CALIFORNIA'S "AQUATIC ASSASSIN" – THE EX-GERMAN U-BOAT *UB-88*: AN ARCHAEOLOGICAL RESOURCE FROM A WORLD WAR I NAVAL BATTLEFIELD

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Resting off Los Angeles Harbor in southern California's San Pedro Bay is a unique remnant of a World War I naval battlefield. The ex-German U-boat UB-88 participated in what has been described as the "First Battle of the Atlantic." Surrendered at the end of the war, the UB-88 was acquired by the U.S. Navy in 1919 and sunk as a target in 1921 after being dismantled. This article discusses the historical contexts of the UB-88 and summarizes the latest archaeological investigation of the site and what can be learned from an archaeological resource from a World War I naval battlefield.

The ex-German submarine *UB-88* is approximately 12 km (7.5 mi) south of the entrance to Los Angeles Harbor in 58 m (190 ft) of salt water in San Pedro Bay, California (Figure 1). The *UB-88* was a submarine in the Imperial German Navy during World War I and was sunk after the war as a target on the afternoon of January 3, 1921, from gunfire from the destroyer USS *Wickes* (DD-75), commanded by Commander William Halsey (who would later become Fleet Admiral of the United States William "Bull" Halsey).

In July 2003, the *UB-88* was relocated by local shipwreck enthusiast Gary Fabian. Fabian used publicly available multibeam sonar data from the United States Geological Survey's (USGS) Pacific Seafloor Mapping project to identify the wreck. Later, local divers used the same methodology to relocate the wreck themselves around 2010, and freely distributed the wreck coordinates. The *UB-88* has since become a popular diving attraction for technical divers.

Video footage collected in 2004 by technical divers was used to create a 3D photogrammetric model and develop a site map. In 2013, video footage collected by technical divers was used to examine the site for structural changes and site degradation. Focus was placed on the archaeological interpretation of video footage and photogrammetric data to establish site condition, look for anthropogenic impact (e.g., anchor drags, relic hunting), and to determine whether there was unexploded ordnance (UXO) onboard.

HISTORICAL CONTEXT

It may have been the Battle of Jutland that was responsible for the existence of the *UB-88*. The battle between the British Grand Fleet and the German High Seas Fleet between May 31 and June 1, 1916, results in a strategic victory for the British. The German High Seas Fleet will never attempt to engage the Royal Navy in a major naval offense during World War I, and the German High Seas Fleet commander, Admiral Reinhard Scheer, concludes that victory will only be possible by resuming unrestricted submarine warfare and starving the British economy (Rahn 2015:191). Kaiser Wilhelm II signs the order authorizing the resumption of unrestricted submarine warfare on February 1, 1917.

This is a big gamble for Germany. They will need to deploy as many submarines as possible to force England to capitulate before America can join the war and have their forces deployed in France. Shortages of materials and skilled shipyard workers have slowed down submarine production. In early 1917, constructing U-boats is so important that the Germans give them priority for materials, and soldiers skilled in ship construction are released from the Imperial German Army to assist (Rössler 2001:76). Priority is given to the construction of the smaller coastal Type UBIII U-boat that can be constructed faster, requires less materials, and still has enough offensive power to make a difference (Rössler 2001:76).

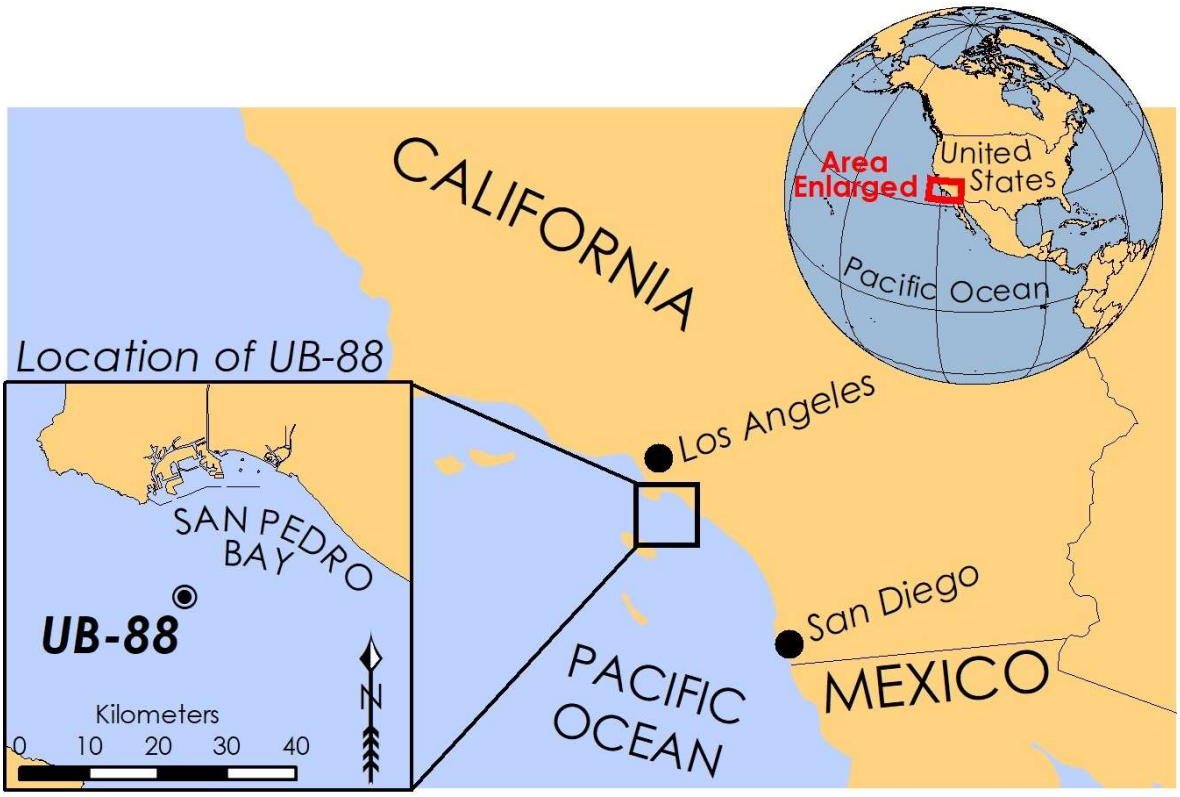

Figure 1. Map showing the location of UB-88. Map by J. Delsescaux.

UB-88 During World War I

Only a week after the resumption of unrestricted submarine warfare in early February 1917, the keel of the *UB-88* was laid down in the AG Vulcan Shipyard in Hamburg, Germany. About eight months later she was launched, on December 11, 1917 (Mooney 1981:382). She was 55.52 m (182.15 ft) long and had a beam of 5.76 m (18.89 ft). She had four forward torpedo tubes and one aft torpedo tube and could carry a complement of ten 50-cm (19.7-in) torpedoes. She was armed with a 10.5-cm (4.13-in) deck gun that could be used on the surface to sink ships without expending valuable torpedoes. She displaced 510 tons surfaced and 650 tons submerged and could travel on the surface at 13.6 knots surfaced, 8 knots submerged. She had a crew complement of 34 men (Gröner 1991:25-27).

All five torpedo tubes were inscribed with the phase "Gott Mit Uns" or "God With Us," a physical display of the religious beliefs of the Germans at the time (Figure 2). Written on torpedo tube doors, this inscription is full of symbolism.

On January 26, 1918, at the AG Vulcan Shipyard and with three hurrahs for his Imperial Majesty, Kaiser Wilhelm II, the *Seiner Majestät Unterseeboot* (SM) *UB-88* hoists its ensign and commissioning pendant with *Oberleutnant zur See* Johannes Ries in command. After being delayed by a shipyard worker strike, fog, and fitting-out, the *UB-88* finally gets underway for Kiel, Germany, in the Baltic Sea, on February 1, 1918, and travels through the Kiel Canal (*UB-88 Kriegstagebuch* [KTB], Record Group [RG] 242.8.1 General Record, T1022, Roll 81, National Archives and Records Administration, Washington, D.C. [NARA]) exactly one year after the resumption of unrestricted submarine warfare.

After arriving in Kiel, the *UB-88* is transferred from Ries to *Kapitãnleutnant* Reinhard von Rabenau. Ries will take command of von Rabenau's former command *UC-77*. The *UC-77* will strike a mine off the Flanders coast on July 14, 1918, and Ries will perish along with his entire crew (Termote 2017:340).

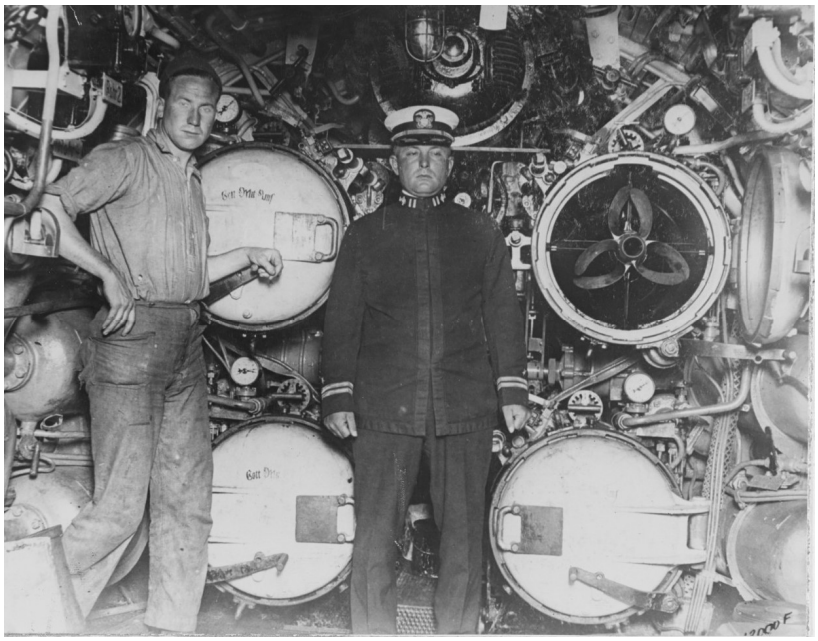

Figure 2. UB-88 forward torpedo tubes. German writing, "Gott Mit Uns," or "God With Us" is visible on the torpedo doors. Photo courtesy of the Naval History and Heritage Command (NH #42487).

From February until June 1918, the *UB-88* conducted sea trials, underwent repairs, and performed training exercises near Kiel. After conducting test dives in Kiel Bay, on May 10, 1918, outside of Kiel fjord, the *UB-88* collided with the *Vorpostenboot* (VP-Boat) *Laubert* of the Kiel Outpost Flotilla. The *UB-88* sustained damage to the bow and on the port side. The pressure hull was undamaged, and the boat proceeded to the Imperial Shipyard in Kiel for repairs (*UB-88* KTB, RG 242.8.1 General Record, T1022, Roll 81, NARA). The collision is noteworthy because, besides delaying the *UB-88*'s deployment to the war zone, this incident might have been how the *UB-88* obtained its distinctive crushed and torn bow that newspapers in the United States will attribute to "the disgraceful ramming of a lifeboat" (*Los Angeles Examiner* [LAE] 2 September 1919:3).

On June 4, 1918, the *UB-88* left Kiel, Germany, and headed to Zeebrugge, Belgium, to operate with the *1 U-Flotille Flandern* (1st Submarine Flotilla, Flanders). During her short wartime career from June to October 1918, the *UB-88* conducted three patrols and traveled through the North Sea, Irish Sea, English Channel, and Bay of Biscay. She successfully attacked 16 merchant ships (14 were sunk and two damaged, although multiple sources claim she sank 16 vessels [Termote 2017:273]).

It was at the *1 U-Flotille Flandern* that the *UB-88* received its distinctive "eyes" painted on the bow (Figure 3). The "eyes" were a recognition mark painted on U-boats operating in the *1 U-Flotille Flandern*. It was "introduced by an officer who had served in China where it was traditional in paint eyes on local junks to ward off evil spirts" (Termote 2017:66).

On September 12, 1918, the *UB-88* traveled through the Straits of Dover in the English Channel on her last war patrol. The British Admiralty believed she was the last German U-boat to have successfully navigated through the Dover Barrage (Nielson 1923:1275). Wisely not attempting the Straits of Dover again, the *UB-88* returned to Belgium through the Irish Sea and around the Orkney Islands north of Scotland, only to find Zeebrugge being evacuated. She left the next day and arrived in Heligoland, a small group of islands in the southeastern part of the North Sea. Here she was assigned to the *U-Flotille, Hochseeflotte* (2nd Submarine Flotilla, High Seas Fleet). Soon she traveled to Wilhelmshaven, Germany, for repairs and remained there inactive through the end of the war (Mooney 1981:384).

Figure 3. View of damaged bow of UB-88 with painted eyes. Photo courtesy of the Naval History and Heritage Command (NH #111085).

A German U-Boat in the U.S. Navy

After the armistice on November 11, 1918, the *UB-88* and her crew surrendered at Harwich, England, on November 27, 1918. On March 13, 1919, the *UB-88,* along with the *UC-97*, *UB-148*, *U-111*, *U-117*, and *U-140,* were given to the United States under the pretext of being exhibited during the Victory Bond campaign, but the U.S. Navy wanted these submarines for their close examination.

Lieutenant Commander Joseph L. Nielson was assigned as the Commanding Officer of the *UB-88*. The U-boat was given a special commission into the U.S. Navy (but was not formally a part of the U.S. Navy). Nielson and his crew worked on getting the newly commissioned USS *UB-88* ready for its transatlantic voyage to the United States (Figure 4). They found the UB-88 in poor condition, with souvenir hunters having removed many important instruments and the Germans having thrown their last meals into the bilges. With all the water condensation in the interior, and after four months of neglect, rust covered all the steel surfaces. The engines were one rusted mess (Nielson 1923:1282). No one else wanted the *UB-88* (Freidman 1995:160).

With determination and ingenuity, the sailors replaced many missing pieces with parts from other nearby surrendered German U-boats and managed to get the *UB-88* operational in only three weeks. On April 7, 1919, the *UB-88* cast off from Harwich, England, along with the other ex-German U-boats *UC-97*, *UB-141*, *U-117*, and the submarine tender USS *Bushnell* (AS-2). They headed for Ponta Delgada in the Azores before crossing the Atlantic. After a rough crossing from the Azores and the crew finding their drinking water contaminated by fuel oil, the *UB-88* arrived in New York City under her own power on April 25, 1919, with a very thirsty crew (Nielson 1923:1286-1289).

On May 5, 1919, the *UB-88* began her exhibition cruise for the Victory Loan campaign (Figure 5). From May 1919 until finally docking at the San Pedro Submarine Base on November 7, 1919, the *UB-88* traveled 24,721 kilometers (15,361 miles) and up the Mississippi River, through the Panama Canal, and as far north as Seattle, Washington (Nielson 1923:1291-1298). This trip was longer than any other captured U-boat (Friedman 1995:160).

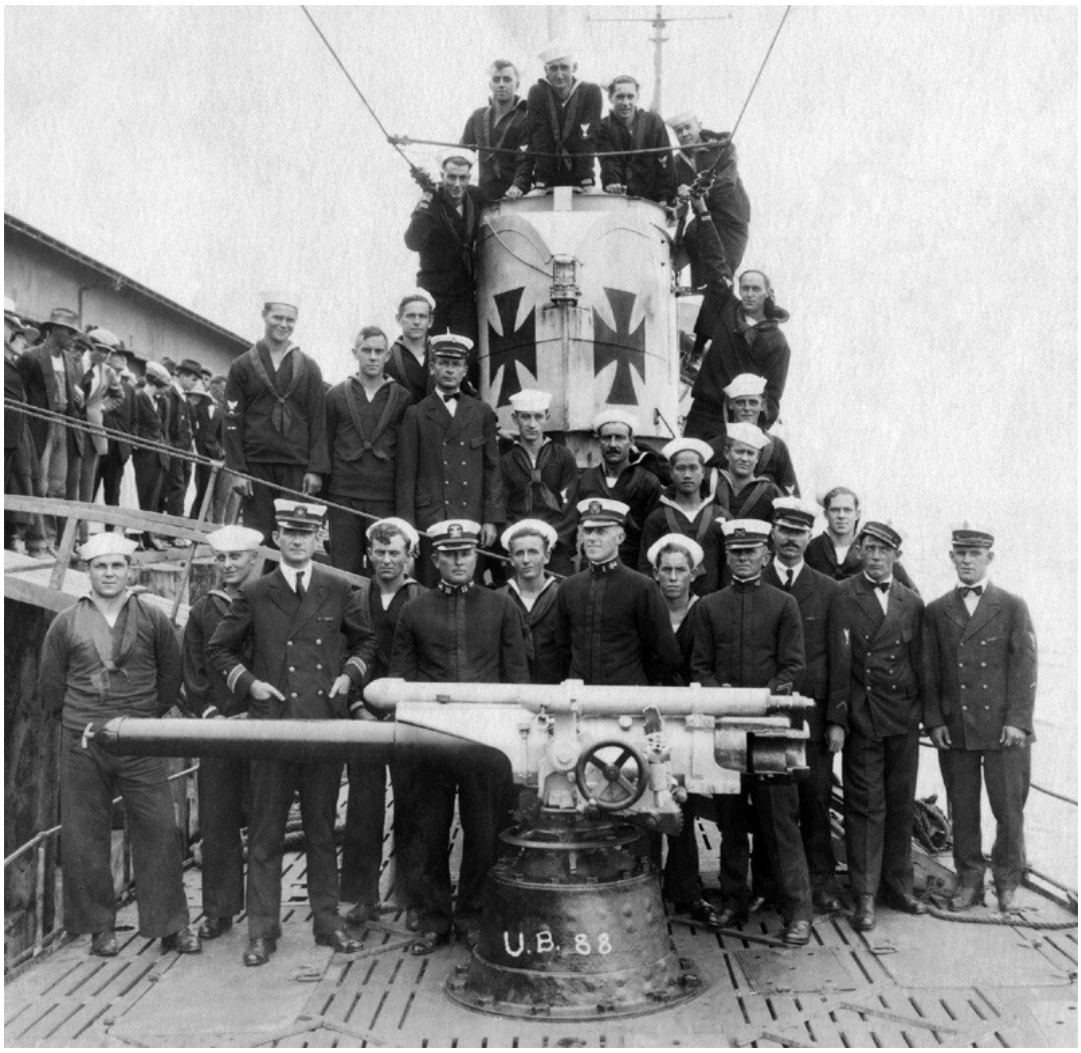

Figure 4. U.S. Navy sailors on board UB-88. Photo courtesy of the Gary Fabian Collection.

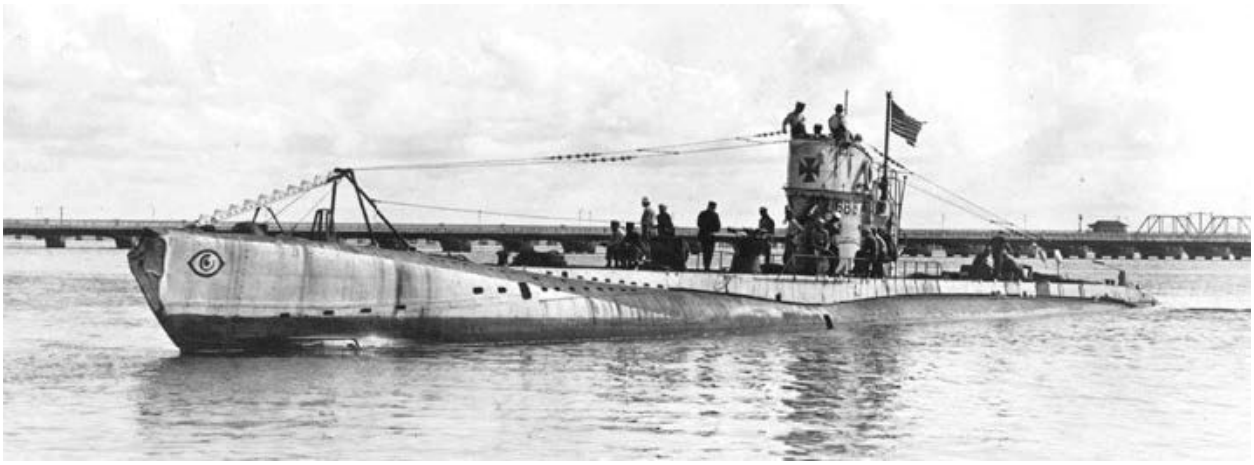

Figure 5. UB-88 on exhibition cruise in Miami, Florida. Photo courtesy of the Gary Fabian Collection.

Dismantlement and Abandonment

Dismantlement began on April 1, 1920, and was completed on August 31, 1920. The *UB-88* was officially decommissioned on November 1, 1920 (Mooney 1981:384). It was "entirely dismantled, every bolt, nut, screw and everything of any value, whatsoever had been removed. Engine, batteries and all machinery available was taken off for use in a more favorable way by the government" (*San Pedro Daily News*, 3 January 1921:1).

On the afternoon of January 3, 1921, at 4:08 pm, Commander William F. Halsey, commanding officer of the destroyer USS *Wickes* (DD-75), ordered his sailors to open fire on the float hulk of the *UB-88* with their portside 4-inch guns. Nearby on board the flagship of the Pacific Fleet, the battleship USS *New Mexico* (BB-45) was Admiral Hugh Rodman, Commander-in-Chief of the U.S. Pacific Fleet. On board with Rodman were dozens of reporters, the Mayor of Los Angeles, local dignitaries, and other high-ranking U.S. Navy personnel (*Los Angeles Times* [LAT] 4 January 1921:1). On board the *Wickes* with Halsey was Captain Chauncey Shackford, Commanding Officer of the San Pedro Submarine Base, and other U.S. Navy observers (LAE 4 January 1921:1). All eyes were focused on the *UB-88*.

One shot hit the conning tower, causing spectators on the *New Mexico* to cheer and Rodman to remark that it was one of the most effective shots he had ever witnessed (LAT 4 January 1921:1). At 4:12 pm, after only four minutes of bombardment, Halsey ordered his sailors to cease firing. Forty-three of the 55 shells fired had hit their target, and at 4:16 pm the *UB-88* took her last dive, watched by cheering spectators. Rodman signaled "Well Done, Wickes" (LAE 4 January 1921:1). Halsey steered the *Wickes* back towards Los Angeles Harbor to offload his passengers before proceeding back to Naval Base San Diego. In 20 years, an older "Bull" Halsey would battle the Japanese in the Pacific, earn the rank of Fleet Admiral of the United States, and become a U.S. Navy legend.

Post-Abandonment Relics of the UB-88

Scrapped bronze and brass removed from the *UB-88* was melted down and made into "a novel souvenir, a miniature submarine in brass and bronze suitable for a desk or mantel ornament" with "U.B. 88" stamped on the bow (LAT 26 May 1921) (Figure 6). These party favors were passed out on May 27, 1921, at the Hotel Virginia in Long Beach, California, at a farewell ball for Captain Chauncey Shackford, Commanding Officer of the San Pedro Submarine Base (LAT 28 May 1921).

Figure 6. Souvenir made from bronze and brass from the UB-88, scale in cm. Photo by J. Delsescaux.

Both bronze propellers were removed prior to the sinking of *UB-88* and stored in a warehouse at the Submarine Base. They were to be presented to the City of Los Angeles and placed on display in Plaza Park in San Pedro. However, the propellers were reported stolen on April 25, 1923 (LAT 27 April 1923). Los Angeles Police detectives eventually uncovered a burglary ring that had stolen the propellers and copper wire for sale as scrap metal. One of those arrested was a Chief Petty Officer on the USS *S-3* (SS-107) at Mare Island Naval Shipyard (LAT 14 July 1923). The final deposition of the bronze propellers is unknown, and newspaper accounts at the time suggested that the police might have recovered them, while others suggested that they had already been sold.

Ten years after the *UB-88* sank beneath the waters of the Pacific, she would, in a way, appear in a Hollywood film. In 1931, a Hollywood studio filmed a major motion picture called *Suicide Fleet* about the U.S. Navy's battle with a villainous German U-boat commander. The U-boat set was designed by a man who had helped dismantle the *UB-88* in 1920 and patterned the submarine in the movie after her. Parts from the *UB-88* are even said to be incorporated into the film, including a speaking tube from the U-boat (*Salt Lake Tribune* 10 February 1932:18).

Public Opinion on German U-boats

While there is admiration for the technology incorporated in these submarines, there is an equal level of disdain. World War I was the true beginning of undersea warfare, and the comments from Admiral Hugh Rodman, the U.S. Navy's Commander-in-Chief of the Pacific Fleet, while watching the *UB-88* sink below the ocean, is probably an example of the views of the time. Rodman said the sinking was "a great moral lesson to those who think they can terrorize the world with frightful slaughter. The UB 88 received the same death penalty that it had so ruthlessly passed upon many Allied vessels. Yet the death of the UB 88 was more human. There was nobody aboard it, while sinking of the sixteen Allied vessels by the submarine caused the deaths of many innocent ones" (LAT 4 January 1921:1).

Many in the U.S. Navy and the public did not foresee the impact undersea warfare would have on future conflicts. Many saw the submarine as something sneaky, piratical. American newspapers frequently referred to the *UB-88* in negative terms, such as an "aquatic assassin" or "Kaiser's Pet 'Sea Thug'" (LAE 2 September 1919:1). The Chief of Naval Operations of the U.S. Navy in 1918 thought submarines would soon be outlawed, as with chemical weapons, and that it was useless to study the German U-boats (Beigel 1986:289). It would take the effort of foresighted U.S. Navy officers to finally get the six U-boats to the U.S.

Some allies, most notably the Japanese, realized the potential of undersea warfare. After the war, the Japanese acquired their own German submarines and towed them back to Japan, where they were studied in detail. They even hired German submarine experts to come to Japan to help accelerate their submarine development during the interwar period (Beigel 1986:289; Rössler 2001:88).

To the annoyance of the sailors on board these ex-German submarines, many in the U.S. Navy minimized their superiority and frequently wrote that U.S. Navy submarines were still superior (see Land 1919). However, there were ways in which even the naysayers had to admit that the German submarines were superior to their American counterparts: the diesel engines (Land 1919:121).

The greatest importance of the *UB-88* and the Type UBIII was their influence on the submarines of World War II. The ubiquitous Type VII U-boat that was the scourge of Allied shipping 20 years later was essentially an improved Type UBIII (Westwood 1984:9) The *UB-88* and other ex-German submarines influenced the design of future American submarines, particularly in their diesel engines and perhaps their hull shapes (Friedman 1995:160; Dubbs 2014:160).

DISCOVERY

On July 9, 2003, Gary Fabian located the *UB-88* by utilizing publicly available multibeam sonar data collected by the United States Geological Survey (USGS). Local technical divers later assisted in confirming

the wreck and brought back the first video footage of the *UB-88* (Balzar 2004). The location of the *UB-88* was not public knowledge until around 2010, when local divers followed Fabian's methodology and used the same USGS multibeam sonar dataset to find the *UB- 88* for themselves. They later distributed the coordinates on a public forum, and the location became common knowledge (Gary Fabian, personal communication 2018).

Since then the *UB-88* has seen a significant increase in visitation from technical divers, including at least one fatality (*San Pedro Daily Breeze* 17 July 2017). The heavy visitation is not surprising, given the proximity to Southern California's large technical diving community. As the only German U-boat on the west coast and one of the few submarines in Southern California, it was destined to become a popular diving attraction.

FIELD METHODS

The footage of the *UB-88* used for this study was provided by Gary Fabian, who discovered the *UB-88*, and Karim Hamza of Los Angeles Global Underwater Explorers. Fabian provided footage taken in 2004 by technical divers. Karim Hamza provided footage of the *UB-88* taken in 2013. Additionally, Fabian provided side scan sonar imagery of the *UB-88,* historical research, and remarkable footage of the sinking of the U-boat captured by newsreels in 1921. The two diver-acquired videos were taken almost 10 years apart and provide an opportunity to explore the site formation processes and perhaps understand how the wreck is degrading.

Following the methodology in Mertes et al. (2017), the 2004 footage was inputted into Agisofts PhotoScan Pro (Version 1.4.1), a Structure from Motion (SfM) software program. The footage was grainy and there was only one transit looking down over the site. Most of the footage was from different angles and distances and no accurate photogrammetry of the side of the wreck could be obtained, despite multiple attempts. Images from the single transit were more successful in creating an incomplete 3D model (Figure 7).

A scale was developed for the photogrammetric model by taking measurements from Type UBIII submarine plans. The distance between the periscope wells, for instance, is known and was inputted into the software. Through this method, a site map accurate to within 10 cm (4 in) or 20 cm (8 in) was possible. While this map is not as accurate as those developed using traditional survey methods (e.g., trilateration, DMS), water depth preludes the recordation by archaeologists and this seemed like an acceptable compromise.

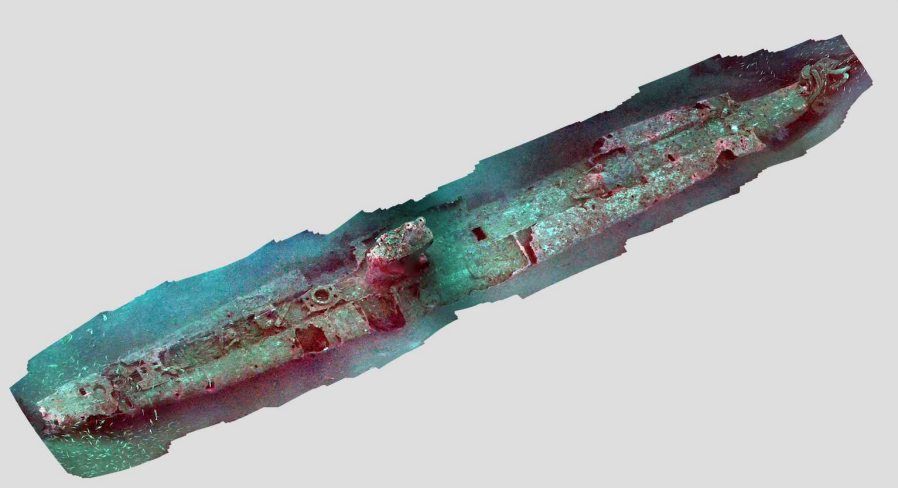

Figure 7. Photogrammetric model of the UB-88 as it was discovered in 2003. Photo by J. Delsescaux.

Using diver acquired video footage has disadvantages as a source of archaeological data. The footage frequently does not cover the entire site and the archaeologist is forced to rely on someone else's impressions and tour of the site. The footage reflects the diver's focus and areas not of archaeological interest are emphasized (Arnshav and McWilliams 2017:32). All limitations aside, the diver acquired video footage of the *UB-88* provides the only source of data of the wreck as it was shortly after its initial discovery and is instrumental in answering questions regarding the deterioration of the site.

Bojakowski et al. (2015) recommended using SfM for 3D visualization not as a replacement to traditional underwater recording methods. In most instances, this is a good recommendation. While there are disadvantages using only SfM as our recoding method, these disadvantages are countered by the fact that without SfM the *UB-88* would not have any type of archaeological investigation. The depth of the *UB-88* is a barrier to the accessibility of the site. No archaeologist will dive to record the site with a tape measure anytime soon. The cost and time alone would be prohibitive, not to mention the necessity of having technical diving equipment and training. There are too many other sites of more scientific value that archaeologists gravitate towards. While this does not neglect the importance of the *UB-88*, the reality is the time and effort taken to record a site is commensurate with its perceived importance. In addition, a detailed traditional recording of the *UB-88* with a tape measure is not likely to reveal any new information that is not already revealed in the photogrammetric model.

SITE DESCRIPTION

The *UB-88* rests upright off the coast of southern California approximately 12 km (7.5 mi) south of the entrance to Los Angeles Harbor (Figure 1). The submarine rests in a sandy depression approximately 24 m (79 ft) wide and 78 m (256 ft) long on the San Pedro Shelf. The seafloor is 58 m (190 ft) deep, with the conning tower resting 51 m (168 ft) underwater. The bow is facing southwest at 226° True North (Figure 8).

By the time the *UB-88* was discovered in 2004, she had already lost roughly 50 percent of the outer hull, exposing the interior pressure hull. Since then, a significant portion of the outer hull has further deteriorated, especially on the bow where the torpedo tubes are now fully exposed. The thoroughness of the U.S. Navy's dismantlement is evident throughout the hull. Video footage from 2004, when divers entered the submarine, show a barren interior with the engines, periscopes, and other major equipment removed. Only a few steel pipes and valves remain inside.

The intact section of hull measures approximately 54 m (177 ft) long with the front 1.5 m (5 ft) of the bow missing. A small detached 1 m (3 ft) segment of the bow lies 2 m (6.5 ft) directly in front of the wreck. The hull has a fracture 5 m (16.5 ft) from the bow on both starboard and port sides. The fracture appears to go through to the keel.

The starboard bow exterior torpedo tube door shows evidence of having been exposed to an extreme force that has bent it outwards. Either this was caused by the impact of the bow hitting the seafloor in 1921, or, alternatively, it might have been caused by an impact with a purse seine net, which could explain the missing portion of the bow. Video footage from 2004 does not adequately cover this section of the wreck, and it could not be determined if this torpedo tube door was already bent prior to 2004. The entry points of the 4-inch shells appear on the port side, indicating that the *Wickes* had been firing from that direction. This is corroborated by film footage that was taken of the event in 1921 that shows the *Wickes* firing into the port side of the *UB-88*. Evidence of the pre-deposition salvage efforts can be seen in the entries that were cut into the pressure hull to facilitate removal of material. The opening aft of the conning tower was used to remove the diesel engines and has become an entry point used by divers to explore the interior.

There are reports in multiple newspapers that an 11 kg (25 lb) TNT scuttling charge was placed in the bow to be ignited if shelling proved ineffective. Historical evidence of its detonation is contradictory, some reporting that it was never ignited (LAT 4 January 1921:1) and others reporting that a 4-inch shell detonated the scuttling charge (LAE 4 January 1921:1). Most accounts agree that one of the initial shots from the *Wickes* cut the towline from the harbor tug and the scuttling charge could not be detonated manually.

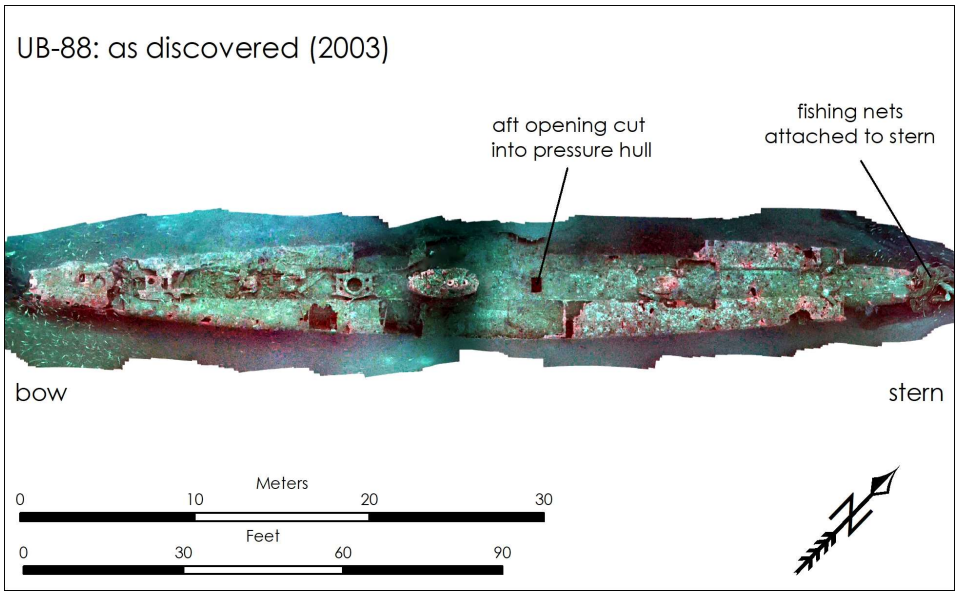

Figure 8. Site map of the UB-88 as discovered in 2003. Map by J. Delsescaux.

Video footage of the interior taken in 2004 shows a large obstruction blocking the passageway forward of the control room and near the bow torpedo room. The obstruction was probably not originally part of the submarine and was added during or after the Navy began dismantlement. Judging by its placement, the switch on the side, and the orange discoloration seeping from the obstruction, it might be the TNT scuttling charge. Its size, however, is larger than the 11 kg (25 lb) cited in newspaper accounts and might be closer to 113 kg (250 lb).

Local fishermen knew the location of the *UB-88* before anyone else, as evidenced by the purse seine net still attached to the stern, along with other random fishing lines. These nets account for the damage to the stern. Here the entire outer hull has been removed and the port strut of the propeller has been torn out of the wreck with a purse seine net wrapped around it.

The fishing net is not only a threat to the marine life but might also be a threat to the stability of the site. Still floated by plastic buoys, the net hangs over the wreck and moves with the current, waves, and tide. Over time, this movement will continue to weaken the metal and help accelerate the corrosion processes (Atkinson 2012:40). This is especially true during the winter months, when San Pedro Bay experiences large winter storms.

STUDY FINDINGS AND CONCLUSIONS

It was initially hoped that current footage could be obtained to create a photogrammetric model to compare with the 2004 model and generate quantifiable data on the *UB-88*'s degradation. However, this study was unable to obtain the footage and had to rely on the 2004 video to create a photogrammetric model and use the 2013 video footage for comparison.

Possible National Register Eligibility

An argument can be made that the *UB-88* is eligible for the National Register of Historic Places under all four criteria. Between its association with World War I, having been sunk by Fleet Admiral William "Bull" Halsey, the fact that it is only one example of a German U-boat from either world war on the Pacific

Coast and one of only two examples of Type UBIII German U-boats in the Western Hemisphere, and its potential to provide new insights into human behavior through the application of ship abandonment studies and maritime cultural landscapes, the *UB-88* might be found eligible under Criteria A, B, C, and D.

Being a former U.S. Navy vessel, the *UB-88* is already protected under the Sunken Military Craft Act (2004). From a maritime heritage management perspective, the *UB-88* is an extremely important resource to the State of California and the U.S. Navy. Given its popularity as a diving attraction, it should be periodically monitored. Its unique, exciting history and popularity with divers would make the *UB-88* a good topic for the Naval History and Heritage Command (NHHC) to engage in public archaeology. The NHHC Underwater Archaeology Branch could inform the public about itself and about how U.S. Navy vessels (including the *UB-88* and other target ships) are protected from disturbance by the Sunken Military Craft Act (2004). An interpretive "dive slate" can be developed for the public so divers are better informed and can appreciate what they are seeing.

Possible Unexploded Ordnance

The unknown obstruction in the passageway forward of the control room near the bow torpedo room might be the unexploded scuttling charge. The possibility of UXO on board is something that needs to be explored further. If the obstruction noted in the interior is the unexploded TNT scuttling charge, the U.S. Navy's Explosive Ordnance Disposal (EOD) community should be consulted to determine the effects 100 years of submergence in salt water would have on TNT's combustibility. If its instability could cause it to ignite underwater, a steel plate may need to be welded over the opening aft of the conning tower to prevent divers from penetrating the interior.

Welding a steel plate to cover the aft opening would probably be an adverse effect to a historic property and require additional documentation and mitigation. The *UB-88* would need to be evaluated for National Register eligibility and, if determined eligible, the California State Historic Preservation Officer would need to be consulted to approve a treatment plan. If the site is determined eligible, mitigation measures might involve documentation of the interior through video footage and 3D LiDAR using 3D at Depth's SL3 LiDAR, or a similar device, such as the bottom based acoustic scanner Teledyne BlueView used to document the Swedish warship *Mars* that sank in 1564 (Erikson 2017:94). Welding a steel plate over the aft opening would be unpopular with the local diving community and would require public outreach. It would also be only a temporary solution. The *UB-88* will continue to deteriorate and the pressure hull will one day collapse, potentially exposing the possible TNT again.

Anthropogenic Impacts

McCarthy (1998) noted the unique archaeological potential of submarines and their tendency to survive better than other vessel types underwater. One of the primary reasons is because the pressure hull of a submarine is "much thicker and normally it has a water flow only across its outer surface. Even then the rate of that flow is impeded by the presence of the outer hull, which can remain hydrodynamically-efficient for many decades" (McCarthy 1998:63). Since being discovered in 2003, the outer hull has significantly deteriorated, particularly in the bow. This might be from the natural corrosion process since, as McCarthy (1998:63) noted, the outer hull is made of thinner metal than the pressure hull and should deteriorate at a rate similar to other metal hulled shipwrecks.

Most of the anthropogenic impacts to the *UB-88* appear to have been caused by contact with purse seine nets used for tuna fishing. The popularity of the *UB-88* to the local technical diving community does increase potential impacts from anchors, looting, and diver contact as well. While the threat of looting is minimal, as most of the brass and bronze was removed prior to disposal, the threat of anchor impact and diver contact is high. There is also an extremely high risk of further purse seine net damage, given the history of damage to the site caused by fishing and the remaining purse seine nets attached to the stern.

It is difficult to differentiate between anthropogenic impacts and the natural deterioration of the site. The sustained history of commercial fishing in San Pedro Bay and the purse seine nets attached to the stern make it likely that the *UB-88* has experienced multiple impacts from purse seine nets. The post-2010 video footage shows that there has been significant deterioration since 2004 in the bow. The outer hull has been completely removed, exposing the forward torpedo tubes. The new footage shows the starboard bow exterior torpedo tube door having been exposed to an extreme force that caused it to bend outwards. This was probably caused by the impact of the bow hitting the seafloor in 1921.

Importance of *UB-88* as an Archaeological Resource

As Adams (2013:48) has written, "These wrecks are all laden with information about the societies that built and used them. Their remains carry meaning in ways that both complement and add to historical texts and are of far more interpretative value than the identification labels in an old-fashioned museum case." Naval shipwrecks provide insights into human behavior associated with conflict that historic records alone cannot provide (Adams 2013:48; Gould 1983:105). By examining naval shipwrecks "it should be possible to identify specific relationships between certain kinds of behavior under the stress of war and the characteristic material by-product of that behavior in their final (i.e., archaeological) context of discard" (Gould 1983:134).

There is an often-quoted adage that "historical archaeology is the most expensive way in the world to learn something we already know" (Deetz 1991:1), and this can be a risk in the archaeology of modern ships. Keith Muckelroy (1980:10) described the study of World War I and II naval vessels as "interesting, and sometimes furnish useful displays for museums, [but] they are not archaeology . . . it becomes redundant at that point in the past after which surviving records, descriptions, plans, and drawings of contemporary objects can tell us more about the culture of the time than we can learn by digging up a few relics." Reinforcing Muckelroy's viewpoint, many archaeological projects of World War I and II shipwrecks focus on the descriptive (e.g., identifying their locations, causes of sinking, and documentation of site condition) and ignoring any theoretical perspectives (Neyland 2011:711).

This is changing, however, with more studies expanding upon the descriptive and looking into the theoretical perspectives that World War I and II shipwrecks provide (such as Delgado et al. 2018a; Delgado et al. 2018b; McCarthy 1998; McKinnon and Carrell 2015). There are various theoretical orientations that can be used to move the study of the *UB-88* from the descriptive into the more explanatory. Some of these include ship abandonment studies and maritime cultural landscapes. The *UB-88* is what has been termed a "deliberately abandoned vessel." According to Richards (2008:10):

> Deliberately abandoned vessels are significantly different from catastrophically or deliberately wrecked watercraft because their final resting place, the intactness of their hull, and the inclusion of any material within their hull is totally determined by human intentions, decision-making processes, and actions. A classic example of a deliberately abandoned naval vessel would be the HMS *Vixen* in Bermuda (Gould 1991; 2000:281-289).

Most deliberately abandoned naval vessels outside of wartime are used as target ships to test the effectiveness of weapons, while others are sunk for their political overtones (Richards 2008:31). An example of this could be the Japanese battleship *Nagato*. The *Nagato* was the flagship of the Imperial Japanese Navy in World War II and had been used during the planning of the attack on Pearl Harbor in December 1941. During the Operation Crossroads atomic weapons test at Bikini Atoll in July 1946, the *Nagato*, along with other captured Japanese warships, were placed within proximity to the atomic bomb blast to ensure their sinking (Delgado 2001:179). The symbolism is difficult to ignore. The sinking of the *UB-88* is undoubtedly symbolic, being sunk as "a great moral lesson to those who think they can terrorize the world with frightful slaughter" (LAT 4 January 1921:1).

Recently, Delgado et al. (2018a, 2018b) examined World War II shipwrecks off the west coast of the United States as part of a larger maritime cultural landscape. Maritime cultural landscape is a concept first introduced in Scandinavia by Christer Westerdahl in 1978 that "comprises the whole network of sailing routes, old as well as new, with ports and harbors along the coast, and its related constructions and remains of human activity, underwater as well as terrestrial" (Westerdahl 1992:6). After publishing his ideas in English for the first time in 1992, Westerdahl has seen an increase in the use of this theoretical orientation in maritime archaeology (Ford 2011).

Using this approach, Delgado et al. (2018a, 2018b) saw these deliberately abandoned shipwrecks as a maritime cultural landscape that developed as ships from war were returned to home waters for evaluation and then deposed of offshore. Delgado et al. (2018a:145) wrote, "These warships that survived the war and were sunk off California represent the war's South Pacific battlefield, as they had an impact on those landscapes, but without their physical presence represented on the seabed. Today they are part of a broader maritime cultural landscape across the surface of the Pacific, but were uprooted from those areas of significance and redeposited in US waters." A naval shipwreck "uprooted from those areas of significance . . . exhibits damage from its life, its sinking, and the history of the shipwreck since the time of its sinking to the present day" (Delgado et al. 2018a:124).

Jon Adams wrote, "the way in which old vessels are disposed of reveals a great deal about social attitudes to them and the mechanisms of which they were part" (Adams 2001:295). The wreck of the *UB-88* embodies a desperate people's gamble to win a futile war, American public distain for this new kind of warfare, and the public's optimism for the future. No one could foresee the horror of the Second World War in the future and the importance that unrestricted submarine warfare would have.

It is interesting to note that, according to the terms of the 11 November 1918 Armistice with Germany, only the U-boats were ordered to be surrendered to the Allies "with armament and equipment complete" (Bevans 1969:13). The other vessels of the Imperial German Navy were to be "disarmed and thereafter interned in neutral ports" while the Allies negotiated over their fate (Bevans 1969:13).

The *UB-88* is an example of an early combat tested submarine design and the only U-boat from either World War on the west coast. Some of the avenues of future research could include the study of what types of materials were used in the construction of the submarine. Since the *UB-88* was built near the conclusion of World War I, it can be inferred that metals such as brass and copper were scarce and difficult to acquire. Nielson mentioned this in a report he submitted to the Chief of Naval Operations' Director of Submarines, Captain Thomas C. Hart. Nielson's report from November 1919 can be found in the National Archives and Record Administration's JU (U-boat) file, part of the Navy Subject File, Record Group 45, Naval Records Collection of the Office of Naval Records and Library in Washington, D.C. In his report, Nielson writes:

> The interior arrangement of the UB88 is exceedingly poor. This is probably accounted for by the fact that these boats were built in a hurry and were only intended for the duration of the war. The lack of copper and brass is apparent and much of the piping is rapidly going to pieces. This is especially true of the circulating water piping on the main engines and the high pressure air lines.

The shortage of materials required the builders to decide where they could substitute with steel and where bronze or copper were vital. Construction will also be interesting to evaluate since she has a riveted construction, which is different than the welded construction used on submarines in World War II. Were corners cut in her construction to facilitate quicker completion, or did the Germans complete a solid boat with no compromises? These are interesting questions that further study might answer.

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REFERENCES CITED

Adams, Jonathan
2013 *A Maritime Archaeology of Ships: Innovation and Social Changes in Medieval and Early Modern Europe*. Oxford, UK: Oxbow Books.
2001 Ships and Boats as Archaeological Source Materials. *World Archaeology* 32(3):292-310.

Arnshav, Mirja, and Anna McWilliams
2017 Submarine in the Silent World: Exploring Films as an Archaeological Record. *Journal of Contemporary Archaeology* 4(1):19-37.

Atkinson, Christopher M.
2012 *Impacts of Bottom Trawling on Underwater Cultural Heritage*. Master's thesis, Texas A&M University, College Station, TX.

Balzar, John
2004 When Blood Fizzes. *Los Angeles Times* 27 January:F-4. Los Angeles, California.

Beigel, Harvey M.
1986 The Last Strange Cruise of the *UB-88*. *Warship International* 23(3):287-304.

Bevans, Charles I. (editor)
1969 *Treaties and Other International Agreements of the United States of America 1776-1949.* Volume 2, Multilateral 1918-1930. Department of State Publications, Washington, D.C.

Bojakowski, Piotr, Katie Custer Bojakowski, and Perry Naughton
2015 A Comparison Between Structure from Motion and Direct Survey Methodologies on the Warwick. *Journal of Maritime Archaeology* 10(2):159-180.

Deetz, James
1991 Introduction: Archaeological Evidence of Sixteenth- and Seventeenth-Century Encounters. In *Historical Archaeology in Global Perspectives*, edited by Lisa Falk, pp. 1-9. Washington, D.C.: Smithsonian Institution Press.

Delgado, James P.
2001 *Lost Warships: An Archaeological Tour of War at Sea*. New York: Checkmark Books.

Delgado, James P. Frank Cantelas, Robert V. Schwemmer, Robert S. Neyland, Agustin Ortiz, Jr., George Galasson, and Michael L. Brennan
2018b Archaeological Survey of the Ex-USS *Bugara* (SS/AGSS331). *Journal of Maritime Archaeology* 13:191-206.

Delgado, James P., Michael L. Brennan, Kelley Elliott, Russell E. Matthews, Megan Lickliter-Mundon, John G. Lambert, Frank Cantelas, and Robert V. Schwemmer
2018a Archaeological Survey of the Ex-USS *Independence* (CVL22). *Journal of Maritime Archaeology* 13:123-144.

Dubbs, Chris
2014 *America's U-Boats: Terror Trophies of World War I.* Lincoln, NE: University of Nebraska Press.

Eriksson, Niklas
2017 *Mars* (1564): The Initial Archaeological Investigations of a Great 16th-Century Swedish Warship. *International Journal of Nautical Archaeology* 46(1):92-107.

Ford, Ben (editor)
2011 *The Archaeology of Maritime Landscapes*. New York: Springer.

Friedman, Norman
1995 *U.S. Submarines Through 1945: An Illustrated Design History*. Annapolis: Naval Institute Press.

Gould, Richard A.
2000 *Archaeology and the Social History of Ships.* Cambridge, UK: Cambridge University Press.
1991 The Archaeology of HMS Vixen, An Early Ironclad Ram in Bermuda. *International Journal of Nautical Archaeology* 20(2):141-153.
1983 The Archaeology of War: Wrecks of the Spanish Armada of 1588 and the Battle of Britain, 1940. In *Shipwreck Anthropology,* edited by Richard A. Gould, pp. 105-142. Albuquerque, NM: University of New Mexico Press.
Gröner, Erich
1991 *German Warships 1815-1945: Volume Two. U-Boats and Mine Warfare Vessels*. Revised and expanded by Dieter Jung and Martin Maass. London: Conway Maritime.
Land, E. S.
1919 Submarines in General – German Submarines in Particular. In *Transactions of the Society of Naval Architects and Marine Engineers*, Vol. 28, edited by Daniel H. Cox, pp. 111-125. Jersey City, NJ: Society of Naval Architects and Marine Engineers.
Los Angeles Examiner (LAE)
1921 *Down for the Last Time! U-boat is U.S. Navy's Target*. 4 January: 1. Los Angeles, California.
1919 *Kaiser's Pet "Sea Thug" Here*. 2 September: 3. Los Angeles, California.
Los Angeles Times (LAT)
1923 *Arrest Three as Navy Theft Ring Plotters*. 14 July: I5. Los Angeles, California.
1923 *Propellers Off German U-Boat Stolen at Port*. 27 April: II1. Los Angeles, California.
1921 *Thousands Attend Shackford Farewell*. 28 May: II10. Los Angeles, California.
1921 *For Base Commander. Dance Will be Given in Honor of Capt. And Mrs. Shackford*. 26 May: II4. Los Angeles, California.
1921 *Hostile Submarines, Take Notice: German U-Boat is Sunk at Two-Mile Range in Fog by Swiftly Steaming Destroyer*. 4 January: 1. Los Angeles, California.
McCarthy, Michael
1998 The Submarine as a Class of Archaeological Site. *Bulletin of the Australian Institute for Maritime Archaeology* 22:61-70.
McKinnon, Jennifer F., and Toni L. Carrell
2015 *Underwater Archaeology of a Pacific Battlefield: The WWII Battle of Saipan.* New York: Springer.
Mertes, J. R., C. N. Zant, J. D. Gulley, and T. L. Thomsen
2017 Rapid, Quantitative Assessments of Submerged Cultural Resource Degradation Using Repeat Video Surveys and Structure from Motion. *Journal of Maritime Archaeology* 12:91-107.
Mooney, James L. (editor)
1981 UB-88. In *Dictionary of American Naval Fighting Ships*, Volume VII, edited by James L. Mooney, pp. 382-384. Washington, D.C.: Naval Historical Center.
Muckelroy, Keith
1980 Prologue. In *Archaeology Underwater: An Atlas of the World's Submerged Sites*, edited by Keith Muckelroy, pp. 7-11. New York: McGraw-Hill Book Company.
Neyland, Robert S.
2011 Underwater Archaeology of the World Wars. In *Oxford Handbook of Maritime Archaeology*, edited by Alexis Catsambis, Ben Ford, and Donny L. Hamilton, pp. 708-732. Oxford, UK: Oxford University Press.
Nielson, Joseph L.
1923 The Last Cruise of the UB-88. *United States Naval Institute Proceedings* 49(8):1275-1298.
Rahn, Werner
2015 The Battle of Jutland from the German Perspective. In *Jutland: World War I's Greatest Naval Battle*, edited by Michael Epkenhans, Jörg Hilmann, and Frank Nägler, pp. 143-282. Lexington, KY: University Press of Kentucky.

Richards, Nathan
2008 *Ships' Graveyards: Abandoned Watercraft and the Archaeological Site Formation Process.* Gainesville, FL: University Press of Florida.
Rössler, Eberhand
2001 *U-Boat: The Evolution and Technical History of German Submarines.* London, UK: Cassel and Company.
Salt Lake Tribune
1932 *Thrilling U-Boat Drama Now Offered Gem Patrons*. 10 February: 18. Salt Lake City, Utah.
San Pedro Daily News
1921 *Dismantled Sub is Sunk Today*. 3 January: 1. San Pedro, California.
San Pedro Daily Breeze
2017 *Authorities Identify Diver Who Died After Being Found Unresponsive Off San Pedro*. Electronic document, http://www.dailybreeze.com/2017/07/17/authorities-identify-diver-who-died-after-being-found-unresponsive-off-san-pedro/, accessed 28 February 2019.
Termote, Tomas
2017 *War Beneath the Waves: U-Boat Flotilla Flanders 1915-1918.* London: Uniform Publishing.
Westerdahl, Christer
1992 The Maritime Cultural Landscape. *International Journal of Nautical Archaeology* 21(1):5-14.
Westwood, David
1984 *Anatomy of the Ship: The Type VII U-Boat*. London: Conway Maritime.