of these nonrenewable cultural resources" for shipwrecks in US waters (NOAA 2013a, 1). As a US agency, NOAA is required to comply with federal laws that protect natural and cultural resources. Therefore, the RULET work not only assessed which shipwrecks in U.S. waters might pose a risk of polluting, but also whether they met the standard for listing on the National Register of Historic Places.

To narrow down the list of shipwrecks in US waters that could pose a pollution threat, the RULET study used a series of risk factors to assess the potential structural integrity of those identified wrecks and the oil remaining on board, and oceanographic factors that might influence removal operations. These include the amount oil on board, if the wreck had been demolished as a risk to navigation, if a large amount of oil was lost during the sinking, and the nature of the sinking event (NOAA 2013a, ES-3). Responses included a variety of options from leaving shipwrecks alone and responding to leaks or spills as they arose, to full oil removal and salvage. Intermediate options include background research for wreck-specific response plans, site monitoring, and *in situ* assessments through remote sensing and ROV documentation (NOAA 2013a, 74).

Factors affecting response options include the type and volume of oil on board, water depth and visibility, location relative to shore, and other site factors like the wreck orientation. The study also addresses the potential impact of remediation on shipwrecks' historical integrity: "this vessel is of historic significance and will require appropriate actions under the NHPA and the Sunken Military Craft Act (SMCA) prior to any actions that could impact the integrity of the vessel" (NOAA 2013b, 6). Such assessments are important in protecting shipwrecks that are historically significant and war graves. However, for many of the shipwrecks in the NOAA PPW study, they have yet to be located, so the response options are high level and all encompassing.

The U.S. Coast Guard, which would lead, coordinate, and often contract for the remediation of polluting wrecks, is required under Section 106 of the NHPA to consider adverse effects to the PPWs that are also historic properties (Symons et al. 2014, 2024). In an emergency response situation, there is often insufficient time to adequately comply with the NHPA, to determine if a wreck warranted mitigation because it was listed in or was eligible for the National Register of Historic Places (NRHP). What was needed was a proactive approach that streamlined the process. Thus, the responsible federal agencies entered into the NHPA Section 106 Programmatic Agreement (PA) to ensure that historic properties are considered in their planning for and conduct of the emergency response under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Following the larger contextual study, NOAA's Maritime Heritage Program evaluated three representative shipwrecks with a high pollution potential to determine which characteristics and historical associations would be eligible for the NRHP, meet the definition of a historic property, and would then be subject to Section 106 consultation should the Coast Guard move forward with assessment and pollutant recovery activities (Symons et al. 2014, 2025). The three wrecks nominated as tests were the WWII combat losses of *SS Lancing*, *SS Empire Gem*, and *SS Coimbra*. All three were pollution risks and lie off the coast of North Carolina and New York. The results include how they were accepted and listed in the NRHP.

RESULTS

The expected results of this combination of historical research and on-site assessments and remediations is a greater understanding of how to efficiently and effectively mitigate pollution risks from sunken oil tankers and other potentially polluting wrecks. Modern technology has allowed for better access to sites in deep water and will continue to improve the process. However, not only are there more potentially polluting wrecks that have yet to be found and assessed, there are actively leaking wrecks in US waters and elsewhere.

Satellite detection of oil slicks, such as that which led us to the wreck of *Bloody Marsh*, has located repeating slicks over areas of deep water that have yet to be explored, but likely point to the locations of other PPW sites. However, the cost is high of bringing vessels and deep-water survey equipment to those remote areas offshore. Additional dedicated funds and resources need to be brought to bear to address these polluting sites. Some of these documented repeating slicks are off the eastern seaboard of the United States along the path of the Gulf Stream and, were a catastrophic release to occur, could oil a large area of the east coast shoreline (NOAA 2013a, 2013b).

Expanded ocean exploration, targeted efforts to find and assess potentially polluting wreck sites, and the implementation of new technologies, such as satellite detection of oil slicks, is imperative to addressing this problem and mitigating the environmental hazard these wrecks pose.

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BIBLIOGRAPHY

- Etkin, D.S., van Rooij, H., McCay French, D., Risk assessment modeling approach for the prioritization of oil removal operations from sunken wrecks. *Effects of Oil on Wildlife*. Estonia: Tallin, 2009
- Gilbert, Trevor, Sefanaia Nawadra, Andy Tafleichig, Leonard Yinug, 2003. Response to an Oil Spill from a Sunken WWII Oil Tanker in Yap State, Micronesia. *International Oil Spill Conference Proceedings* 1, (2003): 175-182.
- Landquist, H., I.-M. Hassellöv, L. Rosén, J.F. Lindgren, I. Dahllöf., Evaluating the needs of risk assessment methods of potentially polluting shipwrecks. *Journal of Environmental Management* 119 (2013): 85-92.
- Mair, Michael. "Oil, Fire, and Fate: The Sinking of the USS Mississinewa AO-59." *WWII by Japan's Secret Weapon*. Platteville, WI: SMJ Publishing, 2008.
- Michel, Jacqueline, Trevor Gilbert, Jon Waldron, Charles Blocksidge, Dagmar Schmidt Etkin, Robert Urban. *Potentially Polluting Wrecks in Marine Waters*, 2005 International Oil Spill Conference, IOSC 2005.
- NHPA Section 106 Programmatic Agreement (PA) to ensure that historic properties are taken into account in their planning for and conduct of the emergency response under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (2002, signed 1997) https://www.nrt.org/sites/2/files/Programmatic_Agreement_on_Protection_of.pdf
- Naval Sea Systems Command, U.S. Navy Salvage Report, USS *Mississinewa* Oil Removal Operations. Naval Sea Systems Command, S0300-B6-RPT-010, 0910-LP-102-8809, 2003.
- Naval Sea Systems Command, U.S. Navy Salvage Report, Ex-USS *Prinz Eugen* Oil Removal Operations. Naval Sea Systems Command, S1740-AK-RPT-010, 0910-LP-118-8301, 2019.
- NOAA. *Risk Assessment for Potentially Polluting Wrecks in U.S. Waters*. 2013a
<https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/protect/ppw/pdfs/2013_potentiallypollutingwrecks.pdf>. Accessed 6 April 2022
- NOAA. *Screening Level Risk Assessment Package: Bloody Marsh*. 2013b
<https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/protect/ppw/pdfs/bloody_marsh.pdf>. Accessed 6 April 2022.
- Symons, Lisa, and Heather A. Parker-Hall. "The SS *Jacob Luckenbach*: Integration of NOAA Trust Issues into the Response." *International Oil Spill Conference Proceedings* 2003 1 (2003): 649-653.
- Symons, Lisa J., James P. Delgado, Deborah Marx, and Erika Martin Seibert, A Means to Streamline Historic and Cultural Resource Consultation and Compliance for Pollution Assessment and Recovery Activities on Shipwrecks. *International Oil Spill Conference Proceedings* 2014 1 (2014): 2024-2036.